Academic Sciences International Journal of Pharmacy and Pharmaceutical Sciences

ISSN- 0975-1491 Vol 3, Suppl 5, 2011

Research Article

ANTIFERTILITY POTENTIAL OF SOME MEDICINAL PLANTS IN MALES: AN OVERVIEW

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Received: 6 July 2011, Revised and Accepted: 2 Nov 2011

ABSTRACT

The development of an effective, reversible and safe male contraceptive has been the focus of research around the world for more than 30 years. This review concentrates on those recent advances in science and technology that offer possible inroads for shifting the paradigm for male-based contraception. A large number of scientists are searching for a relatively cheap, widely available, easily accepted and effective contraceptive of plant origin that is equally non-invasive, non-hormonal in action, non-toxic and relatively long acting. Medicinal plants are important elements of indigenous medical system in India as well as in other countries. In these days, the use of traditional medicines has received considerable interest and a large number of plants have been screened for their antifertility activity. Thus, the present review includes a brief account of research reports on plants with antifertility potential.

Keywords: Contraceptive, Male-based, Non-hormonal, Antifertility Potential, Effective

INTRODUCTION

Fertility control is an issue of global and national public health concern. There is a global need to support individuals in family-planning due to the increasing growth rate of the world's population with its negative impact on environment, economic growth and poverty reduction in underdeveloped countries[1]. About 90% of the world's contraceptive users are women. Though considerable progress has been made in the development of highly effective, acceptable and reversible methods of contraception in females, progress and possibilities on males are still slow and limited[2,3]. Aware of this responsibility, health organizations and pharmaceutical companies continue to financially support or actively pursue research towards new contraceptive approaches[4]. Current methods of contraception result in an unacceptable rate of unintended pregnancies and many side effects also[5,6]. A large number of chemical agents have been known but all tend to lead to total spermatogenic arrest and, ultimately, to irreversible sterility[7]. As concerns regarding side effects of existing male contraceptive methods prevent universal acceptance[8, 9], the development of additional male methods of fertility control can provide tremendous social and public health benefits. There are relatively few realistic approaches currently being pursued which include (a) the suppression of sperm production, (b) disruption of sperm maturation and/or function, and (c) interruption of sperm transport[10,1]. Contraceptive vaccines, and inhibitors of spermatogenesis and sperm motility, provide a potential for nonhormonal male contraceptives[11]. It has, therefore, become necessary to use biologically active botanical substances or fertility-regulating agents of plant origin which are ecofriendly in approach and interfere with the natural patterns of reproduction[12]. Male antifertility drugs can induce contraception by interfering with spermatogenesis progression. Their action mechanism is correlated with the apoptosis of spermatogenic cells[13].

In our country as well as in the world, there are several medicinal plants associated with antifertility properties[14-16]. Although very few contraceptives have been developed from plant extracts, their potentiality has not been determined accurately, and their mode of action has been beyond our knowledge until now because there are many problems in assessing plant extract including batch to batch variation and a lack of definite active portion of the extract used for the development of herbal contraceptives[17].

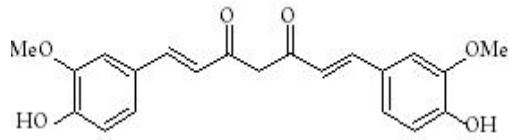
Several plant products inhibit male and female fertility and may be developed into contraceptives. Even though, many indigenous plants have been shown to prevent the birth, only few plants have so far been investigated for antifertility activity[18]. The World Health Organization (WHO) has set up a Task Force on Plant Research for fertility regulation with an objective to find new orally active non-steroidal contraceptive compounds[19]. Various medicinal plant extracts have been tested for their antifertility activity both in male and female. Some of these plants had spermicidal effects; other caused reduction in the sperm counts and altered the mobility of the sperms. Some of them caused testicular changes and altered hormone levels[20]. It is necessary to use biologically active botanical substances or fertility-regulating agents of plant origin which are ecofriendly. The natural plant substances possessing mild inherent estrogenic and antiestrogenic properties offer themselves as an effective nonconventional source of contraception with less deleterious side effects[21].

Plants showing antifertility potential in males are listed in table 1 and some of them are discussed below.

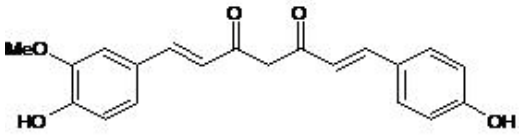
Curcurma longa

Curcuma longa Linn., commonly known as Turmeric, Indian saffron or Haldi belongs to family Zingiberaceae, is a perennial herb cultivated throughout India and is widely used as an antibiotic in folk medicines and as spices. Its tubers, rhizomes and oil have great importance. *C. longa* also possesses antimutagenic and anticarcinogenic properties[22].

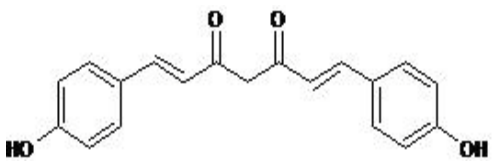
Phenolic diketone, curcumin (diferuloylmethane) (3–4%) is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%) [23].



Curcumin I



Curcumin II



Curcumin III

Curcumin found to inhibit 5a-reductase, which converts testosterone to 5a-dihydrotestosterone, thereby inhibiting the growth of flank organs in hamster. Curcumin also inhibited human sperm motility and has the potential for the development of a novel intravaginal contraceptive[24,25].

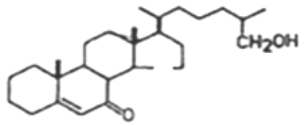
Rats fed with *Curcuma longa* aqueous and 70 % alcoholic extract for 60 days (500 $mg.kg^{-1}.day^{-1}$) showed a reduction in sperm motility and density. *C. longa* may have affected the androgen synthesis either by inhibiting the Leydig cell function or the hypothalamus pituitary axis and as a result, spermatogenesis is arrested[26].

Male mice of the Parkes (P) strain were orally administered aqueous rhizome extract of *C. longa* (600 mg/kg body weight per day for 56 and 84 days) showed adverse effect of on various male reproductive organs and fertility. The treatment had adverse effects on motility, viability, morphology and number of spermatozoa in the cauda epididymidis, serum level of testosterone and on fertility. By 56 days of treatment withdrawal, however, the above parameters recovered to control levels. The results show that *C. longa* treatment causes reversible suppression of spermatogenesis and fertility, thereby suggesting the potential of this plant in the regulation of male fertility[27].

