Herbal Contraception and Abortion

In Pre-Industrial, Sex-Positive Cultures:

Selected Reprints of Articles

Assembled by James DeMeo, Ph.D.
as Reserve Reading Materials for his University Seminars on
The Geography of Human Behavior

Also see:
http://www.orgonelab.org/contracep.htm

and
"Contraceptive Plant Materials Used in Sex-Positive Cultures",
by James DeMeo, in the 2006 Edition of *Saharasia*
http://www.saharasia.org

Items Included in this Reprint Package:

* Attitudes of Four Peruvian Jungle Tribes Towards Plants Employed as Oral Contraceptives, Nicole Maxwell, unpublished monograph, 1970.

* Contraceptive Plant Drugs, V. J. Brondegaard, *Planta Medica* 23(2):167-182, 1973.

* Antifertility Agents of Plant Origin, J. R. Price, from *A Symposium on Agents Affecting Fertility*, C.R. Austin & J.R. Perry, Eds., Little, Brown & Co., 1965.

* Alleged Antifertility Plants of India, R.C.D. Casey, *Indian J. Med. Sci.,* 14:590-600, 1960.

* Plant Materials Used by Primitive Peoples to Affect Fertility, H. deLaszlo & P.S. Henshaw, *Science,* 119:626-631, 7 May 1954.

* Cherokee Belief and Practice with Regard to Childbirth, F.M. Olbrechts, *Anthropos* XXVI:17-19, 1931.

* Plants Used by the Indians of Mendocino County, California, by V.K. Chesnut, *US Nat. Herbarium*, VII(3), Government Printing Office, Washington, DC, 1902, pp.344 & 367.

* Vegetable Antifertility Drugs of India, B.S. Malhi & V.P. Trivedi, *Quar. J. Crude Drug Research*, 12:1922-1928, 1972.

* Plants as Oral Contraceptives in the Northwest Amazon, R.E. Schultes, *Lloydia*, 26:67-74, June 1963.

* Some Native Herbal Remedies at Present in Use in Mashonaland, H.Wild & M. Gelfand, *Cent. African J. of Med.,* 5(6):292-305, June 1959.

* Physiological and Medical Observations Among the Indians of the Southwestern United States and Northern Mexico, A. Hrdlicka, Smithsonian Institution *Bureau of Am. Ethnology, Bulletin* 34, 1908, pp. 163-166.

* Some Sex Beliefs and Practices in a Navaho Community, F.L. Bailey, *Papers, Peabody Museum of Am. Archaeology and Ethnology*, Harvard U., 40(2):23-27, 1950.

* Potential Value of Plants as Sources of New Antifertility Agents I & II, N.R. Farnsworth, et al, *J. Pharmaceutical Sci.,* 64(4):535-598, April 1975 and 64(5):717-754, May 1975.

* Inhibition on Glucagon After In-Vitro Mixture with Lithospermum, W.R. Breneman & M. Carmack, *Endocrinology*, 62(5):627-636, May 1958.

* Action of Lithospermum Ruderale on Ovulation in the Hen, F.J. Zeller, W.R. Breneman & M. Carmack, *Poultry Science*, 37(2):455-459, March 1958.

* Plants Suggested as Possible Oral Antifertility Agents, source unknown, pp.1-19.

Items Not Included, but Highly Recommended:

* *Natural Healing in Gynaecology: A Manual for Women*, Rina Nissim, Harper/Collins, 1996.

* "Contraceptive Plant Materials Used in Sex-Positive Cultures", by James DeMeo, in *Saharasia: The 4000 BCE Origins of Child Abuse, Sex-Repression, Warfare and Social Violence, In the Deserts of the Old World*, Revised 2nd Edition, Natural Energy Works, Ashland, Oregon, 2006. http://www.saharasia.org

* "Oral Contraceptives in Ancient and Medieval Times", J. Riddle & J.W. Estes, *American Scientist*, 80:226-233, May-June, 1992.

* "Ever Since Eve: Birth Control in the Ancient World", J. Riddle, J.W. Estes & J.C. Russell, *Archaeology*, March/April 1994, pp.29-35.

NOTE: As with any medicine or chemical compounds, caution is advised before simply going out and ingesting unfamiliar plants and herbs. Essential oils of some of these plants are known to be deadly toxic, and even when taken in the original herbal formula, the dosages are very important. For example, *Spotted Cowbane Root*, noted in several of the papers herein is potentially deadly in high doses, as is *Cicuta maculatum*, better known as *Water Hemlock*, one of the most poisonous plants in North America and related in its actions to the plant that killed Socrates. For an empirically oriented discussion on which plants work best in which dosages, and for which purposes, please review the following internet sites, operated by a collective of women, world-wide, who are recapturing this ancient knowledge. Web links to companies selling these herbs are also provided.

Preventing and Ending Pregnancy by Alternatives:
http://www.geocities.com/RainForest/Vines/2279/PregT.htm
Herbal Abortion:
http://www.geocities.com/RainForest/Vines/2279/Abortif.htm
Sharing Our Wisdom:
http://www.geocities.com/RainForest/Vines/2279/Sharing.htm

Also the book *Natural Healing in Gynaecology: A Manual for Women* by Rina Nissim is highly recommended, as it gives an effective and worked-through herbal remedy for bringing on a late menstrual period and abortion in the early months. The original French and German translations of this book openly used the word "abortion", but the American edition does not, instead using the term *emmenagogue*, which means "a medicine which induces or hastens menstruation". Essential information from the Nissim book are reproduced on the three above websites, as well as on this one:
http://www.orgonelab.org/contracep.htm

From: Nicole Maxwell,
150 East 30th. St.,
New York, N.Y. 10016, U.S.A.

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ATTITUDES OF FOUR PERUVIAN JUNGLE TRIBES TOWARD PLANTS EMPLOYED AS ORAL CONTRACEPTIVES

By
Nicole Maxwell
Research Associate, Museum of the American Indian
(Heye Foundation)

INTRODUCTION

It has long been known that members of many tribes in the Amazon Basin deliberately limit the number of their offspring. Their motives for this have been mentioned by many investigators, but the methods they employ have been little reported, the only one widely discussed being infanticide. There are, however, a few published accounts of tribes whose women take "secret" preparations of plants for the purpose of provoking abortion or preventing conception. The most explicit report that I have found is in Dr. Norman E. Himes' book, The History of Contraception,(1) which quotes Rafael Karsten's statement, made in 1920: "In order to be able to cohabit

"with a man without getting pregnant, the Canelos women are in the habit of taking a medicine from the small piripiri plant. The root knots are crushed in water and the woman takes a quantity of this drink." (2) It is interesting to note that as late as 1935, when this book was written, such an authority as Dr. Himes stated flatly that no substance existed which, taken orally by a woman, could prevent her conceiving, and that any belief in such substances should be classed as superstition.

The purpose of this paper is to describe the attitudes of the members of four tribes of the Peruvian Amazon region toward the plants which they use for this purpose. The observations given here were made on visits to the Seuene Witotos on the Napo River in 1953, 1959, 1961, and 1966; to the Jívaros living on the Corrientes River in 1959 and 1961; to Shipibos on the Ucayali and Pisqui Rivers in 1963 and 1966; and to Conibos on the Utucuru River (Upper Ucayali) in the first months of 1970. The purpose of all these trips was the collection and study of botanical medicines of the tribes.

DISCUSSION

Primitive peoples are generally reluctant to reveal their medical lore to a stranger, but with care and considerable time it is usually possible to develop a feeling of friendship and confidence. If this is done they can, as a rule, be persuaded to

gather and explain the use of many plants they depend on to treat injuries or diseases. But this is by no means the case with plants they employ as contraceptives. Not all tribes seem to know these plants, but those who do are extremely secretive about them. In fact, any botanicals which they believe to affect the giving or withholding of life are surrounded by powerful taboos which prevent their disclosure to an outsider. This is not only true of the plants they take to prevent conception, but also of those used to increase fertility in women, to facilitate parturition, and to provoke abortion. Unless a feeling of intimacy, even of identification can be established, all the tribes I have known guard all such secrets jealously. Any premature attempt to pry, however delicate, is apt to bring all communication to an abrupt, sullen end.

An experience with the Witotos demonstrates the force of this reaction. This group, originally from the Putumayo, has lived on the Napo more than thirty years with a patrón who treats them with affection and indulgence far above the average. These tribesmen are less acculturated than many who live in such communities because their patrón has consistently striven to prevent the loss of their old culture. My first informant here was a tribeswoman in her seventies. Ema's integrity and strong character, added to her heritage as daughter of a great shaman and aunt of the hereditary chief of the Suenes has given her a position of greater

authority than I have observed in any tribeswoman. A warm friendship developed between us, but I learned little from her until my second visit to the tribe. Then she told me that in this community they no longer give female children in marriage at a very early age. Nevertheless, the mother of a girl reaching puberty still gives her a potion, one dose of which will prevent her conceiving a child during the next six or seven years. By the time it wears off, the girl should be mature enough for motherhood. Ema confided this one night when we had been listening for hours to my radio, which she loved. She even promised to get me the plants, but by morning she had changed her mind. Her excuse was that I could never learn the icaro, the song ritual which must accompany preparation of the brew. I did not insist, for that would have destroyed our friendship. Weeks later her nephew Sere, the chief, surreptitiously brought me four contraceptive plants that they still use. Two specimens came from trees, one was a herb and another a tuberous plant. This last his wife cultivated in her chacra, but the others he had brought from the jungle. On my next trip this was repeated. Ema talked of the plants but it was Sere who brought them to me.

I make a point of going alone on all jungle collecting trips, except for such boatmen, bearers, or interpreters necessary. But my last trip to the Witotos was an exception; I went with a group of pharmacognosists, both men and women, who wanted Witoto medicinal plants. The Witotos accepted them cordially as my friends but I strove to maintain the old intimacy with the tribe by avoiding the party whenever possible. I stayed at Ema's house, as I had always done before, while my companions ate and

slept on the boat. I gossiped with the women while their husbands collected many medicinal plants from the surrounding jungle for the pharmacognosists. But they brought in not a single contraceptive plant. Privately, I asked Sere to get me them. He was embarrassed. He pretended to have forgotten them, then not to know where they grew. I dropped the subject quickly, knowing that insistence would make trouble. Unfortunately, despite my warnings one of the scientists blurted out the name of a plant I had told him of, and offered a reward for it. That ended the expedition. The Witotos all found that they had work to do elsewhere. They remained courteous, but could no longer find time to collect any plants. We left, and I have not returned since. I am not sure I would be welcome.

With the Jívaros, it was again a woman who told me of their secret plants. Tesa was a Lowland Quechua and had come to the Corrientes with her mother, now wife of the tribe's shaman. Her stepfather had taught her the use of three plants: one was abortifacient, another promoted fertility in women who could not conceive, and the third was a contraceptive with effects lasting for many years. Tesa told me that some of the tribeswomen grew these in their chacras, which were located at a short distance from their dwellings. I found that they were all different varieties of sedges, like the plants mentioned by Karsten. Piripiri is the name given to all sedges of the genus Cyperus throughout the northwestern Amazon region.

According to Dr. Ketsuo Koyama, of the Bronx Botanical Gardens, there are some 2,200 species of Cyperus growing throughout the Amazon Basin. Strangely enough these sedges are valued for magical powers attributed to them by a considerable number of tribes widely scattered throughout the jungles of South America.(3)

That the men of Tesa's community knew these piripiri and shared the belief that they must be kept secret became obvious when I was about to put the baskets of plants in my canoe. One tribesman noticed them and excitedly called the others, who suddenly became unfriendly. After brief discussion, they turned to the shaman and two elders who seated themselves in a solemn row. The oldest made a speech; I understood nothing for they all spoke only Jivaro. Next, Tesa spoke for a few moments and was followed by my two other women friends, who seemed to be making declarations. My interpreter later told me that they said I had known all these plants before I came to the tribe. Finally the shaman, whom I had earlier taken care to propitiate, spoke at some length. When he finished, tension eased, and the people again showed friendliness. I was allowed to depart with my plants.

In Shipibo and Conibo colonies I have visited I have found these same sedges, or sedges looking very like them, used for the same purpose and surrounded by a mystique at least as powerful. In addition to the three types mentioned above, these tribes have another for obstetrical use, employed in what one might even describe as a sort of rudimentary prenatal care program. A woman who is pregnant takes her first dose of this plant about four or five weeks before

parturition is expected, and continues to ingest a solution of the roots at intervals of several days, the last dose being taken as labor begins. They claim that this promotes a rapid and almost pain-free parturition.

The Shipibo and Conibo should be considered together, for their language, dress, customs and general culture are strikingly similar. They are both of Panoan language stock. Most of the Shipibo live on the Ucayali River and its tributaries below the city of Pucallpa and the Conibo generally live on that same river and its tributaries upstream from Pucallpa. Both are extended matrilineal and matrilocal societies practising sororal polygyny, and marriages between members of the two tribes are not infrequent. Family size in both is usually small. One seldom sees a woman with more than three or at most four children, and many have told me that it is foolish and unhealthful for a woman to have children at intervals shorter than two or three years. Both tribes have an elected headman for each community, and the head of every family is a man, although women appear to exert a good deal of inconspicuous influence. The shamans of both groups are men and they take care of all healing by supernatural methods, while women have charge of the tribal botanic pharmacopeia. But though women do all the gathering and treatment with plant medicines, men of the tribe have never hesitated to point out for me and to collect plants which they believe medicinally valuable. This, however, does not apply to piripiri. They are purely a feminine affair and both men and women guard their secrets jealously. I once blighted what I believed to be a rapidly

progressing friendship with a Shipibo woman merely by mentioning prematurely that I noticed the characteristic scent of piripiri in her house.

In these communities, every woman seems to have a small bed of one species or another of Cyperus growing close to her house, and in every case I queried, she had obtained the original plants from her mother, a female relation or a woman friend. These small plantations, seldom more than a yard or so in diameter, may be of one of the above mentioned sedges or they may consist of any of the numerous varieties which are cultivated for a variety of purposes. I have collected more than twenty kinds which were used for such oddly different objectives as curing malaria or diarrheas, or to dye the hair, to calm anger, to silence an overly talkative woman, or to keep a husband faithful. Each plant is so peculiarly the property of the woman who grows it that even a close female friend or relative is not supposed to know what it is good for. If I ask Maria about a plant I got from Alicia, she will reply, "Only Alicia knows", even though it may be obviously the one for fattening children. Another peculiarity is the affection the women show their plants. When a Shipibo woman dug some up for me, she explained to them:"I am sorry you must leave me but I am giving you to the Señorita Nicole. She is very good. She will be kind to you. She will love you and care for you and you will be happy with her. You must grow strong and abundant for her."

Shipibo and Conibo men, though they know the plants, shy away from discussion of them and make it quite clear that such things are reserved to women. I know of no case of a man's

using any of them for medical treatment. While I was with the Conibo both my boatman, a Shipibo, and I were troubled by arthritic pain. I accepted a dose of the piripiri suggested by the women, and soon, possibly by coincidence, felt much better. The boatman, who was suffering far more than I, let the women apply poultices of leaves, which did little or no good. But when I asked whether he would not be wise to try the piripiri, he would not even discuss the idea. The one Cyperus that I have known men to take in this region is the sedge which his highly valued for treatment of snake-bite. I have not seen it in the Ucayali region, but I brought a plant from the jungle near Iquitos. My boatman enthusiastically accepted this, said he would propagate it and that he intended always to carry a bit of it with him when he went into the bush. However, men showed no reluctance to handle the piripiri the women had given me; they did not hesitate to put them in the boat for me or to carry them up a long path to the house.

The four above mentioned tribes are not the only ones that secretly use the contraceptive sedges. I have confined this discussion to Witotos, Jívaros, Shipibos and Conibos because among the groups who know these plants, these are the ones I have stayed with for periods long enough to be able to study their reactions. I should mention, however, that a slightly acculturated Yagua once gave me the contraceptive piripiri. He did it very surreptitiously and was so anxious to finish with the transaction that I had difficulty in getting him to tell me how his women used it --- and this despite the fact that he was an old friend. He also made me promise never to tell that he had given it to me. Further, a Campa woman friend, now married to a missionary, told me of two vines used by women of her tribe as oral contraceptives. She specified that the

tea made from them must be prepared and taken late at night when everyone else was asleep, or very early in the morning before anyone was awake, and that one should never let anybody know one had taken it. Whenever she spoke of either of these two plants, she lowered her voice to a nearly inaudible whisper, though we were quite alone. But I had no difficulty in persuading her to go into the jungle and cut some for me, nor did she act furtive when she delivered them, except for keeping her voice to a whisper.

Further supporting evidence comes from Brazil. A letter from Dr. Octavio Rodriguez Lima of the Maternidade Escola of the Federal University in Río de Janeiro reports his queries about tribal use of oral contraceptive plants in the jungles of Brazil. For this, he addressed himself to Dr. Francisco F. Soares de Meireles, Inspector of Indians for the Federal Agency for the Protection of Indians. To the question as to whether jungle tribes of Brazil knew and used oral contraceptives, Dr. Soares de Meireles replied: "Yes, there exists a very real control of birth. This affirmative answer is from studies and observations which we have made for several years, including those by ethnologists of the Emilio Goeldi Museum. --- How do they control birth? In general they use plants,whose names are secret, for baths and beverages in the form of tea." A specific query as to whether this applied to the Xavantes Indians brought a telegraphed reply from the same authority, saying, "I confirm the existence of birth control among the Xavantes Indians, using plants with contraceptive properties which only they know."

SUMMARY

There exists in the Amazon region of South America a considerable body of material of botanical origin which women of a number of tribes take orally in order that they may cohabit with men without risking pregnancy.for periods of time varying with the material chosen. In addition, there are other plants which they employ for abortifacient, gynecological and obstetrical purposes. Reactions observed among Siuene Witoto on the Napo River, Jívaro on the Corrientes River and Shipibo and Conibo groups on the Pisqui and Ucayali Rivers demonstrate that in their cultures, knowledge of such botanicals is reserved as private to the tribe and discussion of them outside tribal borders is strictly taboo. The men of the four tribes discussed know these plants but do not wish to be involved in their use. Male and female members of the tribes are convinced of the physiological effectiveness of these botanicals and evidence accumulated over a number of years has inclined me to agree with them.

ACKNOWLEDGEMENT

I wish to express my thanks to Dr. Frederick J. Dockstader, Director of the Museum of the American Indian (Heye Foundation) for his valuable advice on the selection and presentation of the data given here.

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150 East 30th Street,
New York, N.Y. 10016,
October 14, 1973.

Dear Mr. De Mec:

Thank you for your letter and the reproduced pages from Malinowski. I think that one reason Malinowski gave little weight to the report that the people he was studying had and used oral contraceptives was that such things were unknown by our scientists in those days. Perhaps the paper I gave in 1970 and which I'm sending with this will explain that.

I'm glad, though, that you called the Malinowski book to mind for me. I'd forgotten that particular bit.

One of the fascinating slants, to me at least, is <u>why</u> so many cultures who know the use of these things surround them with such strong taboos: It is the same in the Fijis, the Philippines, the hill tribes of India--- or at least, from what Santha Rama Rau told me, in one hill tribe, as it is in the many tribes who use them in the Amazon.

Yours sincerely

Nicole Maxwell

Nicole Maxwell

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CONTRACEPTIVE PLANT DRUGS

By V. J. Brondegaard

From the numerous abortives and emmenagogues, the contraceptives differ fundamentally for they, when used before or shortly after the coitus, prevent the fecundation or growth of the fecundate egg. A contraceptive therefore may make three claims: it shall 1. block up the ripening of the egg cells, make them incompetent for fecundation or, after the fullfilled conception, block up further development in its first phases; 2. fully preserve the libido and sexual desire; 3. after use re-establish the normal cycle.

The steadily growing consumption of contraceptive preparations for birth control has actualisized the search in the vegetable kingdom for substances that, alone or as starting matter, could be used for mass production of contraceptives without undesirable subordinate effect.

Bradbury and White [1] indicate 60 plant species, which in animal experiments showed an estrogen effect. De Laszlo and Henshaw [2] mention about the same number of contraceptives used in folk medicine, of which at least 25 really are abortives and emmenagogues.

One of course could systematically analyze and clinically test each plant species, although it is a very tedious as well as expensive method. A shorter way perhaps would be an investigation of the very many „contraceptives" mentioned in the old school and newer folk medicine, in addition to the native medicine in America, Africa and other continents.

Until now these contraceptives have only been moderately tested for their ascribed effect in fertility control; although, undoubtedly, several are based upon practical experiences – made, for the first time, surely by using the drug for various diseases.

The table below indicates some vegetable drugs which, perhaps, should be investigated for substances with contraceptive effect. They all are taken orally.

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Table I

Anthurium tessmanni	Araceae	spadices	dried, pulv.		South-Amer. Indian women [3]
Arisaema atrorubens	Araecae	rhizomes	infus	+ *Asclepias syriaca*	Caughnawaga-Indians, Canada [4]
Arisaema triphyllum	Araceae	rhizomes	decoction		Hopi-Indians, Arizona [5]
Aristolochia clematitis	Aristolochiaceae	seeds			Hungary [6]
Asarum canadense	Aristolochiaceae	rhizomes	decoction		North America [7]
Asclepias hallii	Asclepidaceae		infus	post partum	Navajo-Indians, Colorado [8]
Asclepias syriaca, see *Arisaema*					
Asparagus acutifolius, officinalis	Convallariaceae	berries	decoction		South Europe [9]
Asplenium adiantum-nigrum	Filices				Himalaya [10]
Atractylis gummifera	Compositae	roots	decoction	men	Arabia [11]
Bahia dessecta	Compositae	roots	decoction	both sexes	Navajo-Indians [12]
Callicarpa sp.	Labiatae	leaves	juice		Torres Straits [13]
Castilleia angustifolia	Scrophulariaceae		decoction		Hopi-Indians [14]
Chelidonium majus	Papaveraceae		juice		Russia [15]
Chusquea ramosissima	Gramineae	young shoots	chewed		Guarani-Indians, Paraguay [16]
Cicuta maculata	Umbelliferae	roots	juice		Cherokee-Indians, North America [17]
Cocos nucifera	Palmae	nut-milk			Java [18]
Crataeva nuxvala	Capparidaceae	bark			Bastar, India [19]
Cuscuta sp.	Cuscutaceae	herb			Paiutes-Indians, Nevada [20]
Dieffenbachia sequine	Araceae	leaves, stems	chewed	both sexes	Natives in Puerto Rico, Guadelope, Cuba, Santa Lucia, Dominica [21]
Dryopteris filix-mas	Filices		infus		Tartarean women [22]
Entada scandens	Mimosaceae	seeds	raw or roasted		Kawadjii-tribe, Cap York [23]
Eriogonum jamesii	Polygonaceae	roots	decoction	both sexes	Navajo-Indians, Arizona [24]
Franseria artemisiodes	Compositae	herb	decoction		Santander, Columbia [25]
Frasera speciosa	Gentianaceae		decoction		Shoeshone-Indians, Nevada [26]
Geum macrophyllum	Rosaceae	leaves	decoction		Chehalis-Indians, Washington [27]

Table I continued

Globba marantina	Zingiberaceae				Gunantuna, Melanesia [28]
Gossypium herbaceum	Malvaceae	roots	decoction		Creoles, South America [29]
Hedera helix	Araliaceae	fruits		after departure of placenta	Mediterranean [30]
		flowers	infus		Iran [31]
Hibiscus tiliaceus	Malvaceae	flowers	in tobacco, smoked		Gunantuna, Melanesia [32]
H. abelmoschus	Malvaceae	flowers	infus		Viti Islands [33]
Juglans regia	Juglandaceae	leaves	infus	with saffron	Slovakia [34]
Licuala sp.	Palmae	rootbark		both sexes	Salomon Isles [35]
Lithospermum ruderale, officinale	Boraginaceae	roots	infus		Navajo-, Owyhee-, Shoeshone-Indians [36]
Lonicera ciliosa	Caprifoliaceae	leaves	infus	Chehalis ~~Chelis~~,	Squaxin-Indians [37]
Lycopodium annotinum	Lycopodiaceae		decoction		Russia [38]
Lygodium dichotomum	Schizeaceae	roots	chewed	with betel	Salomon Isles [39]
Mallotus sp.	Euphorbiaceae	as Lygodium			
Ocimum basilicum	Labiatae	leaves	chewed		Gunantuna [40]
Paeonia officinalis	Ranunculaceae		decoction		South Russia [41]
Philodendron dyscarpium	Araceae	flowers	dried, pulv.		Vaupes, Columbia [42]
Phlox stansburyi	Polemoniaceae	leaves	decoction	below menses	Ramah Navajo Indians [43]
Piliostigma thonningii	Caesalpiniaceae	see Vigna	extract		
Pisum sativum	Papilionaceae	seeds			India [44]
Populus alba	Salicaceae	bark		+ kidneys of mule	Mediterranean [45]
Prosopis algarrobilla	Mimosaceae	roots	decoction		Toba-Indians, Chaco in South Am. [46]
Prunus emarginati	Amygdalaceae	rotten wood	in water		Indian women, Washington [47]
					Ramah Navajo [48]
Rhus trilobata	Anacardiaceae	leaves	decoction		
Ricinus communis	Euphorbiaceae	seeds	dipped in	warm blood of rabbit	Algiers [49]

Table 1 continued

Rosmarinus officinalis	Labiatae		decoction	with „ocean artemisia"	Opata-Indians [50]
Salsola sp.	Chenopodiaceae	leaves	infus		Algiers [51]
Semecarpus stellata	Anacardiaceae	roots	decoction	in sour rice mucilage	India [52]
Smilacina stellata	Convallariaceae	roots, leaves	infus		Indians in Nevada [53]
Sphaeralcea munroana	Malvaceae	roots	decoction		
Stenomesson variegatum	Amaryllidaceae				Indians, South Amer. [54]
Stevia rebaudiana	Compositae	leaves, stems	infus		Indians, Paraguay [55]
Tillandsia decomposita	Bromeliaceae	flowerstems	decoction		Toba-Indians, South Amer. [46]
Urena lobata	Malvaceae	leaves	juice		New Ireland [56]
Urospatha antisylleptica	Araceae	spadices	pulv.		Barasana-Indians, Columbia [57]
Veratrum californicum	Liliaceae	root	decoction		many tribes in Nevada [58]
Viburnum prunifolium	Caprifoliaceae		decoction		Italia [59]
Vigna phaseoloides	Papilionaceae	roots	infus	+ rt. of *Piliostigma thonningii*	Malawi, Nyasaland in East Africa [60]
Vitex lagundi	Verbenaceae	roots			Kurtatchi, North Bougainville [61].

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Address: V. J. Brondegaard, Pueblo Cómpeta, Malaga, España

SEPARATION AND CHARACTERIZATI
FROM THE FRUIT OF *DU*

By F. Yousef[1], S. K. Wahba Kha

Little work has been done on the chemistry o
analyzed the oil of *D. repens* seeds. Manson [2
undiluted and in aqueous dilution up to 1 : 10
cicine larvae. Chopra et al. [3] stated that t
fruits contain an alkaloid analogous to narcot
hydrochloric acid extract of the bark, leaf an
conventional alkaloid reagents, gave negative
studied the effect of certain amino acids and g
survival and rooting behavior of *D. plumieri* cu
lated by Greshoff [6, 7] from the bark of *D. re*

Since the presence of alkaloids had never be
paper to describe the isolation and prelimina
from this plant.

Experimental and

Plant material: Fresh ripe fruits (10 kg) of *Duranta*
wild growing plants near Cairo, Egypt, were air dried i
dried fruits was 2.5 Kg. The fruits were ground to fine po

Isolation of crude alkaloids: The powdered fruits
process using different solvents of increasing polarit
reduced pressure, and tested for alkaloids by tlc. The
spraying the plates with modified Dragendorff's reagen
in color, was purified by extraction with acid-water, a
filtrate was extracted twice with chloroform (10 ml eac
extracted with dilute hydrochloric acid (10 ml). The
washings were mixed and rendered alkaline with 10%
line solution was then extracted several times with chl
extraction was repeated several times until the final ch
alkaloids became pale brown in color. Several attempt
the chloroform extract after evaporation using differe

[1] The Research and Control Center, The Egyptian O
ces, Egypt, U.A.R.
[2] The Pharmacognosy Department, College of Pharm
[3] The Chemistry Department, College of Chemistry
sity, Fargo, North Dakota 58102.

well as its inherent scientific interest, this volume is likely to have a very wide circulation and one not entirely restricted to the scientific world. We have, therefore, avoided the use of the word 'drugs' in the title because the word has, to many, a somewhat unfortunate implication.

This Symposium, like its predecessors in the series, was arranged by an Organizing Committee appointed by the Co-ordinating Committee and supported by a number of societies. A list of members of the Organizing Committee and the names of the supporting societies are given in the Preface. Many of the societies in question are regular supporters of the Symposia in this series, but on this particular occasion they were joined by a number of specialist organizations concerned with the subject of fertility. It should be added that, as in the past, this Symposium was generously supported by the Wellcome Trust and the Ciba Foundation.

As Chairman of the Organizing Committee, it was my very pleasant duty to welcome members of supporting societies and particularly, of course, the invited speakers and other participants from abroad. It would be invidious to mention individuals from such a distinguished company; the contents list of the volume speaks for itself. Rarely have I had the good fortune to see such an eminent and representative gathering of what I ventured at the first session to call 'fertilitarians'. This sobriquet was more than justified by the rapid proliferation of information and ideas which the Symposium engendered and which made the occasion a memorable one for all those who attended.

May 12th 1964. A. S. PARKES

from: A Symposium on Agents Affecting Fertility
C.R. Austin & J.S. Perry - Eds.
Little, Brown & Co. Publishers 1965

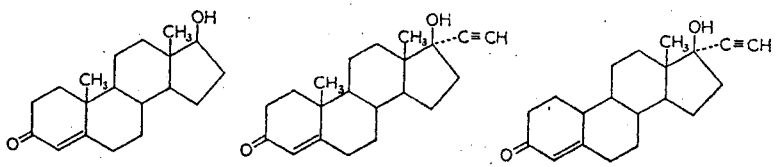
ANTIFERTILITY AGENTS OF PLANT ORIGIN

J. R. PRICE

C.S.I.R.O., Melbourne, Australia

IT is clear from the programme arranged for this Symposium that its major interest hinges around methods of controlling human fertility. This being so, my review of antifertility agents of plant origin must necessarily be brief, since there is little information which will stand up to critical evaluation other than that concerning plant oestrogens. On the other hand, there are a great many reports, published or passed on by word of mouth, of the use by primitive peoples of plant preparations to prevent conception. While the frequency of these reports might appear to lend credence to such beliefs, the number of plant species involved is so great that one inevitably suspects at least a large proportion of them. It may be noted that recent studies of declining populations attribute the cause entirely to the incidence of disease. Depopulation in New Ireland, for example, has been ascribed to malaria and gonorrhoea, and the possibility that contraception may be a contributory factor has been specifically discounted (Scragg, 1957). ?
However, there is no *a priori* reason why there should not be present in plants substances which might be capable of interfering at one point or another with the reproductive cycle and I believe that the need for greater knowledge of oral contraceptives is so urgent that we should investigate these reports, however small the chance of success, rather than risk overlooking potentially valuable information. Unquestionably, the most important approach in searching for substances which meet the various requirements for fertility control is to further our basic scientific knowledge of reproductive physiology. But experience suggests,

where there is a degree of urgency, that almost as important is the kind of empirical approach which has been so successful in providing the medical profession with many—perhaps most—of the battery of drugs it uses today for the treatment of disease—and indeed in providing us with many other kinds of potent biologically active materials, insecticides, herbicides and the like. The screening of culture media from tens of thousands of micro-organisms has given us a dozen or so of the antibiotic drugs in common clinical use and it is essentially the same procedure which has made available the numerous useful modifications of the natural steroid hormones. It could scarcely have been predicted that the substitution of an acetylenic group in the 17α-position of the androgenic testosterone molecule (I) would give rise to a substance, ethisterone (II), and by a further step norlutin (III)—with such a dramatic change to high oral progestational activity.

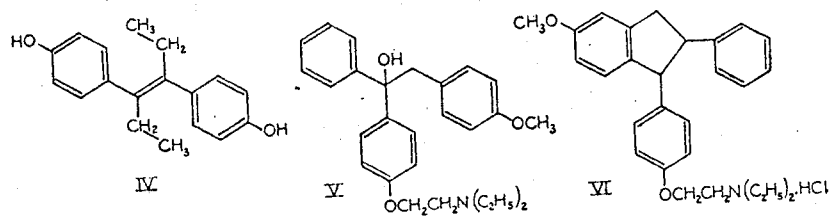


I II III

And despite a superficial structural resemblance to diethylstilboestrol (IV), it is even less likely that one could predict that 1-(*p*-2-diethylaminoethoxyphenyl)-1-phenyl-2-*p*-anisylethanol ((V), MER 25; Segal & Nelson, 1958) and the 2,3-diphenylindenes, such as (VI) (Lednicer *et al.*, 1961), would act as potent antifertility (antioestrogenic) agents.

Thus we must recognize that to have the best chance of speedy success, a search for chemical agents for controlling fertility should embrace empirical as well as more fundamental studies. I have already referred to one empirical procedure which has produced valuable information—the screening of culture media for antibiotic activity. This is, in effect, the screening of a complex

mixture of substances and as such is little more than a refinement of the time-honoured procedure by which man, over many thousands of years, has searched for and found those drugs made use of in so-called 'folk-medicine'. It is well known that in the majority of instances the beneficial effects ascribed to folk-medicine are found to be without foundation when subjected to critical experimental examination. But it is also true that from a small proportion of these drugs have been derived agents such as morphine, reserpine, quinine, ephedrine, mescaline, santonin and others which have proved of real value, many of them being still in use. What is more important is that these and others have given



IV V VI

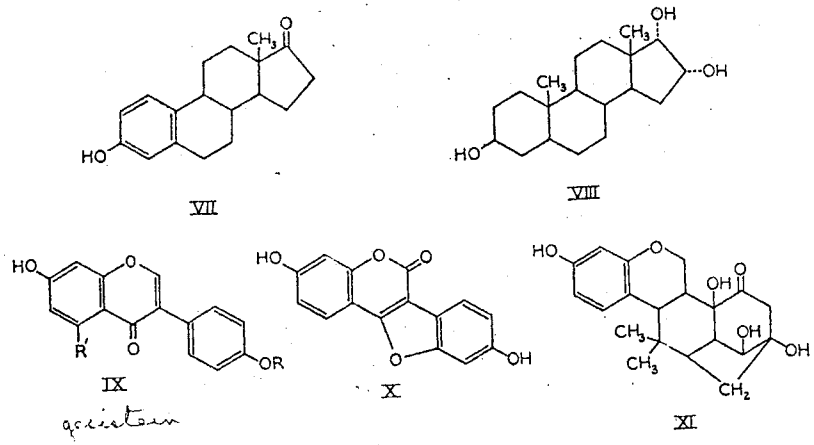
rise to better drugs by providing a pattern on which the organic chemist can ring the changes. Moreover, he can often do this with sufficient versatility to produce cheaper or more effective substances, as exemplified by the synthetic cocaine analogues. Granted, then, that fundamental studies of the reproductive system should be supplemented by an empirical approach to fertility control, how should such empirical programmes be orientated? Has the plant kingdom anything to offer as a starting point for the possible development of useful antifertility agents? On the face of it, it has a great deal to offer, and it is my task, this morning, to present a picture of the situation which will enable you to form an opinion as to the amount of effort which should be put into this area as compared with others. The following account of what is known of antifertility agents of plant origin is selective rather than comprehensive; no consideration has been given to abortifacients.

Oestrogenically active substances

There are known to be present in certain plants substances with marked antifertility effects on grazing animals. This subject has been reviewed recently by Moule, Braden & Lamond (1963). In an earlier review, not restricted to problems of animal production, Bradbury & White (1954) listed over 50 species of plants reported to exhibit oestrogenic activity. I propose to comment only on those in which the active principle has been identified, with one interesting exception, the bulb of the garden tulip. It was reported by Coussens & Sierens (1949) that during the last months of the Second World War, because of the shortage of food, large quantities of tulip bulbs were eaten by the population, and many women experienced symptoms of oestrogen unbalance. Coussens & Sierens showed that an extract of tulip bulbs is oestrogenically active in mice, but they made no attempt to isolate the active principle. They expressed the view that 'the activity is not surprising as several chemical compounds with steroid structure are found in this plant material'. This may well be true (though it does not appear to be substantiated by the literature, see for example, Hegnauer, 1963) since steroidal substances have been found in a great many plant species. In this context the most significant report is that of the isolation and identification of oestrone (VII) by Butenandt & Jacobi (1933) from palm kernel press-cake (*Elaeis guineensis*). Other claims concerning the isolation of steroidal oestrogens from plants lack the necessary supporting chemical data, but the occurrence of plant constituents closely resembling the animal hormones is confirmed by a recent well-authenticated identification, namely the isolation of 5α-androstan-3β, 16α, 17α-striol from *Aplopappus heterophyllus*, a plant which is responsible for a disease known as 'milk sickness' in the higher animals (Zalkow, Burke & Keen, 1964). Bednar & Zenisek (1961) have reported recently that hop extracts are oestrogenic (see also Chury, 1960) and that the

β-acids (lupulone, colupulone, adlupulone) are partially responsible for this activity; the α-acids are inactive.

By far the most important manifestation of oestrogenic activity in plants is due to isoflavones and related compounds. Infertility in sheep resulting from the ingestion of these substances was first recognized in Western Australia during the Second World War when in certain areas lamb marking percentages fell from about 80% to as low, in some instances, as 10%. Generally referred to nowadays as 'clover disease', the condition has been recognized



in other areas of southern Australia, and in eastern Australia, New Zealand and the United States. Infertility of cattle due to ingestion of oestrogenic pasture has also been observed in many countries including Israel, Italy, Germany, the United States and Australia. Because of their economic implications, pasture oestrogens are currently being subjected to intensive investigation. As already stated, the causative agents are isoflavones or substances structurally related to them, notably the coumaranocoumarin coumestrol.

Isolated occurrences of isoflavones and their derivatives have been reported from several plant families such as the Iridaceae, Moraceae, Rosaceae, Compositae and Coniferae, but the major source is the

sub-family Papilionatae of the Leguminosae in which they have so far been reported from 34 genera. A number of these genera, such as *Trifolium* and *Medicago*, include valuable pasture species, while others may be grazed by stock living on unimproved pastures. The isoflavones which have been shown to exhibit oestrogenic activity in experimental animals are genistein (IX; R = H, R′ = OH), its 4′-methyl ether biochanin A (IX; R = CH_3, R′ = OH), and daidzein (IX; R = R′ = H). Formononetin (IX; R = CH_3, R′ = H), the 4′-methyl ether of daidzein has been variously reported as inactive or at most only slightly active in mice. However, Nilsson (1962) demonstrated that formononetin is demethylated to daidzein in rumen liquor so it can be predicted with confidence that formononetin is oestrogenically active in sheep and cattle. Nilsson (1961) has likewise shown that biochanin A is demethylated by rumen micro-organisms to genistein. The 7-methyl ether of genistein, prunetin, causes an increase in uterine weight in immature mice.

The level of activity of the isoflavones is low, genistein, the most active when given orally to mice, having about 10^{-5} the activity of diethylstilboestrol under the same test conditions. However, the low oestrogenic potency is unfortunately more than offset by the amounts present, in *Trifolium* species particularly, which may be such that a sheep grazing a clover-predominant pasture might ingest up to 10 to 15 g isoflavone per day. Moreover, there is in many clovers a small amount of the coumaranocoumarin coumestrol (X) (and probably analogues of it) which is about 30 times as active as genistein when given orally to mice. Genistein and coumestrol have been shown to be what Emmens (1941) describes as pro-oestrogens, they are believed to be converted in the animal body into the true, oestrogenically-active material.

The most potent substance of this group, miroestrol (XI), is not involved in animal infertility problems but was isolated as a result of a report that the roots of a plant, now named *Pueraria mirifica*, were used in northern Thailand as a rejuvenating drug. The

structure of miroestrol is rather more complex than that of the simple isoflavones but it is clearly biosynthetically related to them. In this connexion, daidzein has been reported present in the roots of three other *Pueraria* species (Shibata, Murakami & Nishikawa, 1959). The oestrogenic activity of miroestrol is very much greater than that of the isoflavones, being comparable with that of oestradiol; miroestrol is more than three times as active as diethylstilboestrol in causing an increase in uterine weight in the immature mouse when given orally.

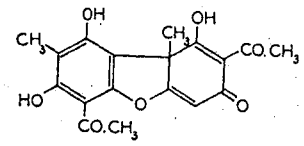
Before concluding this brief account, reference must be made to the possible presence in plants of oestrogen inhibitors. For example, Adler (1962) claims to have separated and concentrated an oestrogen-inhibiting substance from *Medicago sativa*, which not only inhibits the action of the oestrogens in that species, but also inhibits the action of oestradiol and diethylstilboestrol. Further work in this field will be awaited with interest.

Other substances of known chemical constitution

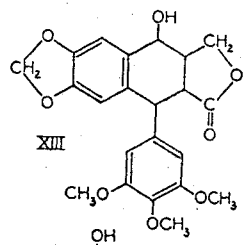
In this section I shall refer briefly to the few substances, other than oestrogens, which are derived from plants and are of known structure, for which antifertility activity of any kind has been reported. Firstly, certain plant alkaloids, which are unlikely to be of significance in relation to human fertility, have been shown to reduce the fertility of experimental animals. These alkaloids, listed by Jöchle (1962), include reserpine and morphine—stated to inhibit ovulation—and pilocarpine, physostigmine, certain of the ergot alkaloids and (if it may be classified as an alkaloid) the growth hormone, indolyl-3-acetic acid, which inhibits nidation. Jöchle suggests that it might be possible to develop a suitable morphine analogue which is non-addicting and free of other side-effects. One other alkaloid, the well-known antimitotic agent colchicine, and certain of its derivatives, have been studied by several workers and shown to interrupt pregnancy. For what it may be worth, the liliaceous species *Gloriosa superba* which contains colchicine, has a

reputation in Indonesia as an abortifacient (van Steenis-Kruseman, 1953).

Other substances exhibiting antimitotic activity are the lichen colouring matter usnic acid (XII) and the lignanes podophyllotoxin



XII



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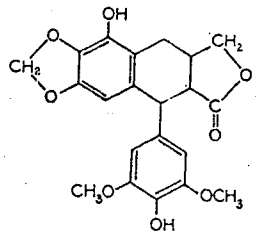
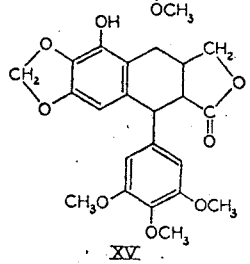


XIV



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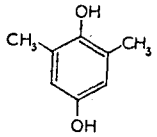

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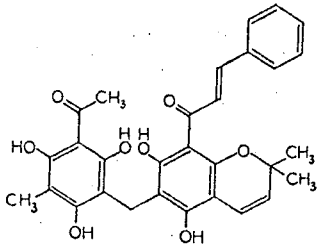

XVII

(XIII), α-peltatin (XIV) and β-peltatin (XV). The effects of these substances on the fertility of mice have been reported by Wiesner & Yudkin (1955), Wiesner, Wolfe & Yudkin (1958), and others. Administration of usnic acid by stomach tube to mice before pairing or immediately after copulation was usually not followed

by pregnancy. However, the results were variable and after repeated treatment the animals became resistant and pregnancy was no longer prevented. Podophyllotoxin and α- and β-peltatin were both effective in reducing the incidence of pregnancy, preferably when given about three days after copulation, and there was no evidence of acquired resistance up to three consecutive pregnancies. Despite the close structural similarity between the three substances α-peltatin was more active and its toxicity was significantly lower than that of either β-peltatin or podophyllotoxin.

Gujral, Varma & Sareen (1960) observed that 'Kamala', an orange-red powder which occurs as a glandular pubescence on the fruits of *Mallotus philippinensis*, when given orally to rats or guinea-pigs, disturbs the oestrous cycle in such a way that the animals fail to mate; the effect is reversible. The kamala, which has a long history of use in India as a dyestuff and anthelminthic, was fractionated and each fraction tested separately, with the result that the activity was shown to reside in the principle constituent, rottlerin (XVII). Further investigation has led to the conclusion that rottlerin acts by antagonizing the peripheral effects of chorionic gonadotrophin (Varma, *et al.*, 1959).

One further substance for which antifertility activity has been claimed, and which has received considerable attention, is *m*-xylohydroquinone (XVI) from *Pisum sativum*. However, later workers have not been successful in substantiating this claim.

Antifertility agents of unknown constitution

I have already drawn attention to the fact that there are a great many reports of the use of plant preparations to prevent conception. Such recipes come from all parts of the world and some date back to antiquity. I have also pointed out that the number of plant species involved is so large that it seems probable that the great majority have no sound foundation. If this is correct, it is not surprising since one must recognize that observations relating to

human fertility are likely to be less valid than those concerned with the alleviation of an ailment in which cause and effect are not so widely separated in time. Moreover, the belief that a particular species is a contraceptive agent might not be the result of any 'trial and error' process whatsoever. Schultes (1963), in describing three species which he ascertained were used as oral contraceptives by Indians in the Amazon basin, pointed out that all three belonged to the same family, the Araceae. He also pointed out that it has been suggested that the use of aroids as contraceptives may be the result of phallic symbolism in reference to the spadix of these plants. Certainly reports of the use of aroids are to be found in many parts of the world. One wonders whether anything more than superstition was involved in the view expressed by the S.S. physician, Dr Adolf Pokorny, who is reported to have told Himmler that he had found the right means for sterilizing concentration camp inmates—the araceous plant *Caladium seguinum* which, he said, induced lasting sterility (Shirer, 1961). On the other hand, one should remember that the potent oestrogen miroestrol was discovered solely because of a report that the plant containing it was used as a 'rejuvenating' drug, and Jones & Pope (1961) point out that there is evidence for the validity of two of the claims traditionally made for *Pueraria mirifica* root.

There is also at least one other report of this kind for which there is some foundation, though the active principle has not yet been isolated. We must therefore keep an open mind concerning the large numbers of reports which remain to be investigated. Of those which have been studied, most attention has been given to *Lithospermum ruderale*, an infusion of the roots of which was believed by the Nevada Indians to lead to sterility. It seems clear that *L. ruderale* extracts are capable of inhibiting the action or formation of gonadotrophic hormones, but the great amount of work carried out has been somewhat ineffective, primarily because it has not yet been possible to separate the active principle, even in a crude form. Until this is done, it cannot be examined without

the introduction of dietary and other complications. The difficulty seems to lie in the instability of the active substance. Schultes, in the article referred to above, pointed out the desirability of obtaining a number of independent reports in order to be sure that belief in the contraceptive properties of a species is genuine, whether or not the belief itself is erroneous. The genus *Lithospermum* provides an example of such corroboration, in that *L. arvense* is also reported (de Laszlo & Henshaw, 1954) as having been used in Central Europe, that is, by a people widely separated geographically from those who made use of *L. ruderale*, and of different ethnic origin. In addition, an extract of a third species, *L. officinale*, has been shown by Wiesner & Yudkin (1952) to inhibit oestrus in mice, but a daily dose 20 to 40 times that received by the mice had no significant effect on a woman.

A substance cirantin isolated from orange peel (*Citrus aurantium*) has been reported by Ghosh, Mukherjee & Banerjee (1955) to prevent pregnancy in rabbits. In subsequent papers Ghosh (1958) has claimed that phosphorylated cirantin shows antihyaluronidase activity and that a water-soluble sulphonated derivative is more effective than cirantin itself in preventing pregnancy (Ghosh & Bose, 1961). However, we appear to have no information concerning the chemical structure of cirantin beyond the unsupported statement that it is a pyrone derivative.

Reports of plant species believed to possess contraceptive properties are widespread throughout the anthropological literature, they are not uncommon in popular publications and are also to be found in a variety of biological journals. Attempts have been made to collect these reports together and there are a number of published lists of plant species allegedly used as contraceptives. Examples of such lists are those of de Laszlo & Henshaw (1954), Casey (1960) and Jöchle (1962). My colleagues and I, by gathering information from anthropological reports, from compilations of the uses to which plants are put by native peoples (for example, Rageau, 1957) and from direct enquiries

made on our behalf in Papua and New Guinea, have compiled a list of plants allegedly used in the south-west Pacific area for controlling fertility. This list contains over 200 species. We have tested the effect of extracts of about 80 of these species on the fertility of rats by the following method. The whole of the extractable material, which could be expected to contain any potentially active compounds, was removed in three fractions and each fraction tested separately by daily oral administration at a level equivalent to 10 g dry plant per kilogram body weight for a period of four weeks. From the time of joining with males, the females were examined daily for evidence of oestrus and mating, pregnancy and parturition. The effectiveness of the treatment was assessed by the interval of time to first mating, and by the fertility of matings and the size of litters produced, compared with controls similarly treated with the pure vehicle used for the treated animals. Toxicity of extracts was gauged by weight changes during the experiment. The use of extracts, rather than incorporating whole plant into the diet, was preferred, in order to avoid effects on fertility arising from nonspecific nutritional deficiencies. However, while the oral administration of such crude extracts can provide useful information, as in the investigation of the clover oestrogens, it is recognized that the method has its limitations, as is evident from work on the *Lithospermum* problem.

The results of these tests are that almost all of the approximately 80 species examined had no significant effect on the fertility of rats. One species, of which extracts of the leaves are still under investigation, has been shown by previous workers to contain desoxypodophyllotoxin in the seeds, so this or a related substance may well be present in the leaves.

In addition to testing a large number of plants not previously investigated, we examined *m*-xylohydroquinone and rottlerin and in neither case was any evidence of lowered fertility obtained.

Our inability to detect any effect on fertility resulting from the oral administration of these substances, coupled with the inactivity

of almost all the plant species examined, has forced us to ask ourselves whether the procedure we have adopted as a screening test is satisfactory, whether rats are the most suitable experimental animals, and whether the dose levels employed are adequate.

What is possibly a more serious limitation of this type of testing is that, because of the distance of the laboratories from the source of the plants, dried material was employed in almost every instance, whereas the anthropological reports refer almost always to the use of fresh material. There is increasing evidence that the process of drying plant material may have marked effects on the nature of the extractives and on the physiological properties of drugs of plant origin. We must accept therefore that until these materials have been re-examined in the fresh condition they cannot be regarded as proven ineffective. This we hope to do, at least with a proportion of them.

This review ends, therefore, on a rather pessimistic note, but as I said in my introductory remarks, I believe the work should be continued, and where there is any evidence of activity, every possible effort should be made to isolate the active principle in a pure condition. It should be remembered that the long-term importance of isolating new classes of substances with anti-fertility activity lies in the opportunity they will provide for the synthetic organic chemist to produce better and more effective agents.

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DISCUSSION

D. P. Moody (St. Bartholomew's Hospital Medical College, London): The first point that I was going to make has been very adequately covered by the paper, and that is, why bother to look for these plants and these reports at all? The answer must be that one is only looking for leads; one is not aiming to achieve a world-record break. It is only a lead one wants and it is then turned over to the big battalions for the analogues, the syntheses and so on. Why go through the route of anthropology?

There are two points that, perhaps, have not come out in the paper so far. One is that if no attempt is made to recover the knowledge of cultures that are collapsing under the impact of civilization, then, of

course, this knowledge is lost to humanity and a considerable amount of empirical work done over the years disappears.

The other point is that one would expect to find a very high species specificity in any of these agents. It is, therefore, quite possible that even if the active principles do survive drying, transport and time on the laboratory shelf, one is simply testing them in the wrong animal.

With this sort of background in mind, I should like to say something about a visit to British Guiana that my wife, children and I made. We were looking for medicinals in general, and we stumbled over some contraceptives in a rather odd way. As the job had to be done during the long vacation, we had only three months in the field.

In the course of our travels we met a girl whose sister my wife had treated for infantile paralysis, which is another and very sad story. From this girl we obtained an account of how she took some scrapings from a nut about three or four days before she was due to menstruate. She repeated this three or four days before the next menstruation and so on. After three or four doses she ceased to menstruate for up to two years, and was infertile. She could apparently continue this period of infertility by booster courses of the same nut, and could terminate it rather viciously by what one can only assume is some kind of plant oestrogen. This, of course, sounded to us to be a very good thing and well worth collecting, but there are some questions that occur in the follow-up. Does the story make any sense at all? And are tests on non-menstruating animals of any significance at all in this kind of context? If non-menstruating animals are not significant test animals what should be used in their place? In the area in which we worked there is a marmoset as a native animal which is about the size and weight of a laboratory guinea-pig. I can see no reason why it should not be kept in the laboratory. Perhaps the zoologists can say something about that point.

There is one final point on which I should appreciate some help. Assuming that this substance is active—and this is a big assumption—and assuming that it turns out to be useful, we are then going to need a name for it.

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298 ALLEGED ANTI-FERTILITY PLANTS OF INDIA

R. C. D. Casey

This piece of research into Indian plants was stimulated by reading de Laszlo and Henshaw's review of world literature on plants with anti-fertility effects. They discuss 60 of these.[6]

It seems the anthropological, historical and medical literature of many countries is permeated with reports of such plants. Some go back many years, and one of de Laszlo and Henshaw's is dated 1849.

Fortunately in India the local systems of medicine have for centuries relied heavily on plant cures, and the job of finding plants with special effects has been made much easier. A number of imposing works have been written collating this vast resevoir of semi-medical lore. In these works the plants have been given their proper botanical names, and where possible, any references in the medical and scientific journals are quoted. They are a strange pot-pourri of science and folk-lore. The works I have carefully gone through, page by page, are listed in the references.[1, 2, 5, 6, 7]

The fact that each plant may have attributed to it as many as a dozen different therapeutic qualities has made the study quite tedious. It may appear amusing, but it is quite usual to find a plant described in the manner of the following panacea* "...The root is less bitter; purgative, expectorant, antipyretic, emmenagogue; removes bad humors, piles, inflammation, useful in hemicrania, nose troubles, chest complaints, leucoderma; good for the gums and the teeth. (Yunani.)"

Some serious work is quoted by Chopra[2] to have been done to check the claims of many so-called snakebite and scorpion sting antidotes. Apparently none were found effective out of many hundreds.

Nevertheless, it would be rash to dismiss *all* claims made by the Ayurvedic, Unani, and other systems as pure imagination. Among important drug containing plants in this list are: *Rauwolfia serpentina* (tranquillizer), *Ruta graveolens* (antithrombic agent), *Cinchona calisaya* (quinine), *Claviceps purpurea* (ergometrine) and many others well used and documented in Western medicine.

The 298 plants listed here—except for a very few I may have missed—should cover all the plants with alleged antifertility effects mentioned in the books concerned. I think these books are the classical and most exhaustive references available.

Almost all these plants could be classed as abortifacients (abortion producing substances). Abortifacients can be subdivided into emmenagogues (menstruation stimulators), ecbolics (uterine contractors), anti-metabolites, and others, but the source material did not warrant such niceties. The majority of the plants in the list are described as emmenagogues. I have included anything which is prescribed for amenorrhea, and some occasional plants said to assist labour, in some cases in animals. Although most of the plants are said to be for oral use, a number are described as having a local effect.

When examining more closely the reports on a plant, it will be necessary to find which parts contain the active principle e.g. leaves, stem, bark, fruit, tubers, roots, etc. I have not gone into this detail.

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* *Picrorrhiza kurrooa*, p. 1825[5]

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All the species (or their close relatives) listed here grow in India or areas nearby. The reports of the abortifacient effects, however, sometimes come from outside, e.g. Indo-China or Europe, where the plants are also found.

Chopra[2] (p. 563) goes to some length to explain that there are no indigenous abortifacients which do not at the same time endanger the life of the mother. Apparently many of the drugs concerned are merely poisonous, with abortion being a side-effect, while others act by being violent purgatives.

Although Chopra may be right, there are a large number of plants here which are not included in his book, and to which his generalization may not apply. However, I have taken the precaution of annotating those plants which Chopra has indicated as having poisonous effects or containing stated poisonous principles (p. 543 and 593). These constitute some 11% of all the plants listed. It must be remembered that plants not mentioned by Chopra may also fall into this category.

Owing to the notorious unreliability of Indian so-called plant cures (e.g. snakebite antidotes) I have classified the species depending on the degree of agreement among the authorities. A plant appearing in Class I has the distinction of being mentioned in all five references. One appearing in Class II is mentioned in only 4 references, and so on, down to one reference only. When I say "mention" here. I mean mention as an abortifacient. In the list, these are marked with a "+".

The following shows the frequency of occurrence of plants in each class.

	No. of mentions	No. of plants
Class I	5	2
Class II	4	16
Class III	3	65
Class IV	2	86
Class V	1	129
Total		298

In assessing which species look more attractive for further research, no doubt the higher classes will be given more weight.

Even allowing for the fact that many of the reference works have copied from each other (this is obviously not always the case), it seems to me remarkable that there is as much consensus as there is.

I have analysed out the frequency of occurrence of the species among various families. (See appendix). Perhaps a plant biochemist or a taxonomist will be able to explain the significance of the high number of strikes among the *Leguminosae* and *Compositae*. This may, however, merely reflect the enormous size of the two families rather than the special presence of certain chemicals in their tissues.

In a work of this size I have almost certainly made some errors, although by careful checking I have done my best to eliminate them. I would appreciate any help in this respect.

I mention two recent works[3, 8] in this general field which apply to the Pacific area. These might deserve attention. No reference has been made to them in the list, and I do not know where they are locally available.

It is my hope that this list may help to stimulate research into this potentially very important aspect of birth control. In my opinion, a *safe* abortifacient would seem to have certain advantages over the popular lines of research into oral contraceptives now current. e.g. steroids, and metaxylohydroquinone.

This is because, in theory, they would not be needed probably more than twice a year, and the woman would be unlikely to forget to use them. The oral contraceptives mentioned have to be taken regularly, and are keyed into the rhythm of the menstrual cycle. However, it would be unwise to suggest at this stage that chemical contraceptives other than abortifacients will not be found, which have the blessing of needing use not more often than twice a year.

Although it is beyond the scope of this study to suggest the modi operandi of these plants, it may be that many of them have an effect on the progesterone/estrogen ratio in the blood. Henshaw[4] gives a useful survey which could give some leads on this.

In considering abortifacients, and what Chopra says about their often being poisonous, it may not be axiomatic in *all* cases that the active principle is the poisonous one. Synthetic chemistry will no doubt be important in this area. Perhaps if these plants do nothing else, they may start some synthesizers on the right track. Out of the nearly 300 plants mentioned here it would not surprise me if 2 or 3 as such, or their derivatives, emerge as of first class importance.

In view of the urgency of the population problem in India, and the apparent distaste with which the average villager is said to view more orthodox birth control/methods, this list is felt to fulfil a need.

LEGEND

The first word for each plant is the genus. The second is the species.

@	=	The plant has two generic names, both of which may appear in the list. It will be clear from the appendix which is the synonym for which.
A & S	=	Authority and synonyms (see appendix).
P/pp	=	P: said by Chopra[2] p. 543 to have "poisonous properties." pp: said by Chopra[2] p. 593 to contain "(stated) poisonous principles."
F	=	Family (see appendix).
(1), (2), (3), etc.	=	See references.
+	=	Mentioned as having abortifacient effects.
M	=	Mentioned, but not as an abortifacient.
—	=	Not mentioned at all.

	A & S	P/pp	F	(1)	(2)	(5)	(7)	(6)
CLASS I								
Ananas comosus	1	pp	15	+	+	+	+	+
Ruta graveolens	2	—	69	+	+	+	+	+
CLASS II								
Aloe barbadensis	3	—	45	+	+	+	+	—
Annona squamosa	4	—	6	+	+	+	+	—
Apium graveolens	4	—	78	+	+	+	+	—
Aristolochia bracteata	5	—	9	+	+	+	+	—
Aristolochia indica	5	—	9	+	+	+	+	—
Artemisia siversiana	6	—	24	+	+	+	+	—
Gossypium herbaceum	7	—	51	+	+	+	+	M
Lepidum sativum	4	—	27	+	+	+	+	—
Momordica tuberosa	8	—	28	+	+	+	+	—

	A & S	P/pp	F	(1)	(2)	(5)	(7)	(6)
Moringa oleifera	9	—	54	+	+	+	+	—
Peganum harmala	4	—	69	+	+	+	+	—
Randia dumetorum	10	pp	68	+	+	+	+	—
Rubus moluccanus	4	—	67	+	+	+	+	—
Semecarpus anacardium ..	4	—	5	+	+	+	+	M
Taxus baccata	4	—	75	+	+	+	+	—
Trianthema pentandra	4	P	78	+	+	+	+	—
CLASS III								
Abroma augusta	4	—	73	+	M	+	+	—
Abrus precatorius	4	—	43	+	+	+	M	—
Achillea millefolium	4	pp	24	+	M	+	M	+
Adiantum capillus-veneris ..	4	—	64	+	M	+	+	—
Adiantum venustum	4	—	64	+	M	+	+	—
Agave americana..	4	—	43	+	M	+	+	—
Allium cepa	4	—	45	+	M	+	+	—
Areca catechu	4	P	58	+	+	+	M	—
Asplenium adiantum-nigrum ..	4	—	64	+	M	+	M	+
Bambusa bambos	11	pp	36	+	M	+	+	—
Bauhinia retusa	12	—	43	+	—	+	+	—
Bragantia tomentosa	13	—	9	+	M	+	+	—
Cadaba farinosa	14	—	18	+	—	+	+	—
Caesalpinia jayabo	15	—	43	+	M	+	+	—
Caesalpinia pulcherrima@ ..	40	—	43	+	M	+	+	—
Caesalpinia sappan	4	—	43	+	—	+	+	—
Capsella bursa-pastoris	16	—	27	+	—	+	M	+
Cardiospermum halicacabum ..	4	P	71	+	M	+	+	—
Carica papiya	4	—	20	+	M	+	+	—
Cedrela toona	17	—	52	+	M	+	+	—
Cheiranthus cheiri	4	—	27	+	—	+	+	—
Cichorium intybus	4	pp	24	+	M	+	+	—
Cissus quadrangularis@ ..	113	—	82	+	M	+	+	—
Crotalaria juncea..	4	—	43	+	M	+	+	—
Cyperus rotundus	4	—	29	+	M	+	+	—
Daucus carota	4	pp	78	M	+	+	+	—
Dendrocalamus strictus ..	18	—	36	+	M	+	+	—
Dictamnus albus	4	—	69	+	M	+	+	—
Dolichandrone falcata	19	—	12	+	M	+	+	—
Dolichos biflorus	4	—	43	+	M	+	+	—
Garcinia morella	20	P	37	+	+	+	M	—
Gloriosa superba	4	—	45	M	+	+	+	—
Glossocardia bosvallia	21	—	24	+	—	+	+	—
Grangea maderaspatana ..	22	—	24	+	M	+	+	—
Helleborus niger	4	—	66	+	—	—	+	+
Hypericum perforatum ..	4	P	38	+	M	+	+	—
Hyssopus officinalis	4	—	41	+	M	+	+	—
Indigofera linifolia	5	—	43	+	—	+	+	—
Jatropha gossypifolia	4	—	32	+	—	+	+	—
Leucas stelligera	23	—	41	+	—	+	+	—
Melia azedarach	4	—	52	+	M	+	+	—
Mentha arvensis	4	—	41	+	M	+	+	—
Michelia champaca	4	—	50	+	M	+	+	—
Mollugo cerviana	24	—	33	+	—	+	+	—
Mollugo pentaphylla	4	—	33	+	M	+	+	—
Momordica charantia	4	—	28	M	+	+	+	—
Morinda citrifolia	4	—	68	+	M	+	+	—
Nigella sativa	4	—	66	+	M	+	+	—
Parmelia spp.	—	—	44	+	M	+	+	—
Pedalium murex	4	—	60	+	M	+	+	—
Plumeria acuminata	25	—	7	M	+	+	+	—
Poinciana pulcherrima @ ..	26	—	43	+	M	+	+	—
Polygonum hydropiper	4	—	63	+	M	+	M	+
Prangos pabularia	27	—	78	+	M	+	+	—
Rauwolfia serpentina	28	—	7	+	M	+	+	—
Rubia tinctorum	4	—	68	+	—	+	+	—
Sagittaria sagittifolia	4	—	2	+	M	+	+	—
Salicornia brachiata	12	—	22	+	+	+	—	—
Sapindus trifoliatus	4	—	71	M	+	+	+	—
Sesamum indicum	29	—	60	+	M	+	+	—

	A & S	P/pp	F	(1)	(2)	(5)	(7)	(6)
Trianthema portulacastrum ..	30	—	78	+	+	M	+	—
Uraria lagopoides	21	—	43	+	M	+	+	—
Verbena officinalis	4	P	81	+	M	+	+	—
Viburnum foetidum	23	—	19	+	—	+	+	—
Vitex trifolia	4	—	81	+	M	+	+	—
Vitis quadrangularis@	31	—	82	+	M	+	+	—
Withania somnifera	32	—	74	+	+	+	M	—
CLASS IV								
Allium sativum	4	—	45	M	M	+	+	—
Allium schoenoprasum	4	—	45	+	M	+	—	—
Aloe perryi	33	—	45	+	—	—	+	—
Amorphophallus campanulatus	34	P	8	M	M	+	+	—
Anastatica hierochuntica ..	4	—	27	+	—	—	+	—
Andropogon iwarancusa@ ..	35	—	36	M	M	+	+	—
Andropogon muricatus	5	—	36	+	M	—	+	—
Anethum sowa@..	36	—	78	M	M	+	+	—
Artemisia vulgaris	4	—	24	+	M	+	M	—
Balsamodendron mukul@ ..	37	—	16	+	M	M	+	—
Balsamodendron myrrha@ ..	38	—	16	+	M	—	+	—
Beta vulgaris	4	—	22	M	M	+	+	—
Blumea balsamifera	21	—	24	M	M	+	+	—
Blumea eriantha	21	—	24	+	M	+	M	—
Boswellia glabra	12	—	16	—	—	+	+	—
Boswellia serrata	12	—	16	+	M	M	+	—
Cadaba trifoliata	39	—	18	+	—	+	—	—
Caesalpinia crista	4	—	43	+	M	+	—	—
Caesalpinia sepiaria	12	—	43	+	—	+	—	—
Calendula officinalis	4	—	24	+	—	+	M	—
Calotropis gigantea	41	—	10	M	+	M	+	—
Capparis spinosa	4	—	18	+	M	+	M	—
Carthamus tinctorius	4	—	24	+	M	+	M	—
Carum roxburghianum	42	—	78	M	—	+	+	—
Celastrus paniculatus	43	—	21	+	M	+	M	—
Celtis australis	4	—	77	+	—	+	—	—
Chrysanthemum indicum@ ..	44	—	24	M	—	+	+	—
Cinnamomum cassia	13	—	42	M	M	+	+	—
Citrullus colocynthis	45	P	28	M	+	M	+	—
Claviceps purpurea	46	—	39	+	M	—	+	—
Commiphora mukul@	47	—	16	+	M	M	+	—
Commiphora myrrha@ ..	48	—	16	+	M	—	+	—
Crinum asiaticum	4	P	4	+	M	+	M	—
Crocus sativus	4	—	40	M	+	M	+	—
Croton tiglium	4	—	32	M	+	+	M	—
Cuminum cyminum	4	—	78	M	M	+	+	—
Cuscuta reflexa	12	—	26	M	+	+	M	—
Cyclamen persicum	49	—	65	+	M	—	+	—
Cymbopogon jwarancusa@ ..	50	—	36	M	M	+	+	—
Cyperus longus	4	P	29	+	M	+	—	—
Cyperus scariosus	73	—	29	M	M	+	+	—
Daemia extensa@	51	—	10	M	M	+	M	+
Desmodium retroflexum ..	21	—	43	+	—	+	—	—
Dipteracanthus suffruticosa@ ..	52	—	1	+	—	+	M	—
Dracontium polyphyllum ..	4	—	8	+	—	—	+	—
Erythrina indica	10	—	43	—	M	+	+	—
Eupatorium cannabinum ..	4	—	24	+	—	+	M	—
Euphorbia resinifera	53	—	32	+	—	—	+	—
Excoecaria agallocha	4	—	32	+	+	M	M	—
Ferula asafoetida	54	—	78	M	M	+	+	—
Foeniculum vulgare	49	—	78	+	M	—	+	—
Glycyrrhiza glabra	4	—	43	M	M	+	+	—
Gossypium hirsutum	4	—	51	+	—	+	M	—
Gymnopetalum cochinchinense ..	55	—	28	+	—	+	—	—
Hedychium spicatum	56	—	83	+	M	+	M	—
Hibiscus manihot	4	—	51	+	—	+	—	—
Hibiscus rosa- sinensis ..	..	4	—	51	M	+	+	—
Jasminum officinale	57	—	57	+	M	+	M	—
Jasminum sambac	58	—	57	+	M	+	M	—
Jatropha multifida	4	—	32	+	M	+	M	—
Jutiperus communis	4	pp	25	M	M	+	+	—

