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A Review of Research on Plants for Fertility Regulation in Korea*

Won-Sick Woo, Eun-Bang Lee, Kuk-Hyun Shin,
Sam-Sik Kang and Hyung-Joon Chi
Natural Products Research Institute Seoul National University
Seoul, Korea

Historical Overview of the Korean Population

According to the census conducted in last November, the population of Korea was thirty seven and a half million persons, and the density of population was calculated to be 378.4 persons per square kilometer. It is one of the highest population densities in the world.

Traditionally, in Korea in patriarchal and extended family was the basis of social and economic life. They were expected to produce many children to enter the civil service and so gain power and influence and work on the soil.

Therefore, marriage was early and universal, in such a family system that arranged marriage in the early teens.[1)]

During the 1940's, Korean women married at ages 16 to 18. The country was occupied and administered by Japan, which took no measures to suppress fertility. The forcible draft of Koreans to Japan at age 20 encouraged marriage before that birthday. Man should marry before going off to an unknown fate in war.

Therefore, 50 years ago fertility was high and steady at about 45 births per thousand population per year[2)]. However, mortality levels were relatively high; they reflected the time with about 22~26 death per thousand population per year.

Average life expectancy at birth was about 40~47 years at that time and about 20 percent of the infants died in the first year of life according to the Dr. Kwon's report[3)].

Furthermore amazing degree of out-migration to manchuria and Japan which resulted in separation of couples, was another factor discouraging high fertility. According to the Manchurian census in 1940 these were 1.3 million Korean there, of whom 70 percent were listed as immigrants and the rest as having been born there[1)]. Then, in 1937, the Chinese-Japanese War broke out, and a forcible draft of Korean to Japan was started.

The annual number of migrants to Japan climbed from less than 50,000 to a peak of over 200,000. Thus in the seven years from 1939 to liberation in 1945 these was a movement of 1,230,000 Koreans, including 820,000 draftees and 410,000 volunteer migrants[1)]

Therefore, the population of Korea was relatively stable. Just before the liberation of the

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country from Japanese dominator in 1944, the Korean population numbered 25.9 million. The population in the Southern part alone then amounted to 15.9 million, or 61.4% of the total population. This grew to 20.2 million in 1949, an increase of 4.3 million in five years or an annual growth rate of 4.7 percent.

Contributing to the rapid growth rate were the return of Koreans who emigrated out of the country during the Japanese occupation and the migration of North Koreans across the 38th parallel shortly after the country divided into two parts in 1945[4]. Because of the high death rate and temporary drop in fertility during in Korean War, the annual population growth rate between 1949 and 1955 was only 1.1 percent.

Population Growth and Fertility Regulation Research

It increased to 3.0 percent per year for the 1955~60 period, mainly due to improved standards of living, medical advances that decreased infant mortality, extended life expectancy, and modified the ravages of diseases, both endemic and epidemic as well as Post-Korean War baby boom. With shortages in housing, food, transportation, and employment, an annual population growth rate of 3 percent and an annual economic growth rate of only 4.4 percent, the government and the general public were forced to pay serious attention to measures to curb population growth.

A vigorous and successful family planning program was initiated in the early 1960s by the government, the birth rate steadily declined starting in 1966 and the annual population growth rate in 1980 stood at 1.58 percent.

This is a remarkable achievement; but in so densely crowed a country, with such limited resources for increasing food production, continued emphasis on family planning is imperative to avoid future crisis.

In spite of such a serious population problem, unfortunately we can hardly find research works carried out in Korea for the development of antifertility agents. Only one attempt at the development of antifertility agents was the work led by Dr. Lee for utilization of soil micro-organisms to obtain steroidal hormones by enzymatic degradation from sterols.[5]

The plausible excuses for lack of substantive research efforts in developing antifertility agents are as follows:

1) **Lack of interest in research:** Due to successful family planning program, as mentioned above very little attention has been directed to the development of antifertility agents.

2) **Shortage of research grants:** All the facilities were destroyed by Korean War and financial supports have subsequently been concentrated on the works for the development of industry for more rapid growth of economy rather than on the works for the development of drugs for health.

3) **Difficulties in collaboration between chemists and biologists:** In case of natural products chemistry, modern scientific investigations on Chinese traditional drugs have been carried out and a number of chemical compounds have been isolated to determine their chemical structure by chemists. But chemists have not been moved to collaborate with the pharmacologists. And pharmacological studies have independently been carried out mainly on the extracts of drugs by pharmacologists, or *vice versa*.

Therefore noncooperation between chemists and biologists have made development of new drugs very slow.

Plant Sources of Fertility Regulating Agents

We have traditional stories suggesting that certain plants are capable of regulating fertility in human subject, inspite of the traditional social background for pronatalist system, and some herbs were evidently used for this, but the particular methods are not recorded.

In addition, some prescriptions for ending pregnancy in case pregnancy itself threatened the maternal health were described in old medicinal books.