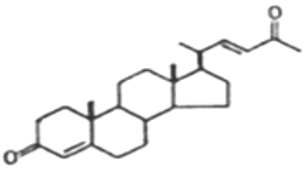
Abrus precatorius

The plant *Abrus precatorius* Linn, popularly known as Rosary pea belong to the family leguminosae (Fabaceae), is found throughout India in hedges and bushes in exposed areas[28]. Usually seeds are used against leucoderma, wounds, alopecia, asthma, tubercular glands, leprosy, fever, ulcer and tumor[29].

Precatorine, trigonelline, choline and abrine are present in the seeds. Abricin and abridin, two steroids were also reported in the seeds; the latter exhibited anti-fertility property[30].



Abricin



Abridin

The contraceptive and toxicologic effects were observed with administration of methanolic extract (70%) of the seeds of *A. precatorius* (L.) (Fabaceae) (20 and 40 mg/kg b.wt./day) for 45 days. Treatment caused a significant decrease in caudal sperm motility, count and viability. There was a complete suppression of fertility at 40 mg/kg dose level. The decrease in weights of testis and cauda epididymis of mice at 40mg/kg level could be attributed to a loss of spermatogenic elements in testis and absence of sperms in cauda epididymis[31].

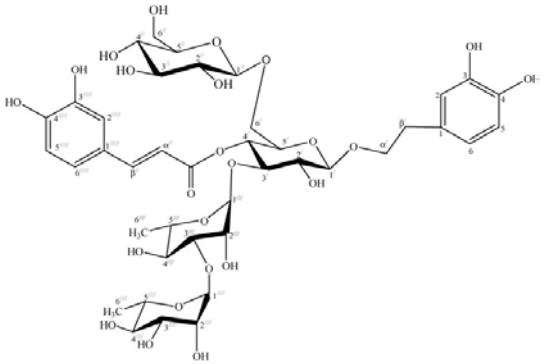
The inhibitory effects of a methanolic extract of *A. precatorius* seeds (5 and 20 mg/ml) on the motility of washed human spermatozoa was noticed. The extract caused a concentration-related impairment of percentage sperm motility. With the highest concentration tested (20 mg/ml), the onset of the antimotility action was almost immediate. In addition, this concentration impaired the functional integrity of the plasma membrane (hypoosmotic swelling test) and viability (nigrosin-eosin stain) of spermatozoa. In contrast, with a lower concentration (5.0 mg/ml), such effects were not evident. It is concluded that at the lower concentrations the antimotility action may result from a rise in intracellular calcium (not via influx) and/or a decline in cAMP content and/or enhanced generation of a reactive oxygen species[32].

The ethanolic extract of *A. precatorius* seeds intraperitoneally administered with 20, 40 and 60 mg/kg doses for 20 days showed disrupted arrangement of seminiferous tubules, loosening of germinal epithelium and low counts of leydig cells, germ cells and sperm cells. Histomorphology of the epididymus showed a decrease in tubule size, epithelial height and a reduction in sperm number in the tubular lumen. Plasma testosterone levels decreased significantly with a higher dose (60 mg/kg) compared to controls. This suggests that *A. precatorius* seed extract with higher dose (60 mg/kg) tends to suppress spermatogenesis and is hence liable to cause infertility in male mice[33].

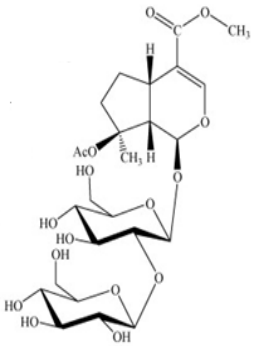
Barleria prionitis

Barleria prionitis L. (Family Acanthaceae) is commonly known as Vajradanti. In indigenous system of medicine in India, the aerial parts (stem, leave & flower) are used in fever, toothache, inflammation, as diuretic and gastrointestinal disorders; bark in whooping cough as an expectorant; the whole plant and especially the roots are used as tonic[34]. Leaves, stem and root of *B. prionitis* possess antibacterial and anti-inflammatory activities.

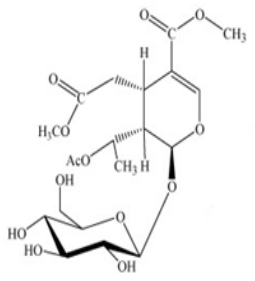
From the aerial parts of *B. prionitis*, one new phenylethanoid glycoside, barlerinoside along with six known iridoid glycosides, namely, shanzhiside methyl ester, 6-O-trans-p-coumaroyl-8-O-acetylshanzhiside methyl ester, barlerin, acetylbarlerin, 7-methoxydiderroside, and lupulinoside were isolated[35].



Barlerinoside



Lupulinoside



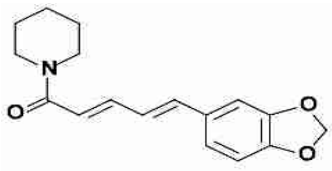
7-methoxydiderroside

Male rats treated with isolated fractions of the *B. prionitis* root methanolic extract (100 mg/kg for 60 days) showed a significant reduction on spermatogenesis without affecting general body metabolism. Sperm motility as well density in cauda epididymides was reduced significantly. The population of various spermatogenic cells such as primary spermatocytes, secondary spermatocytes and round spermatids were declined significantly in treated animals[36].

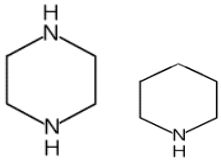
Oral administration of root extract of *B. prionitis* L. to male rats (100 mg/rat per day) for the period of 60 days did not cause body weight loss. The root extract brought about an interference with spermatogenesis. The round spermatids were decreased by 73.6% (P< or =0.001). The extract reduced the fertility of male rats by 100%. Cross sectional surface area of Sertoli cells and mature Leydig cell numbers were significantly reduced (36.9%). Testicular glycogen contents were low. Antifertility effects of Barleria seemed to be mediated by disturbances in testicular somatic cells functions (Leydig and Sertoli cells) resulting in the physio-morphological events of spermatogenesis [37].