	A & S	P/pp	F	(1)	(2)	(5)	(7)	(6)
Laurus nobilis	4	—	42	+	—	—	+	—
Luffa echinata	12	—	28	M	M	+	+	—
Melia azadirachta	59	—	52	M	M	+	+	—
Nardostachys jatamansi ..	21	—	80	M	M	+	+	—
Nerium odorum	60	—	7	M	+	M	+	—
Origanum vulgare	4	—	41	+	M	+	M	—
Pergularia extensa@	104	—	10	M	M	+	M	+
Peucedanum graveolens@ ..	61	—	78	M	M	+	+	—
Picrorrhiza kurrooa	62	—	72	M	M	+	+	—
Piper longum	4	—	61	M	M	+	+	—
Plumbago rosea	63	—	62	M	M	+	+	—
Plumbago zeylanica	4	—	62	M	M	+	+	—
Pyrethrum indicum@	64	—	24	M	—	+	+	—
Ranunculus sceleratus ..	4	—	66	+	M	M	+	—
Raphanus sativus	4	pp	27	M	M	+	+	—
Rhynchosia minima	21	—	43	+	—	+	M	—
Ricinus communis	4	—	32	M	M	+	+	—
Rubia cordifolia	4	—	68	M	M	+	+	—
Ruellia suffruticosa@	65	—	1	+	—	+	M	—
Santalum album	4	—	70	M	M	+	+	—
Sesbania aegyptiaca	66	—	43	M	M	+	+	—
Strychnos nux-vomica ..	4	—	47	M	M	+	+	—
Tanacetum spp.	4	—	24	M	+	+	—	—
Thevetia neriifolia	67	—	47	M	+	M	+	—
Thymus serpyllum	4	—	41	+	M	+	M	—
Trachylobium hornemannianum	68	—	43	+	M	—	+	—
Trichosanthes cucumerina ..	4	—	28	+	M	+	M	—
Trigonella foenum-graeceum ..	4	—	43	M	M	+	+	—
Triumfetta bartramia	4	—	76	+	M	+	—	—
Urginea indica	69	—	45	M	M	+	+	—
Urtica dioica	4	—	79	+	M	+	M	—
Walsura piscidia	12	—	52	—	M	—	+	—
CLASS V								
Acacia rugata	70	—	43	—	—	+	—	—
Acalypha indica	4	—	32	M	M	M	+	—
Achyranthes aspera	4	—	3	M	M	M	+	—
Acorus calamus	4	—	8	M	M	+	M	—
Adansonia digitata	4	—	13	M	M	+	M	—
Adhatoda vasica	71	—	1	M	M	+	M	—
Adiantum pedatum	4	—	64	+	M	M	M	—
Aganosma marginata	72	—	7	+	—	—	—	—
Alstonia scholaris	73	—	7	M	M	+	M	—
Andropogon monticola	74	—	36	—	M	—	+	—
Aneilema conspicuum	69	—	23	+	—	—	—	—
Aneilema lineolatum	69	—	23	+	—	—	—	—
Anodendron paniculatum ..	75	—	7	M	M	M	—	+
Anthemis cotula	4	—	24	+	M	—	—	—
Anthemis nobilis	4	—	24	M	M	—	+	—
Antidesma ghesaembilla ..	76	—	32	+	—	—	—	—
Arundo donax	4	—	36	+	—	—	—	—
Asparagus officinalis	4	—	45	M	M	M	M	+
Astragalus hamosus	4	—	43	M	—	+	M	—
Berberis aristata	21	—	11	M	M	M	+	—
Blumea lacera	21	—	24	M	M	M	+	—
Brassica alba	77	—	27	—	—	—	+	—
Brassica nigra	78	—	27	M	—	M	+	—
Buddleja asiatica	79	—	47	+	—	—	—	—
Butea monosperma	80	—	43	M	M	+	—	—
Calendula arvensis	4	—	24	+	—	—	—	—
Calotropis procera	81	—	10	M	+	M	M	—
Cannabis sativa	4	—	17	M	M	+	M	—
Capparis decidua	82	—	18	M	—	+	—	—
Carum copticum	83	—	78	—	M	+	—	—
Cassia lanceolata	84	—	43	—	M	—	+	—
Celsia causcasica	43	—	72	—	—	—	+	—
Centaurea cyanus	4	—	24	+	—	—	M	—
Centipeda orbicularis	85	—	24	M	M	+	M	—
Cerbera odollam	76	—	7	M	M	M	+	—
Chenopodium ambrosioides ..	4	P	22	M	M	+	M	—

	A & S	P/pp	F	(1)	(2)	(5)	(7)	(6)
Cicer arietinum	4	pp	43	M	M	+	M	—
Cinchona calisaya	86	—	68	M	+	M	M	—
Cinnamomum camphora ..	87	—	42	M	+	M	M	—
Cinnamomum tamala	87	—	42	M	M	+	M	—
Cissampelos pareira	4	—	53	M	M	+	M	—
Cocos nucifera	4	—	58	M	M	M	M	+
Corydalis spp.	88	—	34	M	—	+	M	—
Cotula spp.	89	—	24	M	—	+	M	—
Cucumis trigonus	12	P	28	M	+	M	M	—
Curcuma longa	4	—	83	M	M	+	M	—
Curcuma zedoaria	90	—	83	M	M	+	M	—
Cyperus canescens		—	29	—	—	—	+	—
Dalbergia sissoo	12	—	43	M	M	+	M	—
Desmodium tiliaefolium ..	72	—	43	M	—	+	M	—
Dolichos lablab	4	—	43	M	—	+	M	—
Dryopteris felix-mas	91	—	64	M	M	—	M	+
Elettaria cardamomum	92	—	83	M	M	+	M	—
Ervatamia coronaria	93	—	7	M	—	+	—	—
Erythrina variegata	4	—	43	+	—	—	—	—
Erythroxylon coca	10	P	31	M	M	M	+	—
Euonymus cannabinum ..	4	—	21	+	—	—	—	—
Eupatorium odoratum	4	—	24	M	M	—	—	+
Euphorbia atoto	94	—	32	+	—	—	—	—
Euphorbia tirucalli	4	—	32	M	+	M	M	—
Fagonia cretica	4	—	84	M	M	+	M	—
Ferula orientalis	4	—	78	—	—	—	+	—
Gentiana kurroo	95	—	35	M	M	+	M	—
Grewia asiatica	4	—	76	M	M	+	M	—
Grewia hirsuta	96	—	76	M	M	+	—	—
Hagenia abyssynica@	97	—	67	M	—	—	+	—
Helianthus annuus	4	—	24	M	M	+	M	—
Heliotropium indicum	4	—	14	M	M	+	M	—
Hydrocotyle asiatica@	115	—	78	M	M	M	+	—
Hyptis pectinata	98	—	41	+	—	—	—	—
Jasminum pubescens	43	—	57	M	M	M	+	—
Jatropha glandulifera	12	—	32	M	M	+	M	—
Lavandula stoechas	4	—	41	M	—	—	+	—
Lawsonia inermis	4	—	49	M	M	+	M	—
Leonotis nepetaefolia	73	—	41	M	M	+	M	—
Leucaena glauca	99	—	43	M	—	M	—	+
Leucas cephalotes	100	—	41	M	M	M	+	—
Linum usitatissimum	4	P	46	M	M	+	M	—
Luffa acutangula	12	P	28	M	M	+	M	—
Lycium barbarum	4	pp	74	M	M	+	M	—
Lycopodium clavatum	4	—	48	M	—	—	+	—
Marrubium vulgare	4	—	41	M	M	M	+	—
Matthiola incana	73	—	27	M	M	+	M	—
Matthiola tristis	73	—	27	—	—	+	—	—
Matthiola varia	21	—	27	—	—	+	—	—
Mesua ferrea	4	—	37	M	M	M	+	—
Mucuna prurita	101	—	43	M	M	+	M	—
Myristica fragrans	102	P	55	M	M	M	+	—
Myrtus communis	4	—	56	M	M	+	M	—
Nasturtium officinale	73	pp	27	M	M	—	M	+
Nepeta cataria	4	—	41	+	—	—	—	—
Ochrocarpus longifolius	103	—	37	M	—	M	+	—
Ocimum basilicum	4	—	41	M	M	+	M	—
Olea cuspidata	23	—	57	M	—	+	M	—
Paederia foetida	4	—	68	M	M	+	M	—
Passiflora foetida	4	—	59	M	M	+	M	—
Phyllanthus urinaria	4	—	32	M	M	+	M	—
Pinus longifolia	105	—	25	M	M	+	M	—
Piper aurantiacum	23	—	61	M	—	M	+	—
Piper nigrum	4	P	61	M	M	+	M	—
Prunus mahaleb	4	—	67	M	M	+	M	—
Prunus persica	106	—	67	M	M	+	M	—
Pteroselinum hortense	107	—	78	—	—	—	+	—
Pyrethrum umbelliferum ..	108	—	24	—	—	—	+	—
Rheum emodi	23	pp	63	M	M	+	M	—
Rosmarinus officinalis	4	—	41	M	M	—	M	+

	A & S	P/pp	F	(1)	(2)	(5)	(7)	(6)
Salvia officinalis	4	—	41	M	—	M	+	—
Salvia plebeia	73	—	41	M	M	M	+	—
Saraca indica	4	—	43	M	M	M	+	—
Saussurea lappa	109	—	24	M	M	+	M	—
Siegesbeckia orientalis	4	—	24	M	—	+	M	—
Solanum nigrum	4	—	74	M	M	+	M	—
Sphaeranthus indicus	4	—	24	M	M	+	M	—
Stachys palustris	4	—	41	+	—	—	—	—
Stachys sylvatica	4	—	41	+	—	—	—	—
Stachytarpheta jamaicensis ..	114	—	81	M	+	—	—	—
Tamarindus indica	4	pp	43	M	M	+	M	—
Tribulus alatus	110	—	84	M	M	+	M	—
Tribulus terrestris	4	P	84	M	M	+	M	—
Trichillia emetica	12	—	52	—	—	—	+	—
Trichosanthes palmata	111	P	28	M	M	+	M	—
Tussilago farfara	4	—	24	M	—	+	M	—
Tylophora asthmatica	112	P	10	M	M	M	+	—
Urena lobata	4	—	51	M	M	M	M	+
Valeriana wallichii	21	—	80	M	M	+	M	—
Vateria indica	4	—	30	M	M	+	M	—
Vitex negundo	4	—	81	M	M	M	+	M
Withania coagulens	32	—	74	M	—	+	M	—
Ziziphora tenuior	4	—	41	M	—	M	+	—

AUTHORITY & SYNONYMS

(Appendix)

1. Merr. (A. sativus Schult. f.)
2. Linn. (Var. Angustifolia)
3. Mill. (A. indica Royle
   A. vera Tourn. ex Linn.
   A. littoralis Koening)
4. Linn.
5. Retz.
6. Ehrh. ex Willd.
7. Linn. (G. indicum Lam.)
8. Cogn. (M. cymbalaria Fenzl ex Naud)
9. Lam. (M. pterygosperma Gaertn.)
10. Lam.
11. Druce (B. arundinacea Retz.)
12. Roxb.
13. Blume
14. Forsk. (C. indica Lam.)
15. Maza (C. bonduc (Linn.) Roxb.)
16. Medic.
17. Roxb. (In Nadkarni's book (5) it is spelled Cedreia)
18. (Roxb.) Nees
19. Seem.
20. Desr.
21. DC
22. Poir.
23. Wall.
24. Ser.
25. Ait. (P. acutifolia Poir.)
26. Linn. (Caesalpinia pulcherrima Swartz)
27. Lindl.
28. Benth. ex Kurz
29. DC (S. orientale Linn.)
30. Linn. (T. monogyna Linn.)
31. Wall. (Cissus quadrangularis Linn.)
32. Dunal
33. Baker
34. (Roxb.) Blume
35. Roxb. (A. Jwarancusa Jones? Cymbopogon jwarancusa Schult?)
36. Kurz (Peucedanum Graveolens Linn.)
37. Hook. (Commiphora mukul (Hook ex Stocks) Engl.)
38. Nees (Commiphora myrrha (nees Engl.)
39 Roxb. (W. & A.)
40. Swartz (Poinciana pulcherrima Linn.)
41. (Linn.) Dryand (C. gigantea R. Br.)
42 Benth. & Hook. f.
43. Willd.
44. Linn. (Pyrethrum indicum DC)
45. Schrad.
46. (Fr.) Tul.
47. (Hook. ex Stocks) Engl. (Balsamodendron mukul Hook.)
48. (Nees) Engl. (Balsamodendron myrrha. Nees)

49. Miller
50. Schult. (Andropogon jwarancusa Jones)
51. R. Br. (Pergularia extensa N.E. Br.)
52. Voigt (Ruellia Suffruticosa Roxb.)
53. Berg.
54. Linn. (F. foetida Regel; F. Narthex Boiss.)
55. Kurz
56. Ham. ex Smith
57. Linn. var Grandiflorum Bailey
58. Ait.
59. Linn. (A. indica A. Juss.)
60. Soland
61. Linn. (Anethum sowa Kurz)
62. Royle ex Benth.
63. Linn. (P. indica Linn.)
64. DC (Chrysanthemum indicum Linn.)
65. Roxb. (Dipteracanthus suffruticosa Voigt)
66. Poir. (S. sesban (Linn.) Merr.)
67. Juss. ex Steud (T. Peruviana (Pers.) Merr.)
68. Hayne
69. Kunth.
70. (Lam.) Ham.
71. Nees
72. G. Don
73. R. Br.
74. Schult.
75. A.DC
76. Gaertn.
77. Rabenh.
78. (Linn.) Koch
79. Lour. (or Buddleia a.)
80. (Lam.) Kuntze
81. (Linn.) Dryand (C. procera R. Br.)
82. Edgew
83. B. & H.
84. Linn. & Forsk.
85. Lour. (C. minima (Linn.) A. Br. et Aschers.)
86. Wedd.
87. Nees. & Eberm.
88. Vent.
89. (Tourn.) Linn.
90. Rosc.
91. (Linn.) Schott.
92. Maton
93. Stapf.
94. Forst. f.
95. Royle
96. Vahl.
97. Gmel. (Brayera anthelmintica Kunth.)
98. Poit.
99. Benth.
100. Spreng.
101. Hook.
102. Houtt.
103. Benth. & Hook ex T. Anders (in ref. (5) is Longifolium ochrocarpus)
104. N.E. Br. (Daemia extensa R. Br.)
105. Roxb. (P. roxburghii Sargent)
106. Batsch
107. Hoffm.
108. Boiss.
109. C.B. Clarke
110. Del.
111. Roxb. (T. bracteata (Lam.) Voigt)
112. W. & A.
113. Linn. (Vitis quadrangularis Wall.)
114. (Linn.) Vahl. Var. Indica H.J. Lam (S.indica Vahl.)
115. Linn. (Centella asiatica (Linn.) Urban.)

FAMILIES (Appendix)

1.	Acanthaceae	2
2.	Alismaceae	1
3.	Amaranthaceae	1
4.	Amaryllidaceae	1
5.	Anacardiaceae	1
6.	Annonaceae	1
7.	Apocynaceae	9
8.	Araceae	3
9.	Aristolochiaceae	3
10.	Asclepiadaceae	4
11.	Berberidaceae	1
12.	Bignoniaceae	1
13.	Bombaceae	1
14.	Boraginaceae	1
15.	Bromeliaceae	1
16.	Burseraceae	4
17.	Cannabinaceae	1
18.	Capparidaceae	4
19.	Caprifoliaceae	1
20.	Caricaceae	1
21.	Celastraceae	2
22.	Chenopodiaceae	3
23.	Commelinaceae	2

24.	Compositae	27
25.	Coniferae	2
26.	Convolvulaceae	1
27.	Cruciferae	11
28.	Cucurbitaceae	9
29.	Cyperaceae	4
30.	Dipterocarpaceae	1
31.	Erythroxylaceae	1
32.	Euphorbiaceae	12
33.	Ficoidaceae	2
34.	Fumariaceae	1
35.	Gentianaceae	1
36.	Gramineae	6
37.	Guttiferae	3
38.	Hypericaceae	1
39.	Hypocreales	1
40.	Iridaceae	1
41.	Labiatae	18
42.	Lauraceae	4
43.	Leguminosae	32
44.	Lichenes	1
45.	Liliaceae	8
46.	Linaceae	1
47.	Loganiaceae	2
48.	Lycopodiaceae	1
49.	Lythraceae	1
50.	Magnoliaceae	1
51.	Malvaceae	5
52.	Meliaceae	5
53.	Menispermaceae	1
54.	Moringaceae	1
55.	Myristicaceae	1
56.	Myrtaceae	1
57.	Oleaceae	4
58.	Palmae	2
59.	Passifloraceae	1
60.	Pedaliaceae	2
61.	Piperaceae	3
62.	Plumbaginaceae	2
63.	Polygonaceae	2
64.	Polypodiaceae	5
65.	Primulaceae	1
66.	Ranunculaceae	3
67.	Rosaceae	4
68.	Rubiaceae	6
69.	Rutaceae	3
70.	Santalaceae	1
71.	Sapindaceae	2
72.	Scrophulariaceae	2
73.	Steruliaceae	1
74.	Solanaceae	4
75.	Taxaceae	1
76.	Tiliaceae	3
77.	Ulmaceae	1
78.	Umbelliferae	14
79.	Urticaceae	1
80.	Valerianaceae	2
81.	Verbenaceae	4
82.	Vitaceae	1
83.	Zingiberaceae	4
84.	Zygophyllaceae	3
		298

Frequency of Occurrence v. Fam.

(Mentioned more than 3 times)

Leguminosae	32
Compositae	27
Labiatae	18
Umbelliferae	14
Euphorbiaceae	12
Cruciferae	11
Apocynaceae	9
Liliaceae	8
Gramineae	6
Rubiaceae	6
Malvaceae	5
Meliaceae	5
Polypodiaceae	5
Asclepiadaceae	4
Burseraceae	4
Capparidaceae	4
Cyperaceae	4
Lauraceae	4
Oleaceae	4
Rosaceae	4
Solanaceae	4
Verbenaceae	4
Zingiberaceae	4
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It should be noted that the list of plants is only a summary of the information available from the above references. Some of the plants are quite well documented.

DIABETIC RETINOPATHY: Leading Article, Lancet, ii, 653-655, 1959.

40 years ago, diabetics used to die of diabetic coma, but now it is due to atheromatous disease and renal failure. The pattern of the disease is considerably changed. Infections like tuberculosis and osteomyelitis have been replaced by neuropathy and retinopathy.

These two complications if allowed to develop, particularly retinopathy, will destroy all the pleasures in the life of a diabetic patient. The cause of retinopathy is not known; there have been a number of explanations offered, but none are satisfactory.

Professor Ashton has carried out a large amount of experimental pathological work in his department, at the Institute of Ophthalmology, Moorfields Eye Hospital, and has put forward a series of sequence of events leading to diabetic retinopathy. The earliest changes are of the nature of varicose veins in the macula. Red dots appear next, in the posterior polar region; these are due to formation of capillary microaneurysms which spread, and may eventually affect the whole retina. Exudates containing lipid form close to some of the aneurysms, and are seen as yellowish-white patches. New vessels may form, appearing as a delicate intravitreal network overlying areas of retinal ischemia. Hemorrhage may occur behind the hyaloid membrane or bursting through into the vitreous, and may become organised and vascularised (called retinitis proliferans).

Similar aneurysms have been known to occur in the conjunctiva, and, in the retina in other conditions like malignant hypertension or Eales' disease. Occasionally, in sickle-cell anemia.

The cause of formation of microaneurysms is not definitely established, but probably it is due to some kind of metabolite changes in the deeper cells of the retina and that is why diabetic retinopathy is common in badly controlled diabetic patients.—**J. C. Patel.**

The Minimumest.—The woman was taking out a life insurance policy and trying to answer the innumerable questions to the best of her knowledge.

"Now, what," queried the insurance man, "do you consider to be your maximum weight?"

"Hmmm... I should say about 148 pounds," she answered.

"And your minimum weight?"

The woman paused, perplexed, and then beamed.

"Oh, of course—8 lb., 7 oz."—(The Bright Side, J.A.M.A., 170: 11, 209, 1959.)

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58. The average survival time following this radiation alone was 4.1 ± 0.11 days in 22 mice.
59. One experiment was also tried in which 10 female mice were exposed simultaneously to radiation and oxygen, with another 10 mice exposed to oxygen only. Unfortunately, these mice could not be observed during the radiation because of danger to the observer; and when observations were resumed, 8 of the experimental and 7 of the control mice were already dead. Since no average survival time could be stated, these results are not listed in the table. Female mice are significantly less sensitive to oxygen than males. At a pressure of 5 atm, the female survival times were so widely dispersed that experimentation was difficult. For this reason, simultaneous exposures to radiation and oxygen could be tried only in males.

Plant Materials Used by Primitive Peoples to Affect Fertility

Henry de Laszlo and Paul S. Henshaw

Fertility Research Center, Colnbrook, Bucks, England, and
Planned Parenthood Federation of America, Inc., New York, N.Y.

RECENT publications (*1–3*) have stressed the need for finding inexpensive and harmless oral agents capable of controlling human fertility. Numerous agents are known which affect fertility, both in a positive and a negative sense but have side effects, some of which are undesirable. One method of finding useful materials is the screening of naturally occurring substances to discover those with the optimum characteristics that will guide chemists to the synthesis of the ideal drug.

As work goes forward on other approaches, it may be profitable to consider the information acquired by ancient and more remote peoples concerning the use of herbs and various plant materials for fertility control purposes. Such information, almost completely unevaluated, is available in fragmentary form about many plants found in all latitudes. It comes primarily from the collected folklore of primitive peoples, from the literature of so-called "popular medicine" of Western cultures, from 19th-century books on medical botany, and from old *materia medica.*

Information from such sources is to some extent held in question by modern investigators who often dismiss the accounts as superstitions or "old wives' tales." Confidence in such sources of information may be strengthened, however, by recognizing examples of valuable drugs recently isolated from plants used by primitive peoples for generations.

1. Many soils have been claimed to cure human ills; molds from them provide us today with valuable antibiotics (*4*).
2. The powerful antithrombic agent "Rutin" is found in *Ruta graveolens.*
3. Muscle relaxant Tubo-Curare is extracted from the Indian arrow poison of Guiana (*5*).
4. The heart-regulating agent, cratioaegolic acid, and other unidentified active substances are found in *Crataegus oxyacantha* (*6*).
5. The alkaloids of Indian *Rauwolfia serpentina* reduce blood pressure and act as a general sedative (*7*).
6. The glucoside Foliandrin from the oleander shrub provides a cardiac stimulant of great value to elderly patients (*8*).
7. The coronary stimulant "khellin" is obtained from *Amni visnaga* (*9*).
8. The antimalarial "Febrifugine" from Hydrangea (ancient Chinese Chang-Shan roots) has been isolated and synthesized very recently (*10*).

Even greater confidence may be gained by referring to the recent scientific literature (*2*) on the desert herb, *Lithospermum ruderale,* used by Indians in the southwestern part of the United States for fertility control purposes.

The authors, working separately at first, have accumulated a list of more than 100 plants reported to contain substances that affect human reproduction. These have been classified into three categories:

Oc—so called oral contraceptives thought to cause temporary sterility.

Oc,—substances which in certain doses are believed to interfere with implantation or gestation but which might well prove to be in class *Oc* if used in smaller concentrations.

Oc_2—emmenagogues, plant materials believed to affect menstruation, many of which after investigation might be put in class Oc when their active principles have been isolated and their therapeutic activity determined.

Sixty of the plants for which full scientific names are available and for which there is some information (though mostly unscientific) have been selected for inclusion in the compilation of Table 1. The plant names have been listed alphabetically and the category (Oc, Oc_1, or Oc_2) is shown. It is stressed that, so far as is known, none of the plant materials (excepting Lithospermum extracts) have been studied from the standpoint of deleterious side effects. Some of the plants listed are known to contain poisonous substances—any indiscriminate use would be dangerous.

TABLE 1. Selected list of plants reported to contain substances that affect human reproduction.

Botanical name	Common name	Country and group	Use; comments
Achillea millefolium L. (*11*)	yarrow	N. Europe	Oc, Oc_2. Powdered plant mixed with normal diet (25–50% conc) to suppress estrus; hot infusion used
Ananas comosus L., Merr. (*sativa* L.) (*12*)	pineapple	Malaya	Oc_1. Unripe pineapple juice taken raw, sometimes salt added
Anodendron paniculatum A.DC. (*13*)	leurapasekitong creeper	Assam	Oc_2. Root crushed in water taken 3 or 5 times a day at intervals of 2–3 hr to aid parturition
Apocynum androsaemifolium L. (*14*)	dogbane	N. America	Oc. Roots boiled with water and liquid drunk once a week
Arisaema triphyllum (L.) Schott (*15*)	indian turnip	N. America (Hopi)	Oc. Decoction of powdered, dried root, 1 tsp in ½ glass cold water strained and drunk prevents conception for 1 yr; two tbs hot infusion renders permanent sterility
Aristolochia clematitis L. (*16*)	birthwort	Hungary	Oc, Oc_2. Seed parts used to prevent fertility and menstrual pain
Asarum canadense L. (*17*)	wild ginger	N. America	Oc. Root and rhizome boiled slowly in a a little water for a long period; decoction drunk by women
Asclepias hallii Gray (*18*)	milkweed	Colorado (Navaho)	Oc. Infusion of plant drunk after childbirth
Asclepias syriaca L. (*19*)	petits-cochons	Quebec, Canada	Oc. Handful of roots and rhizomes dried and powdered, infused for 20 min in pint of water and drunk to produce temporary sterility
Asparagus officinalis L. & *acutifolia* L. (*20*)	asparagus	S. Europe	Oc, Oc_1. Fresh or dried berry decoction drunk as contraceptive; fruit or plant infusion drunk to induce menstruation
Asplenium adiantum-nigrum L. (*22*)	black spleenwort	India-Himalayas	Oc. Considered in Yunani system of medicine to produce sterility in woman
Bahia dissecta (Gray) Britton (*18, 23*)	"twisted medicine"	N. America (Navaho)	Oc. Infusion of roots boiled 30 min, drunk by women during menstruation; said to be used by both sexes
Begonia balmisiana Ruiz. (*24*)	begonia	C. America	Oc_2. Promotes menstruation
Byrsonima crassifolia H.B.K. (*25*)	nanche	C. America (Oaxaca)	Oc_1. Bark, leaves, and fruit used to expel placenta; roots used by Indians of Oaxaca to produce expulsion
Caladium seguinum Vent. (*26*)	poison arum	S. America (Indian)	Oc. "Heard of plants used by Indian women to render temporary or permanent sterility; on two occasions evidently Araceae"; stops spermatogenesis and follicle growth in rats

TABLE 1.—(*Continued*)

Botanical name	Common name	Country and group	Use; comments
Callicarpa sp. (*27*)	argerarger	Torres Straits	*Oc*. Young leaves well chewed until women's bodies are saturated with the juice swallowed; causes permanent sterility
Capsella bursapastoris (L.) Medic. (*28*)	hirtentaschelkraut	N. Europe	*Oc*. Powdered plant mixed with normal diet (25–50% conc) to inhibit the estrus cycle; hot infusion used as emmenagogue
Cnicus benedictus L. (*Carbenia benedicta* Adans) (*29*)	thistle	N. America (Quinault Indians)	Oc_1. Brewed and taken as tea
Castilleja linariae-folia Benth. (*30*)	indian paint brush	N. America (Hopi)	*Oc*. "A decoction of this plant was sometimes used—as it dried up the menstrual flow"
Caulophyllum thalictroides (L.) Michx. (*31*)	squaw root	N. America (Chippewa Indians)	Oc_1, Oc_2. Strong decoction of 5–30 g powdered root taken to expedite parturition and menstruation
Chenopodium album L. (*32*)	Weisser gansefuss	Hungary	*Oc*. Powdered plant mixed with normal diet (25–50% conc) found to suppress estrus cycle
Cicuta maculata L. (*33*)	spotted cowbane	America (Cherokee)	*Oc*, Oc_1. Women chew and swallow roots on 4 consecutive days to produce permanent sterility
Cocos nucifera L. (*34*)	green coconut	Pacific Isles	*Oc*, Oc_1. Milk used; "too much may be injurious." People in Java afraid to drink milk of coconuts (ripe or unripe) because it is believed to diminish libido or fertility
Cordia quarensis Gürke (*35*)	os segi	Africa (Masai)	Oc_1. Pieces of root chewed by girls
Daemia extensa R.Br. (*36*)	phala kantaka	India	*Oc*. Leaves used in the preparation of a purgative medicinal oil for amenorrhea and dysmenorrhea
Dalbergia terruginae Roxb. (*ferruginea* Roxb.?) (*37*)	balibagan	West Indies	Oc_1. Decoction of wood of stem or root used as emmenagogue, and in doses to induce expulsion of fetus
Dioscorea sativa L., var. Rotunda (*38*)	tjarri	Cape York, Australia (Kawadji)	*Oc*. Tuber eaten raw early morning on empty stomach; woman lies down and drinks nothing all day in attempt to become permanently sterile
Dryopteris filix-mas (L.) Schott (*21*)	malefern	Europe	Oc_1. German women used root to produce expulsion of fetus and sterility; Tartar women used seeds for same purpose
Entada scandens Benth. (*38*)	pi'ala	Australia (Kawadji)	*Oc*. Generally eaten raw, sometimes roasted; taken in early morning on empty stomach, after which woman lies down and does not drink throughout the day
Epimedium alpinum L. (*39*)	barrenwort	N. Europe	*Oc*. Finely ground leaves; 5 drams taken in wine after menstruation prevents conception for 5 days; root causes sterility
Eriogonum jamesii Benth. (*18, 23, 40*)	antelope sage	Arizona (Navaho)	*Oc*. Root boiled for 30 min and 1 cupful drunk by woman during menstruation to prevent conception; used by both sexes

Botanical name

Eupatorium odoratum (*41*)

Frasera speciosa Dou (*42*)

Geranium robertianum (*43*)

Gossypium herbaceum (*44*)

Hedera helix L. (*45*)

Helleborus niger L.

Leucaena glauca Ben (*47*)

Licuala sp. (*48*)

Lithospermum arvens L. (*32*)

Lithospermum ruder Dougl. (*49*)

Lomatophyllum refle Boj. (*50*)

Lygodium dichotom Sw. (*51*)

Mallotus sp. (*48, 52*)

Montanoa tomentosa Cery. (*54*)

Nasturtium officinale

Origanum majorana (*56*)

Phoradendron flaves Nutt. (*57*)

Plantago lanceolata (*58*)

Polygonum hydropi L. (*59*)

Populus alba L. (*60*)

Rosmarinus officinal L. (*61*)

Ruta graveolens L.

TABLE 1.—(*Continued*)

Botanical name	Common name	Country and group	Use; comments
Eupatorium odoratum L. (*41*)	xtokabal	C. America (Zapotec)	Oc_2. Root used; plant consecrated to goddess of pregnancy and childbirth
Frasera speciosa Dougl. (*42*)	deer's tongue	Nevada (Shoshone)	*Oc*. ". . . a half cupful taken once in a while" as a contraceptive
Geranium robertianum L. (*43*)	ruprechtskraut	C. Europe	*Oc*, Oc_2. To stop excessive hemorrhage at menstruation
Gossypium herbaceum L. (*44*)	cotton root	S. America	*Oc*. Creoles give a decoction of plant root for contraceptive; also give seeds to mothers to increase lactation
Hedera helix L. (*45*)	ivy	Mediterranean	*Oc*. The finely pulverized berries drunk after purification; dose of 1 dram causes sterility
Helleborus niger L. (*46*)	christmas rose	Europe	Oc_1. Solid extract of root, 3–5 grains, taken to induce expulsion of the fetus
Leucaena glauca Benth. (*47*)	ipil-ipil	W. Indies and Central America	Oc_1, Oc_2. Decoction of root and bark used
Licuala sp. (*48*)	win	Solomon Isles (Buka)	*Oc*. Outer part of root chewed and swallowed by both sexes
Lithospermum arvense L. (*32*)	gromwell	C. Europe	Oc_1. Powdered plant mixed with normal diet (25–50% conc) and used to suppress the estrus cycle
Lithospermum ruderale Dougl. (*49*)	nemishaw or stoneseed	Nevada (Shoshone)	*Oc*. Cold water infusion of roots taken daily for 6 mo insures sterility
Lomatophyllum reflexum Boj. (*50*)	hassu.	Madagascar	Oc_2. One or two budding flowers eaten is powerful emmenagogue
Lygodium dichotomum Sw. (*51*)	asam	Solomon Isles (Buka)	*Oc*. Root chewed with betel and some of mixture swallowed
Mallotus sp. (*48*, ~~*52*~~)	haholon	Oceania (Buka)	*Oc*. Scrapings from root chewed with betel mixture and swallowed
Montanoa tomentosa Cery. (*54*)	zoapatle	C. America (Zapotec)	Oc_1, Oc_2. Used for difficult parturition and postpartum uterine hemorrhages
Nasturtium officinale (*55*)	cresson	W. Europe	Oc_1. Cooked or eaten raw, it assists menstruation and removes fetus
Origanum majorana L. (*56*)	marjoram	Germany	Oc_1. Taken as a tea during menstruation
Phoradendron flavescens Nutt. (*57*)	American mistletoe	California (Indians of Mendocino County)	Oc_1. Tea made from leaves
Plantago lanceolata L. (*58*)	spitzwegerich	C. Europe	*Oc*. Powdered plant mixed with normal diet (25–50% conc) suppresses estrus
Polygonum hydropiper L. (*59*)	water pepper	C. Europe	*Oc*, Oc_2. Liquid extract of powdered plant used
Populus alba L. (*60*)	white popular	Mediterranean	*Oc*. Popular superstition that the bark taken with the kidney of the mule causes sterility
Rosmarinus officinalis L. (*61*)	rosemary	C. America (Opata)	*Oc*, Oc_1, Oc_2. Tea made of rosemary and the "ocean artemisia" for fertility control
Ruta graveolens L. (*62*)	rue	Europe and S. America	Oc_1, Oc_2. Hot decoction of plant, 1 oz to 1 pt of water, allowed to stand for 8 hr and then drunk to promote menstruation; larger doses induce fetal expulsion

not native
Germans
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TABLE 1.—(*Continued*)

Botanical name	Common name	Country and group	Use; comments
Sanguisorba officinalis L. (*58*)	garden burnet	C. Europe	*Oc.* Powdered plant mixed with normal diet (of mice)
Semecarpus anacardium L. (*63*)	pavak or agni tree	India (Hindu)	*Oc.* Roots cooked in sour rice water and taken for 3 days at end of menstrual period produces sterility
Smilacina stellata (L.) Dest. (*64*)	false solomonseal	Nevada (Indians)	Oc_1, Oc_2. Root infusion regulates menstrual disorders; conception prevented by tea of leaves, ½ cup daily for 1 wk
Urena lobata L. (*65*)	wuzawuza	New Ireland	Oc_1. Leaves chewed and juice swallowed
Viburnum prunifolium L. (*66*)	black haw	Italy	Oc_1, Oc_2. Relieves dysmenorrhea and controls fertility; hot decoction taken 4 or 5 days before menstrual period
Vitex agnus-castus L. (53)	monchpfeffer	C. Europe	*Oc.* Sterility increased with increasing doses; retardation of estrus observed in female rats
Vitex negundo L. (?) (*67*)	paparau	Solomon Isles (Buka)	*Oc.* Root scrapings chewed with betel mixture and swallowed

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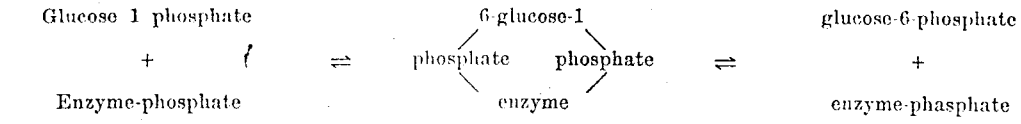
The Occurrence of a Group Transfer Involving Enzyme (phosphoglucomutase) and Substrate[1]

Victor A. Najjar and Maynard E. Pullman

Department of Pediatrics, The Johns Hopkins University School of Medicine, and The Johns Hopkins Hospital, Baltimore, Maryland

THE transfer of a reactive group involving substrate and enzyme was postulated by Doudoroff, *et al.* (*1*) for sucrose phosphorylase. This was based on the interchange of phosphate between glucose-1-phosphate and radioactive inorganic phosphate in the presence of the enzyme. Jagannathan and Luck (*2*) later suggested a similar transfer mechanism for phosphoglucomutase, based on the exchange of radioactive phosphate between glucose-1-phosphate and a proposed enzyme-phosphate. They suggested the following mechanism:



As is indicated in the diagram, the enzyme-phosphate could combine with glucose-1-phosphate or glucose-6-phosphate to form a double link with glucose through two phosphate bonds. This compound could yield enzyme-phosphate and glucose-1-phosphate or glucose-6-phosphate by a split of the appropriate bonds.

Recently, Najjar (*3*) reported direct evidence of a transfer of phosphate from crystalline phosphoglucomutase (*4*) to glucose-1-phosphate and glucose-6-phosphate with a net synthesis of glucose-1,6-diphosphate in relatively substantial amounts. The following two-step mechanism was therefore postulated:

Glucose-1-phosphate + phospho-enzyme ⇌ glucose-1,6-diphosphate + dephospho-enzyme; (1)

Glucose-1,6-diphosphate + dephospho-enzyme ⇌ glucose-6-phosphate + phospho-enzyme. (2)

This mechanism differs from that proposed by Jagannathan and Luck in three respects. (i) Glucose-1,6-diphosphate is an actual reactant that accumulates in the medium as a product of the interaction of either of the hexose phosphates and the phosphorylated enzyme rather than as a part of a transient enzyme-substrate complex. (ii) The enzyme exists in a phosphorylated state as well as in a dephosphorylated state, rather than in the phosphorylated state alone. (iii) This mechanism also accommodates glucose-1,6-diphosphate in a manner quite befitting its coenzymatic function.

The validity of this mechanism was established by

[1] This investigation was supported by a research grant PHS, G 3289 C, from the Division of Research Grants, National Institutes of Health, U.S. Public Health Service.

Cherokee belief and practice with regard to Childbirth[1].

By Dr. FRANS M. OLBRECHTS.

Summary.

Introduction.
1. Sexual Life.
2. Conception.
3. Abortus. Contraceptives.
4. During Pregnancy.
5. Tabu's.
   a) Pregnant Woman's.
   b) Husband's Tabu's.
6. Partus.
7. After Birth.
8. Care for Child. Child-life.
9. Raising the Child to become a Witch. Twins.

Introduction.

Some of the Cherokee Indians of Western North Carolina, where the following observations were made, still cling to their aboriginal beliefs and customs with a tenacity which is unequalled by any of the other Indians living on reservations East of the Mississippi.

This is soon accounted for, when we know how secluded the Cherokee live in their Great Smoky Mountains' settlements, how difficult of access some of these are, and how primitive the "mountaineers", the white population of the region, the only whites with whom the Cherokee come into sparing contact.

The credit for most of the work done on the Cherokee is due to the late JAMES MOONEY, of the Bureau of American Ethnology, Smithsonian Institution, some of whose publications on the subject are cited in the course of this paper. The subject on which MOONEY was working when his untimely death put an end to his activities, viz. the Cherokee sacred and medicinal formulas: prayers, conjurations and incantations, was again taken up by the present author at the request of the B. A. E.; a study was made of more than 500 medical prescriptions and formulas, written in the Sequoya syllabary (a syllabary of Cherokee invention), and the results will be made known in a forthcoming publication of the B. A. E.: MOONEY-OLBRECHTS: "The Swimmer-Manuscript of Cherokee Sacred Formulas and Medicinal Prescriptions". In the following pages the beliefs and customs pertaining to Childbirth and the practices connected with these beliefs are described.

1. Sexual Life.

Since the manuscript, to which this discussion is partly an introduction, does not contain any formulas dealing with love-matters, as e. g.:

[1] With the permission of the Bureau of American Ethnology, Smithsonian Institution, for which the data were collected. For the scientific identification of the "medicinal" plants collected by the Cherokee medicine-men for me, I am obliged to Mr. PAUL C. STANDLEY, of the United States National Museum, Washington, D. C.

conjurations to gain the affection of a woman;

to destroy in a particular woman the promiscuous tendencies she has shown;

incantations to take vengeance of a woman who has scoffed at sympathies proferred;

to sow discord between a couple of lovers, &c.;

it has not been considered necessary to go into such minute details on this score, as has been done with matters pertaining to purely medical lore, which constitutes the bulk of the material offered in the Swimmer-Manuscript.

Two more mss., on which some work has already been done, and of which the publication is contemplated, will afford a far better opportunity to treat at length of such topics as: Sense of Shame, Puberty, Sexual Life, Adultery, Sexual Pathology, &c.

2. Conception.

It would seem, at first blush, that Cherokee ideas on this subject have been considerably influenced by the views of their white neighbors. This need however not be the case. There are less civilized peoples whose conceptions about disease and medicine are not any more reasonable than the Cherokee's, and whose explanation of the process of conception is even more rational (cf. e. g. Kleiweg de Zwaan, "Die Heilkunde der Niasser", Haag 1913, p. 158—159).

Male and female alike, "produce the matter which becomes mixed and goes to form the child" in the womb of the mother. In some cases, this matter is mixed rightaway, in which case they will have a child right soon; in other cases it may take several months, or even a couple of years.

"She is pregnant" is rendered: *ganēldę.*

It is held that unsimultaneous detumescence can not produce offspring.

There is no clear conception as to the origin of the soul of the child. The majority of the informants say that they do not know: "they have never thought of it." The keenest of the medicine-men, Ww. [2] thought that it came along with what went to form the body of the child, and was therefore secreted by both the individuals concerned in the act.

A woman knows she has conceived by the stopping of her menses.

3. Abortus. Contraceptives.

Abortus is totally unknown; even Ww., my best informant (a man of 56, prominent medicine-man, holding a leading position in the tribal organisation, twice married, high school graduate), had never heard of it, and I had a good deal of difficulty in making him understand what I meant. He was horriefied at the idea, and I noticed that his esteem for the white people and the ways of some of them was not improved, when he finally grasped the idea.

[2] Ww., Og, Ol., Del. are abbreviations for the names of the informants used: *Wi̱li-wę́sti, O̱ganstǫ́ta, O̱lly* and *Dęli̱ski. O̱lly* was a mid-wife (aged 80 years); the others were medicine-men.

It does not seem to have dawned on them that the foetus can be tampered with at all, and to do so, Ww. thought, would be murder out right. As he put it: "You might as well cut a 5 years old child's head off!"

Of contraceptive measures, they do not seem to be quite so ignorant. They know one:

thiliyusti Cicuta maculata, L.;
Spotted Cowbane; Musquash Root;
Beaver's Poison;

the roots of which are chewed and swallowed for 4 days consecutively by the woman who wants to put an end to her conceptive abilities. It is alleged that if a woman uses this, she will become sterile for ever.

From a point of view of morals, it is considered nothing less than a crime, and none of my informants knew of a case where it had been used. One, Ww., said that he never knew it to be used, but that he imagines that it might be used by a woman who cannot keep her children alive, or when it is considered that "partus" would endanger her life. But even then, he said, they would not do it, "for a woman will just as lief take the risk of dying with her baby, rather than to live without a child".

There is a vague hint by some of the informants, at the possibility of promiscuous women using this drug, especially if they are married, so that there can be no material proof of their misbehavior. But substantial evidence to prove this impression could not be given.

When we consider their total ignorance of abortive measures and the scant and vague knowledge of contraceptives, I am inclined to think that the Cherokee hold the only means known to them from the white settlers. As is well known, at an early period of its growth the plant closely ressembles parsley (Petroselinum sativum, HOFFM.), and parsley has been, and still is popular in several European countries as an abortive [3]. It is still now used in official medecine as an emmenagogue (U. S. Disp. 19th edit. [1907], p. 1393).

4. During Pregnancy.

As soon as a woman feels she is with child, she informs her husband and her friends about it; soon the whole settlement knows about her condition, and she becomes subjected to the multifarious tabu's and injunctions relating to her condition. The most important of the latter is that she be "taken to the water" every new moon.

Going to the river to pray, to be prayed for and to bathe is the outstanding ceremony of Cherokee ritual. It is now fast disappearing, and only the staunch and conservative oldtimers cling to it as to one of the main vestiges of aboriginal religion.

There are several occasions on which the Cherokee should perform this ceremony; as a whole, the ceremony is pretty much the same in every case;

[3] Cf. VON HOVORKA und KRONFELD, Vergleichende Volksmedizin, Stuttgart 1908, I, p. 170. — LEMERY, Dictionn. ou Traité universel des Drogues simples, Amsterdam 1716, p. 417. — DODONAEUS, REMBERTUS, Cruydt-Boeck, Antwerpen 1644, p. 1176.

Nothing more of value here...

PLATE X.

ROUND VALLEY, MENDOCINO COUNTY, CAL.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF BOTANY.

CONTRIBUTIONS

FROM

THE U. S. NATIONAL HERBARIUM.

Vol. VII, No. 3.

PLANTS USED BY THE INDIANS OF MENDOCINO COUNTY, CALIFORNIA.

BY

V. K. CHESNUT.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

Many individual trees of this species, apparently diseased forms, are very abundantly covered with large galls, usually a couple of inches in diameter, which are called *fā-hut'* by the Yukis. In July and August, when they are still green, these are nearly solid, the interior having the consistency of a rather juicy, ripe pear. The juice, which may be readily squeezed out of them, is light green in color and is certainly very rich in gallo-tannic acid. It is used to a considerable extent in medicine and for ink, as mentioned below. The galls remain adhering to the tree indefinitely, but change in color from light green to black, and in texture from a fleshy to a light pithy interior, which is surrounded by a woody exterior. The abundance of the galls and their apparently large content of gallo-tannic acid would seem to indicate that they might be used very considerably as a substitute for the Turkish galls (from *Quercus infectoria*), which are most widely esteemed in commerce.

The Indians have been taught to make ink from the juice of the fresh galls by allowing it to remain in contact with rusty iron, and one old Indian told me that by simply dipping an old steel pen into the gall one could write freely. The experiment was tried by myself with very satisfactory results, several hundred words having been written. The color produced was nearly as black as that produced by ordinary ink and proved to be permanent after a year. The Redwoods, Concows, and Numlakis all value the fresh galls as a remedy for sore eyes, when diluted and used as a wash.

MORACEAE. Mulberry Family.

Humulus lupulus L.

No Indian name was learned for the common hop vine. It is cultivated very extensively near Ukiah and has escaped from cultivation to a slight extent both at that place and at Round Valley, where it was formerly grown under Government supervision. The hops are soaked in warm water and applied as a poultice for swellings or bruises.

LORANTHACEAE. Mistletoe Family.

Phoradendron flavescens Nutt.

Tsī mä-är'-shē (Little Lake).—The common mistletoe, which is parasitic on trees, chiefly on the oaks of the region, it being so abundant on some trees that they are actually killed by the growth. It is asserted by the Indians that it also grows on the buckeye (Aesculus) and that its leaves, which are of a glutinous character, are then particularly valuable in medicine. They are chewed "all day long" to relieve toothache, and a tea is made of them to produce abortion. Those from certain trees are regarded as poisonous both to man and to cattle.

methods are used in preparing it for food, but they consist essentially in roasting and then washing out the poison. The buckeyes are placed in a hole lined with rock and willow leaves in which a fire has previously been built, more willow leaves are added and the whole is covered with hot ashes and dirt and allowed to remain from 1 to 8 or 10 hours. The fruit then has the consistency of boiled potatoes, and may be either sliced, placed in a basket, and soaked in running water for from 2 to 4 or 5 days, depending upon the thinness of the slices, or mashed and rubbed up into a paste with water (when the red-brown skin floats and is removed from the surface) and placed to soak from 1 to 10 hours in sand, as in the case of acorns. A wider and deeper hole is used because the water drains off more slowly. After this process the resultant mass, which has the consistency of gravy, is ready for consumption. It is frequently eaten cold and without salt. Buckeyes decay or sprout very rapidly and are therefore not preserved for future use for long periods. After sprouting the taste is said to be disagreeable. The buckeye fruit is also a favorite food for squirrels, but hogs will not eat it. It is claimed that they are very useful for expelling bot worms from the intestines of horses, and that when they are eaten by cows they are very apt to cause abortion.

The leaves or young shoots are probably used to a slight extent by the Yuki and Concow to poison fish, but for this purpose they are inferior even to blue curls (*Trichostema lanceolatum*). Sheep and cattle nibble at the leaves, and cattle, especially, seem to get fat on them. A large cattle owner informed me, however, that cattle when thus fattened lose their flesh with remarkable rapidity when driven over the country to any considerable distance. The bark is apparently the only part of the tree used medicinally. Small fragments are placed in the cavity of a tooth to stop the toothache. One well-authenticated case of the fatal poisoning of goats from eating the bark was recently investigated by the writer. The mistletoe which occasionally grows upon it is said to be used as an abortifacient.

The wood, which is quite soft, was formerly used as twirling sticks in the process of making fire by friction. The Yokia name for the tree is *bä-shä'*, the Yuki, *sympt'-ōl*, and the Numlaki, *fär'-sökt*.

RHAMNACEAE. Buckthorn Family.

Ceanothus cuneatus (Hook.) Nutt.

Yūk (Yuki).—A low evergreen species of California lilac 6 to 12 feet high, which has small, thick opposite leaves, rigid branchlets, white flowers, and large, three-horned resinous fruit. It forms impassable thickets on the edges of the valleys and on low, dry hillsides. The brush is useful on account of its rigid branches in building fish dams. Deer feed on the leaves and squirrels are fond of the seed, which is

allergic to penicillin. The allergic manifestations of this drug will include the entire gamut of allergic reactions, including anaphylactic shock.

However, the fact remains that penicillin and its derivatives are, as far as can be ascertained, the safest drug in our clinical armamentarium. There is, in fact, much less incidence of hypersensitivity to penicillin than to most other drugs. Of course, we cannot know if it might create genetic damage or maybe even cancer, but the probability that such manifestations do occur appears rather remote at this juncture.

VEGETABLE ANTIFERTILITY DRUGS OF INDIA

B. S. Malhi and *V. P. Trivedi*
C.C.R.I.M. & H. Research Unit, Govt. Pharmaceutical Laboratories,
Ranikhet, U.P. (India)

Growing population is a great challenge to the new world. It is the duty of scientists to find suitable contraceptive techniques, which should be harmless and cheap, having antifertility effect temporarily. For all this one should have an adequate knowledge of physiological, biochemical and immunological problems involved in reproduction. Greater understanding of normal physiology of reproduction has made possible the sudden streaking forward of search in physiological control of fertility.

Seeds of Pisum sativum Linn. [17]) are reported to have antifertility effect in females. Pea oil when given to women once a month in the form of i.m. injection showed promise of preventing pregnancy. The active principle, which is responsible for antifertility is meta-xylohydroquinone, which appears to act by interfering with the working of progesterone. Trials on women with capsules containing 300-500 mg of meta-xylohydroquinone for variable periods have shown a 50-60 % reduction in the pregnancy rate. In trials on man, the drug was also found to bring about 50 % reduction in the number of spermatozoa, which reverted to normal count in 4 days after the withdrawal of the drug. According to an investigation in the U.S.A. on the contraceptive efficacy of the pea oil, females became pregnant only in 50 % of the cases. In Egypt Miss Blackman [19]) reported that there will be no pregnancy for at least nine months if the woman takes castorseeds, one on the day after the child is born.

If the researches conducted by the scientists rightly hit the target, women would be relieved of the unilateral burden of taking contraceptive drugs. The workers are engaged in search of a 'pill' for males. The male 'pill' should have the property of inactivating the enzyme, acrosin, present in the sperm head. The enzyme is responsible for digesting the outer protective cover of the ovum to facilitate entry of a spermatozoa into it. This digestive action is similar to that of the enzyme trypsin against protein.

A number of substances obtained from soyabean are known today to inhibit protein-digesting activity of trypsin against protein. There is every possibility that a compound which may combine firmly with acrosin and prevent fertilization may be found in soyabean.

In the ancient Indian system of medicine the importance of antifertility drugs has long been recognised. So many plants are included as antifertility drugs in Susruta Samhita [39]) (2500 B.C.). In this paper an account of selected species with antifertile activities is given (Table 1).

As will be seen from Table 1, in general, plants which are used as antifertile, contain alkaloids, resins, tannins and bitter principles. The function of the active principles, how they act, is not known in many cases. The possibility of their action as a contraceptive may be by acting any of these vulnerable points - spermatogenesis, ovulation, fertilization and implantation of the zygote in the uterus in connection with the process of reproduction.

Acknowledgment

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Table 1

anical name	Indian name	Part used	Reference	Chemical constituents	Remarks
roma augusta L.	Ulat kambal	Root	(13, 34)	Alkaloids, fixed oil, resins, and magnesium salts.	Regulates the menstrual flow, magnesium may be responsible for uterine haemorrhage (21).
us precatorius L.	Gunja	Seed	(15, 28)	Seeds contain abrin, urease, haemagglutinin and glucoside abraline. Roots and leaves contain glycyrrhizine.	When taken internally by women, the seeds disturb the uterine functions; prevents conception. Roots are emmenagogue (34).
hyranthes aspera L.	Apamarg	Root	(4, 37)	Achyranthine, this is a betaine derivative of N-methyl-pyrrolidine-3-corboxylic acid.	Root paste is used (8).
onitum heterophyllum Wall.	Atis	Root	(13, 16, 39)	Atisine, heteratisin, hetisin.	Alkaloids are toxic (38).
orus calamus L.	Vacha	Root	(1)	Acorin and volatile oil.	Taken with milk after menstruation (39).
bizzia lebbeck Benth.	Sirisha	Root	(1, 20, 38)	Tannins and saponins.	Bark and seeds are astringent and abortifacient (21).
maranthus blitum L.	Vannatya	Root, seed	(21, 27)	Proteins and carbohydrates.	Plant is considered emollient and mildly astringent.
ethum sowa L.	Satpushpa	Fruit	(6, 34)	Essential oil, contains carvone and limonene.	Pungent and bitter (21).
thocephalus indicus A. Rich.	Kadamba	Leaves, flower	(27)	Alkaloids.	Bitter and astringent.
saema tortuosum (Wall.) ott.	Nagdaman	Root	(8)	Alkaloids, proteins, sterols and mucilage.	Poisonous properties (21).
istolochia indica L.	Ishvarimul	Root	(34)	Alkaloid aristolochine, bitter principle, isoaristolochic acid and essential oil.	The plant is also used as abortifacient (6).
mbusa arundinacea Willd.	Vansh	Root	(27, 34, 43)	Cyanogenetic glucoside and albuminoids.	Cyanogenetic glucosides are poisonous.
ella alba L.	Potaki	Root	(8)	Proteins and colouring matter.	Poisonous.
hincasa hispida Thunb.	Kooshmanda	Fruit	(6, 35)	Proteins, fats and essential oil.	Action on urinary discharges (21).
tula bhojpattra Wall.	Bohjpattra	Stem bark	(8)	Alkaloid betuline and volatile oil.	Irritant poison.
rberis aristata D.C.	Rasanjan	Exudation	(7, 15, 29)	Alkaloids such as berberine and others.	Astringent.
assica alba Boiss.	Swet Rajika	Seed	(8, 34, 39)	Glucoside sinalbin, myrosin, proteins, and sinapine.	Bitter and poisonous.
assica nigra Koch	Rajika	Seed	(27)	Glucoside sinigrin, fixed oil, allyl isothiocyanate, and volatile oil.	Bitter and poisonous (21).
ca monosperma Lam.	Palash	Flower, seed	(10, 29, 34)	Proteolytic and lipolytic enzyme, butin and glucoside butrin.	Astringent and toxic.
otropis procera R.Br.	Arka	Root	(10, 11, 30)	Calotropin, calotropagenin and latex contain cardiac principles, calotropin and calotoxin.	Irritant and poisonous (13).
um roxburghianum L.	Ajmod	Seed	(6, 39)	Volatile oil and fixed oil.	Antiseptic and bitter.
um carvi L.	Krisna jirak	Fruit	(39, 42)	Volatile oil, fixed oil and resin.	Antiseptic.
sia fistula L.	Aragvadh	Fruit	(8, 10)	Methyl anthraquinones, tannins and oxyanthraquinone which is a mixture of emodin and crysophanic acid.	Purgative and abortifacient properties (6).
astrus paniculatus Willd.	Jyotishmati	Root, leaves	(8, 10, 34)	Alkaloids, celastrine, paniculatine, and fatty acids.	Leaves are emmenagogue (21).
ullus colocynthis Schrad.	Maherdravaruni	Root, fruit	(6, 35, 44)	Alkaloids, resins, colocynthin, sterols, and saponins.	It is used in urinary discharges and diseases.
us medica L.	Beejpur	Fruit	(8, 21, 44)	Citric acid and vitamins.	Astringent.
ampelos pareira L.	Patha	Root	(7, 8, 15, 28, 34, 38)	Alkaloid bebeerine, deyamettin, and resins.	Sold under the name false Pareira Brava L.
iceps purpurea F.T.	Annamay	Fungus	(16, 34, 44)	Ergotamine, ergotoxine, ergometerine, ergosterol, etc.	Powerful contractile action on uterus and is abortifacient (21).
rodendrum serratum L.	Bhargi	Root	(6, 39)	Bitter principles and proteins.	Pungent and bitter.
lia dichotama Forst.	Shlesmatak	Fruit	(7, 12)	Tannins.	Astringent and poisonous.
taeva nurvala Buch.	Varuna	Stem bark	(15, 38)	Tannins and saponins.	Stem bark is bitter and poisonous.
talaria juncea L.	Sanha	Root, leaves	(34)	Fat and proteins.	The leaves are emmenagogue and abortifacient (21).
ura metel L.	Dattura	Leaves, fruit	(10, 12)	Alkaloid hyoscyamine, seeds also contain fixed oil.	The whole plant is bitter and toxic (42).
belia ribes Burm.	Vidanga	Root	(7, 15, 18, 39)	Embelin, quercitol, alkaloid christembine, tannins, and volatile oil.	Bitter and astringent.
phorbia neriifolia L.	Snuhi	Root	(8, 32, 34)	Latex contains caoutchouc.	The plant is bitter, pungent and laxative.
rula narthex Boiss.	Hingu	Gum resin	(8, 15, 34)	Resins, gum, and essential oil.	Gum resin is emmenagogue and pungent.
riosa superba L.	Langali	Tuberous root	(8, 25, 34)	Alkaloids, colchicine, essential oil, phytosterol, and stigmasterol.	Tuber is abortifacient and used to remove the placenta from the uterus (21).

Botanical name	Indian name	Part used	Reference	Chemical constituents	Remarks
Gossypium herbaceum L.	Karpas	Root bark	(31, 34)	Poisonous phenolic substance gossypol, resins, fixed oil, and tannins.	Root bark is used as abortifacient; flowers are used in treatment of uterine discharges.
Hibiscus resasinensis L.	Japa	Flower	(7, 10, 13)	Purple dye, anthocyanin pigment diglucoside cyanidin, and vitamins.	Flowers are emmenagogue, buds are used in treatment of vaginal and uterine discharges (21).
Holarrhena antidysenterica L.W.	Indrayava	Seed	(22, 39)	Alkaloid conessine; seventeen other alkaloids are also present.	Useful to regulate menstruation.
Lagenaria siceraria Standl.	Katutumbi	Fruit, seed	(8, 10)	Steroidal sapogenins, cucurbitacin B, D, G, and H, fruits also contain beta-glucoside.	Pungent and emetic.
Lepidium sativum L.	Chandrashura	Seed	(27, 31)	Alkaloids glucotropoeolin, sinapin, proteins, and volatile oil.	The seeds when given after boiling with milk cause abortion (7).
Mallotus philippinensis Muell.	Kampillak	Fruit	(17, 23)	Crystaline compound rottlerin, resins, tannins, and volatile oil.	Reduces fertility in albino rats (18).
Marsdenia tenacissima W. and R.	Murva	Root	(29, 39)	Caoutchoue, resins and other water solubles.	Roots of this plant constitute the drug white turpeth.
Michelia champaca L.	Champak	Root, flower	(27, 34)	Essential oil, resins, and resin acids.	It is a valuable emmenagogue.
Nigella sativa L.	Kalajaji	Seed	(34)	Fixed oil, the glycerides of the oil are trilinolein, oleodilinolein, volatile oil, bitter principle nigellin, tannins, resins, and saponins.	Seeds are emmenagogue and abortifacient (21).
Peganum harmala L.	Harmal	Seed	(34, 40)	Alkaloids harmine, harmaline, and harmalol.	Seeds are bitter, emmenagogue and abortifacient.
Picrorhiza kurroa Royle	Katuki	Root	(33, 38, 39)	Bitter principle picrorhizin, kutkin, non bitter principle kurrin, and sterols.	White variety used in menstrual disorders; black variety is emmenagogue (21).
Piper longum L.	Pippali	Fruit	(2, 3, 39)	Alkaloids piperine and piplartine, sterols, and essential oil.	Emmenagogue and abortifacient.
Piper nigrum L.	Kalimirch	Fruit	(6, 39)	Pungent principle piperine, chavicine, piperidine, and volatile oil.	Black pepper is sometimes used by Malay women as an abortifacient.
Pisum sativum L.	Field pea	Seed oil	(17)	Pea oil, proteins, and vitamins; pea oil contains m-xylohydroquinone.	Pea oil when given to women once a month in the form of i/m injection, showed promise of preventing pregnancy (21).
Plumbago zeylanica L.	Chitrak	Root	(8, 13, 38)	Plumbagin, enzymes proteose, invertase and volatile oil.	Roots are astringent and have anti-implantation effects (41).
Randia spinosa Lam.	Mainphal	Fruit	(8, 13)	Saponins randia, randia acid, resins, essential oil, proteins, and fats.	Anti-ovulatory and anti-implantation effects (41).
Rauwolfia serpentina Benth.	Sarpgandha	Root	(26, 34, 36)	Alkaloids, reserpine, yohimbine, ajmalicine, etc.	A decoction of the root is employed in labours to increase contractions of uterus.
Ricinus communis L.	Erand	Seed	(42)	Fixed oil, contain glucosides of ricinoleic acid and ricin, alkaloid ricinine.	If the seeds are given to women one day after the child is born, after that there will be no conception for at least nine months (19).
Ruta graveolens L.	Sitab	Root	(34)	Glycoside rutin, and essential oil.	Plant is emmenagogue and abortifacient. also useful in urinary discharges (21).
Sapindus trifoliata L.	Aristak	Fruit	(34)	Fixed oil.	Emetic and abortifacient.
Saussurea lappa Clarke.	Kusth	Root	(6, 8, 9)	Essential oil, and alkaloids.	Bitter and emmenagogue.
Scindapsus officinalis Schott.	Gejpippali	Fruit	(5, 39)	Alkaloids, glycosides, scindaspin A and scindaspin B, and fixed oil.	Emmenagogue; also used in excessive menstrual flow.
Sesbania aegyptiaca L.	Jayanti	Root, leaves	(34, 35)	Fixed oil and polysaccharides.	Seeds are emmenagogue; flowers are antifertile (21).
Strychnos nux-vomica L.	Kupilu	Seed	(9, 15)	Alkaloids strychnine and brucine, also fixed oil.	Emmenagogue; also used in urinary discharges (34.
Taxus baccata L.	Talish	Leaves	(27	Alkaloids taxine, and taxinine.	Leaves are sedative and emmenagogue.
Terminalia arjuna W. & A.	Arjun	Stem bark	(7, 15, 38)	Alkaloids, and glycosidal substances.	Bitter and astringent.
Trigonella foenum-graecum L.	Methika	Seed	(34)	Alkaloids trigonelline and choline, essential oil, saponin, and bitter principles.	Astringent and emmenagogue.
Vitex negundo L.	Nirgundi	Seed, root bark	(14, 24, 34, 39)	Alkaloids nishindine, volatile oil, glycosides.	Bitter and poisonous.

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PHARMACOGNOSTIC STUDY OF ROOT OF *INULA RACEMOSA* HOOK

Pratap Singh and B. M. Sharma
Regional Research Laboratory, Jammu-Tawi (India)

Introduction

Inula racemosa Hook. (fam. Compositae) is a stout herb with 1-5 ft. (1.5 m) tall, grooved stem. It grows in western Himalayas between 5000-14000 ft. (1524-4267 m) elevation (Wealth of India - 1959 and Kirtiken and Basu - 1933) and is known as 'POSHKAR' and 'RASAN' (Chopra *et al.* 1956). Its roots are used in indigenous medicines as well as adulterated with those of *Saussurea lappa* Clarke (Datta & Mukerji - 1950 and Nadkarni - 1954). Roots of *I. racemosa* contain about 10 % inulin and 1.3 % essential oil. According to Singh *et al.* (1959) the main constituents of the oil are alantolactone, isoalantolactone, and sesquiterpenes. Srivastava *et al.* (1970) and Srivastava *et al.* (1971) have investigated the chemical properties of the constituents of the root.

The oil is strongly anthelmintic, being more potent but less toxic than santonin. The root is antiseptic, carminative, resolvent in induration, dispells effects of shock and is described to cure pain of heart, liver, spleen and joints etc. besides finding use in veterinary medicines. Root is also used to cure asthma, amenorrhoea and chronic diseases of lungs (Kirtikar and Basu 1933, Watt 1890 and Chopra *et al.* 1958). *Inula helenium* L., a native of Western Asia and Europe, and commonly known as 'ELECAMPANE' is the official drug in Europe. It finds medicinal uses as *I. racemosa* in the Indian system of medicines besides several other uses (Trease - 1946, Heberlandt - 1965 and Grieves - 1971).

The present study is intended to bring out salient pharmacognostic characters of the root of *I. racemosa* so as to distinguish it from its adulterants.

Material and Method

Authentic samples of the material were collected from Tangmarg and Gulmarg regions in Kashmir. Air dried as well as preserved roots in 70 % ethenol were used in the present study. Transverse sections cut on a rotary microtome were stained with safranin and fast green as per Johansen's Schedule (1940). Roots were also macerated in 30 % nitric acid, washed repeatedly with tap water and mounted in 10 % aqueous glycerine for microscopic study. The powder of the root was similarly examined for diagnostic features. Fresh transverse section were taken for cell content study. Preliminary chemical tests were done according to Trease (1952).

ıay be useful for the detection of certain alkaloids and glycosides in plant ex-
racts or crude drug preparations.

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Missionary Guide

Plantae Colombianae. XVI. Plants as Oral Contraceptives in the Northwest Amazon – Colombia

RICHARD EVANS SCHULTES

(*Botanical Museum of Harvard University, Cambridge 38, Massachusetts*)

In the course of twelve years of field work in the northwestern part of the Amazon basin, I heard repeated references to the use by Indians of plants as oral contraceptives. Most of these reports were indirect or were in the nature of hearsay, and their reliability was, consequently, suspect. Some, however, were direct reports based upon personal knowledge and seemed to me to be worthy of serious investigation.

The use of a substance in a primitive society in the belief that it will control or prevent conception is not easy to investigate in the field. "Wherever the Indian has come into close contact with civilization, he acquires a self-consciousness and reticence about free discussion of such a topic as contraceptive agents. He may very well employ them, but he refuses to talk about them. This is especially true within the sphere of influence of missionaries who usually crusade against the use of contraceptives."

That plants are widely employed in the Amazon in the belief that they prevent conception even the causal traveller will soon discover. The botanist who spends long periods in any region in close association with the natives of the area, hearing constantly about this use of plants but unable even to begin research on their identification, often feels a deep sense of frustration.

My itinerary, fortunately, took me on several occasions for long periods to rivers where the influence of civilized man is either weak and nebulous or does not exist at all. In such isolated areas, I learned of three plants employed as oral contraceptives and was able to collect botanical material for their determination. For two of these plants, I have a number of independent reports over a period of several years from members of different tribes. The third plant was pointed out independently by two Indians whom I had always found to be reliable sources of information, but both of them belong to the same tribe.

It is obviously impossible to prove or disprove in the field the efficacy of an agent which is taken to prevent conception, but repeated independent reports from sundry sources and which coincide in their details would appear to me reliably to indicate that the plant really is so employed. That all three of these plants belong, curiously enough, to the same family—the Araceae—might be interpreted as strengthening the reliability of these reports. It has been suggested that the use of aroids as oral contraceptives could be the result of phallic symbolism in reference to the spadix of the plant; and this may be true. Yet might we not risk the loss of perhaps a significant discovery were we to set ourselves up as judges and dismiss these uses as pure superstition?

The three plants in question belong to three different genera of the Araceae: *Anthurium*, *Philodendron* and *Urospatha*.

A spot test for the presence of alkaloids (Raffauf in Econ. Botan. 16 (1962) 171) proved to be negative in all three of the plants under discussion.

ANTHURIUM TESSMANNII *K. Krause* in Notizbl. 9 (1925) 260. Plate I[1]

Epiphytic plant with rather long, climbing caudex about 2 cm in diameter with congested, fibrous roots. Leaves chartaceous, conspicuously reniform or paddle-shaped, apically acute, basally long and gradually attenuate, nerves conspicuous on both surfaces but strongly elevated below, secondary nerves arcuate, at a 50–

[1]Illustrations were made possible through a grant from the National Science Foundation.

LLOYDIA V. 26 June 1963 P. 67–74

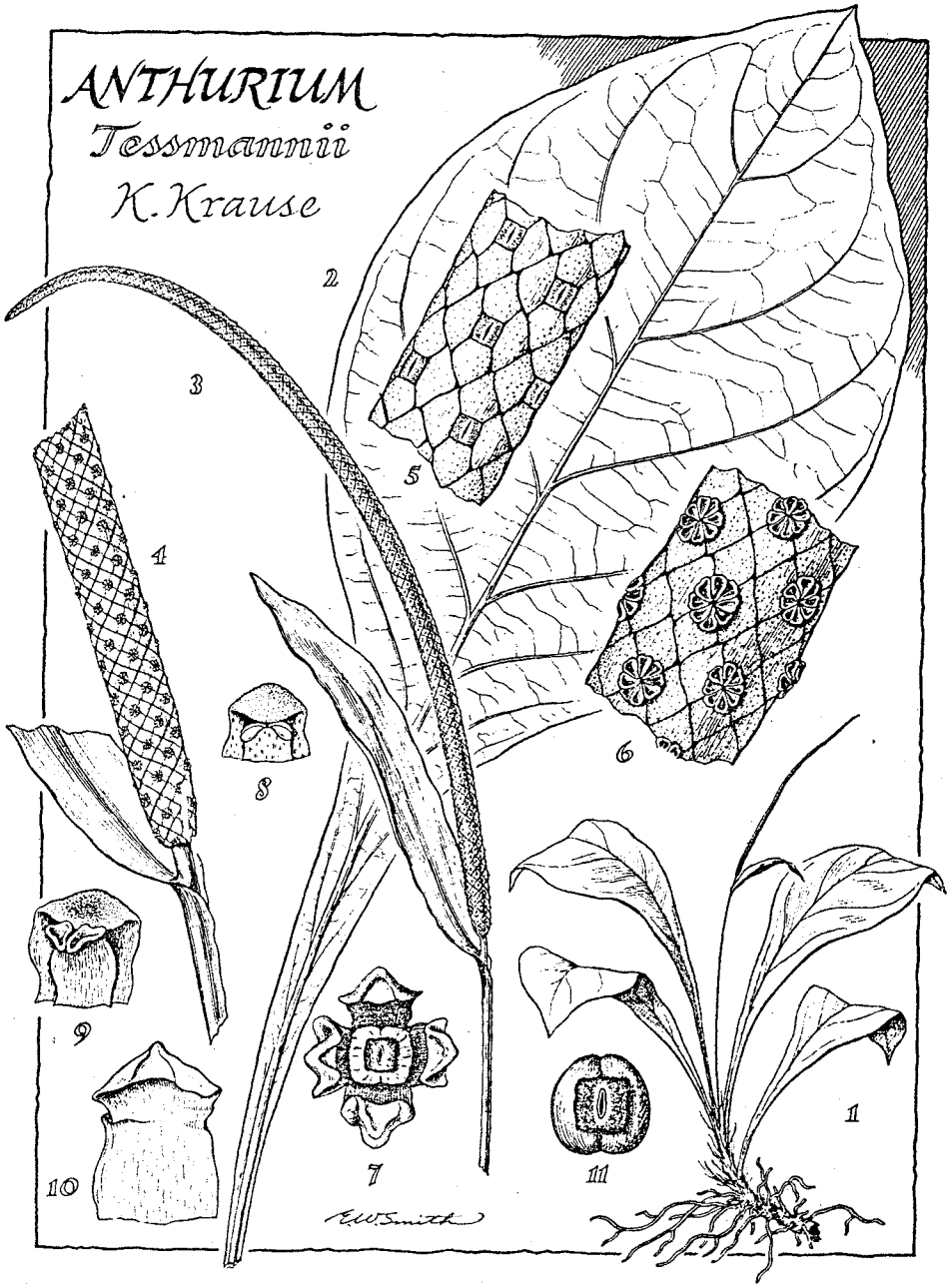

PLATE I

Anthuruim Tessmannii K. Krause

FIG 1. *Habit*, × *about* ¼. FIG. 2. *Leaf*, × *approx* ⅔. FIG. 3. *Inflorescence*, ×¾. FIG. 4. *Base of inflorescence, showing stipitate condition*, ×2. FIG. 5. *Portion of young spadix, showing slit-like stigmas*, ×6. FIG. 6. *Portion of mature spadix, showing opened anthers*, ×6. FIG. 7. *Single mature flower (after dehiscence of stamens)*, ×6. FIG. 8. *Young tepal and stamen from fig. 5*, × *approx* 12½. FIG. 9. *Tepal and stamen from fig. 6*, × *approx* 12½. FIG. 10. *Mature tepal*, ×8 FIG. 11. *Developing*

60° angle to mid-vein, 7–10, strongly petiolate (petiole much shorter than bl up to 8 cm long), up to 50–60 cm long and about 25 cm wide. Peduncle slen terete, up to 35 cm long, dark green. Spathe green without, green mottled w purple within, linear, up to 10 cm long, 10–15 mm wide, marginally someti subcrispate. Spadix pale red, brownish or purple, stipitate (stipe up to 15 r long), narrowly cylindrical, apically subacute, up to 28 cm long, 1 cm in diame Tepals ligulate, apically carnose-swollen, obtuse, growing in length and wi with maturity: in very young state about 0.8 mm long, mature 3 mm long, 2 r wide, carnose apical portion extremely plicate. Anthers yellow, about 0.3 r long. Ovary quadrate-subglobose, 0.7 mm×0.9 mm surmounted by sess square to rectangular style (with an elliptic stigmatic surface) 0.45 mm long, mm wide.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, between Ríos Pacoa a Kananarí, Soratama. Alt about 250 m "Epiphyte. 'Spike' p ple. Fruits violet. Spathe greenish." June 21, 1951, *R. Schultes et I. Cabrera 12772*.–Same locality. "Epiphyte. 'Spi grey-brown. Spathe green outside, green mottled with pur inside. Oral contraceptive–inflorescence." August 20, 1951, *E. Schultes et I. Cabrera 13621*.–Same locality. "Epiphy 'Spike' red-brown. Spathe greenish." August 16, 1951, *R. Schultes et I. Cabrera 13535*.–Same locality. "Epiphyte. Spat brownish-green inside and out. Spadix brown." August 1951, *R. E. Schultes et I. Cabrera 13796*. Comisaría del Vaup Río Piraparaná, middle course. "Epiphyte." September 1952, *R. E. Schultes et I. Cabrera 17128*.

