A REVIEW ON PLANTS/PLANTS PRODUCTS POSSESSING ANTIFERTILITY/CONTRACEPTIVE EFFICACY IN MALES

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Summary

The population explosion is one of the major problems of present era in the world. This rise in population in developing world is overwhelming and this intensified the need for the development of effective birth control measures. The synthetic agents available today for fertility control produce severe side effects such as hormonal imbalance, hypertension, and increased risk of cancer and weight gain. Thus there is a need to replace these agents by safe and effective agents such as plant based contraceptive agents. Many plants have been used as antifertility agents in traditional medicines without producing toxic effects e.g. neem, tulsi etc. Various medicinal plant extracts have been tested for their antifertility activity. Some of these plants have spermicidal effects, other caused reduction in sperm count and altered the motility of the sperms. Some of them caused testicular changes and altered hormone levels. The present review includes a brief account of research reports on plants with antifertility potential.

Key words: fertility control, contraceptive drugs, antifertility, hormone, medicinal plant, spermicidal.

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Introduction

Population explosion is a leading cause of poverty and pollution in developing countries. Several potential approaches for infertility have been investigated over a long period, including chemical, hormonal and immunological approaches. However, no suitable method has emerged that is effective and free from side effects. The World Health Organization (WHO) has constituted a population control programme, which includes studies having traditional medical practices. Medicinal plants products have a long history of indigenous use in India as well as other countries (1).

Fertility regulation comprising contraception and management of infertility forms an important component of reproductive health (2). Fertility regulation with plants or plant preparations has been reported in the ancient literature of indigenous systems of medicine.

A large number of plant species with anti-fertility effects have been screened in China and India

beginning about 50 years ago and were subsequently fortified by national and international agencies (3-6). 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 (7). However, the search for an orally active, safe and effective plant preparation or its compound is yet to be needed for fertility regulation due to incomplete inhibition of fertility or side effects.

A male contraceptive might help decrease the 13% of global disease burden attributable to maternal conditions such as hemorrhage, infection, or unsafe abortion among women aged 15-44 (8). Thus, the successful development of a male contraceptive will offer real alternatives to family planning and will contribute significantly to reducing these health and economic burdens worldwide. Based on animal studies and clinical results from treating hypogonadotropic hypogonadal men, a contraceptive agent that would functionally suppress either the formation or maturation of spermatozoa with a 90% efficacy would probably have little or no effect on fertility (9).

A list of plants having antifertility/contraceptive efficacy is given in Table-1 and some of them are discussed below.

Azadirachta indica (Family-Meliaceae; Common name-Neem)

The leaves of *Azadirachta indica* are deleterious to the fertilizing activity as administration of dry powder of leaves of *A. indica* at the dose level of 20 mg, 40mg and 60mg/rat/day results in a decrease in weight of seminal vesicle and a decrease in the sperm count (10). Histological and biochemical changes in the testis of rats treated with the leaf powder of *A. indica* were reported by Joshi et al. (11) suggested a possible reversible antiandrogenic property of the leaves of *A. indica* in male albino rats. Neem seed extract is reported as an anti-fertility agent as when given to male rats it indicated abnormality in spermatogenesis and sperms production in some of the seminiferous tubules (12). Ultrastructural changes like intracellular spaces and vacuolization in Sertoli cells and defects in the mitochondrial sheath of late spermatids were induced by leaves of

A. indica (Neem) in the testis of albino rats (13). Neem oil proved spermicidal against rhesus monkey and human spermatozoa in vitro. Antifertility effect of neem oil has also been studied and suggested to be a novel method of contraception (14).

The effective concentration of aqueous extract of old and tender *A. indica* (neem) leaves immobilize and kill 100% human spermatozoa within 20s (15). A dose of 200 mg/kg body weight caused adverse effects on motility, morphology, and number of spermatozoa in the cauda epididymidis (16). Kabeh and Jalingo (17) observed that the leaf extracts act as powerful spermicide and significantly inhibited spermatogenesis, decreased sperm motility, count and cessation of fertility.

