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Review Article

A review on medicinal plants exhibiting antifertility activity in males

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Abstract

Fertility control is an issue of global and national public health concern. Many studies have been done on the male contraception. The traditional use of medicinal plants to treat different sorts of diseases, including fertility related problems is widespread throughout the world as many plant substances are known for their interferences with the male reproductive system. The present review is an attempt to summarize the fertility regulatory plants with part used, type of extract/isolated compounds (active principles) along with animal model used. The literature covered is of 25 years i.e. from 1980 to 2005 for 105 plants showing antifertility activity in males.

Keywords: Antifertility activity, Spermatogenesis, Testes, Medicinal plants.

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Introduction

Rising human population through out the world more particularly in developing and underdeveloped parts has detrimental effects on the life supporting system on earth. The possibility of an effective check on human fertility may soon be realized through biological means. Fertility regulation comprising contraception and management of infertility forms an important component of reproductive health[1]. Though considerable progress has been made in the development of highly effective, acceptable and reversible methods of contraception among females, progress and possibilities on males are still slow and limited. With recent progress towards a better understanding of male reproductive physiology there is a need to develop new contraceptive modalities for male.

Several potential approaches for induction of infertility have been investigated over a long period including hormonal, chemical and immunological approaches.

The chemical compounds affecting testicular function include different groups like steroidal and non-steroidal among them are: Danazol, Depot medroxy progesterone acetate (DMPA), Cyproterone acetate (CPA), Levenogestral, Melatonin,α-Chlorohydrin, Metapiron and Serotonin. But application of all these compounds has been seriously questioned owing to various hazards as they were proved toxic or idiosyncratic on both the short as well as long term use in the reproductive organs[2].

Despite the availability of various contraceptive modalities, one of the most challenging pursuits in the realm of pharmaceutical and medical sciences is search for newer, more potent, additionally safe and less expensive method that require infrequent and self administration and should have long lasting but complete reversible antifertility effect.

Recently efforts are being made to explore the hidden wealth of medicinal plants for contraceptive use. With the exciting prospects of gene therapy, herbal medicine remains one of the common forms of therapy, available to much of world's population, to maintain health and to treat diseases.

There has been a steady accumulation of information regarding the screening of plants having antifertility efficacy[3-9]. The folklore information and the ancient literature about the plants and herbs can help the antifertility program. In the recent past a number of plants have been identified and evaluation of extracts and active principles from different parts of plants like seeds, roots, leaves, flowers, stem or stem barks have been done by various researchers. These reports have been exhaustively reviewed by Orzechowski[10], Brondegaard[11], Kholkute *et al*[12], Kamboj and Dhawan[13], Zhu[14] and Satyawati[15].

A literature survey for the period of 25 years (1980-2005) revealed that there are about 105 plants which possesss antifertility activity in males. They have been discussed in Table1 along with plant

part, type of extract, active principles and animal model used in the study.

The status of the more active plants is briefly described below.

***Gossypium herbaceum* Linn.**
(Family- Malvaceae, Levant Cotton)

Gossypol, a yellow phenolic compound isolated from cotton seed oil was proposed as a male contraceptive drug, after the Chinese clinical trials in 1970's. Hadley *et al*[16] found that gossypol treatment reduced the level of serum testosterone (T) and luetinizing hormone (LH) levels in a dose and duration dependent manner. Gossypol acts directly on testes and induces azoospermia or oligospermia[17-19]. Zavos and Zavos[20] demonstrated that gossypol blocked cAMP formation in sperm, which resulted into inhibition of sperm motility. Nair and Bhiwgade[21] have studied the effect of gossypol on pituitary gonadal axis and found the decreased secretary activity of accessory sex glands. Bai and Shi[22] also investigated inhibition of T-type Ca^{2+} currents in mouse spermatogenic cells by gossypol. Antifertility activities were also found in hamsters[23] and in rats[24-25].

Gossypium herbaceum

***Tripterygium wilfordii* Hook. f.**
(Family - Celastraceae)

A multiglycoside extracted from the root xylem long used in Chinese

Tripterygium wilfordii

traditional herbal medicine for treatment of psoriasis and other dermatological conditions were shown to have a reversible antifertility action in male rats in a Task-Force-supported study[26]. Its antifertility activity is well documented in rats[27], mice[28] and humans[29]. It caused degenerative changes in seminiferous-tubular epithelium and decrease in plasma testosterone[30]. Bai and Shi[31] also investigated inhibition of Ca^{2+} channels in mouse spermatogenic cell by GTW, which could be responsible for the antifertility activity of this compound. Triptolide, an active diterpene epoxide isolated from this plant has been reported to cause infertility in male rats. It's action is post-testicular and produced severe impairment in cauda epididymal sperm[32-33]. Tripchlorolide-a derivative of triptolide has significant effect on the fertility in male rats. The primary sites of action are spermatids and testicular as well as epididymal spermatozoa[34]. Tripchlorolide T_4 also inhibited hyaluronidase activities of testes and epididymis in rats[35].