Anthurium Tessmannii was described and has hitherto been recorded only fr eastern Peru where it grows in rain forest at about 225 m altitude. Krause i dicated that it was similar to *Anthurium Uleanum* Engler, also from Amazoni Peru.

In the Apaporis basin, *Anthurium Tessmannii* is not a rare plant. It is esp cially abundant in the middle course of the Apaporis and its affluent, t Piraparaná, where the Makuna Indians employ it in the belief that it has t property of preventing conception. The dried, ripened spike is pulverized a added to food taken by the women. Several Indians, belonging to the Maku Barasana and Taiwano tribes, all living in the middle Apaprois basin, point *Anthurium Tessmannii* out independently as a contraceptive agent, and all agre in the method of its employment. The Makunas call the plant *ma-te-ke-pa*.

Philodendron dyscarpium *R. E. Schultes* sp. n. Plate II, I

Suffrutex robustus, usque ad sex (saepius quattuor) ped. altus in saxis arenos crescens. Caudiculus erectus, subarborescens, basi plus minusve 6 cm in diametr dense foliati, internodiis elongatis inferioribus usque ad 25 cm longis, superiorib brevibus. Foliorum petiolus crassus, atroviridis, semiteres, usque ad 60 c longus, supra late canaliculatus, basi conspicue vaginatus et cataphyllis praeditu Lamina crassiuscula, coriacea, atroviridia, oblongo-ovata vel saepe ovata, apic breviter acuminata, basi rotundata, usque ad 40 cm longa, 25 cm lata, nerv centrale prominenter crasso, stramineo-viride, 1 cm in diametro, nervis lateralibu densissimis, omnibus aequalibus, a costo angulo acuto adscendentibus percurs Pedunculi crassiores, apicem versus leviter incrassati, atrovirides sed sanguine maculati, plerumque 10–15 cm long, 1 cm in diametro. Spatha extus viridis v flavo-viridis et sanguineo- vel purpureo-maculata, intus intense sanguinea, sub triangularis, apice acuta, aliquid convoluta, medio leviter constricta, expans usque ad 15 cm longa, basi ad 6 cm lata, tubo 3–3.5 cm diametiens, basi inflat

Spadix rectus, cylindricus, crassus, apice redondatus, spathae aequilongus vel paullo brevior, inflorescentia feminea rufo-brunnea, 5 cm longa, 2 cm in diametro, inflorescentiae maculae pars sterilis brevis, paullum incrassata, fertilis flava vel subalba, elongata, anguste claviformis, usque ad 11.5 cm longa, 2 cm in diametro, summo apice obtusiuscula: pistillum late columnare, apicem versus aliquid constrictum, angulatum, plus minusve 3.5 mm longum, basi 2–2.3 mm diametriens, stigmate rotundato piloso coronatum, 5- vel 6-loculare, loculis multiovulatis; flores masculi 2- vel 4-andri, stamina plus minusve 4.5 mm longa, apice 3 mm lata, anthera circiter 2.7 mm longa; staminodium columnare, truncatum, angulatum, 2.3 cm longum, in circuitu irregulariter rhomboideum, 1.8–3 cm diametriens.

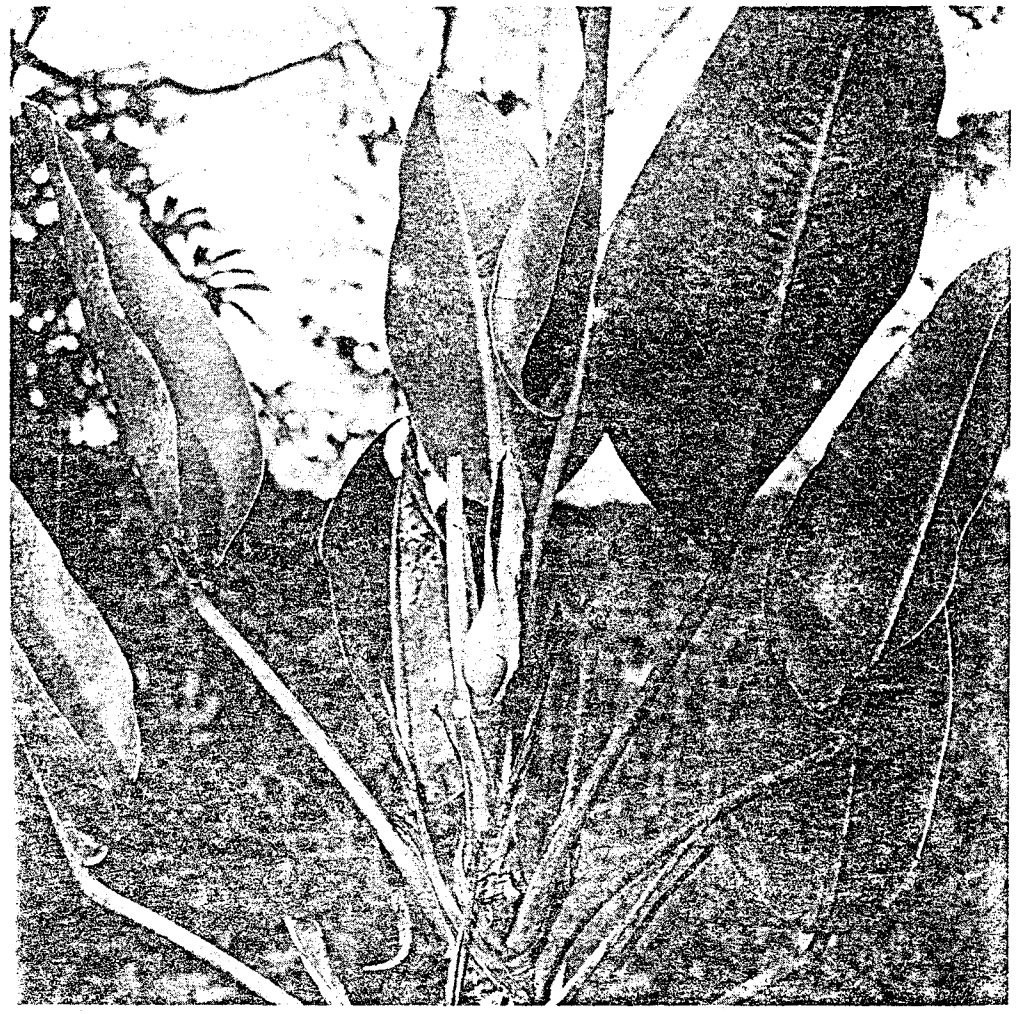

PLATE II

Habit photograph of **Philodendron dyscarpium** *R. E. Schultes from the type locality.* Photograph by R. E. Schultes.

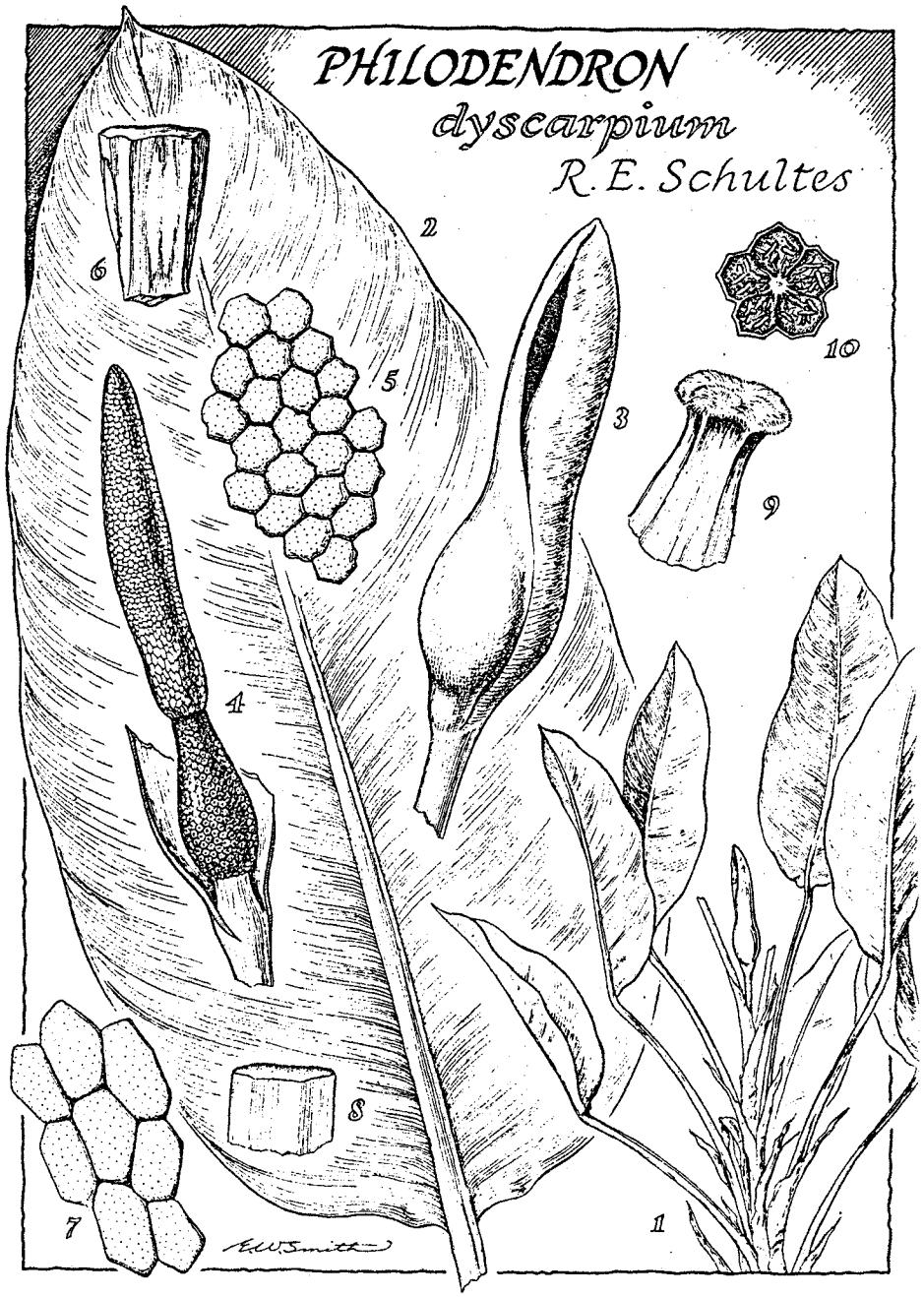

PLATE III

Philodendron dyscarpium *R. E. Schultes*

FIG. 1. *Habit,* ×⅛. FIG. 2. *Leaf,* ×½. FIG. 3. *Inflorescence,* ×½. FIG. 4. *Inflor cence with part of spathe removed,* ×½. FIG. 5. *Portion of surface of distal part of spadix, show stamens from above,* × *approx* 4. FIG. 6. *Stamen, lateral view,* × *approx* 7½. FIG. 7. *Port of surface of central part of spadix, showing staminodes from above,* × *approx* 4. FIG. 8. *Stamino lateral view,* × *approx* 4. FIG. 9. *Pistil, lateral view,* × *approx* 10. FIG. 10. *Pistil, cr section,* × *approx* 10. Drawn by Elmer W. Smith.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Yapobodá. Quartzite savannah near headwaters. Alt about 275-300 m. Lat 1°20'N, long 70°30'W. April 1953, *Richard Evans Schultes et Isidoro Cabrera 20059*. (TYPE in Econ. Herb. Oakes Ames; DUPLICATE TYPE in Herb. Nac. Colomb.)–Same locality. August 15, 1960, *R. E. Schultes 22615*.–Same locality. June 25, 1958. *H. García-Barriga, R. E. Schultes et H. Blohm 15839*. Río Kubiyú. Quartzite savannah of Guranjudá. Alt about 350–400 m. June 10, 1958, *H. García-Barriga, R. E. Schultes et H. Blohm 16034*.

This most interesting new species of *Philodendron* appears to belong to section *Baursia* in subgenus *Euphilodendron*. It is distinguished from other species by ts large size and its xerophytic, saxicolous habit. A number of floral characteristics, such as the peculiar columnar staminodes and stamens and the unusual ›ilose stigma, further separate the species from others in the section.

Philodendron dyscarpium grows abundantly in dense clumps on the metanorphic quartzite of the xerophytic savannahs north of the Río Vaupés in eastern Colombia. It has been collected only on the connected savannahs known as Yapobodá (near the head-waters of the Río Kuduyarí) and Guranjudá (along the Río Kubiyú), but I know from air reconnaissance that it covers vast areas of other imilar and adjacent savannahs.

Philodendron dyscarpium, so named in reference to its contraceptive use, is ›pparently the most important of the plants employed in the Vaupés in the belief hat it can reduce fertility. It was independently indicated by natives of the Kubeo nd Tukano tribes who live along the Río Vaupés and its affluents, the Kuduyarí nd Kubiyú, and who make occasional trips to the savannahs along these affluents or supplies of the drug. I have nine independent reports from four natives belonging to these two tribes. The inflorescence of *Philodendron dyscarpium* is dried nd pulverized and the powder added to the food of the women as a deterrent to onception.

Examination of oven-dried (at 60°C) inflorescences by an American pharmaeutical house failed to disclose the presence of any constituent which might have ontraceptive action, but the possibility that some volatile compound might have een lost in the drying or in the several months between collection and examination hould be considered.

The Kubeo name for *Philodendron dyscarpium* is *he-pe-koo-ta-ta*; the meaning f this name could not be discerned.

'ROSPATHA ANTISYLLEPTICA *R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 18 (1959) 311. Plate IV

Herb up to 2 m tall, inhabiting swampy forests. Petiole of leaf succulent, omparatively slender, glabrous, lightly striated, dark green variegated with ashy reen and dark purple spots, up to 150 cm long; blade hastate, up to 80 cm long hen mature; upper lobe lanceolate, up to 47 cm long, basally 13 cm wide, at the ase (near apex of petiole) with a very conspicuous, deep blood-red callus; lower obe widely lanceolate, as long as upper lobe, up to 14 cm broad at widest part. eduncle glabrous, more slender than petiole but similarly variegated, up to more less 115 cm long. Spathe much shorter than leaves, open, spirally contorted, ongate-lanceolate, very long acuminate, greenish purple without, pale green but isally pink within, up to more or less 33 cm long, often splitting in maturity. padix sessile (not stipitate), perfectly cylindrical, apically rounded, reddish brown, iort-adnate to basal part of spathe, about 5.5 cm long, 1 cm in diameter, half rtile. Flowers with 4 tepals, green. Ovary obovoid, locules 4-ovulate. Fruits id seeds not known.

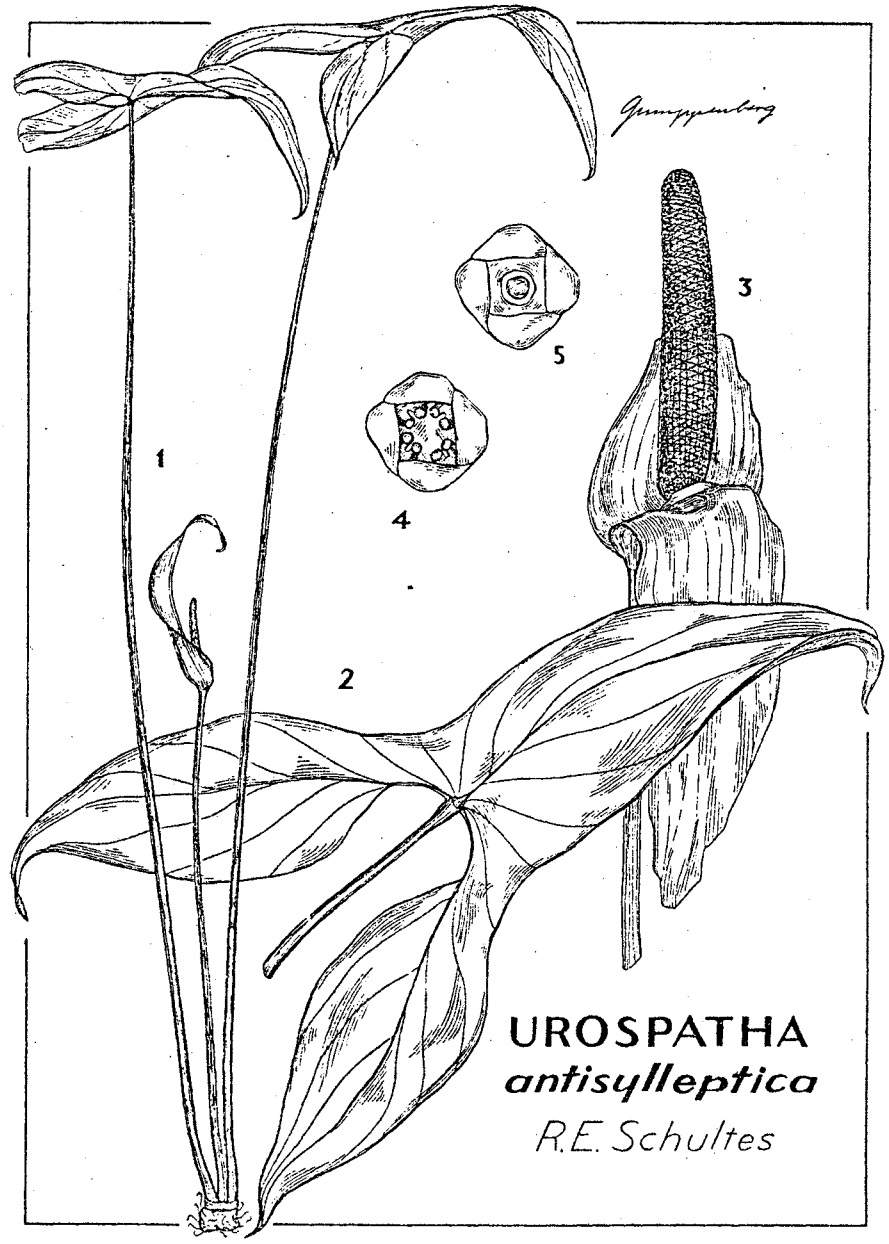

PLATE IV

Urospatha antisylleptica R. E. Schultes

FIG. 1. *Habit*, × *approx* 1/14. FIG. 2. *Mature leaf*, × *approx* 1/6. FIG. 3. *Inflorescenc with spathe partially removed to show sessile spadix*, × *approx* 3/4. FIGS. 4, 5. *Aspects of flowe and ovary*, × *approx* 10. Drawn by John Gumppenberg.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná (Tributary of Río Apaporis), headwaters of Caño Tee-mee-ña. September 10, 1952, *R. E. Schultes et Isidoro Cabrera 17425.*

The genus *Urospatha* has fourteen species. All are tropical American in range, occurring from Guatemala to southern Brazil. Speciation appears to be strongest in the Amazon Valley, with eight of the fourteen species (including the most variable with its several varieties: *Urospatha sagittifolia* (Rodsch.) Schott native to that region. All of the species are adapted to the wetest of swamps, and some may grow for months as aquatic plants during the season of highest floods.

Urospatha antisylleptica differs from *U. decipiens* primarily in being much larger and in having the sinus between the median and lateral lobes of the leaf at least twice as long. From *Urospatha Hostmanii*, the new species may be distinguished by its larger size, by its verruculose (not glabrous) petioles and by its having the base of the spathe only very shortly adnate to the spadix.

The bright blood-red or scarlet callus at the base of the leaf blade or apex of the petiole in *Urospatha antisylleptica* may be a distinguishing feature from all other species, for I have seen no reference to such a colour in the literature nor have I noticed it in several other species of this genus which I have had occasion to study and collect in the field.

Urospatha antisylleptica was pointed out independently by two Barasana Indians, who inhabit the upper course of the Río Piraparaná and its affluents, as the source of an oral contraceptive which is in common use in the tribe. They report that the unripened spadix is dried and pulverized and that, in order to prevent conception, the resulting brown powder is taken by women in their food. My stay in the Río Piraparaná was not long enough to permit me to check these statements thoroughly or to see the plant used. The specific name *antisylleptica* (from the Greek meaning "against pregnancy") calls attention to this unusual use of the plant.

Received 25 February 1962.

Occurrence of Ergot on *Festuca obturbans* in East Africa

A. BRACK, R. BRUNNER AND H. P. FREY

(Research Laboratories of Pharmaceutical Chemistry, Sandoz Ltd., Basle, Switzerland)

In February 1962 ergot was collected by one of the authors (A.B.) on *Festuc obturbans* St.-Yves, found in the grassland zone above the montane forest belt c the Kilimanjaro (Tanganyika) at 3200 m, between Bismarck Hut and Peters Hu The occurrence of the ergot was limited to this grass, which forms large tussock there. Other grasses were not infested. *Festuca obturbans* is not mentioned i any of the host lists published for *Claviceps* species (1, 3-6, 9) and therefore publ cation of our findings is being made.

The ergot infested *Festuca obturbans* was found in small, irregularly limite areas. Up to seven sclerotia per panicle could be counted on individual plant This high frequency perhaps could be attributed to the fact that the area abou Kilimanjaro was beset with extremely heavy rainfall in late December 1961 an early January 1962 whereas in February—when we collected the ergot—the norma dry season prevailed.

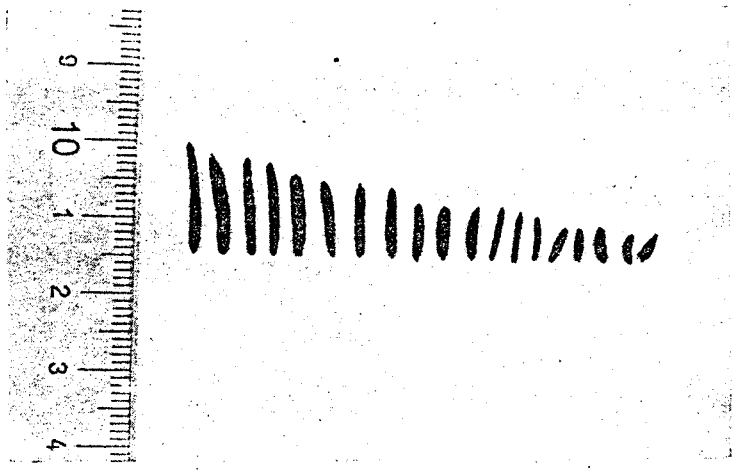

FIG. 1. *Sclerotia of ergot from Festuca obturbans St.-Yves.*

The sclerotia gathered (total weight 3.0 g) had a length of 3.5–14.5 mm and a thickness of 0.7–2 mm (fig. 1). Their color was purplish dark brown externally and grayish-white internally, being very similar to ergot of rye.

Colorimetric analysis of the sclerotia showed an alkaloid content of 0.32 per cent (average molecular weight 600). Separation by paper chromatography (2, 12) of the total alkaloids isolated from 500 mg of sclerotia gave the following composition:

Ergocryptine	76.9%
Ergocryptinine	5.0%
Ergosine	5.0%
Ergosinine	0.6%
Ergocornine	3.1%
Clavine alkaloids	4.1%
Unknown alkaloids	5.3%

Bound too tightly

Some Native Herbal Remedies at Present in Use in Mashonaland

BY

H. WILD, PH.D., A.R.C.S.
Senior Botanist, Federal Department of Agriculture;

AND

M. GELFAND, C.B.E., M.D., F.R.C.P.
Physician, Salisbury.

Europeans have for many years taken an interest in the plant remedies used by Africans in the hope that some at least might possess real and hitherto unrecognised pharmacological properties of use to medical science. That this is not an entirely unfounded assumption can be shown, even in our area, by the development of the use of the drug Strophanthine resulting from the observations of David Livingstone and Sir John Kirk on the use of extracts of the liane *Strophanthus kombe* as an arrow poison by Natives in the Zambesi area.* Furthermore, extensive compilations of such remedies as used in Southern Africa, which cover the Federation to some extent, already exist, the principal one being that of Watt and Breyer-Brandwijk (*The Medicinal and Poisonous Plants of Southern Africa*, published by E. & S. Livingstone, Edinburgh, 1932). Before the potential value of any individual remedy can be assessed it is of course necessary that a properly conducted experimental trial be carried out, first on animals and then on man. Unfortunately, the number of plants in use by Natives is very large and for various reasons a high proportion of them are likely to be of little real value, so there would be a great waste of effort if a systematic attempt were made to test them all. The development of Native medical lore has naturally been of a very empirical nature and, like the medical sciences of Europe in mediaeval and earlier times, plants have been chosen either on the principle of signatures, i.e., the fancied resemblance of some plant organ to the human organ which it is required to treat, or for subconscious psychological rather than pharmacological reasons, as is seen, for instance, by the frequent inclusion of the parts of a cock in cures for male sterility, or probably very often since the remedy appears to be efficacious because the symptoms disappear of their own accord, as would have happened without the use of the treatment—the innumerable supposed remedies for syphilis which appear to be so successful on the disappearance of the primary lesions offer a good illustration of this last example. It is very desirable, therefore, that some attempt be made to try and select instead those remedies that may have survived by natural selection because of their real value. The following is the description of an attempt to apply a rational and scientific approach to this problem in S. Rhodesia.

The first difficulty that is encountered in an investigation of this kind is that, if the *nganga* (Native herbalist or doctor) is asked to show his plant specimens as used in his cures, he invariably produces collections of roots, chopped up stems, powdered leaves and so on, all in a very dried up condition. In the state of our botanical knowledge in Rhodesia at present these are rarely capable of being determined by a botanist and one is then left with no more than the Native name. These names vary from area to area and their interpretation depends on the accuracy of any previous European records of their application to particular plants. As it is of the first importance that the plants used be determined accurately, Native names or determinations based on such material cannot be relied on. The only way under the circumstances is for the botanist to have the living plants pointed out to him by the *nganga* in the field and to determine them on the spot. As the plants are often sterile there are still difficulties in determination which can only be overcome if the botanist has considerable field experience in the area concerned as well as herbarium experience. In the present instance it was therefore decided to organise a small team consisting of a medical man (Dr. M. Gelfand), a botanist (Dr. H. Wild), the African *nganga* himself and an interpreter (a qualified and reliable African medical orderly, Mr. T. Gapani). The team would then go to an area selected by the *nganga*, who pointed out in turn the trees, shrubs or herbs he used, giving their African names and medical uses. Simultaneously the botanist named the plant while the medical member of the team made notes on the symptoms of the disease concerned and the method of application of the remedy.

During 1955 and 1956 we visited a number of reserves in Mashonaland in this way until unfortunately, the botanical member of the team had to leave Rhodesia for London to assist in the writing of the Flora Zambesiaca at Kew and

* *Narrative of an Expedition to the Zambesi and its Tributaries*, by D. & C. Livingstone. John Murray, London, 1865; pp. 465-467.

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Table I

NGANGA 1—MREWA DISTRICT

African Name	Botanical Name	Symptom of Disease	Method Employed
Musisinwa	*Temnocalyx obovatus*	Backache.	Also applied to umbilicus of new-born babies. Burnt ashes of root rubbed into incisions. For backache the ashes are rubbed into incisions made.
Chipindura	*Terminalia rhodesiaca*	Acute abdominal pains.	Roots crushed, added to water and given to person to drink.
Chibayamakono	*Randia vestita*	Constipation.	Root crushed. Water added and drunk by patient.
Mupumanuka	*Becium angustifolium*	Abdominal pain with blood in stool.	The roots and leaves are mixed with fresh piece of meat; all are cooked together and given to person to drink. The mixture is cooked the whole night on the fire.
Xindakubaya	*Cissus jatrophoides*	Diarrhoea in babies.	The roots are crushed, added to water and given to the baby to drink.
Chizhuzhu	*Maytenus senegalensis*	Pain over the chest.	Roots dug, crushed and added to porridge and given to the patient to eat. Leaves wrapped in a cloth are also applied over the chest wall where the pain is felt.
Nyabotu	*Becium obovatum*	Pain and tightness in chest.	The plant is placed in water which is boiled and the patient inhales the vapour, his head being covered in a blanket.
Myandachirimo	*Indigofera hirsuta*	Dizziness.	Roots are added to water. A tin of water is left outside near ashpit, and the next morning the patient washes his face with the water, first facing west and then east. This is done for four days. He also drinks medicine. On the fourth day the rest of the medicine is thrown away at ashpit.
Prundasi	*Neorautanenia pseudopachyrrhiza*	Mhepo.	The roots are used. Also used as a fish poison.
Marumanyama	*Cassia abbreviata*	Gonorrhoea.	The roots are mixed with those of Chipunduna and given to the patient to drink.
Nyamepo	*Clerodendrum wildii*	Mhepo.	Roots soaked in water and drunk and/or mixture blown up rectum.
Xywindaku Rayagure	*Cissus cornifolia*	Pains in legs.	The roots are stored so as to dry. Then crushed into powder and nyora cut.
Chiwungudzi	*Peltophorum africanum*	For Ngozi (angered spirit).	Roots added to water and patient washes his face with the water. Then he smells water. Ngozi so driven away.
Mukundanyoka	*Indigofera rhynchocarpa*	Dysmenorrhoea.	Roots are added to water and drunk.

NGANGA 1—MREWA DISTRICT—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Mufufu	*Securidaca longepedunculata*	Convulsions in babies and children.	Roots are dried, crushed into powder, put in Chayenga in which these are burnt to ashes, and the baby is made to inhale the smoke.
Rurengari	*Asparagus asiaticus*	Constipation in young infants.	Roots soaked in water and baby given to drink.
Murungu	*Heeria reticulata*	For abdominal pains.	Roots soaked in water. Mixture drunk.
Chitowamatera	*Astrochlaena malvacea*	For person ill for long time with a sluggish circulation.	Roots placed in water, which is then boiled and vapour inhaled. The leaves are applied to affected parts.
Rambatuku	*Indigofera endecaphylla*	To strengthen all medicines.	Roots added to the different medicines.
Mhingami	*Heteromorpha trifoliata*	For chitsinga (rheumatism).	Roots burnt in a chayenga and nyora cut.
Muriranyenze	*Albizia antunesiana*	Sterility.	A cock is killed and the root is eaten after cooking it together. Eaten in morning. Taken once.
Bupire	*Vernonia amygdalina*	Chitsinga.	The dried flowers and branches are burnt together and nyora incisions made.
Muchenji used with Xwinya Bybuza	*Dialiopsis africana*	Chipotswi.	Roots soaked in water and medicine drunk.
Musodzambudzi —	*Steganotaenia araliacea*	For sore eyes.	Mix leaves with *Asparagus* in water and then wrap in cloth and squeeze drops of water into eyes.
Muchecheni	*Ziziphus abyssinica*	A pregnant woman at end of five months having no foetal movements will take this medicine.	Roots placed in water and mixture drunk.
		For abscesses.	Fruit and leaves applied locally.
Chinamira	*Ansellia gigantea*	For babies who are only on the breast.	Three pieces are cut from the pseudobulb and tied round the waist of the baby.
Mutengeni	*Ximenia caffra*	For burns.	Powder made from roots and sprayed over the burnt areas.
Munenza	*Glossostelma spathulatum*	For chronic cough.	Roots burnt and patient eats the ashes.
Dembezeko	*Rhoicissus erythrodes*	For swellings.	Roots powdered and porridge made and eaten. Some also rubbed on the swellings.

NGANGA 1—MREWA DISTRICT—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Werazuwa	*Eriospermum abyssinicum*	Chipande.	Root added to water and then a small hole is cut in it and it is tied around the neck. The rest of the water is given to the baby to drink.
Cumuzambgwa	*Cucumis hirsutus*	Convulsion.	Root is boiled with mfuta oil and the mixture given to baby to drink.
Nyamaradzo	*Aspilia brachyphylla*		Inhalation used with Nyamabota.
Muswaswa	*Psorospermum febrifugum*	Scabies.	Powder from roots sprinkled on rash.
Chifukavu	*Pavetta schumanniana*	Cough.	Leaves eaten.
Katsayi	*Lasiosiphon kraussianus*	Anorexia. Loss of weight (also a fish poison).	Root added to water for whole night. The root is boiled in water. Mixture drunk when cool. This root must not be given to pregnant women because it destroys the pregnancy.
Mucherekedzi	*Swartzia madagascariensis*	Convulsions in babies.	Roots added to water and mixture drunk.

NGANGA 2—CHIKWAKWA DISTRICT

African Name	Botanical Name	Symptom of Disease	Method Employed
Jero	*Sphenostylis erecta*	Mhepo.	Roots crushed and powder blown up into rectum.
Mutswatswa	*Psorospermum febrifugum*	For wounds on head.	Roots crushed and mixed with mfuta oil. The roots are first burnt to ashes and mixed with oil.
Matunguru	*Flacourtia indica*	Diarrhoea (children as well as adults).	Roots crushed and added to water and mixture drunk.
Kavuswa	*Cyperus angolensis*	Constipation in a child.	Roots dug out and mixed with water and mixture drunk.
Masambara	*Carissa edulis*	Dyspnoea.	Roots crushed and added to water.
Masa	*Brachystegia* with *Loranthus* sp. (*Gomerara*)	?	Leaves and twigs crushed, water added and rubbed on face.
Sanumgure	*Rhus tenuinervis*	?	Roots crushed in water and woman drinks the mixture for ten days.

NGANGA 2—CHIKWAKWA DISTRICT—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Musisinwa used with Sunangwe	*Bridelia cathartica* ssp. *melanthesoides*	Sterility.	Roots added to water.
Murmanyama	*Elaeodendron capense*	Sterility in male.	Roots added to water.
Mhingano	*Heteromorpha trifoliata*	Sterility in women.	Roots used.
Mutsatsati	*Faurea saligna*	Chibayo.	Leaves and twigs are burned to ashes and nyora cut.
Chigarapasi	*Thunbergia lancifolia*	Painful menstruation.	Roots are dug out and water added.
Chipfuvapasi	*Indigofera* sp.	Pain in chest and cough.	Roots are dug out and porridge made.
Rurimirwemombe	*Vernonia amygdalina*	Gonorrhoea.	Roots used in usual way.
Mundemberembe	*Cassia abbreviata*	Gonorrhoea.	Roots used. Used with *Vernonia amygdalina*.
Mutengene	*Ximenia caffra*	Diarrhoea.	Roots used with water.
Mucherahanga	*Securinega virosa*	Pains and swellings of legs.	Roots dug and burnt to ashes and incisions made.
Muchejene	*Ziziphus abyssinica*	Chipande.	Leaves stamped in Duri.
Chibaya mhondoro	*Acacia ? karroo*	Buka.	Roots added to water. Mixture drunk and face washed with it.
Musodzambudzi	*Steganotaenia araliacea*	Gonorrhoea.	Roots used.
Mukonono	*Terminalia sericea*	To widen vagina.	Roots added to water and the woman washes vagina with the mixture.
Muroro	*Annona nana*	No disease given.	Roots.
Chirapamapenzi	*Lasiosiphon kraussianus*	For people who are going mad.	Root dug. Put into water. Porridge prepared. Placed in small plate and given to the person, who is made to drink.
Mhingano	*Nesaea heptamera*	Diarrhoea.	Roots.
Mufuti	*Brachystegia boehmii* with *Loranthus* sp. as parasite	For people who are going mad.	The leaves and twigs of the gomerara are crushed, water added and mixture given to patient to drink after Chirapamapenzi has been taken (see above).

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RHODESIAN HERBAL REMEDIES

NGANGA 3—NEAR SALISBURY

African Name	Botanical Name	Symptom of Disease	Method Employed
Mugaranjwa	*Maytenus senegalensis*	For difficult delivery.	Leaves and root are crushed, added to water, and the woman in labour sips it.
Mubonda and Mutswanzwa	*Protea uhehensis* and *Ximenia caffra*	Whooping cough.	Crushed roots added to water and child given to drink.
Sikavakadzi	*Leonotis* sp.	For burns.	Roots burnt and flowers grounded and both of these applied in form of ointment.
Muzizi	*Heeria reticulata*	Stomach ache and abdominal pains.	Leaves crushed and put in water and given to drink.
Nzeveyetsuro	*Senecio lasiorhizus*	For chipundi.	
Nanzwa	*Pouzolzia hypoleuca*	For chipundi.	Roots crushed and applied to fontanelle.
Muchechene	*Ziziphus abyssinicus*	Boils.	Crush the green leaves and apply to boil directly.
Mufesco	*Dicerocaryum zanguebarium*	Smallpox.	To prevent smallpox water disease. When lesions appear, fluid is applied to the lesions.
Muroro	*Annona nana*	For gonorrhoea.	Crushed roots are mixed with Mufufu roots (*Securidaca longepedunculata*) and mixture drunk.
Katowapasi	*Cryptolepis oblongifolia*	Pneumonia.	Roots used. Root applied to affected part.
Mukwiramofu	*Heteromorpha trifoliata*	Sterility in men.	Root of this is mixed with Nyanurura and Mukandira-Lamiri. These three roots are crushed together, ground to powder, which is added to porridge or drunk.
?	*Clematopsis scabiosifolia*	For varicose veins.	Roots applied on enlarged vein and a blister is produced.
Musuntguzose	*Elephantorrhiza elephantina*	Any abdominal pain.	Roots crushed in water and patient given mixture to drink.
Mutsubvu	*Vitex payos*	For coughing.	Adult given the leaves to smoke and inhale. For the child, the dried leaves are dried and used as a snuff.
Dzwaka	*Swartzia madagascariensis*	Sterility in women.	Roots added to water and mixture drunk.
Kajhongwe	*Combretum platypetalum*	Diarrhoea in children.	Roots added to water and child drinks mixture.
Mughuma	*Sutera burkeana*	Sore eyes (conjunctivitis).	Leaves broken and placed in water, and soak the affected eye.

NGANGA 3—NEAR SALISBURY—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Mukonde	*Euphorbia ingens*	For asthma.	The bark from the msasa tree is taken. The fibre is chewed. When fibre is soft the mukonde tree is cut and the fibre is soaked with its milk. Then it is dried, wrapped in paper and smoked.
Ruzambu	*Cissampelos mucronata*	Vaginal bleeding. Stops bleeding, also sore throat.	Roots crushed, added to water and fluid given to drink.
Muchenya	*Dialiopsis africana*	If patient, he will recover. Also used for headache.	Bark of root used, crushed and dried.

NGANGA 4—KANDEYA RESERVE

African Name	Botanical Name	Symptom of Disease	Method Employed
No African name	*Grewia herbacea*	Chipande.	Roots dug and applied to fontanelle.
Kamwazizi	*Dyschoriste monroi*	Lubricant in midwifery.	
Chipundura	*Acalypha senensis*	Sterility in men.	Roots dug and boiled with meat of cock and eaten by man.
Sunangura	*Hypoestes verticillata*	For constipation in babies.	Roots chewed by *nganga* and given to baby.
Vumbanutchi	*Rhynchosia* sp.	Used to cool babies with high temperature. Baby washed in water.	Roots crushed, mixed with H_2O and body washed.
Rukata	*Becium obovatum*	Used for touching clothes of deceased.	Roots sprinkled.
Mukwirambira	*Agathisanthemum bojeri*	Asthma.	Smoke leaves. Leaves enclosed in paper like tobacco and smoked.
Mutowe	*Azanza garckeana*	Used when babies have pain in chest.	A piece of bark is taken and put round the chest.
Zevarasuro	*Inula glomerata*	Constipation in babies; also for earache.	Root dug and mixed with H_2O and instilled in ear.
Chipindura	*Turraea nilotica*	Constipation in babies.	Roots dug, put in water and given to baby to drink.

NGANGA 4—KANDEYA RESERVE—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Muduro	*Vigna nuda*	Used for pain in chest with cough and blood in sputum.	Root dug and put in water. Make some porridge and patient is given the porridge or the porridge is placed in a wooden spoon, a little salt is added and the patient is given it to eat.
Chifumuro	*Dicoma anomala*	Used for general body pains.	Root obtained, placed in water and patient washes the body.
Dambatuku	*Tephrosia* sp.	To prevent illnesses brought in by people who have had sexual intercourse.	Roots crushed and placed in water and given to baby.
Muvara	*Monotes tomentellus*	Leprosy.	Leaves are crushed and rubbed on the body or the whole body is washed.
	Ochna pulchra	Diarrhoea.	Root mixed with beans, cooked and given to patient.
Chibayamakono	*Randia vestita*	Pneumonia.	Root mixed with porridge and given to patient to eat.
Chigaranjiva	Bean = *Voandzeia subterranea* Leaf = *Protea angolensis*	For new-born baby.	The root is dug and cooked with three beans. The water is then poured in leaf and baby drinks the water from the leaf. Holes are made in each of the three beans and strung together and hung round the neck.
Muhunzura	*Heeria reticulata*	Diarrhoea with blood in stools.	Root mixed with water and porridge made and given to patient.
Chichorabadza	*Pavetta schumanniana*	Baby with chest pain.	The *nganga* chews the leaves and she then spits on the baby. The leaves are also given to the baby by mouth.
Katowapasi	*Cryptolepis producta*	Diarrhoea (chronic).	Leaf is chewed and given to baby.
Mindura	*Endostemon obtusifolius*	To strengthen babies who are weak.	Root is dug and piece attached to string and worn around waist.
Chinyimo	*Thunbergia lancifolia*	Used to fatten the baby.	Root dug and put in clay pot, mixed with water and baby washed.
Musamvi	*Ficus burkei*	(1) Epistaxis. (2) Constipation.	(1) The root is dug and crushed root is added to porridge, which is eaten. (2) Bark is chewed and given internally.
Kavangwe	*Tragia okanyua*	For babies unable to walk.	Root dug and burnt to ashes. Nyora made and powder rubbed in.
Kanwenwe	*Laggera pterodonta*	Pneumonia.	Root dug and porridge made.

NGANGA 4—KANDEYA RESERVE—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed	African Name
Gomerara Munye	*Loranthus* on *Peltophorum africanum*	Epilepsy.	Root stamped in duri and mfuta oil added. Patient inhales it.	Kajenjevana Munondo
Kapotanzo	*Ormocarpum kirkii*	Chipande.	Leaves taken, chewed and put over fontanelle.	Chitovamatera
Jero	*Sphenostylis erecta*	Diarrhoea.	Roots dug and porridge added.	No name
Musambatsi	*Lannea edulis*	Bilharzia.	Porridge prepared, powdered roots added and patient given to drink.	Nyamakatiro
Tsondzoa	*Pseudolachnostylis maprouneifolia*	Nausea.	Bark taken from either side, stamped in duri and patient is given it to drink in water, lying flat on his abdomen.	Tchimayicho-machenji
Nyargwazi	*Astrochlaena malvacea*	Used for abdominal pain in children.	Roots are dug, chewed and given to the baby.	Musukura
Rimiremombe	*Sonchus rarifolius*	Warts.	Roots crushed and rubbed into wart.	Wirazuru
Mesoembudzi	*Temnocalyx oboratus*	Applied to umbilicus so that it will drop off.	Root used.	Kasakwe
Kasangaoma	*Psorospermum febrifugum*	Pneumonia.	Root crushed and added to porridge.	Nyakavanga
Muroro	*Annona nana*	Not given, as *nganga* could not remember.	Root is dug. Root crushed and added to porridge.	
Mukombego	*Crossopteryx febrifuga*	Abdominal pain and for fever.	Leaves added to water, given by rectum.	African Name
Chikondepai	*Euphorbia schinzii*	Breast feeding when the mother leaves her baby and the foster mother has to feed the baby. The new mother takes this.	Root burned to ashes and nyora made and powder rubbed in.	Name not recalled Rambkurima
Tasama	*Indigofera* sp.	A pregnant woman complaining of abdominal pain.	Root dug, crushed and added to porridge.	Mutsakatsiyana
Mumbumbu	*Lannea schimperi*	For retained placenta.	Bark taken, added to porridge and woman given to drink.	Chifamura
Katengeniyatwa	*Ximenia americana*	Abdominal pain and diarrhoea in adults and children. Also for sore eyes.	Root dug and given in form of porridge. For sore eyes, leaves are crushed, mixed with H_2O and face washed.	Munyamaraze Mushava

NGANGA 4—KANDEYA RESERVE—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Kajenjevana	*Euclea divinorum*	Diarrhoea in adults and babies.	Root dug and made into porridge and given to the patient to drink.
Munondo	*Cissus rhodesiae*	To fatten ~~baby.~~	Root crushed, added to porridge and given to patient to drink.
Chitovamatera	*Leucas nyassae*	For babies who cannot walk.	Leaves rubbed on legs. Done every day.
No name	*Lightfootia denticulata*	For babies with fever.	Leaves added to water and body washed.
Nyamakatiro	*Tinnea zambesiaca*	Convulsions. Also for good luck.	Roots added to water and baby's body washed. Leaves can also be used.
Tchimayicho-machenji	Termite fungus	For rubbing into nyora.	Used with Chikondepasi (*Euphorbia root*).
Musukura	*Steganotaenia araliacea*	Abdominal pain.	Roots crushed and added to porridge.
Wirazuru	*Allophylus holubii*	Sterility in women.	Leaves added to porridge and eaten.
Kasakwe	*Cassia singueana*	For abdominal pain in babies.	Root chewed by mother and mixture put in baby's mouth.
Nyakavanga	*Ostryoderris stuhlmannii*	For men to be sterilised.	

NGANGA 5—WEDZA DISTRICT

African Name	Botanical Name	Symptom of Disease	Method Employed
Name not recalled	*Sutera burkeana*	Babies born with rash around umbilicus. Also for sterility in women.	Stamped in stamping block, mixed with water and baby washed. For sterility, roots added to water and given to woman to drink.
Rambkurima	*Pelargonium aconitophyllum*	Backache.	Root placed in water and given to patient to drink.
Mutsakatsiyana	*Rhus pyroides* var. *transvaalensis*	For delirious patient.	Root placed in water and given to patient to drink.
Chifamura	*Dicoma anomala*	For abdominal pain.	Root added to water and given to patient to drink.
Munyamaraze	*Ochna pulchra*	Diarrhoea.	Dried root added to water and patient drinks mixture.
Mushava	*Monotes glaber*	Toothache.	To stop the pain. Root dug which is put on tooth and chewed. Pain stopped.

NGANGA 5—WEDZA DISTRICT—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Wakwa	*Tephrosia radicans*	Toothache.	This works together with Mushava (*Monotes glaber*). Root is dried, added to water and few drops of the mixture are placed in ear on side where tooth is aching.
Muchakatapasi	*Parinari capense*	For delirious patient.	Root dug and added to water and patient given it to drink, and body is rubbed.
Chiparurangoma	*Borreria dibrachiata*	Pneumonia.	Root mixed with water and patient given this to drink.
Muzezepasi	*Elephantorrhiza goetzei*	Mhepo (long-continued fever).	Root added to water and given as porridge to the patient to drink.
Mucherechese	*Swartzia madagascariensis*	Swellings in body.	Root dug, burnt to ashes and nyora made.
Mukono	*Securinega virosa*	For men who are impotent.	Roots mixed with meat of a cock and patient given it to eat.
Cikarudzi	*Vernonia colorata*	Sterility in women.	Root is added to water and patient given it to drink.
Chipundura	*Turraea nilotica*	Dizziness, delirium.	Leaves taken and added to water. Patient washed in water and given to drink.
Somerara of Nhongotowa	*Loranthus* on *Dombeya rotundifolia*	Sterility in both men and women.	Gomerara taken and mixed with water and given to patient to drink.
Munwhahuku	*Sesbania* sp.	High fever in babies.	Seeds taken and added to water and patient given to drink. Body also washed in it.
No name remembered	*Inula glomerata*	Pneumonia.	Root mixed with water and patient given this to drink. The root is also burnt to ashes and nyora made.
No name remembered	*Clematopsis scabiosifolia*	For anorexia.	Root added to water and boiled with food.
No name remembered	*Grewia herbacea*	Sterility in women.	Roots added to water and patient given to drink.
No name remembered	*Hemizygia bracteosa*	Epistaxis. Also for urticaria.	Root added to water, porridge made and patient given to drink.
No name remembered	*Catha edulis*	For impotence.	Root added to water or beer.
Kanyekwere	*Crabbea hirsuta*	When mother and father have intercourse, the child is given this herb to prevent it falling sick.	Mother of baby chews roots and inserts mixture into baby's mouth.

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RHODESIAN HERBAL REMEDIES

NGANGA 5—WEDZA DISTRICT—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Mupangara	*Dichrostachys glomerata*	Urticaria.	Seeds are mixed with oil and body rubbed.
Muveranyimo	*Ekebergia* sp.	Constipation. Sore throat.	Root placed in water and mixture given to patient to drink. Also the dry root is crushed and nyora made.
No name remembered	*Vernonia melleri*	Rungoxa.	Roots added to water and mixture drunk.
Muchenje	*Dialiopsis africana*	For pains in body and headache.	Root dried, powdered and used as a snuff. Some is also rubbed into nyora.
No name remembered	*Rynchosia resinosa*	Lower abdominal pains in pregnancy.	Leaves are crushed and inserted into the vagina. This is retained for a whole night.
No name remembered	*Becium obovatum*	Sterility.	Roots added to water and patient drinks the mixture.
Chizhuzhu	*Maytenus senegalensis*	Venereal disease. Penile sores.	The roots are crushed, added to water and the patient drinks the mixture.
Mutsondzowa	*Pseudolachnostylis maprouncifolia*	Convulsions in babies. Sterility in women.	Leaves are stamped and mixed with water and baby washed. For sterility, the roots are used, mixed with water.
Rwenya	*Diplolophium zambesiacum*	Sore eyes.	Root mixed with water and drops distilled in eye.
Name not remembered	*Dicoma sessiliflora*	Poisonous insect bites.	Roots added to porridge and patient eats this.
Name not remembered	*Brachylaena rhodesiana*	Penile sore.	Roots added to water and patient drinks the mixture.
Name not remembered	*Gladiolus psittacinus*	Mhepo.	Root mixed with water and mixture blown into rectum.
Name not remembered	*Thunbergia lancifolia*	Nausea.	Root added to water and patient drinks mixture.
Mufufu	*Securidaca longepedunculata*	Backache.	Roots added to water and given to patient to drink.
Name not remembered	*Trichodesma physaloides*	For wounds.	Roots crushed and added to wound.
Muzeze	*Peltophorum africanum*	Sterility in women.	Root added to water and patient given the mixture to drink.
Mususu	*Terminalia mollis*	Diarrhoea.	Bark added to water and given to patient to drink.
Mutufu	*Vangueria tomentosa*	Rash on umbilicus.	Root added to water and baby washed in the water.

NGANGA 5—WEDZA DISTRICT—*Continued*

African Name	Botanical Name	Symptom of Disease	Method Employed
Name not remembered	*Pappea capensis*	Epistaxis.	Leaves stamped in Duri and patient imbibes.
Name not remembered	*Euclea divinorum*	Headache.	Roots crushed, added to water and drops applied in both ears.
Mutondochuru	*Schotia brachypetala*	Swellings on body.	Bark added to boiling water and water rubbed on swellings.
Mutowa	*Grewia monticola*	Venereal sores on penis.	Roots put in water and patient given to drink.
Name not remembered	*Cassia singueana*	Sores on penis.	Roots crushed into powder, to which a little salt is added and nyora made.
Name not remembered	*Grewia flavescens*	Venereal sores on penis.	Roots added to water and patient drinks.
Name not remembered	*Pavetta schumanniana*	Nausea.	Roots added to water and water drunk.
Name not remembered	*Sphedamnocarpus angolensis*	Venereal sores on penis.	Roots added to water and patient drinks.
Katsweswe	*Melhania prostrata*	For delirium.	Root mixed with water and patient washed.
Rurowahanga	*Asparagus* sp.	Pneumonia.	Root dug, added to water and patient drinks.
Mushesha	*Pygmaeothamnos zeyheri*	Delirium.	Root put in water and patient drinks it and washes body with water.
Chinyakadtzai	*Eupatorium africanum*	For wounds.	The root is rubbed on the wound.

the British Museum. For this reason the results of these investigations are somewhat inconclusive and it is hoped that they will be continued on the botanist's return to Rhodesia in 1959. It was nevertheless thought worth while to publish this account so as to give interim results and to describe the methods employed.

Once the lists from the various *nganga* had been compiled they were analysed to see if there was any correlation between them. Firstly, plants were noted which were used by more than one *nganga;* and secondly, if these plants were used in the treatment of similar symptoms. Plants correlated in this way, it was hoped, would provide a more fruitful field for further investigation than the remainder. The results of the field observations will be found set out in Table I.

Table I contains the data on 210 specimens and includes 143 species. Thirteen species were common to three *nganga* (Table II) and 18 to two *nganga*. Of the species common to three *nganga*, only one, *Heeria reticulata*, had uses which were all closely related, i.e., for diarrhoea and abdominal pains. Of the species common to two *nganga*, the following had uses which were similar for both *nganga*: *Dicoma anomala* (abdominal pain), *Ochna pulchra* (diarrhoea), *Temnocalyx obovatus* (applied to umbilicus), *Cassia abbreviata* (gonorrhoea). The degree of correlation is obviously not very great, but as far as they go the above results suggest that out of the 143 species, *Heeria reticulata*, *Dicoma anomala*, *Ochna pulchra* and *Cassia abbreviata* might be worthy of further investigation. In addition, there are other species listed in

Table II

SPECIES COMMON TO THREE NGANGA

Species	Symptoms
Vestenus senegalensis	Pain over chest. For difficult delivery. Venereal disease. Penile sores.
Ionum obovatum	Pain and tightness of chest. Used for touching clothes of deceased. Sterility.
Feeria reticulata	Abdominal pains. Stomach ache and abdominal pains. Diarrhoea with blood in stools.
Erteromorpha trifoliata	Chitsinga. Sterility in women. Sterility in men.
Ballopsis africana	Chipotswa. Headaches. Pains in body and headache.
Ciphus abyssinica	For pregnant women who have no foetal movements at the end of five months, taken as medicine. Also for abscesses.
Tomenia caffra	Burns. Diarrhoea. Whooping cough.
Paraspermum febrifugum	Scabies. Wounds on head. Pneumonia.
Rosetta schumanniana	Cough. Baby with chest pain. Nausea.
Swartzia madagascariensis	Convulsions in babies. Sterility in women. Swellings in the body.
Chaubergia lancifolia	Painful menstruation. To fatten baby. Nausea.
Ranona nana	No disease given. Gonorrhoea. No disease given.
Ganotaenia araliacea	Sore eyes. Gonorrhoea. Abdominal pain.

...h, from earlier experience of the botanical ...hor not associated with this particular investigation, are known to be widely used and might ...be worth further study. These are *Securi...a longepedunculata* (the violet tree), *Lasio...phon kraussianus*, *Elephantorrhiza goetzei* and *...rtzia madagascariensis*.

Finally, one of the principal difficulties encountered in this method of approach was to ...d *nganga* willing to co-operate. A great deal ...patience was necessary before suitable subjects were found, and we also have to thank a number of officials of the Native Department for their very kind assistance in this regard. The traditional *nganga* is a fine field botanist, but one of the disadvantages of modern trends is that while these men are growing older their children are rapidly becoming urbanised and losing all interest in their fathers' knowledge of the veld and its natural history. African herbal lore is therefore diminishing rapidly and so studies of this nature should be pressed forward while there is still time.

Missing quote

SMITHSONIAN INSTITUTION
BUREAU OF AMERICAN ETHNOLOGY
BULLETIN 34

PHYSIOLOGICAL AND MEDICAL OBSERVATIONS

AMONG THE INDIANS OF SOUTHWESTERN UNITED STATES AND NORTHERN MEXICO

BY

ALEŠ HRDLIČKA

WASHINGTON
GOVERNMENT PRINTING OFFICE
1908

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As to location, in 13, or 38 per cent, of the total cases the calvitia was frontal; in 12, or 35 per cent, it was on the vertex; in 2, or 0.6 per cent, it extended over both front and vertex, while in 7, or 2 per cent, there was general thinness.

The largest proportion of cases was found among the male Cora, and in all these the baldness (thinness) was general. These people do not carry burdens on the head or back. What influence syphilis or other diseases may have had, particularly in this tribe, could not be determined.

X. NOTES ON SOCIAL ABNORMALITIES

The foregoing chapter concludes the necessarily deficient physiological observations, and the writer will now approach the pathology of the tribes. In this connection it is necessary to touch on, first of all, the unpleasant subject of social abnormalities, which often have a direct connection with disease, injury, or even death.

Artificial Abortion

Desire for and love of children are universal among the Indians. Nevertheless artificial abortion is practised among all the tribes visited, and is told of by the older men or women without much hesitation. The causes of the practice are shame or fear in the unmarried, and among married women inability through poverty to provide for the family, or a loss of many previous children, or a desire to be rid of concomitant physical difficulties and necessary subsequent cares. The occurrence is more frequent in the unmarried, notwithstanding the fact that among most of the tribes early illicit sexual intercourse is not very uncommon and the additional fact that the bearing of children by unmarried women brings no particular discredit and is but a slight obstacle to future marriage.

Nothing definite was learned as to the period of gestation at which abortion is preferably induced; but it seems probable that no efforts are made before the fetus has betrayed viability. The means employed are mainly some form of direct physical violence applied to the abdomen; occasionally one hears of an ingestion of some "medicine." In most instances it appears that the prospective mother is aided in the execution of her design by another woman, by a medicine-man, or by the husband. There was found nowhere much fear of serious bodily consequences, which suggests that these may be more limited than under similar circumstances among white women.

DETAILS

Among the San Carlos Apache the means for induction of abortion are mainly mechanical (e. g., pressure, as over an edge of a box or a rock). Some of the old people are said to know a strong medi-

cine which produces the desired result. The attempt is always made in secrecy.

Among the White Mountain Apache abortion is usually produced by leaning on a rock or a stout stick, or by manual pressure applied to the fundus of the uterus.

Among the Mescaleros, according to information given to the writer by Dr. W. McM. Luttrell (in 1900 the agent of the tribe), as well as by others, abortion was not very rare. For this purpose the women swallowed certain vegetal substances, particularly large doses of the fermented acid juice of the inner bark of the pine; or they tried to destroy the fetus by violent pressure upon the abdomen. In a few instances a stick or a bent wire was said to have been used, being introduced by another woman into the uterus; this practice was not heard of elsewhere, and it is possible that it did not originate with the Indians.

Among the Jicarillas, according to Mr. Johnson, the agent, and Doctor Murphy, the physician of the tribe, abortion is but seldom practised, and only in the case of unmarried women. For this purpose certain herbs and plants found in that part of the country are used; what they are is a secret with the old women of the tribe. It is very probable that the herbs are aided by physical means.

Among the Navaho, Hopi, and other tribes manual or bandage (sash) pressure is applied to the woman's abdomen with the object of crushing or expelling the fetus. The Zuñi woman drinks some decoctions, but if these fail, has recourse to pressure.[a]

Among the Pima, as with some other tribes, there are remarkably few half-breeds. It is said that this is partly due to the fact that in most cases where a woman becomes pregnant by a white man an abortion is induced. One well-known attempt of this nature occurred very recently (see under Infanticide, p. 166). Mr. Alexander, the agent, was told by the Indians of another case where abortion was induced by burying the woman up to her waist in the earth.

In an eighteenth century Pima confessionary are the following suggestive questions: "Have you drank, from a desire to kill the child within you, *sanari* or anything else?" "Or have you placed (with the same object in view) a very hot stone upon your abdomen?" "Or have you lain for a length of time upon your front?" "Or have you lain a long time in the sun?" "Have you abstained for a long time from eating, wishing that the baby in you dies of hunger?" "Have you aided another woman to kill her unborn infant?"

[a] A restraining influence in this tribe is the belief that the woman who induces abortion is likely to lose the capacity of having more children. According to information given to the writer by Dr. E. J. Davis, the agency physician, so great is this fear that as soon as a mother becomes aware that her daughter is pregnant with an illegitimate child she at once assures her that all will be well and that she must not interfere with it. When the old women learn of a recent case of abortion on the part of a young woman, they place her at once in warm sand for ten days to prevent her "drying up."

A method favored in this tribe [Zuñi] is for the woman to grasp her gravid uterus through the abdominal wall and twist and squeeze it until she succeeds in detaching the fetal connections.

Among the Mexican Indians the writer heard more about "medicines" and less about violence as a means of inducing abortion; but among most of the Mexican tribes observed, on account of their contact with whites and their adoption of Christianity, investigation of subjects of this nature is usually unsatisfactory.

Among the Opata, according to Doctor Alderman, abortion is sometimes attempted, principally from two causes—first, the rapidly increasing family without corresponding means of support, and second, the shame that comes to the unmarried women from having children. The old women give various roots and herbs which they claim are infallible. One is a tea made of rosemary and the "ocean artemisia." They administer these, then place the woman on her back and knead her abdomen until pains are brought on. Then they place her on her knees, take a position before her, and holding her by the hips, shake her back and forth with all their force, as in normal labor. If this is not successful the first time the whole process is repeated.

Artificial Sterility

There is a very general belief among the Indians visited that sterility may be artificially induced. To produce this result the women desiring to have no more children take internally certain harmless substances (see chapter dealing with medicine), which to the Indian are representative of sterility. The San Carlos Apache believe that artificial sterility can be induced, but the means is not generally known. It is supposed to be some variety of root. One of the women applied to the writer for a "medicine to make her have no more children." When questioned as to the propriety of such a proceeding, the answer was that when one child after another is born and dies, or when a number of children, one after another, are born dead, something should be done to end this unfortunate state of affairs.

Among the White Mountain Apache a woman desiring to have no children, or to stop bearing, swallows now and then a little of the red burned earth from beneath the fire. This means, which is much believed in, is used mostly by the dissolute unmarried, but also by sickly or very poor married women. Some of the Huichol women drink a decoction of a certain plant to prevent childbearing. Cora women, for the same purpose, take internally the scrapings of the male deer horn.

Infanticide

Among the Apache, Pima, Mohave, Navaho, Zuñi, and Tepecano, information was obtained from some of the Indians themselves that no deformed or monstrous child (though such are very rare) is allowed to live, and similar statements concerning other tribes were received. It is said that a deformed child is smothered, or carried away and

left in the brush, or buried alive. But there are also instances of the purely criminal infanticide—of the killing of a normal child by its mother or some of her near female relatives. As a rule the child in a case of this kind is either a mixed-blood (with an American, or white Mexican, or, rarely, a negro father) or the mother is an unmarried girl, ashamed of her condition.

One of the San Carlos men informed the writer that the newborn infant who "has no father" (meaning a halfbreed) is sometimes thrown into brush and abandoned. One specific case was mentioned. Among the Mescaleros, according to one of the tribe, if a monstrous child is born—a very rare occurrence—it is killed. Half-bloods also in most instances are not allowed to live, being destroyed either by induced abortion, or by choking immediately after birth. The latter act is very infrequent and is effected by the grandmother or some relative, not the mother.

Among the Pima, according to Chief Antonio's sister, infanticide is rare. Quite recently one of the educated girls became pregnant by a white man. As the gestation advanced to near the end, she was observed to have a rope hanging from the roof, upon which she pulled herself up and then dropped down. On another occasion she was seen to run wildly against the door and strike it with her abdomen. Finally a live child was born, but it died the same night. The cause of death was not learned. In another case, about 1860, a young mother killed a child 4 or 5 months old. She was "a bad woman who ran much with white men" and eventually contracted syphilis and died. She was seen to take her child with her on the road and while walking far from the village throw it up into the air and catch it. This she repeated several times until once she did not extend her arms and the child fell to the ground. It became unconscious and she went to the graveyard near by where she wanted to bury it. Just then it began to cry again whereupon she killed it, probably by choking.

At Zuñi five specific instances were heard of in each of which a newborn infant came to death through its mother. In two of these cases the children, born out of wedlock, were supposed to have been killed purposely very soon after birth. In three other instances, which may not have been intentional, the babies were suffocated by their mothers rolling upon them at night.

Crime

The most frequent and most serious transgressions among the Indians here dealt with, at the present time, are deeds of violence due to intoxication. In their normal state the Indians will deceive and some will steal, and these lapses embrace by far the greater part of their criminality. Juvenile offenders of serious grade are rare, and the same is true of female adults, even if those spoken of in the preceding

CONTRACEPTION

SOME Navahos feel the need for a method of contraception in order to limit their families. Certain women express the desire that they may have no children or, because of illness resulting from childbirth, feel that they should not conceive again.

One young woman asked two white friends for contraceptive information, anything short of an operation, saying that her mother didn't want her to have any more children.

She said she wished she hadn't had so many but her husband wouldn't have liked it if she had stopped. The trouble was that when you got old you didn't have enough money to take care of them or yourself. Also, it was too hard when you lost some. Her mother didn't want her to have an operation but any medicine or mechanical device was all right. — 248 (CK — 8/20/48)

There are also cases, as Hill records, where a woman before birth

went kind of crazy from fear. A woman during a birth will say that she is never going to have another child but she will do so just the same. Some girls are so afraid of having babies that they will not get married. Others who get married go to a medicine man and get a medicine which prevents them having children. Some girls are so afraid of having babies that they will not let their husbands have intercourse with them. They say that girls from ages 13–15 are often afraid of the sex act because they fear they will be hurt by it.

Knowledge of contraceptive methods, however, is mainly by hearsay. Five informants admitted they had made use of the medicines mentioned and others related experiences of family or friends. A Ramah informant remarked about another woman,

She can't have any more children, she took some medicine, Navaho medicine, to have no more babies. — 257 (JC — 6/28/46)

Another informant related that

Everybody was very surprised at Sally's pregnancy. When she was thirteen, gave her medicine — "never thought she'd get that." Had Evilway for her because she got dizzy. "Women with baby they get that way — they just think she got troubled by a ghost." — 82 (CK — 1/28/42)

One informant, an old man, offered a moral judgment on the subject of contraceptives. He said:

Other Navahos think that is bad. Children grow and raise some more people. — 1 (CK — 8/9/36)

Morgan in his publication on Witchcraft [1] quotes a story related by one of his informants in which a belief in the efficacy of contraceptive medicines is affirmed. It will be noted that the story also brings out the point that the man left his wife (who had taken contraceptive medicine and was therefore sterile) in order to marry a woman who did give him children. The first woman, however, remained sterile even though she remarried.

Contraceptive methods mentioned include *coitus interruptus*, medicine taken internally, and continence. Only one informant confirmed the use of the first method. Others either said they had never heard of the practice or thought it a strange thing to ask about. One man made the following statement:

Many people use this method (*coitus interruptus*). They don't want any more babies so they pass the word around that this works, and they try it. — 12

One informant mentions *coitus interruptus*, disclaiming knowledge of the practice but speculating on others who may know.

Never heard of *coitus interruptus*. Maybe those who don't have children know about it. Manuel, an old man now, maybe he knows. He never had any children, by any of his wives. Might be the man's fault, I don't know. — 1 (CK — 8/11/36)

Continence is practised in connection with ceremonials as one of the numerous restrictions placed upon the patient, the co-patients, and the singer.[2] Continence rules are in force from four days preceding to four days following a ceremonial.[3] A woman also remains continent after the delivery of a child for a period of time which varies with the individual

Flora L. Bailey "Some Sex Beliefs & Practices in a Navaho Community", Papers of the Peabody Museum of American Archaeology & Ethnology, Harvard University, 1950, vol 40 #2

(see pp. 31–32). If a man feels compelled to cease having children by his wife (because of her ill health), he will often take a second wife in order that he may give the proper consideration and care to his first wife (see section on post-partum hemorrhage, pp. 86–87). The practice of taking plural wives is sanctioned in a number of legends. Therefore, this pattern meets with "religious" as well as social approval.[4] The Sun himself had two wives, one at his home in the east, and Changing Woman for whom he made a home in the west.[5] The great gambler also had two wives,[6] and in the legend of "The Great Shell of Kintyel" the Navaho hero is promised eight wives in marriage by the Pueblo chiefs.[7] There is even mention of twelve wives belonging to one legendary hero. The unfaithfulness of these wives resulted in their being mutilated as a punishment for adultery.[8] Matthews adds a note to the effect that such mutilation was not practised by the Navahos at the time of his investigations,[9] and I have not heard of such a practice in recent times. The Flintway legend relates several instances of adultery with the two wives of the Chiefs and the subsequent punishment of the hero.[10] *The Hail Chant* [11] relates the episode of the adultery with Winter Thunder's wife and its drastic consequences. The Franciscan Fathers [12] confirm punishment for adultery, and add that virginity and celibacy are not practised by the Navahos.

The prevalence of myth episodes dealing with adulterous incidents and sexual excesses reflects the emotional tensions of the modern Navaho. Kluckhohn has stated [13] that "one of the principal sources of friction among the Navahos is sexual jealousy." He goes on to say that it is controlled to a certain extent by the institution of witchcraft for "fear of witches at night acts to some slight extent as a deterrent to extra-marital sex relations because night-time would otherwise provide favorable conditions for secret rendezvous." However, it is only under certain circumstances or with certain persons that the Navahos feel sexual activity is improper, for "they never regard sexual desires in themselves as 'nasty' or evil. In school and elsewhere, whites have tended to operate upon the premise that 'any decent Navaho' will feel guilty about a sexual act which takes place outside of marriage. This attitude simply bewilders Navahos and predisposes them to withdrawal of co-operation in all spheres. To them sex is natural, necessary, and no more or no less concerned with morals than is eating."