In rabbits, the inclusion of neem leaf meal up to 15% in the ration of matured rabbit bucks could cause mild depressive effect on the spermatogenesis, semen quality and seminiferous tubule diameter (18). The mature male albino rat treated with low dose (0.6 mL of neem oil/animal) and high dose (1.2 mL of neem oil/animal) of neem oil revealed significant decrease in the seminiferous tubular diameter and number of spermatozoa (19). A dose related reduction in the testicular sperm count, epididymal sperm count and motility and abnormal sperm count were observed with aqueous leaf extract of *A. indica* (Neem) (20).

The fertility rate was significantly reduced in male rats with treatment of *A. indica* (neem) seed alcoholic extract. This reduction was observed due to the decrease in cauda epididymal sperm motility and their morphological abnormalities. Since the effect on epididymal sperm motility and morphology was manifested in short period of 15 days, it is evident that the extract has potential as an antifertility agent (21).

Carica papaya (Family-Caricaceae; Common name-Papaya)

Administration of aqueous extract of papaya seeds for 3 weeks showed that the lamina of seminiferous tubules were more prominent and empty with no spermatids or spermatozoa (22). The chloroform extract of seeds has shown contraceptive efficacy and reversibility in decreasing the sperm concentration in male adult rabbits. It produces gradual decline in the sperm concentration after 75 days treatment (oligospermia) and azoospermia after 120 days of treatment. It also affects the sperm motility and viability (23).

The benzene chromatographic fractions of chloroform extract of the seeds possess reversible male contraception potential and the effect appears to be mediated through the testis without adverse toxicity (24, 25). Its effect on cauda epididymal microenvironment was reported by Verma and Chinoy (26). It may selectively act on the developing germ cells, possibly mediated by sertoli cells, leading to azoospermia (27). Even aqueous extract of papaya bark has potential contraceptive activity (28). Another study revealed that the inhibition of sperm motility may be due to ultrastructural changes in epididymis (29).

The male rats treated with *Carica papaya* seed extract revealed gradual degeneration of germ, sertoli and Leydig cells as well as germinal epithilium which confirm its antifertility activity (30). The seeds also have toxic effects on spermatozoa (31). A recent report revealed that it has good contraceptive efficacy in langur monkeys and action is mediated through inhibition of sperm motility (32). The extract of *C. papaya* leaf exerts toxic effect on the seminiferous tubule epithelium with concomitant reduction in reproductive potentials of the male rat. *C. papaya* leaf should therefore be cautiously used in both man and animal (33).

***Albizzia lebbeck* (L.) Benth** (Family-Mimosaceae; Common name-Siris tree)

The methanolic extract of *Albizzia lebbeck* pods causes spermatogenic arrest in male albino rats. *A. lebbeck* pod extract brought about a significant decrease in the weights of testis, seminal vesicles, epdidymis and ventral prostate. The sperm motility and density were significantly reduced. There was a marked reduction in the numbers of primary spermatocytes, secondary spermatocytes and spermatids (34).

A. lebbeck bark extract administration arrests spermatogenesis in male rats without noticeable side effects. Methanolic extract of bark of *A. lebbeck* when administered orally at the dose level of 100mg/rat/day to male rats of proven fertility for 60 days did not cause any significant loss in their body weights but the weights of reproductive organs, i.e. testis, epididymides, seminal vesicle and ventral prostate were decreased in a significant manner when compared to controls. Sperm motility as well as sperm density were reduced significantly which resulted in reduction of male fertility by 100% (35).

Aegle Marmelos (Family-Rutaceae; Common name-Bael)

The ethanolic extract of *Aegle marmelos* leaf possesses anti spermatogenic activity (35). The aqueous of the leaf has antimotility action on spermatozoa (37). *A. marmelos* has effects on male rat reproduction, affecting the sexual behavior and epididymal sperm concentration. 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.) (38). Administration of *A. marmelos* caused a significant reduction in sperm motility of the cauda epididymis, and in sperm concentration/density of the testes and cauda epididymis. The fertility index of the males was inhibited by 70% (39).

50% ethanolic extract of *A. marmelos* leaves when fed orally to male albino rats at the dose levels of 200 and 300 mg/kg body wt./day for 60 days caused reduction in the motility and sperm concentration along with complete inhibition of fertility at a dose of 300 mg/kg. The antifertility effects of *A. marmelos* seemed to be mediated by disturbances in structure and function in testicular somatic cells including Leydig and Sertoli cells resulting in an alteration in physio-morphological events of spermatogenesis (40, 41).