At present, practically widely used oral contraceptives in Korea are steroids. However a number of pharmaceutical companies with permission of government produce emmenagogues which consist of all chinese drugs. A total number reaches 17. All these drugs are prescribed according to the old medicinal books, and typical prescriptions are listed in Table I.

These drugs can be obtained freely in the pharmacy without doctor's prescription and reportedly used for the purpose of inducing abortion in the early stage of gestation, although the drugs have not yet been shown by contemporary scientific standards to exert such effects.

While we were interested in this problem and concerned with the possibility of discovering new drugs capable to regulating fertility, in 1975, Dr. Farnsworth and his colleagues have published an exhaustive review article on the potential values of plants as sources of new antifertility agents[6].

They cited over 1,300 plant species that might have such activity based on their folkloric reputation, on their chemical constituents, and on the results of their testing in animals.

However, antifertility plants which have been used in Far Eastern countries have not been included in this review in spite of the wide variety of use of crude plant or animal prepar-

Table I. Typical emmenagogues (Products in Korea)

Items	Ingreadients	
Kamisoyo-san Tab.	1 Tab.	
(加味逍遙散)	*Atractylidis*	
	Rhizoma alba	0.5g
	Paeoniae Radix	0.5g
	Hoelen	0.5g
	Angelicae gigantis Radix	0.5g
	Bupleuri Radix	0.5g
Vinus-whan	1 Pill	
(뷔너스丸)	*Rehmanniae Radix*	100mg
	Cyperi Rhizoma	62mg
	Dioscoreae Rhizoma	50mg
	Angelicae gigantis Radix	50mg
	Leonuri Herba	50mg
Chiljehyang-	1 Pill	
bu-whan	*Cyperii Rhizoma*	500mg
(七製香附丸)	*Angelicae gigantis Radix*	71.43mg
	Moutan Cortex	35.71mg
	Cnidii Rhizoma	35.71mg
	Bupleuri Radix	35.71mg
Ghejibokreong-	1 Pack	
ghadaewhang	*Cinnamomi Cortex*	667mg
(桂枝補經加大	*Hoelen*	667mg
黃湯)	*Moutan Cortex*	667mg
	Persicae Semen	667mg
	Paeoniae Radix	667mg
Onkyung-tang	1 Pack	
(溫經湯)	*Pinelliae Tuber*	1.4g
	Liriopis Tuber	1.4g
	Angelicae gigantis Radix	1.0g
	Cnidii Rhizoma	0.7g
	Paeoniae Radix	0.7g
Hosaeng-dan	1 Pill	
(胡生丹)	*Angelicae gigantis Radix*	5.6mg
	Cnidii Rhizoma	5.6mg
	Cyperi Rhizoma	11mg
	Paeoniae Radix	5.6mg
	Rehmanniae Radix	5.6mg

ations in the form of traditional medicines or folkloric remedies in these countries.

This prompted us to search the plants which have been used or suggested to be used as antifertility agents in the literature[7].

Sources of references Korean ancient and modern Materia Medica, and the books on folk medicines that have been used by Koreans as well as Japanese (See footnote of Table III).

The terms of the indications pertinent to fertility regulation which appeared in these reference books are listed in Table II.

Table II. Grouping of plants

Group	Terms of indications
Contraceptives	Prevention of pregnancy
	Cessation of pregnancy
Abortifacients	Abortion
	Expulsion of placenta
	Expulsion of a dead fetus
	Facilitation of difficult labor
Emmenagogues	Amenorrhea
	Menorrhagia
	Scanty menstruation
	Delayed menstruation
	Pre-menstruation
	Menstrual abnormalities

All plants were grouped into three categories as Dr. Farnsworth did[6]; contraceptives, abortifacients, and emmenagogues.

If a plant was alleged in reference books to be used for prevention of pregnancy or cessation of pregnancy, it was assigned to the contraceptive category.

Any plant mentioned as being used to expel the fetus was considered an abortifacient. Therefore, ecbolics and oxytocics were included in this category. And all plants mentioned to be used for all types of menstrual abnomalities such as amenorrhea, monorrhagia and so on were considered emmenagogues. All plants searched and picked out were tabulated in Table III.

In this table, the name of these plants, the planrt part used, the type of activity alleged in the references, together with pharmacological activity reported and chemical compouds reported isolated from or identified in, any of these drugs were recorded.

During our search for antifertility plants in ancient traditional medicinal books we found out that some plants were described simply as contraindicative drugs for pregnancy.

These plants were expected to produce abortive, or fetocidal or teratogenic effect or other harmful effects to the fetus. Such plants were also added for information under the head of CI.

The figures in the Table represent the number of reference which described the pertinent plant.

A total of 128 species of plants was found to be used for fertility regulation in the Far Eastern area, these plants are classified into 122 genera and 64 families.