That this attitude was held at the time of the captivity at Fort Sumner and for the following twenty years is recorded in the life history of *Son of Old Man Hat*,[14] where we find nine cases of sexual jealousy described with the quarrels and reconciliations which resulted. Extra-marital sexual relations are indulged in frequently and casually, and in the majority of cases are with women who are married. The women take the initiative in all the cases and are given a present at the conclusion of the episode. Left Handed describes in detail some fifteen such encounters between the time he has his first experience at about the age of thirteen until the history ends at age twenty.

Hill records that "if a man already has a wife he can pay for this second wife and take her home with him. However, he must first get his first wife's consent. If she is not mean she will not fight with the new wife."

In a conversation a field worker had with a local white, a man's second wife is discussed and the reason for the marriage speculated upon:

> She mentioned that John Coyote had two wives, the second is the sister of the other one. I said that I hadn't heard about the two wives. "Yes, he has two. The second one is very pregnant. She was always hanging around here, poor thing. I felt sorry for her. Of course it won't stand up when it comes to land allotments or anything like that. I guess the main reason they are married is so the baby will have a father." (EV — 10/3/47)

The most widely known method of contraception is that of taking medicine by mouth. This is, however, considered a dangerous practice by many women and those who know the proper plants to use and how to administer them charge high prices for the exact information. Hill records that,

> Recognized prostitutes knew of some medicine they could take which would prevent childbirth.

After she has had her first child she takes this medicine. Then if she has another child it will kill her.

He also gives the information in his notes that a milkweed plant is generally thought to be an effective contraceptive. This he identifies as *Asclepias Hallii* and has notes by three informants on its administration.

Women who have a difficult delivery drink this in solution to prevent future conception.

It is used as a contraceptive. Right after a woman has had a baby some of this plant is boiled and the woman drinks the solution. This will help her to get well and prevent her from becoming pregnant again.

The woman drinks some of this in the period of convalescence after childbirth. Is a contraceptive.

One woman from Ramah stated that she had heard from her grandfather and grandmother that eating the "womb" of a mule would produce sterility. This was confirmed by one Chaco informant but was denied by three Chaco informants.

The majority of informants questioned said they were aware that certain plant medicines were effective contraceptives but only a few admitted first-hand knowledge.

I'm afraid of this medicine. If a woman uses it the little bag is all twisted up. The next baby to start in it will be all twisted in and the mother will be killed. Most people are afraid of this kind of medicine. — cw

There is a medicine called *bičí·doʔačíh*. I've never seen it, just heard about it. When Navaho has too many children and has trouble they make the man and woman both take the medicine so they won't have any more babies. They drink it any time they want to. — jtw

There is a medicine for this. Some people know it. It has a twisted root. It is called *bičíʒ doʔo ʔiłči*. Chop it up. Put it in water. Drink it anytime right after the baby is born. That twisted root twists the bag the baby comes in and prevents another baby. I don't know why the man has to drink it too. — fcw

You get the medicine from an old man or an old woman. — 250, 185

I only know of two men who know this medicine. They live beyond Two Wells. . . . I never used it but I am thinking of getting some because the last baby gave trouble. I never used the things the whites do, either, but I would like to know about them. — 36

There's a plant that can be given to both the husband and the wife to stop any more children. Joseph Nez knows about this. — 54

The medicine man knows about this medicine. I took some and it worked. — 59

Some people have a medicine for this. When two trees or roots are twisted or touching together, you boil small pieces from the places they touch, and drink this. You use it right after the baby is born until you get well. It will make the cords inside the woman twist and she won't have another baby. — 249

A woman and her husband both must drink the medicine. The woman drinks more of it than the man does. If only the woman drinks it, it will hurt her. I don't understand how it works but it stops the woman from menstruating and sometimes after that she gets sick from too much blood in her and it bothers the woman. Then she takes another medicine to clean this blood out and make her not be sick from it. — 50

BN's wife is old enough to know (these medicines). Her mother knows them, too. You have to pay six to ten dollars for it, or a sheep. You drink a lot of the plant medicine right after you have had a baby and you won't have any more. Mary had a baby eighteen years ago. She had a bad pain and took the medicine, so she has had no children since. That baby died. — TM

My mother knew about these plants but I don't know. My husband doesn't either. — rnw

There is an old woman still living who used to have three daughters. They all died having babies. This old woman knows about these plants to stop you from having more babies and she gave the medicine to her daughters, that's why they died. — ctw

Some people have medicine but it's dangerous because it twists up the bag the baby starts in. Then when the baby starts again there is no place for it and it makes trouble. Better do without it. When the baby quits you itself you don't have any more of them. Babies quit me a long time ago. Some women my age still have them (ca. 60–65 years). — dkw

Plants are boiled and drunk at the menstrual periods. After the last baby, when the first period after her delivery begins, don't sleep with your husband for fifteen days. After that it is o.k. You can also eat the mule pieces. The three pieces from those parts put together. — 1

There are plants that are used. Pancho knows what they are. Boil and drink them. Mrs. Andres takes it. When you have a baby begin to drink it from the first menstrual period following delivery. Drink it every day for one month. No — start immediately after the first bath following delivery and drink every day for a month. For a long time use it every two weeks. Five medicines are put together to do this. I don't know them. Many years ago a man

whom Pancho calls my maternal grandfather knew it. Old Man Roberto knows it. The woman doesn't sleep with her husband for one year while taking the medicine. After a year she can sleep with her husband and still won't have a baby. — 3

There is medicine for it called *ʔaze· ła dil dé·hi·* ("one medicine"). Use it, boiled, with another medicine called *ʔaze·ʔ bahał łoni* and others that I can't tell you about. When you have your first menses, boil them and drink it the first day and for four days. The singer sings (Puberty Rite) at the same time. Drink one or two cups every day. When the singer goes home, and you are clean, stop drinking it. You'll never have a baby, even if you get married. My mother gave it to me and I've not had a baby yet, even though I've got a man. — 253

The most detailed information was obtained from 82 and her grandmother, A, of Two Wells. Plants were obtained for identification and the information was given in detail for their use. Three plants were obtained,[15] two of which were given no Navaho name but were identified as *Bahia dissecta* (Gray) Britt. and *Eriogonum Jamesii* Benth. The third was called *ʔazeʔ ʔaxǰe·sgiz* and, although it is different in appearance from the second, is actually the same species, *Eriogonum Jamesii* Benth. Wyman and Harris [16] have this plant listed as a contraceptive under another name, "twisted medicine," but do not have the name given by my informants.

In the prescription for the medicine the plant, *Bahia dissecta*, is indicated as the most important of the three and one which could be used alone effectively. It should be boiled in one cup of water for one-half hour. One cupful is drunk at every menstruation until the woman is married. The second and third species are used together with the first, all being prepared and administered as above. After marriage both the husband and wife drink the decoction when the woman is menstruating. The old woman who gave the prescription for the contraceptive explained it as follows:

This medicine is drunk when the baby is four days old, if the woman doesn't want any more babies, or it may be drunk every time the woman menstruates (on the second day) using nearly one cup each time. You won't ever get a baby, even if you marry, if you drink this medicine. It works fine on white women. Maybe only drinking it once before marriage would be enough for a white woman because it works better on them than on Navahos. If you drink it you won't get a baby before you marry, even if you sleep with a man. If you want a baby, though, wait until you have it. Then when it is four days old both the woman and her husband drink it and the woman won't have any more babies.

If both husband and wife drink it, it kills the strength of his blood and makes hers stronger so she doesn't get a baby. If a man's blood is stronger than a woman's she will have a baby. If the woman's is stronger she won't have one. Babies come from the man's blood.

If you take the medicine before you are married and then marry it does not matter whether the husband drinks it or not because if you are married already your blood is mixed with his, and so both of you must take some. But if you drink it before being married your blood becomes stronger than his and it won't mix with his. If a woman is married and her husband drinks it too, he need only drink it once. — A

The granddaughter of the above woman gave this explanation on another occasion.

If a girl's mother doesn't want her to have a baby they give her this medicine at her first menstruation. My mother gave it to my half-sister and she has never had any children. I was in school and my mother didn't give it to me. My mother also made the tea for my sister's girl (age 14) because the girl asked for it, saying she didn't want to have babies. Her mother thought she was old enough to know her own mind. If you drink this medicine you mustn't bother[17] a man after that for one month.

If you are married and the husband and wife both drink it, they mustn't sleep together for one month. After that time they can do it all they want to and they'll not have any babies. You have to be holy about it. This medicine costs a horse, a cow, a sheep, or five dollars and a bracelet. — 82

One other method (according to three informants from Chaco Canyon) by which a woman can make sure she will not become pregnant again is to bury the exuviae from her last childbirth in a badger hole. No reason or further explanation was given. Another woman (from Chaco) recommends placing the exuviae across a river.

FOOTNOTES FOR CONTRACEPTION

1. Morgan, 1936, p. 36. "Well, before those children were born her husband used to go around to lots of dances. That is the reason . . . (refers to pre-natal infection from ceremonials). He was married to a woman for nine years but they never had any children and then he married my (half) sister. That was about six years ago. (Did the other woman marry and have children?) Yes, she married but she had no children . . . they took medicine a year ago so they can't have any more children. (Did they both take it?) Yes. (More children would be too much trouble I guess.) Well, they are some trouble but it is because it makes you so sad when they die. Their children have always been sick and it is always sad."

2. See Kluckhohn and Wyman, 1940, p. 18.

3. Haile, 1943a, p. 50. ". . . an unmarried person should remain at home after the close of a ceremonial (for four days). The married person should observe continence for this period, but may be absolved from this restriction by bathing himself with the roots of dodgeweed and grama grass."

Kluckhohn and Leighton, 1946, p. 137. "The 'medicine man' may never marry anyone over whom he has sung; if he sings over his own wife they must thenceforth behave to each other as close relatives between whom any sexual contact would be strictly forbidden."

4. Dyk, 1938, pp. 4, 16, 19, 107, 163, and 328, makes reference to plural marriages which were in effect during the time Left Handed covers in his story.

Sapir and Hoijer, 1942, p. 31, refer to plural wives in the "Legend of the Hollow Floating Log and of the Boy Raised by an Owl."

5. Matthews, 1897, pp. 133–34.

6. Matthews, 1897, p. 84.

7. Matthews, 1897, p. 204.

8. Matthews, 1897, p. 143. "Gontso had twelve wives; . . . but, in spite of his generosity, they were unfaithful to him."

9. Matthews, 1897, p. 240.

10. Haile, 1943a, pp. 5, 12, 183, 187, 189.

11. Reichard, 1944, p. 7.

12. Franciscan Fathers, 1910, p. 450.

13. Kluckhohn and Leighton, 1946, pp. 179, 234.

14. Dyk, 1938.

15. Dr. Clyde Kluckhohn paid the informant five dollars for these plants and the prescription for their use. I am indebted to him for this information.

16. Wyman and Harris, 1941, p. 61.

17. Kluckhohn, 1941. An explanation of the use of the term "bother" is given here.

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REVIEW ARTICLE

Potential Value of Plants as Sources of New Antifertility Agents I *

NORMAN R. FARNSWORTH *, AUDREY S. BINGEL, GEOFFREY A. CORDELL, FRANK A. CRANE, and HARRY H. S. FONG

Keyphrases □ Antifertility agents—review of plant sources, classified by anatomical mechanism and folkloric route of administration □ Medicinal plants—sources of antifertility agents, classified by anatomical mechanism and folkloric route of administration, review □ Plant extracts—potential sources of antifertility agents, review □ Contraceptives—plants with active constituents, review □ Abortifacients—plants with active constituents, review □ Oxytocics—plants with active constituents, review □ Estrogenic plants—review of active principles

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*Editor's note: Part II of this article will appear in the May 1975 issue of the *Journal of Pharmaceutical Sciences*.

The world population explosion has pointed out the need for new and effective contraceptive agents and/or methods, having a minimum of side effects and giving a maximum protective effect. To date, the most effective and widely used contraceptives have been steroids, but these are not without side effects (1, 2).

Practically all major research to date involved with the search for new oral contraceptives has been of the synthetic type, particularly the preparation of steroid derivatives. Very little attention has been directed to the plant kingdom. There are those who continue to argue that plant products are of little importance as drugs. However, an analysis of some 1.05 billion new and refilled prescriptions dispensed from community pharmacies during 1967 showed that 25% contained one or more active principles derived from higher plants (3). Only three of the higher plant products (papaverine, ephedrine–pseudoephedrine, and caffeine) are produced commercially by synthesis, the remainder still being produced by extraction from

plants. Practically every pharmacological category of drug has as its prototype a substance of natural origin; thus it is not unreasonable to believe that the plant kingdom should yield an effective antifertility drug.

The problem underlying the search for natural antifertility drugs basically concerns deciding which of the approximately 750,000 species of higher plants should be examined in an animal system for their potential antifertility effects. There appear to be only three paths to follow, *i.e.*, *(a)* test plants that have folkloric reputation as having been used by primitive women as oral contraceptives, *(b)* test plants that are known to contain constituents that theoretically could affect the female cycle to produce antifertility effects (estrogenic sterols, coumestrols, and isoflavones) or that have a potential to contract the uterus, and *(c)* make a random collection–mass screening of all available plants for antifertility effects. The first two of these methods appear to be the most practical and realistic.

The tables in this article list those plants that have a folkloric reputation as having been used as oral contraceptives or that have been tested for antifertility effects in animals but may or may not have shown activity. We hope to point out that even though certain plants have been tested in animals for antifertility effects, the negative results presented may or may not be valid. Different species can vary in their response to different types of compounds. Furthermore, the antifertility tests used have not always been designed to test for all types of antifertility effects; that is, by using a too restricted dosing period (giving the extract only prior to mating or for only a few days after mating), for example, antifertility effects produced by some mechanisms will be identified but not those produced by others.

Because of the importance of the selection of the proper biological test to detect antifertility effects in plant extracts, the various mechanisms whereby compounds can exert an antifertility effect in various common laboratory animal species will also be reviewed.

ANTIFERTILITY MECHANISMS IN LABORATORY ANIMALS

Reproductive Cycles of Commonly Used Laboratory Species—There are a number of areas within the female mammal where substances having antifertility effects may exert their action(s); these areas are the hypothalamus, anterior pituitary, ovary, oviduct, uterus (including the endometrium, myometrium, and cervix), and vagina. A given compound may exert its antifertility effects in more than one of these areas and not necessarily by the same pharmacological mechanism. Conversely, different compounds may act in the same area to inhibit fertility but in some cases by different mechanisms.

Much information concerning the mechanisms by which chemicals may inhibit fertility has been obtained from studies carried out in commonly used laboratory species such as the rat, mouse, hamster, guinea pig, and rabbit. The reproductive cycles of these species differ among themselves as well as from those of the human and other primates. Such differences can explain, in part, the varying effects sometimes exhibited by a given antifertility substance when tested in different species; *i.e.*, antifertility agents interrupt reproductive function at some point, and if endogenous control at this point varies among species, different results with a given compound are possible. Consequently, and also since an understanding of antifertility mechanisms requires an understanding of reproductive function, a brief comparison of the latter in the commonly studied species will be made first. Additional comparisons among species will be made where pertinent during discussion of specific antifertility mechanisms.

Table I summarizes the major similarities and differences in the reproductive cycle function among the rat, mouse, hamster, guinea pig, and rabbit; the first four species are spontaneous ovulators, and the fifth is a coitus-induced ovulator. Schwartz (4) recently compared the ovulation-controlling systems in these two types of ovulators. In spontaneous ovulators, folliculotrophic hormone (follicle-stimulating hormone and luteinizing hormone) stimulates ovarian follicles to grow and secrete estrogen, the latter serving as a feedback signal to the hypothalamic–pituitary axis that follicles have matured. The estrogen acts with an environmental facilitating signal, *e.g.*, the time of day, to induce the ovulatory surge of luteinizing hormone. The latter also causes progesterone secretion which, in turn, acting on a background of estrogen, causes mating behavior. In induced ovulators, folliculotrophin also stimulates follicle growth and estrogen secretion. However, besides signaling the hypothalamic–pituitary axis that follicles have become ovulable, the estrogen, centrally, also induces mating behavior and hypothalamic sensitivity to feedback from coital stimulation. The latter triggers the luteinizing hormone surge which, in turn, causes progesterone secretion and ovulation.

As can be seen in Table I, complex hormonal interrelationships are involved also in the induction and maintenance of pregnancy.

Antifertility Mechanisms Classified by Anatomical Site Involved—The disruption and/or desynchronization of integrated preovulatory and preimplantational events are the means by which many kinds of compounds can impair fertility. A discussion of the mechanisms involved follows. Antifertility mechanisms involving other stages (*e.g.*, postimplantational) of the reproductive cycle also will be considered. The mechanisms will be presented according to the site in the animal at which the antifertility action is exerted.

Hypothalamus–Pituitary—These two areas are considered together for two reasons. First of all, functioning of the pituitary is under intimate control of the hypothalamus by means of hormone-specific releasing factors, *e.g.*, follicle-stimulating hormone and luteinizing hormone releasing factors (10). Secondly, the question as to whether certain substances might act on the hypothalamus and/or on the pituitary has been controversial. While steroids, for example, may exert some effect directly on the pituitary (10), evidence suggests that their major site of antifertility action is in the hypothalamus (8). Other drugs appear to act in the brain *outside* the hypothalamus; *i.e.*, certain central nervous system (CNS) depressants and autonomic blocking agents apparently block neural pathways to the hypothalamus (8, 10).

Therefore, two basic mechanisms can be considered; *(a)* disruption of the normal humoral and hormonal functions of the hypothalamus and/or pituitary, respectively, by steroids, by nonsteroidal agents (*e.g.*, methallibure[1]) having antigonadotrophic activity, and by steroid antagonists (8); and *(b)* disruption of neural input to the hypothalamus, *e.g.*, from the environment (10) and from the postulated "clock" that controls the release of gonadotrophin-releasing factor(s) in spontaneous ovulators (8).

With respect to *(a)*, antigonadotrophic activity of estrogenic steroids can be demonstrated, for example, by their ability to block compensatory hypertrophy of the remaining ovary in unilaterally ovariectomized rats (11); in women, decreased follicle-stimulating hormone excretion can be measured during usage of contraceptive doses of estrogens (12). Progestagens in women (11, 12) and presumably also in laboratory animals (13) are able to inhibit the ovulatory surge of luteinizing hormone.

Demonstrating both ovulation-inhibiting *and* antifertility effects of estrogens and progestagens in laboratory animals could present a problem, however, since spontaneous ovulators may become coitus-induced ovulators under certain circumstances (4). The occurrence of such a phenomenon could explain the less than

[1] 1-α-Methylallylthiocarbamoyl-2-methylthiocarbamoylhydrazine (ICI 33,828).

Table I—Comparison of Reproductive Cycles of Five Laboratory Species[a]

Species	Ovulation	Nonmated Cycle Length, days	Luteal Phase[b]	Luteolysis	Hormonal Requirements for Mating Behavior	Pseudopregnancy		Implantation		Pregnancy			
											Endocrine Gland Requirements[d]		
						Length, days	Hormonal Requirements	Day[c]	Hormonal Requirements	Length, days	Anterior Pituitary	Ovary	Hormonal Requirements[e]
Rat	Spontaneous	4, 5	Ps	Nonpregnant uterus[f]	Estrogen and progesterone	12–14	Estrogen, prolactin	5–6	Progesterone and estrogen	22	12	20–21	Prolactin, follicle-stimulating hormone, and luteinizing hormone
Mouse	Spontaneous	4, 5, 6	Ps	Nonpregnant uterus[f]	Estrogen and progesterone	10–12	Prolactin	4–5	Progesterone and estrogen	19–20	11–12	18–19	Prolactin; luteinizing hormone after implantation
Hamster	Spontaneous	4	Ps	Nonpregnant uterus[f]; luteinizing hormone[g]; estrogen (by inhibiting follicle-stimulating hormone)	Estrogen and progesterone	8–10	Prolactin, follicle-stimulating hormone, and luteinizing hormone	4	Progesterone	16	16	16	Prolactin, follicle-stimulating hormone, and luteinizing hormone
Guinea pig	Spontaneous	15–18	S	Nonpregnant uterus[f]; estrogen (mediated by uterus)	Estrogen and progesterone	—	—	6–7	None	67–71	3	20	None, providing viable fetuses are present *in utero*
Rabbit	Coitus induced	Relatively continuous estrus[h]	SPs	Nonpregnant uterus[f]; luteinizing hormone[g]	Estrogen	17	Estrogen	7–8	Estrogen is unnecessary	32	32	32	Estrogen, to maintain the progesterone-secreting corpora lutea

[a] Data presented taken from Refs. 4–9. [b] Ps = pseudopregnancy; functional corpora lutea found following sterile mating or cervical stimulation. S = spontaneous. SPs = in the rabbit, the luteal phase occurs spontaneously following ovulation, but ovulation must be induced, *e.g.*, by sterile mating. [c] Day 1 of pregnancy is the morning on which a copulation plug and/or sperm in the vagina are found. [d] Days of pregnancy through which endocrine glands must be present for pregnancy to be maintained; removal is compatible with pregnancy if and when the placenta can assume the role. [e] In the absence of the anterior pituitary. In the rat, the replacement therapy indicated stimulates both estrogen and progesterone secretion. In the mouse, luteinizing hormone sustains estrogen secretion. The conceptus in all five species secretes a luteotrophic hormone to varying degrees. [f] The luteolytic factor produced by the endometrium is believed to be a prostaglandin, probably $PGF_{2\alpha}$. [g] High doses of luteinizing hormone are luteolytic in these species. [h] There are seasonal variations in mating behavior and responsiveness to other ovulation-inducing procedures.

100% inhibition of ovulation produced by a norethynodrel–mestranol combination in rats (14). Nevertheless, the achievement of satisfactory contraception in women, in the absence of consistent inhibition of ovulation by contraceptive steroids (12), implies that additional antifertility mechanisms may be at work. The latter possibility is of special significance since it has been suggested that external stimuli may also be able to induce women to ovulate (8).

Nonsteroidal antigonadotrophic agents and steroid antagonists may present even further difficulties with respect to the demonstration of ovulation-inhibiting *and* antifertility (*before* fertilization) effects. As shown in Table I, estrogen and progesterone are necessary for normal mating behavior in the spontaneous ovulators, while estrogen is necessary for such behavior in coitus-induced ovulators such as the rabbit. Compounds given chronically to inhibit gonadotrophin secretion directly would indirectly inhibit ovarian secretion; if such compounds themselves had no estrogenic and/or progestagenic activity, animals treated with them possibly might not mate. Furthermore, estrogen antagonists such as 1-(*p*-diethylaminoethoxyphenyl)-1-phenyl-2-*p*-methoxyphenylethanol[2] and *trans*-1-(*p*-α-dimethylaminoethoxyphenyl)-1,2-diphenylbut-1-ene[3], which apparently block the estrogen feedback on the hypothalamus that is necessary for the ovulatory surge of luteinizing hormone, also can block mating behavior, at least in the rat (15, 16).

With respect to *(b)*, since the hypothalamus is subject to neural input from other areas of the brain, substances having CNS depressant activity and/or effects on neurohumoral transmission could be expected to alter gonadotrophin secretion. Pentobarbital, morphine, and atropine have been shown to block the ovulatory surge of luteinizing hormone in laboratory animals, apparently by elevating an arousal threshold in the midbrain reticular formation (17). Tranquilizers such as reserpine and chlorpromazine, anesthetics such as ether (diethyl) and halothane, and adrenergic (as well as cholinergic) blocking agents also have been shown to exert inhibitory effects (directly or indirectly) on the hypothalamus (8, 10, 18, 19). The antifertility usefulness of drugs having such effects is questionable, partly because of their other pharmacological effects but also because it has been shown that rats, at least, have sometimes become coitus-induced ovulators following blockade of their gonadotrophin surge by pentobarbital or chlorpromazine (4).

It is apparent from Table I that interference with gonadotrophin secretion may have postovulatory antifertility effects. The secretion of estrogen and/or progesterone needed for implantation in some species is under pituitary control. Luteal function also remains directly under pituitary control for half the length of pregnancy in the rat and mouse and for the entire duration of pregnancy in the hamster; it remains indirectly under pituitary control throughout pregnancy in the rabbit since *estrogen* is the ultimate luteotrophin in this species (5).

In contrast, in the guinea pig, the pituitary is unnecessary after the 3rd day of pregnancy (5); and hypophysectomized women, caused to ovulate by the sequential administration of follicle-stimulating hormone and human chorionic gonadotrophin, have become pregnant without further gonadotrophin replacement therapy (20). It is not surprising, therefore, that ergocornine, which has been shown to inhibit prolactin secretion in rats (21), has also been shown to inhibit progesterone secretion in pseudopregnant rats (22) and to interrupt pregnancy in rats (23), the latter two effects presumably mediated by the former. Ergocornine did not interrupt pregnancy in rabbits (12) or guinea pigs (13) nor interfere with luteal function in nonpregnant women (24).

Ovary—Substances having antifertility properties may exert their effects at the ovarian level by inhibiting ovulation and/or steroidogenesis. Although the actual intraovarian mechanisms causing ovulation are still unclear, it appears that protein synthesis may be involved; actinomycin D, which inhibits DNA-dependent RNA synthesis, has been shown to block pregnant mare serum gonadotrophin- and human chorionic gonadotrophin-induced ovulation in hamsters (25).

Although the mechanism(s) involved have not been elucidated, the results of work by other investigators suggest that phenoxybenzamine (26), an α-adrenergic blocking drug, and CNS depressant drugs, particularly reserpine (8), may inhibit spontaneous and pregnant mare serum gonadotrophin–human chorionic gonadotrophin-induced ovulation, respectively, by acting directly on the ovary. Experimental evidence suggests that contraceptive steroids also may act directly on the ovary to inhibit ovulation and/or some aspect of steroidogenesis (12).

Steroidogenesis, itself, may be involved in the process of ovulation. 2α-Cyano-4,4,17α-trimethylandrost-5-en-17β-ol-3-one (cyanoketone), a compound that inhibits the conversion of Δ^5-pregnenolone to progesterone, of 17α-hydroxypregnenolone to 17α-hydroxyprogesterone, and of dehydroepiandrosterone to Δ^4-androstenedione, has been shown to inhibit ovulation, possibly by interfering with steroidogenesis in the ovary (27).

As can be deduced from Table I, steroidogenesis is important for the induction and/or maintenance of pregnancy. The specific requirements vary among species, however; in the hamster and guinea pig, estrogen actually is luteolytic. The steroidogenic function of the ovaries is taken over by the placenta or the fetoplacental unit in the guinea pig by Day 20 of pregnancy (5), in the monkey by Day 25 (20), and in the human by Day 41 (28). Drugs having a direct inhibitory effect on ovarian steroidogenesis, particularly on luteal function, have the potential for interrupting pregnancy in the latter three organisms if given early enough and in the rat, mouse, hamster, and rabbit if given at any time during pregnancy. Depending on the species considered, estrogens and prostaglandins are two such classes of compounds.

As already indicated, estrogen is luteolytic in the hamster and guinea pig (Table I). In the monkey, estrogen administration early in the luteal phase has been shown to decrease progesterone secretion and to hasten the onset of menstruation (20); similar effects have been produced by estrogens in women (20, 29). The lowering of postovulatory plasma progesterone levels may be at least one mechanism by which postcoitally administered high dose estrogen exerts its antifertility effect in women (29). In contrast, in species such as the rabbit and rat in which estrogen is needed for normal luteal function, estrogen antagonists such as *trans*-1-(*p*-α-dimethylaminoethoxyphenyl)-1,2-diphenylbut-1-ene are likely to interfere with luteal function (30).

Prostaglandins can interrupt pregnancy in many species, but the mechanisms of action are still unclear (31); in some cases, the actions are at site(s) other than in the ovary *(vide infra)*. Administration of $PGF_{2\alpha}$ has been shown to shorten the lifespan of the corpus luteum and/or to decrease the ovarian secretion of progesterone in the rat, hamster, guinea pig, rabbit, mouse, and sheep (32); in the primate, however, effects of prostaglandins on corpus luteum function have been inconsistent (31). Even in the rat (31) and rabbit (33), susceptibility of the corpora lutea to the luteolytic effects of $PGF_{2\alpha}$ varies with the stage of pregnancy.

All species in which prostaglandins have been shown to be luteolytic are those in which the uterus influences the lifespan of the corpus luteum. The uterus in these species apparently secretes a luteolytic factor which is believed to be a prostaglandin(s) (31). In the guinea pig, hamster, and rat, at least, the endogenous luteolytic effect has been shown to be produced locally (5).

Oviduct—Since normal implantation depends on the correct timing of the arrival of the blastocyst in the uterus, disturbances of tubal transport may be accompanied by failure of implantation (8). Substances having the ability to alter oviductal motility may thereby be able to inhibit fertility. However, although ovarian hormones have been shown to influence the motility of the human oviduct *in vitro*, what effect, if any, contraceptive steroids may have on the latter in the *in vivo* situation is unknown (12). It is possible, however, that postcoitally administered, high dose estrogen may act in part by this means in the human (29, 34). The effects of some other substances on the human oviduct *in vivo* have been studied. For example, PGE_2 has been shown to inhibit tubal motility whereas $PGF_{2\alpha}$, at the same dose, has been shown to stimulate it (35).

The oviducts of rats, rabbits, and humans possess a rich sympathetic innervation, especially in the region of the isthmus, maintaining the tone of the isthmic sphincter and causing retention of fertilized ova in the oviducts. Administration of autonomic drugs, at least to these species, can influence the rate of ovum transport, although their ability to do so may be modified by estrogens and progesterone (25).

It has long been thought that luteal progestagen regulates the

[2] MER-25, ethamoxytriphetol.
[3] ICI 46,474.

relatively slow rate of passage of preimplantation ova through the oviducts (36) and that the smooth muscle of the reproductive tract exhibits maximal contractility only under the influence of estrogens (37). Recent evidence, however, suggests that smooth muscle (at least of the rabbit oviduct) is minimally active in the presence of physiological concentrations of estrogens; that its activity increases as estrogen content decreases; and that, when it is subject to the influence of estrogen, it will become increasingly active if progestagens are introduced (37). Megestrol acetate, a progestagen without estrogenic effects (38), has been shown to accelerate ova transport in the rabbit, which mechanism might contribute in part to its antifertility effect in that species (39). Nevertheless, since both estrogens and antiestrogens have been shown to alter ova transport and simultaneously to impair fertility, it would appear that a critical balance of estrogen and progesterone may be necessary for normal postovulatory events to occur (8). However, additional postovulatory antifertility mechanisms *(vide infra)* may also be playing a role in at least some cases; this possibility should not be ruled out.

Exogenous estrogen administered to many species during early pregnancy results in rapid passage of ova through the oviducts and expulsion of the ova from the uterus (36). However, at certain dosages (36) and/or when given at very specific times (40), estrogen alternatively may cause the retention of ova in the oviducts. For example, treatment of mice with 1.6 μg of estradiol on Day 1 of pregnancy, when the ova were still in the ampulla of the oviduct, resulted in retention of the ova in the oviduct (largely in the ampulla) until Day 4, presumably due to prolonged closure of the ampulla–isthmus junction. In contrast, treatment with 0.4 μg on Day 2, when the ova already were in the isthmus of the oviduct, resulted in premature entry of the ova into the uterus and a decrease in the recovery of ova by 50% (40).

A number of compounds having estrogenic activity *(vide infra)* and representing several different chemical classes have been shown to accelerate ova transport, *e.g.*, two nitriles, 2,3-bis(4-hydroxyphenyl)valeronitrile[4] and 2,3-bis(4-methoxyphenyl)pent-2-enenitrile[5], in rats (41); dienestrol [4,4′-(diethylideneethylene)diphenol] in rats (42); and nafoxidine[6] [1-[2-[*p*-(3,4-dihydro-6-methoxy-2-phenyl-1-naphthyl)phenoxy]ethyl]pyrrolidine] in mice (8, 43).

That accelerated transport of ova results in decreased fertility is, of course, partly due simply to the expulsion of the fertilized ova from the reproductive tract (36). However, it has been shown (34) that fertilized ova degenerate when transplanted into the uterus too early; an inability of the ova to survive in the uterus apparently contributes to the impaired fertility observed following accelerated ova transport from the oviducts. The decreased fertility, however, is thought to be due to the uterine environment and not to the rapid transport *per se* (8).

Nafoxidine also has been referred to as an antiestrogen *(vide infra)*, as has a structurally related compound, 1-[2-[*p*-(3-hydro-5-methoxy-2-phenylindyl)phenoxy]ethyl]diethylamine[7] (44). It is to the antiestrogenic property of these compounds and to that of *erythro*-ethyl-α′-methyl-4,4′-dihydroxybibenzyl that the investigators attribute their findings that these three compounds can cause tube locking of ova in mice.

Tube locking of ova, of course, obviously impairs fertility by preventing the fertilized ova from getting to the uterus, the normal site for implantation. The fertility of tube-locked ova *per se* may not be impaired, however, as suggested by observations made in one study in the mouse (40). Although tubal retention of ova, induced by estradiol, was associated with delayed development of the blastocele, the ova implanted normally following transfer to vehicle-treated recipients.

That the antifertility activity of a compound such as nafoxidine has been attributed to estrogenicity of the compound in some studies (8) and to its antiestrogenic activity in others (44) may seem confusing at first, but it has been difficult to determine whether many compounds have antifertility activity by virtue of their being estrogenic, their being antiestrogenic, or their having some other property (8). Certain compounds, in fact, are antiestrogenic at lower doses and estrogenic at higher doses. Furthermore, some evidence (45) suggests that there may be species differences, at least between the rat and the hamster, with respect to whether a given compound exerts antifertility activity, estrogenic activity, and/or antiestrogenic activity, differences not entirely explicable by differences in hormonal requirements between the two species (Table I).

The estrogenicity of a compound is defined most specifically as the latter's ability to produce vaginal cornification (keratinization) in ovariectomized rats or mice (the Allen–Doisy test) (11); androgens and progestagens may produce vaginal mucification, but they are incapable of producing keratinization (46). Alternatively, investigators may employ a uterotrophic bioassay in immature and/or ovariectomized rats or mice to determine estrogenicity. This test is less specific, however, since a small degree of uterine growth can be produced by androgens and progestagens (11). The latter test does have the advantage that a dose–response curve for a given compound can be obtained more objectively (47).

Antiestrogenicity similarly may be defined as the ability of a compound to inhibit the effects of standard estrogens such as estrone (11), estriol (11), and estradiol (48) when the test compound is administered with the known estrogen in one and/or both of the tests for estrogenicity. Androgens and progestagens may show antiestrogenic activity in these tests (11); the weak plant estrogens, coumestrol and genistein, also have been shown to have inhibitory effects in such tests (49). Antiestrogenicity in an antifertility test could be manifested by the blocking of a step in the reproductive cycle that requires estrogen (Table I).

Uterus—Antifertility agents that prevent ovulation and/or fertilization commonly are referred to as contraceptive agents, whereas those that act after implantation has taken place usually are called abortifacients. The term interceptive has been used by some workers (50) to refer to compounds that act after the occurrence of fertilization but prevent implantation from taking place. By this definition, then, compounds interfering with the secretion of the proper amounts of steroids needed during this time period, whether acting directly on the ovaries or indirectly by inhibiting gonadotrophin or prolactin secretion, can be referred to as interceptives, although their earlier or later administration might render some of them contraceptive or abortifacient, respectively. Drugs altering ova transport *(vide supra)* also can be considered interceptives, as can those that destroy the fertilized ova or blastocysts and those that act on the trophoblast or uterus to prevent implantation.

Experimental designs may not always be sufficient to distinguish among these specific mechanisms for given compounds. It is quite possible, furthermore, that agents exhibiting antifertility effects when given to experimental animals during the first several days postcoitum may actually be acting in more than one of these ways. Experiments in which the test compound is administered from Days 1 to 7 of pregnancy and in which only the number of implantation sites and/or litter size is determined do not elucidate which interceptive mechanisms might be involved and/or if indeed an early abortifacient action might be involved (51, 52). With additional techniques and/or more restricted dosing periods, one or more of these effects can be identified.

Although blastocyst transfer experiments (8, 53) seem to have ruled out a direct zygotoxic effect as a possible mechanism by which a number of compounds inhibiting implantation may act, observations made in a few other studies suggest the contrary. Degenerating morulae, for example, have been found in rats treated with medroxyprogesterone acetate[8] on Day 1 of pregnancy followed by estrone on Day 3 (54), and degenerating blastocysts have been found in mice treated with ethinyl estradiol on Day 1 of pregnancy (55); tubal transport appeared to be altered in the latter study as well. Inhibited growth of blastocysts, as indicated by computed blastocyst volume, together with accelerated ova transport has been demonstrated in rabbits administered the progestagen, chlormadinone acetate, for 3 days preceding the occurrence of induced ovulation (56). A mixed copolymer of phenylmethylcyclosiloxane that was administered to rabbits on Days 4 and 5 of pregnancy subsequently was found to have been taken up by the 6-day-old trophoblasts, resulting in degenerative changes in the trophoblasts (57); there was no effect on the embryonic cells. Implanta-

[4] SC-3402.
[5] SC-3296.
[6] U-11,100A.
[7] Triethylamine, U-11,555A.

[8] Depo-Provera.

tion did not occur; neither did changes in the uterine cells that normally accompany implantation.

That implantation *per se* can be inhibited has been shown in a number of studies. Neuraminidase in the mouse was most effective when given on Days 4 and 6 or 5 and 7 of pregnancy, times at which ova had begun implanting or had just implanted in the controls (58). The results suggested that the compound might have interfered with the development of already implanted ova as well as with the implantation of ova. *N*-(2-Chloro-1-naphthylidene)-3-amino-2,6-lutidene was more effective in preventing implantation in rats when given on Days 3-5 of pregnancy (59), while the effectiveness of 5-[[(α,α,α-trifluoro-*m*-tolyl)oxy]methyl]-2-oxazolindinethione[9] in rats required that its administration be continued beyond Day 3 of pregnancy or be begun before Day 7 (60).

Observations reported in two studies (61, 62) suggest a centrally mediated anti-implantational effect for D-6-methyl-8-cyanomethylergoline[10], a compound structurally related to the naturally occurring alkaloid agroclavine, which has been reported to inhibit implantation in mice and rats (63). D-6-Methyl-8-cyanomethylergoline was effective in rats when given orally up to Day 7 of pregnancy (61). In mice, there was failure of implantation as well as failure of occurrence of the progesterone-influenced uterine cellular changes characteristic of Day 4 of pregnancy when D-6-methyl-8-cyanomethylergoline was given on the first 2 or 3 days of pregnancy but not when given only on Day 1 (62). Treatment on Days 6 and 7 resulted in resorption of fetuses in some mice by Day 9, whereas treatment beginning on Day 7 had no effect. D-6-Methyl-8-cyanomethylergoline probably acts by suppressing prolactin release *via* stimulation of prolactin-inhibiting factor release from the hypothalamus (61); prolactin from the pituitary apparently is necessary until Day 7 of pregnancy, at which time the placenta begins secreting a luteotrophic substance for corpora lutea maintenance (62).

It has already been pointed out *(vide supra)* that a certain hormonal balance in the internal milieu of the reproductive tract appears to be important for postovulatory events to occur normally. However, although estrogen is necessary during early pregnancy in some species (Table I), it is not necessary for implantation in the rabbit, guinea pig, and hamster; furthermore, the requirements are not known for the larger domestic animals or for the primates (8), including the human (12). Nevertheless, it appears possible that nonphysiological treatment of the endometrium with hormones may impair fertility in the human.

Klopper (64), for example, pointed out that some progestagens, such as those found in oral contraceptives, produce an asynchronism between the development of the endometrial stroma and that of the endometrial glands. He suggested that an endometrium so treated might resist implantation. On an acute treatment basis, it has been suggested (60) that an excess amount of estrogen present shortly after ovulation (in mammals) might prematurely sensitize the uterus so that the latter would be in a refractory state at the time of arrival of the blastocyst.

On the other hand, it has been suggested (65) that, by virtue of their antiestrogenic properties, compounds such as *trans*-1-(*p*-α-dimethylaminoethoxyphenyl)-1,2-diphenylbut-1-ene, 1-[2-[*p*-(3-hydro-5-methoxy-2-phenylindyl)phenoxy]ethyl]diethylamine, nafoxidine, and clomiphene prevent implantation, at least in the rat, by counteracting the estrogen needed for implantation; this estrogen is thought to be secreted on Day 4 of pregnancy. *trans*-1-(*p*-α-Dimethylaminoethoxyphenyl)-1,2-diphenylbut-1-ene appeared to be maximally effective when given on Day 4 and inactive when given on Day 5. Estriol, a so-called "impeding" estrogen, inhibited pregnancy *completely* when administered at a dose of 12.5 μg for the first 4 days of pregnancy but not when administered for only the first 3 days (66). Its presumably anti-implantational effect was inhibited when 0.05 μg of estradiol was administered on Day 4 together with the estriol (67).

Certain substances instilled locally into the uterus can impair fertility by affecting the endometrium in such a way that obstruction of the lumen occurs. Intrauterine instillation of a suspension of quinacrine in the rat, for example, induced a giant cell foreign body reaction in the endometrium and a consequent obstruction of the lumen, resulting in infertility for several months (68). Quinacrine instillation into the oviducts has been used as a nonsurgical means of inducing sterility in women (69).

Some compounds have postimplantational antifertility effects in nonprimate mammals but apparently not in the primate (70, 71). Demecolcine, for example, produced fetal death in rabbits and rats by means of a direct effect on the fetus; the placentae and implantation sites were not damaged. This compound had no effect on pregnancy in the macaque monkey. Clomiphene also was effective postimplantationally in the rabbit but again not in the macaque monkey. This drug, in contrast to demecolcine, affected the implantation site but exerted no effect on the fetus.

An abortifacient type of antifertility effect can be produced by compounds that stimulate uterine contractility. Sulman (72) suggested the latter as being the ultimate means by which monoamine oxidase inhibitors might induce abortion when injected into the human amnion. He reasoned that an inhibition of the amniotic monoamine oxidase enzyme system would result in serotonin's not being metabolized to 5-hydroxyindolylacetic acid. Therefore, serotonin would accumulate in the uterus and promote uterine contractility and eventually abortion. Monoamine oxidase inhibitors have been reported to interrupt pregnancy in several species, and intrauterine instillation of pargyline hydrochloride has been used successfully to induce abortion in the human (12).

The hormone, oxytocin, can be used close to term to induce labor but is ineffective as an abortifacient agent if used earlier in pregnancy (73). Prostaglandins, however, are now widely being used for the latter purpose. Observations made in humans (74), rabbits (74), and rats (75) suggest the following as the means by which prostaglandins induce abortion.

Prostaglandins appear to promote myometrial contractility which, in turn, generates internal shortening and stretch of the myometrial wall. As a result, cyclic intrauterine pressure is promoted which, together with vasoconstriction contracture, reduces uterine blood flow. The degree of this effect apparently is sufficient to compromise the endocrine function of the fetoplacental unit; as a result, estradiol and progesterone levels in the blood decrease. Following steroid withdrawal, the uterus, relieved from suppression, becomes converted into a spontaneously active, pharmacologically reactive organ, such as is normally seen only near term. The endogenous stimulatory mechanism at this time may be sufficient to complete the abortion; if not, additional prostaglandin or oxytocin may be used.

This hypothesis is supported indirectly by the results of another study (76). Three of nine women less than 4 weeks pregnant aborted completely following intravaginal administration of $PGF_{2\alpha}$. Only these three showed a significant fall in serum human chorionic gonadotrophin level, which was followed by a decrease in serum steroid level. Unfortunately, no measurements of uterine contractility were made.

Antifertility activity exerted at the level of the cervix (the neck of the uterus) or at the level of the vagina *(vide infra)* once more involves a discussion of prefertilization events. For example, the production of a cervical mucus that is "hostile" to sperm penetration is thought to be the major mechanism by which low dose progestagen-only contraceptives exert their antifertility effect in the human (77); it also has been suggested that progestagens in the human may inhibit further transport of the sperm that are able to reach the uterus (8). Testing for such activity in laboratory species, however, presents some difficulty. In the rat, mouse, hamster, and guinea pig, sperm are deposited in the uterine horns immediately after copulation (78). The rabbit, however, may be used as a model for investigating substances for contraceptive activity based on inhibition of sperm transport through the cervix; in this species, the ejaculate is deposited merely deeply within the vagina. One study did indeed show that relatively few sperm reached the anterior uterus and oviduct in rabbits pretreated for 7 days with progesterone, as compared with the number of sperm reaching these sites in the oil-treated controls (79).

Vagina—Spermicidal preparations, of course, are available for local application within the vagina. Their mechanisms of action are not well understood, and the effectiveness of many is poor (80). The five preparations that appear to have the highest rate of use effectiveness all contain polyethoxy derivatives, and four of the five contain compounds derived from phenoxypolyethoxyethanol. The results of recent experiments suggest that the effectiveness of

[9] U-11,634.
[10] 6605 VUFB, CME.

vaginal contraceptives might be able to be improved by means of the incorporation of an acrosin inhibitor into the preparation.

Acrosin is a proteolytic enzyme extractable from sperm acrosomes and is essential for penetration of the zona pellucida of the ovum by the spermatozoon during the process of fertilization (81). This trypsin-like protease has been found in sperm from a number of species: dog, rabbit, ram, bull, monkey, man, rooster (82), boar, stallion, guinea pig, hamster, and rat (83). Ejaculated sperm tend to have lower acrosin activity than do epididymal sperm, apparently due to adsorption by the sperm of an inhibitor substance present in the seminal plasma (83). This natural inhibitor is removed from the sperm during their residence in the female reproductive tract (84). Other substances that inhibit human and boar acrosin include trypsin–plasmin inhibitor bdellin B-3 from leeches, trypsin inhibitor and trypsin–plasmin inhibitor from guinea pig seminal vesicles, and the pancreatic trypsin inhibitors of pig, sheep, and dog (85). Human acrosin also is inhibited by soybean trypsin inhibitor and 1-chloro-3-tosylamido-7-amino-2-heptanone (86), a synthetic proteinase inhibitor that forms an irreversible complex with acrosin (84). Rabbit acrosin is inhibited by lima bean trypsin inhibitor, ovomucoid (87), diisopropylfluorophosphate, 1-chloro-3-tosylamido-7-amino-2-heptanone, and soybean trypsin inhibitor (81).

Of greater significance is that a number of these acrosin inhibitors have been shown to inhibit fertilization. Crystalline ovomucoid and soybean trypsin inhibitors inhibited the *in vitro* fertilization of rabbit ova by capacitated rabbit sperm (87), capacitation being defined as the physiological and biochemical change that allows for penetration and fertilization of ova (88). *In vivo* fertilization of rabbit ova was inhibited by rabbit seminal plasma trypsin inhibitor and pancreatic trypsin inhibitor, following placement into rabbits' oviducts of capacitated sperm treated with one of these inhibitors (89). *In vivo* fertilization of hen ova also was decreased in birds inseminated with rooster sperm that had been incubated with 1-chloro-3-tosylamido-7-amino-2-heptanone (82). Inhibition of fertilization following intravaginal deposition of synthetic trypsin inhibitors also has been reported (81).

This discussion has been an attempt to outline the mechanisms by which compounds having antifertility properties may exert their effects; it has been noted that different effects may be seen in different species. Only a small number of compounds showing antifertility effects have been indicated. Additional examples (predominantly synthetic compounds) can be found in Refs. 8, 10–12, 17, 34, 36–38, 44–50, 59–61, 64, 65, 68, 70, 71, and 80.

CONTRACEPTIVE AND INTERCEPTIVE PLANTS

The review of the literature in this and subsequent sections has included plants having folkloric reputations as well as those extracts shown to be active in animals or humans as antifertility agents, abortifacients, uterine stimulants, estrogenic agents, or cytotoxic agents (as applied only to antifertility effects). The search of the literature extends through 1973. Sources of references included *Chemical Abstracts*, *Biological Abstracts*, *Index Medicus*, and *Pharmacognosy Titles*.

Folkloric references can be obtained by an intensive study of ancient herbals and/or books on medical botany or by referral to review articles for which others have supposedly gleaned the older literature. Most folkloric references were obtained from the latter source, since a rather substantial number of articles and books have been acquired on medicinal folklore. No literature search of the medicinal folklore can ever be considered as complete, but we have done the best possible with available resources. Many references to books and articles on medicinal folklore could not be obtained by library personnel, even after exhaustive source searches. Such articles may or may not have contained information pertinent to the current effort.

In this section, we shall refer only to plants that have a folkloric reputation as preventing conception or that have been tested in animals or humans for the ability to prevent conception. Conception is being defined here as the successful implantation of a blastocyst in the uterine lining. Plants owing their activity to an estrogenic effect will be considered later in this review. Abortifacients and cytotoxic agents will not be considered in this section, since they do not prevent conception.

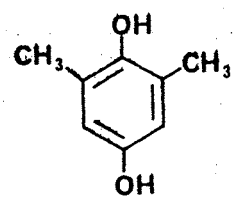
The most helpful references to plants alleged to have contraceptive (and/or interceptive) properties were the reviews of de Laszlo and Henshaw (90), Malhi and Trivedi (91), and Brondegaard (92). Many articles were encountered in which the titles implied that contraceptive plants were to be considered; however, the major thrust of such articles was an enumeration of folkloric abortifacient and/or emmenagogue plants. These will be considered in a subsequent section.

A total of 225 species of plants was found to be used as folkloric contraceptives and/or interceptives. These plants are classified into 181 genera and 76 plant families. The names of these plants, together with other pertinent data, are presented in Table II.

Another source of information on contraceptive and/or interceptive plants was a compilation of papers from the current literature in which, for one reason or another, certain plants were screened for their antifertility effects in laboratory animals. The names of these plants, together with other data such as the plant part used, the type of solvent used for preparing the extract to be tested, the test animal, and comments relative to the results, are presented in Table III. There are 145 species of plants tabulated in Table III, and these are classified into 132 genera and 57 families.

Active Contraceptive Agents—Only a few purified active antifertility principles from higher plants have been isolated. A brief summary will be made concerning each of these principles.

m-Xylohydroquinone—In his review of studies leading up to the isolation of *m*-xylohydroquinone (I), Sanyal (174) indicated that a study involving the vitamin contents of different cereals in India had led to the observation that male and female rats fed on a restricted diet consisting entirely of "matar" or peas *(Pisum sativum)* did not produce offspring. Sanyal (143) also cited a study in which litter production in mice was decreased when the animals were fed *P. sativum* at a level of 20% in the diet; litter production was completely abolished when the level was raised to 30%. He noted that the population of Tibet had remained stationary for the previous 200 years and, coincidentally, that the staple diet of the Tibetians consisted of barley and peas.



I: *m*-xylohydroquinone

The active principle of peas was finally isolated from pea oil and characterized as I (174). The compound produced fetal resorption in pregnant rats when given during the first 8 or 10 days of pregnancy but had no effect when given later. Further observations in rats suggested that I might be acting as a vitamin E antagonist.

Sanyal (174) cited a clinical trial of I. The pregnancy rate in Indian women was reduced by about one-half in those receiving this compound as compared with those receiving a placebo. Compound I appeared to be nontoxic in women treated twice monthly with 150–300- (147) or 300–350- (146) mg doses.

Price (175), without citing references, more recently reported that later workers had not been able to substantiate the earlier claims for the antifertility effects of I.

Lithospermic Acid—One of the most intriguing of the antifertility plants is *Lithospermum ruderale*. It was first used by the Navajo Indians as a contraceptive, as reported in 1941 (97). This plant is an herb indigenous to some of the Rocky Mountain states and is commonly known as "stoneweed." In 1945, Cranston (176) reported that when this plant was fed to adult female mice with previously regular estrous cycles, the mice developed prolonged periods of diestrus. This finding was confirmed later (177, 178). In 1949, Cranston and Robinson (179) demonstrated that extracts of *L. ruderale* decreased the gonadotrophic activity of the pituitary glands of adult female mice without producing irreversible or histological damage to the pituitary. In 1952, Kleber and Gisvold (180) confirmed that anestrus was produced in mice fed *L. ruderale*, but a phytochemical study failed to yield active principles.

Plunkett *et al.* (181) and Plunkett and Noble (182) studied the effects of *Lithospermum* extracts on rats and demonstrated that:

Effects noted in Lab Tests, Table III ?

Table II—Folkloric Antifertility Plants

Plant Name	Part[a]	Method of Use	Country	Reference
Aizoaceae				
Trianthema pentandra[b]	—	—	India	192
Trianthema portulacastrum[b]	—	—	India	192
Amaranthaceae				
Achyranthes aspera[b]	—	—	India	192
Amaranthus spinosus[b]	—	—	India	171
Amaryllidaceae				
Stenomesson variegatum	—	—	South America	92
Anacardiaceae				
Rhus trilobata	LF	Decoction is drunk	United States	92
Semecarpus anacardium	RT	Root is cooked in sour rice water; taken for 3 days at end of menstruation; produces sterility	India	90, 192
Semecarpus stellata	RT	Decoction is drunk in sour rice mucilage	India	92
Annonaceae				
Annona squamosa[b]	—	—	India	192
Apocynaceae				
Apocynum androsaemifolium	RT	Boiled in water and drunk once weekly	North America	90
Cerbera manghas[b]	—	—	India	171
Nerium indicum[b]	—	—	India	171
Rauvolfia serpentina[b]	—	—	India	192
Thevetia peruviana[b]	—	—	India	171
Araceae				
Acorus calamus	RT	Water decoction is drunk with milk after menstruation	India	91
Anthurium tessmannii	IF	Powdered and added to food eaten by women	Columbia	92, 93
Arisaema atrorubens	RZ	Infusion is drunk with *Asclepias syriaca*	Canada	92
Arisaema triphyllum	RT	Decoction is taken to prevent conception for 1 year	United States	90, 92
Caladium seguinium	PL	Juice is used by women to achieve temporary or permanent sterility; added to diet in prisoner-of-war camps	South America, Germany	90, 94, 95, 175
Dieffenbachia seguine	LF, ST	Chewed by both sexes	Puerto Rico, Guadeloupe, Cuba, Dominican Republic, Santa Lucia	92, 94, 95
Philodendron dyscarpium	IF	Powder is added to food eaten by women	Colombia	92, 93
Urospatha antisylleptica	SP	Powder is added to food eaten by women	Colombia	92, 93
Araliaceae				
Hedera helix	FR	Decoction of dried berries is drunk after "purification"; 1 dram causes sterility	Mediterranean	90, 92
	FL	Infusion is drunk	Iran	92
Aristolochiaceae				
Aristolochia clematitis	SD	Used to prevent conception	Hungary	90, 92
Aristolochia indica[b]	—	—	India	192
Asarum canadense	RT, RZ	Boiled slowly over a long period; decoction is drunk by women	North America	90, 92
Asclepiadaceae				
Asclepias hallii	PL	Infusion is drunk after birth	United States	90, 92
Asclepias syriaca	RT, RZ	Infusion is drunk to produce temporary sterility	Canada	90, 92
Calotropis gigantea[b]	—	—	India	192
Calotropis procera	RT	Water decoction is drunk	India	91
Marsdenia tenacissima	RT	Water decoction is drunk	India	91
Basellaceae				
Basella alba	RT	Water decoction is drunk	India	91
Berberidaceae				
Berberis aristata	EX	Water decoction is drunk	India	91, 192
Epimedium alpinum	LF, RT	Taken in wine after menstruation to prevent conception for 5 days; root causes sterility	Europe	90
Podophyllum hexandrum[b]	—	—	India	171
Betulaceae				
Betula bhojpattra	SB	Water decoction is drunk	India	91
Bignoniaceae				
Dolichandrone falcata[b]	—	—	India	192
Boraginaceae				
Cordia dichotoma	FR	Water decoction is drunk	India	91

Table II—*(Continued)*

Plant Name	Part[a]	Method of Use	Country	Reference
Cordia quarensis	RT	Chewed by young women	Africa	90
Lithospermum arvense	PL	Mixed with food	Europe	90
Lithospermum officinale	RT	Infusion of root is drunk	United States	92
Lithospermum ruderale	RT	Infusion of root is taken daily for 6 months	United States	90, 92, 97
Bromeliaceae				
Ananas comosus	FJ	Fresh juice is taken raw	Malaya	90, 192
Ananas sativa	FJ	Fresh juice is taken raw	Malaya	90
Tillandsia decomposita	FS	Decoction is drunk	South America	92
Buddlejaceae				
Buddleja asiatica	—	—	India	192
Capparidaceae				
Crataeva nurvala[b]	SB	Water decoction is drunk	India	91, 92
Caprifoliaceae				
Lonicera ciliosa	LF	Infusion is drunk	United States	92
Viburnum prunifolium	—	Hot decoction is taken before menstrual period; relieves dysmenorrhea and controls fertility	Italy	90, 92
Caricaceae				
Carica papaya[b]	—	—	India	192
Celastraceae				
Celastrus paniculatus[b]	—	—	India	192
Chenopodiaceae				
Chenopodium album	PL	Mixed with diet	Hungary	90
Salsola sp.	LF	Infusion is drunk	Algiers	92
Commelinaceae				
Aneilema conspicuum[b]	—	—	India	171
Aneilema scapiflorum[b]	—	—	India	171
Compositae				
Achillea millefolium	PL	Hot infusion is drunk or mixed with food	Europe	90
Artemisia siversiana[b]	—	—	India	171
Artemisia vulgaris[b]	—	—	India	171
Atractylis gummifera	RT	Decoction is drunk by men	Arabia	92
Bahia dissecta	RT	Boiled 30 min; drunk during menstruation; used also by men	United States	90, 92
Chrysanthemum indicum[b]	—	—	India	171, 192
Cnicus benedictus	PL	Taken as a tea	North America	90
Echinops echinatus[b]	—	—	India	171
Eupatorium odoratum	RT	Taken orally	Central America	90
Franseria artemisioides	PL	Decoction is drunk	Colombia	92
Stevia rebaudiana	LF, ST	Infusion is drunk	Paraguay	92
Tanacetum umbelliferum	—	—	India	171, 192
Convolvulaceae				
Cuscuta sp.	PL	—	United States	92
Cuscuta reflexa[b]	—	—	India	171, 192
Crassulaceae				
Crassula abyssinica	PL	Used to reestablish the menstrual cycle in case of a late period	Africa	98
Cruciferae				
Anastatica hierochuntica[b]	—	—	India	171, 192
Brassica campestris[b]	—	—	India	171
Brassica nigra	SD	Water decoction is drunk	India	91, 171
Capsella bursa-pastoris	PL	Mixed with food	Europe	90
Lepidium sativum[b]	—	—	India	171, 192
Cucurbitaceae				
Citrullus colocynthis[b]	—	—	India	171, 192
Cucumis sativus[b]	—	—	India	171
Cucumis trigonus[b]	—	—	India	171, 192
Lagenaria siceraria	FR, SD	Water decoction is drunk	India	91
Luffa acutangula[b]	—	—	India	171, 192
Luffa echinata[b]	—	—	India	171
Momordica charantia[b]	—	—	India	192
Momordica tuberosa[b]	—	—	India	192
Trichosanthes bracteata[b]	—	—	India	171
Trichosanthes cucumerina	—	—	India	171
Dioscoreaceae				
Dioscorea sativa var. *rotunda*	TU	Eaten raw without water	Australia	90
Ericaceae				
Rhododendron anthopogon[b]	—	—	India	171
Euphorbiaceae				
Croton tiglium[b]	—	—	India	171, 192
Euphorbia atoto[b]	—	—	India	171, 192
Euphorbia neriifolia	RT	Water decoction is drunk	India	91
Euphorbia resinifera[b]	—	—	India	192
Euphorbia tirucalli[b]	—	—	India	171, 192

(continued)

Table II—*(Continued)*

Plant Name	Part[a]	Method of Use	Country	Reference
Excoecaria agallocha[b]	—	—	India	192
Mallotus sp.	RT	Scrapings from root are chewed with betel and swallowed	Oceania (Buka)	90, 92
Mallotus philippinensis	FR	Water decoction is drunk	India	91
Ricinus communis	SD	Eaten 1 day after delivery	India	91
	SD	Dipped in warm blood of rabbit	Algiers	92
Gentianaceae				
Frasera speciosa	PL	Decoction; one-half cupful is taken occasionally	United States	90, 92
Gramineae				
Bambusa arundinacea	RT	Water decoction is drunk	India	91
Chusquea ramosissima	YS	Chewed	Paraguay	92
Dendrocalamus strictus[b]	—	—	India	192
Echinochloa frumentacea[b]	—	—	India	171
Guttiferae				
Garcinia morella[b]	—	—	India	192
Garcinia pedunculata[b]	—	—	India	171
Juglandaceae				
Juglans regia	LF	Infusion is drunk (with saffron)	Slovakia	92
Labiatae				
Ocimum basilicum	LF	Chewed	Gunantuna	92
Ocimum sanctum	LF	Taken orally	India	99
Origanum majorana	LF	Taken orally as a tea	Germany	90
Rosmarinus officinalis	PL	Decoction with "Ocean *Artemisia*"	Central America (Opata Indians)	92
	PL	Tea with "Ocean *Artemisia*"	Central America (Opata Indians)	90
Salvia officinalis[b]	—	—	India	192
Salvia plebeia[b]	—	—	India	192
Lauraceae				
Cinnamomum cassia[b]	—	—	India	192
Leguminosae				
Abrus precatorius	SD	Powder is eaten	India	192
Butea monosperma	FL, SD	—	India	91, 192
Cassia lanceolata[b]	—	—	India	192
Cicer arietinum[b]	—	—	India	192
Desmodium retroflexum[b]	—	—	India	192
Entada scandens	SD	Eaten raw or roasted	Australia	90, 92
Erythrina variegata var. *occidentalis*[b]	—	—	India	171, 192
Piliostigma thonningii	RT	Infusion is drunk	East Africa	92
Pisum sativum	SO	—	India	171
Prosopis algarobilla	RT	Decoction is drunk	South America	92
Rhynchosia minima[b]	—	—	India	192
Sesbania aegyptica[b]	—	—	India	91, 192
Sesbania sesban[b]	—	—	India	171
Trifolium subterraneum[b]	—	—	India	171
Uraria lagopoides[b]	—	—	India	192
Vigna phaseoloides	RT	Infusion is drunk together with root of *Piliostigma thonningii*	East Africa	92
Liliaceae				
Aloe barbadensis[b]	—	—	India	192
Asparagus acutifolia	FR	Decoction is drunk	Europe	90, 92
Asparagus officinalis	FR	Decoction is drunk	Europe	90, 92
Gloriosa superba[b]	—	—	India	192
Smilacina stellata	RT, LF	Tea from leaves; one-half cupful is drunk daily for 1 week	United States	90, 92
Veratrum californicum	RT	Decoction is drunk	United States	92
Loranthaceae				
Phoradendron flavescens	LF	Taken orally as a tea	United States	90
Lycopodiaceae				
Lycopodium annotinum	PL	Decoction is drunk	Soviet Union	92
Lythraceae				
Lawsonia inermis	—	—	India	192
Magnoliaceae				
Michelia champaca[b]	—	—	India	192
Malvaceae				
Gossypium herbaceum	RT	Decoction is drunk	South America, India	90, 92, 192
Hibiscus abelmoschus	FL	Infusion is drunk	Viti Islands	92
Hibiscus manihot[b]	—	—	India	192
Hibiscus rosa-sinensis	PT	Taken orally	India	99, 192
Hibiscus tiliaceus	FL	Smoked with tobacco	Melanesia, Gunantuna	92
Sphaeralcea munroana	RT	Decoction is drunk	United States	92
Urena lobata	LF	Leaves are chewed and juice is swallowed	New Ireland, India	90, 92, 192

Table II—*(Continued)*

Plant Name	Part[a]	Method of Use	Country	Reference
Melastomataceae				
Memecylon amplexicaule[b]	—	—	India	171
Menispermaceae				
Cissampelos pareira	RT	Water decoction is drunk	India	91
Curarea tecunarum	ST	Water extract of liana is drunk by male and female in gallon quantities	Brazil	172
Moraceae				
Cannabis sativa[b]	—	—	India	192
Moringaceae				
Moringa oleifera[b]	—	—	India	192
Myristicaceae				
Myristica fragrans[b]	—	—	India	192
Virola sp.	ST	—	Brazil	101
Myrsinaceae				
Embelia ribes	RT	Water decoction is drunk	India	91
Oleaceae				
Jasminum multiflorum[b]	—	—	India	171
Palmae				
Cocos nucifera	SD	Milk is drunk	Java	92
	FJ	Juice of ripe or unripe fruit is drunk	Pacific Islands	90
Licuala sp.	RB	Chewed and swallowed by males and females	Solomon Islands (Buka)	92
Pandanaceae				
Pandanus tectorius[b]	—	—	India	171
Papaveraceae				
Argemone mexicana[b]	—	—	India	171
Chelidonium majus	PL	Juice is drunk	Soviet Union	92
Phytolaccaceae				
Phytolacca decandra[b]	—	—	India	171
Piperaceae				
Piper aurantiacum[b]	—	—	India	192
Piper leptostachyum[b]	—	—	India	171
Piper longum[b]	—	—	India	171, 192
Piper nigrum[b]	—	—	India	171, 192
Plantaginaceae				
Plantago lanceolata	PL	Powdered plant in diet	Europe	90
Plumbaginaceae				
Plumbago indica[b]	—	—	India	171
Plumbago rosea[b]	—	—	India	192
Plumbago zeylanica	RT	Water decoction is drunk	India	91, 192
Polemoniaceae				
Phlox stansburyi	LF	Decoction is drunk	United States	92
Polygonaceae				
Eriogonum jamesii	RT	Boiled 30 min; cupful is drunk during menstruation to prevent conception; also used by males	United States	90, 92
Polygonum hydropiper	PL	Infusion is drunk	Europe	90
Polypodiaceae				
Asplenium adiantum-nigrum	—	—	India	90, 92, 171, 192
Dryopteris filix-mas	—	—	India	192
	—	Infusion is drunk	Tartarean women	92
	RT, SD	Used for sterility	Europe	90
Punicaceae				
Punica granatum[b]	—	—	India	171
Ranunculaceae				
Aconitum heterophyllum	RT	Water decoction is drunk daily	India	91
Paeonia officinalis	—	Decoction is drunk	Soviet Union	92
Rosaceae				
Geum macrophyllum	LF	Decoction is drunk	United States	92
Hagenia abyssinica[b]	—	—	India	192
Prunus emarginata	WD	Water decoction is drunk	United States	92
Prunus mahaleb[b]	—	—	India	192
Sanguisorba officinalis	PL	Mixed with normal diet	Europe	90
Rubiaceae				
Anthocephalus cadamba	—	—	India	171
Anthocephalus indicus	LF, FL	—	India	91
Randia spinosa	FR	—	India	91
Rutaceae				
Citrus maxima[b]	—	—	India	171
Citrus medica	FR	Water decoction is drunk	India	91
Salicaceae				
Populus alba	SB	Decoction of bark is drunk	Mediterranean	90, 92
Santalaceae				
Santalum album[b]	—	—	India	192
Sapindaceae				
Sapindus trifoliatus[b]	—	—	India	192

(continued)

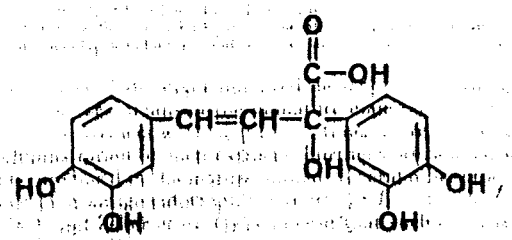
Table II—*(Continued)*

Plant Name	Part[a]	Method of Use	Country	Reference
Schizaeaceae				
Lygodium dichotomum	RT	Root is chewed with betel and some is swallowed	Solomon Islands (Buka)	90, 92
Scrophulariaceae				
Castilleja angustifolia	—	Decoction is drunk	United States	92
Solanaceae				
Datura metel	LF, FR	Water decoction is drunk	India	91
Solanum nigrum[b]	—	—	India	192
Withania somnifera[b]	—	—	India	192
Sterculiaceae				
Abroma agusta[b]	—	—	India	192
Tiliaceae				
Triumfetta bartramia[b]	—	—	India	192
Umbelliferae				
Anethum sowa	FR	Water decoction is drunk	India	91
Apium graveolens[b]	—	—	India	192
Carum carvi	FR	Water decoction is drunk	India	91
Carum roxburghianum	SD	Water decoction is drunk	India	91
Cicuta maculata	RT, RJ	Women chew and swallow roots on 4 consecutive days	United States	90, 92
Cuminum cyminum[b]	—	—	India	192
Ferula assa-foetida	—	—	India	192
Trachyspermum roxburghianum	—	—	India	171
Verbenaceae				
Callicarpa sp.	LF	Leaves are chewed and juice swallowed	Torres-Straits	90, 92
Callicarpa macrophylla[b]	—	—	India	171
Clerodendrum phlomidis[b]	—	—	India	171
Clerodendrum serratum	RT	Water decoction is drunk	India	91
Gmelina asiatica[b]	—	—	India	171
Stachytarpheta jamaicensis var. *indica*	—	—	India	171, 192
Vitex agnus-castus	PL	—	Europe	90
Vitex lagundi	RT	—	North Bougainville, Kurtachi	92
Vitex negundo	RT	Root scrapings are chewed with betel and swallowed	Solomon Islands (Buka)	90
	SD, RB	Water decoction is drunk	India	91, 192
Vitex trifolia[b]	—	—	India	192
Zingiberaceae				
Curcuma longa[b]	—	—	India	171, 192
Curcuma zedoaria[b]	—	—	India	171, 192
Globba marantia	—	—	Melanesia, Gunantuna	92

[a] EX = exudate, FJ = fruit juice, FL = flower, FR = fruit, FS = flower stems, IF = inflorescence, LF = leaf, PL = whole plant, PT = petals, RB = root bark, RJ = root juice, RT = roots, RZ = rhizome, SB = stem bark, SD = seed, SO = seed oil, SP = spadix, ST = stem, TU = tuber, WD = wood, and YS = young stems. [b] These plants have been stated to have "antifertility" properties, but it is possible that they may be abortifacients or emmenagogues.

(a) dried roots of the plant impaired development of the gonads and accessory sex organs of the immature male rat, and *(b)* injections of root extracts were at least 10 times more effective than oral administration of such extracts. Furthermore, similar effects could be produced in the mature animal. Several other groups also demonstrated antigonadotrophic activity for *L. ruderale* extracts (183–186), and Zeller *et al.* (187) showed that such extracts exert an anovulatory effect in hens.

In 1955, Graham and Noble (169) surveyed a number of plants for antigonadotrophic activity and showed this activity to be present not only in *L. ruderale* but also in *L. croccum, L. distichum, L. latifolium, L. arvense, L. officinale, Fatsia horrida, Arctostaphylos uva-ursi, Ambrosia artemisiifolia, Cnicus benedictus, Chenopodium album, Chamaelirium luteum, Amaranthus retroflexus, Borago officinalis,* and *Rubus idaeus*. The *Lithospermum* activity was found to be concentrated in the roots and increased in amounts from June to September (169). Furthermore, root extracts were highly active after a 4-year storage period, but extracts



II (?): lithospermic acid

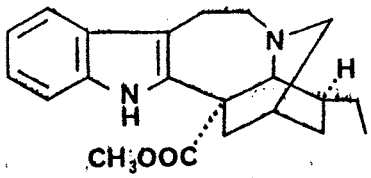
kept at 4° and pH 7.5 lost 50% of their potency after 1 week (169). Other members of the Boraginaceae, *i.e., Anchusa officinalis, Echium vulgare,* and *Symphytum officinale,* have also been shown to elicit antigonadotrophic activity (170).