Piper nigrum

Piper nigrum L. commonly known as black pepper belongs to family Piperaceae. The fruits of *P. nigrum* are not only important as a spice or flavoring agent, but have also been prescribed for cholera, dyspepsia, diarrhea, various gastric ailments, and paralytic and arthritic disorders[38]. It mainly contains amide alkaloids, and piperine is the major active component[39,40].



Piperine



Piperazine Piperidine

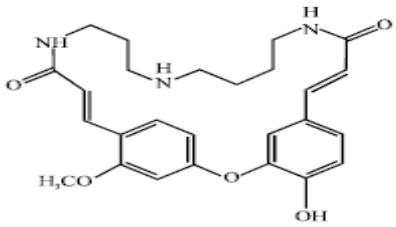
Oral administration of fruit powder of *P. nigrum* (25 and 100 mg/kg body weight/day for 20 and 90 days) to male mice of the Parkes (P) strain adversely affects sperm parameters and also caused marked alterations in male reproductive organs[41].

Piperine (1-piperoylpiperidine) is an alkaloid present in the fruits of black pepper (*Piper nigrum*), long pepper (*Piper longum*) and other piper species. Piperine is the major pungent substance present in these plants and is commonly used as a spice all over the world for seasoning and flavoring food. The weights of the caput, corpus and cauda regions of the epididymis significantly decreased at dose of 100 mg/kg. Epididymal sperm count and motility decreased at 10 mg/kg and 100 mg/kg, and sperm viability decreased significantly at 100 mg/kg. Piperine could damage the epididymal environment and sperm function[42].

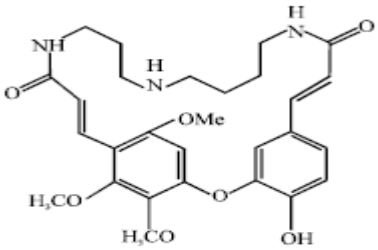
Capparis aphylla

Capparis aphylla (syn: *C. decidua*), family Capparidaceae, is commonly known as desert broom (Eng.); Swartstrom, Babejaanarm (Afr.); Sengam, Kuzhalaathondai (Tamil)[43]. The plants were used in several medicines such as anthelmenties, muscular injury, swelling, jaundice, appetizer, cardiac diseases, pyorrhea, cholera, dysentery, rheumatism, constipation, stomach disorder and skin diseases[44].

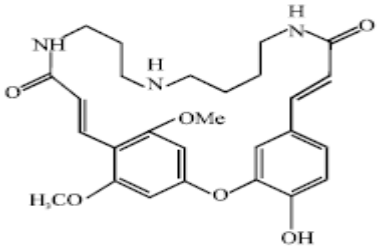
It contains capparin, capparilin, capparinin, caparidisine, capparisine, capparisinine, sitosterole, i-stachydrin, n-pentocosane and n-triacontanol[45,46].



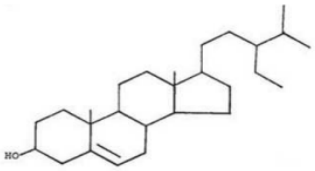
Capparisine



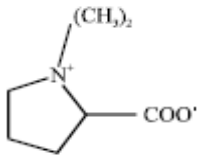
Capparidisine



Capparisinine



Sitosterole



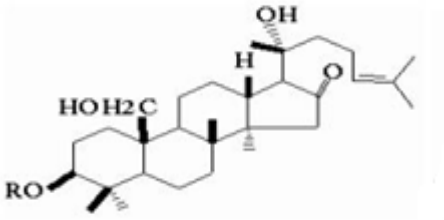
Stachydrine

Ethanol extract of *C. aphylla* was evaluated for possible spermatotoxic effect in 90 days old male rat. The ethanol extract of *C. aphylla* at the doses of 50, 100 and 200 mg/kg of body weight when administered intra peritonially for 55 days revealed spermatotoxic effect in 90 days old male rat. The fertility of the treated rats was reduced drastically. The sperm concentration in the epididymis and sperm motility decreased, whereas sperm abnormalities increased in particular sperm abnormalities like flexed head, detached head and coiling of end tail. Thus *C. aphylla* treatment resulted in impairment of male fertility in the rat by affecting both spermatogenesis and cauda epididymal spermatozoa[47].

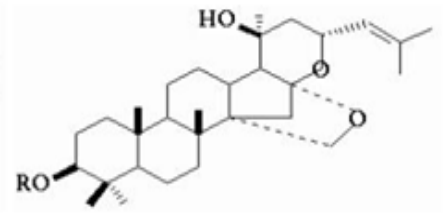
Bacopa monnieri

Bacopa monnieri L. (Family Scrophulariaceae) commonly known as Brahmi has been used in the Ayurvedic system of medicine for centuries[48].

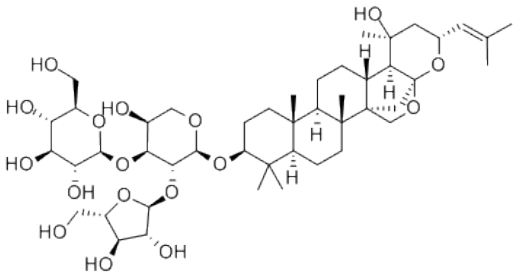
Main chemical components are saponins, bacosides, bacopasides, monnierin, brahmine, nicotine, herpestine and hersaponin[49,50].



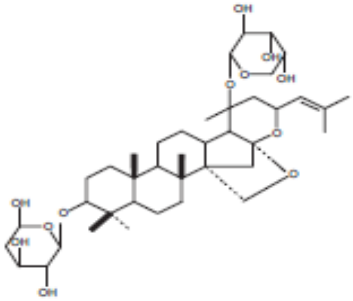
Bacoside A



Bacoside A1



Bacopaside



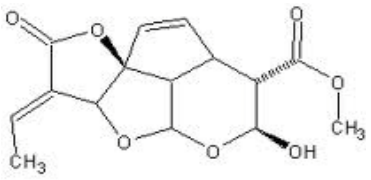
Bacosaponin

Oral administration of Brahmi (250 mg/kg body weight/day, for 28 and 56 days) to male mice of the Parkes (P) strain caused reduction in motility, viability, morphology, and number of spermatozoa in cauda epididymidis. Histologically, testes in mice treated with the plant extract showed alterations in the seminiferous tubules. These results thus suggest that Brahmi treatment causes suppression of spermatogenesis and fertility, without producing apparent toxic effects[51].