Summing up (Table IV), this will come to the following result.

The plants described to be used as contraceptives were 15 species, abortifacients 64 species and emmenagogues 87 species.

Among them 9 species were described to be exclusively used as a contraceptive 30 species as a abortifacient add 53 species as an emmenagogues. However 2 species were described to be used for both contraception and abortion and other 2 species for both contraception and inducing menstruation, whereas 30 species were described to used for inducing both abortion and menstruation. And 2 species were described to be used in all three cases.

In last two usages, it would be reasonable to presume that the lack of menstruation might

Table III. Supposed fertility regulating plants found in literature

Plant name	Korean name (Chinese name)	Part	C	A	E	CI	Activity	Constituents
Alismataceae								
Alisma plantago	질경이택사(澤瀉)	rz		1				
Amarantaceae								
Achyranthes japonica	쇠무릎(牛膝)	rt	2	12	124	1		saponin(achyranthessaponin)[8]
Amaranthus ascendens	비름(莧菜)	px		1	3			
Anacardiaceae								
Rhus verniciflua	참옻나무(乾漆)	ex			12	1		polyphenol (dihydrourushiol, dehydrourushiol)[9]
Arisaemaceae								
Arisaema amurense var. *serratum*	넓은잎천남성(天南星)	rz		124		1		
Pinellia ternata	끼무릇(半夏)	tb		12		1		alkaloid (choline)[10], phenol (3, 4-dihydroxybenzaldehyde)[11]
Aristolochiaceae								
Asarum maculatum	개족도리(杜衡)	rt			4			
Balsaminaceae								
Impatiens balsamina	봉선화(鳳仙花)	sd	2	12			estrogenic[12]	
Bignoniaceae								
Campsis grandiflora	능소화(凌霄花)	fl			2			
Borraginaceae								
Lithospermum erythrorhizon	지치(紫根)	rt	2					naphthoquinone (shikonin, isovalerylshikonin, deoxyshikonin)[13]
Burceraceae								
Canarium album	감람나무(橄欖)	sd	2					
Campanulaceae								
Adenophora triphylla	더덕(沙蔘)	rt		3				
Caprifoliaceae								
Lonicera japonica	인동덩굴(金銀花)	fl			3		uterotonic[14]	flavonoid(lonicerin)[15]
Caryophyllaceae								
Dianthus sinensis	패랭이꽃(瞿麥)	sd		12	1234	1		
Melandium firmum	장구채(王不留行)	px		124	12			flavonoid(vitexin, orientin, cathimoside)[16]
Celastraceae								
Euonymus alatus	화살나무(衛矛)	st		4	14			flavonoid(quercetin, euonymin)[17], alkaloid(alatamine, wilfordine)[18]

Table III. (*Continued*)

Plant name	Korean name (Chinese name)	Part	C	A	E	CI	Activity	Constituents
Compositae								
Arctium lappa	우엉(牛蒡根)	rt			23		uterotonic[19]	lignan(lappaol A, B)[20], sesquiterpene(eremphilene, fukinone)[21]
Artemisia asiatica	쑥(艾葉)	px			34			
Artemisia keiskeana	맑은대쑥(菴蕳子)	px			14			
Carthamus tinctorius	잇꽃(紅花)	fl			5 12345	1	estrogenic[22]	quinone(ubiquinone-9)[23], flavonoid(carthamin)[24], lignan(matairesinolglucoside)[25]
Chrysanthemum indicum	감국(甘菊)	fl	5	5	45			sesquiterpenoid(arteglasin A)[26], flavonoid (acacetin 7-O-galactoside)[27]
Circium segetum	조뱅이(小薊)	rt			3			
Echinops setifer	결구대(漏蘆)	rt			134			
Erigeron canadensis	망초(芒草)	px		2				essential oil (terpeneol, limonene, dipentene)[28]
Eupatorium fortuinei	등골나물(蘭草)	px			24			
Gymura japonica	삼칠(三七)	rt			4			
Convolvulaceae								
Pharbitis nil	나팔꽃(黑丑)	sd		12		1	uterotonic[14]	resin glycoside(pharbitin[29], pharbitic acid)[30]
Cornaceae								
Macrocarpium officinalis	산수유(山茱萸)	fr			134			iridoid glycoside(loganin, sweroside, morroniside)[31]
Cruciferae								
Brassica campestris var. *nippooleifera*	유채(蕓台子)	sd		2			uterotonic[14]	
Brassica juncea	갓(芥子)	sd			235			flavonoid (kaempferol, isorhamnetin)[32], isothiocyanate (2-phenylethylisothiocyanate, 3-butenylisothiocyanate)[33]
Draba nemorosa var. *hebecarpa*	꽃다지(葶藶子)	sd			2			
Cucurbitaceae								
Cucumis melo	단참외(甜瓜子)	sd			4			flavonoid(meloside A,L,I)[34]
Cucumis sativus	오이순	vn	5	3				sterol([Δ-stigmastenone-(3), Δ^7-stigmastenol-(3β)])[34]
Luffa cylindrica	수세미(絲瓜)	fr			24		uterotonic[36] decreased[38] litter size	cucurbitan(U)[37]
Trichosanthes cucumeroides	하늘타리(王瓜)	rt			124			sterol (stigmastanol)[39]
Trichosanthes kirilowii	노랑하늘타리(天花粉)	rt	3		14			protein(A) (trichosanthin)[40]
Cyperaceae								
Cyperus rotundus	향부자(香附子)	rz			25 2345		estrogenic[41]	sesquiterpene (E) (cyperol, isocyperol, cyperenone)[42]