In 1958, Kemper and Loeser (188) showed that extracts of *L. officinale in vitro* and *in vivo* were capable of blocking the effect of pituitary hormones, such as hypophyseal gonadotrophins and thyrotrophin, as well as that of chorionic gonadotrophin, pregnant mare serum gonadotrophin, and prolactin.

In 1963, Johnson *et al.* (113) reported on a tentative structure for lithospermic acid (II), presumably the principal phenolic acid in members of the Boraginaceae eliciting antigonadotrophic activity. In the same year, this research group presented evidence that a very active polyphenoloxidase present in *L. ruderale* polymerizes the inactive lithospermic acid to an active polymer of unknown structure (112).

However, more recently Wagner *et al.* (115) gave evidence that "lithospermic acid" (from *S. officinale* and *Lycopus europaeus*) was a mixture of at least three different substances, based on chromatographic studies, thus refuting the structure work of Johnson *et al.* (113). They confirmed that a polyphenoloxidase preparation from the leaves of *L. europaeus* and *L. officinale* induced the lithospermic acid to acquire antigonadotrophic properties, and further showed that the addition of rutin or chlorogenic acid increased this activity.

Coronaridine—Meyer *et al.* (106) found that an aqueous ethanol extract from the roots of *Tabernaemontana heyneana* prevented pregnancy in adult female rats when the extract was administered orally. Investigation of this plant led to the isolation of a number of indole alkaloids, of which coronaridine (III) was found

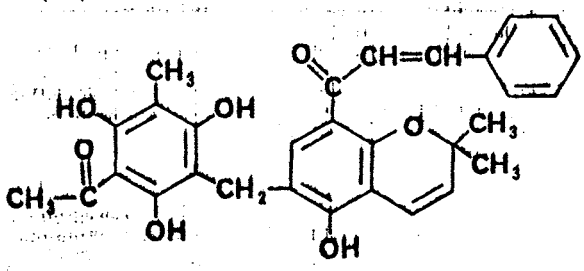


III: coronaridine

to be the active principle. Coronaridine, at a dose level of 5 mg/kg/day, prevented pregnancies and had a high degree of estrogenic activity.

Rutin—Cutting *et al.* (190) showed that a diet containing 0.1% of the flavonoid glycoside rutin impaired the fertility of female mice. But Wilson *et al.* (191) reported that a 1% rutin diet fed for 28–400 days did not modify the estrous cycle of female rats nor impair the fertility of male or female rats.

Rottlerin—The antifertility principle of *Mallotus philippineneis* has been identified as the chromene derivative rottlerin (IV) (168). At a dose level of 10 mg/kg, IV remained 100% effective for 10 days and 84% effective for 20 days; 20 mg/kg produced 100% infertility. Acetylrottlerin also was active, but isorottlerin was inactive (168).



IV: rottlerin

The isoflavones of known structure, as well as the coumestans, sterols, and cytotoxic agents, will be discussed in subsequent sections.

Antifertility Agents of Unknown Structure—Chou *et al.* (137) isolated two saponins having antifertility activity from *Gleditsia horrida*. One saponin was characterized as a triterpene attached to a single hexose sugar.

A new pyrone derivative of unknown structure, referred to as cirantin and isolated from *Citrus aurantium*, was reported to induce antifertility effects in two rabbits given oral doses of 0.75 mg/kg for 7 days (162). No further work has been found concerning this agent.

ABORTIFACIENTS, ECBOLICS, OXYTOCICS, AND EMMENAGOGUES

In this section, the literature concerning abortifacients, ecbolics, oxytocics, and emmenagogues will be reviewed relative to folkloric history, *in vitro* and *in vivo* animal studies (uterine stimulants), and human studies. When reviewing the folkloric uses of plants, it is often difficult to interpret differences between the four mentioned types of biological activities. For this review, any plant mentioned as being used to expel the fetus was considered an abortifacient. This definition groups together all ecbolics, oxytocics, and abortifacients simply as abortifacients. Also included in this category are plants said to be effective in "expelling the placenta," "useful in aiding childbirth," *etc.* Emmenagogues, on the other hand, were most often stated as such, but it is apparent that some authors consider the terms abortifacient and emmenagogue to be synonymous. We considered all plants mentioned to alter the menstrual cycle, unless specifically stated to be abortifacients, ecbolics, or oxytocics, to be emmenagogues.

There are many important reviews from which folkloric data were obtained (90, 91, 192–197), but the majority of plant names were found in minor references in the literature. The names of plants reported in the literature to have abortifacient (A) and emmenagogue (E) applications are presented in Table IV, together with the names of the plant parts used when this information was cited.

To determine whether or not plants having folkloric applications as abortifacients and/or emmenagogues might be confirmed, the literature was searched for plants whose extracts were shown to stimulate uterine tissue by means of *in vitro* or *in vivo* animal experiments. These data are presented in Table IV as (U) notations, together with the part of the plant from which the active extracts were prepared when such data were given.

Table III—Plants Evaluated in Animals or Humans for Antifertility Effects

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
Acanthaceae						
Adhatoda vasica	LF	PE, ET, W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	No activity	102
Amaranthaceae						
Amaranthus retroflexus	PL(?)	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Anacardiaceae						
Semecarpus anacardium	SD	PE, ET, W	100 mg/kg/day on Days 1–4, po(?)	Rat	No inhibition of implantation	103
Annonaceae						
Artabotrys odoratissimus	LF	Fresh leaf	0.5–1.0 g/day for 3 days, po	Rat	Diestrus prolonged; degenerative changes in follicles; no body weight changes	104
Apocynaceae						
Apocynum androsaemifolium	PL	—	—	—	Anovulatory effect	171
Apocynum cannabinum	RT	—	—	—	Anovulatory effect	171
Catharanthus roseus	LF	Vinblastine	0.3–0.5 mg/kg, iv	Rabbit	66% reduction in normal fetuses	70
Stemmadenia galeottiana	FR	AC	Twice daily for 5 days, sc	Mouse	Number of litters reduced 44%	105
Tabernaemontana heyneana	RT	Coronaridine	5 mg/kg/day, po	Rat	Antifertility effect	106
Araceae						
Dieffenbachia seguine	SJ	Fresh stem sap, po	—	Mouse	Sterility in males 40–90 days; 30–50 days in females	95
	LF	—	—	Humans	Experimental	94

(*continued*)

Table III—*(Continued)*

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
Lysichiton americanum	RT	ET/W	1-2% of diet, po	Mice	Inactive	117
Araliaceae						
Fatsia horrida	PL(?)	W	—	Rat	Antigonadotrophic effect *in vitro*	169
Asclepiadaceae						
Asclepias hallii	—	—	—	—	Anovulatory effect	171
Calotropis gigantea	RT	PE, ET, W	100 mg/kg/day on Days 1-4, po(?)	Rat	No inhibition of implantation	103
Calotropis procera	LF	PE, ET, W	100 mg/kg on Days 1-7, po	Rat	No inhibition of implantation	108
Daemia extensa	LF	In ration	po for 4 weeks; 3 g/day for rats; 9 g/day for guinea pigs	Rat, guinea pig	No effect on fertility	127
Marsdenia cundurango	BK	—	—	—	Anovulatory effect	171
Berberidaceae						
Berberis vulgaris	—	—	—	—	Anovulatory effect	171
Podophyllum peltatum	RT, RZ	Podophyllotoxin	0.25 mg, sc	Mouse	No pregnancies when treated on Day 3 or later	109
	RT, RZ	Podophyllin	5 g/ml in petroleum jelly, 0.2 ml instilled in uterus	Rat	No effect on implantation	110
Boraginaceae						
Anchusa officinalis	PL	W	—	Mouse	Antigonadotrophic activity	170
Borago officinalis	PL(?)	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Echium vulgare	PL	W	—	Mouse	Antigonadotrophic activity	170
Lithospermum arvense	PX	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Lithospermum croceum	PX, RT	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Lithospermum distichum	PX, RT	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Lithospermum latifolium	PX, RT	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Lithospermum officinale	PX	W	—	Rat	Antigonadotrophic activity *in vitro*	169
	LF	W	—	Rat, guinea pig	Antigonadotrophic activity *in vitro*; diestrus in rats	188
	PL	W	1 g/day, po	Mouse	Inhibited vaginal cornification	114
Lithospermum ruderale	PX, RT	W	—	Rat	Antigonadotrophic activity *in vitro*	169
	RT	—	po	Mouse	Cessation of estrous cycles	188
	PX	—	—	Mouse	Depressed estrous cycles	180
	RT	Oxidized lithospermic acid	sc or po daily for 6 days (rat); daily injections for 7 days (hen)	Rat, hen	Antigonadotrophic activity (rat); anovulatory activity (hen)	112
	—	—	In ration, 15% of diet	Mouse	Produced anestrus; nonestrogenic and nonandrogenic	111
Pulmonaria officinalis	PL	W	—	Rat	Antigonadotrophic activity *in vitro*	115
Symphytum officinale	PL	W	—	Rat	Antigonadotrophic activity *in vitro*	115
	RT	Oxidized lithospermic acid	6-12 mg/kg, sc	Mouse	Antigonadotrophic activity increased by rutin or chlorogenic acid	115
Bromeliaceae						
Ananas comosus	RZ, FR	PE, ET, W	"Suitable amount," po	Mouse	Antifertility activity in PE and ET extracts	102
	FR	Juice	50 ml/kg on Days 1-7	Rat	60% inhibition of implantation	116
Caprifoliaceae						
Lonicera ciliosa	LF	ET/W	Dry extract as 1-2% of diet, po	Mouse	45% reduction in litters	117
Caricaceae						
Carica papaya	FP	PE, ET, W	100-500 mg/kg on Days 1-7, po	Rat	Variable inhibition of implantation	118
	SD	In ration	*Ad libitum*	Mouse	Reduced fertility with toxicity	119

Table III—(Continued)

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
Caryophyllaceae						
Dianthus superbus	PL	W, AC	0.1 ml twice daily for 5 days, sc	Mouse	Interferes with early pregnancy; may be an estrogenic effect	120
	PL	W, AC	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters; post-copulatory effect	121
Vaccaria pyramidata	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters; no post-copulatory effect	121
Chenopodiaceae						
Chenopodium album	LF	In ration	3 g/day for 4 weeks, po	Rat	No effect on fertility	127
	LF	In ration	9 g/day for 4 weeks, po	Guinea pig	No effect on fertility	127
	PL(?)	W	—	Rat	Antigonadotrophic effect *in vitro*	169
Combretaceae						
Terminalia catappa	—	—	—	—	Antifertility effect	171
Compositae						
Ambrosia artemisifolia	PL(?)	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Artemisia sp.	PL(?)	Santonin	Added to ration, po	Mouse	Delay in estrus, ovulation, and onset of mating	119
Artemisia maritima	—	—	—	—	Anti-implantation effect	171
Cnicus benedictus	PL(?)	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Cnicus spicatus	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Grindelia sp.	PL	—	—	—	Anovulatory effect	171
Solidago odora	LF	—	—	—	Anovulatory effect	171
Stevia rebaudiana[d]	PL	W	10 ml of a 5% decoction for 6 days during mating	Rat	Fertility reduced 57–79%	122
Cruciferae						
Capsella bursa-pastoris	PL	In ration	20–40% of ration	Mouse	40% in ration impeded ovulation	123
Isatis oblongata	PL	W (distilled with limestone)	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Raphanus sativus	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Cucurbitaceae						
Ecballium elaterium	PL, FR	Dihydro-elatericin A	20–100 mg/kg/day, po	Mouse	Inhibition of ovulation at 100 mg/kg	124
Luffa cylindrica	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Momordica charantia	LF	W	250–500 mg/day on Days 1–7, po	Rat	No activity	125
Cupressaceae						
Thuja occidentalis	LF	—	—	—	Anovulatory effect	171
Ericaceae						
Arctostaphylos uva-ursi	PL(?)	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Euphorbiaceae						
Euphorbia lathyris	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters; no post-copulatory activity	121
Jatropha curcas	FR, SD	In ration	3.3% of ration for 25 days, po	Rat	Complete inhibition of reproduction	126
Mallotus philippinensis	TR	In ration	Daily for 4 weeks, po; rat 0.75 g/day, guinea pig 3 g/day	Rat, guinea pig	Decreased mating in rats and guinea pigs	127
	TR	Rottlerin	20–840 mg/kg, po	Rat	Prevented mating	168
	—	—	—	—	Anti-implantation effect	171
	SD	PE, ET, W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	No activity	102
Ricinus communis	SD	PE, ET, W	100–500 mg/kg on Days 1–7, po	Rat	No inhibition of implantation	118
Stillingia sylvatica	RT	—	—	—	Anovulatory effect	171
Gramineae						

(continued)

Table III—*(Continued)*

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
Dendrocalamus strictus	LF	PE, ET, W	100 mg/kg on Days 1–7, po	Rat	No inhibition of implantation	108
Labiatae						
Hyssopus officinalis	PL	W	—	Rat	Antigonadotrophic	115
Lycopus europaeus	LF	Oxidized lithospermic acid	—	Mouse	Antigonadotrophic activity increased by rutin or chlorogenic acid	115
Lycopus lucidus	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters; postcopulatory activity	121
Majorana hortensis	PL	W	—	Rat	Antigonadotrophic	115
Marrubium officinalis	PL	W	—	Rat	Antigonadotrophic	115
Melissa officinalis	PL	W	—	Rat	Antigonadotrophic	115
Mentha piperita	PL	W	—	Rat	Antigonadotrophic	115
Ocimum sanctum	LF	PE, BZ, E, AC ET	100–200 mg/kg, po	Rat	80% antifertility for BZ extract, 60% for PE extract, others inactive	99
Orthosiphon stamineus	PL	W	—	Rat	Antigonadotrophic	115
Rosmarinus officinalis	PL	W	—	Rat	Antigonadotrophic	115
Salvia officinalis	PL	W	—	Rat	Antigonadotrophic	115
Thymus serpyllum	PL	W	—	Rat	Antigonadotrophic	115
Thymus vulgaris	PL	W	—	Rat	Antigonadotrophic	115
Lecythidaceae						
Combretodendron africanum	SB	W	Various doses, iv and sc	Rat, rabbit	Tannins and saponins inhibited estrous cycle, mating, and pregnancy	130
Leguminosae						
Abrus precatorius	LF	PE, ET, W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	No antifertility activity	102
	SD	PE	150 mg/rat for 20 days before mating or on Days 1–5	Rat, mouse	Antifertility effects	131
	SD	PE, ET, W	100 mg/kg, po; PE, ET = Days 1–4; W = Days 1–7	Rat	No significant inhibition of implantation	103
	RT	PE, ET	100 mg/kg on Days 1–5, po	Rat	Prevention of nidation; ET extract has antiestrogenic activity	100
	SD	PE	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	Antifertility activity but toxic	102
Acacia koa	LF	ET, W	Twice daily for 5 days, sc	Mouse	Number of litters reduced 88–100%, but toxic	105
Astragalus glycyphyllus	PL	W	Continuous oral dosage	Rat	Increased duration of estrous phase of cycle	132
Butea frondosa	SD	ET, CH, W	10 mg–1 g/kg/day for 15 days, po	Rat	No change in estrous cycle; delayed mating with higher doses	133
	SD	ET, CH, W	10–1500 mg/kg/day, po; 100 mg/kg on Days 1–5, sc	Mouse, rat	Antifertility effect	133
	PT	ET	10–200 mg/kg	Mouse, rat	Antifertility effect	134
	PT, SD	ET	Various doses, parenteral	Mouse, rat	No estrogenic activity	135
Butea monosperma	SD	ET	25–200 mg/kg for 7 days, po	Rat	No inhibition of implantation	136
	FL	PE, ET, W	100 mg/kg/day on Days 1–7	Rat	No inhibition of implantation	116
Butea parviflora	SD	PE, ET, W	100 mg/kg on Days 1–7, po	Rat	No inhibition of implantation	108
Clitoria ternatea	FR	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Gleditsia horrida	FR	ET	Doses not stated, given for 5 days, sc	Mouse	Two saponins and sugars produced antifertility effect	137
Medicago sativa	IF	E, CH, acid	Not stated	Rat	E extract was estrogenic, CH extract was antiestrogenic, acid extract inter-	141

Table III—(Continued)

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
					fered with seminal vesicle growth and potentiated action of estrogens	
	—	—	—	Rat	Antigonadotrophic	140
	PL	In ration	po	Rabbits (male)	Degenerative changes in ova after mating	142
Phaseolus aureus	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters; postcopulatory activity	121
Pisum sativum	SO	*m*-Xylohydroquinone	On Days 16 and 21 of cycle, po	Human	Reduction in relative number of pregnancies	143, 144, 146
	SD	In ration	20–30% of diet	Rat	20% decreased and 30% stopped litter formation	148
	SD	—	po	Rat	Decreased fertility	147
	SO	—	im monthly	Human	Postponed pregnancy	147
	SO	*m*-Xylohydroquinone	300–350 mg on Days 16 and 21 of cycle, monthly, po	Human	Reduction in number of pregnancies	147, 148
Psoralea coryllfolia	SD	In ration	0.35 g/day for 37–77 days, po	Mouse	Fertility impaired; estrogenic effect Psoralen was not the active principle	149
Sesbania sesban	FL	W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	Antifertility effect	102
	LF	W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	No activity	102
Trifolium subterraneum	PL	In ration	*Ad libitum*, po	Sheep	Impaired release of luteinizing hormone by isoflavones; morphological changes in cervix	150–152
Uraria lagopoides	PL	PE, ET, W	100 mg/kg on Days 1–7, po	Rat	50% inhibition of implantation with W extract	103
Liliaceae						
Aloe barbadensis	LF	W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	Antifertility activity	102
	FP	W	100–500 mg/kg on Days 1–7	Rat	No significant antiimplantation effect	116
Asdgraea officinalis	SD	—	—	—	Anovulatory effect	171
Chamaelirium luteum	PL(?)	W	—	Rat	Antigonadotrophic activity *in vitro*	169
Colchicum autumnale	CO	Demecolcine	0.1–5.0 mg/kg, sc	Rabbit	Toxic to fetus when given after implantation	70
	CO	Colchicine	0.5 mg/ml saline; 0.2 ml instilled into one uterine horn	Rat	Few fetuses both horns	110
Gloriosa superba	TU	PE, ET, W	10–100 mg/kg on Days 1–7, po	Rat	No inhibition of implantation; toxic	108
Paris polyphylla	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Smilax bona-nox	RT	—	—	—	Anovulatory effect	171
Veratrum californicum	PL	In ration	*Ad libitum*, po	Sheep	Prolonged gestation associated with cyclopic fetuses	153
Magnoliaceae						
Magnolia virginiana	BK	—	—	—	Anovulatory effect	171
Michelia champaca	RT	PE, ET, W	100 mg/kg on Days 1–7, po	Rat	No inhibition of implantation	108
Malvaceae						
Gossypium herbaceum	SD, ST, SB, RB	PE, ET, W	100 mg/kg on Days 1–4 or 1–7	Rat	No significant antiimplantation effect	116
Hibiscus rosa-sinensis	PT	PE, BZ, E, ET	100–200 mg/kg, po	Rat	80% inhibition of implantation by BZ extract	99
	PT	—	—	—	Anovulatory effect	171

(continued)

Table III —(Continued)

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
Menispermaceae						
Chondodendron tomentosum	RT	—	—	—	Anovulatory effect	171
Stephania hernandifolia	RZ	PE, ET	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats; po	Mouse, rat	Antifertility effect with ET extract; increased fertility with PE extract	102
Moraceae						
Ficus pumila	LF	W	Twice daily for 5 days, sc	Mouse	61% reduction in litters	105
Moringaceae						
Moringa pterygosperma	SB	PE, ET, W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats; po	Mouse, rat	No effect by any of the extracts	102
Musaceae						
Ensete superbum	SD	AA	Various dosages for varying periods prior to and after mating, po	Mouse, rat, hamster, rabbit, guinea pig	Anti-implantational and postimplantational effects	155
Myrsinaceae						
Embelia ribes	PL	—	The following is taken in equally divided doses daily for 22 days while abstaining from intercourse: 4 drams active principle of *Embelia ribes*, 4 drams *Piper longum*, 2 drams assafoetida, and 4 drams borax	Human	Prevention of conception for 1 year	138 ←
Myrtaceae						
Metrosideros collina	LF	W	Twice daily for 5 days, sc	Mouse	53% reduction in litters	105
Palmae						
Areca catechu	FR	PE, ET, W	100–500 mg/kg on Days 1–7, po	Rat	Inhibition of implantation with higher dose	118
	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Inactive	121
Papaveraceae						
Argemone glauca	IF	ET	Twice daily for 5 days, sc	Mouse	Reduced litters by 78%	105
	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Inactive	121
Pinaceae						
Pinus ponderosa	LF	VO, W, AC	In ration	Mouse	Complete disruption of pregnancy with W extract	156
	LF[e]	W	In ration	Mouse	See Footnote *e*	145
Piperaceae						
Peperomia sp.	LF, ST	W	Twice daily for 5 days, sc	Mouse	43–50% reduction of litters	105
Piper betle	LF, RT	PE, ET, W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	Inactive	102
Piper latifolium	RT	—	—	—	Anovulatory effect	171
Piper longum	FR	—	See *Embelia ribes* (Myrsinaceae)	Human	Prevents conception for 1 year	138 ←
	LF, RT	PE, ET, W	7 days before and 14 days during cohabitation in mice and 5 days after mating in rats, po	Mouse, rat	Inactive	102
Plumbaginaceae						
Plumbago zeylanica	RT	PE, ET, W	100 mg/kg on Days 1–7, po	Rat	No inhibition of implantation	108
Polygonaceae						
Polygonum hydropiper	PL	In ration	1 g/day	Mouse	Impaired fertility in mice	157
	PL	In ration	9 g/day	Guinea pig	Sterility in female guinea pigs	157
	RT	ET	100 mg/kg on Days 1–7	Rat	80% inhibition of implantation with PE fraction of ET extract	158

Table III—(*Continued*)

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
Polygonum multiflorum	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Polypodiaceae						
Aspidium sp.	LF, ST	In ration	*Ad libitum*	Mouse	Reduced fertility with high toxicity	119
Dryopteris filix-mas	—	—	—	—	Anovulatory effect	171
Punicaceae						
Punica granatum	PC	In ration	3 g/day for 4 weeks, po	Rat	Infertile matings	127
	PC	In ration	9 g/day for 4 weeks, po	Guinea pig	Infertile matings	127
Ranunculaceae						
Aconitum napellus	RT	—	—	—	Anovulatory effect	171
Cimicifuga racemosa	RT	—	—	—	Anovulatory effect	171
Paeonia sp.	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Paeonia moutan	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Inactive	121
Rosaceae						
Hagenia abyssinica	LF, ST	In ration	*Ad libitum*	Mouse	Reduced fertility with toxicity	119
Prunus emarginata	WD	EW	1–2% of ration, po	Mouse	45% reduction of litters	117
Pyrus communis	SB	W	po and im	Mouse, rat, dog	Pregnancy interrupted at all stages	159
Quillaja saponaria	BK	—	—	—	Anovulatory effect	171
Rubus idaeus	LF	W	—	Rat	Antigonadotrophic	169
Sanguisorba officinalis	PL	In ration	20–30% of diet, po	Mouse	Prolongation of diestrus	160
	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Inactive	121
Rubiaceae						
Adina cordifolia	LF	ET	100 mg/day after copulation for 5 days, po	Rat	No effect	161
Randia dumetorum	FR	PE, ET, W	100 mg/kg on Days 1–7, po(?)	Rat	No significant inhibition of implantation	103
Rubia cordifolia	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Rutaceae						
Citrus aurantium	PC	Cirantin	0.75 mg/kg for 7 days, po	Rabbit	No pregnancies after several matings	162
Evodia rutaecarpa	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Salicaceae						
Salix sp.	BK	—	—	—	Anovulatory effect	171
Saxifragaceae						
Hydrangea arborescens	RT	—	—	—	Anovulatory effect	171
Scrophulariaceae						
Rehmannia glutinosa	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Simaroubaceae						
Brucea amarissima	SD	ET	Twice daily for 5 days, sc	Mouse	100% reduction in litters	105
Simarouba amara	BK	—	—	—	Anovulatory effect	171
Solanaceae						
Nicotiana tabacum	LF	Smoking	Smoking	Human	Alters ovarian cycle	163
	LF	Nicotine	Implant *in utero*	Rat	Increase in number of stillborn	164
Solanum dulcamara	TW	—	—	—	Anovulatory effect	171
Solanum xanthocarpum	ST, LF	In ration	Rats, 3 g/day; guinea pigs, 9 g/day for 4 weeks, po	Rat, guinea pig	No effect	127
Withania somnifera	RT	In ration	25 mg/day, po	Mouse	Reduction in fertility	165
Stemonaceae						
Stemona japonica	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Taxaceae						
Taxus baccata	LF	PE, ET, W	50–100 mg/kg on Days 1–7 with W extract and on Days 1–5 with PE and ET extracts	Rat	60% infertility with PE and W extracts	166
	ST	PE, ET, W	100 mg/kg on Days 1–4, po(?)	Rat	No significant anti-implantation effect	103

(*continued*)

Table III—(*Continued*)

Plant Name	Part Tested[a]	Type of Extract[b]	Dose and Route of Administration[c]	Species	Results	Reference
	LF	PE, ET, W	100 mg/kg on Days 1–4, po(?)	Rat	55% inhibition of implantation with W extract	103
	LF	In ration	Rat, 3 g/day; guinea pig, 9 g/day, for 4 weeks, po	Rat, guinea pig	No infertility effect	127
Thymelaeaceae						
Daphne genkwa	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Tiliaceae						
Grewia asiatica	SD	PE, ET, W	500 mg/kg on Days 1–7, po	Rat	40–66.6% inhibition of implantation	118
Umbelliferae						
Apium graveolens	SD	PE, ET, W	100 mg/kg on Days 1–7	Rat	No inhibition of implantation	116
Carum carvi	SD	In ration	3 g/day/rat; 9 g/day/guinea pig, for 4 weeks, po	Rat, guinea pig	No effect	127
Daucus carota	SD	PE, ET, W	100–500 mg/kg on Days 1–7, po	Rat	Variable inhibition of implantation	118
	SD	PE, ET, W	20–100 mg/kg on Days 1–7, po	Rat	Various results with different chromatographic fractions	52
Ferula assa-foetida	R	Resin	See *Embelia ribes* (Myrsinaceae)	Human	Prevention of conception for 1 year	138
Leptotaenia reticulata	—	—	—	—	Anovulatory effect	171
Siler divaricatum	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Decreased number of litters	121
Verbenaceae						
Clerodendrum uncinatum	PL	W	—	Rat	Antigonadotrophic	115
Verbena hastata	PL	—	—	—	Anovulatory effect	171
Verbena officinalis	PL	W	—	Rat	Antigonadotrophic	115
	PL	W	0.05–0.2 ml twice daily for 5 days, sc	Mouse	Inactive	121
Vitex agnus-castus	SD	In ration	3 g/day/rat; 9 g/day/guinea pig 4 weeks, po	Rat, guinea pig	No effect	127

[a] BK = bark, CO = corm, FL = flower, FP = fruit pulp, FR = fruit, IF = inflorescence, LF = leaf, PC = pericarp, PL = whole plant, PT = petals, PX = aerial parts, R = resin, RB = root bark, RT = root, RZ = rhizome, SB = stem bark, SD = seed, SJ = stem juice, SO = seed oil, ST = stems, TR = trichomes, TU = tuber, TW = twigs, and WD = wood. [b] Extraction solvents were: AA, absolute ethanol; AC, acetone; BZ, benzene; CH, chloroform; E, ether; ET, 95% ethanol; EW, ethanol–water (1:1); ME, methanol; PE, petroleum ether; VO, volatile oil; and W, water. [c] Routes of administration were: im, intramuscular; ip, intraperitoneal; iv, intravenous; po, oral; and sc, subcutaneous. [d] This activity could not be confirmed in at least two laboratories (128, 129). [e] Activity suspected to be due to mycotoxins produced by fungi parasitizing the pine needles (145).

Table IV—Emmenagogue, Abortifacient, and Uterine Stimulant Plants and Their Active Principles Where Known

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
Acanthaceae				
Adhatoda vasica	A, E	LF	192, 193	—
Dipteracanthus suffruticosa	A	RT	192, 193	—
Ruellia suffruticosa	See *Dipteracanthus suffruticosa*			
Strobilanthes crispus	U	LF	199	—
Agavaceae				
Agave americana	A	—	192	—
	E	LJ	193	—
	E	PL, JU	194	—
Agave lecheguilla	U	—	200	Crude saponin
Yucca gloriosa	U	—	201	—
Aizoaceae				
Carpobrotus edulis	A	FR	194	—
Trianthema decandra	A	PL	193	—
Trianthema monogyna	See *Trianthema portulacastrum*			
Trianthema pentandra	See *Trianthema decandra*			
Trianthema portulacastrum	A	—	192	—
	A	RT	193	—
Alangiaceae				
Alangium lamarckii	U	LF	202	Total alkaloids
	I	—	203	Emetine (CXXVIII)
Alismataceae				
Sagittaria sagittifolia	A	—	192	—
Amaranthaceae				
Achyranthes aspera	A	—	204	—
	A	LJ	192, 193	—
Alternanthera sessilis	A	—	194	—
Amaranthus gangeticus	E	LF	193	—
Amaranthus thunbergii	A	PL	194	—
Bragantia tomentosa	A	—	192	—

Table IV.—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	E	PL	193	—
Amaryllidaceae				
Clivia miniata	A	RT	194	—
	I	—	204–210	Lycorine (CXXVII)
Crinum sp.	I	—	211	Hordenine (VI)
	I	—	205–210, 218	Lycorine
Crinum asiaticum	A	—	192	—
	I	—	205–210, 218	Lycorine
Pancratium sp.	I	—	211, 310	Hordenine
	I	—	212–217, 312	Tyramine (IX)
Pancratium sickenbergi	U	BU	218	—
	I	—	205–210, 218	Lycorine
Anacardiaceae				
Anacardium occidentale	U	TE	219	—
Lannea schimperi	A	BK	220	—
Rhus coriaria	U	—	221	—
Rhus glaucescens	See *Rhus longipes*			
Rhus incana	See *Rhus longipes*			
Rhus incana var. *cuneidoliolaya*	See *Rhus longipes*			
Rhus longipes	A	PL	222	—
Rhus ruzizensis	See *Rhus longipes*			
Rhus succesanea	I	—	223	Ellagic acid (CXXXIII)
Rhus toxicodendron	U	—	224	—
Rhus villosa	See *Rhus longipes*			
Semecarpus anacardium	A	—	192	—
	A	SD	193	—
	E	SD	193	—
Spondias lutea	U	SB	219	—
Tapirira guianensis	U	SB	219	—
Annonaceae				
Annona muricata	U	LS	225	—
Annona squamosa	A	—	192	—
	A	SD	193	—
	U	—	219	—
Unona setigera	See *Uvaria rufa*			
Uvaria ridleyi	See *Uvaria rufa*			
Uvaria rufa	A	RT	195	—
Uvaria setigera	See *Uvaria rufa*			
Uvaria solanifolia	See *Uvaria rufa*			
Apocynaceae				
Aganosma marginata	A	—	192	—
	E	PL, RT	193	—
Alstonia constricta	U	BK	226, 227	Total alkaloids
	I	—	228–232	Reserpine (LXXXIX)
Alstonia scholaris	A	—	192	—
	E	BK	193	—
	I	—	228–232	Reserpine
Anodendron paniculatum	A	—	192	—
	A	RT	90	—
Carissa edulis	A	RT	233	—
Catharanthus roseus	A	RT	234	—
Cerbera odollam	A	SD, FR	193	—
	A	—	192	—
Ervatamia coronaria	A	—	192	—
	E	RT	193	—
Forsteronia floribunda	U	LS	225	—
Holarrhena antidysenterica	E	SD	91	—
Holarrhena febrifuga	A	RT, LF	194	—
	E	LF	194	—
Nerium indicum	A	RT	193	—
	E	RT	193	—
	U	—	201	—
Nerium odorum	See *Nerium indicum*			
Nerium oleander	U	—	235, 236	—
Peschiera affinis	U	RB	219	—
Pleioceras barteri	A	FR, SD, RB, LF	196	—
	E	FR, SD, RB, LF	196	—
Plumeria acuminata	A	—	193	See also *Plumeria rubra* f. *acutifolia*
Plumeria bracteata	U	RB	219	—
Plumeria rubra	A	FR	194	—
	E	FR	194	—
Plumeria rubra f. *acutifolia*	A	—	193	—
Rauvolfia serpentina	A	RT	91, 193	—
	A	—	192	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	U	RT	237	Total alkaloids
	I	RT	228–232	Reserpine
	I	RT	238	Neoajmaline (ajmaline) (XCI)
	I	—	239	Corynanthine (LXXXVIII)
Rauvolfia vomitoria	A	LF	194	—
	E	LF	194	—
	I	—	228–232	Reserpine
Strophanthus sp.	I	—	240–244	Strophanthin (CXLIII)
Tabernanthe iboga	I	—	245, 246	Ibogaine (LXXXIII)
Thevetia nereifolia	See *Thevetia peruviana*			
Thevetia peruviana	A	SD	192, 193	—
	A	SD, PL	194	—
	E	SD	193	—
	U	—	247	—
	I	—	248	Thevetin (CXLIV)
Vallaris solanacea	U	LF	249	Crude glycosidic mixture
Vinca erecta	U	—	250	Alkaloid mixture
	H	—	257, 258	Vincamine (XC)
	I	—	251	Ervamine (LXXXV)
	I	—	252, 256	Vincamine
	I	—	251, 254, 255	Vineridine (XCIV)
	I	—	251	Vinervine (LXXXVI)
Vinca major	A	—	194	—
	A	RT	259	—
	I	—	228–232	Reserpine
Araceae				
Acorus calamus	A	—	192	—
	E	RZ	193	—
Amorphophallus campanulatus	A	—	192	—
	E	RT	193	—
Cyrtosperma griffithii	See *Cyrtosperma merkusii*			
Cyrtosperma merkusii	A	SP	195	—
Dieffenbachia seguine	U	LS	225	—
Dracontium polyphyllum	A	—	192	—
	E	PL	193	—
Dracunculus vulgaris	E	PL	194	—
Lasia merkusii	See *Cyrtosperma merkusii*			
Scindapsus officinalis	E	FR	91	—
Araliaceae				
Cussonia arborea	E	RT	194	—
Hedera arborea	See *Hedera helix*			
Hedera helix	E	EX	194	—
	E	LF	197	—
Aristolochiaceae				
Aristolochia sp.	I	—	260, 261	Aristolochic acid (CI)
Aristolochia bracteata	A	—	192	—
	E	PL	193	—
Aristolochia clematitis	E	RZ	197	—
	U	—	262	—
	I	—	260, 261	Aristolochic acid
Aristolochia indica	A	—	192	—
	A	RT, PL	193	—
	A	RT	91	—
	I	—	260, 261	Aristolochic acid
Aristolochia rotunda	E	RT	197	—
	I	—	260, 261	Aristolochic acid
Asclepiadaceae				
Asclepias tuberosa	U	RT	263, 264	—
Calotropis gigantea	A	LX	265	—
	A	—	192	—
	E	LX	193	—
	U	LX	265, 266	—
	U	TW	204	—
Calotropis procera	A	—	192, 267	—
	A	PL	192, 194	—
	E	LX	193	—
	U	RT	263	—
Chlorocodon whitelii	A	PL	194	—
Daemia extensa	A	—	192	—
	E	LF	90	—
	I	—	269	Uncharacterized glycoside
Gymnema sylvestre	A	LF	194	—
	I	—	270	Betaine (CXV)
Omphalogonus nigritanus	A	LF, RT	196	—
Pergularia extensa	A	LF	196	—
	A	—	192	—
	E	LF	196	—
Tylophora asthmatica	A	—	192	—
Xysmalobium undulatum	A	RT	194	—

Table IV—(Continued)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	U	RT	271	Uzarine
Berberidaceae				
Berberis sp.	I	—	272, 274-2[illegible]	Berberine (umbellatine) (LII)
B[illegible]ur[illegible]sis	U	RT	277	—
	I	—	273	Jatrorrhizine (LIV)
Berberis aristata	A	—	192	—
	E	RT, WD	193	—
	I	—	274-280	Berberine
	I	—	280, 281, 597, 599	Palmatine (LV)
Berberis lycium	I	—	282	Berberine (umbellatine)
	I	—	274-280	Erysotrine (CXXIII)
Berberis thunbergii	U	—	283	—
	I	—	274, 280	Berberine
	I	—	284	Columbamine (isocorypalmine) (LIII)
	I	—	273	Jatrorrhizine
	I	—	281	Palmatine
Berberis vulgaris	U	SB	278, 285	Total alkaloids
	U	LF	286	—
	U	BK	287	—
	U	PL	288	—
	I	—	274-280	Berberine
	I	—	284	Columbamine
	I	—	273	Jatrorrhizine
	I	—	281	Palmatine
Caulophyllum thalictroides	A	RT	90	—
	E	RT	90, 289	—
Caulophyllum thalictroides var. *robustum*	U	—	283	—
Epimedium sempervirens	U	—	283	—
Leontice alberti	U	—	290	Alkaloid mixture
Nandina domestica	I	—	274-280	Berberine
	I	—	273	Jatrorrhizine
	I	—	291	Nandinine (XLIX)
Betulaceae				
Betula paltyphylla	U	—	283	—
Bignoniaceae				
Dolichandrone falcata	A	—	192	—
	A	FR, PL	193	—
Bombacaceae				
Adansonia digitata	A	—	192	—
	E	FS	193	—
Bombax malabaricum	U	SD	292, 293	—
Boraginaceae				
Cordia quarensis	A	RT	194	—
Heliotropium angiospermum	U	LS	294	—
Heliotropium indicum	A	FL	193	—
	A	—	192	—
	E	FL	193	—
	U	RT	295	—
	I	—	296	Retrornecine (LXXIII)
Tournefortia hirsutissima	U	LS	294	—
Bromeliaceae				
Ananas comosus	A	—	192	—
	A	LF, FR	193	—
	A	FR, JU	194	—
	E	LF, FR	193	—
	E	FR	194	—
Ananas sativus	A	LF, FR	193	—
	I	—	297-309	5-Hydroxytryptamine (LXXVII)
Buddlejaceae				
Buddleja asiatica	A	PL	193	—
	A	—	192	—
Burseraceae				
Balsamodendron mukul	A	—	192	See also *Commiphora mukul*
	E	—	193	—
Balsamodendron myrrha	A	—	192	See also *Commiphora myrrha*
Boswellia glabra	A	—	192	—
	E	BA, RA	193	—
Boswellia serrata	A	—	192	—
	E	VO, GU	193	—
Commiphora mukul	A	—	192	—
	E	GU, RE	193	—
Commiphora myrrha	A	—	192	—
	E	GU	193	—

(continued)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
Cactaceae				
Harrisia gracillis	U	LS	294	—
Lophophora williamsii	I	PL	211, 310	Hordenine
	I	—	311	Mescaline (VII)
	I	—	212, 217, 312	Tyramine
Calycanthaceae				
Calycanthus sp.	I	—	313	Calycanthine (CXIX)
Cannabaceae				
Cannabis sativa	A	—	192	—
	A	SD	193	—
	E	PL	193	—
	U	—	219, 314–316	—
	I	—	317	Nicotine (X)
Capparidaceae				
Cadaba farinosa	A	—	192	—
	E	LF, RT	193	—
	E	LF	194	—
Cadaba indica	See *Cadaba farinosa*			
Cadaba trifoliata	A	—	192	—
	E	RT, LF	193	—
Capparis aphylla	See *Capparis decidua*			
Capparis decidua	A	—	192	—
	E	PL	193	—
Capparis spinosa	A	—	192	—
	E	RB	193	—
Crataeva religiosa	E	LF	194	—
Crataeva tapia	U	LF	219	—
Gynandropsis gynandra	A	LF	194	—
Gynandropsis pentaphylla	A	—	318	—
Caprifoliaceae				
Viburnum foetidum	A	—	192	—
	E	PL	193	—
	U	LF	267	—
Caricaceae				
Carica papaya	A	FR, LX, SD	193	—
	A	—	192	—
	E	FR, LX, SD	193	—
	I	—	297–309	5-Hydroxytryptamine
Caryophyllaceae				
Lychnis miqueliana	U	—	201	—
Silene gallica var. *quinquevulnesea*	U	—	201	—
Casuarinaceae				
Casuarina equisetifolia	A	BK	195	—
Celastraceae				
Celastrus paniculatus	A	BK, LF	193	—
	A	—	192	—
	E	LF	91, 193	—
Euonymus cannabinum	A	—	192	—
Maytenus senegalensis	A	LF, RT	220	—
Chenopodiaceae				
Beta vulgaris	A	—	192	—
	E	SD, RT, LF	193	—
	E	LF, RT	194	—
Chenopodium ambrosioides	A	PL	194	—
	A	—	192	—
	E	PL	193	—
	E	LF	194, 197	—
Chenopodium vulvaria	E	LF	194	—
Mabrina ambrosioides	See *Chenopodium ambrosioides*			
Salicornia brachiata	E	AH	193	—
Salsola arbuscula	I	—	319	Salsoline (XVII)
Chloranthaceae				
Chloranthus serratus	U	—	201	—
Cochlospermaceae				
Cochlospermum insigne	U	SB	219	—
Cochlospermum tinctorium	E	RT, ST	193	—
Cochlospermum vitifolium	U	SB	219	—
Combretaceae				
Combretum gueinsii	A	RT	194	—
Terminalia bellerica	U	FR	320	—
Terminalia catappa	U	LS	294	—
Terminalia chebula	U	[illegible]	321	—
Terminalia ivorensis	I	—	322	Ellagic acid (CXXXIII)
Commelinaceae				
Aneilema conspicuum	A	—	192	—
	E	PL	193	—
Aneilema lineolatum	A	PL	193	See also *Murdannia elata*
[illegible]	A	[illegible]	[illegible]	[illegible]
[illegible]	A	[illegible]	[illegible]	[illegible]
[illegible]	E	[illegible]	[illegible]	[illegible]
[illegible]	E	LF	[illegible]	[illegible]

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
Murdannia elata	A	PL	193	—
Compositae				
Achillea millefolium	A	—	192	—
	E	FL, PL, LJ	193	—
	E	FL, LF	193	—
Anthemis nobilis	A	—	192	—
	E	VO	193	—
	E	PL	197	—
Anthemis tinctoria	E	FL, LF	197	—
Arctium lappa	U	—	201	—
Arnica sp.	U	—	324	—
Artemisia sp.	H	—	325	—
Artemisia abrotanum	E	LF, FL, SD	197	—
Artemisia absinthium	E	LF, FL	197	—
	H	—	326	—
Artemisia pontica	E	LF, FL	197	—
Artemisia siversiana	A	—	192	—
	E	PL	193	—
Artemisia vulgaris	A	PL	193	—
	A	—	192	—
	E	PL, LF, FL	193	—
	E	PL	323	—
	E	LF, RT, FL	197	—
	U	—	265	—
Atractylis lanatus	See *Carthamus lanatus*			
Atractylodes lancea	U	—	201	—
Baccharis articulata	U	—	327	—
Balsamita major	See *Tanacetum balsamita*			
Balsamita suaveolens	See *Tanacetum balsamita*			
Balsamita vulgaris	See *Tanacetum balsamita*			
Bidens pilosa	A	—	318	—
Blumea balsamifera	A	—	192	—
	E	LF	193	—
Blumea erlantha	A	—	192	—
	E	PL	193	—
Blumea lacera	A	—	192	—
	E	PL	193	—
Calcitrapa stellata	See *Centaurea calcitrapa*			
Calendula arvensis	A	—	192	—
	E	FL	193	—
	E	LF, FL	197	—
Calendula officinalis	A	—	192	—
	E	PL	197	—
	E	FL	193, 323	—
Carduus marianus	See *Silybum marianum*			
Carduus stellatus	See *Centaurea calcitrapa*			
Carthamus lanatus	E	LF, FL	197	—
Carthamus maculatus	See *Silybum marianum*			
Carthamus tinctorius	A	—	192	—
	E	FL	193	—
Centaurea calcitrapa	E	RT, FL	197	—
Centaurea centaurium	E	RT	197	—
Centaurea cyanus	A	—	192	—
	E	FL	193	—
Centaurium majus	See *Centaurea centaurium*			
Centipeda orbicularis	A	—	192	—
Chamaemelum tinctorium	See *Anthemis tinctoria*			
Chamomilla nobilis	See *Anthemis nobilis*			
Chrysanthemum indicum	A	—	192	—
	E	FL	193	—
Chrysanthemum leucanthemum	E	PL	197	—
Chrysanthemum parthenium	E	PL	197	—
Chrysanthemum sinense	E	PL	194	—
	I	—	328	Stachydrine (CXIV)
Chrysanthemum tanacetum	See *Tanacetum vulgare*			
Chrysanthemum vulgare	See *Tanacetum vulgare*			
Cichorium intybus	A	—	192	—
	E	PL	193	—
	E	SD	194	—
	E	RT	323	—
Conyza squarrosa	See *Inula conyza*			
Conyza vulgaris	See *Inula conyza*			
Costus hortensis	See *Tanacetum balsamita*			
Cota tinctoria	See *Anthemis tinctoria*			

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
Cotula sp.	A	—	192	—
	E	—	193	—
Dichrocephala chrysanthemifolia	A	PL	194	—
Doronicum pardalianches	E	RZ	197	—
Echinops echinatus	A	RT	193	—
Eriocoma floribunda	U	—	329	—
Ethulia conyzoides	A	RT	222	—
Eupatorium cannabinum	A	—	192	—
	E	PL	193	—
	E	FL, RZ, LF	197	—
Eupatorium odoratum	A	—	192	—
Gazania pinnata	E	LF, FL	194	—
Glossocarida bosvallea	A	—	192	—
	E	PL	193	—
Glossocardia linearifolia	See *Glossocardia bosvallea*			
Grangea maderaspatana	A	—	192	—
	E	RT, LF	193	—
	U	FR	330	—
	U	LF	267	—
Gutierrezia microcephala	U	—	200	Crude saponin mixture
Helianthus annuus	A	—	192	—
	E	FL	193	—
Hentrophyllum lanatum	See *Carthamus lanatum*			
Inula conyza	E	LF	197	—
Inula graveolens	E	PL	194	—
Inula squarrosa	See *Inula conyza*			
Leucanthemum parthenium	See *Chrysanthemum parthenium*			
Leucanthemum vulgare	See *Chrysanthemum leucanthemum*			
Leuzea carthamoides	U	—	331	—
Matricaria chamomilla	E	PL	197	—
Matricaria parthenium	See *Chrysanthemum parthenium*			
Melanthera scandens	A	LF	194	—
Microglossa pyrifolia	A	PL	194, 233	—
Montanoa tomentosa	A	—	90, 332	—
	E	—	332	—
Ormenis nobilis	See *Anthemis nobilis*			
Petasites sp.	I	—	333	Platyphylline (LXVIII)
	I	—	333	Senecionine (LXX)
Petasites officinalis	E	RZ, LF, FL	197	—
Porophyllum lencospermum	E	RT	334	—
Pyrethrum indicum	A	RT	193	—
	A	—	192	—
Pyrethrum parthenium	See *Chrysanthemum parthenium*			
Pyrethrum tanacetum	See *Tanacetum balsamita*			
Pyrethrum umbelliferum	A	—	192	—
	A	PL	193	—
Pyrethrum vulgare	See *Tanacetum vulgare*			
Santolina chamaecyparissus	E	LF, FL, SD	197	—
Santolina incana	See *Santolina chamaecyparissus*			
Saussurea lappa	A	—	192	—
	E	RT	91, 193	—
Senecio sp.	I	—	501–503	Cytisine (XLII)
	I	—	333	Integerrimine (LXVI)
	I	—	333	Longilobine (LXX)
	I	—	333	Platyphylline (LXVIII)
	I	—	333, 335	Pterophine[e]
	I	—	333	Retrornecine (LXXIII)
	I	—	333	Riddelliine (LXIX)
	I	—	333	Senecionine (LXX)
	I	—	333	Seneciphylline (jacobine) (LXXI)
	I	—	333	Spartioidine (LXXII)
Senecio sceleratus	I	—	333	Isatidine (LXVII)
	I	—	333	Sceleratine (LXV)
Senecio spartioides	I	—	333	Spartioidine
Senecio vulgaris	E	PL	194, 197	—
	I	—	333	Jacobine (seneciphylline)
	I	—	333	Platyphylline
	I	—	336	Senecine[e]
	I	—	333	Senecionine
	I	—	333	Seneciphylline (jacobine)
Siegesbeckia orientalis	A	—	192	—
	E	PL	193	—
Silybum marianum	E	RT, SD	197	—
	I	—	212, 217, 312	Tyramine
Sonchus asper	A	—	318	—

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part	Reference	Active Constituent(s)
Sphaeranthus sp.	A	PL	194	—
Sphaeranthus indicus	A	—	192	—
	E	PL	193	—
	U	—	337	—
Spilanthes acmella	A	—	318	—
Spina alba-hortensis	See *Silybum marianum*			
Tagetes minuta	E	LF	194	—
Tanacetum sp.	A	—	192	—
Tanacetum balsamita	E	LF, FL	197	—
Tanacetum vulgare	E	—	338	—
	E	PL	193	—
	E	FL, LF	197	—
	U	VO	339[d]	—
Tithonia diversifolia	U	LS	294	—
Tussilago farfara	A	RT, LF	193	—
	A	—	192	—
Tussilago hybrida	See *Petasites officinalis*			
Tussilago petasites	See *Petasites officinalis*			
Vernonia corymbosa	A	BU	194	—
	E	BU	194	—
Convolvulaceae				
Convolvulus bidentatus	A	PL	194	—
Convolvulus ulosepalus	A	PL	194	—
Cuscuta chinensis	A	—	204	—
Cuscuta reflexa	A	—	192	—
	A	ST, SD	193	—
	E	SD	193	—
Exogonium purga	E	TR	340	—
Ipomoea violacea	U	SD	341	Alkaloid fraction (ergonovine) (XCIII)
Operculina macrocarpa	U	TU	219	—
Rivea corymbosa	U	SD	341	Alkaloid fraction (ergonovine)
Coriariaceae				
Coriaria japonica	I	—	322	Ellagic acid
Crassulaceae				
Crassula sp.	A	RT	194	—
Cruciferae				
Anastatica hierochuntica	A	—	192	—
	A	PL	193	—
Brassica alba	A	—	192	—
Brassica cernua	U	—	201	—
Brassica juncea	E	—	193	—
Brassica nigra	A	—	192	—
Capsella bursa-pastoris	A	PL	192	—
	A	—	194	—
	E	PL	90, 194	—
	E	RT	197	—
	U	—	342	—
	I	—	212, 217, 312	Tyramine
Cheiranthus cheiri	A	—	192	—
	E	FL	193	—
Lepidium sativum	A	—	192	—
	A	SD	91, 193, 194	—
Matthiola incana	A	—	192	—
	E	LF	193	—
Matthiola tristis	A	—	192	—
	E	LF	193	—
Matthiola varia	E	LF	193	—
Nasturtium fontanum	See *Nasturtium officinale*			
Nasturtium officinale	A	—	192	—
	A	PL	90, 194	—
	E	PL	90, 194, 197	—
Raphanus sativus	A	—	192	—
	E	SD, LF	323	—
	E	SD	193, 194	—
Sisymbrium cardamine	See *Nasturtium officinale*			
Sisymbrium nasturtium	See *Nasturtium officinale*			
Cucurbitaceae				
Citrullus colocynthis	A	—	192	—
	A	RT	193	—
	E	RT	194	—
Cucumis trigonus	A	RT	193	—
	A	—	192	—
Cucurbita foetidissima	U	—	343	—
Gymnopetalum cochinchinensis	A	PL	193	—
	A	—	192	—
Luffa acutangula	A	—	192	—
Luffa acutangula var. *amara*	A	RB	193	—
Luffa cylindrica	U	LS	294	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
Luffa echinata	A	RB	193	—
	A	—	192	—
Luffa operculata	U	FR	219	—
Momordica balsamina	A	RT, FR, SD	194	—
Momordica cabrei	U	FR, BR, RT	344	—
Momordica charantia	A	PL, RT, JU	193	—
	A	—	192	—
	A	RT	194	—
	E	PL, RT, JU	193	—
Momordica cymbalaria	See *Momordica tuberosa*			
Momordica foetida	A	—	318	—
Momordica tuberosa	A	TR	193	—
	A	—	192	—
Trichosanthes bracteata	A	FR	193	—
Trichosanthes cucumerina	A	LS	193	—
	A	—	192	—
	E	LS	193	—
Trichosanthes palmata	See *Trichosanthes bracteata*			
Wilbrandia sp.	U	—	219	—
Cupressaceae				
Juniperus sp.	U	VO	345	—
Juniperus communis	A	VO	193	—
	A	—	192	—
	E	ST, VO, FR	193	—
Juniperus sabina	E	LF	197	—
	U	—	346	—
	U	VO	347–349, 919	—
	H	—	350–353	—
Thuja occidentalis	A	—	354	—
	U	—	355, 356	—
	H	—	355	—
Cyperaceae				
Carex brevicollis	I	—	357–361	Brevicolline (LXXIX)
	I	—	362, 398	Harman
Cyperus canesceus	A	—	192	—
Cyperus longus	A	—	192	—
	E	TU	193	—
Cyperus rotundus	A	—	192	—
	A	TU	193	—
	A	TU	194	—
	E	RT, TU	194	—
Cyperus scariosus	E	RT	192, 193	—
Dipsacaceae				
Scabiosa succisa	E	RZ, PX	197	—
Succisa pratensis	See *Scabiosa succisa*			
Succisa scabiosa	See *Scabiosa succisa*			
Dipterocarpaceae				
Vateria indica	A	—	192	—
Ebenaceae				
Diospyros tricolor	U	—	363	—
	I	—	363	Uncharacterized quinone[e]
Ephedraceae				
Ephedra vulgaris	U	—	364	—
	I	—	364–380	Ephedrine
	I	—	381	Pseudoephedrine (VIII)
Ericaceae				
Ledum palustre var. *nipponicum*	U	—	201	—
Erythroxylaceae				
Erythroxylum coca	A	—	192	—
	E	LF	193	—
	I	LF	382–396	Cocaine (XIII)
	I	LF	317, 798–800	Nicotine
Lyonia ovalifolia var. *elliptila*	I	—	397	Lyoniol A (lyoniatoxin) (CXL)
Euphorbiaceae				
Acalypha indica	A	—	192	—
	E	—	193	—
Acalypha petiolaris	A	RT	194	—
Antidesma ghaesaembilla	A	—	192	—
	E	WD	193	—
Croton linearis	U	LS	225	—
Croton tiglium	A	RT, SO	193	—
	A	—	192	—
Euphorbia atota	A	JU	193	—

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	A	—	192	—
Euphorbia lathyris	I	—	398	Aesculetin (CXXXIV)
Euphorbia pilulifera	U	—	399	—
Euphorbia resinifera	A	PL	193	—
	A	—	192	—
Euphorbia restituta	A	—	194	—
Euphorbia tirucalli	A	JU	193	—
	A	—	192	—
Excoecaria agallocha	A	LX	193	—
	A	—	192	—
Jatropha glandulifera	A	—	192	—
	E	LF	193	—
Jatropha multifida	A	—	192	—
	E	SO	193	—
Mildbraedia fallax	E	PL	194	—
Phyllanthus urinaria	A	—	192	—
	A	PL	193, 194	—
	E	PL	194	—
Ricinus communis	A	—	192	—
	E	LF, SO, SD	193	—
	E	LF	194	—
	U	LS	294	—
	I	—	409	Ricin[e]
	H	SO	401–409	Castor oil
Tragia involucrata	A	—	204	—
Gentianaceae				
Gentiana kurroa	A	—	192	—
	E	PL	193	—
Geraniaceae				
Erodium sp.	I	—	212, 217, 312	Tyramine
Erodium cicutarium	A	PL	194	—
	U	—	410	—
Pelargonium fumarioides	A	PL	194	—
Pelargonium reniforme	E	PL	194	—
Sarcocaulon sp.	A	PL	194	—
Gramineae				
Andropogon iwarancusa	A	—	192	—
Andropogon monticola	A	—	192	—
Andropogon muricatus	A	—	192	See also *Vetiveria zizanioides*
Andropogon schoenanthus	E	PL	194	—
Andropogon sorghum	I	—	211, 310	Hordenine
Arundo donax	A	—	192	—
	E	RZ	193, 197, 411	—
	I	—	412, 413	Gramine (= donaxine) (LXXVI)
Bambusa arundinacea	E	LF	193	—
Bambusa bambos	A	—	192	—
Brachiaria purpurascens	U	—	414	—
Coix lacryma-jobi var. *frumentacea*	I	—	415	Palmitic acid (CLIV)
Cymbopogon citratus	U	—	201	—
Cymbopogon iwarancusa	A	—	192	—
	E	PL	193	—
Cymbopogon nardus	E	PL	194	—
Dendrocalamus strictus	A	LF	193	—
	A	—	192	—
Eleusine indica	A	LF, JU	194	—
Eriocoma floribunda	A	PL	416	—
	U	—	416	—
Lolium temulentum	E	FR	197	—
	U	—	201	—
Panicum sp.	I	—	211, 310	Hordenine
Panicum maximum	U	LS	294	—
Vetiveria zizanioides	E	RT, RZ	193	—
Guttiferae				
Garcinia morella	A	—	192	—
	A	GU, RE	193	—
Hypericum perforatum	A	—	192	—
	E	PL	193, 323	—
	U	LF	267	—
Mesua ferrea	A	—	192	—
	E	PL	193	—
Ochrocarpus longifolius	A	—	192	—
Halorrhagidaceae				
Gunnera perpensa	A	RT	194	—
Iridaceae				
Crocus sativus	A	—	192	—
	E	—	323, 417	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	E	SG, SL	193	—
	H	—	418	—
	U	—	419	—
Iris foetidissima	E	RZ	197	—
Iris germanica	U	RT	420	—
Iris sisyrinchium	U	SD	421	—
Spatula foetida	See *Iris foetidissima*			
Labiatae				
Ajuga genevensis	I	—	422	—
Ballota foetida	See *Ballota nigra*			
Ballota nigra	E	LF, FL	197	—
Calaminta clinopodium	See *Clinopodium vulgare*			
Cataria vulgaris	See *Nepeta cataria*			
Clinopodium vulgare	E	LF, FL	197	—
Coleus sp.	A	LF	194	—
Coleus barbatus	E	PL	194	—
Coleus kilimandscharica	A	LF	194, 423	—
Fuerstia africana	E	PL	194	—
Hedemoa pulegioides	E	LF, FL,	424	—
	U	VO	425[d]	—
Hyptis pectinata	A	—	192	—
	E	PL	193	—
Hyssopus officinalis	A	—	192	—
	E	LF, PL	193	—
	E	LF	197, 323	—
Hyssopus vulgaris	See *Hyssopus officinalis*			
Iboza riparia	U	—	201	—
Lagochilus sp.	U	—	426	—
Lagochilus inebrians	I	—	328	Stachydrine (CXIV)
Lamium sp.	I	—	212, 217, 312	Tyramine
Lamium album	E	PL	197	—
Lavandula stoechas	A	—	192	—
	E	PL	193	—
Leonotis nepetaefolia	A	—	192	—
	E	PL	193	—
Leonurus cardiaca	U	—	427	K ions (?)
	I	—	428	Leonurine[e]
	I	—	328	Stachydrine
Leonurus rubiastrum	U	—	427	K ions
Leonurus sibiricus	I	LF	429	Uncharacterized alkaloid
	I	—	428	Leonurine[e]
Leucas cephalotes	A	—	192	—
	E	PL	193	—
Leucas stelligera	A	—	192	—
	E	PL	193	—
Marrubium nigrum	See *Ballota nigra*			
Marrubium vulgare	A	—	192	—
	E	PL	197	—
	U	—	430	—
Melissa graveolens	See *Melissa officinalis*			
Melissa officinalis	E	LF, FL	197	—
Mentha arvensis	A	—	192	—
	E	PL	193	—
Mentha piperita	E	LF, FL	197	—
Mentha pulegium	A	VO	194	—
	E	VO	194	—
Nepeta cataria	A	—	318	—
	E	LF, FL	192, 193, 197	—
Nepeta vulgaris	See *Nepeta cataria*			
Ocimum basilicum	A	—	204	—
	E	PL	192, 193	—
Ocimum sanctum	A	—	204	—
Origanum amaracus	E	—	197	—
Origanum dictamnus	E	LF, FL	197	—
Origanum vulgare	A	—	192	—
	E	PL	193	—
Orthosiphon pallidus	U	—	431	—
Rosmarinus officinalis	A	—	192	—
	A	FL	194	—
Salvia sp.	E	LF	323	—
Salvia officinalis	A	—	192	—
	E	LF	193	—
Salvia plebeia	A	SD	193	—
	A	—	192	—
Salvia sclarea	E	LF, FL	194	—
Stachys aquatica	See *Stachys palustris*			
Stachys betonicaefolia	U	—	432, 433	—
Stachys lanata	U	—	434	—
	I	—	328	Stachydrine
Stachys palustris	A	—	192	—

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	E	PL	193	—
	E	LF, FL	194	—
	I	—	328	Stachydrine
Stachys sylvatica	A	—	192	—
	E	PL	193	—
	U	—	435	—
	I	—	328	Stachydrine
Teucrium polium	U	—	436	—
Thymus durius	See *Thymus vulgaris*			
Thymus serpyllum	A	PL	194	—
	A	—	192	—
	E	PL	193	—
Thymus vulgaris	E	PL	194, 197	—
Ziziphora tenuior	A	—	192	—
	E	PL	193	—
Lauraceae				
Cinnamomum camphora	A	PL	194	—
	A	—	192	—
	E	—	193	—
	I	—	437	Camphor (CXXXVII)
Cinnamomum cassia	A	BK	193	—
	A	—	192	—
	E	BK	193	—
Cinnamomum tamala	A	—	192	—
Cinnamomum zeylanicum	E	VO	193	—
Laurus nobilis	A	—	192	—
	E	FR, LF	193	—
Persea sp.	I	—	212, 217, 312	Tyramine
Persea americana	E	FP	194	—
	I	—	297-309	5-Hydroxytryptamine
Persea gratissima	E	LF	197	—
	I	—	297-309	5-Hydroxytryptamine
Lecythidaceae				
Combretodendron africanum	U	—	438	—
Leguminosae				
Abrus precatorius	A	SD	193	—
	A	—	192	—
	E	SD	91	—
Acacia sp.	A	WD	194	—
	I	—	211, 310	Hordenine
	I	—	317, 798-800	Nicotine
	I	—	212, 217, 312	Tyramine
Acacia nilotica	E	LF	194	—
Acacia rugata	A	—	192	—
Aeschynomene leptophylla	A	LF	233	—
Albizia sp.	I	—	439	Albitocin[e]
Albizia adianthifolia	U	RT	440	Saponin glycoside (?)
Albizia chinensis	A	PL	194	—
	U	—	441	—
	U	BK	440	Saponin glycoside (?)
Albizia grandibracteata	U	—	441	—
	U	BK	440	Saponin glycoside (?)
Albizia gummifera	U	—	441	—
	U	BK	440	Saponin glycoside (?)
	I	—	442, 443	Albitocin[e]
Albizia lebbeck	A	BK, SD	91	—
Anagyris foetida	E	FR	197	—
	I	—	250-252, 361, 385, 444-493	Sparteine (XL)
Astragalus hamosus	A	—	192	—
	E	PL	193	—
Bauhinia gapini	U	LS	294	—
Bauhinia retusa	A	—	192	—
	E	GU	193	—
Butea frondosa	See *Butea monosperma*			
Butea monosperma	A	—	192	—
	E	FL	193	—
Caesalpinia bonduc	E	FL	194	—
Caesalpinia crista	A	—	192	—
	E	LF, BK	193	—
Caesalpinia jayabo	A	—	192	—
	E	LF	193	—
Caesalpinia nuga	See *Caesalpinia crista*			
Caesalpinia pulcherrima	A	—	192	—
	A	LF, SD	194	—
	E	LF, BK, PL	193	—
Caesalpinia sappan	A	—	192	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	E	WD	194	—
Caesalpinia sepiaria	A	—	192	—
Cassia absus	I	—	494–498	Chaksine (CXVII)
	I	—	499	Erysotrine (CXXIII)
Cassia didymobotrya	A	—	318	—
Cassia fistula	A	FR	91	—
Cassia lanceolata	A	—	192	—
	A	LF	193	—
Cassia occidentalis	U	LS	225	—
Cassia tora	I	SD	500	Uncharacterized principle
Cicer arietinum	A	—	192	—
	A	LF	193	—
Crotalaria incana	A	—	318	—
	I	—	333	Integerrimine (LXVI)
Crotalaria juncea	A	—	192	—
	A	LF	91	—
	E	LF	91	—
	E	SD	193	—
	I	—	333	Riddelliine (LXIX)
	I	—	333	Senecionine
Crotalaria spectabilis	I	—	333	Monocrotaline (LXIV)
Cytisus sp.	I	—	501–503	Cytisine (XLII)
	I	—	504	D-Lupanine (XXXVI)
	I	—	212, 217, 312	Tyramine
Cytisus laburnum	I	—	501–503	Cytisine
	I	—	250, 252, 361, 385, 444, 493	Sparteine
Cytisus scoparius	I	—	501–503	Cytisine
	I	—	250, 252, 361, 385, 444–493	Sparteine
	I	—	212, 217, 312	Tyramine
	H	—	250–252, 361, 385, 444–493	Sparteine
Dalbergia ferruginea	A	SW, RT	90	—
	E	SW, RT	90	—
	I	—	869	Coumingidine (CVI)
	I	—	869, 870	Coumingine (CVII)
Erythrophleum guineense	I	—	869	Cassaidine (CIV)
	I	—	869, 870	Cassaine (CV)
	I	—	869–872	Erythrophleine[e]
	I	—	869, 870	Homophleine[e]
	I	—	870	Norcassaidine (CVIII)
Genista sp.	I	—	501–503	Cytisine
	I	—	867, 868	Retamine (XXXIX)
	I	—	250, 252, 361, 385, 444–493	Sparteine
Genista tinctoria	U	FL	873	—
	I	FL	873	Sugar-like principle[e]
	I	—	501–503	Cytisine
	I	—	876, 878, 879	D-Lupanine (XXXVI)
Glycyrrhiza sp.	U	—	201	—
Glycyrrhiza glabra	A	—	192	—
	E	RT	193, 323	—
Indigofera linifolia	A	—	192	—
Indigofera suffruticosa	A	—	332	—
Lespedeza bicolor var. *japonica*	U	—	201	—
	I	—	874	*N,N*-Dimethyltryptamine (LXXIV)
	I	—	874	*N,N*-Dimethyltryptamine *N*-oxide (LXXV)
	I	—	874	5-Methoxy-*N,N*-dimethyltryptamine (LXXVIII)
Leucaena glauca	A	—	192	—
	E	RT, BK	194	—
Lupinus sp.	I	—	875	17-Hydroxylupanine (XXXV)
	I	—	875	Lupamine *N*-oxide (XXXVII)
	I	—	876	17-Oxolupanine (XXXVIII)
	I	—	504	Lupinine (XLIII)
	I	—	250, 252, 361, 385, 444–493	Sparteine
	I	—	504	Trilupine (XLI)
Lupinus albus	U	—	877	—
	I	—	875	17-Hydroxylupanine
	I	—	876, 878, 879	D-Lupanine (XXXVI)
	I	—	250, 252, 361, 385, 444–493	Sparteine
Lupinus perennis	I	—	875	13-Hydroxylupanine (XXXIV)
	I	—	875	17-Hydroxylupanine
Lupinus westianus	I	—	876, 878, 879	D-Lupanine