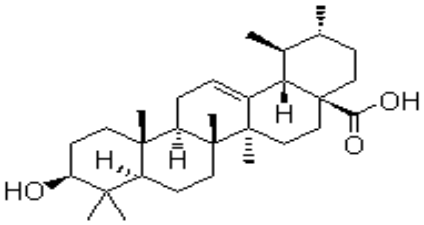
Allamanda cathartica

Allamanda cathartica Linn. (Apocyanaceae) is widely growing perennial shrub. The leaves are smooth and thick[52]. The roots are used against jaundice, complications with malaria and enlarged spleen in traditional medicine. The flowers act as a laxative. Moreover, yellow Allamanda has also antibiotic action against Staphylococcus[53].

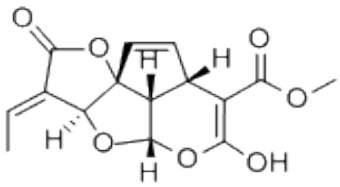
All parts of the plant contain allamandin, a toxic iridoid lactone. Leaves and stems yield ursolic acid, β-amyrin and β-sitosterol. Plumericin and isoplumericin are extracted from stem and root-bark, also from leaves and roots, besides plumieride and long chain esters[54].



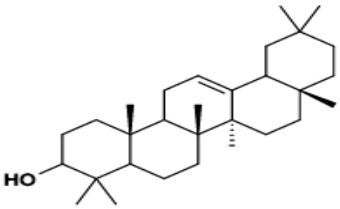
Allamandin



Ursolic acid



Plumericin



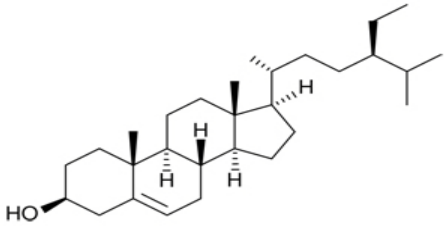
β-amyrin

The oral administration of aqueous leaf extract of *A. cathartica* (150 mg/kg body weight/day for 14, 28 and 42 days) induces infertility and changes in various male reproductive endpoints in Parkes strain mice. Histologically, testes in extract-treated mice showed nonuniform degenerative changes in the seminiferous. The treatment also had adverse effects on motility, viability, morphology and on number of spermatozoa in the cauda epididymidis. Fertility of the extract-treated males was also suppressed[55].

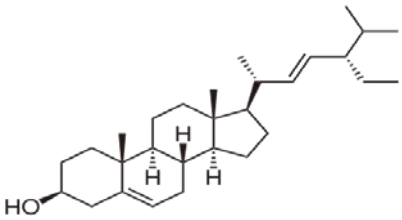
Dendrophthoe falcate

Dendrophthoe falcate (L.f.) Ettingsh. (known as mistletoe) is a perennial, climbing woody parasitic plant of the family Loranthaceae. In India, it is widely distributed and is commonly known as 'bandaa' and 'bandhulu'[56]. It is used ethnomedicinally for treating ulcers, asthma, impotence, paralysis, skin diseases, and wounds[57].

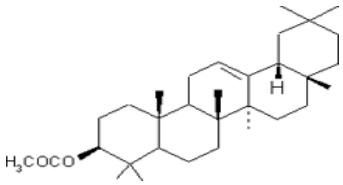
Leaves contain flavonoids such as Quercetin, quercetrin;Tannins comprising of gallic and chebulinic acid. Young shoots contain nearly 10 percent tannins and the stem contains β-amyrin-0-acetate, oleonolic acid its methyl ester acetate, β-sitosterol and stigmasterol. Root contains Catechin and leucocynidin in the bark[58].



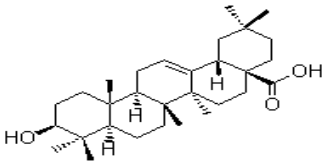
β -Sitosterol



Stigmasterol



β-amyrin-0-acetate



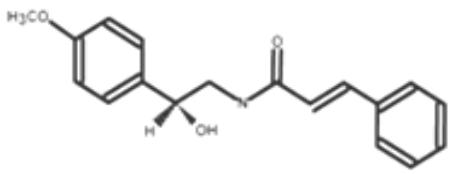
Oleonolic acid

An oral administration of 70% methanolic extract of stem of *D. falcata* at a dose level of 100 mg/kg wt/day fed to male albino rats for 60 days did not decrease body weight, while the testes and epididymides weight were significantly reduced, and the seminal vesicles and ventral prostate also showed a significant reduction ($P < 0.01$). Treated animals showed a notable depression of spermatogenesis. The reduced sperm count and motility resulted in 100% negative fertility at 100 mg/kg dose level[59].

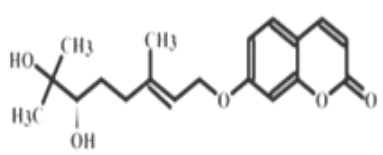
Aegle marmelos

Aegle marmelos (Linn), family Rutacae, commonly known as Bael, is a sacred tree for Hindu Religon[60]. Alcoholic extracts of the roots and fruits showed hypoglycemic and antidiabetic activity[61, 62]. With respect to clinical applications, it should be noted that the roots are astringent, bitter and febrifuge. They are useful in diarrhea, dysentery, dyspepsia and stomachalgia[63].

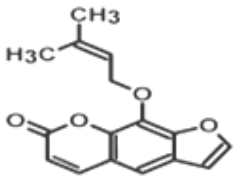
Several chemical constituents have been isolated and from various parts of the bael tree. These include alkaloids, coumarins and steroids. The leaves contain skimianinc, sterol and aegelin. The active constituent of the fruit is marmolosin, which is identical to imperatorin. Odler coumarins contained in the fruits are altoimperatorin and B-sitosterol. Roots of the tree have been found to contain psoralin, xanthotoxin, scopoletin and tembamide[64].