Table III. (*Continued*)

Plant name	Korean name (Chinese name)	Part	C	A	E	CI	Activity	Constituents
Scirpus fluviatilis	매자기(荊三稜)	rt		12	124	1		hydroxystilben(scirpusin A, B)[43]
Equisetaceae								
Equisetum hiemale	속쇠(木賊)	px			24			saponin[44]
Ericaceae								
Rhododendron japonicum	철쭉(躑躅)	rt				1		tropoid (grayanotoxin I, rhodojaponin)[45]
Eucommiaceae								
Eucommia ulmoides	두충나무(杜冲)	sd		2				lignan glycoside (pinoresinol-di-β-D-glucoside)[46]
Euphorbiaceae								
Croton tiglium	파두(巴豆)	sd	5	125	12	1		phorbol ester (phorbol A_1, B_1, B_2)[47]
Euphorbia pekinensis	대극(大戟)	rt		12	24	1		
Euphorbia lathyris	속수자(續隨子)	sd			1		uterotonic[48] decreased[33] litter size	aesculetin(U)[48], phorbol (ingenol-3-hexadecanoate)[49]
Ricinus communis	아주까리(蓖麻子)	sd	5	35	5		estrogenic[50] uterotonic[36,51,52]	ricin(U)[51], castor oil(U)[52] flavonoid(quercetin, rutin, isoquercitrin)[53]
Fagaceae								
Quercus aliena	갈참나무(柞木皮)	sb		2				
Ginkgoaceae								
Ginkgo biloba	은행나무(銀杏)	sd		3				flavonoid (3′-O-methylmyricetin-3-rhamnoglucoside, rutin)[54], terpene (dihydroatlantone, bilobanone)[55]
Gramineae								
Coix lacyma-jobi var. *mayuen*	율무(薏苡仁)	sd		14	2	1	uterotonic[56]	benzaldehyde glucoside(3, 4-dihydroxybenzaldehyde glucoside)[57]
Hordeum sativum	보리(麥芽)	sd		1				flavonoarid(saponarin)[58], alkaloid (hordatin A,B)[59]
Imperata cylindrica var. *koenigii*	띠(白茅根)	rt			2	1		triterpenoid(fernenol)[60]
Zea mays	옥수수	fm		3			estrogenic[61]	flavonoid(maysin)[62]
Iridaceae								
Crocus sativus	사프란	sg		5	45		uterotonic[63]	terpeneglycoside(picrocrocin)[64]
Belamcanda chinensis	범부채(射干)	rz			12			xanthone(mangiferin)[65], isoflavone(iridin, tectoridin)[65]
Labiatae								
Leonurus sibiricus	익모초(益母草)	px		2	1234		estrogenic[66] uterotonic[14,68]	leourine(U)[67]
Mentha arvense	박하(薄荷)	lf			4			essential oil[69]
Ocimum sanctum	영릉향(零陵香)	px	245	5			antifertility[70]	
Prunella vulgaris	하고초(夏枯草)	fl		4				triterpenoid(ursolic acid)[71]

Table III. (*Continued*)