***Carica papaya* Linn.**
(Family - Caricaceae)

Administration of chloroform extract of Papaya seeds showed suppression of cauda epididymal sperm motility and counts in rats and suggested that contraceptive effects are mainly post testicular in nature without influencing toxicological profile and libido of animals[36]. In langur monkey the extract induces long-term reversible azoospermia[37]. An oral dose of crude ripe paw seeds in male albino rats caused degeneration of the germinal epithelium and germ cells reduction in the number of Leydig cells and vacuoles in the tubules[38]. Pathak *et al*[39] reported the sterility in rats due to total suppression of sperm motility. Verma and Chinoy[40] concluded that the papaya seed extract alters cauda epididymal microenvironment. It was also evaluated that it reversibly reduced the contractile responses of cauda epididymal tubules, which possibly retards the sperm transport in cauda epididymis[41]. Manivannan *et al*[42] also observed ultrastructural changes in the testis and epididymis of rats following treatment with the benzene chromatographic fraction of the chloroform extract of the seeds.

***Andrographis paniculata* Wall. ex Nees** (Family - Acanthaceae)

It is manifested that extract of Creat plant (Hindi — *Kirayat*) showed antispermatogenic and antiandrogenic effect. Dry leaf powder when fed orally to rats (20 mg powder/day/rat) resulted in cessation of spermatogenesis, degeneration in seminiferous tubules and

Andrographis paniculata

regression of Leydig cells. Degeneration and reduction has also been seen in the accessory sex organs and its fluid content[43]. Andrographilode, one of the major contituents of this plant also showed antifertility effect. This compound, when administered in male rats affected spermatogenesis by preventing cytokinesis of the dividing spermatogenic cell lines. Sperm counts, motility seems to be decreased and sperm also possess abnormalities[44].

***Solanum surattense* Burm f.** syn. *S. xanthocarpum* Schrad. & Wendl.
(Family - Solanaceae)

Crude extract of Yellow berried nightshade (Hindi — *Kateli*) reported to possess spermicidal activity on rat epididymal spermatozoa. Solasodine, a steroidal alkaloid of ***S. surattense*** caused disruptive changes in the acrosomal membrane of sperm and arrest spermatozoal motility[45]. Mali *et al*[46], found that the root extract caused degenerative changes in seminiferous epithelium and spermatogenic elements in male rats. Oral administration of solasodine to intact dogs significantly decreased the epithelial cell height of the cauda epididymides. Concurrent treatment of solasodine along with testosterone propionate was unable to restore the normal epithelial lumen parameters[47].

Solanum surattense

***Embelia ribes* Burm. f.**
(Family - Myrsinaceae)

Berries of ***E. ribes*** have been reported to possess antifertility activity. It shows spermicidal activity in male bonnet monkeys- *(Macaca radiata)* as it adversely affects the sperm motility, the quantity and quality of semen, and lowered the hormonal level[48]. Embelin (2, 5-dihydroxy-3-undicyl-1, 4- benzoquinone) isolated from the berries altered the testicular histology and compound is suggested to possess antiandrogenic properties[49]. Gupta *et al*[50] observed that both *in vitro* and *in vivo* treatment caused profound morphological changes.

Embelia ribes

***Catharanthus roseus* G. Don** syn. *Vinca rosea* Linn.
(Family — Apocynaceae)

Antispermatogenic as well as antiandrogenic actions in male rats have been shown by leaf extract[58]. Vinblastin and Vincristine, the indole-indoline dimeric alkaloids isolated from ***C. roseus*** (Hindi — *Sadabahar*) affect spermatogenic cell lines other than spermatogonia[58-59]. Averal *et al*[60] reported the pathological changes in the principal and apical cells of caput and nuclear cells of cauda causing impairment of epididymal function supporting antiandrogenic properties of vincristine. However, side effects like nausea/vomiting, alopecia, hepatocellular damage, pulmonary fibrosis, etc., are also attributed to vincristine treatment[61-62].