Ocimum sanctum (Family-Lemiaceae; Common name-Holy Basil, Tulsi)

Ocimum sanctum which is in the same genus with *O. gratissimum* had been reported to have antifertility effects in male albino rats (42-44). *O. gratissimum* caused distortion/destruction of the architecture and structure of the testicular histology, characterized by edema, reduced spermatogenesis and maturation arrest of spermatozoa at different stages of germ cell development (45).

Aqueous crude extract of *O. gratissimum* has anti-fertility effect in the male mouse, which may be mediated through a direct deleterious action on the testis without disruption of the testicular endocrine function. It caused damage to the seminiferous epithelium, characterized by varying degrees of edema within the tubules and the interstitial cells and reduced spermatogenesis (maturation arrest) (46).

Terminalia bellirica (Family-Combretaceae; Common name-Bahera)

Antifertility effects of Terminalia species have been reported on mammals (47). When fruit extract of *Terminalia bellirica* (50 mg/day/rat) were fed orally to male albino rats for 60 days, the sperm motility of cauda epididymis and sperm count of cauda epididymis and testis declined significantly leading to negative fertility test (48, 49). A significant reduction in the weight of accessory reproductive organs were observed in the rats treated with 10 and 25mg dose level of benzene and ethanol extract *T. bellirica* barks. Structural and functional alteration in epididymis, vas deferens, prostate gland, seminal vesicle and reduction in sperm count and deformation in structure (50).

Allium sativum (Family-Alliaceae; Common name-Garlic, Lehsun)

The crude aqueous extract of *Allium sativum* bulb possesses spermicidal activity in vitro. The crude aqueous extract of the bulb of *A. sativum* L. showed the most promising results by instant immobilization of the ram epididymal sperm at 0.25 g/mL and human ejaculated sperm at 0.5 g/mL. Sperm immobilizing effects were irreversible and the factor of the extract responsible for immobilization was thermostable up to 90. More than 50 % reduction in sperm viability occurred in treated sperm, indicating the possibility of plasma membrane disintegration which was further supported by the significant reduction in the activity of membrane bound nucleotidase and acrosomal acrosin (51).

Crude garlic consumption during 1 month reduced testosterone secretion and altered spermatogenesis at 10%, 15% and 30% doses (52). On the testes, use of garlic has been noted to compromise some male reproductive functions, as it affects spermatogenesis and testosterone levels, which are vital to reproduction (53). Aqueous extract of garlic was administered orally at different doses (Group B: 500 mg/kg/d; Group C: 1000 mg/kg/d) to the wistar rats, the percentage of morphologically normal spermatozoa as well as sperm concentration was significantly reduced (54).

Juniperus phoenica (Family-Cupressaceae; Common name-Phoenician juniper)

Juniperus phoenica (L.) (Cupressaceae) is widely growing on the rocky soils of the Mediterranean regions. Animals administered with single daily intraperitoneal injections of 400 or 800 mg/kg of *J. phoenica* cones ethanol extract for 21 consecutive days show a marked dose-dependent decrease in the counts and motility of the sperms collected from the cauda epididymis of treated rats. Histologically, seminiferous tubules of treated rats showed marked arrests of spermatogenesis and a marked decrease in the number of mature sperms. Therefore, the ethanolic extract of the cones of *J. phoenica* possesses potential antifertility effects (55).

Citrullus colocynthis (Family-Cucurbitaceae; Common name-Bitter apple, Indrayan)

A 50% ethanol extract of *Citrullus colocynthis* showed an antiandrogenic nature, thereby reduced reversible infertility in male albino rats. The testes showed degenerative changes in the seminiferous epithelium, arrest of spermatogenesis at the secondary spermatocyte stage, cytolysis, and the lumen filled with eosinophilic material (56).

A crude 50% ethanol extract of *C. colocynthis* Schrad roots when administered orally to male albino rats at dose levels of 50, 100 and 200 mg/kg b.wt./day for a period of 60 days, a significant decreases in cauda epididymal sperm motility, density, number of pups and fertility were observed in all treatment groups (57).