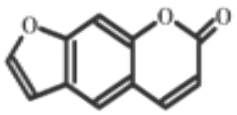
Aegelin



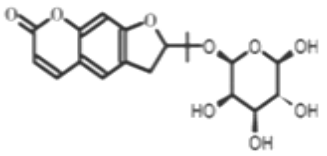
Marmin



Marmelosin



Psoralen



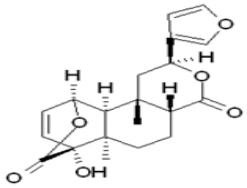
Marmesin

50 % ethanolic extract from the leaves of *A. marmelos* (AMLEt) (100, 200 and 300 mg(-1) kg (-1) day(-1) for each rat for 60 days) caused a reduction in weight of all the major accessory sex organs. There was a marked decline in motility and density of the sperm derived from cauda epididymis of the treated animals. *A. marmelos* reduced fertility of male rats by 100% at the 300-mg dose level. Serum testosterone levels also decreased significantly. Thus, the leaf extract of *A. marmelos* (AMLEt) suppresses fertility in male rats[65]. A dose related reduction in the testicular sperm count, epididymal sperm count and motility and abnormal sperm count was observed when the animals were administered the aqueous leaf extract (250mg/kg body wt., and 350mg/kg body wt.)[66].

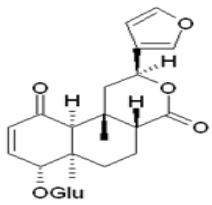
Tinospora cordifolia

Tinospora cordifolia (Willd.) belongs to the Menispermaceae family and known as Gulancha in English, Guduchi in Sanskrit, and Giloya in Hindi[67]. It is reported to possess anti-spasmodic, antiinflammatory, anti-allergic, anti-diabetic, antioxidant properties[68].

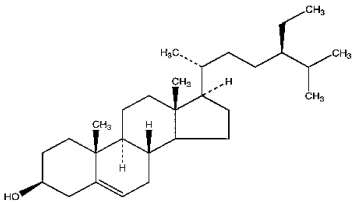
The chemical constituents reported from this shrub belong to different classes, such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides. Tinosporin, β-sitosterol, cordifol, columbin, chasmanthin, tinosporid, tinosporasid, cordifolid and palmarin are the main[69, 70].



Columbin



Tinosporid



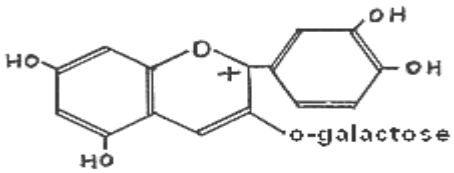
β –sitosterol

Oral administration of 70% methanolic extract of *T. cordifolia* stem to male rats at the dose level of 100 mg/rat/day for 60 days did not cause body weight loss but decreased the weight of testes, epididymis, seminal vesicle and ventral prostate in a significant manner. Sperm motility as well as sperm density were reduced significantly which resulted in reduction of male fertility by 100%. The stem extract brought about an interference with spermatogenesis. These results suggested antifertility effects of the stem extract of *T. cordifolia* in male rats[71].

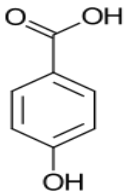
Martynia annua

Martynia annua L. (Family Martyniaccae), commonly known as scorpion (in Hindi, Bichchhu or Baghnukh), possess different medicinal properties. Fruit is used as anti-inflammatory. Leaves are antiseptic and are used in epilepsy. Roots used treatment of snake bite. Entire plant used to treat menstrual disorders. Dried entire plant has analgesic activity, anticonvulsant activity[72].

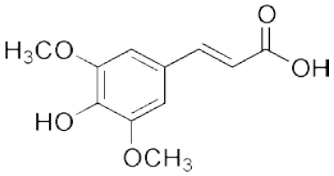
Chemical examination of *M. annua* plant revealed the presence of alkaloid, glycosides, tannin, carbohydrates[73], phenols, flavonoids, lcucanthocyanins[74]. Flowers contain cyanidin-3-galactoside[75] whilst p-hydroxy benzoic acid and snapic acid, and gentisic acid, respectively, are present in leaves and fruits, in addition to the p - hydroxy benzoic acid[76].



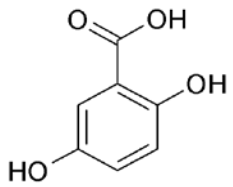
Cyanidin-3-galactoside



p-hydroxy benzoic acid



Snapic acid



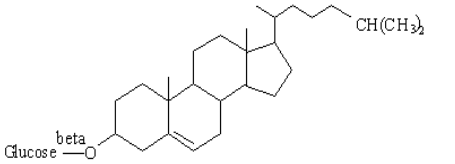
Gentisic acid

The 50% ethanol extract of *M. annua* L. root at dose level of 50 mg, 100 mg and 200 mg/kg body weight daily for a period of 60 days showed adverse effect on reproduction of male rats. Significant decrease in the weights of testes, epididymides, seminal vesicle and ventral prostate was noticed. There was a dose related reduction in the testicular sperm count, epididymal sperm count and motility. Significant reduction in serum concentration of luteinising hormone and testosterone was also observed. It is concluded that the 50% ethanol extract of *M. annua* root have dose related effects on male reproduction without altering general body metabolism[77].

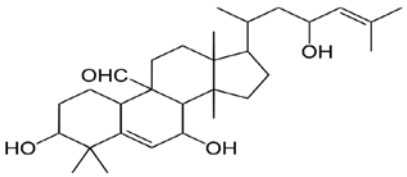
Momordica charantia

Momordica charantia Linn, belonging to the family of Cucurbitaceae, is an indigenous medicinal and vegetable plant found in the tropical and subtropical regions of the world and is commonly known as bitter gourd or bitter melon. *M. charantia* is one of the most promising plants for diabetes today[78-80].

Bitter melon has some interesting biological and pharmacological activities, e.g. anticancer, antiviral, antibacterial, analgesic, anti-inflammatory, hypotensive, anti-fertility, hepatotoxicity and antioxidant[81-83]. Fruit contains Momordicin, charantin, polypeptide-p insulin and ascorbigen[84].