Catharanthus roseus

***Abrus precatorius* Linn.**
(Family - Fabaceae)

It has long been claimed by Ayurvedic physicians in Sri Lanka that the powdered

Abrus precatorius

seeds of ***A. precatorius*** (Indian Liquorice) inhibit conception in humans when taken orally[63]. Degenerative changes were reflected in testes of rats, rabbits and presbytis monkey after administration of 50% ethanolic extract of seeds. Rao[64] reported that extract-receiving animal showed altered sperm morphology, reduced sperm motility and metabolism, which is correlated with its decreased fertility rate. Dose dependent reduction in testicular weight, sperm count and degeneration in later stages of spermatogenesis were found in the testis of rats treated with steroidal fraction of seeds[65]. Ratnasooriya *et al*[66] found that the seed extracts caused concentration related impairment of sperm motility with the EC_{50} concentration being 2.29 mg/ml. According to Sinha[67] it caused post-testicular antifertility effects and suppressed sperm motility in cauda epididymis.

***Azadirachta indica* A. Juss.**
(Family - Meliaceae)

Extract of neem leaves caused disturbance in structure and function of testis and spermatozoa in male rats[51]. Histological and biochemical changes in the caput and cauda of rats were studied by Kasturi *et al*[52], who also suggested its possible antiandrogenic property due to reduction in concentration of serum testosterone. Mass atrophy of spermatogenic elements in rats was also reported by Joshi *et al*[53]. Ethanolic extract of neem bark and flowers induced reversible infertility in male rats and spermatogenesis was arrested at late spermiogenesis stage (late XII)[54-55]. Morphological changes occurred in the head of the sperm and its acrosome, which is due to its androgen deficiency consequent upon its antiandrogenic property[56]. Spermicidal activity of leaf extract was observed by Khillare and Shrivastav[57]. According to them minimum effective concentration of aqueous extract of old leaves attains 100% immobilization and killing of sperm within 20 seconds.

Discussion and Conclusion

Pharmacological effects of many plants have been studied in various laboratories. However, there are many limitations regarding safety and efficacy of these preparations. Knowledge about active principles of herbal preparations is not well defined and information on toxicity and adverse effects of these formulations are lacking. Information regarding pharmacokinetics and bioavailability is not available. Assurance of safety, quality and efficacy of medicinal plants and herbal products are key issues, which needs to be addressed. Selection of plant material should be based on quality, standardization of methods of preparation, enforcement of regulation regarding appropriate labels are measures, which will improve the quality and acceptability of herbal preparation. Ecotype pharmacological evaluation is very essential when the drug is used in crude form. The relative proportion of phytochemical present in medicinal plants can vary in different ecotypes. There is also a need for documentation of research and publication of results in peer-reviewed journals. Most of the information on pharmacological study of plants are incomplete since they are published as abstract presented at conferences. Standardization of tests and methods of preparation and documentation of adverse effects of herbal medicines merits attention. Standardization of methods, quality control, data on safety and efficacy are needed for proper understanding of the use of the herbal medicines.

The development of better prophylactics requires new breakthroughs of theories about this process that could only be obtained from basic researches in reproductive biology and medicines.

Owing to the belief that post testicular agents have a more rapid antifertility effect and a correspondingly more rapid recovery than would agents that acts on spermatogenesis, a dual approach was pursued. Drugs with post meiotic or post testicular action would not disturb spermatogenesis, libido or any other hormonally related features. Their effects are rapid both in onset and in the return of normal sperm on withdrawal of the drug[68].

New targets for drug interventions should be pursued through support of basic sciences, taking advantage of modern cellular and molecular biological techniques. The relatively slow emergence of fertility control technologies for practical application clearly reflects the complexities of science and the requirement of multi-disciplinary research approach. Recent biotechnological, biochemical and immunological advances have overcome some of these difficulties and now make the production and use of contraceptive vaccines feasible. They can provide a valuable alternative to currently available methods of family planning. A vaccine that targets sperm represents a promising approach to contraception. Antisperm antibodies (ASA) in men and

women cause infertility, but the antigens that are recognized by ASA are not characterized.

Prostasomes (organelles secreted by human prostatic cells) are one of the major targets for ASA and that several antigens can cause antibody response associated with immunological infertility. Carlsons *et al*[69] suggested that prostasomes are available after a new set of antigens for research on male immunoinfertility and immunocontraception.

In conclusion the experimental studies summarized in this review may focus researchers' attention for clinical studies which would be of great scientific contribution to the society.