Crotalaria juncea (Family-Fabaceae; Common name-Indian hemp, Kharif)

The various extracts of *C. juncea* seeds arrest spermatogenesis and are likely to have an antiandrogenic activity. Adult male mice were treated with the petroleum ether, benzene and ethanol extracts of *C. juncea* seeds, 25 mg x (100g)(-1) x day(-1) for 30 days. In treated rats, there was a decrease in the weights of testis and accessory reproductive organs. The diameters of the testis and seminiferous tubules were decreased. Spermatogonia, spermatocytes and spermatids in the testis and the sperm count in cauda epididymis were also decreased (58).

Catharanthus roseus (Family-Apocyanaceae; Common name-Sada bahar)

Antifertility activity of *Catharanthus roseus* has been reported in male rats and mice (59-61). Oral administration of *C. roseus* Linn, leaf extract caused widespread testicular necrosis, hyalinization of tubules and Sertoli cell-only-Syndrome. Biochemical studies revealing notable reduction in glycogen and fructose levels in reproductive tissues support the histological observations and confirm the antifertility properties of *C. roseus* extract (62).

Conclusion

Phytotherapy has a very long tradition, although proper scientific explanation is relatively new. Medicinal plant products have a long history of indigenous use in India as well as in other countries. In our country, as well as in the world, there are several medicinal plants associated with antifertility properties. Evaluation of herbs for antifertility effects has been in progress worldwide for several decades to identify effective and safe substances for control of population explosion. However, the search for an orally active, safe and effective plant preparation or its compound is yet to be needed for fertility regulation due to incomplete inhibition of fertility or side effects. 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. Among the plant based contraceptives, inhibition of male fertility after administration of natural substances has been related to decreased spermatozoa density. Also, for male contraception, it is not necessary to stop spermatogenesis, but rather to eliminate the fertilizing ability of the spermatozoa by causing changes in the morphology or in the function of the sperm. Results of some studies indicate that plant extracts may have impaired androgen synthesis either by inhibiting Leydig cell function or hypothalamus pituitary axis, resulting in infertility. Normal blood and serum parameters indicate a low systemic toxicity of the plant material. 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/ Active Principles	Animal Model	Activities	Worker(s)
1.	*Abrus precatorius*	Chirmi	Seed	50% ethanolic extract	Rat	Post-testicular anti-fertility effect	63
			Seed	Steroidal fraction	Rat	Anti-spermatogenic effect and reduced activity of testicular enzyme	64
			Seed	Methanolic extract	Rat	Sperm antimobility activity	65
			Seed	Alcoholic extract	Rat	Antifertility effect	66
			Seed	ethanolic extract	Mice	Antifertility effect	67
2.	*Achyranthes aspera*	Kadaladi	Root	50% ethanolic extract	Rat	Spermicidal action	68
3.	*Actiniopteris dichotoma*	Morepankhi	Whole plant	50% ethanolic extract	Rat	Antifertility effect	69
4.	*Aegle marmelos*	Bael	Leaf	Methanolic extract	Rat	Resist process of spermatogesis and decrease sperm motility	36, 37
			Leaf	Methanolic extract	Rat	Antifertility effect	39
			Leaf	50% ethanolic extract	Rat	Antifertility effect	40
					Human	Spermicidal activity	41
			Leaf	Aqueous Extract	Rat	Antifertility effect	38
5.	*Ahillea millefolium*	Yarrow	Flowers	Ethanolic extract	Mice	Spermicidal and Semen coagulating activity	70
6.	*Albizzia lebbeck*	Siris	Pods	Methanolic extract	Rat	Antifertility effect	34
			Bark	Methanolic extract	Rat	Antispermatogenic and antiandrogenic activities	35
7.	*Allamanda cathartica*		Leaf	Aqueous extract	Mice	Antifertility effect	71
8.	*Allium sativum*	Lahsun	Bulb	Crude aqueous extract	Rat	Spermicidal activity	51
			Bulb	Crude extract	Rat	Antispermatogenic and antiandrogenic activities	52
			Bulb	Aqueous extract	Rat	Antispermatogenic and antiandrogenic activities	53
			Bulb	Aqueous extract	Rat	Antispermatogenic Activity	54
9.	*Alstonia scholaris*	Saptaparni	Stem bark	Mehanolic extract	Rat	Antifertility effect	72
10.	Amalakyadi churna			Ethanol extract	Mice	Antifertility effect	73
11.	*Anethum graveolens*		Seeds	Aqueous extract	Rat	Antifertility effect	74
12.	*Andrographis paniculata*	Kirayat	Leaves	Andrographilode	Rat	Effect on Spermatozoa	75
13.	*Austroplenckia populnea*		Leaf	Hydromethanolic extract	Rat	Antifertility effect	76
14.	*Azadirachta indica*	Neem	Leaves	Dry powder	Rat	Antispermatic activity	10
			Leaves	Dry powder	Rat	Antiandrogenic property	11