Plant name	Korean name (Chinese name)	Part	C	A	E	CI	Activity	Constituents
Salvia multiorrhiza	단삼(丹蔘)	rt		14	24			
Scutellaria baicalensis	속썩은풀(黃芩)	rt			12			flavonoid(baicalin, wogonin)[72]
Lardizabalaceae								
Akebia quinata	으름덩굴(木通)	st		134	1234	1	uterotonic[14]	saponin(hedragenin and oleanolic acid glycoside)[73], anthocyanin(cyanidin 3-monoglucoside)[74]
Lauraceae								
Cinnamomum cassia	계피나무(桂皮)	bk	5	1245	35	1		diterpenoid(cinncassiol C_1, cinncassiol B)[75]
Leguminosae								
Caesalpinia sappan	소방목(蘇方木)	wd		5	245	1		fatty acid(stearic acid, palmitic)[76], saponin(amyrin-3-O-glucoside)[77]
Gleditschia japonica	주엽나무(皂莢)	fr		124		1		saponin(gleditsia saponin C,E,G)[78]
Glycine max	콩(黑大豆)	sd		34	2		estrogenic[79]	isoflavonoid(daidzein, genistein)[80], coumestan (coumesterol, sojagol)[81], saponin(sojasaponin Ⅰ, Ⅱ, Ⅲ)[82]
Pasoralia corylifolia	보골지(補骨脂)	sd		2	2			
Phaseolus radiatus	녹두(綠豆)	sd	2					protein(α,β-globulin)[83]
Phaseolus radiatus var. *aurea*	팥(赤小豆)	sd		24	4			polysaccharide(arabinan AL-Ⅰ, AL-Ⅱ)[84]
Pueraria thunbergiana	칡(葛根)	rt	2	1		1	estrogenic[85]	isoflavonoid(daidzein, genistein, puerarin)[86]
Sophora japonica	회나무(槐實)	sd		14		1	estrogenic[87]	isoflavonoid(genistein, genistein-4′-O-glucoside)[88], alkaloid(cytisine, sophocarnine, matrine)[89]
Liliaceae								
Aloe vera	아로에(蘆薈)	ex	5	5	245	1	uterotonic[90]	anthrone(aloin)[91], polysaccharide[92]
Allium sallium	마늘(大蒜)	rz		5	5	1	uterotonic[93]	saponin[84]
Hosta undulata	옥잠화(玉簪花)	rz	24					
Smilax china	청미래(土茯苓)	rz	2					saponin(diosgenin glycoside)[95], anthocyanin(cyanidin-3-glucoside, cyanidin-3-rutinoside)[96]
Loganiaceae								
Strychnos ignatii	보두(寶豆)	sd		1				alkaloid(strychine, brucine)[97]
Magnoliaceae								
Magnolia obovata	후박(厚朴)	sb				1		essential oil(α,β-pinene, camphene, limonene, bornyl acetate)[98], alkaloid(1-n-acetylanonaine, liriodeine)[99]
Malvaceae								
Althaea rosea	접시꽃(蜀葵花)	fl		14	3		estrogenic[12]	
Gossypium nanking	면화(綿花子)	sd			4			flavonoid(gossypetin)[100]
Hibiscus manihot	황촉규(黃蜀葵)	sd	5	245	5			

Table III. *(Continued)*

Plant name	Korean name (Chinese name)	Part	C	A	E	CI	Activity	Constituents
Malva verticillata	아욱(冬葵子)	sd		124		1		
Moraceae								
Cannabis sativa	삼(大麻)	rt	5	1245	245		uterotonic[101,102]	alkaloid [nicotine (U)][102], cannabinoid (Δ^1-3, 4-trans-tetrahydrocannabinol)[103]
Morus alba	뽕나무(桑)	fr				13		flavonoid(kuwanon G, mulberrin, cyclomulberrin)[104]
Musaceae								
Musa basjoo	파초(巴蕉)	px			3			
Nymphaeaceae								
Nelumbo nucifera	연꽃(蓮花)	fl		24				alkaloid(armepavine, nuciferine, roemerine, nornuciferine)[105]
Oleaceae								
Forsythia viridisima	약개나리(蓮翹)	fr			4			ligan(arctiin, arctigenin, matairesinol)[106], flavonoid (astragalin, isoquercitrin)[106]
Orchidaceae								
Gastrodia elata	천마(天麻)	rz				1		phenol(gastrodin[107], gastrodioside, 4-hydroxybenzaldehyde[108])
Palmae								
Trachycarpus fortunei	종려(棕梠子)	sd	2					
Papaveraceae								
Corydalis racemosa	현호색(玄胡索)	rz		14	124		uterotonic[14]	
Padaliaceae								
Sesamum indicum	참깨(胡麻)	sd		45	45		estrogenic[109]	flavonoid(pedaliin)[110], lignan (sesamin, sesamolin)[111]
Phytolaccaceae								
Phytolacca esculenta	자리공(商陸)	rt		124				saponin(phytolaccoside B,E)[112]
Piperaceae								
Piper retrofractum	필발(蓽茇)	fr			2			alkaloid(piperine)[113]
Plantaginaceae								
Plantago asiatica	질경이(車前子)	sd		12	34			essential oil(camphor, guaiacol, cresols, limomene)[114]
Polygonaceae								
Fagopyrum esculentum	모밀(蕎麥)	sd	3		3			anthraquinone(fagopyrin)[115]
Polygala tenuifolia	원지(遠志)	rt		4			uterotonic[14]	xanthone(1, 2, 3, 7-tetramethoxyxanthone, 1, 2, 3, 6, 7-pentamethoxyxanthone)[116], saponin(onjisaponin G,F)[117]
Polygonum multiflorum	하수오(何首烏)	rz		4			decreased[38] litter size	flavonoid(8-C-galactosylapigenin, 6-C-galactosyl-8-C-arabinosylapigenin)[118]
Reynoutria cuspidatum	호장(虎杖)	rz			134			
Rheum undulatum	종대황(大黃)	rz			124	1		