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Table 1: Summary of medicinal plants exhibiting antifertility activity in males (1980-2005)

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract / active principles	Animal models	Activities	Reference (s)
1.	***Abrus precatorius* Linn.**	*Chirmi*	Seed	50% Ethanol extract	Rat	Reduces sperm motility and density	70,71
				Steroidal fraction	,,	Antispermatogenic effect and reduced activity of testicular enzyme	65
				50% Ethanol extract	,,	Post-testicular antifertility effect	67
				Alcoholic extract	,,	Reduced sperm motility	64
				Methanol extract	,,	Sperm motility activity	66
				-	Langur Monkey	Antispermatogenic and antiandrogenic effect	72
2.	***Acacia concinna* DC.**	*Shikakai*	Stem bark	Acacic acid	Rat	Spermicidal and semen coagulating activities	13
3.	***Acacia auriculae-formis* A. Cunn.**	-	-	Triterpene, saponins	-	Sperm immobilizing effect	73
4.	***Acacia caesia* Wight & Arn.**	*Aila*	Fruit	Saponins	-	Immobilization of spermatozoa	74
5.	***Achillea millefolium* Linn.**	*Gandna Yarrow*	Flowers	Ethanol and hydro - alcoholic extract	Mice	Antispermatogenic effect	75
6.	***Achyranthes aspera* Linn.**	*Kadaladi*	Root	50% Ethanol extract	Rat	Spermicidal action	77
7.	***Actiniopteris dichotoma* Kuhn**	*Morepankhi* Peacock's Tail	Whole plant	50% Ethanol extract	Rat	Antifertility effect	76
8.	***Aegle marmelos* Corr. ex Roxb.**	*Bael*	-	-	Rat	Resist process of spermato-genesis and decrease sperm motility	78,79

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
9.	***Albizia lebbek* (Linn.) Benth.**	*Siris*	Pod Bark	Methanol extract Saponins	Rat ,,	Antifertility activity ,,	80 81
10.	***Albizia procera* (Roxb.) Benth.**	*Safed siris*	Seed and root	Proceric acid and leanic acid	Rat	Spermicidal and semen coagulating activities	13
11.	***Allium sativum* Linn.**	*Lahsun*	Pod	Dry powder	Rat	Antispermatogenic activity	82
12.	***Aloe barbadensis* Mill.**	*Gheekunwar*	Leaves	50% Ethanol extract	Dog	Antiandrogenic activity	83
13.	***Alstonia scholaris* R.Br.**	*Saptaparni*	Stem bark ,,	Methanol extract α- Amyrine	Rat Rat	Antifertility effect Suppression of fertility with marked decline in germ cell population	84 85
14.	***Anagallis arvensis* Linn.**	*Dhartidhak*	Whole plant	-	,,	Spermicidal and semen coagulating activities	13
15.	***Ananas comosus* Merr.**	Annanas	Unripe fruit	Alcoholic extract	Rat	Antispermatogenic activity	15
16.	***Andrographis paniculata* Wall. ex Nees**	*Kirayat*	Leaves ,,	Dry powder Andrographilode	Rat ,,	Antispermatogenic and antiandrogenic Effect on spermatozoa	43 44
17.	***Annona squamosa* Linn.**	*Sitaphal*	Seed	Alcoholic	-	Antispermatogenic activity	86
18.	***Aristolochia indica* Linn.**	*Hukka bel*	Root	Aristolochic acid	Presbytes langur	Antispermatogenic and antiandrogenic effects	87
19.	***Austroplenckia populnea* (Reiss.) Lundell.**	-	-	Hydro-methanol extract	Rat	Affects the sexual behaviour and epididymal sperm concentration	88
20.	***Azadirachta indica* A. Juss.**	Neem	Seed - - - - - ,, ,, ,, Leaves	Seed oil Neem oil ” ” ” ” Seed oil ,, Praneem cream Ethanol extract	Rat Mouse Rat ,, Monkey, Human Monkey ,, Rat ,, ,,	Antispermatogenic and antiandrogenic effect Antispermatogenic effects Post-testicular antifertility effects Antispermatogenic effect Spermicidal activity Induced azoospermia Antispermatogenic and antiandrogenic effect Spermicidal activities ,, Antispermatogenic activity	89 90 91 15 92 93 55 94 95 96