			Seeds	Aqueous extract	Rat	Antifertility effect	12
			Leaves	Aqueous extract	Rat	Antispermatogenic and antiandrogenic properties	13
			Seeds	Neem oil	Rat	Spermicidal effect	14
			Leaves	Aqueous extract	Rat	Spermicidal activity	15
			Seeds	Alcoholic extract	Mice	Antifertility effect	21
			Leaves	Aqueous extract	Mice	Antispermatic activity	16
			Leaves	Alcoholic extract	Rat	Spermicidal activity	17
			Leaves		Rabbits	Antispermatogenic effect	18
			Neem oil		Rat	Structural changes	19
			Leaves	Aqueous extract	Rat	Spermicidal Activity	20
15.	*Bacopa monnieri*	Brahmi	Leaves	Dry powder	Mice	Suppression of spermatogenesis and fertility	77
16.	*Barleria prionitis*	Vajradanti	Root	Methanolic extract	Rat	Antispermatogenic Activity	78
			Root	Alcoholic extract	Rat	Antifertility effect	79
17.	*Basella alba*		Leaves	Aqueous extracts	Rat	Antifertility activity	80
18.	*Cananga odorata*		Root bark	50% ethanolic extract	Rat	Spermatotoxic effects	81
19.	*Cannabis sativa*	Ganja	Root	Alcoholic extract	Rat	Antispermatogenic activities	82
20.	*Capparis aphylla*			Ethanolic extract	Rat	Disruption of the spermatogenic as well as androgenic compartment of the testis	83
21.	*Carica papaya*	Papita	Seeds	Chloroform extract	Monkey	Inhibition of sperm motility	32
			Bark	Aqueous crude extract	Rat	Antifertility effect	28
			Seeds	Aqueous extract	Rat	Antispermatogenic properties	22
			Seeds	Alcoholic extract	Rat	Affects cauda epididymis	26
			Seeds	Chloroform extract	Monkey	Antispermatogenic effect	27
			Seeds	Alcoholic extract	Mice	Spermicidal activity	31
			Seeds	Chloroform extract	Rabbit	Antifertility effect	23
			Seeds	Chloroform extract	Rat	Inhibition of sperm motility	25
			Seeds	Chloroform extract	Rat	Ultrastructural changes in the testis	29
			Leaves	Aqueous extract	Rat	Antifertility effect	33
			Seeds	Alcoholic extract	Rat	Antifertility effect	30
			Seeds	Chloroform extract	Rabbit	Spermicidal activity	24
22.	*Catharanthus roseus*	Sadabahar	Leaves	Alcoholic extract	Rat	Antifertility effect	62
			Leaves	Aqueous extract	Mice	Antifertility effect	59
			Leaves	Alcoholic extract	Rat	Antifertility effect	60
			Leaves	Alcoholic extract	Rat	Antispematogenic effect	61
23.	*Cestrum parqui*		Leaves	Leaf extract	Rat	Potential spermicidal effect	84
24.	*Chromolaena odoratum*		Leaves	Aqueous extract	Rat	Antiandrogenic effects	85