Table III. (*Continued*)

Plant name	Korean name (Chinese name)	Part	C	A	E	CI	Activity	Constituents
Ranunculaceae								
Aconitum chinense	천웅(天雄)	rt		124		1		alkaloid(mesaconine, aconitine, benzoylmesaconine, benzoylaconitine)[119]
Aconitum japonicum	초오두(草烏頭)	rt		14		1		alkaloid(yokonoside,[120], mesaconitine, aconitine, hypaconitine[121])
Aconitum sinense	부자(附子)	rt	2	12	24	1		
Clematis mandshurica	으아리(威靈仙)	rt			34			saponin(oleanolic acid glycoside)[122]
Paeonia albiflora	참작약(赤芍藥)	rt			1234			flavonoid(paeonin)[123]
Paeonia moutan	모란(牧丹皮)	rb		1	1234	1	antiimplantation[124]	benzonoid(paeonol[125], paeonolide[126]), flavonoid(paeonoside, astragalin)[127]
Pulsatilla koreana	할미꽃(白頭翁)	rt		3	4			saponin(hedragenin oligoglycoside)[128]
Rosaceae								
Duchesnea chrysantha	뱀딸기	fr			3			
Potentilla kleiniana	가락지나물(蛇含)	px		3				
Prunus mume	매화나무(梅根皮)	rb			4			
Prunus persica	복숭아(桃仁)	sd		5	1234	51		flavonoid (multinoside A, quercitrin, multiflorin A,B)[129]
Rosa multiflora	찔레나무(營實)	fr			3			flavonoid(quercitrin, multinoside A)[130]
Sanguisorba officinalis	오이풀(地楡)	rt	5		12			saponin(ziyu glycoside Ⅰ, Ⅱ)[131]
Rubiaceae								
Gardenia jasminoides	치자나무(梔子)	fr	2					iridoid(gardenoside, geniposide)[132]
Rubia akane	꼭두선이(茜草)	rt			34	1		pigment(mecocyanin, pseudopurpurin)[133]
Scrophulariaceae								
Rehmania glutinosa	지황(生地黃)	rz		2	23		decreased[38] litter size	
Selaginellaceae								
Selaginellia involvens	바위손(卷柏)	wp			14			
Solanaceae								
Physalis francheti	꽈리(酸漿)	fr		134	3		uterotonic[14,134]	terpenoid(physalin A,B)[135]
Solanum melongena	가지(茄子)	fl	2					
Styracaceae								
Styrax benzoin	안식향(安息香)	ex		2				
Taxaceae								
Taxus cuspidata	주목(朱木)	lf			4			flavonoid(ginkgetin, kayaflavone)[136]
Thymelaeaceae								
Daphne genkwa	완화(莞花)	rt		24		1	uterotonic[19] decreased[38] litter size	flavonoid(genkwanin)[137]
Typhaceae								
Typha latifolia	부들(蒲黃)	fl		12	24		uterotonic[14]	flavonoid(myricetin-3-glucoside, quercetin and myricetin-3-rutinoside)[138]

Table III. (*Continued*)

Plant name	Korean name (Chinese name)	Part	C	A	E	CI	Activity	Constituents
Ulmaceae								
Ulmus japonica	느릅나무(楡皮)	sb	1					
Umbelliferae								
Angelica dahurica	구릿대(白芷)	rt		12	4			coumarin(imperatorin, phellopierin)[139]
Angelica gigas	참당귀(土當歸)	rt		23	34			
Bupleurum falcatum	시호(柴胡)	rt			24			saponin(saikoside Ia, Ib)[140]
Cnidium officinale	천궁(川芎)	rz			4			essential oil(cnidilide, neocnidilide)[141]
Daucus carota	당근(鶴虱)	fr		5	5	1	estrogenic[142] uterotonic[14,144] antiimplantation[146] abortifacient[147]	flavonoid(luteolin glycoside)[143] terpene(β-bisabolene, carotol, dancol)[145]
Urticaceae								
Boehmeria nivea	모시풀(苧麻)	rt		3	3			
Verbenaceae								
Verbena officinalis	마편초(馬鞭草)	wp		5	124		uterotonic[148] antigonadotropic[151]	coumarin[verbenalin(U)[149], hastatoside][150]
Vitex cannabifolia	목형(牧荊子)	fr			4		uterotonic[19]	
Zingiberaceae								
Amomum xanthioides	축사인(縮砂仁)	sd			4			
Curcuma longa	강황(薑黃)	rz	5	5	1245		uterotonic[19] antifertility[153]	essential oil(turmerone, curcumin, curcumon)[152]
Curcuma zedoaria	아출(莪蓯)	rz	5	5	14			phenylpanoid(ethyl p-methoxycinnamate)[154], essential oil(zederone, isocurzerenone)[155]
Zingiber nigrum	익지(益智)	sd		4				
Zingiber officinale	생강(生薑)	rz		5		1		essential oil (gingerol, gingediol, methylgingediol)[156]
Zygophyllaceae								
Tribulus terrestris	백질려(白蒺藜)	fr		2				saponin(terrestroside F, saponin C,G)[157]