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
				Dry powder	,,	,,	51
			Seed	Neem oil	,,	Antispermatogenic activity	97
			,,	Dry powder	,,	Antispermatogenic activities and histological changes in testes and epididymides	52
			Leaves	Dry powder	,,	Degeneration of fertilizing ability of sperm	53
			,,	Aqueous suspension	,,	Antiandrogenic activity	56
			Bark and flower	50% Ethanol extract	,,	Antispermatogenic and antiandrogenic activity	54
			Bark and seed	50% Ethanol extract and seed oil	,,	Leydig cell dysfunction	98
			Leaves	Aqueous extract	,,	Spermicidal activity	57
21.	***Balanites roxburghii* Linn.**	*Hingan*	Fruit	Pulp extract	Dog	Antispermatogenic activity	99
			Fruit pulp	Ethanol extract	,,	Testicular necrosis and atrophy	100
22.	***Bambusa arundinacea* Willd.**	*Baans*	Shoots (tender)	Ethanol extract	Rat	Impaired the structural and functional activity of epididymis	101
			Stem	Stem extract	,,	Reduced sperm motility	102
23.	***Barleria prionitis* Linn.**	*Vajradanti*	Root	Methanol extract	,,	Antifertility effect	103
24.	***Berberis chitria* Buch.-Ham. ex Lindl.**	-	Root	Palmitine hydroxide	Dog	Antispermatogenic action	104
25.	***Bursera* sp.**	Mexican copal	Stem, Leaf	Saponins, Leaf extract	Human Bovine	Sperm aggregation	105
26.	***Butea monosperma* (Lam.) Kuntze**	*Palash*	Seeds	Butin	Rat, Dog and Monkey	Effects on testicular function	106
			Whole Plant	Water soluble ethanol extract	Rat	Antispermatogenic effect	107
27.	***Calotropis procera* (Ait.) R. Br.**	*Aak*	Root	Calotropin	Gerbil and Rabbit	Antispermatogenic effect and Leydig cell atrophy	108
			Flower	Aqueous ethanol extract	Mice	Functional alteration in the genital organs and inhibition of fertility	109
28.	***Cannabis sativa* Linn.**	*Ganja*	Leaves	Butin	Presbytis Monkey	Testicular lesions and atrophy of Leydig cells	110
29.	***Carica papaya* Linn.**	*Papita*	Fruit	Dry powder	Rat	Antispermatogenic activity	111
			Seed	Aqueous extract	Rat	Induced total sterility	112
			Seed Powder	-	Rabbit	Inhibit fertility	113

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract / active principles	Animal models	Activities	References (s)
			Seed	Aqueous extract	Rat	Reversible post testicular antifertility effects	114
			,,	Chloroform extract	Rat	Antifertility activity and reversible sterility	36
			,,	Aqueous extract	Rabbit	Contraceptive effect	115
			,,	”	Mouse	Antispermatogenic effects	116
			,,	Benzene chromatographic sub fraction of chloroform extract	Rabbit	Induced azoospermia and reversible regressive effect	117
			,,	”	,,	Induced azoospermia and oligospermia	118
				”	Human	Spermicidal activity	119
				Aqueous extract	Rabbit	No side effects	120
			,,	Chloroform extraction	Langur monkey	Induced azoospermia	37
			,,	-	Rat	Antifertility effect	38
			,,	-	,,	Induce sterility due to total suppression of sperm motility	39
			,,	-	,,	Alter cauda epididymal microenviroment	40
			,,	Benzene extract	Rabbit	Ultrastructural changes in the testis and epididymis	42
30.	***Catharanthus roseus* G. Don** syn. *Vinca rosea* Linn.	*Sadabahar*	Leaves	Extract	Rat	Antispermatogenic activity	229
			,,	,,	Mice	Antiandrogenic activity	58
			,,	Aqueous extract	Mice	Antispermatogenic activity	59
			Whole plant	Vincristin	Rat	Regression of entire reproductive system	230
			,,	,,	,,	Decrease in secretory activity of accessory sex gland	231
			,,	,,	,,	Epididymal dysfunction	60
			-	-	,,	Presence of multinucleated giant cells, spermatogenic arrest	232
31.	***Celastrus paniculatus* Willd.**	-	Seed	Seed extract	Rat	Antispermatogenic activity	121
32.	***Cichorium intybus* Linn.**	*Kasni*	Whole plant	Aqueous extract	-	Antispermatogenic activity	122
33.	***Cinnamomum camphora* Nees & Eberm.**	-	Seed	-	Sparrow	Arrest and inhibition of spermatogenesis	123