Charantin



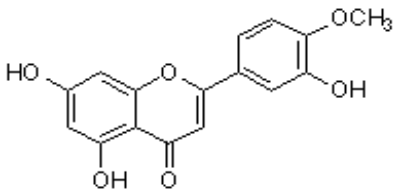
Momordicin

Petroleum ether, benzene and alcohol extracts of the seeds of *M. charantia* tested in rats at the dose level of 25 mg/100 g body weight for 35 days showed antispermatogenic activity as the number of spermatocytes, spermatids and spermatozoa was decreased. Increase in cholesterol level and Sudanophilic lipid accumulation indicates inhibition in the steroidogenesis. Out of the three extracts, the alcohol extract was more potent in its antispermatogenic, antisteroidogenic and androgenic activities[85].

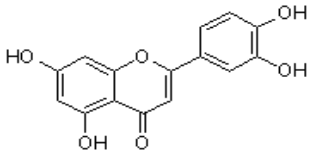
Rosmarinus officinalis

Rosmarinus officinalis L. (Labiatae) is an edible evergreen shrub native to the Mediterranean area. The leaves of the plant are commonly used as a spice and as a source of antioxidant compounds employed in food conservation[86-89].

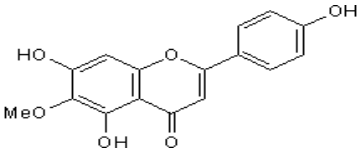
Phytochemical studies revealed the presence of several compounds in *R. officinalis* including phenolic diterpenes, diterpenoid quinines, flavonoids and essential oils[90]. Flavonoids have been shown to produce antiandrogenic activity and affect fertility in male dogs. Flavonoids include diosmetin, diosmin, genkwanin and derivatives, luteolin and derivatives, hispidulin, neptin, nepitrin and apigenin [91].



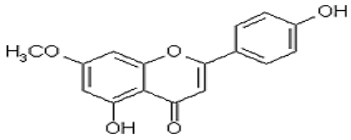
Diosmetin



Luteolin



Hispidulin



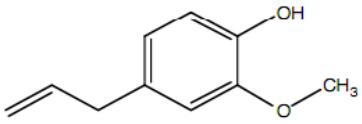
Genkwanin

Ingestion of rosemary (*R. officinalis* L.) at levels of 250 and 500 mg/kg body wt for 63 days caused a significant decline in spermatogenesis in testes due to a decrease in the number of primary and secondary spermatocytes and spermatids is attributed to a significant decrease in testosterone. Sperm motility and density were also significantly decreased in the cauda epididymis and in the testes of rosemary-treated male rats[92].

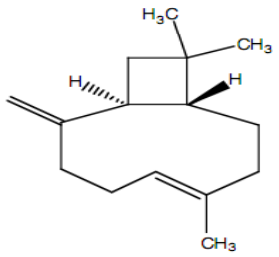
Syzygium aromaticum

Syzygium aromaticum L. commonly known as clove belongs to family Myrtaceae. It is used as a spice to add flavor to exotic food preparations[93].

Important constituents of clove oil include eugenol, beta-caryophyllene and vanillin; crategolic acid; tannins, gallotannic acid, methyl salicylate (painkiller); the flavonoids eugenin, kaempferol, rhamnetin, and eugenitin; triterpenoids like oleanolic acid, stigmasterol and campesterol; and several sesquiterpenes[94,95].



Eugenol



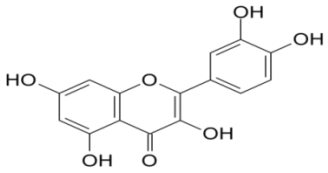
β-caryophyllene

The flower buds of *S. aromaticum* (clove), a common food flavor, have been used as indigenous medicine for the treatment of male sexual disorders in Asian countries. Oral exposure of hexane extract of flower buds of *S. aromaticum* in three doses (15mg, 30mg and 60mg/kg BW) for a single spermatogenic cycle (35 days) in Parkes (P) strain mice induced non-uniform degenerative changes in the seminiferous tubules associated with decrease in daily sperm production and depletion of round and elongated spermatids population[96].

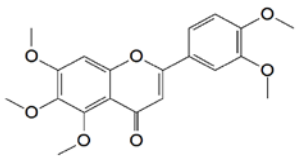
Chromolaena odoratum

Chromolaena odorata (Asteraceae) commonly known as Siam weed, is a fast-growing perennial and invasive weed. It has been reported to possess anti-inflammatory, antipyretic, antispasmodic activities[97-99].

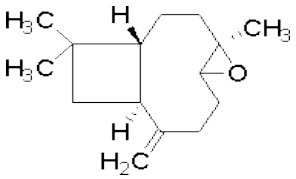
Terpenoids compounds were major components of *C. odorata* oil, such as trans-caryophyllene (16.58%), delta-cadinene (15.85%), alpha-copaene (11.58%), caryophyllene oxide (9.63%), germacrene-D (4.96%), and delta-humulene (4.32%). The leaves of this plant have be found to be a rich source of flavonoids which are quercetin, sinensetin, sakuranetin, padmatin, kaempferol, salvagenin[100,101].



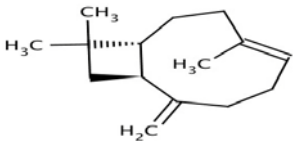
Quercetin



Sinensetin



Caryophyllene oxide



Trans-caryophyllene

Oral administration of aqueous extract of *C. odoratum* leaves (250 and 500 mg kg(-1) body weight) for 14 days in male albino rats revealed a significant reduction ($P < 0.05$) in testicular body weight ratio and histological examination revealed disruption in the arrangement of seminiferous tubules with no distinct basement membrane. These changes were accompanied by reduction in the number of spermatozoa. All these results indicated that aqueous extract of *C. odoratum* leaves possesses antiandrogenic property by interfering with steroidogenesis at the testicular level and this will adversely affect the functional capacity of the testes and the fertility of the animal[102].

CONCLUSION

Plants have been a source of medicine in the past centuries and today scientists and the general public recognize their value as a source of new or complimentary medicinal products. Recently, wide array of research investigations highlight the potential health beneficial principles from phytal sources. Medicinal plants constitute one of the main sources of new pharmaceuticals and health care products.