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	I	—	250, 252, 361, 385, 444, 493	Sparteine
Maackia amurensis	U	BK	880	—
	I	—	876, 878, 879	D-Lupanine
Medicago sativa var. *italica*	U	—	201	—
	I	—	328	Stachydrine
Mucuna cylindrosperma	I	—	881, 882	Physostigmine (XCII)
Mucuna pruriens	A	—	883	See also *Mucuna prurita*
	I	LF	883	*N,N*-Dimethyltryptamine
	I	LF	883	*N,N*-Dimethyltryptamine *N*-oxide
	I	LF	883	5-Hydroxytryptamine (LXXVII)
	I	LF	883	5-Methoxy-*N,N*-dimethyltryptamine (LXXVIII)
	I	—	317, 798–800	Nicotine
Mucuna prurita	A	—	192, 883	—
	E	RT	193	—
Physostigma venenosum	I	—	881, 882	Physostigmine
	I	SD	881, 882	Physostigmine
Pisum sativum	U	SD	884	—
	I	—	212, 217, 312	Tyramine
Pithecellobium multiflorum	U	GA, SB	219	—
Poinciana pulcherrima	A	—	192	—
Rhynchosia minima	A	—	192	—
	A	LF	193	—
Saraca indica	A	—	192	—
	E	BK	193	—
	I	—	885, 886	Phenolic glycoside
Sarcococca saligna	I	—	499	Erysotrine
Sesbania aegyptiaca	A	—	192	See also *Sesbania sesban*
	E	SD	91	—
Sesbania sesban	E	SD	193	—
Smirnovia turkestana	I	—	505	Sphaerophysine
	I	—	501–503	Cytisine
	I	—	250, 252, 361, 385, 444–493	Pachycarpine (sparteine)
Spartium junceum	U	—	889	—
	I	—	501–503	Cytisine
Sphaerophysa salsula	I	—	505	Sphaerophysine
Sutherlandia microphylla	E	LF	194	—
Swartzia madagascariensis	A	SP	194	—
Tamarindus indica	A	—	192	—
Tephrosia lupinifolia	A	RT	194, 920	Rotenone
Tephrosia piscatoria	I	—	504	Rotenone
Trachylobium hornemannianum	A	—	192	—
	E	GU	193	—
Trigonella foenum-graecum	A	—	192	—
	E	PL, SD	193	—
	E	SD	91	—
	U	SD	201, 507	—
Uraria lagopoides	A	PL	193	—
	A	—	192	—
	U	—	508	—
Liliaceae				
Agapanthus africanus	A	RT	194	—
Aletris farinosa	U	RZ, RT	509	—
Allium cepa	A	—	192	—
	E	BU, JU	193	—
	U	—	510	—
Allium fistulosum	U	—	201	—
Allium kurrat	U	LF	511	—
Allium sativum	A	—	192	—
	E	BU	193	—
	U	BU	510, 512, 513	—
Allium schoenoprasum	A	—	192	—
	E	BU	193	—
Aloe sp.	H	—	514	—
Aloe barbadensis	A	—	192	—
	E	PL	193	—
Aloe capensis	U	—	515	—
Aloe ferox	A	LF	194	—
Aloe littoralis	E	PL	193	—
Aloe perryi	A	—	192	—
Aloe vera	See *Aloe barbadensis*			
Asparagus acutifolia	E	—	90	—
Asparagus officinalis	A	—	192	—
	E	FR, PL	90	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	E	FR	194	—
Asparagus striatus	A	TU	194	—
Asphodelus sp.	U	—	516	—
Chlorophytum comosum	A	TU	194	—
Colchicum sp.	I	—	517, 518	Colchicine (CXVIII)
Dipcadi glaucum	A	PL, BU	194	—
Eriospermum latifolium	E	TU	194	—
Fritillaria roylei	I	—	519	Peimine (verticine) (C)
	I	—	519	Fritillarine (CII)
	I	—	520, 521	Fritimine[e]
Gloriosa superba	A	—	192	—
	A	RS	194, 204	—
	A	TU	91, 193	—
	E	TU	91, 193	—
Lilium candidum	E	BU, PL	197	—
Lomatophyllum reflexum	E	FL	90	—
Ornithogalum eckloni	A	PL	194	—
Urginea indica	A	—	192	—
	E	BU	193	—
Veratrum sp.	I	—	522–524	Veratrine (CI)
Linaceae				
Linum usitatissimum	A	—	192	—
	E	—	193	—
Loganiaceae				
Gelsemium sempervirens	I	—	525–527	Gelsemicine (XCVI)
	I	—	528	Gelsemine (XCVII)
Strychnos sp.	I	—	529–547	*d*-Tubocurarine (XXXIII)
	I	—	548	Macusine B (LXXXIV)
Strychnos aculeata	A	PU	549	—
Strychnos nux-vomica	A	—	192	—
	E	SD	91	—
	E	FR	193	—
	I	—	550	Brucine (XCVIII)
	I	—	551–558	Strychnine (XCIX)
Strychnos toxifera	I	—	548	Macusine B
Loranthaceae				
Oryctanthus occidentalis	U	LS	225	—
Phoradendron sp.	I	—	312	Tyramine
Phoradendron rubrum	U	LS	225	—
Viscum album	I	—	559	"Cardiac principle"
	I	—	312	Tyramine
Viscum capense	E	ST	194	—
Lycopodiaceae				
Lycopodium sp.	I	—	560	Complanatine (CXI)
	I	—	560	*Lycopodium* alkaloid L-9 (lycofawcine) (CXIII)
	I	—	560, 561	Lycopodine (CIX)
	I	—	560	Obscurine (CXII)
Lycopodium annotinum	I	—	560, 561	Annotinine (CX)
	I	—	560, 561	Lycopodine
	I	—	317, 798–800	Nicotine
	I	—	560	Obscurine
Lycopodium selago	E	PL	197	—
	I	—	560, 561	Lycopodine
Lythraceae				
Lawsonia alba	See *Lawsonia inermis*			
Lawsonia inermis	A	—	192	—
	A	RT	193	—
	E	BK, FR	193	—
Woodfordia floribunda	A	PL	194	—
	E	PL	194	—
Magnoliaceae				
Michelia champaca	A	—	192	—
	E	RT, RB	193	—
	E	RT, FL	91	—
Malpighiaceae				
Byrsonima crassifolia	A	BK, FL, FR	90	—
Byrsonima sericea	U	SB	219	—
Malvaceae				
Abelmoschus manihot	E	BK	193	—
Abutilon indicum	A	—	318	—
	A	PL	194	—
Abutilon zanzibaricum	A	—	318	—
Gossypium sp.	U	LS	225	—
Gossypium arboreum	A	—	204	—
Gossypium barbadense	A	—	562	—
	E	—	562	—
Gossypium herbaceum	A	—	192	—
	A	PL	194, 562	—
	A	RB, SD	193	—

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	A	RB	91	—
	E	—	562	—
	E	RB	193, 197	—
	E	PL	194	—
Gossypium hirsutum	A	—	192	—
	E	RT	193, 562	—
	E	—	562	—
	I	—	297–309	5-Hydroxytryptamine
Hibiscus manihot	A	—	192	See also *Abelmoschus manihot*
Hibiscus rosa-sinensis	A	—	192	—
	E	FL	91, 193	—
Malva moschata	U	—	201	—
Urena lobata	A	RT	193	—
	A	—	192	—
Melastomataceae				
Memecylon amplexicaule	A	RT	193	—
Meliaceae				
Azadirachta indica	E	LJ, FL	193	—
Cedrela toona	A	—	192	—
	E	FL	193	—
Melia azadirachta	A	—	192	See also *Azadirachta indica*
Melia azedarach	A	—	192	—
Trichilia emetica	A	—	192	—
	E	BK	193	—
Walsura piscidia	A	—	192	—
	E	BK	193	—
Menispermaceae				
Anamirta cocculus	I	—	563–566	Picrotoxin (CXXXIX)
Arcangelisia flava	A	PL	567	—
	I	—	224–280	Berberine
	I	—	284	Columbamine
	I	—	280–281	Palmatine
	I	—	273	Jatrorrhizine
Chondodendron sp.	I	—	529–547	*d*-Tubocurarine
Cissampelos mucronata	A	RT	96	—
Cissampelos pareira	A	—	192	—
	E	RT	193, 194	—
Jateorhiza columba	I	—	273	Jatrorrhizine
	I	—	280, 281, 597, 599	Palmatine
Menispermum dauricum	I	—	568	Dauricine (XXXII)
	I	—	569–574	Parasinomenine[e]
	I	—	575–582	Sinomenine (LXII)
Pycnarrhena manilliensis	A	—	195	—
Tinospora bakis	E	RT	196	—
	I	—	280, 281, 597, 599	Palmatine
	I	—	274–280	Berberine
Molluginaceae				
Mollugo pentaphylla	A	—	192	—
Moraceae				
Antiaris toxicaria	U	JU	583, 584	—
Cecropia carbonaria	U	LF	219	—
Ficus sycomorus	A	—	318	—
Moringaceae				
Moringa oleifera	A	—	192	—
	A	RT, SB	193	—
	E	RT, SB	193	—
Moringa pterygosperma	A	RB	193, 194	See also *Moringa oleifera*
	I	—	583	Uncharacterized alkaloid
Myristicaceae				
Myristica fragrans	A	—	192	—
	A	PL	193	—
Myrsinaceae				
Embelia robusta	A	—	204	—
Embelia tsjeriam-cottam	See *Embelia robusta*			
Myrtaceae				
Myrtus communis	A	—	192	—
	E	FR	193	—
Nyctaginaceae				
Boerhaavia coccinea	U	RT	219	—
Olacaceae				
Liriosma ovata	U	BK	585	—
Oleaceae				
Jasminum multifida	A	SD	193	—
Jasminum multiflorum	E	RT	193	—
Jasminum officinale	A	—	192	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
Jasminum officinale var. *grandiflorum*	E	PL	193	—
Jasminum pubescens	See *Jasminum multiflorum*			
Jasminum sambac	A	—	192	—
	E	RT	193	—
Olea cuspidata	A	—	192	—
	E	FR	193	—
Phyllyrea latifolia	See *Phyllyrea media*			
Phyllyrea media	E	LF	197	—
Orchidaceae				
Dendrobium sp.	I	—	586	Dendrobine (CXX)
Oxalidaceae				
Oxalis acetosella	E	PL	194	—
Paeoniaceae				
Paeonia emodi	U	TU	587	—
Paeonia officinalis	E	RT	197	—
Palmae				
Areca catechu	A	—	192	—
	E	SD	193	—
	U	SD	588, 589	Tannin (?)
	I	—	590, 591	Arecoline (XI)
Cocos nucifera	A	—	192	—
Pandanaceae				
Pandanus odoratissimus	U	RT	592	—
Pandanus tectorius	A	RT	192	—
Papaveraceae				
Adlumia fungosa	I	—	593, 594	Adlumine (XIX)
	I	—	593	Bicuculline (XX)
Argemone mexicana	A	RT	195	—
	E	SO	194	—
	U	RS	595	Total alkaloids
	U	—	201	—
	I	—	274–280	Berberine
	I	—	596–598	Chelerythrine (XLIV)
	I	—	201, 597, 599	Protopine (LVIII)
Chelidonium majus	U	—	201	—
	I	—	274, 280	Berberine
	I	—	596–598	Chelerythrine
	I	—	597, 918	Chelidonine (XLV)
	I	—	201, 597, 599	Protopine (LVIII)
	I	—	250–252, 361, 385, 444–493	Sparteine
	I	—	312	Tyramine
Corydalis sp.	A	—	192	—
	E	RT	193	—
	I	—	274–280	Berberine
	I	—	593	Bicuculline
	I	—	600	Corlumine (XXII)
	I	—	597	Capauridine [(±)-capaurine] (XLVI)
	I	—	597	Capnoidine (XXI)
	I	—	601	Cularine (CXXI)
	I	—	597	Ochotensine (CXXII)
	I	—	597	Ophiocarpine (L)
	I	—	280, 281, 597, 599	Palmatine
Corydalis ambigua	I	—	602	*Corydalis alkaloid* B (tetrahydropalmatine) (LI)
	I	—	597	Adlumine
	I	—	602	*Corydalis* alkaloid J[e]
	I	—	602	*Corydalis* alkaloid L[e]
	I	—	602	*Corydalis* alkaloid M[e]
	I	—	280, 281, 597, 599	Palmatine
	I	—	597	Tetrahydropalmatine
	I	—	597	Adlumidine (XVIII)
Corydalis incisa	I	—	280, 281, 597, 599	Protopine
	I	—	597	Tetrahydropalmatine
Corydalis ochotensis	I	—	603–605	Cryptocavine (cryptopine) (LVI)
	I	—	597	Ochotensine
	I	—	201, 597, 599	Protopine
Corydalis tuberosa	I	—	597	Canadine (CXXV)
	I	—	597	Corydaline (XLVIII) (*Corydalis* alkaloid A)
	I	—	597	Tetrahydropalmatine
Fumaria micrantha	U	—	843	—
Glaucium flavum	U	—	606	—
	I	—	596, 598	Chelerythrine

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	I	—	597, 918	Chelidonine (XLV)
	I	—	201, 597, 599	Protopine
Glaucium rubrum	U	—	606	—
Hunnemannia fumariaefolia	I	—	274–280	Berberine
	I	—	596–598	Chelerythrine
	I	—	603	Hunnemannine (LVII)
Macleaya cordata	U	—	201	—
	I	—	596, 598	Chelerythrine
	I	—	201, 597, 599	Protopine
Papaver sp.	I	—	607, 849	Narcotine (XXIV)
	I	—	607, 849, 851, 852, 864, 865	Thebaine (LXIII)
Papaver somniferum	I	—	607, 865	Codeine (LX)
	I	—	608, 848–863	Morphine (LXI)
	I	—	609, 850, 852, 866	Papaverine (XVI)
Sanguinaria canadensis	A	—	603	—
	U	RT	603	Total alkaloids
	I	—	274–280	Berberine
	I	—	596–598	Chelerythrine
	I	—	201, 597, 599	Protopine
Passifloraceae				
Passiflora foetida	A	—	192	—
	E	LF	193	—
	I	—	297–309	5-Hydroxytryptamine
	U	—	610	—
Passiflora incarnata	U	—	828	Harman (LXXXI)
	U	—	823–826	Harmaline (LXXX)
Pedaliaceae				
Dicerocaryum zanguebaricum	A	LF, JU	194	—
Pedalium murex	A	FL	194	—
	A	—	192	—
	E	FJ, LF	193	—
	E	FL	194	—
Sesamum indicum	A	SD, OL	194	—
	A	SD	193	—
	A	—	192	—
	E	SD	193	—
	E	SD, OL	194	—
Phytolaccaceae				
Petiveria alliaceae	U	LS	294	—
Phytolacca americana	U	—	201	—
Phytolacca decandra	A	RT	611	—
	A	LF, SH	194	—
Pinaceae				
Pinus longifolia	A	—	192	See also *Pinus roxburghii*
Pinus ponderosa	U	LF	612	—
Pinus roxburghii	E	GU	193	—
Piperaceae				
Piper aurantiacum	A	FR	193	—
	A	—	192	—
	U	—	613	—
Piper auritum	U	LS	225	—
Piper betle	A	—	204	—
Piper longum	A	FR	91, 193	—
	A	—	192	—
	E	FR	91, 193	—
Piper nigrum	A	—	192	—
	A	FR	91, 193, 194	—
Plantaginaceae				
Plantago sp.	A	—	318	—
Plumbaginaceae				
Plumbago capensis	U	LS	294	—
Plumbago europaea	I	—	614, 615	Plumbagin (CXXXVI)
Plumbago indica	A	RT	193	—
Plumbago rosea	A	—	193	See also *Plumbago indica*
	U	RT	192, 616	—
Plumbago viscosa	See *Plumbago zeylanica*			
Plumbago zeylanica	A	RT	193	—
	A	PL	194, 195	—
	A	—	192	—
	I	—	614, 615	Plumbagin
Polygalaceae				
Polygala amara	E	RT	197	—
Polygala amarella	See *Polygala amara*			
Polygala senega	U	—	201	—
Polygala teretifolia	A	PL	194	—
Polygala uliginosa	See *Polygala amara*			
Securidaca longepedunculata	A	RB	194	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
Polygonaceae				
Antigonon leptopus	U	LS	294	—
Fagopyrum cymosum	U	—	201	Rutin (CXLVII)
Polygonum aviculare	H	—	616	—
Polygonum bistorta	U	—	201	—
Polygonum hydropiper	A	PL	323	—
	A	—	192	—
	E	PL, LF	193	—
Polygonum senegalense	A	LF	233	—
Rheum emodi	A	—	192	—
	E	RT	193	—
Triplaris gardenriana	U	SB	219	—
Polypodiaceae				
Adiantum capillus-veneris	A	—	192	—
	E	PL	193	—
Adiantum pedatum	A	—	192	—
	E	PL	193	—
Adiantum venustum	A	—	192	—
	E	FD	193	—
Asplenium adiantum-nigrum	A	—	192	—
	E	FD	193	—
Dryopteris filix-mas	A	RT	90	—
	A	—	192	—
Pteridium aquilinum	E	RT	194	—
Portulacaceae				
Portulaca oleracea	U	LS	225	—
Talinum cunefolium	A	—	318	—
Primulaceae				
Androsale septentrionalis	A	PL	616	—
Cyclamen europaeum	E	TU	197	—
Cyclamen persicum	A	—	192	—
	E	—	193	—
Punicaceae				
Punica granatum	A	RB	194	—
	A	—	193	—
	E	RB	194	—
	U	FP	616	—
Ranunculaceae				
Anemone obtusiloba	E	LF, BK	193	—
Clematis hirsuta	A	LF	617	—
Coptis japonica	U	—	618	Crude alkaloids
	I	—	274–280	Berberine
	I	—	284	Columbamine
	I	—	273	Jateorrhizine (= jatrorrhizine)
	I	—	280, 281, 597, 599	Palmatine
Helleborus niger	A	—	192	—
	A	RT	90	—
	E	RZ	193	—
Hydrastis canadensis	U	—	619	—
	I	—	274–280	Berberine
	I	—	597	Canadine
	I	—	620–627	Hydrastine (XXIII)
	I	—	628–633	Hydrastinine (XV)
Jateorhiza palmata	U	—	618	Alkaloid extract
	I	—	280, 281, 597, 599	Palmatine
Melanthium sativum	See *Nigella sativa*			
Nigella sativa	A	—	192	—
	A	SD	91	—
	E	SD	91, 193, 197	—
Pulsatilla sp.	U	—	634	—
Ranunculus sp.	I	—	297–309	5-Hydroxytryptamine
Ranunculus sceleratus	A	—	192	—
	E	PL	193	—
Thalictrum sp.	I	—	358, 361	Thalictrimine (β-allocryptopine) (LIX)
Thalictrum revolutum	U	—	635, 636	Tertiary alkaloids
Rhamnaceae				
Zizyphus abyssinica	A	RT	220	—
Zizyphus joazeiro	U	SB	219	—
Zizyphus mauritiana	U	LS	294	—
Zizyphus undulata	U	SB	219	—
Rosaceae				
Caryophyllata urbana	See *Geum urbanum*			
Caryophyllum officinalis	See *Geum urbanum*			
Geum caryophyllum	See *Geum urbanum*			
Geum urbanum	E	RZ	197	—
Hagenia abyssinica	A	—	192	—

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	A	PL	193	—
Prunus sp.	I	—	297–309	5-Hydroxytryptamine
	I	—	212–217	Tyramine
Prunus amygdalus var. *amara*	E	SD	194	—
Prunus amygdalus var. *dulcis*	E	SD	194	—
Prunus cerasus	E	SD	194	—
Prunus mahaleb	A	—	192	—
	E	FR	193	—
Prunus persica	A	—	192	—
	E	SD	193	—
Pyracantha angustifolia	U	—	201	—
Rubus moluccanus	A	—	192	See also *Rubus rugosus*
Rubus rigidus	A	RT	194	—
Rubus rugosus	A	LF	193	—
	E	LF	193	—
Rubiaceae				
Borreria verticillata	U	RT	219	—
	I	—	637	Emetine (CXXVIII)
Cephaelis ipecachuana	I	—	637	Emetine
Cinchona calisaya	A	—	192	—
	E	—	193	—
	I	—	638	Cinchonidine (XXVII)
	I	—	638, 639	Cinchonine (XXVIII)
	I	—	638, 640	Quinidine (XXX)
	I	—	641, 682	Quinine (XXXI)
	H	—	347, 402–404, 408, 409, 683–767	Quinine
Cinchona ledgeriana	I	—	682	Hydroquinine (XXIX)
Crossopteryx africana	See *Crossopteryx febrifuga*			
Crossopteryx febrifuga	A	BK	222	—
Crossopteryx kotschyana	See *Crossopteryx febrifuga*			
Diodia barbeyana	U	RT	219	—
Guettarda angelica	U	RB	219	—
Mitragyna inermis	I	—	768, 769	Mitrinermine (XCIV) (rhynchophylline)
Mitragyna stipulosa	I	—	768, 769	Mitrinermine (rhynchophylline)
Dalbergia sissoo	A	BK, WD	193	—
	A	—	192	—
Delonix regia	U	SB	219	—
Derris chinensis	I	—	194, 920	Rotenone (CXLVIII)
Derris elliptica	I	—	194, 920	Rotenone
Desmodium retroflexum	A	—	192	—
	E	RT	193	—
Desmodium tiliaefolium	A	—	192	—
Dolichos biflorus	A	—	192	—
	E	SD	193	—
Dolichos lablab	A	—	192	—
	E	LF	193	—
Elephantorrhiza sp.	A	BK	194	—
Entada africana	A	BK	194	—
Entada phaseoloides	A	SD	194	—
Eremosparton flaccidum	I	—	505	Sphaerophysine (CXVI)
Erythrina indica	A	—	192	See also *Erythrina variegata* var. *occidentalis*
Erythrina suberosa	I	—	499	Erysotrine (CXXIII)
Erythrina variegata	A	—	192	—
Erythrina variegata var. *occidentalis*	E	LF	193	—
Erythrina velutina	U	SD	219	—
Erythrophleum coumingo	I	—	869	Coumingaine[e]
Morinda citrifolia	A	—	192	—
	E	FR	193	—
Oldenlandia affinis	U	PL	770	—
	I	—	771, 772	Two polypeptides[e]
Oldenlandia herbacea	A	PL	194	—
Paederia foetida	A	—	192	—
	E	PL	193	—
Pentas purpurea	E	RT	194	—
Pseudocinchona africana	I	—	773, 774	Corynanthine (LXXXVIII)
Randia dumetorum	A	—	192	—
	A	FP	193	—
Rondeletia africana	See *Crossopteryx febrifuga*			
Rondeletia febrifuga	See *Crossopteryx febrifuga*			
Rubia cordifolia	A	—	192	—
	A	PL	194	—
	E	RT	193, 194	—
Rubia major	See *Rubia tinctorum*			
Rubia tinctorum	A	—	192	—

(*continued*)

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	E	RT	193, 197	—
Tocoyena formosa	U	RB	219	—
Uncaria sp.	I	—	775	Mitrinermine (rhynchophylline)
Uncaria gambier	I	—	775	Gambirine (LXXXVII)
Rutaceae				
Citrus sp.	I	—	776	Hesperidin (CXLV)
	I	—	212–217	Tyramine
Clausena anisata	A	PL, LF	194	—
Dictamnus albus	A	—	192	—
	E	RT	197	—
	I	—	777	Dictamnine (XXV)
	I	—	778	Skimmianine (XXVI)
Dictamnus fraxinella	See *Dictamnus albus*			
Evodia hortensis f. hortensis	E	BJ	779	—
	I	—	274, 280	Berberine
Evodia inu-ankend	E	FL, LF	193	—
Evodia roxburghiana	See *Evodia inu-ankend*			
Evodia rutaecarpa	U	—	201	—
Lunasia amara	I	—	780	Lunamarine (CXXIV)
Pilocarpus jaborandi	I	LF	781, 786	Pilocarpine (CXXVI)
Ruta graveolens	A	—	192	—
	A	PL	90, 194, 323	—
	A	RT	91	—
	E	PL	90, 193, 194, 323	—
	E	RT	91	—
	E	LF	197	—
	U	—	787, 789, 790	—
	H	—	326	—
	I	—	778	Skimmianine
Ruta hortensis	U	PL	791	—
Ruta montana	A	LF	197	—
Ruta sylvestris-major	See *Ruta graveolens*			
Santalaceae				
Santalum album	A	—	192, 193	—
Thesium hystrix	A	RT	194	—
Sapindaceae				
Cardiospermum halicacabum	A	—	192	—
	A	PL	194	—
	E	RT, LF	193	—
	E	PL	194	—
Sapindus emarginatus	A	FR, SD	91, 193	—
	E	SD	193	—
Sapindus trifoliatus	A	FR	91	See also *Sapindus emarginatus*
	A	—	192	—
Schmidelia affinis	See *Rhus longipes*			
Sapotaceae				
Mimusops elengi	A	FR	195	—
Saxifragaceae				
Ribes americanum	E	RT	792	—
Scrophulariaceae				
Buchnera ciliata	A	PL	793	—
Celsis caucasica	A	—	192	—
Herpestis monnieri	I	—	794	Saponin glycoside
	I	—	317, 798–800	Nicotine
Pedicularis palustris	I	—	795	Uncharacterized glycoside
Picrorhiza kurroa	A	—	192	—
	A	RZ	193	—
	E	RZ	193	—
	E	RT	91	—
Scoparia dulcis	U	RT	219	—
Sutera atropurpurea	A	FL	194	—
	E	FL	194	—
Simaroubaceae				
Picrasma ailanthoides	U	—	201	—
Simarouba versicolor	U	RB	219	—
Solanaceae				
Capsicum frutescens	U	LS	294	—
Datura tatula	U	—	201	—
	I	—	796, 797	Scopolamine (XIV)
Lycium barbatum	A	—	192	—
	E	FR	193	—
Nicotiana tabacum	A	LF	194	—
	I	—	317, 798–800	Nicotine (X)
Physalis minima	A	PL	194	—
Solanum sp.	A	—	318	—
	I	—	212–217	Tyramine

Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	I	—	297–309	5-Hydroxytryptamine
Solanum nigrum	A	—	192	—
	A	RB	193	—
Solanum paniculatum	U	LF, RT	801	—
	U	RT	219	—
Solanum variabile	U	—	801	—
Solanum verbascifolium	U	LS	294	—
Withania coagulans	A	—	192	—
	E	SD	193	—
Withania somnifera	A	—	192	—
	A	RT	193, 194	—
	I	—	317, 798–800	Nicotine
Stemonaceae				
Stemona sp.	I	—	802	Paipunine[e]
Stemona japonica	U	—	201	—
Sterculiaceae				
Abroma augusta	A	—	192	—
	A	BK	194	—
	E	RB	193	—
	E	RT, RB	194	—
	E	PL	803	—
	E	RT	91	—
	U	ST, RT	804, 805	—
Guazuma ulmifolia	U	SB	219	—
Helicteres isora	U	FR	267	—
Pentapetes phoenicea	A	—	204	—
Theobroma cacao	A	RT	195	—
Waltheria indica	A	PL	194	—
Styracaceae				
Styrax japonica	U	—	201	—
Taxaceae				
Taxus baccata	A	—	192	—
	A	LF	194	—
	E	LF	91, 197	—
	E	LF, FR	193, 194	—
	U	—	91, 791, 806	—
	H	—	807	—
	I	—	365, 380	Ephedrine (V)
Torreya nucifera	U	SD	808	—
Theophrastaceae				
Jacquinia pungens	A	—	332	—
Thymelaeaceae				
Arthrosolen polycephalus	A	PL	194	—
Daphne genkwa	U	—	201	—
Gnidia chrysantha	A	RT, FL	194	—
Lasiosiphon capitatus	A	PL	194	—
Lasiosiphon kraussianus	A	RT	220	—
Tiliaceae				
Grewia asiatica	A	—	192	—
Grewia barteri	U	—	809	—
	I	—	810	Amine-imidazole type of compound[e]
Grewia bicolor	U	—	809	—
Grewia carpinifolia	U	—	809	—
	I	—	810	Amine-imidazole type of compound[e]
Grewia cissoides	U	—	809	—
	I	—	810	Amine-imidazole type of compound[e]
Grewia cyclopetala	U	—	809, 811	—
Grewia elyseoi	U	—	809, 812	—
	I	—	810	Amine-imidazole type of compound[e]
Grewia hirsuta	A	—	192	—
	E	LF, FR	193	—
Grewia lasiodiscus	U	—	809	—
	I	—	810	Amine-imidazole type of compound[e]
Grewia malacocarpa	U	—	809	—
	I	—	810	Amine-imidazole type of compound[e]
Grewia occidentalis	A	PL	194	—
Grewia salvifolia	See *Grewia bicolor*			
Grewia venusta	U	—	809	—
	I	—	810	Amine-imidazole type of compound[e]
Grewia villosa	U	—	809	—
Triumfetta bartramia	A	—	192	—

(*continued*)

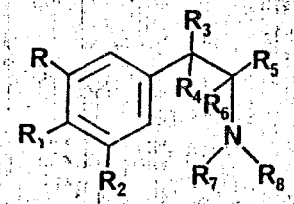
Table IV—(*Continued*)

Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
	A	RT	193	—
Triumfetta rhomboidea	A	RT	193, 194	See also *Triumfetta bartramia*
Turneraceae				
Turnera sp.	U	RT	219	—
Typhaceae				
Typha capensis	A	RT, PL	194	—
Ulmaceae				
Celtis australis	A	—	192	—
Umbelliferae				
Ammi visnaga	E	FR	197	—
	I	—	813	Khellin (visammin) (CXXXV)
Anethum foeniculum	See *Foeniculum officinale*			
Anethum graveolens	E	FR	193	—
Anethum sowa	A	—	192	—
Angelica archangelica	E	PL	323	—
Angelica sylvestris	E	RT	197	—
Apium graveolens	A	—	192	—
	A	RT, SD	193	—
	A	VO	194	—
	U	—	814	—
Athamanta cretensis	E	FR	176	—
Athamanta neumi	See *Meum athamanticum*			
Carum copticum	A	—	192	See also *Trachyspermum ammi*
	E	SD	193	—
Carum roxburghianum	A	—	192	—
	E	SD	193	—
Centella asiatica	E	PL	193	—
Chaerefolium silvestre	U	RT	814	—
Cuminum cyminum	A	FR	193	—
	A	—	192	—
	E	FR	193, 197	—
	I	—	506, 507	Coumingine (CVII)
Daucus carota	A	—	192	—
	A	SD, LF	194	—
	E	SD	193	—
	E	RT, SD	197	—
	E	RT	194	—
	U	—	814	—
Daucus creticus	See *Athamanta cretensis*			
Daucus visnaga	See *Ammi visnaga*			
Eryngium sp.	A	—	332	—
Ferula assa-foetida	A	—	192	—
Ferula caspica	U	—	815	—
Ferula foetida	E	GU, RE	193	—
Ferula nartex	E	GU	91	—
	E	ST, GU	193	—
Ferula orientalis	A	—	192	—
	E	GU, RE	193	—
Foeniculum capillaceum	See *Foeniculum officinale*			
Foeniculum officinale	E	FR, RT	197	—
Foeniculum sylvestre	See *Foeniculum officinale*			
Foeniculum vulgare	A	—	192	See also *Foeniculum officinale*
	E	SD, FR	193	—
	E	FR	194	—
Hydrocotyle asiatica	A	—	192	See also *Centella asiatica*
Imperatoria ostruthum	See *Peucedanum ostruthum*			
Imperatoria sylvestris	See *Angelica sylvestris*			
Meum athamanticum	E	RT, SD	197	—
Meum foeniculum	See *Foeniculum officinale*			
Petroselinum crispum	E	FR	194	—
Petroselinum hortense	A	—	192	—
	U	—	816	—
Petroselinum sativum	A	PL	194	—
	E	FR	194	—
	I	FR	817–822	Apiol (CXXIX)
	H	FR	823–844	Apiol
Peucedanum galbanum	A	PL	194	—
Peucedanum graveolens	A	—	192	See also *Anethum graveolens*
Peucedanum officinale	E	RT	197	—
Peucedanum ostruthum	E	RZ	197	—
Pimpinella saxifraga	E	RT	197	—
	U	—	814	—
Prangos pabularia	A	—	192	—
	E	FR, RT	193	—
Selinum sylvestre	See *Angelica sylvestris*			

Table IV—(*Continued*)

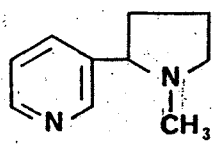
Plant Name[a]	Type of Activity[b]	Plant Part[c]	Reference	Active Constituent(s)
[illegible] araliacea	A	PL	194	—
Trachyspermum ammi	E	SD	193	—
Urticaceae				
Urtica sp.	I	—	270	Betaine
Urtica dioica	A	PL	194	—
	A	—	192	—
	E	PL	193	—
	I	—	297–309	5-Hydroxytryptamine
Urtica urens	A	PL	194	—
	I	—	297–309	5-Hydroxytryptamine
Valerianaceae				
Nardostachys jatamansai	A	—	192	—
	E	RT	193	—
Valeriana wallichii	A	—	192	—
	E	RT	193	—
Verbenaceae				
Clerodendrum inerme	U	LF	887	—
Clerodendrum serratum	A	—	204	—
Gmelina asiatica	A	RT	193	—
Stachytarpheta jamaicensis	A	—	192	—
	A	PL	193	—
Verbena bonaviensis	A	PL	194	—
Verbena officinalis	A	—	192	—
	I	—	888, 889	Verbenalin (verbenaloside) (CXLIX)
Verbena stricta	I	—	888, 889	Verbenalin (verbenaloside)
Vitex agnus-castus	E	FR	197	—
Vitex cannabifolia	U	—	201	—
Vitex gardneriana	U	SB	219	—
Vitex negundo	A	—	192	—
	E	FR	193	—
Vitex trifolia	A	—	192	—
	E	FR	193	—
Vitaceae				
Ampelopsis hederaceae	I	—	890–892	Catechol (CXXXI)
Cissus quadrangularis	A	—	192	—
Cissus sicyoides	U	LS	294	—
Rhoicissus cuneifolia	A	RT	194	—
Vitis quadrangularis	A	—	192	—
Vitis vinifera	E	FL	193	—
Zingiberaceae				
Alpinia speciosa	U	LF	219	—
Curcuma longa	A	—	192	—
	A	RZ, JU	194	—
	E	RZ	193	—
	U	—	201	—
Curcuma zedoaria	A	—	192	—
Elettaria cardamomum	A	—	192	—
	E	FR	193	—
Hedychium spicatum	A	—	192	—
	E	RT	193	—
Zingiber officinale	A	—	204	—
Zygophyllaceae				
Fagonia arabica	See *Fagonia cretica*			
Fagonia cretica	A	—	192	—
	E	PL	193	—
Peganum harmala	A	—	192	—
	A	PL, SD	193	—
	A	SD	91	—
	E	PL, SD	193	—
	E	—	91	—
	I	SD	893–896	Harmaline
	I	SD	893–897	Harmine (LXXXII)
Tribulus alatus	A	—	192	—
	E	FR	193	—
Tribulus terrestris	A	—	192	—
	E	RT	193	—
	I	—	898	Harman
	I	—	893–897	Harmine
Zygophyllum coccineum	U	—	899	—
Zygophyllum decumbens	U	—	900	—

[a] Plant names are as stated in the original articles except for corrections of obvious spelling errors. Arrangement is alphabetical by family, genus, and species; assignment to families is according to the system of Engler (1672). [b] A = abortifacient, ecbolic, oxytocic (folkloric); E = emmenagogue, affecting the menstrual cycle (folkloric); U = uterine stimulant as shown by *in vitro* or *in vivo* tests in animals; H = abortifacient effects as determined in humans; I = active substance isolated and shown to stimulate uterine tissue either *in vitro* or *in vivo*. [c] AH = ash, BA = balsam, BJ = bark juice, BR = branches, BK = bark, BU = bulb, EX = exudate, FL = flower, FP = fruit pulp, FR = fruit, FS = fruit shell, GU = gum, JU = juice, LF = leaf, LJ = leaf juice, LS = leaf and stem, LX = latex, OL = oil, PL = whole plant, PU = pulp, PX = aerial parts, RB = root bark, RE = resin, RS = root stalk, RT = root, RZ = rhizome, SB = stem bark, SD = seed, SG = stigma, SL = style, SO = seed oil, SP = seed pod, SW = stem wood, TE = tegumen, TR = tuberous root, TU = tuber, TW = twigs, VO = volatile oil, WD = wood, and — = plant part not stated in original article. [d] Although popularly believed to exert an oxytocic effect, the essential oil was shown to depress uterine tissue *in vitro* rather than cause a contraction. [e] Denotes that although the material was obtained as a crystalline or otherwise pure entity, the structure is not yet known.

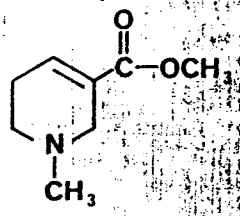


	R	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
V: ephedrine	H	H	H	OH	H	CH_3	H	H	CH_3
VI: hordenine	H	OH	H	H	H	H	H	CH_3	CH_3
VII: mescaline	OCH_3	OCH_3	OCH_3	H	H	H	H	H	H
VIII: pseudoephedrine	H	H	H	H	OH	CH_3	H	H	CH_3
IX: tyramine	H	OH	H	H	H	H	H	H	H

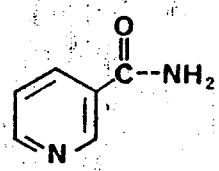
Structures of Phenethylamine Alkaloids Having Uterine Stimulant Activity



X: nicotine

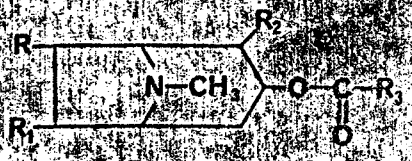


XI: arecoline



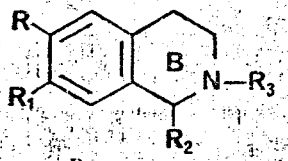
XII: nicotinamide

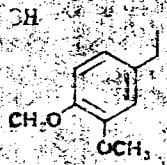
Structures of Pyridine Alkaloids Having Uterine Stimulant Activity



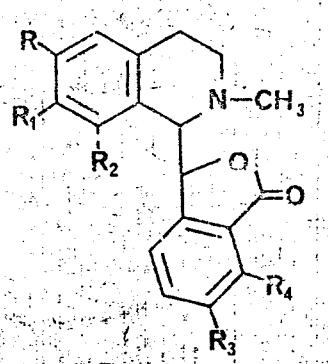
	R_1	R_2	R_3	R_4
XIII: cocaine	H	H	$COOCH_3$	phenyl
XIV: scopolamine	—O—	H_2		CH_2OH | —CH—

Structures of Tropane Alkaloids Having Uterine Stimulant Activity



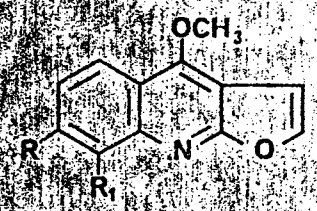
	R	R_1	R_2	R_3
XV: hydrastinine	—O—CH_2—O—			
XVI: papaverine	OCH_3	OCH_3		ring B unsaturated
XVII: salsoline	OH	OCH_3	CH_3	H

Structures of Quinoline Alkaloids Having Uterine Stimulant Activity



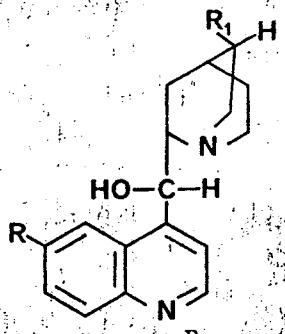
	R	R_1	R_2	R_3	R_4
XVIII: adlumidine	—O—CH_2—O—		H	—O—CH_2—O—	
XIX: adlumine	OCH_3	H	H	—O—CH_2—O—	
XX: bicuculline	—O—CH_2—O—		H	—O—CH_2—O—	
XXI: capnoidine	—O—CH_2—O—		H	—O—CH_2—O—	
XXII: corlumine	OCH_3	OCH_3	H	—O—CH_2—O—	
XXIII: hydrastine	—O—CH_2—O—		H	OCH_3	OCH_3
XXIV: narcotine	—O—CH_2—O—		OCH_3	OCH_3	OCH_3

Phthalidisoquinoline Alkaloid Structures Having Uterine Stimulant Activity



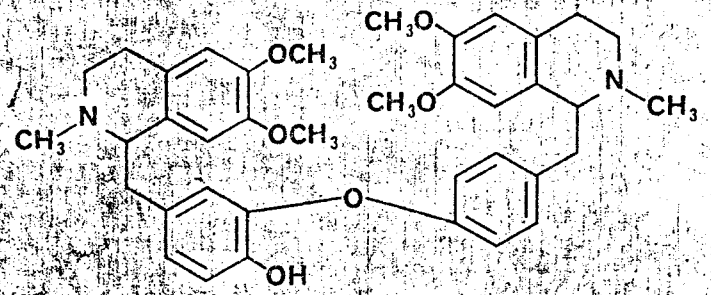
	R	R_1
XXV: dictamnine	H	H
XXVI: akimmianine	OCH_3	OCH_3

Structures of Furoquinoline Alkaloids Having Uterine Stimulant Activity

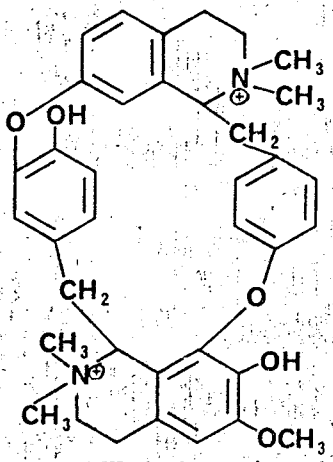


	R	R_1
XXVII: cinchonidine	H	$CH=CH_2$
XXVIII: cinchonine	H	$CH=CH_2$
XXIX: hydroquinine	OCH_3	$CH_2—CH_3$
XXX: quinidine	OCH_3	$CH=CH_2$
XXXI: quinine	OCH_3	$CH=CH_2$

Structures of Quinine Alkaloids Having Uterine Stimulant Activity

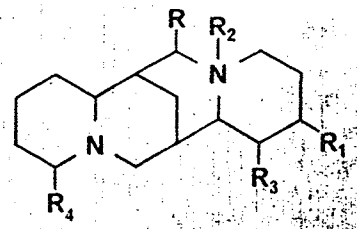


XXXII: dauricine

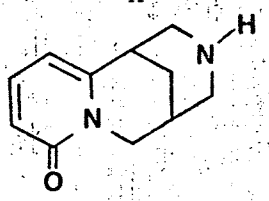


XXXIII: *d*-tubocurarine

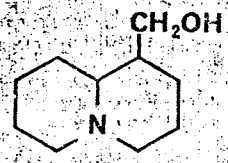
Structures of Bisbenzylisoquinoline Alkaloids Having Uterine Stimulant Activity



	R	R_1	R_2	R_3	R_4	other
XXXIV: 13-hydroxylupanine	H	OH	—	H	=O	—
XXXV: 17-hydroxylupanine	OH	H	—	H	=O	—
XXXVI: D-lupanine	H	H	—	H	=O	—
XXXVII: lupanine *N*-oxide	H	H	O	H	=O	—
XXXVIII: 17-oxolupanine	=O	H	—	H	=O	—
XXXIX: retamine	H	H	—	OH	=O	—
XL: sparteine	H	H	—	H	H	—
XLI: trilupine	H	H	—	H	=O	HCl·2H₂O

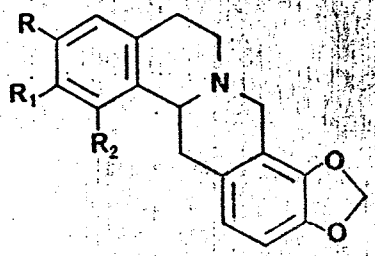


XLII: cytisine



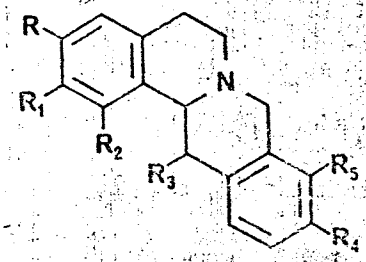
XLIII: lupinine

Structures of Quinolizidine Alkaloids Having Uterine Stimulant Activity



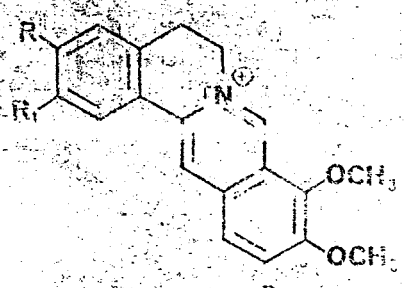
	R	R_1	R_2	other
XLIV: chelerythrine	OCH_3	OCH_3	H	unsaturated C ring
XLV: chelidonine	—O—CH_2—O—		OH	$\Delta^{1,2}$

Structures of Benzophenanthridine Alkaloids Having Uterine Stimulant Activity



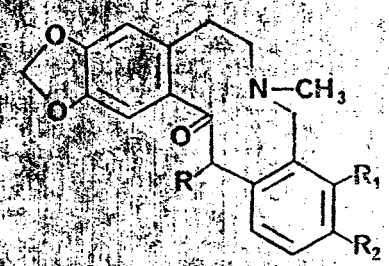
	R	R_1	R_2	R_3	R_4	R_5
XLVI: capauridine	OCH_3	OCH_3	OH	H	OCH_3	OCH_3
XLVII: capaurine	OCH_3	OCH_3	OH	H	OCH_3	OCH_3
XLVIII: corydaline	OCH_3	OCH_3	H	CH	CH_3	OCH_3
XLIX: nandinine	—O—CH_2—O—		H	H	OCH_3	OH
L: ophiocarpine	—O—CH_2—O—		H	OH	OCH_3	OCH_3
LI: tetrahydropalmatine	OCH_3	OCH_3	H	H	OCH_3	OCH_3

Structures of Protoberberine Alkaloids Having Uterine Stimulant Activity



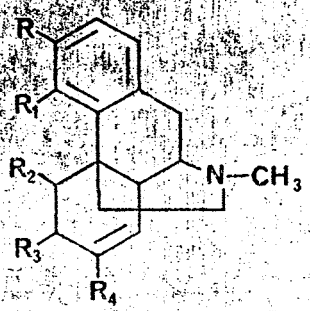
	R	R_1
LII: berberine	—O—CH_2—O—	
LIII: coreximbamine	OCH_3	OH
LIV: jatrorrhizine	OH	OCH_3
LV: palmatine	OCH_3	OCH_3

Structures of Protoberberine Alkaloids Having Uterine Stimulant Activity



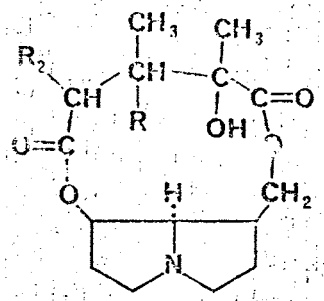
	R	R_1	R_2	other
LVI: cryptocavine	H	OCH_3	OCH_3	—
LVII: hunnemannine	CH_3	OCH_3	OCH_3	—
LVIII: protopine	H	—O—CH_2—O—		—
LIX: thalictimine	H	OCH_3	OCH_3	desoxy

Structures of Protopine Alkaloids Having Uterine Stimulant Activity



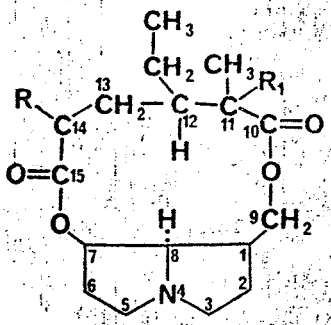
	R	R_1	R_2	R_3	R_4
LX: codeine	OCH_3	—O—		OH	H
LXI: morphine	OH	—O—		OH	H
LXII: sinomenine	OCH_3	OH	H	=O	OCH_3
LXIII: thebaine	OCH_3	—O—		OCH_3	H

Structures of Morphinan Alkaloids Having Uterine Stimulant Activity

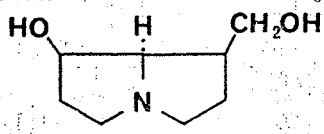


	R	R_2
LXIV: monocrotaline	OH	—CH_3
LXV: scelerratine	H	—CH(OH)—$(CH_3)_2$

Structures of Pyrrolizidine Alkaloids Having Uterine Stimulant Activity

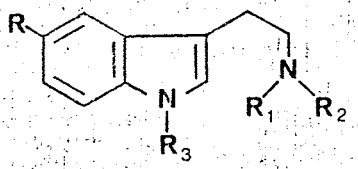


	R	R_1	other
LXVI: integerrimine	CH_3	OH	$\Delta^{1,2}$
LXVII: isatidine	CH_2OH	OH	—
LXVIII: platyphylline	CH_3	OH	—
LXIX: riddelliine	OH	CH_2OH	$\Delta^{12,13}$
LXX: senecionine	OH	CH_3	—
LXXI: seneciphylline	CH_3	OH	$\Delta^{12,13}$
LXXII: spartioidine	OH	CH_3	$\Delta^{12,13}$



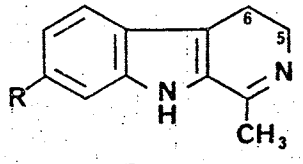
LXXIII: retrornecine

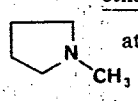
Structures of Pyrrolizidine Alkaloids Having Uterine Stimulant Activity



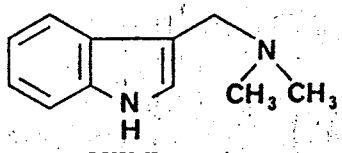
	R	R_1	R_2	R_3
LXXIV: *N,N*-dimethyltryptamine	H	CH_3	CH_3	H
LXXV: *N,N*-dimethyltryptamine *N*-oxide	H	CH_3	CH_3	H
LXXVII: 5-hydroxytryptamine	OH	H	H	O
LXXVIII: 5-methoxy-*N,N*-dimethyltryptamine	OCH_3	CH_3	CH_3	H

Structures of Tryptamine Alkaloids Having Uterine Stimulant Activity

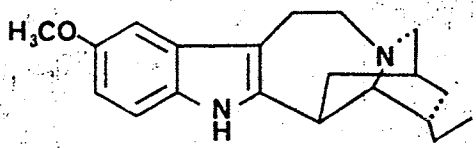


	R	other
LXXIX: brevicolline	H	 at 6-position
LXXX: harmaline	OCH_3	—
LXXXI: harman	H	—
LXXXII: harmine	OCH_3	$\Delta^{5,6}$

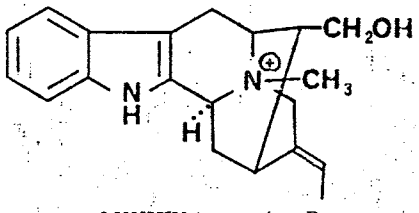
Structures of β-Carboline Alkaloids Having Uterine Stimulant Activity



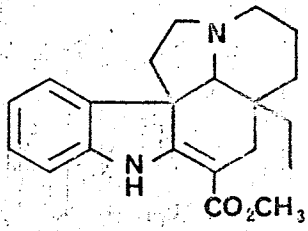
LXXVI: gramine



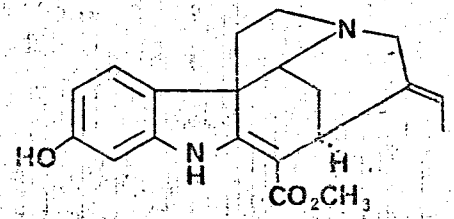
LXXXIII: ibogaine



LXXXIV: macusine B

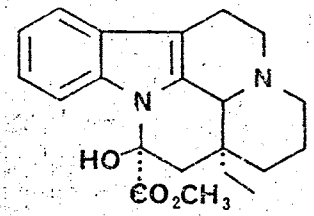


LXXXV: ervamine

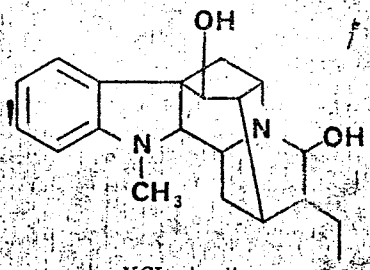


LXXXVI: vinervine

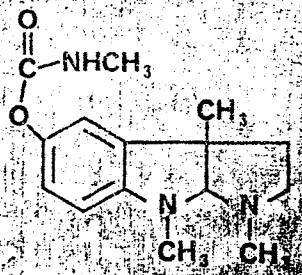
Structures of Miscellaneous Indole Alkaloids Having Uterine Stimulant Activity



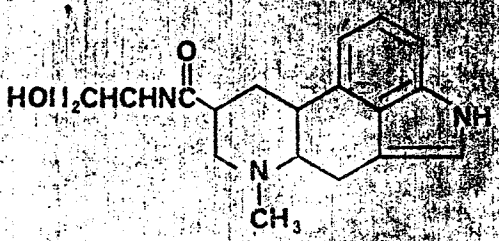
XC: vincamine



XCI: ajmaline



XCII: physostigmine



XCIII: ergonovine

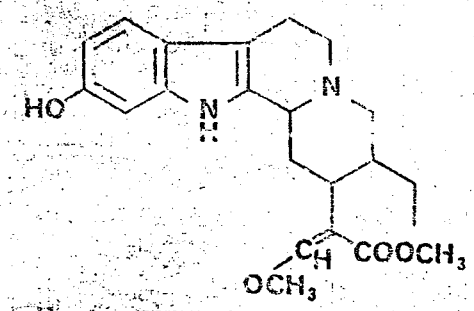
Structures of Miscellaneous Indole Alkaloids Having Uterine Stimulant Activity

During the literature search, some naturally occurring plant principles were found that were active as uterine stimulants, but the plants from which they were obtained were not noted. Whenever one of these active principles was known to occur in a plant previously noted under (A), (E), or (U), it was entered in Table IV as (I).

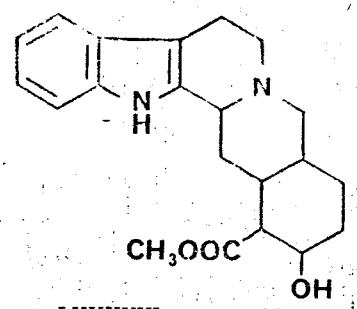
Finally, Table IV lists those plants and/or constituents that have been shown to be abortifacient or to have uterine stimulant activity as judged from tests in humans. These entries are noted as (H).

Although it is not within the scope of this presentation to give detailed information on all animal and human studies, a few remarks will be made concerning the abortifacient effects of some plant materials that have been used over the years as abortifacients.

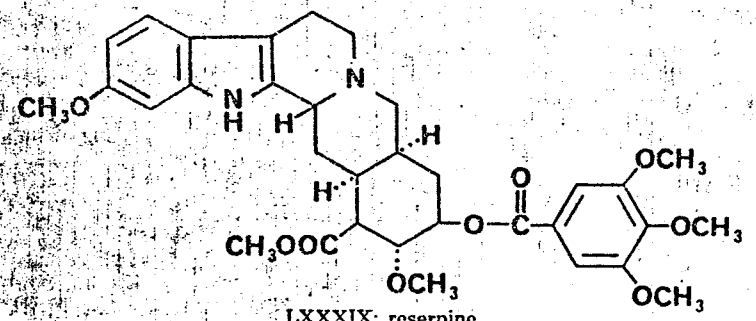
Volatile Oils—The most commonly employed volatile oils used in the past to induce abortion are those derived from *Tanacetum vulgare* (tansy), *Hedeoma pulegioides* (pennyroyal), *Ruta graveolens* (rue), *Petroselinum sativum* (apiol), and *Juniperus sabina* (savin). The literature contains virtually nothing [illegible] regard to the proven abortifacient effects of [illegible] of these materials for abortifacient effects has been deleted from most standard pharmacology textbooks published in the last two decades. It has been shown that the excised human uterus is not stimulated by the oils of pennyroyal, savin, or tansy.[illegible] It is



LXXXVII: gambirine



LXXXVIII: corynanthine



LXXXIX: reserpine

Structures of Miscellaneous Indole Alkaloids Having Uterine Stimulant Activity

speculated that when abortion does occur after the use of these volatile oils, it occurs only following toxic doses (198); fatal doses are not always abortifacient.

An interesting situation exists with apiol. There are two forms of this drug, "green apiol," which is the oleoresin of *P. sativum*, and "apiol" proper or "crystallized apiol," a compound of known structure. Both of these materials have a long history as abortifacients, alone or in combination with such materials as ergot extract. Numerous toxicities to apiol following its use in attempted abortion, as evidenced by a polyneuritis, were reported in the 1930's (823–832, 840, 841). It was eventually found that the toxicities were due to the presence of *ortho*-tricresyl phosphate in the apiol, presumably present as an adulterant (842, 843). It is safe to conclude that these materials were never consistently effective as abortifacients in humans and that their use will always be attendent with varying degrees of toxicity and even death (844).

Quinine and Castor Oil—These two agents have been used extensively in the past, alone or in combination with pituitary extract, to induce abortion in humans. Quinine has been reported in many studies to contract uterine tissue in both *in vitro* and *in vivo* experiments (641–682). Clinical studies are also numerous (347, 402–404, 408, 409, 683–767). It has been concluded (767) that except in cases of idiosyncrasy, quinine does not act to expel the premature fetus. There is no doubt, however, that quinine does help to promote uterine contractions after they have begun. The contractions produced by quinine in these cases are intermittent and not tetanic.

Although studies involving the use of castor oil in human abortion are numerous (401–409), one cannot find experimental studies to explain the rationale for its use. Presumably, it produces pelvic congestion as a result of intestinal irritation, as with the volatile oils (198).

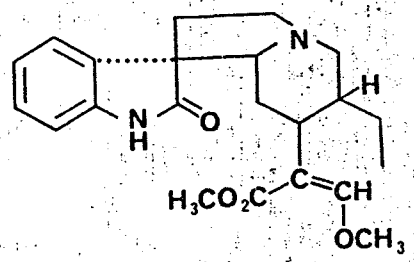
Sparteine—The only clinically useful abortifacient plant product known at present is sparteine (pachycarpine), which is an alkaloid derived from several Leguminosae species, especially those in the genera *Ammodendron*, *Baptisia*, *Cytisus*, *Genista*, *Goebelia*, *Lupinus*, *Retama*, *Sarothamnus*, *Templetonia*, and *Thermopsis* (845–847). Reports of the occurrence of sparteine in the unexpected Papaveraceae *(Chelidonium majus)* and Scrophulariaceae *(Leptorhabdos parviflora)* species should be reexamined (845–847).

Sparteine was first introduced into clinical practice as an oxytocic in 1939, and thousands of patients have been treated with it (487–489). Numerous reports confirm its *in vitro* and *in vivo* uterine stimulant activity (250, 252, 361, 385, 444–493). It has virtually all of the oxytocic properties of oxytocin and the ergot alkaloids. Untoward effects in humans almost always relate to overstimulation of the myometrium; thus, the dose of this alkaloid must be closely monitored. The latest review on the clinical use of sparteine as an oxytocic was published in 1966 (489).

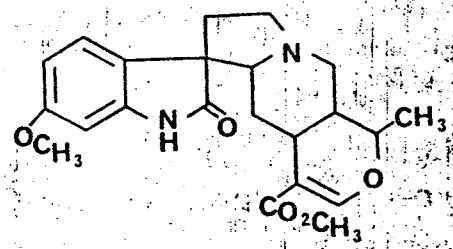
From the data presented in Tables IV and V, it can be seen that 565 species of plants are known to have a folkloric reputation for use as abortifacients, ecbolics, or emmenagogues. These 565 species are classified in 125 plant families. Of this 565 species, 225 have been shown to elicit a stimulant response when tested against uterine muscle either *in vitro* or *in vivo*, and active uterine stimulants have been isolated from 198 species. Of the isolated compounds, 148 are of known structure and 24 are of unknown structure; 122 of the isolated active compounds are alkaloids. Table V lists a number of common and widespread plant constituents that have been reported to stimulate uterine tissue either *in vivo* or *in vitro*.

Table V—Plant Principles of Widespread Occurrence Reported to Stimulate Uterine Tissue

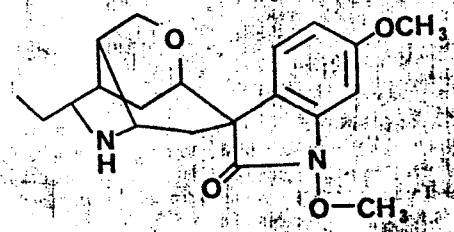
Plant Principle Type	Constituent	Reference
Simple amines	Betaine (CXV)	270
	Hordenine (VI)	310
	5-Hydroxytryptamine (LXXVII)	297–309
	Tyramine (IX)	312
Fatty acid	Arachidonic acid (CLI)	901, 902
	Linoleic acid (CLII)	901
	Linolenic acid (CLIII)	901
	Palmitic acid (CLIV)	415
Flavonoids	Hesperidin (CXLV)	776
	Quercetin (CXLVI)	903
	Rutin (CXLVII)	904
Sterols	Cholesterol (CXLI)	905
	β-Sitosterol (CXLII)	906
Polyphenols	Catechol (CXXXI)	820, 822
	Pyrogallol (CXXXII)	906
Miscellaneous	Ascorbic acid (CXXX)	907–911
	Ellagic acid (CXXXIII)	322
	Guaiazulene (CXXXVIII)	912
	Nicotinamide (XII)	913–915
	Tannin	916, 917



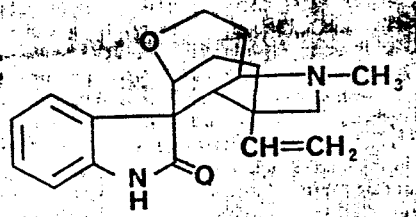
XCIV: mitrinermine



XCV: vineridine

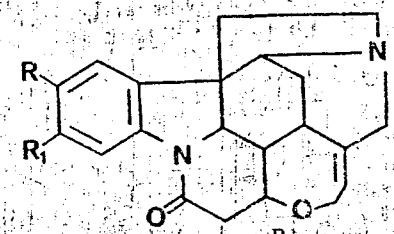


XCVI: gelsemicine



XCVII: gelsemine

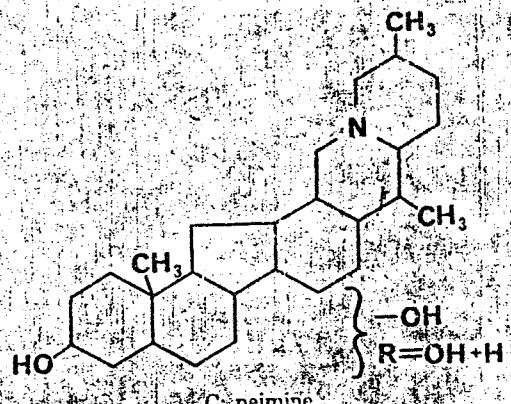
Structures of Miscellaneous Indole Alkaloids Having Uterine Stimulant Activity



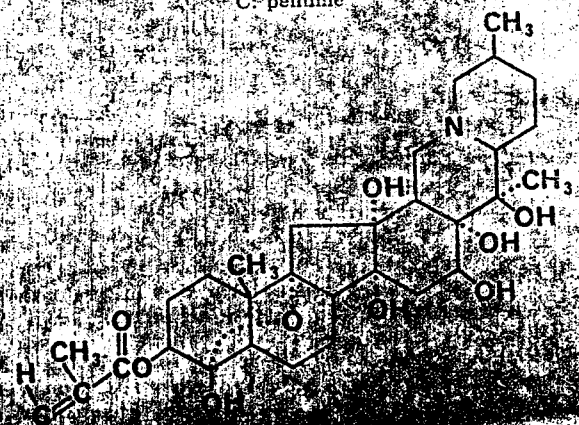
XCVIII: brucine
XCIX: strychnine

R	R_1
OCH_3	OCH_3
H	H

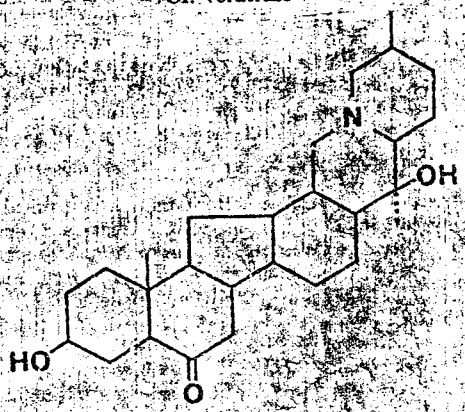
Structures of Miscellaneous Indole Alkaloids Having Uterine Stimulant Activity



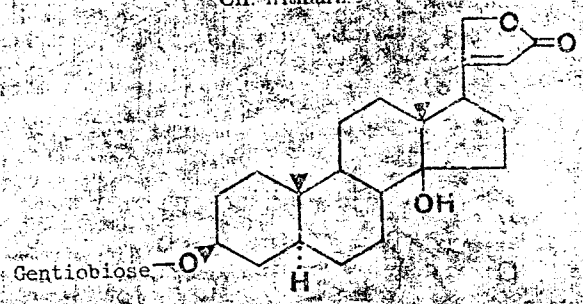
C: peimine



CI: veratrine



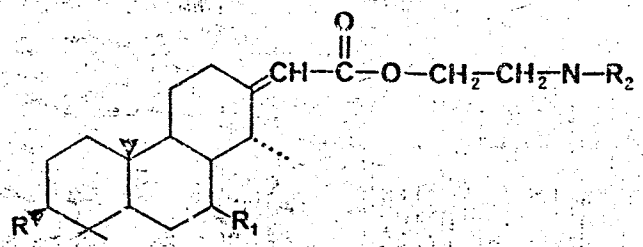
CII: fritillarine



Gentiobiose

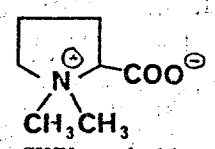
CIII: [illegible]

Structures of Steroid Alkaloids Having [illegible] Stimulant Activity

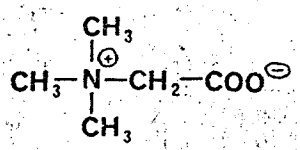


	R	R_1	R_2
CIV: cassaidine	OH	α-OH	$(CH_3)_2$
CV: cassaine	OH	=O	$(CH_3)_2$
CVI: coumingidine	$HO-C(CH_3)_2-CH_2-C(=O)-O-$	=O	HCH_3
CVII: coumingine	$HO-C(CH_3)_2-CH_2-C(=O)-O-$	=O	$(CH_3)_2$
CVIII: norcassaidine	OH	α-OH	HCH_3

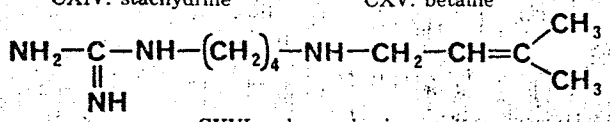
Structures of Diterpene Alkaloids Having Uterine Stimulant Activity



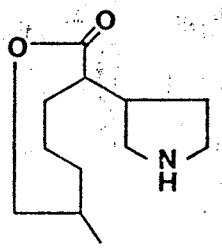
CXIV: stachydrine



CXV: betaine

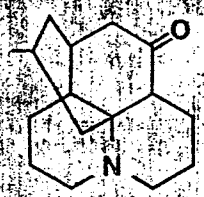


CXVI: sphaerophysine

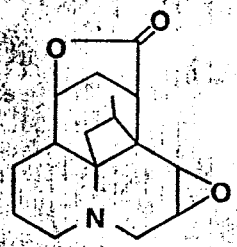


CXVII: chaksine

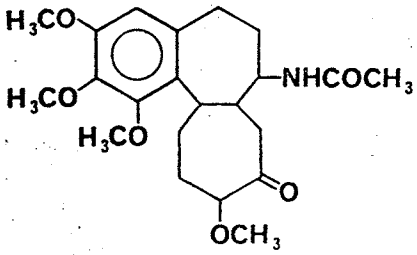
Structures of Miscellaneous Alkaloids Having Uterine Stimulant Activity



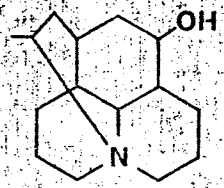
CIX: lycopodine



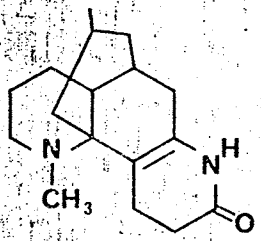
CX: annotinine



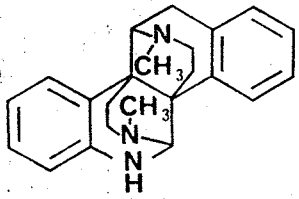
CXVIII: colchicine



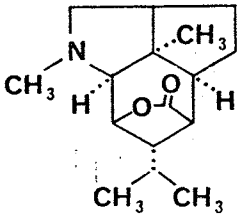
CXI: complanatine



CXII: obscurine

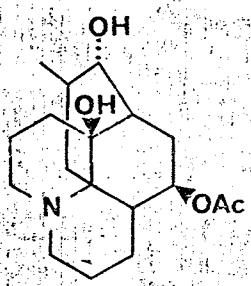


CXIX: calycanthine



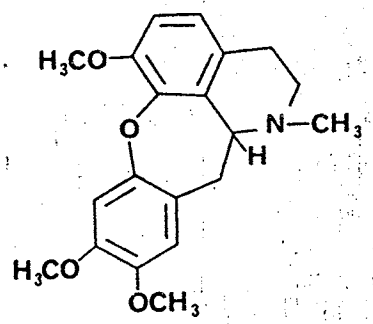
CXX: dendrobine

Structures of Miscellaneous Alkaloids Having Uterine Stimulant Activity

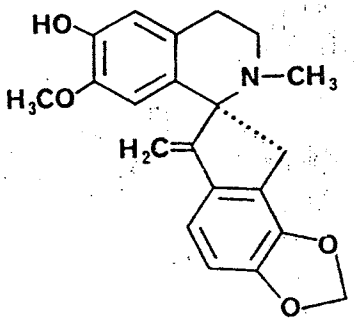


CXIII: lycofawcine

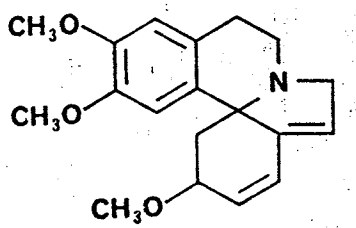
Structures of Hydrojulolidine and Related Alkaloids Having Uterine Stimulant Activity



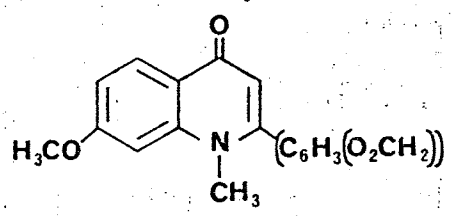
CXXI: cularine



CXXII: ochotensine

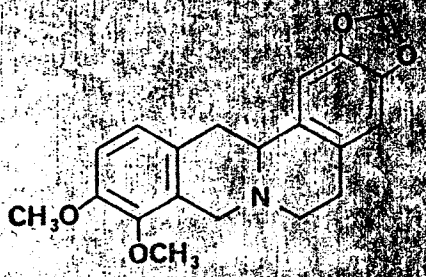


CXXIII: erysotrine

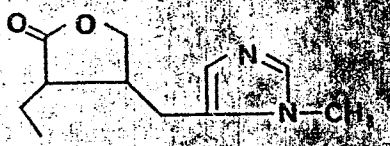


CXXIV: lunamarine

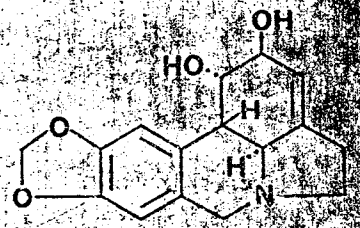
Structures of Miscellaneous Alkaloids Having Uterine Stimulant Activity



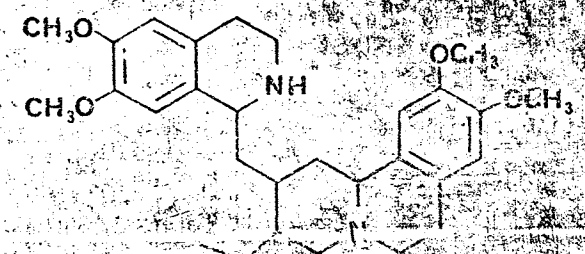
CXXV: canadine



CXXVI: pilocarpine

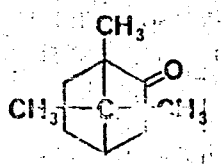


CXXVII: lycorine

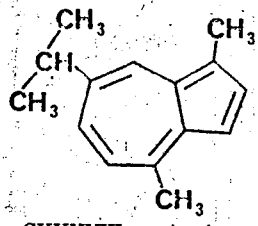


CXXVIII: emetine

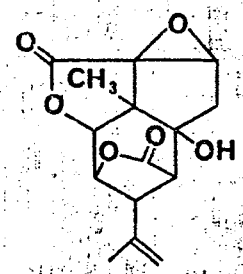
Structures of Miscellaneous Alkaloids Having Uterine Stimulant Activity



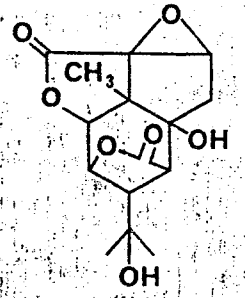
CXXXVII: camphor



CXXXVIII: guaiazulene

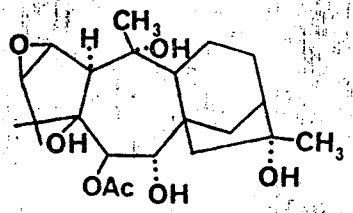


(a)



(b)

CXXXIX: picrotoxin (mixture of *a* and *b*)



CXL: lyoniatoxin

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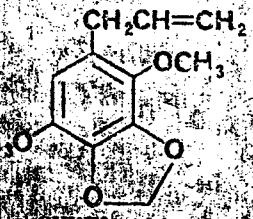
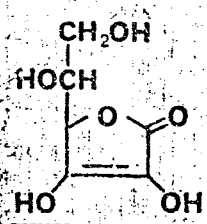
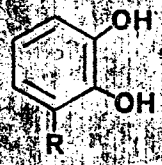


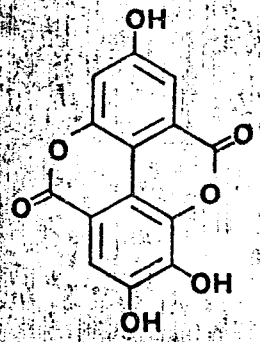
CXXIX: apiol



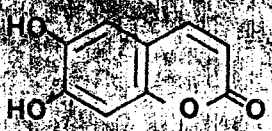
CXXX: ascorbic acid



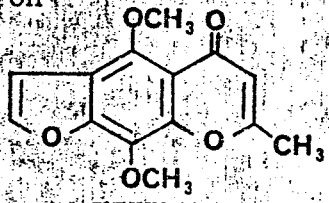
CXXXI: catechol, R = H
CXXXII: pyrogallol, R = OH



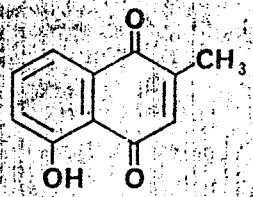
CXXXIII: ellagic acid



CXXXIV: aesculetin



CXXXV: khellin



CXXXVI: plumbagin

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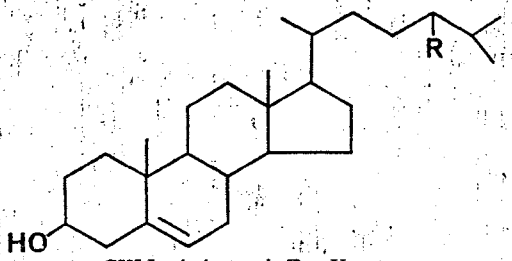
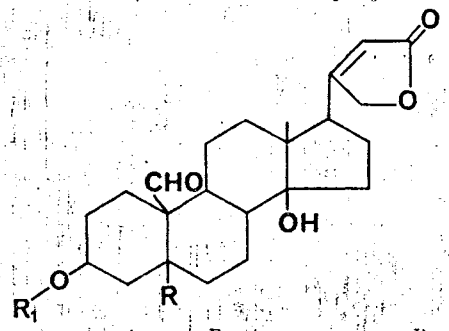
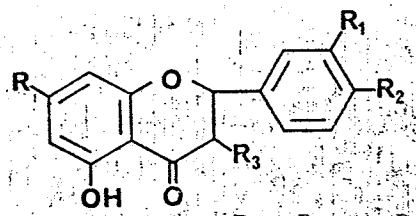


CXLI: cholesterol, R = H
CXLII: β-sitosterol, R = CH_2CH_3

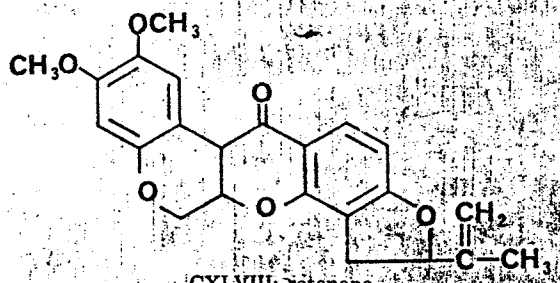


	R	R_1
CXLIII: strophanthin	OH	rhamnose
CXLIV: thevetin	H	thevetose-gentiobiose

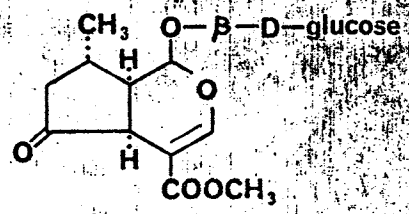
Structures of Nonalkaloid Principles Having Uterine Stimulant Activity



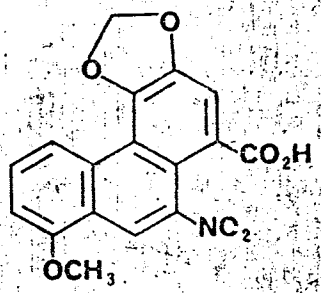
	R	R_1	R_2	R_3	other
CXLV: hesperidin	OH	OH	OH	OH	$\Delta^{2,3}$
CXLVI: quercetin	Rham·Glu	OCH_3	OCH_3	H	–
CXLVII: rutin	OH	OH	OH	*O*-rutinose	$\Delta^{2,3}$



CXLVIII: rotenone

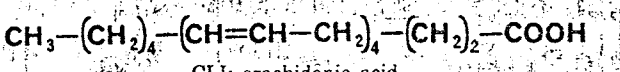


CXLIX: verbenalin

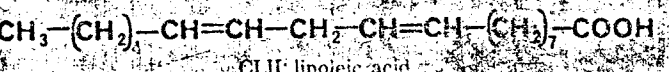


CL: aristolochic acid

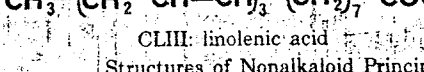
Structures of Nonalkaloid Principles Having Uterine Stimulant Activity



CLI: arachidonic acid



CLII: linoleic acid



CLIII: linolenic acid

CLIV: palmitic acid

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[x] To whom inquiries should be directed.