Abbrebiation: C; contraceptive, A; abortifacient, E; emmenagogue, CI; contraindicative, U; uterotonic rz; rhizome, rt; root, px; aerial part, fl; flower, ex; extract, tb; tuber, sd; seed, st; stem. fr; fruit, vn; vine, sb; stem bark, fm; filament, sm; stigma, lf; leaf, bk; bark, wd; wood, rb; root bark, wp; whole plant

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   B. Nishiyama, Eio, *Oriental and Folkloric Medicine*, Shyogensha, Osaka, (1970).
5. Same Plant Used on Other Continents.
   A. Farnsworth, *et al.*; *J. Pharm, Sci.*, **64**, 535, 717 (1975).

Table IV. Summary of fertility regulating plants (123 Genera, 64 Families)

C	A	E	Number	CI
15	64	87		
×			9	
	×		30	9
		×	53	8
×	×		2	1
×		×	2	
	×	×	30	8
×	×	×	2	2
				6
	Total		128	34

C: Contraceptive A: Abortifacient E: Emmenagogue
CI: Contraindicative

Table V. Ten plants found in majority of references

1) Used also on other continents

Plant name	Korean name	Part
Aloe vera(Liliaceae)	蘆 薈	LF
Caesalpinia sappan(Leguminosae)	蘇 方 木	WD
Cannabis sativa(Moraceae)	大 麻	RT
Carthamus tinctorius(Compositae)	紅 花	FL
Cinnamomum cassia(Lauraceae)	桂 皮	BK
Curcuma longa(Zingiberaceae)	薑 黃	RZ
Cyperus rotundus(Cyperaceae)	香 附 子	RZ
Ocimum sanctum(Labiatae)	零 陵 香	PX
Prunus persica(Rosaceae)	桃 仁	SD
Verbena officialis(Verbenaceae)	馬 鞭 草	WP

2) Used only in Far Eastern Area

Plant name	Korean name	Part
Achyranthes japonica(Amarantaceae)	牛 膝	RT
Akebia quinata(Lardizabalaceae)	木 通	ST
Angelica gigas(Umbelliferae)	土 當 歸	RT
Corydalis racemosa(Papaveraceae)	玄 胡 索	RZ
Dianthus sinensis(Caryophyllaceae)	瞿 麥	SD
Glycine max(Leguminosae)	黑 大 豆	SD
Leonurus artemisia(Labiatae)	益 母 草	PX
Paeonia albiflora(Ranunculaceae)	赤 芍 藥	RT
Paeonia moutan(Ranunculaceae)	牧 丹 皮	RB
Plantago asiatica(Plantaginaceae)	車 前 子	SD

be due to pregnancy and promotion of menstrual discharge by using of these plants may result from abortion.

The plants described as those which should not be prescribed for a pregnant women were amounted to 34 species. It is of interest that most contraindicative plants belong to abortifacients or emmenagogues.

23 kinds of the same plant species among those used in Far Eastern area have been reported to be used for fertility regulation on the other continents as well. Use of the same plant for the same purpose by different peoples lends credence to its possible effectiveness.

Among them the plants listed in Table V(1) are those which have been mentioned in more than five references out of ten references consulted. Table V(2) shows a list of the plants which appeared the majority of references but have been used only in Far Eastern area.

Screening for Uterine Stimulants

In spite of the folkloric fertility regulating reputation of these plants, few have been demonstrated to have activity in the laboratory. Searching the scientific literature for reports in which the pharmacological effects of these plant drugs has been studied in animals showed that about 25% of plant drugs were reported on their activity pertaining to fertility regulation.

Of the 75% of remaining plants no reports, either pro or con, could be found in the literature.

Phytochemical works on these plants were extensively carry out and many compounds were isolated.

Among them a few compounds such as alkaloids, isoflavonoids and coumestans have been known to have pharmacological effects in animals, but most of the remained compounds have

Table VI. Plants possessing uterotonic activity. (Result of *in vitro* test of 160 sp.)