There has been an increase in demand for the phytopharmaceuticals all over the world because of the fact that the allopathic drugs have more side effects. This review makes an

attempt to compile some of antifertility plants from Ayurveda as well as from foreign origin so as to give scientific account on usuage of anti- fertility plants. Various phytoconstituents like alkaloids, flavonoids, tannins, xanthones, triterpenes, quinones etc. were involved in anti- fertility activity. Although a number of plants have been reported to possess cent percent antifertility activity but till date these plants have not yet come up at the level of clinical trials. Standardization of methods, quality control, data on safety and efficacy need for proper understanding of the use of herbal medicines.

Table 1: Summary of work done on indigenous antifertility plants on males

S. No.	Name of plant	Vernacular Name	Part used	Type of plant Extract	Dose	Duration	Animal model	Activities	References
1.	*Abrus precatorius*	Chirmi	Seed	Alcoholic extract	20 and 40 mg/kg	45 days	Rat	Antifertility effect	31
			Seed	Ethanolic extract	20, 40 and 60 mg/kg	20 days	Mice	Antifertility effect	33
2.	*Aegle marmelos*	Bael	Leaf	50% ethanolic extract	100, 200 and 300 mg/kg b. wt./day	60 days	Rat	Antifertility effect	65
			Leaf	50% ethanolic extract	200 and 300 mg/kg b.wt./day	60 days	Rat	Antifertility effect	103
			Leaf	Aqueous extract	250mg/kg body wt. and 350mg/kg b wt	45 days	Rat	Antifertility effect	66
3.	*Albizzia lebbeck*	Siris	Pods	Methanolic extract	50, 100 and 200 mg/kg/day	60 days	Rat	Antifertility effect	104
			Bark	Methanolic extract	100 mg/rat/day	60 days	Rat	Antispermatogenic and antiandrogenic activities	105
4.	*Allamanda cathartica*	Golden trumpet	Leaf	Aqueous extract	150 mg/kg b. wt./day	14, 28 and 42 days	Mice	Antifertility effect	55
5.	*Allium sativum*	Garlic	Bulb	Crude extract	5%, 10%, 15% and 30% crude garlic	30 days	Rat	Antispermatogenic and antiandrogenic activities	106
			Bulb	Aqueous extract	500 and 1000 mg/kg/d	28 days	Rat	Antispermatogenic Activity	107
6.	*Aloe Barbadensis*	Aloe Vera	Leaf	Aqueous extract	70 mg/kg and 100 mg/kg	56 days	Rat	Antifertility effect	108
7.	Amalakyadi churna			Ethanol extract	250 mg/kg and 400 mg/kg b. wt./day	30 days	Mice	Antifertility effect	109
8.	*Anethum graveolens*	Soya	Seeds	Aqueous extract	70 and 100 mg/kg	32 days	Rat	Antifertility effect	110
9	*Andrographis paniculata*	Kiryat	Leaves	Alcoholic extract	250 and 500 mg/kg b. wt.	30 and 60 days	Rat	Antifertility effect	111
10.	*Austroplenckia populnea*		Leaf	Hydro methanolic extract	500 mg/kg/day	70 days	Rat	Antifertility effect	112
11.	*Azadirachta indica*	Neem	Leaves	Dry powder	20, 40 and 60 mg/rat/day	24 days	Rat	Antispermatic activity	113
			Seeds	Aqueous extract	5mg/kg, 15mg/kg and 25mg/kg	6 days	Rat	Antifertility effect	114
			Leaves	Aqueous extract	100 mg/rat/day		Rat	Antispermatogenic and antiandrogenic properties	115
			Seeds	Alcoholic extract	100 mg/kg	15 days	Mice	Antifertility effect	116
			Leaves	Aqueous extract	50, 100, and 200 mg/kg b. wt./day	28 days	Mice	Antispermatic activity	117
			Leaves		5.0%, 10.0% and 15.0% neem leaf meal	16 weeks	Rabbits	Antispermatogenic effect	118
			Neem oil		0.6 and 1.2 mL of neem oil/animal	6 weeks	Rat	Structural changes	119

			Leaves	Aqueous extract	250 and 350 mg/kg body wt.	30 days	Rat	Spermicidal Activity	120
12.	*Bacopa monnieri*	Brahmi	Leaves	Dry powder	250 mg/kg body wt./day	28 and 56 days	Mice	Suppression of spermatogenesis and fertility	51
13.	*Barleria prionitis*	Vajradanti	Root	Methanolic extract	100 mg/kg	60 days	Rat	Antispermatogenic Activity	36
			Root	Alcoholic extract	100 mg/kg	60 days	Rat	Antifertility effect	37
14.	*Cannabis sativa*	Ganja	Root	Alcoholic extract	20 mg/day	20 consecutive days	Rat	Antispermatogenic activities	121
15.	*Capparis aphylla*	kair		Ethanolic extract	50, 100 and 200 mg/kg	55 days	Rat	Antispermatogenic Activity	47
16.	*Carica papaya*	Papaya	Seeds	Aqueous extract	50 and 100 mg/kg b.wt.	8 weeks	Rat	Antispermatogenic properties	122
			Seeds	Alcoholic extract	0.5 mg/kg	7 days	Rat	Affects cauda epididymis	123
			Seeds	Chloroform extract	50 mg/kg	360 days	Monkey	Antispermatogenic effect	124
			Seeds	Alcoholic extract	100, 200 and 300 mg/kg b.wt.	45 days	Mice	Spermicidal activity	125
			Seeds	Chloroform extract	10 mg/rat/day	150 days	Rat	Ultrastructural changes in the testis	126
			Leaves	Aqueous extract	500 mg/kg b.wt.	21 days	Rat	Antifertility effect	127
			Seeds	Alcoholic extract	50 and 200 mg/kg/day	1 and 8 weeks	Rat	Antifertility effect	128
			Seeds	Chloroform extract	20 and 50 mg/animal/day	150 days	Rabbit	Spermicidal activity	129
17.	*Chromolaena odoratum*		Leaves	Aqueous extract	250 and 500 mg/kg b.wt.	14 days	Rat	Antiandrogenic effects	104
18	*Citrullus colocynthis*	Tumba	Root	50% ethanolic extract	50, 100 and 200 mg/kg b.wt./day	60 days	Rat	Antispermatogenic effects	130
			Fruit	50% ethanolic extract	100 mg/kg/day	20, 40, and 60 days	Rat	Antispermatogenic and antiandrogenic activities	131
19.	*Colebrookia oppositifolia*	Binda	Leaves	Ethanolic extract	100 and 200 mg/kg	8-10 weeks	Rat	Depression of spermatogenesis	132
20.	*Crotalaria juncea*	Indian Hemp	Seeds	Petroleum ether, benzene and ethanol extracts	25 mg/kg	30 days	Mice	Antispermatogenic and antiandrogenic effects	133
21.	*Curcuma longa*	Haldi	Rhizome	Methanolic extract	500 mg/kg/day	60 days	Rat	Antifertility effect	26
			Rhizome	Aqueous extract	600 mg/kg b. wt./day	56 and 84 days	Mice	Antifertility effect	27
22.	*Dendrophthoe falcata*	Banda	Stem	70% methanolic extract	100 mg/kg wt/day	60 days	Rat	Depression of spermatogenesis	59
23.	*Fadogia agrestis*		Stem	Aqueous extract	18, 50 and 100 mg/kg b.wt.	28 days	Rat	Adverse effects on the male rat testicular function	134
24.	*Juniperus phoenica*	Phoenicean Juniper or Arâr	Cones	Ethanolic extract	intraperitoneal injections of 400 or 800 mg/kg	21 consecutive days	Rat	Antifertility activity	135
25	*Leptadenia hastata*		Leaves and stem	Aqueous extract	100, 200, 400 and 800 mg/kg b. wt./day	60 days	Rat	Antispermatogenic Activity	136
26	*Madhuca Indica*	Mahua	Leaves	Alcoholic extract	200 mg/kg b. wt./day	20 days	Rat	Antifertility effect	137
27.	*Martynia annua*	Bichchhu	Root	50% ethanol	50, 100 and 200 mg/kg b.	60 days	Rat	Antifertility effect	76