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REVIEW ARTICLE

Potential Value of Plants as Sources of New Antifertility Agents II *

NORMAN R. FARNSWORTH *, AUDREY S. BINGEL, GEOFFREY A. CORDELL, FRANK A. CRANE, and HARRY H. S. FONG

Keyphrases □ Antifertility agents—review of plant sources, classified by anatomical mechanism and folkloric route of administration □ Medicinal plants—sources of antifertility agents, classified by anatomical mechanism and folkloric route of administration, review □ Plant extracts—potential sources of antifertility agents, review □ Contraceptives—plants with active constituents, review □ Abortifacients—plants with active constituents, review □ Oxytocics—plants with active constituents, review □ Estrogenic plants—review of active principles

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ESTROGENIC PLANTS AND THEIR ACTIVE PRINCIPLES

Historically, a number of plants have been used as sex hormones in native medicine. The pomegranate, *Punica granatum* (Punicaceae), was a symbol of immortality, fertility, and love in Oriental religions, and its legendary powers date back to Greek and Judeo-Christian mythology (921). In Egypt, the pollen grains of the date palm, *Phoenix dactylifera* var. *samani* (Palmae), were used to induce fertility in women; while moghat, *Clossostemon brugieri* (Sterculiaceae), is used as a postpartum hot beverage (922).

Phytochemical interest in plant estrogens, however, remained relatively dormant until the 1950's. The increased interest in phytoestrogens was, according to Biggers (923), due to at least four factors:

1. The recognition that infertility in animals and humans could follow excessive ingestion of plants rich in compounds possessing estrogenic activity.
2. The known existence of "spring flush" (increased yield of improved milk) in dairy cattle ingesting certain rapidly growing grasses that contained estrogenic substances.
3. The possibility that the demonstrated improvement in carcass quality, produced by the feeding of synthetic estrogens, might also be able to be produced by the feeding of plants rich in estrogens.
4. The possibility of obtaining estrogenic substances economically from plant sources.

The occurrence of substances in plants capable of inducing animal estrus was first demonstrated by Dohrn *et al.* (924) in 1926. The first isolation of an estrogen from plants was reported by Butenandt and Jacobi (925) in 1933, when they succeeded in isolating 18 mg of estrone from 50 kg of a botanically unspecified palm kernel press cake. In the same year, Skarzynski (926) reported on the isolation of 7.5 mg of estriol from 65 kg of female willow catkins. Thirty years elapsed before any concerted efforts were made in the phytochemical investigation of these compounds. Jacobsohn *et al.* (927), in 1965, raised the question as to the validity of claims for the presence of estrogens in plants when they failed to isolate estrone from any of four geographic varieties of the African oil palm, *Elaeis guineensis* (Palmae). *E. guineensis* may or may not have been the plant investigated by Butenandt and Jacobi (925), although by deductive reasoning Bradbury and White (928) thought that it certainly must have been.

The question of the presence of estrogenic hormones in plants raised by Jacobsohn *et al.* (927) has been answered by work since 1965. The date palm, *P. dactylifera* var. *khadrawy* (Palmae), was

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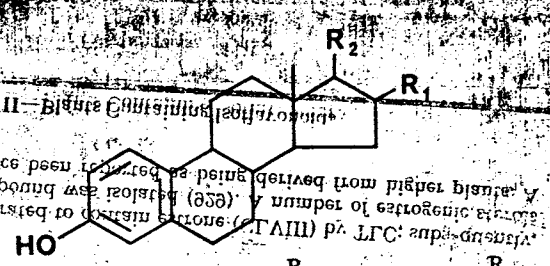
Table VI—Occurrence of Steroid Estrogens in Plants

Plant Name	Steroid Estrogen	Reference
Chenopodiaceae		
Beta vulgaris	β-Sitosterol[a] (CXLII)	1035–1037
Gramineae		
Avena sativa	Estrone (CLVIII)	1038
Oryza sativa	Estrone	1038
Triticum aestivum	Estrone	1038
Leguminosae		
Glycyrrhiza glabra	β-Sitosterol	1035–1037
	Estriol (CLVII)	1039
Phaseolus vulgaris	Estrone	1040
	Estriol	1040
	17α-Estradiol (CLV)	1040
Palmae		
Elaeis guineensis	Estrone	925
Hyphaene thebaica	Estrone	[illegible]
Phoenix dactylifera	Estrone	925
Phoenix dactylifera var. *samani*	Estrone	922
Punicaceae		
Punica granatum var. *nana*	Estrone	1040, 1041
Rosaceae		
Malus sylvestris	Estrone	1048
Salicaceae		
Salix capreа	Estrone	925
Sterculiaceae		
Clossostemon bruguieri	Estrone	922

[a] β-Sitosterol is a ubiquitous substance in plants, and no attempt has been made to document those plants in which it has been reported. The plants listed contain a high enough percentage so that extracts exhibit estrogenic activity.



	R_1	R_2
CLV: 17α-estradiol	H	—OH
CLVI: 17β-estradiol	H	—OH
CLVII: estriol	—OH	—OH
CLVIII: estrone	H	=O

Structures of Estrogenic Sterols

demonstrated to contain estrone (CLVIII) by TLC; subsequently, the compound was isolated (929). A number of estrogenic sterols have since been reported as being derived from higher plants. A list of these compounds and their plant sources is presented in Table VI. A review of steroid estrogens in plants is available (921).

Biological and chemical interest in nonsteroidal estrogenic substances was spurred by the work of Bennetts and his coworkers (930, 931), who reported in 1946 that the serious decline in lambing rates in Australia was due to their grazing on the Dwalganup strain of subterranean clover *(Trifolium subterraneum)*, and the subsequent isolation of the isoflavone, genistein (CXCIII), from this plant (932). This compound was later demonstrated to be estrogenic (933). Since then, other isoflavones having estrogenic activity have been found in various forage plants and studies of environmental factors on the isoflavonoid content of these plants have been made (934–958). A large reduction in sperm numbers was observed on prolonged grazing of sheep on clover pasture (959); it is not known if this activity is also due to the estrogenicity of clover pastures. A list of estrogenic and potential estrogenic isoflavones and their sources is presented in Table VII.

In addition to the steroids and isoflavones, another [illegible] of chemical compounds found in forage plants that have estrogenic activity are the coumestans, having the skeletal structure of 6*H*-benzofuran(3,2-*c*)benzopyran-6-one. The best known compound in

Table VII—Plants Containing Isoflavonoids

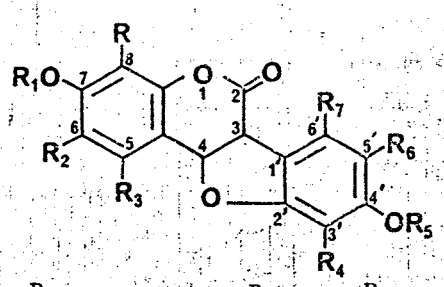
Plant Name	Isoflavonoid	Reference
Amaranthaceae		
Iresine celosioides	Tlatlancuayin (CCXLVIII)	1049
Gramineae		
Bromus mollis	Genistein (CXCIII)	1050
Cynodon dactylon	Daidzein (CLIX)	1051
	Genistein	1051
Hyparrhena filipendula	Daidzein	1051
	Genistein	1051
Setaria ciliolata	Daidzein	1051
	Genistein	1051
Triticum aestivum	Genistein	1050
Iridaceae		
Belamcanda chinensis	Tectorigenin 7-*O*-glucoside (CCXXVI)	1052, 1053
Iris sp.	Irigenin 7-*O*-glucoside	1064
	Tectorigenin 7-*O*-glucoside	1064
Iris florentina	Irigenin (CCXXXIX)	1054
	Irigenin 7-*O*-glucoside (CCXL)	1055, 1056
	Irilone 4′-*O*-glucoside (CCXXVIII)	1052
	Irisflorentin (CCXLIX)	1054
	Irisolone (CCXXX)	1054
	Irisolone 4′-*O*-bioside (CCXXIX)	1057

Table VIII—(*Continued*)

Plant Name	Coumestan	Reference
Medicago constricta	Coumestrol	1321
Medicago corulea	Coumestrol	1321, 1322
Medicago disciformis	Coumestrol	1321, 1322
Medicago dzhawakhetica	Coumestrol	1321, 1322
Medicago falcata	Coumestrol	1321, 1322
Medicago granadensis	Coumestrol	1321, 1322
Medicago hemicycla	Coumestrol	1321, 1322
Medicago hispida	Coumestrol	1323
Medicago intertexta	Coumestrol	1321, 1322
Medicago laciniata	Coumestrol	1321, 1322
Medicago littoralis	Coumestrol	1321, 1322, 1324, 1325
	4′-*O*-Methylcoumestrol	1325
	3′-Methoxycoumestrol (CCXC)	1325
Medicago minima	Coumestrol	1321, 1322
Medicago murex	Coumestrol	1321, 1322
Medicago orbicularis	Coumestrol	1321, 1322
Medicago polychroa	Coumestrol	1321, 1322
Medicago polymorpha	Coumestrol	1321, 1322
Medicago polymorpha var. *denticulata*	Coumestrol	1325
	4′-*O*-Methylcoumestrol	1325
	3′-Methoxycoumestrol	1325
Medicago praecox	Coumestrol	1321, 1322
Medicago rigidula	Coumestrol	1321, 1322
Medicago rotata	Coumestrol	1321, 1322
Medicago rugosa	Coumestrol	1321, 1322
Medicago sativa	Coumestrol	937, 942, 960, 1169, 1170, 1172, 1173, 1312, 1321–1323, 1326–1333
	5-Methoxy-4′-*O*-methylcoumestrol (CCXCII)	1170, 1334, 1335
	4′-*O*-Methylcoumestrol	1170, 1331, 1336
	Sativol (CCXCVI)	1170, 1331, 1337
	Medicagol	1170, 1331
	3′-Methoxycoumestrol	1331, 1338
	Trifoliol (CCXCVII)	1330, 1331
	Lucernol (CCXCIV)	1337
Medicago sauvagei	Coumestrol	1321, 1322
Medicago scutellata	Coumestrol	1321, 1322, 1325
	4′-*O*-Methylcoumestrol	1325
	3′-Methoxycoumestrol	1325
Medicago sogdiana	Coumestrol	1321, 1322
Medicago soleirolii	Coumestrol	1321, 1322
Medicago suffruticosa	Coumestrol	1321
Medicago tenoreana	Coumestrol	1321, 1322
Medicago tianshanica	Coumestrol	1321, 1322
Medicago tornata	Coumestrol	1321, 1322
Medicago truncatula	Coumestrol	1321, 1322, 1325
	4′-*O*-Methylcoumestrol	1325
	3′-Methoxycoumestrol	1325
Medicago turbinata	Coumestrol	1321, 1322
Medicago varia	Coumestrol	1321, 1322
Melilotus alba	Coumestrol	1322
Pachyrrhizus erosus	Erosnin (CCCIV)	1339, 1340
Phaseolus aureus	Coumestrol	1092, 1199, 1200, 1341
	Sojagol	1199
Psoralea corylifolia	Psoralidin (CCCV)	1342
Swartzia leiocalycina	6-Hydroxy-7-*O*-methylmedicagol (CCCI)	1343
	6-Hydroxy-5-methoxy-7-*O*-methylmedicagol (CCCII)	1343
Swartzia madagascariensis	7,4′-Di-*O*-methylcoumestrol	1344
Trifolium fragiferum	Coumestrol	960, 1323
Trifolium pratense	Coumestrol	1312, 1323, 1326, 1332
Trifolium repens	Coumestrol	960, 1280, 1312, 1323, 1326, 1345–1347
	4′-*O*-Methylcoumestrol	1346
	Trifoliol	1346, 1348
	Repensol (CCXCV)	1346
Trifolium subterraneum	Coumestrol	1281, 1282
Trifolium subterraneum var. *dwalganup*	Coumestrol	1323
Trigonella corniculata	Coumestrol	1322

this series is coumestrol (CCLXXXIX), and its isolation and estrogenic activity were first reported by Bickoff *et al.* (960). The coumestans are reported to have a higher order of estrogenic activity than the isoflavones (961). Table VIII gives a list of plants and their contained coumestans.

The synthetic stilbene derivative, diethylstilbestrol (CCCIX), is the prototype of the nonsteroidal estrogenic hormones. Of the natural stilbenes, rhaponticin (CCCX) is the only compound of this type reported to possess estrogenic activity. Knorr *et al.* (962) reported in 1956 that this compound could induce estrus in ovariectomized female rats. On the other hand, Klímek (963) reported in 1970 that rhaponticin produced only an insignificant increase in



		R	R_1	R_2	R_3	R_4	R_5	R_6	R_7
CCLXXXIX:	coumestrol	H	H	H	H	H	H	H	H
CCXC:	3′-methoxycoumestrol	H	H	H	H	OCH_3	H	H	H
CCXCI:	4′-*O*-methylcoumestrol	H	H	H	H	H	CH_3	H	H
CCXCII:	5-methoxy-4′-*O*-methylcoumestrol	H	H	H	H	H	CH_3	OCH_3	H
CCXCIII:	7,4′-di-*O*-methylcoumestrol	H	CH_3	H	H	H	CH_3	H	H
CCXCIV:	lucernol	H	H	OH	H	H	H	H	H
CCXCV:	repensol	H	H	H	H	H	H	H	OH
CCXCVI:	sativol	OH	CH_3	H	H	H	H	H	H
CCXCVII:	trifoliol	H	H	H	H	H	CH_3	H	OH
CCXCVIII:	demethylwedelolactone	H	H	H	OH	H	H	OH	H
CCXCIX:	wedelolactone	H	CH_3	H	OH	H	H	OH	H
CCC:	medicagol	H	H	H	H	H	—CH_2—O—		H
CCCI:	6-hydroxy-7-*O*-methylmedicagol	H	CH_3	OH	H	H	—CH_2—O—		H
CCCII:	6-hydroxy-5-methoxy-7-*O*-methylmedicagol	H	CH_3	OH	OCH_3	H	—CH_2—O—		H
CCCIII:	sojagol	H	H	H	H	—CH_2CH_2—C(CH$_3$)$_2$—O—		H	H
CCCIV:	erosnin	H	—CH=CH—		H	H	—CH_2—O—		H
CCCV:	psoralidin	H	H	—CH_2—CH=C(CH$_3$)$_2$	H	H	CH_3	H	H
CCCVI:	glycyrol	H	CH_3	—CH_2—CH=C(CH$_3$)$_2$	OH	H	H	H	H
CCCVII:	isoglycyrol	H	CH_3	—CH_2CH_2—C(CH$_3$)$_2$—O—		H	H	H	H
CCCVIII:	5-*O*-methylglycyrol	H	CH_3	—CH_2—CH=C(CH$_3$)$_2$	OCH_3	H	H	H	H

Structures of Coumestans

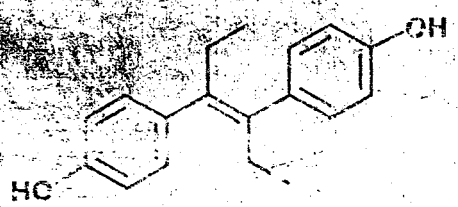
the uterine weight of immature mice. Therefore, the presence of estrogenic activity in this natural product remains to be demonstrated conclusively.

Another group of compounds has been reported to exhibit estrogenic activity. Wenzel and Rosenberg (964) reported that 6,4′-dihydroxyflavone (CCCXI) was estrogenic following subcutaneous injection, and Pretorius *et al.* (965) later found that quercetin (CXLVI) and robinin (CCCXII) showed slight estrogenic activity. Tricin (CCCXIII), from *Medicago sativa*, was also shown to have slight estrogenic activity (966). The estrogenic activity of quercetin has been questioned (967).

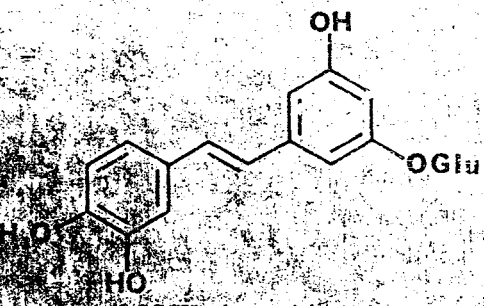
A number of reviews of plants containing estrogenic compounds have appeared (175, 928, 949, 968–1004).

A survey of 150 tender plants for estrogenic activity appeared (1005) but was not available. Table IX presents a list of plants having estrogenic activity. A list of compounds obtained from plants that exhibit estrogenic activity is given in Table X.

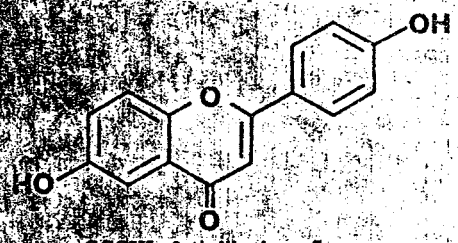
Humulus lupulus, *Avena sativa*, and *Oryza sativa* have been



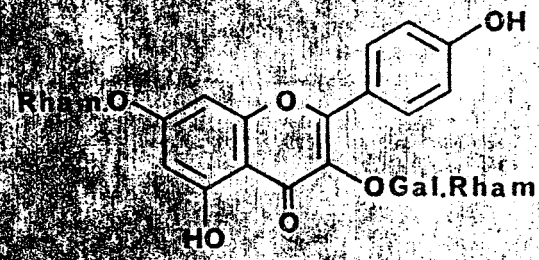
CCCIX: diethylstilbestrol



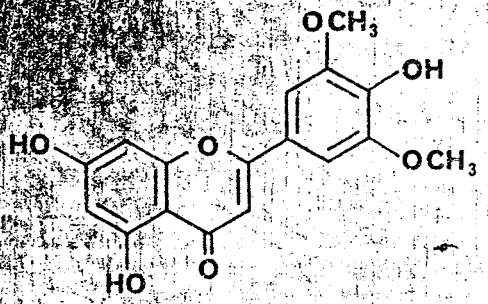
CCCX: rhaponticin



CCCXI: 6,4'-dihydroxyflavone



CCCXII: robinin



CCCXIII: tricin

shown to exhibit estrogenic properties (Table IX); these same plants have also been shown to induce ovulation (1006). Although there is no evidence of positive correlation between these two properties, it is of interest that the following plants also have been mentioned to induce ovulation: *Aralia cordata* (1006), *Citrus limon* (1006), *Lycium chinense* (1006, 1007), and *Raphanus sativus* (1006).

A number of plants have been reported from which products were obtained having properties similar to those of animal hormones. These products were not characterized, and no further details are available. Reviewers (928) have tended to assume that these products were estrogenic and have included them in tables of estrogenic plants. These claims may be unjustified and the plants are listed here rather than in Table IX, *i.e.*, *Convallaria majalis*,

Table IX—Plants Reported to Exhibit Estrogenic Activity

Plant Name		Reference
Agavaceae		
Agave americana		1349
Agave [illegible]		1349
Anacardiaceae		
Mangifera indica		1350
Apocynaceae		
Funtumia sp.		1351
Holarrhena		1351
Araliaceae		
Panax ginseng		1352, 1353
Asclepiadaceae		
Asclepias tuberosa		263, 264, 1039
Balsaminaceae		
Impatiens balsamina		1354
Betulaceae		
Alnus glutinosa		968
Boraginaceae		
Lithospermum ruderale		177
Bromeliaceae		
Ananas comosus		194, 1355
Tillandsia aloifolia		1355
Tillandsia balbisiana		1355
Tillandsia circinata		1355
Tillandsia fasciculata		1355
Tillandsia juncea		1355
Tillandsia simulata		1355
Tillandsia tenuifolia		1355
Tillandsia usneoides		1356
Caprifoliaceae		
Sambucus niger		1357
Chenopodiaceae		
Beta vulgaris		924, 1358–1361
Compositae		
Calendula officinalis		1362
Carthamus tinctorius		1363
Chrysactinia mexicana		1364
Helianthus annuus		1365
Cruciferae		
Brassica napus		1365, 1366
Brassica pekinensis		1367
Cyperaceae		
Cyperus rotundus		1368
Euphorbiaceae		
Ricinus communis		1369
Gramineae		
Avena sativa		925, 968, 1038, 1370–1373
Agrostis tenuis		1374
Bromus mollis		1375–1378
Cynodon dactylon		1051
Dactylis glomerata	+	194, 1374, 1379–1384
	−	1382, 1383, 1385
Eragostris curvula		1386
Festuca pratensis		1371, 1374, 1387
Festuca rubra		1374, 1387
Festuca arundinacea		1383
Hordeum vulgare		1373, 1388
Hyparrhena filipendula		1051
Lolium perenne	+	194, 1374, 1379, 1380, 1383, 1389
	−	1383
Lolium rigidum	+	1390
	−	1391
Oryza sativa		1038, 1363, 1392
Phalaris arundinacea	+	1383
	−	1383
Phleum pratense	+	1374, 1381, 1384, 1393, 1394
	−	1374, 1379, 1395
Poa pratensis	+	1396
	−	1375, 1378, 1385, 1397
Poa trivialis		1374
Secale cereale	+	1385
	−	1385
Setaria ciliolata		1051
Triticum aestivum	+	1038, 1363, 1366, 1389, 1398–1400
	−	1375, 1378, 1385, 1397
Zea mays	+	1363, 1365, 1371, 1389, 1401

(continued)

Table X—Compounds Reported to Have Estrogenic Activity

Compound Name		Reference
Anethole (CCCXIV)		1561
Anisole (CCCXV)		1561
Asiaticoside (CCCXVI)		1172
Biochanin A (CCIII)		999, 1011, 1031–1034, 1246, 1259, 1581
Cafesterol (CCCXVII)	+	1582, 1583
	−	1584–1587
Chiponomonic acid		1588
Coriacine (CXVIII)		1589
Coumestrol (CCLXXXIX)		994, 999, 1011, 1014, 1590–1593
Daidzein (CLIX)	+	1031–1034
	−	928
Deserpidine (CCCXVIII)		1599
Diosgenin (CCCXIX)		1600
17α-Estradiol (CLV)		1601
Estriol (CLVII)		1601
Estrone (CLVIII)		1601
Formononetin (CLXIII)	+	999, 1011, 1014, 1031–1034, 1259, 1273
	−	928, 972, 1034
Genistein (CXCIII)		930, 933, 999, 1011, 1014, 1031–1034, 1259, 1592, 1596, 1602–1604
Genistein 7-*O*-glucoside (CXCV)		1375, 1478, 1591
Genistein 4′-*O*-glucoside (CXCIV)		1605
Gibberellic acid (CCCXX)		1606, 1607
Miroestrol (CCLXXVIII)		994, 1608–1611
Nicotine (X)	+	1613–1615
	−	1616
Phloretin (CCCXXI)		1617
Pilocarpine (CXXVI)		1618
Podocarpic acid (CCCXXII)		1619
Prunetin (CC)		928
Reserpine (LXXXIX)	+	1620–1624
	−	1620–1629
Rhaponticin (CCCX)	+	962
	−	963
β-Sitosterol (CXLII)		1035, 1037
Glycyrrhiza glabra steroids		1427

Table XI—Relative Potency of Sterol Estrogens, Coumestrols, and Isoflavones

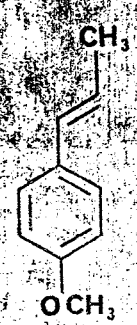
Compound	Quantity Required to Produce a 25-mg Uterus, μg	Relative Potency
Control	—	—
Diethylstilbestrol	0.083	100,000
Estrone	1.20	6,900
Coumestrol	240	35
Genistein	8,000	1.00
Daidzein	11,000	0.75
Biochanin A	18,000	0.46
Formononetin	32,000	0.26

Malus pumila, *Petroselinum crispum*, *Prunus cerasus*, *Rheum rhaponticum*, and *Solanum tuberosum* (1008).

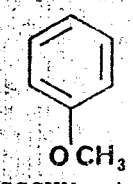
The metabolism of phytoestrogens in animals has been investigated in the sheep (1004–1014), rat (1015), cow (1016, 1017), fowl (1018–1021), other animals (1022), and liver enzyme systems (1023), and the effect of phytoestrogens on the blood in sheep has been studied (1024–1027).

If one inspects the structures of the estrogenic sterols (CXLII and CLV–CLVIII), isoflavones (CLIX–CCLXXXVIII), and coumestans (CCLXXXIX–CCCVIII), one can see a striking similarity of the skeletal structures of these compounds with the structure of the synthetic estrogen diethylstilbestrol (CCCIX).

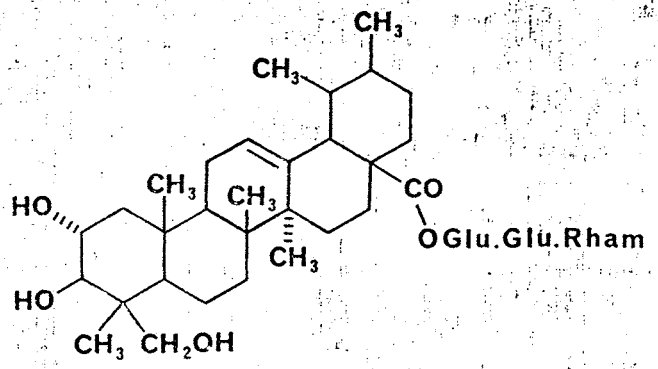
Recently, coumestrol (CCLXXXIX) and genistein (CXCIII) were shown to compete with 17β-estradiol (CLVI) for binding sites on a macromolecular component of the uterus from 6-day pregnant rabbits. The binding affinity of these compounds was related to their reported estrogenic potency; *i.e.*, one part by weight of 17β-estradiol, 70 of coumestrol, and 175 of genistein produced equivalent inhibition of the uptake *in vitro* of ^{3}H-17β-estradiol by the uterine receptor. Biochanin A (CCIII), formononetin (CLXIII), 4′-*O*-methylcoumestrol (CCXCI), sativol (CCXCVI), and medicagol (CCC) did not significantly inhibit 17β-estradiol binding, suggesting that free hydroxyl groups in positions 7 and 12



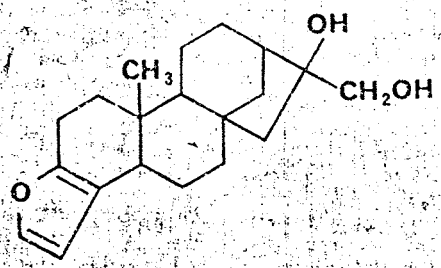
CCCXIV: anethole



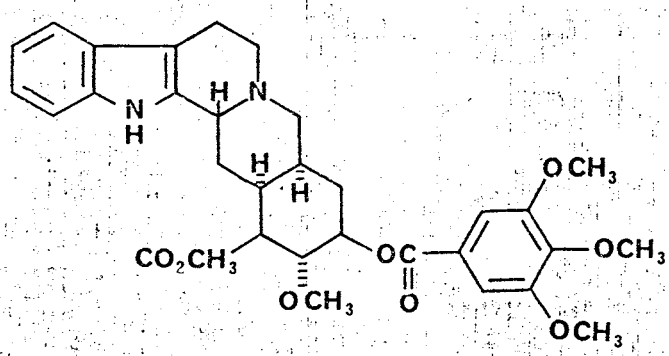
CCCXV: anisole



CCCXVI: asiaticoside

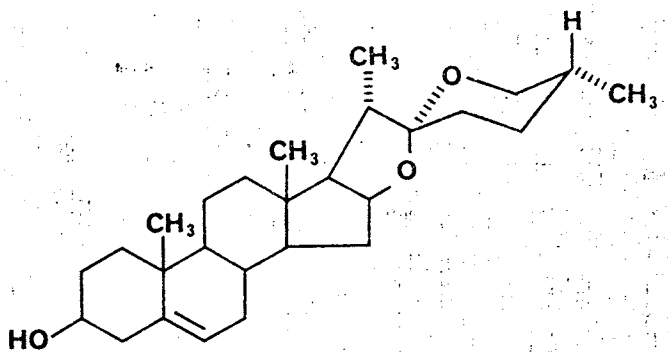


CCCXVII: cafesterol

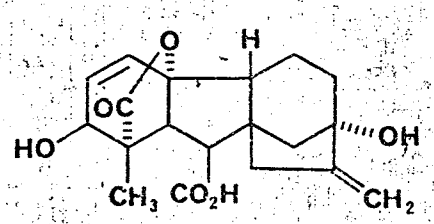


CCCXVIII: deserpidine

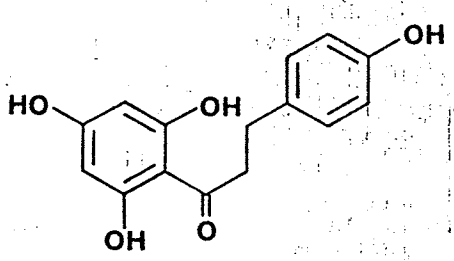
Structures of Additional Compounds Having Estrogenic Activity



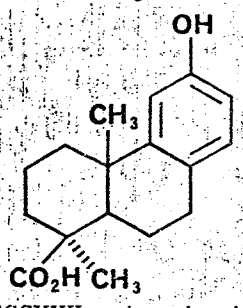
CCCXIX: diosgenin



CCCXX: gibberellic acid

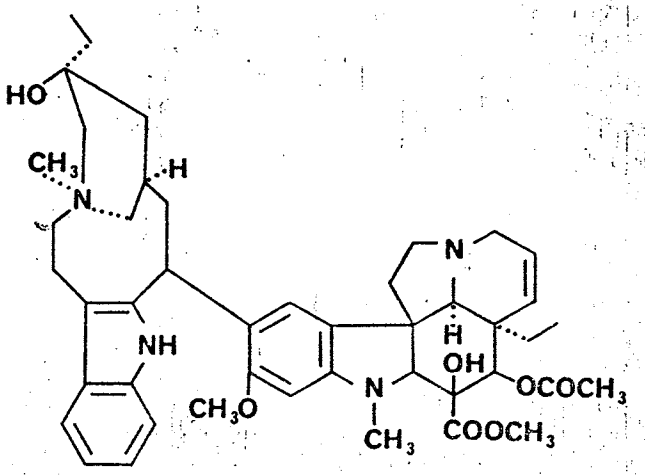


CCCXXI: phloretin

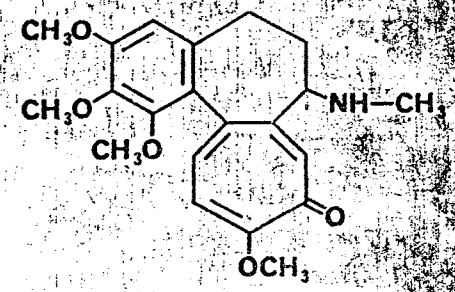


CCCXXII: podocarpic acid

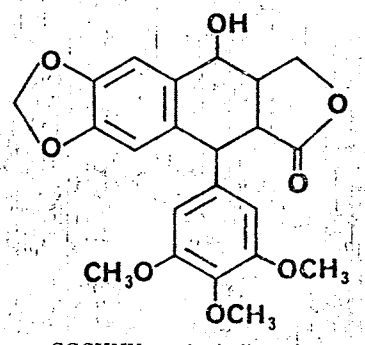
Structures of Additional Compounds Having Estrogenic Activity



CCCXXIII: vinblastine



CCCXXIV: demecolcine



CCCXXV: podophyllotoxin

of coumestans and isoflavones are essential for effective interaction with the estrogen receptor. The 7- and 4′-methoxycoumestans and isoflavones tested appeared to be proestrogens, able to bind to the uterine receptor only after *O*-demethylation *in vivo* (1029).

The order or degree of the biological activity of each of the three main groups of natural estrogens has been investigated (1030). The sterol estrogens were found to be of the highest order of activity, followed by the coumestrols and then the isoflavones. The relative potency of each substance, tested by the mouse-uterine weight bioassay method, with genistein arbitrarily chosen as the reference substance, is given in Table XI.

Other investigators studied the relative estrogenicity of the isoflavones and coumestan-type compounds. Comparison of the estrogenic activity of prunetin (CC), genistein (CXCIII), daidzein (CLIX), biochanin A (CCIII), and formononetin (CLXIII) led to the conclusion that the 5-hydroxyl group was essential for estrogenic activity (928). Genistein, biochanin A, and prunetin were estrogenic, while daidzein and formononetin were devoid of activity. Coumestrol (CCLXXXIX) was found to be many times more active than any of the isoflavonoid derivatives when administered intrarumenally to ovariectomized animals (1011). More recently, Leavitt and Meismer (999) reported that the relative estrogenic properties were in the order coumestrol > genistein > biochanin A > formononetin.

In addition to the work mentioned previously, some studies (1031–1034) have shown that daidzein was the most active isoflavonoid derivative in the mouse-uterine weight assay; biochanin A and genistein were of lesser but approximately equal activity, and

formononetin was essentially inactive. The other isoflavones listed in Table VII have not yet been examined for estrogenic activity, but they have been included because of potential estrogenic activity.

CYTOTOXIC AGENTS AS ANTIFERTILITY DRUGS

Certain naturally occurring cytotoxic agents have been shown to elicit an antifertility effect in laboratory animals, either by local or systemic routes of administration (70, 1630, 1631). For such a compound to be useful as an antifertility agent, it would have to be completely nontoxic, without teratogenic manifestation in marginal doses, and 100% effective (70). A number of plant products have been shown to elicit varying degrees of antifertility activity due to cytotoxicity. For example, vinblastine (CCCXXIII) from *Catharanthus roseus* (Apocynaceae), when administered to rabbits, reduced the percentage of normal fetuses at term to 0–33.3%; however, there were three fetal abnormalities produced in a group of 60 rabbits (70). An attempt was made to prevent this toxic effect by the concomitant administration of glutamic acid, which is known to prevent general toxic effects of vinblastine in mice. When administered prior to vinblastine, a 53.6% implantation rate was observed, with only 41.2% developing into normal fetuses (70).

Demecolcine (CCCXXIV), derived from several *Colchicum* species (Liliaceae), appears to act directly on the fetus and not on the placenta. This alkaloid, in doses of 2–8 mg/kg sc, destroyed the fetuses of rabbits 13–16 days pregnant. The drug was less effective when given orally (70). One or two doses of 2.5 mg/kg ip of demecolcine given to pregnant rats destroyed all litters when given between Days 11 and 19 of gestation. Fetuses showed marked edema, ascites, and hemorrhagic staining of internal organs and skin 6–12 hr after administration of the drug. No gross abnormalities were seen, but stunting was observed in a few surviving fetuses of rats treated with lower doses (70).

Podophyllotoxin (CCCXXV), a lignan derived from *Podophyllum* species (Berberidaceae), was administered to mice as a single subcutaneous dose of 0.25 mg, either immediately after detection of a vaginal plug or 3, 6, 12, or 14 days thereafter. Pregnancy did not continue in animals treated 3 days or more after copulation. Administered within 24 hr after copulation, podophyllotoxin was only occasionally effective (1631).

A number of plants listed in Tables II and III have a folkloric reputation as antifertility agents or have shown some degree of antifertility activity in laboratory animals. Table XII gives the names of those plants found in Tables II and III that are known to contain cytotoxic compounds, or crude extracts of which have shown cytotoxic or antitumor activity and thus could owe their antifertility activity to this mechanism. Known cytotoxic agents are also indicated for each plant in Table XII.

DISCUSSION

It can be seen in Table III that the effects, or lack thereof, of various plant extracts on the fertility of laboratory animals has been expressed in a number of ways by different workers. In the light of current knowledge concerning the reproductive cycles of the various laboratory species *(vide supra)*, it sometimes has not been clear from the procedures and data reported by some workers as to how they arrived at their conclusions that a particular mechanism was responsible for the antifertility effect produced by a given extract. Furthermore, lack of the use of control (vehicle-treated) animals in many studies leaves one to guess what would have been the expected rate of successful pregnancies in the strains and species used had no plant extract been administered. However, a clue was offered by Khanna *et al.* (103); in their estimation, an extract showing 100% "inhibition of implantation" had significant activity, one showing at least 50% inhibition had encouraging activity, and one showing less than 50% inhibition had no significant activity.

With such criteria in mind, it can be seen that some plants listed in Table III do not appear to have antifertility activity in spite of the fact that many of these same plants have a folkloric reputation for having contraceptive activity (Table II). If the fact that species variability *(vide supra)* could be at least partly responsible for the lack of correlation is ignored, it may be considered possible that such a lack could be due at least partly to the testing procedures used. For example, as indicated in the footnote to Table II, a number of plants (including *Calotropis gigantea, Carica papaya, Momordica charantia, Dendrocalamus strictus, Uraria lagopoides, Gloriosa superba, Piper longum,* and *Apium graveolens*) have been stated to have antifertility effects although it is possible that their activity might more narrowly fall into the abortifacient or emmenagogic categories. The plants just named, however, when tested in animals, were never administered past the 7th day of pregnancy; that is, they were administered until just barely beyond the time of implantation, probably not long enough to test for any abortifacient effect other than a very early acting one.

A few of the plants listed in Table II as having a folkloric reputation as antifertility agents are reported in Table III as having antiovulatory activity; these plants are *Apocynum androsaemifolium, Asclepias hallii,* and *Hibiscus rosa-sinensis. Semecarpus anacardium, Mallotus philippinensis, Ricinus communis, Abrus precatorius,* and *Plumbago zeylanica* also are listed in both Tables II and III. These plants, however, apparently have not been tested for antiovulatory activity. As indicated in Table III, extracts of these plants have been administered to animals following mating and have been shown to be ineffective in inhibiting pregnancy under these conditions, probably due to a lack of interceptive activity and/or anti-implantational activity *per se (vide supra)*. That these plants do not possess antifertility activity by means of an antiovulatory effect has not been shown.

Scheme I suggests a means by which one may test for the various possible mechanisms of antifertility activity in the female mammal. If one merely wishes to determine whether a given extract has contraceptive, interceptive, and/or abortifacient activity, the entire procedure can be carried straight through. If activity is demonstrated early in the scheme, obviously additional animals will be required to examine for later effects. As indicated earlier in this paper, a given compound may inhibit fertility by more than one mechanism and/or at more than one site. The offshoots at the right of the scheme indicate the means by which further details concerning mechanism(s) of action may be elucidated. The rat, which appears to be the most commonly used test species, is the species indicated in Scheme I; other species, of course, have been and can be used, but variations among their reproductive cycles (Table I and Ref. 4) should be considered.

It appears, then, that investigators interested in the further

Table XII—Plants Whose Alleged or Demonstrated Antifertility Activity Could Be Explained on the Basis of Cytotoxicity

Plant Name	Cytotoxic Agent	Reference
Annonaceae		
Annona squamosa	Cytotoxicity	1640
Apocynaceae		
Apocynum androsaemifolium	Cardenolides	1632, 1633
Apocynum cannabinum	Apocannoside	1634, 1635
Catharanthus roseus	Vinblastine, vincristine, leurosine, leurosivine, rovidine, leurosidine	1636
Cerbera manghas	Cardenolides	1632
Nerium indicum	Cardenolides	1632
Rauvolfia serpentina	Reserpine	1671
Thevetia peruviana	Cardenolides	1632

(continued)

acclimatize singly housed rats to controlled lighting conditions (1–2 weeks)
daily vaginal smears (10 days–2 weeks) should indicate normal estrous cyclicity
begin dosing of virgin female rats with extract or vehicle
daily vaginal smears (10 days–2 weeks)
possible mechanisms for changes from normal:
1. cornification: estrogenicity } peripheral
2. leukocytes: antiestrogenicity
3. central effect on hypothalamus and/or pituitary (antigonadotrophic) → measure hormone levels in serum and pituitary; examine rats for ovulation (antiovulatory)
pair with proven breeder males: continue daily dosing of females and examination of vaginal smears
lack of mating: lack of estrogen and/or progesterone due to peripheral antagonism or central inhibition (antigonadotrophic)
occurrence of mating; continue dosing females Days 1–7; stop smears
→ examine oviducts, ovaries, and uteri Days 1–7 for:
1. occurrence of ovulation (contraceptive)
2. occurrence of fertilization
3. alteration of ova transport
4. luteolytic effects
5. cytotoxic effects on fertilized ova
6. occurrence of implantation (anti-implantational)
} interceptive
continue dosing females until and including Day 19
no gain in weight: contraception or interception
bleeding, loss of weight gained: resorption
abortion } (abortifacient)
→ test extract for uterine stimulant activity
autopsy females on Day 20
compare number of fetuses and/or implantation sites with number of corpora lutea of pregnancy (histologically)
count number of normal (living), abnormal (living and nonliving), and/or resorbing fetuses and/or number of implantation sites
on 20th day, cease dosing females not mating: continue housing with males for 19 days; autopsy on 20th day
lack of mating: "permanent" sterility
→ measure hormone levels in serum and pituitary; examine pituitary histologically
examine reproductive organs histologically

Scheme I

study of plants as a source of new antifertility agents should note certain data that have been presented herein. First, a proper dosing schedule (Scheme I) should be followed in the testing that will allow the investigator to detect plants, the activity of which may be caused by constituents having a mechanism of interest. Second, it is apparent from published data that many studies have lacked adequate controls; vehicle-treated animals should always be studied concurrently so that the investigator can know the normal pregnancy rate for that particular strain and species of animal. Third, one should not rely on a single solvent extract for testing. For example, it has been shown in the case of *Medicago sativa* that the ether extract was estrogenic, that the chloroform extract was antiestrogenic, and that the acid–water extract interfered with seminal vesicle growth (141). In the case of *Ocimum sanctum*, the benzene extract showed 80% antifertility activity, the petroleum ether extract 60%, and the ethanol extract less than 50% (99).

To separate plant material for testing into fractions of differing polarity, it seems that each plant should be extracted first with petroleum ether. The marc should then be extracted with either ethanol or methanol, with this extract being partitioned between chloroform and water. The resulting three extracts, *i.e.*, petroleum ether, chloroform, and water, should then each be evaluated for antifertility effects; one should not rely on an evaluation of a single solvent extract alone.

Finally, the plant names presented in Tables II and III have been examined and compared with the data presented in Tables IV–XII. From this comparison, we have deleted all plant names in Tables II and III that have also been found in Tables IV–XII. This new list of suggested plants to investigate for antifertility activity is presented in Table XIII.

Table XIII—Plants Suggested to Be Reinvestigated for Antifertility Activity

Plant Name	Plant Part[a]	Reference
Aizoaceae		
Trianthema pentandra	—	192
Trianthema portulacastrum	—	192
Amaranthaceae		
Achyranthes aspera	—	192
Amaranthus retroflexus	PL	169
Amaranthus spinosus	—	171
Amaryllidaceae		
Stenomesson variegatum	—	92
Anacardiaceae		
Rhus trilobata	LF	92
Semecarpus anacardium	RT, SD	90, 103, 192
Semecarpus stellata	RT	92
Annonaceae		
Artabotrys odoratissimus	LF	104
Araceae		
Acorus calamus	RT	91
Anthurium tessmannii	IF	92, 93
Arisaema atrorubens	RZ	92
Arisaema triphyllum	RT	90, 92
Philodendron dyscarpium	IF	92, 93

(continued)

ADDENDUM

Three recent papers have come to our attention since the compilation of data reported herein, which we believe should be included in the review.

Kapoor et al. (1) [illegible] extracts of *Areca catechu*, *Carica papaya*, *Daucus carota*, *Mentha arvensis*, and *Polygonum hydropiper*, which had previously been reported to possess antifertility activity, for anovulatory effects in female rabbits. The only plants of this group showing anovulatory activity were the ethanolic extract of *M. arvensis* leaves and the petroleum ether extract of *P. hydropiper* roots.

Similarly, various extracts and chromatographic fractions of the stems and leaves of *Argemone mexicana*, the seeds of *C. papaya*, the seeds of *Lawsonia inermis*, the leaves of *M. arvensis*, and the seeds of *Sapindus trifoliatus* were tested for antifertility activity in female albino rats (1674). The ethanolic extract of *M. arvensis* leaves, as well as certain chromatographic fractions from a methanolic fraction of *S. trifoliatus* seeds, showed high degrees of antifertility activity.

Petroleum ether and aqueous extracts of *Curcuma longa* (Zingiberaceae) rhizomes exerted a 100% antifertility activity in rats at a dose of 200 mg/kg; the effect was not due to anovulatory activity (1675).

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[x] To whom inquiries should be directed.

RESEARCH ARTICLES

Release of Corticoids from Oleaginous Ointment Bases Containing Drug in Suspension

Z. T. CHOWHAN [x] and R. PRITCHARD

Abstract □ Simplified methods for studying the release of drugs suspended in oleaginous ointment bases were developed. These procedures were used in studying the release rates of two corticoids, fluocinonide and flucloronide, from white petrolatum and petrolatum containing various adjuvants. A practical method for measuring drug solubilities was developed and used in determining solubilities of these corticoids in ointment bases. When using physical data obtained from model ointments, the release rates of drugs from modified ointment bases were predicted. Comparisons of the observed and predicted rates from ointments containing hydrophobic adjuvants indicated the usefulness of the physical model approach in predicting the release rates. For ointments containing emulsifying agents, the simple model used did not provide useful predictions.

Keyphrases □ Fluocinonide—suspension, release from oleaginous ointment bases containing various adjuvants, model predictions □ Flucloronide—suspension, release from oleaginous ointment bases containing various adjuvants, model predictions □ Ointment bases—release of corticoids in suspension □ Release rates—corticoid suspensions from oleaginous ointment bases containing various adjuvants

Percutaneous absorption involves two consecutive steps: the release of the drug from the vehicle and its subsequent penetration through the skin barrier. Generally, the latter step controls percutaneous absorption, because it is the slower of the two events. The release of the drug from the vehicle may play an important role in percutaneous absorption when the drug solubility and its diffusion constant in the vehicle are very small. When the skin barrier is in a damaged state due to disease or injury, drug release from the vehicle then controls percutaneous absorption.

Simplified equations describing the drug release from suspension- (1) and solution- (2) type vehicles have been in the literature for more than a decade. Numerous studies also have attempted to relate vehicle composition to observed changes in the *in vitro* release rate (3–9). Relatively little quantitative information appears in the literature correlating drug release data with variations in physical parameters produced by compositional changes in the formulations. In some cases, the drug release from the vehicles has been complicated by the use of a membrane barrier to separate the donor phase from the receptor phase. The use of dialysis membranes (3), filter membranes (4), membranes of animal origin (5, 6, 8), and dimethyl polysiloxane membranes (7) has been reported.

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INHIBITION OF GLUCAGON AFTER *IN VITRO* MIXTURE WITH LITHOSPERM

W. R. BRENEMAN AND MARVIN CARMACK[1]

Departments of Zoology and Chemistry,[2] Indiana University, Bloomington, Indiana

ABSTRACT

The hyperglycemic effect of glucagon in the fowl was inhibited after its mixture *in vitro* with cold-water extracts of the plant *Lithospermum ruderale.* Spray-dried powders prepared from the cold-water extracts also inhibited glucagon activity after *in vitro* mixture with the hormone. A preliminary fractionation of the spray-dried powders by paper-column chromatography yielded several fractions, some of which were active. The active fractions were eluted by water from the column. The *in vitro* inhibition of glucagon appears to parallel the "inactivation" of pregnant mare serum and other protein hormones which follow *in vitro* mixture with lithosperm.

Very high dosages of the spray-dried lithosperm powder given either subcutaneously or intravenously did not produce hypoglycemia in pullets, cockerels, or laying hens. It is concluded that *in vitro* inactivation of glucagon occurred in the experiments reported.

KEMPER, Loeser, Opitz, and Schwartz (1) have recently reported that the administration of extracts of *Lithospermum officinale* lowered blood-sugar level 45% to 55% in 3 out of 5 rabbits tested. This suggests that extracts of *Lithospermum* may affect carbohydrate metabolism and adds another item to the list of physiological mechanisms reported to be influenced by extracts of this plant. Accordingly, some of our observations relative to the inhibition of glucagon activity by extracts of *Lithospermum ruderale* may contribute to a better understanding of this latest phenomenon.

The *in vitro* assay procedure for lithosperm[3] activity developed by Noble and his co-workers (2, 3, 4) has been used for screening numerous chemical fractions. Since *in vitro* mixtures have been reported by Noble to result in an inactivation of pregnant mare serum, interstitial cell-stimulating hormone, luteotrophic hormone, and thyrotrophin, we wished to determine if our lithosperm extracts affected these and other protein hormones. Atten-

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[2] Contribution Number 651 of the Zoology Department and 814 of the Chemistry Department of Indiana University.

[3] The term lithosperm is used as a convenient generic designation for the hormone inhibiting principle or principles present in any members of the genus *Lithospermum* without committment as to their chemical identity.

tion was first directed to insulin because its molecular structure and amino-acid composition are known. It was hoped that if lithosperm inactivated this hormone it might be possible to determine the exact nature of the inhibitory process. The interesting results of our first lithosperm-insulin mixtures and the availability of both amorphous and crystalline glucagon[4] subsequently led us to extend our investigations to the latter hormone.

MATERIALS AND METHODS

Single-comb White Leghorn cockerels and pullets from 40 to 90 days-of-age were used as test animals in all but one experiment. The procedures followed were those outlined by Beekman (5). The birds were fasted for twelve hours, weighed, and than allowed to feed for four hours before administration of test solutions. The amounts of insulin and glucagon injected were on the basis of kilograms of body weight of the fasted animals. The lithosperm extract in the preliminary insulin experiments was mixed with the hormone and incubated at 37° C for two hours. Incubation was omitted in the glucagon experiments because it was discovered that a change in hormone activity would occur without incubation after mixture for only one hour. The volume of the lithosperm-hormone mixtures was 1.0 ml. The lithosperm preparations were approximately pH 7.0, therefore, it was necessary to adjust the lithosperm-glucagon mixtures with glycine buffer to a pH of 9.5 or 10.0.

Since the amount of insulin-lithosperm or glucagon-lithosperm mixture received by the birds was adjusted for body weight, the quantity injected intramuscularly usually was only 0.15 ml. Blood samples were taken for glucose determinations both before injection and, except in the insulin experiment, one hour after the administration of the solutions. The blood-glucose determinations were made according to the Folin and Malmros micro-method, Horvath and Knehr (6).

Dried whole overground parts of *Lithospermum ruderale* secured from commercial suppliers were used as the starting material. The dried plant was finely ground in a Wiley laboratory grinder and was usually powdered still finer in a hammer-mill. Extracts were made at room temperature with 10 parts of deoxygenated water per part of plant. Several successive extractions generally were made and combined for further processing. The best material was obtained if the first washings were not combined with the bulk of material to be worked up. Filtration of the mass was very difficult and was most successfully achieved in thin layers, with the aid of pressure and with filter aids such as Supercel. The clarified solutions were evaporated as rapidly and gently as possible under reduced pressure. A combined procedure was advantageous, involving a partial concentration in an efficient flash-evaporator followed by a complete drying to powder in a spray-drying apparatus. As an alternative, a freeze-drying technique may be used instead of the spray-drying to remove water. The water-soluble constituents of the powder prepared as described contain some organic and inorganic salts and probably also saccharides (they ferment rapidly and support the growth of molds).

Several methods have been employed for the fractionation of extract powders, but only one preliminary experiment on fractionation is included in this report. An early effort was made to separate the constituents by means of chromatography on columns packed with cellulose powder. The chromatography of 10 grams of an active lithosperm powder was conducted on a column four inches in diameter containing one kilogram of Whatman Standard Grade of cellulose powder. The extract was mixed with a small amount of cellulose powder and carefully placed on the top of the packed column after

[4] The glucagon used in this study was supplied through the courtesy of Eli Lilly and Co., Indianapolis, Indiana.

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which the initial eluting solvent, 3:1 acetone-water was added. The solvent was gradually changed to pure water by the slow addition of water. The fractions used for the data in Table 5 were prepared in this manner.

RESULTS AND DISCUSSION

It may seem unusual to employ the fowl instead of a mammal as a test animal for these studies, especially since the cat is excellent for glucagon assay. Beekman (7, and unpublished data) has shown that blood-sugar of the fowl will be elevated 45% by as little as 0.1 μgm. of crystalline glucagon. Staub and Behrens (8), on the other hand, state that the cat requires 0.2 μgm. for this increase. Furthermore, the maximum response in the fowl is not reached until at least 25.0 μgm. of glucagon is given whereas a maximum response is achieved in the cat with 1.0 μgm. to 2.0 μgm. The log of glucagon dosage against the rise in blood-sugar in the fowl is a straight line from 0.2 μgm. to 50.0 μgm. per kilogram of body weight. The

TABLE 1. EFFECT OF INSULIN AND INSULIN PLUS LITHOSPERM* ON BLOOD-SUGAR OF WHITE LEGHORN FOWL
(Percentage change 90 minutes after administration)

Insulin	Lithosperm	No. of animals	% change blood-sugar
6.7 units insulin plus	250.0 mg. eq.†	2	−21.9
6.7 units insulin plus	500.0 mg. eq.	2	−46.1
1.0 unit/kg. body weight		2	−20.7

* Incubated for 2 hours at 37° C. Each bird received 1.0 unit per kilogram of body weight thus the injection volume was about 0.15 ml. of the lithosperm-insulin mixture.
† Milligram equivalent of the original dried plant.

responses are remarkably reproducible as will be illustrated by the glucagon controls in Tables 2 and 4 of this paper. Finally, it has been reported by Vuysteke and De Duve (9) that the glucagon content of the bird pancreas is six times greater than that of the mammalian pancreas. Since we are interested in analyzing the possible effects of lithosperm on both endogenous and exogenous glucagon, the fowl is especially advantageous for our studies.

Table 1 presents the blood-sugar changes which accompanied the administration of insulin alone and following its incubation for two hours at 37° C with lithosperm. Although these data are very limited, they indicate that lithosperm did not inhibit insulin action and this result is in harmony with the observations of Noble *et al.* (2). For this reason, we did not wish to extend these experiments at this time. We were interested, however, in the observation that there appeared to be a greater decrease in blood-sugar level in those birds given the 500.0 mg. eq. lithosperm-insulin mixture than in those animals which received insulin alone. Two possible explanations for this observation were suggested: first, that there might be a trace of glucagon in the insulin preparation and that the action of this exogenous glucagon might be inhibited; or second, that the 75.0 mg. eq. of lithosperm

which was injected (0.15 ml. or 15% of the 500.0 mg. eq. in the mixture) might inhibit endogenous glucagon. Accordingly, it was decided to test directly for possible *in vitro* inhibition of glucagon and also to examine the possibility that lithosperm might produce hypoglycemia by its action *in vivo*. In the first experiments, various concentrations of a cold-water extract of dried plant were mixed with glucagon *in vitro*. These data are presented in Table 2.

The dosage of amorphous glucagon in this and all subsequent experi-

TABLE 2. DECREASED HYPERGLYCEMIC ACTION OF GLUCAGON AFTER MIXTURE *in vitro* WITH LITHOSPERM PREPARED AS A COLD WATER EXTRACT OF DRIED PLANT MATERIAL

	Glucagon	Lithosperm	No. of animals	% increase blood sugar	% decrease in activity
A*	500.0 μgm. plus	1.0 mg. eq. lithosperm‡	6	+ 54	−44.3
	500.0 μgm. plus	10.0 mg. eq. lithosperm	6	+ 38	−62.5
	500.0 μgm. plus	100.0 mg. eq. lithosperm	6	+ 13	−83.5
	75.0 μgm./kg. of body weight		6	+ 97	
B†	500.0 μgm. plus	0.5 mg. eq. lithosperm	3	+ 78	−23.6
	500.0 μgm. plus	5.0 mg. eq. lithosperm	3	+ 68	−34.4
	500.0 μgm. plus	25.0 mg. eq. lithosperm	3	+ 22	−78.4
	75.0 μgm./kg. of body weight		2	+102	

* Mixed at room temperature for 2 hours before injection
† Mixed at room temperature for 1 hour before injection.
Injection volume was about 0.15 ml. for the lithosperm-glucagon mixtures so that each bird received 75.0 μgm. of glucagon per kilogram of body weight.
‡ The dosage of lithosperm is in terms of milligrams equivalent of the original dried plant.

ments was 75.0 μgm./kg. of body weight. This amount of glucagon is sufficient to produce approximately a 100% increase in the blood-sugar level of the fowl, a fact demonstrated by the figures for the two control series in Table 2 in which the glucagon produced increases of 97% and 102% in the blood-sugar. The two groups of treatments in A and B are not exactly comparable experiments. They were performed at different times and the lithosperm-glucagon mixture was allowed to stand two hours before injection in one series and only one hour in the other. Neither mixture was incubated. Remarkably good correlation existed, however, between the amount of lithosperm used and the percentage decrease in glucagon activity which was observed. The mixture of the glucagon with as little as 0.5 mg. eq. of lithosperm had a slight but definite inhibitory effect on the hyperglycemic action of the glucagon. Except for the slight reversal in the degree of inhibition produced by the 1.0 mg. eq. and the 5.0 mg. eq. dosages, the results were remarkably constant. This reversal of effect will be commented on later. In general, inhibition was greater as the dosage of lithosperm increased. Furthermore, the 0.5 mg. eq. and the 1.0 mg. eq. of the lithosperm-glucagon mixtures were clear and almost colorless. There was no evidence of precipitation. We believe that this is significant since it has been suggested that *in vitro* mixture of lithosperm with other hor-

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TABLE 3. BLO

No. of animals	Animal	
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mones might be effective as a result of precipitation of the hormone. The data in Table 2 demonstrate that glucagon action was inhibited by the cold-water extract of lithosperm after mixture at room temperature for two hours in the case of experiment A, or after mixture for only one hour at room temperature in experiment B. The results show that it is not necessary to incubate the mixtures, which avoids the possibility of heat inactivation of the hormone.

The light brown powders, prepared under the mildest conditions de-

TABLE 3. BLOOD-SUGAR DETERMINATION ON FOWL GIVEN LITHOSPERM

No. of animals	Animal	Treatment	Blood-sugar
		Subcutaneous administration	
2	Pullets	Control	173 mg. %
2	Pullets	2.5 mg. lithosperm 2× daily—4 days	177 mg. %
2	Pullets	5.0 mg. lithosperm 2× daily—4 days	188 mg. %
2	Pullets	10.0 mg. lithosperm 2× daily—4 days	183 mg. %
3	Pullets	20.0 mg. lithosperm 2× daily—4 days	176 mg. %
4	Laying hens	Controls	160 mg. %
4	Laying hens	250.0 mg. lithosperm 2× daily—5 days	161 mg. %
		Intravenous administration	
2	Cockerels	Control	175 mg. %
2	Cockerels	20.0 mg. lithosperm	178 mg. %
2	Cockerels	20.0 mg. lithosperm	181 mg. %
2	Cockerels	20.0 mg. lithosperm subcutaneously followed 40 minutes later by 20.0 mg. lithosperm intravenously	177 mg. %

			Blood-sugar change minutes after injection						
			20	40	60	90	120	150	180
2	Cockerels	Controls	−1%	−8%	−12%	−20%	−7.5%	−8%	−5.5%
2	Cockerels	33.3 mg. LSPM/kg. intravenously	−5.5%	−4.5%	−15%	−16%	−3.5%	3%	11.5%

scribed earlier, keep well in cold-storage and dissolve readily in water with little or no insoluble residue. Tests for biological activity of these powders proved them to be low in toxicity and very potent in the inactivation of pregnant mare serum. Such a powder prepared for us by spray-drying by Dr. Bryce Douglas at the Smith, Kline and French Laboratories has been used as a reference substance and has retained its activity for more than a year. It was decided, therefore, to use this powder for three purposes: first, to test whether it would produce hypoglycemia per se; and second, as a starting material for the possible fractionation of lithosperm by paper-column chromatography. A few representative experiments designed to test the possible hypoglycemic effect of this lithosperm powder *in vivo* are shown in Table 3.

It will be noted that a wide range of dosages from 2.5 mg. to 250.0 mg.

were used and that the birds received amounts of lithosperm which in most instances exceeded those injected when lithosperm-glucagon combinations were given after *in vitro* mixture. For example, the birds which received the maximum amount of lithosperm in Table 2 actually were given only 15.0 mg. eq. of lithosperm since they received 0.15 ml. of the lithosperm-glucagon mixture (500.0 μgm. glucagon plus 100 mg. eq. of lithosperm). Injections were made subcutaneously and with the supposition that subcutaneous injections given twice daily might provide a rather constant level of lithosperm in the blood stream. The lithosperm was also administered intravenously in a few instances.

Pullets which received from 5.0 mg. to 40.0 mg. daily of lithosperm subcutaneously did not demonstrate any hypoglycemic response to the lithosperm. In order to test the possibility that a higher dosage of lithosperm might be necessary to produce a hypoglycemic effect, 250.0 mg. of lithosperm was injected subcutaneously twice daily into laying hens for five days. The blood-sugar level in these birds also was not altered. It is interesting, however, that egg-laying ceased in these hens after the first day of treatment and at the end of five days the ovaries and oviducts had regressed to the non-laying condition.

The route of administration was checked next. It seemed possible that lithosperm given by intravenous injection might act more rapidly and be effective. Cockerels which received lithosperm intravenously, and by both intravenous and subcutaneous injection, however, did not have their blood-sugar levels significantly changed. The possibility that the effect of lithosperm could be very short lasting and, therefore, could be missed whe blood samples were taken only after 60 minutes was the next point to b checked. Cockerels were injected intravenously with lithosperm and bloo samples of both control and treated birds were taken every 20 minutes fc three hours. There was a slight decline in the blood-sugar of lithosper injected cockerels during the first two hours, but the controls showed a equal or even greater drop during the same periods. It must be conclud from the data in Table 3 that under the conditions of these experimen using a spray-dried powder over a wide range of dosages that hypoglycen is not produced in the fowl by our present lithosperm perparation.

Since it is possible that the glucagon inhibiting activity of the lithospe might be lost by the spray-drying, attention was next directed to the stu of the effect of mixing this material with glucagon *in vitro*. The data sho in Table 4 are for a series of birds which received injections of gluca after its mixture with small amounts of spray-dried powder for one h at room temperature. The dosages ranged from a low of 0.01 mg. to mg. of powder but the amount of glucagon, 75.0 μgm./kg. of body wei remained the same.

Attention should be directed to the 98.5% increase in blood-sug

the glucagon control series. This value is very close to the 97% and 102% figures for the controls in Table 2. The inhibition of glucagon activity by lithosperm powder is evident at all of the dosages used. More experiments, of course, should be performed before much significance can be ascribed to the results of the 0.01 mg. and the 0.10 mg. treatment levels. Additional tests also should be done to ascertain if there is a difference between the 3.00 mg. and the 4.00 mg. dosages. It is of some importance to note, however, that Graham and Noble (4) have observed that high and low dosages of some lithosperm preparations are more potent inhibitors of PMS activity than are dosages in the middle range. It will be recalled that there also was an indication of reversal in the degree of response between the 1.0 mg.

TABLE 4. DECREASED HYPERGLYCEMIC ACTION OF GLUCAGON AFTER MIXTURE *in vitro* WITH SPRAY-DRIED LITHOSPERM POWDER PREPARED FROM A COLD WATER EXTRACT

Glucagon	Lithosperm	No. of animals	% increase blood-sugar	% decrease in activity
500.0 μgm.	plus 0.01 mg. lithosperm*	10	+72.9	−25.9
500.0 μgm.	plus 0.10 mg. lithosperm	10	+77.0	−21.8
500.0 μgm.	plus 1.00 mg. lithosperm	5	+67.8	−31.2
500.0 μgm.	plus 3.00 mg. lithosperm	5	+39.0	−60.4
500.0 μgm.	plus 4.00 mg. lithosperm	5	+39.0	−60.4
500.0 μgm.	plus 5.00 mg. lithosperm	10	+12.5	−86.3
75.0 μgm./kg. of body weight		25	+98.5	

* Mixed at room temperature 1 hour before injection.
Injection volume was about 0.15 ml. for the lithosperm-glucagon mixture so that each bird received 75.0 μgm. of glucagon per kilogram of body weight.

eq. and the 5.0 mg. eq. dosages in Table 2. It may be possible that additional data will demonstrate a phenomenon here which is similar to the PMS inhibition. Regardless of the vagaries of the dosage responses, it is evident that inhibition of glucagon action does occur after its *in vitro* mixture with the spray-dried powder. The 5.00 mg. of the powder actually produced a slightly greater inhibition than did the 100.0 mg. eq. of the cold-water extract. The 3.00 mg. and the 4.00 mg. amounts compare favorably in their action with the 10.0 mg. eq. and the 25.0 mg. eq. quantities of the cold-water extract. When it is remembered that the birds injected with the 1.00 mg. lithosperm-glucagon mixture actually received only about 0.15 mg. of lithosperm, it is difficult to see how the 31.2% decrease in response could be accounted for by hypoglycemia produced *in vivo*.

The stability of the spray-dried powder and the evidence that it also would inhibit glucagon action after mixture *in vitro*, encouraged us to attempt some preliminary fractionations on a paper-column. The plant powder constituents were divided by the paper-column into a number of broad bands which showed differences in gross properties. The only bands tested in this experiment were those which we designated as one to five: with one being the 3:1 acetone-water soluble material which was the first

to pass through the column. Approximately 20 fractions were tested in all and the data presented in Table 5 were selected as representative of the results. Unfortunately, the experiments were not as critical as they might have been because of two factors: first, we were forced to use older birds (90 days-of-age) which do not respond as well as younger birds; and second, the glucagon was in solution for two weeks before use. In spite of these deviations in procedure, the results clearly demonstrate that there is a difference in the rate at which the active principle migrates through the paper-column.

The first fractions, 1, 2, and 3, eluted by the acetone-water mixture produced no significant inhibition of glucagon. Fraction 4 and especially fraction 5 definitely inhibited glucagon activity. It is apparent from these preliminary results that the fractions which inhibit glucagon are held rather firmly on the column and come off during the elution with water and as the concentration of water increases. The degree of inhibition produced by the 5.0 mg. of fraction 5 was greater than that which followed the administration of the 10.0 mg. eq. of the whole plant extract. It should again be noted that there was no evidence of precipitation of hormone in these lithosperm-glucagon mixtures. Fraction 5, especially, was clear and almost colorless.