Plant name	Korean name	Part
Akebia quinata(Lardizabalaceae)	木　通	ST
Albizzia julibrissin(Leguminosae)	合歡皮	BK
Astragaglus membranaceus (Leguminosae)	黃　蓍	RT
Brassica campeteris var. *nipp-oleifera*(Cruciferae)	蔓台子	SD
Daucus carota(Umbelliferae)	鶴　虱	FR
Dolichos lablab(Fabaceae)	白扁豆	SD
Evodia rutaecarpa(Rutaceae)	吳茱萸	FR
Inula britannica var. *linearifolia*(Compositae)	旋覆花	FL
Ipomoea nil(Convolvulaceae)	黑　丑	SD
Leonurus artemisia(Labiatae)	益母草	PX
Lilium aurantum(Liliaceae)	白　合	RZ
Lonicera japonica(Caprifoliaceae)	金銀花	FL
Melia japonica(Meliaceae)	苦楝皮	PC
Momordica cochinsinensis (Cucurbitaceae)	木鼈子	SD
Phlomis ambrosa(Labiatae)	續　斷	RT
Phyllostachys reticulata(Gramineae)	竹　茹	LG
Piper retrofractum(Piperaceae)	蓽　茇	FR
Polygala tenuifolia(Polygalaceae)	遠　志	RT
Polygonum aviculare(Polygonaceae)	扁　蓄	PX
Pyrrhosia lingua(Polypodiaceae)	石　韋	PX
Stemona japonica(Stemonaceae)	白部根	RT
Trigonella foenum-graecum (Leguminosae)	胡盧巴	SD
Typha latifolia(Typhaceae)	蒲　黃	FL

not been evaluated for their activity, which could be useful in fertility regulation.

Therefore, interpreting the significance of folkloric reports that a plant is contraceptive or abortifacient is very difficult unless such reports are supported by scientific experimental or clinical data.

In order to determine whether or not plants having folkloric application as an abortifacient might be confirmed, the ability of plant extracts to stimulate uterine muscle contractions has been examined *in vitro*[158].

If the uterine muscle does not contract when the plant extract is added, this indicates that a potentially useful uterine stimulant is absent. If the uterine muscle contracts, this is preliminary evidence that a useful uterine stimulant be present in this extract. Of 160 samples tested 28 showed uterotonic activity.

Table VI shows a list of the plants whose extracts exhibited the activity.

Among them bark of *Albizzia julibrissin* was fractionated and each fraction was investigated to determine which fraction possesses uterotonic

Table VII. Saponins previously isolated from the *Albizzia* genus

Plant name	Part	Compound	Genin	Sugar	Reference
A. anthelmintica	BK	Musennin	Echinocystic acid	Glu, Ara.	160
A. julibrissin	BV	Albiside	Echinocystic acid	Glu, Xyl, Ara, Fuc.	161
A. odoratissima	SD	Odoratissimin	Echinocystic acid	Glu, Ara, Xyl, Rha.	162
A. lebbek	SD	Lebbekanin A	Echinocystic acid	Glu, Gal, Xyl, Fuc, Rha.	163
	FL	Lebbekanin D	Echinocystic acid	Glu, Gal, Ara, Xyl, Rha.	164
		Lebbekanin F	Echinocystic acid	Glu, Ara, Xyl, Fuc, Rha.	164
		Lebbekanin G	Echinocystic acid	Glu, Ara, Xyl, Fuc, Rha.	164
		Lebbekanin H	Echinocystic acid	Glu, Gal, Ara, Xyl, Rha.	164
		Lebbekanin E	Acacic acid	Glu, Ara, Xyl, Rha.	165
A. intsia	SD	—	Acacic acid	Glu, Ara, Xyl, Rha.	166
A. concinna	SD	—	Acacic acid	Glu, Ara, Xyl, Rha.	166
A. borromensis	RT	Heteroside	Acacic acid	Glu, Ara, Xyl, Rha.	167
A. ferruginea	RT	Heteroside	Acacic acid	Glu, Ara, Xyl, Rha.	167
A. glalerrima	RT	Heteroside	Acacic acid	Glu, Ara, Xyl, Rha.	167
A. stipulata	RT	Heteroside	Acacic acid	Glu, Ara, Xyl, Rha.	167
A. zygia	RT	Heteroside	Acacic acid	Glu, Ara, Xyl. Rha.	167
A. adianthifolia	RT	Heteroside	Acacic acid	Glu, Ara, Xyl, Rha.	167
A. gummifera	BK	Albitocin	$C_{30}H_{48}O_5$	Glu, Ara, Xyl, Rha.	168
A. procera	SD	Proceranin	Machaerinic acid	Glu, Ara, Xyl, Rha.	169
	SD	Prceranin A	Proceric acid	Glu, Gal, Ara, Xyl, Fuc, Rha.	170

activity. As a result, it was found that saponin fraction was active.

Repeated chromatography of saponin fraction on silica gel gave several active fractions, one of which were purified by recrystallization.

This compound, on acid hydrolysis, gave acacic acid as an aglycone and in the hydrolyzate after neutralization, glucose, fucose and rhamnose were identified by TLC and GLC.[15,9]

The position of sugar attachment has not been resolved but, this isolated glycoside was different from any one known saponin of *Albizzia genus*

Conclusion

The above is the review of searching plant for fertility regulation in Korea. In a word, the research on development of new antifertility agents from Korean plants is in planning stage and one of the fields which have barely been touched upon in this country.

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