				extract	wt./day				
28.	*Mentha arvensis*	Pudhina	Leaf	Petroleum ether extract	10 and 20 mg/mouse/ day	20, 40 and 60 days	Mice	Antifertility property	138
29.	*Momordica charantia*	Karela	Seeds	Petroleum ether, benzene and alcohol extracts	25 mg/100 g body weight	35 days	Rat	Antispermatogenic and androgenic activities	84
30.	*Mondia whitei*	Whites Ginger	Root bark	Aqueous extract	400 mg/kg/day	55 days	Rat	Antispermatogenic and antifertility activities	139
				Hexane extract	500 and 1000 mg/kg b.wt.	30 days	Rat	Antifertility activities	140
31.	*Morinda lucida*	Indian mulberry	Leaf	Leaf extract	400 mg/(kg·d)	13 weeks	Rat	Antispermatogenic properties	141
32	*Mucuna Urens*		seed	Ethanol extract	70 mg/kg, 140 mg/kg, 210 mg/kg	14 days	Rat	antispermatogenic activity	142
33	*Ocimum sanctum*	Tulsi	leaves	Benzene extract	300 mg/kg b. wt.	Fourty eight hours after the injection the rats were sacrificed	Rat	Antifertility property	143
			Leaf	Aqueous crude extract	11, 22, 44 and 88 mg/kg	1, 2 and 4 weeks	Mice	Antifertility effects	144
			Fresh Leaves		2 g of fresh leaves per rabbit	30 days	Rabbit	Antifertility effects	145
			leaves	Benzene extract	250 mg/kg b. wt./day	48 days	Rat	Antispermatogenic and anti-androgenic property	12
34.	*Piper betle*	Pan	Leaf-stalk	Alcoholic extract	500 and 1000 mg/kg b. wt.	60 days	Mice	Antifertility effect	146
35.	*Piper nigrum*	Long pepper	Fruit	Dry powder	25 and 100 mg/kg	20 and 90 days	Mice	Antispermatogenic and antifertility activity	41
36.	*Quassia amara*	Surinam wood	Bark	Chloroform extracts	different dilutions	Single daily intramuscular injections of the extract for 15 days	Rat	Antifertility effect	147
37.	*Rosmarinus officinalis*	Rosemary	Fruit	Mehanolic extract	250 and 500 mg/kg b. wt.	63 days	Rat	Antispermatogenic Activity	94
38.	*Ruta graveolens*	Sadab	Leaf	Alcoholic extract	20 mg/day	20 consecutive days	Rat	Antispermatogenic activities	121
39.	*Sapindus emarginatus*	Ritha		Alcoholic extract	50 mg/day/rat	60 days	Rat	Antifertility activity	148
40.	*Sarcostemma acidum*	Somlata	Stem	70% methanolic extract	50 and 100 mg/kg/day	60 days	Rat	Arrest of spermatogenesis	149
41.	*Syzygium aromaticum*	Clove	Flower buds	Hexane extract	15mg, 30mg, and 60mg/kg b.wt.	35 days	Mice	Degenerative changes in the seminiferous tubules	98
42.	*Tecoma stans*	Piliya	Leaves	Ethanolic extract	500 mg/day/rat	60 days	Rat	Antispermatogenic properties	150
43	*Terminalia bellirica*	Harad	Fruit	Alcoholic extracts	50 mg/day/rat	60 days	Rat	Antifertility effect	149
			Bark	Benzene and ethanol extract	10mg and 25mg/100g body weight of benzene and ethanol extracts	50 days	Rat	Structural and functional alteration	151
44	*Thevetia peruviana*	Yellow Oleander	stem bark	Methanol extract	100 mg/rat/day	60 days	Rat	antispermatogenic activity	152

45.	*Tinospora cordifolia*	Neem giloy	Stem	70% methanolic extract	100 mg/rat/day	60 days	Rat	Antifertility effect	70
46	*Trachyspermum ammi*	Ajvain	Fruit	Ethanolic extract	100, 200 and 400mg/kg	60 days	Rat	Antifertility effect	153
47.	*Trigonella foenum-graecum*	Fenugreek (Methi)	Seeds	Dry powder	feeding diets containing 30% fenugreek seeds		Rabbit	Antifertility activity	154
48	*Zizyphus mauritiana*	Ber	Bark	Aqueous, methanolic and saponin extracts	0.1mg/ml and 0.5mg/ml		Human	spermicidal property	155

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