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
34.	***Citrullus colocynthis* Schrad.**	*Tumba*	Fruit	50% Ethanol extract	Rat	Impairment of sperm	124
			,,	,,	,,	Induced reversible antifertility effects	125
35.	***Colebrookia oppositifolia* Sm.**	-	Leaves	Ethanol extract	Rat	Antifertility activity	126
36.	***Convolvulus microphyllus* Sieb. ex Spreng.**	*Shankh pushpi*	Whole plant	Ethanol extract	Rat	Antispermatogenic effect	127
37.	***Crotalaria juncea* Linn.**		Seeds	Ethanol extract	Mice	Arrest of spermato-genesis and antiandrogenic activity	128
38.	***Cuminum cyminum* Linn.**	*Jeera*	Seed	Ethanol extract	Rat	Antispermatogenic effect	129
39.	***Curcuma longa* Linn.**	*Haldi*	Root	50% Ethanol extract	Rat	Interference with spermatogenesis at later stages and antiandrogenic effect	130
			-	-	Rat	Arrest of spermato genesis and antiandrogenic effect	131
40.	***Cyclamen persicum* Mill.**		Whole plant	Saponins	-	Spermicidal activity	132
41.	***Cynomorum coccineum* Linn.**	-	-	Aqueous extract	Rat	Effect on epididymal sperm pattern	133
42.	***Daucus carota* Linn.**		Seed	-	Rat		134
43.	***Desmodium gangeticum* DC.**	*Chapot*	Whole plant	Gangenticum	Rat	Antifertility effect	135
44.	***Diploclisia echinatus* Linn.**		Stem	Ecdysterone	-	Spermicidal activity	136
45.	***Ecballium elaterium* A. Rich.**			Contrasperm	Rabbit	Decreases sperm motility	137
46.	***Echeveria gibbiflora* DC.**		Whole plant	Aqueous crude extract	Guinea pig	Reduced sperm motility	138
47.	***Echinops echinatus* Roxb.**	*Oontkatalo*	Root	50% Ethanol extract	Rat	Sperm antimotility. Reduces sperm density in cauda epididymis	139, 140
48.	***Embelia ribes* Burm. f.**	*Vidang*	Berry	Embelin	Rat	Reduced testosterone level	141
						Antifertility activity	142
						Antispermatogenic and antiandrogenic activity	49
						Spermicidal activity	50
						Antifertility activity	143

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
49.	***Epilobium angustifolium* Linn.**	*Rosbay*	-	Hexane/Aqueous extract	Rat	Reduction in weight of accessory sex organs	144
50.	***Eupatorium brevipes* DC.**	-	-	Brevipenin	-	Spermicidal activity	146
51.	***Euphorbia neriifolia* Linn.**	*Thuar*	Root	50% Ethanol extract	Rat	Antispermatogenic effects	147
52.	***Foeniculum vulgare* Mill.**	*Saunf*	Whole plant	Alcoholic extract	Rat	Antiandrogenic activity	148
53.	***Gloriosa superba* Linn.**	*Shakar pusphi*	Tuber	Ethanol extract	Gerbil	Shrinkage of Seminiferous tubules and Leydig cells	149
54.	***Gossypium herbaceum* Linn.**	Cotton	Seed	Gossypol	Mice	Reduced sperm density and weight of reproductive organs	150
			,,	,,	,,	Spermicidal activity	151
			,,	,,	Rat	Reduced motility of spermatozoa, histological changes in epididymis	152
			-	,,	Human	Antispermatogenic effect, muscular paralysis	153
			,,	,,	Mice	Reduction in sperm production	154
			,,	,,	Rat	Antispermatogenic activity	155
			,,	,,	Hamster	Arrest and inhibition of spermatogenesis	156
			,,	,,	Human	Reduce sperm motility	157
			,,	,,	Rat	Alteration in spermatozoa structure	158
			,,	,,	,,	Effect on pituitary reproductive axis and antispermatogenic effect	21
			-	,,	Langur monkey	Induce oligospermia, decrease sperm motility	159
			,,	,,	Rat	Adverse effect on epididymal function	160
			,,	,,	,,	Effect on secretory activity of accessory sex organs	161
			,,	,,	Human	Antifertility effect	162
			-	,,	Human	Reduce sperm motility	163
			,,	,,	Hamster	Inhibition of sperm acrosomal enzyme, decresed fertilizing capacity	23
			,,	,,	Mouse	Antifertility effect	22