TABLE 5. DECREASED HYPERGLYCEMIC ACTION OF GLUCAGON AFTER MIXTURE *in vitro* WITH PAPER-COLUMN CHROMATOGRAM FRACTIONS OF LITHOSPERM

Glucagon	Lithosperm	No. of animals	% increase blood-sugar	% glucagon inhibition
500.0 μgm.	plus 5.0 mg.* fraction 1	4	+68	0
500.0 μgm.	plus 5.0 mg. fraction 2	4	+73	0
75.0 μgm./kg.	control for 1 and 2	4	+67	
500.0 μgm.	plus 5.0 mg. fraction 3	4	+39	− 9.3
500.0 μgm.	plus 5.0 mg. fraction 4	4	+31	−28.0
500.0 μgm.	plus 5.0 mg. fraction 5	4	+14	−67.5
75.0 μgm./kg.	control for 3, 4, and 5	4	+43	

* The dosage of lithosperm is in milligrams of material recovered from the column. Injection volume was about 0.15 ml for the lithosperm-glucagon mixture so that each bird received 75.0 μgm. of glucagon per kilogram of body weight.

The inhibition of glucagon activity following its *in vitro* mixture with lithosperm as reported here parallels closely the results reported for other hormone-lithosperm mixtures. The extensive data for pregnant mare serum "inactivation" by lithosperm appear to us to be very comparable. It seems highly improbable that the lower response of the birds to the glucagon after mixture with lithosperm could be due to *in vivo* inactivating mechanisms. For example, hens which received 2500 mg. of lithosperm powder in five days had blood-sugar levels within the normal range. This is a marked contrast with the mixture of as little as 1.00 mg. of the same powder *in vitro* which produced a 31.2% decrease in the response to glucagon.

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FTER MIXTURE *in vitro*
LITHOSPERM

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68	0
73	0
57	
39	− 9.3
31	−28.0
14	−67.5
43	

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) mg. of the same pow-
response to glucagon.

This occurred in spite of the fact that only 0.15 mg. of the lithosperm was injected (0.15 ml. of the 1.00 mg. lithosperm-glucagon mixture). It is our opinion, therefore, that glucagon is being inactivated by lithosperm when mixed *in vitro*.

It is obvious that additional questions remain to be answered. First, assuming that inactivation does occur, what is the nature of the change in the glucagon molecule? We have been able to demonstrate that crystalline glucagon will be inactivated as well as amorphous glucagon (unpublished data). Furthermore, the active principle of lithosperm has been further fractionated using more refined techniques (unpublished data). We believe, therefore, that we have methods available for attacking this particular problem. Second, we are puzzled by the apparent lack of *in vivo* effect on blood-sugar of the lithosperm. This is especially true since Loeser and his associates have reported such *in vivo* action in rabbits and we have demonstrated that the same powder used in the glucagon experiments inactivates gonadotrophin and thyrotrophin *in vivo* in chicks. Lithosperm, however, is a very complex substance and it is hoped that its further fractionation will assist in resolving this question. Experiments are proceeding using the more purified fractions now available. Liver slices also are being employed for the assay of some of these preparations.

Fortunately, the stability of the lithosperm powder has greatly extended the range of studies of this plant material. Furthermore, the speed with which glucagon activity is inhibited by lithosperm provides a rapid and convenient assay procedure for the various fractions which may be secured from a paper-column or by other means. As was noted in the discussion of Table 4, it is now possible to test for activity in samples of lithosperm of less than 1.00 mg. in amount. Accordingly, a few milligrams of lithosperm powder may now be assayed for inhibitory effect against glucagon, pregnant mare serum, and thyrotrophin.

Acknowledgments

This paper is a preliminary report of an extensive cooperative research project. The authors would like to acknowledge their special indebtedness to Dr. Bryce Douglas and the Smith, Kline and French Laboratories for preparation of some of the lithosperm powders. We also would like to report our indebtedness to Dr. Herbert Asmis, Dr. Stanley Goldberg, and Mr. Richard Shaw for the preparation of lithosperm fractions. The help of Dr. Frank Zeller and Mr. Bruce Beekman in the biological phases of the investigation also has been substantial. Subsequent papers reporting progress in this study will be in co-authorship with one or several of these investigators.

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Action of *Lithospermum Ruderale* on Ovulation in the Hen[1]

FRANK J. ZELLER, W. R. BRENEMAN AND MARVIN CARMACK[2]
Departments of Zoology, and Chemistry, Indiana University,[3] Bloomington

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THERE has been a continuing interest in the effects of extracts of *Lithospermum ruderale* on the inactivation of various protein hormones. Cranston (1945), Drasher and Zahl (1946), Cranston and Robinson (1949), and Drasher (1949, 1950) were the first to demonstrate that feeding dried *Lithospermum ruderale* to mice would inhibit ovulation and produce extended periods of diestrus. More recently, the Canadian workers in Noble's laboratory and the German investigators under the leadership of Loeser have reported that extracts of several species of *Lithospermum* inactivate pregnant mare serum, interstitial cell stimulating hormone, and thyroid stimulating hormone after mixure *in vitro* and *in vivo*. An extensive series of papers has appeared from each laboratory, notably by: Noble, Plunkett and Taylor (1950), Plunkett and Noble (1951), Noble, Plunkett and Graham (1954), Graham and Noble (1955); and Loeser (1955), Loeser and Wernze (1955a, b), Loeser and Opitz (1956), Kemper, Loeser, Opitz and Schwarz (1956), Kemper and Loeser (1957). The hyperglycemic action of glucagon in fowls also has been inhibited after *in vitro* mixture of this hormone with extracts of *Lithospermum ruderale* (Breneman and Carmack, 1958).

Most of the investigations with lithosperm[4] have been done on mammals and major interest has centered about the antiovulatory action of this material. It seemed to us, however, that the hen could also contribute valuable information to this study especially if lithospermum would act in a comparable fashion in birds and mammals. Ovulation in the hen, for example, is much easier to determine than in the mouse and effects on ovaries are more pronounced because of the rapid and extensive weight changes which occur in bird ovaries. The purpose of this paper, therefore, is to report on some of the effects of lithosperm on egg-laying and on inhibition of the reproductive system of the hen.

MATERIALS AND METHODS

Single Comb White Leghorn hens slightly less than one year of age were used in these experiments. The birds were secured as chicks from one hatchery. The animals numbered 1 through 12 were from one hatch and those numbered 13 through 20 were from a second hatch. The hens were kept in individual cages in air-conditioned animal quarters and were fed a standard laying mash. Egg-laying records were kept on the hens before and during the period of treatment except for control birds 5 and 6 for which records preceding the experiment were not tabulated.

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[2] Contribution No. 644 of the Zoology Department and No. 808 of the Chemistry Department of Indiana University.

[3] This paper is part of an extensive inter-departmental research program. The authors also wish to express their indebtedness to Dr. Bryce Douglas and the Smith, Kline, and French Laboratories for the preparation of large quantities of spray-dried lithosperm powder.

[4] The term lithosperm is used as a generic designation for the hormone inhibiting principle, or principles, present in the genus *Lithospermum*.

The lithosperm preparation employed in this study was a spray-dried powder prepared from a cold water extract of dried overground parts of the plant, *Lithospermum ruderale*.[3] The birds were allotted to groups according to body weights and comb sizes in so far as possible at the beginning of treatment. Since only twenty hens were used ranges and averages were somewhat more variable than desired but major bias was avoided. The lithosperm treated hens were divided into four groups which received 120 mg., 100 mg., 60 mg., and 50 mg. of lithosperm powder daily. The total daily dosage for the first day was administered at 9:00 p.m. but thereafter the lithosperm was given in equally divided dosages of 60 mg., 50 mg., 30 mg., or 25 mg. twice daily. All injections were made subcutaneously and the volume of each injection was 1.0 ml. The controls were given 1.0 ml. of water twice daily. All birds were killed twelve hours after the last injection. At autopsy, body weights, and weights of ovaries and oviducts were taken. Pituitary glands were removed and fixed for subsequent cytological study. Comb factors

$$\left(\frac{\text{length mm.} \times \text{height mm.}}{2}\right)$$

were taken at the beginning and end in two of the experiments (birds 1–12) so that it was possible to determine if changes in comb size occurred during the course of the treatment. Comb weights only were taken in two of the four experimental groups (birds 13–20).

RESULTS AND DISCUSSION

Figure 1 is a chart of the egg-laying record of the hens before and during the period of treatment. It is significant that eleven of the fourteen hens which were treated with lithosperm laid only one egg or none following the initiation of treatment. Two hens laid two eggs and only one laid as many as three eggs. It should be noted that two of the three hens which laid more than one egg were in the series which received the lowest dosage of lithosperm powder. Egg-laying actually ceased after the first day of injection in nine of the eleven birds which were most affected. It was surprising to observe how rapidly the lithosperm acted and that as little as 120 mg., 100 mg., or 60 mg. caused cessation of egg-laying. There was no previous information to guide us as to dosage which should be used, therefore, additional experiments must be performed to determine the minimum dose of lithosperm which is effective for the inhibition of ovulation in the hen. The autopsy data

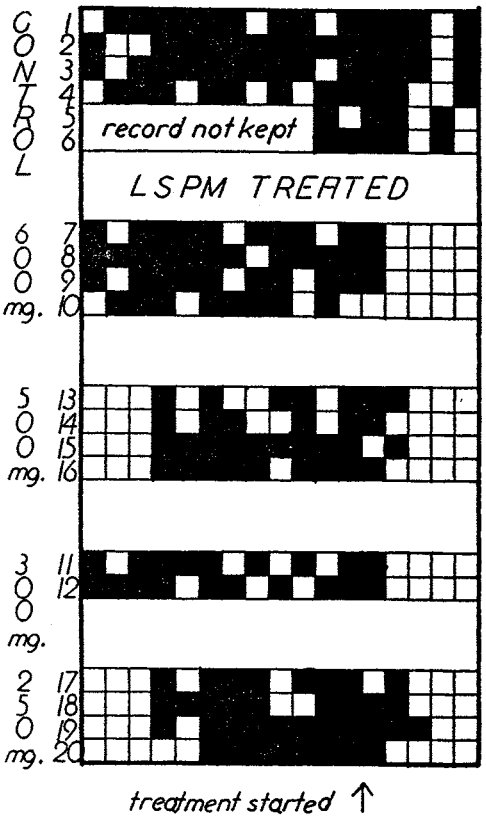

FIG. 1. Egg-laying record.

TABLE 1

Bird	Body	Comb	Ovary	Oviduct
		Controls		
Average 6 birds	2,036	3,651–3,706*	59.4	47.9
		28†		
		Lithosperm treated		
60 mg. lspm.		2×daily 5 days—600 mg. total		
7	2,265	2,285–2,200*	–‡	–‡
8	1,775	3,564–3,500	11.3	17.0
9	1,760	3,502–2,610	7.1	17.7
10	1,678	2,887–1,913	4.7	13.3
30 mg. lspm.		2×daily 5 days—300 mg. total		
11	1,917	3,630–3,897	6.6	16.1
12	2,374	3,575–3,069	7.2	16.5
50 mg. lspm.		2×daily 5 days—500 mg. total		
13	1,220	16†	11.5	16.5
14	1,823	20	10.0	19.4
15	1,956	31	7.2	28.6
16	2,660	15	11.5	16.6
25 mg. lspm.		2×daily 5 days—250 mg. total		
17	1,750	24	6.7	17.8
18	2,316	26	7.8	21.6
19	2,345	10	7.5	14.1
20	2,024	42	10.3	31.5

* Comb factors at start and termination of treatment.
Comb factor = H×L mm./2.
† Comb weight at termination of experiment.
‡ Quickly placed in fixative for cytological study, not weighed.

presented in Table 1 are helpful for further interpretation of the results especially since they reflect the extensive changes which occurred in the weights of the ovaries and oviducts.

Several significant points are immediately apparent in the autopsy data. Only the highest dosage of lithosperm may have had a slight inhibitory effect on body weight; the lower dosages had no such action. Bird number 13 was the lightest of the 20 hens at the beginning of the experiment and its weight at autopsy, therefore, does not reflect any significant inhibition by lithosperm. Analysis of the comb-factors shows that combs continued to grow slightly in the control birds during the experimental period but that the combs decreased in size in all but one of the lithosperm treated hens. Likewise, comb weights were slightly lower in the birds which received lithosperm and which had only their comb weights taken at the end of the experiment. The most pronounced effects of the lithosperm powder, however, were observed in the weight changes of the ovaries and oviducts. Ovarian weights were greatly depressed, the maximum decrease being from a control average of 59.4 grams to only 4.7 grams in bird number 10. Oviductweights, likewise, were greatly diminished and to a remarkably uniform degree with the exception of the two birds which were numbered 15 and 20. The control average of 47.9 grams can be compared with the oviduct range in the treated hens of from 13.3 grams to 31.5 grams.

It is noteworthy that there appear to be no significant differences in the degree of suppression of ovaries and oviducts in the four lithosperm treated series. The two lower dosages, 250 mg. and the 300 mg., seemed to produce an equal, and perhaps maximum suppression. This further emphasizes the need for additional experiments to establish the critical minimum level of inhibition produced by lithosperm.

The appearance of the ovaries and oviducts was essentially that which is observed in pullets shortly before the onset of laying. Except for birds numbered 7 and 20 the small ovaries and oviducts seemed to be normal. The ovaries contained no large ova nor was there any appreciable amount of yolk present in any ova. The maximum size of ova was 20 mm. in diameter. Both birds 7 and 20 had atretic follicles but semi-fluid yolk material was also present in the body cavity. Since it can be assumed that the control- and lithosperm-injected birds were comparable in their ovarian and oviduct development

at the beginning of the 5-day experimental period, the changes in the reproductive system in the lithosperm-treated birds are remarkable. As was pointed out in the discussion of the laying records, laying ceased after the first day in eleven of the fourteen hens. Comparisons of the autopsy data also show that there must have been a re-absorption of yolk from large and medium sized ova, an inhibition of the development of additional ova, and a regression of both the comb and the oviduct in practically all the treated birds.

The physiological significance of these events is considerable. Fraps (1955) has discussed the complexity of the mechanism of ovulation in the hen. He suggests that "an episodic release" of an ovulation inducing hormone (OIH) is accompanied by continued secretion of gonadotrophins, "including possibly luteotrophin," and that both are necessary if maturation of ovarian follicles and ovulation are to occur. Lithosperm would appear to block not only the release or action of OIH (LH?), but also would seem to prevent the maturation of follicles. It should be noted, in this connection, that Drasher (1950) has argued vigorously for the inhibition of the luteinizing hormone by lithosperm in mice. Breneman (1955) reviewed the evidence for the secretion of steroid hormones by the bird ovary and suggested that comb growth is stimulated primarily by testosterone and oviduct growth by estrogen. Oviduct growth possibly is augmented also by testosterone and progesterone. Since LH plays an important role in stimulating the secretion of the ovarian steroid hormones and since both combs and oviducts were diminished in lithosperm treated hens, further evidence for the inhibition of LH by lithosperm is indicated. Perhaps, therefore, the use of lithosperm will assist in the resolution of the problem of the complex mechanism of ovulation in the hen by making it possible to inactivate one or more of the gonadotrophins involved.

SUMMARY

The injection of spray-dried cold water extract of *Lithospermum ruderale* for only five days almost completely inhibited egg-laying in young Single Comb White Leghorn hens. Egg-laying ceased after one injection in eleven of the fourteen treated hens. At the termination of the five-day injection period, comb size, ovarian weight, and oviduct weight were greatly decreased in all of the lithosperm treated birds. The reproductive system of these hens resembled those of non-laying pullets. It is suggested that lithosperm produces its effect by inhibiting the action or secretion of the ovulation inducing hormone (LH?) in the hen.

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Source ?
UNKNOWN
(See 2nd Page for some citations)

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CHAPTER 3 : Comments on the Information Available 14

CHAPTER 4 : Methods for Screening of Plants for Antifertility Activity ... 16

ERRATA

Page 3, para 1. line 4, *read* sources *for* source

Page 6, column 3, line 14 from bottom, *read* Nardostachys *for* Narodostachys

Page 6, column 3, line 6 from bottom, *read* Origanum *for* Origananum

Page 8, column 3, line 1, *read* Viburnum *for* Viburunum

Page 10, column 3, line 9, *read* Baliospermum *for* Baliosperumum

Page 11, column 3, line 10 from bottom, *read* Hydrastis canidensis *for* Hydrastis canidosis

Page 11, column 3, line 9 from bottom, *read* Hydrangea *for* Hudrangea

Page 13, column 3, line 13 from bottom, *read* virginica *for* viriginica

Page 13, column 3, line 2 from bottom, *read* strumarium *for* strumariunn

Page 14, para 1, line 1, last 2 words, *put the mark of full-stop after the word* listed. *Read* Some *for* some

Page 14, line 24 from bottom, *read* Annona squamosa *for* Annona sguamosa

Page 14, line 22 from bottom, *read* Aristolochia *for* Aristolachia

Page 15, line 10, *read* rosa-sinensis *for* rosa-sinesis

Page 15, para 1, line 3, *read* When one looks into this, it can be seen *for* When one looks into this, can be seen

Page 17, line 19 from bottom, *read* If this plant extract *for* In this plant extract

Page 17, line 5 from bottom, *read* plant extract *for* plants extract

CHAPTER I

PLANTS SUGGESTED AS POSSIBLE ORAL ANTIFERTILITY AGENTS

A number of suggestions have been made as to the possible oral antifertility activity of plants. Other suggestions have been made on the basis of the survey of ancient Indian literature in the Ayurvedic and Unani systems of medicine. The source which have been used in drawing up this suggested list of plants, are as follows :—

1. List suggested by the Institute of History of Medicine and Medical Research, Delhi.
2. List from the Institute of Ayurvedic Studies and Research, Jamnagar.
3. List from the College of Medical Sciences, Banaras Hindu University, Banaras.
4. List from the Adviser in Indigenous System of Medicines, Government of India, New Delhi.
5. Miscellaneous list of plants suggested to the author by various persons.
6. List of antifertility plants mentioned in the book "*Glossary of Indian Medicinal Plants*" by Chopra, R.N., Nayar, S.L., and Chopra, I.C. Published by the Council of Scientific and Industrial Research, New Delhi.
7. List of antifertility plants mentioned in the book '*Indigenous Drugs of India*" by Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur, L.D. Published by U.N. Dhar and Sons, Calcutta (1958).
8. List of antifertility plants mentioned in the book "*Indian Medicinal Plants*" by Kirtikar, K.R., and Basu, B.D. Published by L.M. Basu, Calcutta (1935).
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10. List of antifertility plants published by Lazlo, H., and Henshaw, P.S., *Science*, (1954), p. 119, p. 626.

Against the name of each plant is mentioned the number which indicates the source where it has been mentioned as an antifertility agent. Some plants such as *Ananas comosus* have been mentioned by as many as five different sources while others have been mentioned by only one.

LIST OF PLANTS

Name of plant	Reference	Name of plant	Reference
Abroma augusta	2,6,8,9.	*Artemisia siversiana*	6,7,8,9.
Abrus precatorius	1,4,6,7,8.	*Artemisia vulgaris*	1,6,8.
Acasia rugata	8.	*Arundo donax*	6.
Acalypha indica	9.	*Asparagus officinalis*	10.
Achillea millefolium	6,8,10.	*Asplenium adiantum nigrum*	6,8,10.
Achyranthes aspera	1,2,9.	*Astragalus hamosus*	8.
Acorus calamus	8.	*Azadirachta indica*	8,9.
Adansonia digitata	8.		
Adhatoda vasica	8.	*Bambuas bambos*	6,8,9.
Adiantum capillus veneris	6,8,9.	*Bauhinia retusa*	6,8,9.
Adiantum pedatum	6.	*Berberis aristata*	9.
Adiantum venustum	6,8,9.	*Beta vulgaris*	8,9.
Aganosma marginata	6.	*Blumea balsamifera*	8,9.
Agava americana	6,8,9.	*Blumea eriantha*	6,8.
Allium cepa	6,8,9.	*Blumea lacera*	9.
Allium sativum	8,9.	*Boswellia glabra*	8,9.
Allium schoenoprasum	6,8.	*Boswellin serrata*	6,9.
Aloe barbadensis	2,6,7,8,9.	*Bragantia tomentosa*	6,8,9.
Aloe perryi	6,8.	*Brassica alba*	9.
Alstonia scholaris	8.	*Brassica campeestris*	4.
Amaranthus spinosus	3.	*Brassica nigra*	9.
Amorphophallus campenulatus	8,9	*Buddleja asiatica*	1,6.
Ananas comosus	1,6,7,8,9,10	*Butea monosperma*	2,4,8.
Anastatica hierochuntica	1,6,9.		
Andropogon jwarancusa	8,9.	*Cadaba farinosa*	6,8,9.
Aneilema conspicuum	6.	*Cadaba trifoliata*	6,8.
Aneilema lineolatum	6.	*Caesalpinia crista*	6,8.
Aneilema scapiflorum	1.	*Caesalpinia jayabo*	6,8,9.
Anethum sowa	8,9.	*Caesalpinia sappan*	6,8,9.
Annona squamosa	1,2,6,7,8,9.	*Caesalpinia sepiaria*	6,8.
Anodendron paniculatum	10	*Calendula arvensis*	6.
Anthemis cotula	6.	*Calendula officinalis*	6,8.
Anthemis nobilis	9.	*Callicarpa macrophylla*	2.
Anthocephalus cadamba	4.	*Calotropis gigantea*	1,2,7,9.
Antidesma ghesaembilla	6.	*Calotropis procera*	7.
Apium graveolens	1,5,6,7,8,9.	*Cannabis sativa*	1,8.
Areca catechu	6,7,8.	*Capparis decidua*	8.
Argemone mexicana	2.	*Capparis spinosa*	6,8.
Aristolochia bracteata	6,7,8,9.	*Capsella bursapastoris*	6,8,9.
Aristolochia indica	1,6,7,8,9.	*Cardiospermum halicacabum*	6,8,9.

Name of plant	Reference
Carica papaya	1,6,8,9.
Carthamus tinctorius	6,8.
Cassia lanceolata	1,9.
Celastrus paniculatus	1,6,8.
Celsia causcasica	9.
Celtis australis	6,8.
Centaurea cynus	6.
Centella asiatica	9.
Centipeda minima	8.
Cerbera manghas	1,9.
Cheiranthus cheiri	6,8,9.
Chenopodium ambrosioides	8.
Chrysanthemum indicum	1,8,9.
Cicer arietinum	1,8.
Cichorium intyous	6,8,9.
Cinchona calisya	7.
Cinnamomum camphora	7.
Cinnamomum cassia	1,8,9.
Cinnamomum tamala	8.
Cissampelos pareira	8.
Cissus quadrangularis	6,8,9.
Citrullus colocynthis	1,7,9.
Citrus maxima	2.
Claviceps purpurea	6,9.
Clerodendrum phlomidis	4.
Cocos nucifera	10.
Commiphora mukul	6,9.
Commiphora myrrha	6,9.
Corydalis spp.	8.
Cotula spp.	8.
Crinum asiaticum	6,8.
Crocus sativus	7,9.
Crotalaria juncea	6,8,9.
Croton tiglium	1,7,9.
Cucumis sativus	4.
Cucumis trigonus	1,7.
Cuminum cyminum	1,8,9.
Curcuma longa	4,8.
Curcuma zedoaria	8.
Cuscuta reflexa	1,7,8.
Cyclamen persicum	6,9.

Name of plant	Reference
Cymbopogon fulvus	9.
Cymbopogen jwarancusa	8,9.
Cyperus longus	6,8.
Cyperus rotundus	6,8,9.
Cyperus scariosus	8,9.
Dalbergia sissoo	8.
Datura metel	2.
Daucus carota	7,8,9.
Dendrocalamus strictus	1,6,8,9.
Desmodium retroflexum	6,2.
Desmodium tiliaefolium	8.
Dictamnus albs	6,8,9.
Dipteracanthus suffruticosa	6,8.
Dolichandrone falcata	1,6,8,9.
Dolicros biflorus	6,8,9.
Dolichos lablab	8.
Dracontium polyphyllum	6,9.
Dryopteris filixmas	10.
Echinocholoa feumentacea	2.
Echinops echinatus	1.
Elettaria cardamomum	8.
Ervatamia coronaria	8.
Erythrina variegata var. *ocientalis*	2,6,8,9.
Erhyhroxylum coca	9.
Euonymus tingens	6.
Eupatorium cannabinum	6,8.
Eupatorium odoratum	10.
Euporbia atoto	8.
Euphorbia resinifera	1,6,9.
Euphorbia tirucalli	1,7.
Excoecaria agallocha	1,6,7.
Fagonia cretica	8.
Ferula foetida	8,9.
Ferula assafoetida	2.
Ferula orientalis	9.
Foeniculum vulgare	6,9.

Name of plant	Reference
Garcinia morella	1,6,7,8.
Garcinia pedunculata Roxb.	2.
Gentiana kurroo	8.
Gloriosa superba	1,2,7,8,9.
Glossocardia bosvallia	6,8,9.
Glycyrrhiza glabra	8,9.
Gmelina asiatica	1.
Gossypium herbaceum	1,6,7,8,9.
Gossyipum hirstum	6,8.
Grangea maderaspatana	6,8.9.
Grewia asiatica	8.
Grewia hirsuta	8.
Gymnopetalum cochinchinense	6,8.
Hagenia abyssynica	1,9.
Hedychium spicatum	6,8.
Helianthus annuus	8.
Heliotropium indicum	8.
Helleborus niger	6,9,10.
Hibiscus manihot	6,8.
Hibiscus rosa sinensis	3,8,9.
Hypericum perforatum	6,8,9.
Hypti pectinata	6.
Hyssopus officinalis	6,8,9.
Indigofera linifolia	6,8,9.
Jasminum multifrorum	1,9.
Jasminum officinalis	6,8.
Jasminum sambac	6,8.
Jatropha glandulifera	8.
Jatropha multifida	6,8.
Juniperus communis	8,9.
Laurus nobilis	6,9.
Lavandula stoechas	9.
Lawsonia inermis	1,8.
Leonotis nepetaefolia	8.
Lepidium sativum	1.
Leucaena glauca	10.
Leucas cephalotes	9.

Name of plant	Reference
Leucas stelligera	6,8,9.
Linum usitatissimum	8.
Lithosperum ruderale	5.
Luffa acutangula	1,8.
Luffa echinata	8,9.
Mariscus albescens	9.
Marrubium vulgare	9.
Matthiola incana	8.
Matthiola tristis	8.
Matthiola varia	8.
Melia azedarach	6,8,9.
Memecylon amplexicaule	1.
Mentha arvensis	6,8,9.
Mesua ferrea	9.
Michelia champaca	1,6,8,9.
Mollugo cerviana	6,8,9.
Mollugo pentaphylla	6,8,9.
Momordica charantia	1,7,8,9.
Momordia tuberosa	1,6,7,8,9.
Morinda citrifolia	6,8,9.
Moringa oleifera	1,6,7,8,9.
Mucuna pruriens	8.
Myristica fragrans	1,9.
Myrtus communis	8.
Narodostachys jatamansi	8,9.
Nasturtium fontanum	10.
Nepeta cataria	6.
Nerium indicum	1.
Nigella sativa	6,8,9.
Ochrocarphus longifolius	9.
Ocium basilicum	8.
Olea cuspidata	8.
Origananum vulgare	6,8.
Paederia foetida	8.
Pandanus tectorius	1.
Parmelia spp.	6,8,9.
Passiflora foetida	8.
Padalium murex	6,8,9.

Name of plant	Reference
Peganum harmalia	6,7,8,9.
Pergularia extensa	8,10.
Phyllanthus urinaria	8.
Phytolacca decendra	5.
Picrorrhiza kurroa	8.9.
Pinus roxburghii	8.
Piper leptostachyum	1.
Piper aurantiacum	1,9.
Piper kptostachyum	1.
Piper longum	3,8,9.
Piper nigrum	1,8.
Pisum sativum	2,5.
Plumbago indica	1.
Plumbago zeylanica	1,2,4,8,9.
Plumeria rubra var. *acutifolia*	7,8,9.
Podophyllum hexandrum	5.
Poinciana pulcherrima	6,8,9.
Polygonum hydropiper	5,6,8,10.
Prangos pabularia	6,8,9.
Prunus mahaleb	2,8.
Prunus persica	8.
Pteroselinum hortense	9.
Punica granatum	1.
Randia dumetorum	1,6,7,8,9.
Ranunculus sceleratus	6,9.
Raphanus sativus	8,9.
Rauwolfia serpentina	1,5,6,8,9.
Rheum emodi	8.
Rhododendron anthopogon	3.
Rhynchosia minima	1,6,8.
Ricinus communis	8,9.
Rosmarinus officinalis	10.
Rubia cordifolia	8,9.
Rubia tinctorium	6,8,9.
Rubus moluccanus	6,7,8,9.
Ruta graveolens	6,7,8,9.10
Sagittaria sagittifolia	6.8,9.
Salicornia brachiata	6,7,8.
Salvia officinalis	9.

Name of plant	Reference
Salvia plebeia	1,9.
Santalum album	1,8,9.
Sapindus trifoliatus	1,2,7,8,9.
Saraca indica	9.
Saussurea lappa	8.
Semecarpus anacardium	1,6,7,8,9.
Sesamum indicum	6,8,9.
Seebania sesban	4,8,9.
Siegesbeckia orientalis	8.
Sooanum nigrum	1,8.
Sphaeranthus indicus	8.
Stachys palustris	6.
Stachys sylvatica	6.
Stachytarpheta jamaicensis var. *indica*	1,7.
Strychnos nux vomica	8,9.
Tamarindus indica	8.
Tanacetum spp.	7,8.
Tanacetum umbelliferum	1,9.
Taxus baccata	6,7,8,9.
Thevetia peruviana	1,7,9.
Thymus serpyllum	6,8.
Toona ciliata	6,8,9.
Trachylobium hornemannianum	6,9.
Trachyepexmum ammi	8.
Trachysperum roxburiganum	2,8,9.
Trianthema pentandra	1,6,7,8,9.
Trianthema portulacestrum	1,6,7,9.
Tribulus alatus	8.
Tribulus terrestris	8.
Trichilia emetica	9.
Trichosanthes bracteata	1.
Trichosanthes cucumerina	6,8.
Trifolium subterranean	5.
Trigonella foenum graecum	8,9.
Triumfetta bartramia	1,6,8.
Tussilago farfara	8.
Tylophora indica	9.

Name of plant	Reference	Name of plant	Reference
Uraria lagopoides	1,6,8,9.	*Viburunum foetidum*	6,8,9.
Urena lobata	1,10.	*Vitex negundo*	2,9.
Urginea indica	8,9.	*Vitex trifolia*	6,8,9.
Urtica dioica	6,8.		
		Walsura piscidia	9.
Valeriana wallichii	8.	*Withania coagulans*	8.
Vateria indica	8.	*Withania somnifera*	1,6,7,8.
Verbana officinalis	6,8,9.		
Vetiveria zizanioides	6,9.	*Ziziphora tenuior*	9.

CHAPTER 2

Pharmacological screening of plants, reputed to have antifertility activity, has been going at various laboratories in India for some time. One of the drawbacks in such screening was that the method which determined the parameter being tested for, such as anti-ovulatory, anti-spermatogenic or anti-implantation activity, varied from laboratory to laboratory and the results could not be compared. However, the information which has accumulated in the specific parameter tested is considerable and will be of help for future researchers in this field. The results of testing plants have been given. Against each plant is a number which indicates the laboratory where the plant was tested. It is further mentioned whether the test indicated negative (—) antifertility activity or encouraging (+) activity.

The laboratories which have tested plants for antifertility activity are mentioned below. Against each laboratory is mentioned the parameter which that laboratoy has tested.

1. Stanford University Laboratories, California. A rough screening test for anti-ovulatory activity was performed.

2. Council of Scientific and Industrial Research Laboratories, Melbourne. The plants were tested for anti-ovulatory, antizygotic, anti-implantation and abortifacient activity.

3. Indian Cancer Research Centre (Contraceptive Testing Unit of the Indian Council of Medical Research). The plants were tested for anti-ovulatory activity.

4. Ciba Research Centre, Goregaon, and the Institute of Post-graduate Medical Education and Research, Chandigarh. The plants were tested for antizygotic, anti-implantation and early abortifacient activity.

5. Bengal Immunity Research Laboratories, Calcutta. The plants wese tested for antizygotic, anti-implantation and early abortifacient activity.

6. K.G. Medical College, Lucknow. The plants were tested for antizygotic, anti-implantation and early abortifacient activity.

7. Central Drug Research Institute, Lucknow. The plants were tested for antispermatogenic activity.

PLANTS TESTED

Name of plant	Reference
Abroma augusta	2 (—ve)
Abrum precatorious	4 (—ve)
Achillea millefollium	1 (—ve), 2 (—ve)
Acontitum nepellus (Root)	1 (+ve)
Acorus calamus	1 (—ve), 2 (—ve)
Aconitum nepallus (leaves)	1 (—ve)
Adonis vernalis	1 (—ve)
Aegle marmelos	3 (—ve)
Aesculus hippocastanum	1 (—ve)
Alanguim saluri	3 (—ve)
Albizzia lebbeck	7 (—ve)
Aletris farinosa	1 (—ve)
Alisma pronassifolium	2 (—ve)
Aloe ferox	1 (—ve)
Alpinia officinarum	1 (—ve)
Alstonia venenata	3 (—ve)
Althaea	1 (—ve)
Anacardium occidentale	3 (—ve)
Anamirta cocculus	1 (—ve)
Ananas comosus	2 (—ve), 4 (—ve)
Anaphallis margaritaca	1 (—ve)
Ancilema graminium	2 (—ve)
Apocynum androsaefolium (Root)	1 (—ve)
Apocynum androsae folium (whole)	1 (+ve)
Apocynum cannabinum (Root)	1 (+ve)
Aralia racemosa	1 (—ve)
Arctostaphylos uva ursi (Leaves)	1 (—ve)
Artemisia absinthium (leaves)	1 (—ve)
Artemisia dracunculus (Herb)	1 (—ve)
Artemisia maritima (Linn)	6 (+ve)
Artemesia vulgaris	1 (—ve)
Artisolochia indica	3 (—ve)
Aristolochia tagala	2 (—ve)
Asagraea officinalis (seed)	1 (+ve)
Asarum canadense	1 (—ve)
Asclepias hallii	1 (+ve)

Name of plant	Reference
Asclepias curassavica	1 (+ve)
Asclepias verticillata	1 (+ve)
Asparagus officinalis	2 (—ve)
Aspidium	6 (—ve)
Aspidosperum quebracho blanco	1 (—ve)
Azadirachta indica	3 (—ve)
Bahia dissecta	1 (+ve)
Baliosperumum nontanum	3 (—ve)
Baptisia tinctoria	1 (—ve)
Berberis aristata	7 (—ve)
Berberis vulgaris	1 (+ve)
Borago officinalis	1 (—ve)
Bragantia wallichii	3 (—ve)
Brunfelsia hopeana	1 (—ve)
Bryonia alba	1 (—ve)
Butea mono sperma	1 (+ve), 3 (—ve), 4 (+ve)
Calamus australis	2 (—ve)
Caesalpinia crista	3 (—ve), 2 (—ve)
Canavalia virosa	3 (—ve)
Cannabis sativa	6 (—ve)
Capparis zeylanica	3 (—ve)
Capsella bursapastoris	1 (—ve), 2 (—ve)
Carica papaya	6 (—ve)
Carum carvi	6 (—ve)
Cassytha filiformis	2 (—ve)
Casuarina equisetifolia	2 (—ve)
Caulophyllum thalictroides (Root)	1 (+ve)
Cedrus deodara	6 (—ve), 7 (—ve)
Centella asiatica	5 (+ve), 7 (—ve)
Ceratonia siliqua	1 (—ve)
Chamaelifium luterm (Root)	1 (+ve)
Chelidonium sinense	1 (—ve)
Chelone glabra	1 (—ve)
Chenopodium album	2 (—ve), 6 (—ve)

Name of plant	Reference
Chlotidion	1 (—ve)
Chondodendron tomentosum (Root)	1 (+ve)
Cimicifuga racemosa (Root)	1 (+ve)
Citrullus vulgaris	1 (—ve)
Citrus limon	1 (—ve)
Cnicus oleraceus	1 (—ve)
Codiaeum variegatum	2 (—ve)
Coelospermum decipiens	1 (—ve)
Commelina benghalensis	2 (—ve)
Commelina nudiflora	2 (—ve)
Commersonia fraseri	2 (—ve)
Collinsonia canadensis	1 (—ve)
Conium maculatum	1 (—ve)
Cordyline fruticosa	2 (—ve)
Cornus florida	1 (—ve)
Casatanea dentata	1 (—ve)
Crataegus coccinea	1 (—ve)
Curcuma zedoaria	1 (—ve)
Delim extensa	6 (—ve)
Degeneria vitiensis	2 (—ve)
Delphinium ajacis	1 (—ve)
Dendrocalamus strictus	3 (—ve)
Derris elliptica	6 (—ve)
Desmodium gyroides	2 (—ve)
Dioscorea bulbifera	2 (—ve)
Dioscorea villosa	1 (—ve)
Diospyros peregrina	3 (—ve)
Dryopteris filix mas	1 (+ve)
Dryopteris linearis	2 (—ve)
Dilienia indica	5 (—ve)
Entada phaseoloides	2 (—ve)
Endospermum medullosum	2 (—ve)
Enridictyon californicum	1 (—ve)
Equisetium hiemale	1 (—ve)
Eriogonum jamesii (whole)	1 (—ve)
Ervatamia coronacia	3 (—ve)
Erthrina suberosa	7 (—ve)
Euonymus hamiltanianus	1 (—ve)

Name of plant	Reference
Eupatorium perfoliatum	1 (—ve)
Euphorbia geniculata	2 (—ve)
Euphorbia hirta	1 (—ve)
Evodia alata	2 (—ve)
Evolulus alsinoides	3 (—ve)
Ferula sumbul (Root)	1 (—ve)
Flagellaria indica	2 (—ve)
Ficus benjamina	3 (—ve)
Ficus fragaria vesca	1 (—ve)
Fraximus americana	1 (—ve)
Fumaria officinalis	1 (—ve)
Galega officinalis (Herb)	1 (—ve)
Gaultheria procumbens	1 (—ve)
Gelsemium sempervirens	1 (—ve)
Geranium maculatum	1 (—ve)
Gloriosa superba	5 (—ve)
Gmelina arborea	1 (—ve)
Gossypium herbaceum	1(—ve), 6(—ve)
Grewia tiliaefolia	3 (—ve)
Grindelia (Herb)	1 (+ve)
Heritiera littoralis	2 (—ve)
Hibiscus abelmoschus (seed)	1 (—ve)
Hibiscus rosa sinensis (petals)	1 (+ve)
Hibiscus tiliaceus	2 (—ve)
Humulus lupulus	1 (—ve)
Hydrastis canidcsis	1 (—ve)
Hudrangea arborescens(Root)	1 (+ve)
Ichtyomethia piscipula	1 (—ve)
Inula helenium	1 (—ve)
Ipomoea pescaprae	2 (—ve)
Juglans cinerea	1 (—ve)
Juniperus sabina (leaves)	1 (+ve)
Jatropha curcas	3 (—ve)
Lactuca saligna	1 (—ve)
Laurus nobilis	1 (—ve)

Name of plant	Reference
Lepidagathis longifolia	2 (—ve)
Leptodenia reticulata	1 (+ve)
Leucaena glauca	2 (—ve)
Libocedrus decurrens	1 (—ve)
Lindauea	1 (—ve)
Lygodium scandens	2 (—ve)
Macaranga tanarius	2 (—ve)
Mallotus phillippinensis	6 (+ve), 7 (—ve)
Magnolia virginiana (Bark)	1 (+ve)
Marsdenia cundurango (Bark)	1 (+ve)
Melissa officinalis	1 (—ve)
Menispermum canadense (Root)	1 (—ve)
Mentha speicata	1 (—ve)
Menyanthis trifoliata	1 (—ve)
Michelia champaca	3 (—ve)
Michella repens	1 (—ve)
Morinda citrifolia	1 (—ve)
Morinda umbellata	3 (—ve)
Mussaenda frondosa	2 (—ve)
Nerium indicum	1 (—ve), 3 (—ve)
Nymphaea odorata	1 (—ve)
Obeconia iridifolia	2 (—ve)
Operculina tuprpenthum	1 (—ve)
Pairetaria officinalis	1 (—ve)
Passiflora incarnata	1 (—ve)
Phoradendron flavescens (Herb)	1 (—ve)
Phytolacca decandra	1 (—ve)
Pinus strobus	1 (—ve)
Piper augustum	1 (—ve)
Piper latifolium (Root)	1 (+ve)
Piper longum	3 (—ve)
Pistacia lentiscus	1 (—ve)
Podophyllum peltatum	1 (+ve)
Polygonatum officinale	1 (—ve)

Name of plant	Reference
Polygonum hydropiper	1(—ve), 2(—ve)
Polyporus officinalis	1 (—ve)
Pongamia pinnata	1 (—ve)
Pouzolzia hirta	2 (—ve)
Pourzolzia indica	2 (—ve)
Premna thyrsoides	3 (—ve)
Prunus chamoecerasus	1 (—ve)
Psoralea corylifolia Linn.	6 (—ve)
Punica granatum Linn.	6 (—ve)
Purshia tridentata (seed)	1 (—ve)
Quillaja saporanria (Bark)	1 (+ve)
Randia dumetorum	5 (—ve)
Rhamous frangula	1 (—ve)
Rhus copallina	1 (—ve)
Rhus glabra	1 (—ve)
Rubus (Bark)	1 (—ve)
Rubus australis	2 (—ve)
Rubus moluccanus	2 (—ve)
Rumex crispus	1 (—ve)
Sageracea laurifolia	3 (—ve)
Salix (Bark)	1 (+ve)
Sanguinaria canadensis	1 (—ve)
Sassafras albidum	1 (—ve)
Scleria chinensis	2 (—ve)
Scutellaris lateriflora	1 (—ve)
Semecarpus anacardium	6 (—ve)
Sequoia gigantea	1 (—ve)
Serenoa repens	1 (—ve)
Simaruba amara (Bark)	1 (+ve)
Sinecio aureus	1 (—ve)
Skimma laureola	6 (—ve)
Smilax bona-nox (Root)	1 (+ve)
Solanum dulcamera (Twigs)	1 (+ve)
Solanum suraltense	6 (—ve)
Solidago odora (leaves)	1 (+ve)
Sonchus asper	1 (—ve)
Spiraea ulmaria	1 (—ve)

Name of plant	Reference
Stachytarpheta jamaicensis var. *indica*	2 (—ve)
Stephania hernandifolia	5 (—ve)
Sterculia guttata	3 (—ve)
Stillingia sylvatica (Root)	1 (+ve)
Symplocos racemosa	5 (—ve)
Syzygum cumini	1 (—ve)
Tanacetum vulgare	1 (—ve)
Taexacum officinalis	1 (—ve)
Taxus baccata Linn	6 (—ve)
Tephrosia virginiana	1 (—ve)
Terminalia catappa	2 (+ve)
Thuja occidenalis (leaves)	1 (+ve)
Thymus vulgaris	1 (—ve)
Tilia europaea	1 (—ve)
Toona ciliata	3 (—ve)
Trichosanthes anguinea	3 (—ve)
Trigonella foenumgraeum	1 (—ve)
Trillium erectum (Root)	1 (—ve)
Turnera diffusa	1 (—ve)

Name of plant	Reference
Uraria lagopoides	5 (—ve)
Urena lobata	2 (—ve)
Urginea indica	6 (—ve)
Vaccinium murtillus	1 (—ve)
Valeriana officinalis	1 (—ve)
Verbena hastata (Herb)	1 (+ve)
Veronica viriginica	1 (—ve)
Vetiveria zizanoides	1 (—ve)
Viburnum opolus	1 (—ve)
Viburnum prunifolium	1 (—ve)
Viburnum prunifolium (Root)	1 (—ve)
Vicsum articulatum	3 (—ve)
Vitex agnus castus	6 (—ve)
Vitex altissima	3 (—ve)
Vitex negundo	2 (—ve)
Vitex trifolia	2 (—ve)
Viscum album	1 (—ve)
Xanthium strumariunn	3 (—ve)
Zanthorhiza apiifolia	1 (—ve)

CHAPTER 3

COMMENTS ON THE INFORMATION AVAILABLE

Of all the plants reputed to have antifertility activity, 321 have been listed some criteria have to be taken when priority is to be given to one plant over another for testing its biological activity. Could one give priority to a plant which has been mentioned by four or five sources? There are obvious fallacies in a selection of this type. e.g. plant mentioned by one source may be quoted by another. However, if such drawbacks are kept in mind, this list will place the plants in their proper perspective :—

Abroma augusta
Abrus precatorius
Aloe barbadensis
Ananas comosus
Annona sguamosa
Apium graveolens
Aristolachia bracteata
Aristolochia indica
Artemisia siversia
Calotropis gigantea
Cerica papaya
Dendrocalamus strictus
Dolichandrone falcata
Garcinia morella
Glorisa superba
Gossypium herbaceum
Lepidium sativum
Michelia champaca
Momordica charantia
Momordica tuberosa
Momordica tuberosa
Moringa oleifera
Peganum harmalia
Plumbago zeylanica
Polygonum hydropiper
Randia dumetorum
Rauwolfia serpentina
Rubus mohiccanus
Ruta graveolens
Sapindus trifoliatus
Semecarpus anacardium
Taxus baccata
Trianthema pentandra
Trianthema portulacastrum
Uraria lagopoides
Withania somnifera

The result of the pharmacological and endocrinological work already performed by various laboratories can give us some information which may be a useful guide for future work. Thirty-five plant have been mentioned to have encouraging activity as judged by results of preliminary testing. It is natural to hope that these 35 plants will be tested further by laboratories concerned with antifertility work. This is as follows :—

Aconitum napellus (Root)
Aesculus hippocastanum
Apocynum androsa mifolium (Root)
Artemisia maritima Linn.
Asclepias curassavica
Asclepias hallii
Asclepias verticillata
Bahia dissecta

Berberis vulgaris
Borago officinalis
Chamaelirium luteum (Root)
Chondo dendron tomentosum (Root)
Cimicifuga racemosa (Root)
Dryopteris filix mas
Eriogonum jamesii (Whole)
Galega officinalis (Herb)
Hibiscus abelmoschus (seeds)
Hibiscus rosa-sinesis (Petals)
Hydrangea arborescens (Root)
Juniperus sabina (leaves)
Mallotus philippinensis
Magnolia virginiana (Bark)
Marsdenia cundurango (Bark)
Menispermum canadense (Root)
Phoradendron flavescens (Herb)
Podophyllum peltatum
Quillaja saponaria (Bark)
Rubus (Bark)
Salix (Bark)
Smilax bona nox (Root)
Solidago odora
Thuja occidenalis (Leaves)
Verbena hastata (herb)
Viburnum prunifolium (Root)

One would then naturally try and find out whether any of the plants which have been given a priority rating on the basis of the literature survey have been tested by any of the centres mentioned. When one looks into this, can be seen that 15 of the plants have been tested and that all, except *Rubus* bark, have given negative results. This is interesting but one cannot draw any conclusions from this. A plant may have anti-ovulatory, anti-zygotic, anti-implantation, early abortifacient or late abortifacient activity. Only one such parameter may have been tested and it would be very unwise to discard the plant on the basis of the meagre evidence available. The 15 plants are as follows ;—

Abroma augusta
Abrus precatorius
Ananas comosus
Carica papaya
Dendrocalamuj strictus
Glorisa superba
Gossypium herbaceum
Michelia champaca
Polygonum hydropiper
Randia dumeturum
Rubus (bark)
Semecarpus anacardium
Taxus baccata
Uraria lagopoides
Aristolochia tagala.

CHAPTER 4

METHODS FOR SCREENING OF PLANTS FOR ANTIFERTILITY ACTIVITY

The steps that follow each other in the reproductive cycle of the female are as follows :—

1. Production and release of the pituitary gonadotrophic hormones by way of hypothalamic mediation.
2. Stimulation of egg and hormone production in the ovary by the gonadotrophic hormones.
3. Ovulation and passage of egg through the oviduct.
4. Fertilization of the ovum.
5. Cleavage and early development of the fertilized egg during transport.
6. Entrance of zygote into the uterus and formation of the blastocyst.
7. Implantation of the blastocyst in the endometrium.
8. Maintenance of embryonic development.

A plant may have an antifertility effect in the female by acting in any of the following ways :—

(*i*) Preventing ovulation.
(*ii*) Preventing fertilization.
(*iii*) Destroying the zygote.
(*iv*) Preventing implantation.
(*v*) Causing early abortion.

The sequence of events in the male are as follows :—

1. Secretion and release of the pituitary gonadotrophins.
2. Production of spermatozoa and androgenic hormone by testis under the influence of gonadotrophic hormore.
3. Transport of the sperm into the epididymis with simultaneous maturation of spermatozoa.
4. Passage of spermatozoa through vas deferens to the ampulla.
5. Suspension of sperm in seminal plasma during ejaculation.
6. Passage of serum through cervix.

7. Ascent of sperm through the uterus and oviducts and their capacitation.
8. Penetration of the ovum by a spermatozoa.

These are mentioned in the hope that more research will be done in the control of male fertility.

TESTS IN THE FEMALE TO ELUCIDATE POSSIBLE ANTIFERTILITY ACTIVITY.

Preliminary Testing : Preliminary testing may be done as follows :—

Mature female rats are left overnight with mature male rats. Next morning, the vaginal smears are examined for evidence of spermatozoa. Experience in my laboratory in over a thousand rat matings indicates that 99·8 per cent of rats with smears with thick clumps of spermatozoa go on to successful termination of pregnancy. The day the spermatozoa are found is termed Day 1. The plant extract to be tested is fed to the animal at the dose of 100 mg./kg./body-weight from Day 1 to Day 4. The animal is sacrificed on the tenth day and uterus is examined. Absence of implants indicates that the plant extract tested has some antifertility activity. The plant extract can be administered beyond the fourth day. In this event, the effect may be one of causing late abortion. This would not be of much practical significance.

Antiovulatory activity :

(*a*) This can be detected by following mature female rats through two oestrus cycles and then administering the plant extract. In the plant extract has any antiovulatory activity, it will prevent the occurrence of the oestrus phase of reproductive cycle. The number of days of administration of the drug can be varied.

(*b*) When a freshly prepared solution of 2 per cent copper acetate is administered to a mature female rabbit at a dose of 0·3 ml./kg./body-weight, it will induce ovulation 18 to 24 hours after its administration. This can be detected by several bleeding points in the ovaries. This plant extract to be tested should be administered to the female rabbit 30 minutes prior to administration of the copper acetate. An anti-ovulatory agent would prevent the copper induced ovulation.

(*c*) An anti-ovulatory agent may be acting by inhibiting the gonadotrophic activity of the anterior pituitary. This may be tested as follows :—

(*i*) Take 20 male rats, 100 to 125 gms. in weight, and divide them into 2 groups of 10 each. Administer the plants extract to be tested at the dose of 100 mg./kg./body-weight orally for 10 days to one group, keeping the other as control. Sacrifice the animals on the 10th day and dissect their pituitaries. Pool the pituitaries of each group in a separate test tube, weigh and freeze immediately. Weighing the

animals daily during the feeding period may help in detecting gross toxicity of the plant extract.

(*ii*) Macerate the pituitary extracts and suspend in distilled water to bring the concentration to 5 mg./ml. Add a drop of 2·0 per cent sodium hydroxide to each to make the suspension alkaline.

(*iii*) Take fifteen immature female rats, 50 to 55 gms. each and divide into 3 groups. To one group, administer the pituitary extract of the plant treated animals at a dose of 0·2 ml. intraperitoneally twice daily for 4 days. Administer similar doses of pituitary extract from the control group to the second group of rats. The third group acts as control. Sacrifice the animals on Day 5 and record the weight of their uteri and ovaries. If the plant extract inhibits ovulation at the level of the pituitary, the uteri and ovaries of the second group will not hypertrophy and will be comparable to the control group. On the contrary, if the plant extract has no activity the reproductive organs of the second group will show hypertrophy comparable to the third group.

(*d*) Another anti-ovulatory test can be performed as follows. Administer chorionic gonadotrophin at a dose of 2 I.U. intraperitoneally for 4 days to two groups of immature male rats. Simultaneously feed the plant extract to be tested to one of the groups. Sacrifice the animals on Day 5 and weigh the following :—

1. Adrenals
2. Testes
3. Seminal vesicles
4. Levator ani
4. Ventral prostrate

If the plant inhibits ovulation peripherally, it will prevent the effect of the chorionic gonadotrophin on the target organs.

(*e*) *Anti-uterotrophic activity* : This is tested on 20 to 23 days old female mice divided into four groups of 10 each. The first group receives no treatment and acts as control. The second receives a standard oestrogen, *e. g.* oestradiol at the dose of 0·1 micrograms subcutaneously daily for 3 days. The third group receives the standard oestrogen while simultaneously being fed on the plant extract ; the 4th group of animals receives only the vehicle in which the plant extract is suspended. The animals are killed on Day 4, and their uteri weighed to see if the uterotrophic effect of the oestrogen is blocked by the plant.

Anti androgenic activity :

Twenty-one old rats are castrated and divided into 4 groups. The first group acts as control, the second receives any standard androgen preparation, *e.g.*, methyl testosterone, 0·1 mg. subcutaneously daily for 7 days. The third group receives the same dose of androgen while simultaneously being fed on the plant extract to be tested ; the fourth group receives only the vehicle in which the plant extract is suspended. All the animals are killed on the 8th day and the following organs weighed :—

(*a*) Ventral prostrate

(*b*) Seminal vesicle

(*c*) Levator and muscle

If the plant extract has anti-androgenic activity, it will block the effect of androgens on the target organs.

ADDENDUM

Herbal Fertility Control: Contraception and Abortion

An Ancient but Practical Approach for Women Who Want to Take Charge of Their Reproduction and Fertility, and

Make Every Child a Wanted, Loved,

and Planned-For Child!

Note: Please read our "Disclaimer" at the end.

There is a growing movement of self-determined women, to regain ancient knowledge about botanical herbs once widely used for the control of pregnancy. This knowledge was once widespread, perhaps even global in nature, but was largely wiped out in Western society during the "burning times", when the Christian church began a war against midwives and female healers, murdering millions of people who at that time "lived outside of the Church". While the power of the Christian Church has been dramatically reduced in the Western democratic nations over the centuries, the war against midwives was picked up and continued by the Western medical establishment, which

today holds a power and authority position roughly equal to the old priesthood. Outside of the Western democracies, the situation is even worse, especially within the Islamic, Hindu, and Buddhist nations, where women's status is generally low, often at nearly slave-like conditions. And in communist nations, women's reproductive capacities are generally state-controlled. Women's power for self-determination at many levels may not exist in such nations, where an unplanned pregnancy can be a life-threatening disaster, especially for unmarried females, where it may provoke the outrage of dead-hearted dominant males (or equally fanatical and life-hating females) who consider a younger woman's sexual organs and female virginity to be a "badge of family honor". But it is exactly in those places where herbal methods for fertility control may be most suitable, as dominant males generally ignore women's health issues. A woman who carries about "medicinal herbs" for "women's problems" is likely to be ignored, confusing such herbs as "kitchen spices". In medicinal botanical textbooks, the same herbs may also be identified to assist in labor, or to help with irregular menses or other women's health issues, so their usage is not confined merely to fertility control. Under such circumstances, especially in nations where women's status is very low, or where contraception and abortive methods may be expensive or legally forbidden, the herbal-plant methods are most suitable.

Here, we wish to alert all women, and their concerned male partners, about old methods for ending pregnancy in the early stages, mainly for restoring the onset of menstruation where it might be delayed, by use of simple herbal preparations. The materials presented here should be viewed as a guide, a first-step into an ancient body of knowledge, and not as the sole information on how to proceed in the case of an unwanted pregnancy.

In addition to what is presented here, the reader is encouraged to also visit the various excellent web sites given below for even more information on the subject. Several excellent books on this subject are also recommended below.

Once you have educated yourself, it is up to you to make the decision on whether to try the herbal approach, or not.

Getting Started...

The most concise discussion we have found of the subject of abortive herbs exists in a book by Rina Nissim, *Natural Healing in Gynaecology: A Manual for Women* (Pandora/Harper-Collins, 1996, currently out of print, but used copies often available from Amazon.com). Her book was originally written in French language, and has been translated all around the world. The English edition does not use the word "abortion" directly to describe specific herbs, possibly due to the more religious nature of American society as compared to Europe, and a natural desire that the book not inflame the substantial anti-abortion groups in the USA. However, the abortive herbs are discussed in the context of *emmenagogues,* which are substances known to bring on a delayed menstruation. Consequently, the herbs mentioned in her book appear suited only for terminating pregnancy in the very early stages. This means, if a woman is to take this botanical-herbal approach to control her fertility, she must follow her own cycles with some attention, know when to expect her bleeding to start, and have the essential herbs on hand and ready for preparation in advance, in case of a problem. There are herbal methods for producing abortion later in pregnancy, but these are not discussed here, left to the other

websites where women are already engaged in serious discussions about what works, and does not work. For now, however, we can recite a few paragraphs from Rina Nissim's book, in a section on "Delayed Periods, 6 to 8 days overdue" (p.30-32). Her experiences come from the Women's Health Center in Geneva, Switzerland. Read Nissim's book for full details. Information on where to get it is given several pages down.

--quote--
"***Our Experience at the Women's Health Center***
We have obtained between 60 and 80 percent effectiveness among women who suspected an undesired pregnancy. Clearly this figure does not tell us much because we do not know how many of these women were in fact pregnant. The women always used two herbs at one time (most often using either pennyroyal or mugwort, plus one other herb). The best association has been shown to be pennyroyal - blue cohosh. These herbs seem to be very effective for small delays in menstrual bleeding. Their effectiveness drops noticably after the 6th day of delay, but still can be useful as long as an inability to confirm the pregnancy makes abortion impossible. It might be mentioned that these herbs seem ineffective for periods delyaed after going off the Pill, and only slightly effective with irregular cycles. According to the research and experience of a collective of women in Santa Fe, New Mexico, a better result is obtained with cotton root bark than with pennyroyal. We have therefore integrated this 6th herb into our practice. It is important to note that the earlier the herbs are taken [as tea infusions], the more effective they are. There is just one limitation: that the cycle be at its end. Herbs are not effective just after ovulation because it is not possible to loosen mucus which is not yet 'mature'. You can therefore begin to drink infusions the day before the period would normally begin, the same day,

or up until the 10th day thereafter. The percentage of success is very good (60-80 percent) the first 6 days. If you begin drinking the infusions only after the 6th day overdue, however, the percentage of effectiveness falls to 20 percent. For this reason, after our years of experience, we rarely propose infusions after the 6th day overdue. On the other hand, for those who are among the 20 percent, it is worth it! The development of early pregnancy tests, however, will probably change our practice and permit a more precise study. What are the possible side effects? Essentially, contractions whose strength increases in proportion to the length of delay. Sometimes nausea or a light dizziness may result. It is recommended to eat lightly during these days.

Practically speaking *We always prescribe* ***two*** *associated herbs:*

cotton root bark or pennyroyal or mugwort
to be used with
parsley or blue cohosh or black cohosh

Using one teaspoonful of each plant, separately, per cup liquid - in infusion for the leaves (mugwort and pennyroyal), and in decoction for the roots (the others) - drink one cup of each of the 2 herbs three timesa day. This means 6 cups to drink each day for a maximum of 6 days. (more information below) BE CAREFUL: do not overdose. Do not continue treatment more than six days. Do not begin after the 10th overdue day. The better informed women are, the earlier they will begin. It is not necessary to continue taking the herbs once the period has truly begun." **(Nissim, 1996)**

--end quote--

In fact, Nissim indicates the combination of pennyroyal with blue cohosh is the most successful, prepared as given in her book, and as summarized on this web page. Here are her recipies for the different herbs (remember, only two herbs are used, one from Group A, and one from Group B). The teas are prepared either as infusion (pour boiling water over the dried herbs, let steep for 10 minutes) or as decoction (cook dried herbs in a covered enamel pot for 10 minutes). Even if the method of preparation is different for the given herbal combination (like with pennyroyal and blue cohosh), the teas can be mixed together afterwards, and a full-days batch (of six cups of tea) can be prepared all at once without a problem.

--quote--
"***Group A (choose one):***

Cotton Root Bark *(Gossypium herbacetum) Part used: bark of the root, cut and broken up like tea Properties: emmenagogue, imitates oxytocin (childbirth hormone that triggers labor) Preparation: decoction,1 teaspoon of bark per cup of water, 3 cups per day for a maximum of 6 days. We suggest to use only organically-grown cotton root bark, as cotton plants grown for fabric production are heavily sprayed with pesticides.*

Pennyroyal *(Mentha pulegium) Part used: entire plant, broken up, dried Properties: emmenagogue, aids gall bladder and digestive tract Preparation: infusion,1 teaspoon per cup of water, 3 cups per day for a maximum of 6 days. CAUTION:****Do Not Use extracted pennyroyal oil, which is toxic and potentially lethal!*** *The tea recipe as given above, consumed for that limited amount of time, is safe.*

Mugwort *(Artemisia vulgaris) Part used: entire plant, broken up, dried Properties: emmenagogue, antispasmodic Preparation: infusion,1 teaspoon per cup of water, 3 cups per day for a maximum of 6 days. CAUTION: Do Not Overdose! More than 40g per liter causes hepato-renal disorders and convulsions. Contra-indications: uterine inflammation, recent pelvic inflamation.*

Group B (choose one):

Parsley *(Petroselium sativum) Part used: entire plant, broken up, dried. Do Not Use the seeds. Properties: cleanser, diuretic, stimulates menstruation Preparation: decoction,1 teaspoon per cup of water, 3 cups per day for a maximum of 6 days. CAUTION: Do Not Overdose! Parsley is toxic in high doses. The seeds are even stronger than the plant and should not be used because they are dangerous particularly to the kidneys.*

Blue Cohosh *(Caulophyllum thalictroides) Part used: root, cut and broken up like tea Properties: emmenagogue, imitates oxytocin, antispasmodic, diuretic Preparation: decoction,1 teaspoon per cup of water, 3 cups per day for a maximum of 6 days.*

Black Cohosh *(Cimifuga raremosa) Part used: entire plant incl. root, cut and broken up like tea Properties: emmenagogue, antispasmodic, diuretic Preparation: decoction,1 teaspoon per cup of water, 3 cups per day for a maximum of 6 days."* **(Nissim, 1996)**

--end quote—

In different dosages, many of these same herbs have a history of use for easing painful menstruation, or for stimulating childbirth. Other herbs used as emmenagogues are mentioned, but without dosages or preparation being discussed. Consult the Nissim book for details.

Remember! If you wait until you are pregnant to try and obtain these herbs, it might take you days or weeks to get them, and you will have missed the window of opportunity for their effectiveness. It is suggested to take the initiative before you are pregnant, and have all the ingredients on hand. From the cautionary notes given above, it should also be obvious that taking these herbs will usually produce some discomfort in the form of temporary cramping, and possibly slight nausea or dizziness. One should plan accordingly.

Where To Get the Herbs

These herbs are available from various natural food cooperatives, herbal medicine stores, and mail-order catalogs. Check your telephone book and local area first, as fresh herbs are always better. Ask the people at your local health food store to see what's available. The herbs should be freshly dried, not older than 1 year, and in bulk form. Capsules or pills are less effective and unsuitable for tea preparations. *Do Not Use tinctures or essential oils!* The danger of overdose is too high, and most essential oils are toxic if ingested. Use only the raw herbs for making the teas! It is advised to obtain only organically-grown herbs, and best of all if you can get them wildcrafted - that is, harvested from wild and natural sources rather than grown commercially. Here are a few internet links for obtaining the herbs:

* Wild Weeds: http://www.wildweeds.com

* Mountain Rose Herbs:
http://www.mountainroseherbs.com

* Other Sources:
http://www.sisterzeus.com/herbshoppes.html

Some women report that if they feel they might be pregnant, they will start taking Rutin 7 to 10 days before the onset of their period, dose of 500 mg per day (can be found at most health food stores). Rutin is an extract of Rue, a traditional abortifacient used historically all over the world. It works as a "morning after pill" by stimulating adrenaline and prolonging its action within the body, thereby decreasing capillary permeability in the uterine tissues and making them non-nutritive to the fertilized egg. Please consult the following website for more information and cautions about Rutin, which can severely stress the kidneys and liver if used on a regular basis. Rutin is therefore unsuitable as a regular contraceptive except as an emergency measure in case conception has occurred. Also, its essential oil is highly toxic and should never be used internally! **NOTE:** As with any medicine or chemical compounds, caution is advised before simply going out and ingesting unfamiliar plants and herbs. You should NEVER use the extracted "Essential Oils" of some of these plants as can be purchased over-the-counter in small bottles of liquid. In that form, many are known to be deadly toxic. Even when fresh water-extracts are made from the original herbal formulas, the dosages are very important. For example, Spotted Cowbane Root, noted in several of the papers in the above Reprint Package, is potentially deadly in high doses. It is also known as Water Hemlock (Cicuta maculatum), one of the most poisonous plants in North America and related in its actions to the plant that killed Socrates. If you make the decision to try the herbal preparations, stick to the methods and dosages given in the

Nissim book and other resources presented here for termination of early pregnancy - *when you take responsibility for your own health and fertility, you also take responsibility for the risks involved!*

Furthermore, it is important to take into consideration that if the herbs have not worked in your case, for whatever reason, you **must** follow up with a surgical or pharmaceutical abortion, as the herbs are known to be damaging to the normal growth of the fetus, even if they failed to end the pregnancy! For termination of a confirmed and in-progress pregnancy, consult the above websites or contact the nearest offices of Planned Parenthood or the National Abortion Federation. The Food and Drug Administration recently approved the use of RU-486 "abortion pill" in the USA, making this step much easier - but the chemical abortion pill is reported to have side-effects more severe than the herbal methods discussed above. It also can only be administered by physicians, requiring several trips to the physician's office, driving the cost up significantly. The herbal method discussed here costs pennies by comparison. Nevertheless, the legalization of RU-486 provides an important back-up for any woman presently using herbal methods. If you are determined to end a pregnancy, and the herbal methods do not work for you, a pharmaceutical or surgical abortion may be the only final alternative, and become necessary also, as the herbs are known to be disruptive to the normal growth of the fetus.

Do not make casual or last-minute decisions about pregnancy, emmenagogues or abortive herbs! Be smart, educated, and prepared, and let no man or woman dictate your basic life decisions!

For More Information, read the following materials:

* Fertility Awareness, Herbal Contraception, Herbal Abortion: http://www.sisterzeus.com
This is the best web site on the subject anywhere! Lots of excellent information. Here are some sub-sections:
* Preventing and Ending Pregnancy by Alternatives: http://www.sisterzeus.com/PregT.htm
* Herbal Abortion: http://www.sisterzeus.com/Abortif.htm
* Sharing Our Wisdom: http://www.sisterzeus.com/Sharing.htm
* Also here is a website offering straightforward gynecological information: http://www.askmygyn.com

Highly Recommended, Important Books to Get:

* James DeMeo: "Contraceptive Plant Materials Used in Sex-Positive Cultures". This article is contained as a Chapter in the book ***Saharasia: The 4000 BCE Origins of Child Abuse, Sex-Repression, Warfare and Social Violence, In the Deserts of the Old World*** (Natural Energy Works, Ashland, Oregon, 2006) *Saharasia* covers a much broader set of topics than merely contraceptive plants, going deep into subject areas such as the historical decline in women's status, the harsh abuse suffered by children and adolescents world-wide, how patriarchal authoritarian societies crush down women and men, with a lot of new findings on the *origins of patriarchal authoritarian societies* and *origins of human violence and war* questions. See: http://www.saharasia.org

* CLICK HERE TO PURCHASE the comprehensive book *Saharasia: The 4000 BCE Origins of Child Abuse, Sex-Repression, Warfare and Social Violence, In the Deserts of the Old World,* by James DeMeo, Ph.D. 464+ pages, over

100 maps and illustrations, with comprehensive bibliography and index. ***NOW SHIPPING THE 2006 REVISED SECOND EDITION!***

You can also purchase *Saharasia* from Amazon.com. Amazon obtains the book from us, so there is no advantage in time, and they will also charge a slightly higher price ($39 as compared to our $34). However, for destinations outside the USA, they often can offer a much better shipping rate. *Be certain you get the 2nd Revised Edition! Assuming you got the 1st Edition by error,* most of those 2nd Edition changes are identified and can be obtained as PDF downloads from this webpage.

* ***Herbal Contraception and Abortion in Sex-Positive Cultures: Selected Reprints.*** That is this PDF document! Download available from: http://www.orgonelab.org/contracep.pdf This document includes reprints of 16 different published and unpublished Scholarly Articles from old anthropology, ethnobotany and pharmacology journals on the subject, clearly demonstrating that so-called "primitive" peoples had known how to control their fertility long before Western science. Also includes information on other books and web sites giving explicit details on herbal abortion methods. This information once brought a death-sentence by burning!

* ***Natural Healing in Gynaecology: A Manual for Women,*** Rina Nissim, Harper/Collins, 1996. An essential reference book giving women the power of choice in their own healing and reproduction. Covers the limits of modern allopathic medicine, contrasting them to healing alternatives from both Western and Eastern cultures. The author was a founder of the *Dispensaire des Femmes,* a women's health

centre collective in Geneva, Switzerland, and has worked with women and health groups in the USA, Central America and India. 234 pp. Here are some Amazon.com links to obtain this book, which is now out of print:

Nissim 1996 Natural Healing in Gynaecology
1986 Softcover Natural Healing in Gynecology
1986 Hardcover Natural Healing in Gynecology
French Ed. Manual De Ginecologia Natural Para M...

A German-language edition is also available from Amazon.de Use their book-search feature to look for all titles by "Rina Nissim", and also for this title:
Naturheilkunde in der Gynaekologie

This important book may also be available in other world languages. If you learn of another edition, please let us know about it!

Other Published Resources:

* "Oral Contraceptives in Ancient and Medieval Times", J. Riddle & J.W. Estes, *American Scientist,* 80:226-233, May-June, 1992.

* "Ever Since Eve: Birth Control in the Ancient World", J. Riddle, J.W. Estes & J.C. Russell, *Archaeology,* March/April 1994, pp.29-35.

Don't forget that *adoption is a very good alternative to abortion*.

Disclaimer

The information contained on this website is gathered from previously-published and on-line sources, presented here for convenience and educational purposes only. It is not intended to be a substitute for professional healthcare advice. Should you have any healthcare related questions, please call or see your physician or other qualified healthcare provider promptly. You should never disregard verified advice from a healthcare provider, nor delay in seeking it because of something you have read on this website. Any action on your part in response to the information provided on this website is at your, the reader's discretion. Self-educate! Be responsible! Become a Wise Woman, in charge of your own destiny!