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
55.	***Hedera nepalensis* K. Koch**	-	Inflorescence	-	-	Immobilization of spermatozoa	164
56.	***Hibiscus rosa-sinensis* Linn.**	*Gudhal*	Flower	50% Ethanol extract	Rat	Antispermatogenic and antiandrogenic activity	165
			,,	Benzene extract	Nonscrotal bat	Antispermatogenic activity	166
			,,	Benzene/Ether	Mice	Antispermatogenic/ antiandrogenic activity	167
57.	***Hyptis suaveolens* Poit.**	*Wilayati tulsi*	Whole plant	Benzene /Ether extract	Mice	Antifertility effect	168
58.	***Justicia simplex* D. Don**	*Kala adoosa*	Flower	Justicisa saponin	-	Sperm acrosomal membrane stabilizing action	169
59.	***Lepidium meyenii* Walp.**	*Maca*	Root	Aqueous extract	Rat	Invigorates spermato-genesis by acting on its initial stages (IX-XIV)	170
60.	***Malvaviscus conzattii* Greenm.**	Gercenum	Flower	Methanol extract	Mice	Antifertility activity	171
			,,	Alcoholic extract	Mouse	Antispermatogenic and antiandrogenic effect	172
			,,	50% Ethanol extract	Rat	Antispermatogenic activity	173
61.	***Martynia annua* Linn.**	*Bichchhu*	Root	50% Ethanol extract	Rat	Antispermatogenic activity	174
62.	***Melodinus fusiformis* Champ. ex Benth.**	-	-	Solasodine (Plant steroidal alkaloid)	-	Spermicidal activity	175
63.	***Mentha arvensis* Linn.**	*Pudhina*	Leaves	Aqueous extract	Mouse	Sex organs secretion decreased, antiandrogenic effect	176
			,,	Pet. Ether extract	Mice	Antifertility activity	177
			,,	Methanol extract	,,	,,	178
64.	***Millettia auriculata* Baker. ex Brand.**	*Ganj*	Leaves	Alcoholic extract	Rat	Reduction in implantation sites in female mated with *Milettia* treated male rats	98
65.	***Momordica charantia* Linn.**	*Karela*	Seeds	-	Rat	Antispermatogenic, antiandrogenic and antisteroidogenic activity	179
66.	***Mondia whiteii* Skeels**	-	Root bark	-	Rat	Reversible antispermato-genic and antifertility activity	180
67.	***Mucuna urens* Medik.**	Horse eye bean	Seeds	-	Guinea pigs	Effect gonads and sex accessory glands	181

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
68.	***Myristica fragrans* Houtt.**	*Jaiphal*	Seed	Ethanol extract	-	Premature ejaculation	182
69.	***Nicotiana tabacum* Linn.**	Tobacco	Leaves	Nicotine	Rat	Antiandrogenic effects	183
70.	***Ochna jabotapita* Linn.**	*Kanakchampa*	Plant (without root)	Ethanol extract	-	Semen coagulating activity	184
71.	***Ocimum sanctum* Linn.**	*Tulsi*	Leaves	Powder	Rat	Arrest of spermatogenesis and atrophy of Leydig cells	185, 186
			Leaves	-	Rat	Reduction of sperm motility and sperm count	187
72.	***Ophiopogon intermedius* (D. Don) Maxim**	-	Rhizome	n-Octacosanal, β-sitosterol	-	Spermicidal activity	188
73.	***Opuntia dilleni* Haw.**	*Nagphana*	Phylloclade	Methanol extract	Rat	Antispermatogenic effect	189
74.	***Piper betle* Linn.**	Pan	Petiole	Ethanol extract	Rat	Reduced sperm motility	72
			,,	Water soluble ethanol extract	Rat	Biochemical changes in epididymal fluid	190
			Leaf stalk	Stalk extract	Rat	Antiandrogenic effect, altered testicular histology	191
			,,	Alcoholic extract	Mice	Antifertility activity	192
75.	***Piper longum* Linn.**	Long peeper	Flower and bud	Piperine	Rat	Antispermatogenic effect	193
76.	***Pittosporum neelgherrense* Wight & Arn.**	-	Plant (with out root)	Pittosida-A and pittosida-B	-	Spermicidal and semen coagulating activity	194
77.	***Plumbago zeylanica* Linn.**	*Chitrak*	Root, Stem bark	Plumbagin	Rat	Antiandrogenic activity	196
78.	***Plumeria alba* Linn.**		Leaves	-	Rabbit	Total sterility	195
79.	***Polemonium caeruleum* Linn.**	-	-	-	Mouse	Antispermatogenic effect	15
80.	***Portulaca oleracea* Linn.**	*Lunkha*	Seed	Alcoholic extract	Mice	Impairment of spermatogenesis	197
81.	***Primula vulgaris* Huds.**	-	-	Saponins	-	Immobilization of spermatozoa	133
82.	***Pterocarpus santalinus* Linn. f.**	-	Stem bark	-	-	Semen coagulating activity	184
83.	***Pueraria tuberosa* DC.**	*Vidharikand*	Root	Methanol extract	Rat	Inhibition of spermatogenesis	198
84.	***Pyrus cuspidata* Bertol.**	*Naspati*	Plant (with out root)	Extract	-	Spermicidal and semen coagulating activity	13
85.	***Quassia amara* Linn.**	-	Stem wood	Methanol extract	Rat	Antifertility activity	199, 200
			Stem bark	Chloroform extract	,,	,,	201

S. No.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
86.	***Ricinus communis* Linn.**	-	-	50% Ethanol extract	Rat	Alteration in the motility, mode of movement and morphology of sperms	202
87.	***Rubus ellipticus* Sm.**	*Katsan*	Whole plant	-	-	Antifertility activity	203
88.	***Salvia fruticosa* Mill.**	*Satari*	Leaves	Aqueous/Ethanol extract	Rat	No. of implantation site and viable fetuses reduced in female in pregnant by treated male rats	204
89.	***Sapindus mukorossi* Gaertn.**	*Ritha*	Fruit Pericarp	Aqueous extract pericarp	Rat	Alters the sperm membrane physiology	206
90.	***Sapindus trifoliatus* Linn.**	*Ritha*	Fruit	Ethanol extract	Gerbils	Adverse effect on spermatogenesis	205
91.	***Sarcostemma acidum* Voigt**	*Somlata*	Stem	Methanol extract	Rat	Arrest of spermatogenesis	207
92.	***Semecarpus anacardium* Linn. f.**	*Bhilawa*	Seed powder	Aqueous suspension	Rat	Antiandrogenic effect, degeneration of germ cells	208
			Fruit	Ethanol extract	-	Antiandrogenic and antispermatogenic activity	209
			,,	,,	,,	Arrest of spermatogenesis	210
93.	***Solanum surattense* Burm. f.** syn. *S. xanthocarpum* Schrad. & Wendl.	*Kantkari*	Berries	Solasodine	Dog	Impairment of spermatogenesis	211, 45
			,,	,,	Rat	Reversible antifertility activity	212
			,,	,,	Dog	Epididymal dysfunction due to its antiandrogenic potency	47
			Seed	Alcoholic extract	Rat	Reduced testosterone level and effect on testes and maturing sperms	213
			Root	50% Ethanol extract	Rat	Antispermatogenic effect	46
94.	***Stephania hernandifolia* Willd.**	*Aknadi*	Leaf	Aqueous extract	Rat	Deminution of the activities of testicular androgenic key enzymes and plasma testosterone with spermatogenesis	215
95.	***Stevia rebaudiana* Bertoni**	-	Whole plant	Aqueous extract	Rat	Decrease in testosterone level	214
96.	***Striga orobanchoides* Benth.**	*Lalagia*	Whole plant	Ethanol extract	Rat	Antispermatogenic effect and reduced weight of sex organs	216

SNo.	Name of the plant	Common/English name	Part used	Type of plant extract/ active principles	Animal models	Activities	References (s)
97.	***Syzygium cuminii* Linn.** syn. *Eugenia jambolana* Lam.	*Jamun*	Seed	Alcoholic extract	-	Antispermatogenic effect	72
			Flower	Oleanolic acid	Rat	Antifertility effect	145
98.	***Terminalia arjuna* Wight & Arn.**	*Arjun*	Bark	50% Ethanol extract	Rat	Antispermatogenic effect	217
99.	***Tinospora cordifolia* (Willd.) Miers ex Hook. f. & Thoms.**	*Neem giloy*	Stem	70% methanol extract	Rat	Antifertility activity	218
100.	***Trigonella foenum-graecum* Linn.**	-	Seed	-	Rat	Antiandrogenic effect	219, 220
101.	***Tripterygium hypoglaucum* (Level) Hutch**	-	Root xylem	-	Human	Reversible regressive effect	221
102.	***Tripterygium wilfordii* Hook f.**	-	Root	Glycoside	Human and Rat	Antifertility activity	27
			,,	GTW	Rat	Reduced motility of spermatozoa and sperm count	222
			,,	Glycoside	Mice	Plasma level of testo-sterone decreased	28, 223
			,,	GTW	Rat	Degenerative changes in seminiferous tubules	30, 224
			,,	Tripchlorolide T4 Monomers and T II	Rat	Antispermatogenic activity	225
			,,	GTW	Mouse	Antifertility activity	31
			,,	,,	-	Immunosuppressive effect	226
			,,	Tripchlorolide	Rat	Antifertility activity	34
			,,	-	,,	No side effect	227
103.	***Tylophora asthmatica* Wight & Arn.**	*Damabel*	Leaf and Stem	Pure alkaloid	Rat	Antispermatogenic activity	228
104.	***Vigna ungiculata* (Linn.) Walp.**	Cowpea	-	-	Rat	Antifertility effect	233
105.	***Vitex negundo* Linn.**	-	Seed	Seed extract	Dog	Induced azoospermia	234

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