25	*Citrullus colocynthis*	Tumba	Root	50% ethanolic extract	Rat	Antispermatogenic effects	57
			Fruit	50% ethanolic extract	Rat	Antispermatogenic and antiandrogenic activities	56
26.	*Colebrookia oppositifolia*		Leaves	Ethanolic extract	Rat	Depression of spermatogenesis	86
27.	*Crotalaria juncea*		Seeds	Petroleum ether, benzene and ethanol extracts	Mice	Antispermatogenic and antiandrogenic effects	58
28.	*Cuminum cyminum*	Jeera	Seed	Ethanolic extract	Rat	Antispermatogenic effect	87
29.	*Curcuma longa*	Haldi	Rhizome	Methanolic extract	Rat	Antifertility effect	88, 89
			Rhizome	Aqueous extract	Mice	Antifertility effect	90
30.	*Dendrophthoe falcata*		Stem	70% methanolic extract	Rat	Depression of spermatogenesis	91
31.	*Fadogia agrestis*		Stem	Aqueous extract	Rat	Adverse effects on the male rat testicular function	92
32.	Fenugreek seeds		Seeds	Dry powder	Rabbit	Antifertility activity	93
33.	*Hibiscus macranthus*		Leaves	Aqueous extracts	Rat	Antifertility activity	80
34.	*Hibiscus rosasinensis*	Gudhal	Bark	Methanolic extract	Mice	Antispermatogenic and antiandrogenic activities	94
35.	*Juniperus phoenica*		Cones	Ethanolic Extract	Rat	Antifertility activity	55
36.	*Lepidium meyenii*		Root	Ethanolic Extract	Rat	Antispermatogenic Effects	95
37.	*Martynia annua*	Bichchhu	Root	50% ethanol extract	Rat	Antifertility effect	96
38.	*Mentha arvensis*	Pudhina	Leaf	Petroleum ether extract	Mice	Antifertility property	97
			Leaf	Aqueous extract	Mice	Antifertility effect	98
39.	*Momordica charantia*	Karela	Seeds	Petroleum ether, benzene and alcohol extracts	Rat	Antispermatogenic and androgenic activities	99
40.	*Mondia whitei*		Root bark	Aqueous extract	Rat	Antispermatogenic and antifertility activities	100
				Hexane extract	Rat	Antifertility activities	101
41.	*Morinda lucida*		Leaf	Leaf extract	Rat	Antispermatogenic properties	102
42.	*Ocimum sanctum*	Tulsi	Leaf	Antifertility effects	Rat	Antifertility effect	42
			Leaf	Antifertility effects	Rat	Antifertility effect	43
				Antifertility effects	Rat	Antifertility effect	44
			Leaf	Aqueous extract	Rat	Reduced spermatogenesis and maturation arrest of spermatozoa	45
			Leaf	Aqueous crude extract	Mice	Antifertility effects	46
43.	*Piper betle*	Pan	Leaf-stalk	Alcoholic extract	Mice	Antifertility effect	103
44.	*Piper nigrum*	Long pepper	Fruit	Dry powder	Mice	Antispermatogenic and antifertility activity	104
45.	*Quassia amara*		Bark	Chloroform extracts	Rat	Antifertility effect	105
46.	*Ricinus communis*			50% ethanol extracts	Rat	Antifertility effect	106
47.	*Rosmarinus officinalis*	Rosemary	Fruit	Mehanolic extract	Rat	Antispermatogenic Activity	107

48.	*Ruta graveolens*		Leaf	Alcoholic extract	Rat	Antiandrogenic effects	108
			Leaf	Alcoholic extract	Rat	Antispermatogenic activities	82
49.	*Sapindus emarginatus*	Ritha		Alcoholic extract	Rat	Antifertility activity	48
50.	*Sarcostemma acidum*	Somlata	Stem	70% methanolic extract	Rat	Arrest of spermatogenesis	109
51.	*Semecarpus anacardium*	Bhilawa	Fruit	Ethanolic extract	Rat	Spermatogenic arrest	110
52.	*Strychnos potatorum*		Seeds	70% methanolic extract	Rat	Antifertility effect	111
53.	*Syzygium aromaticum*	Clove	Flower buds	Hexane extract	Mice	Degenerative changes in the seminiferous tubules	112
54.	*Tecoma stans*		Leaves	Ethanolic extract	Rat	Antispermatogenic properties	113
55.	*Terminalia bellirica*		Fruit	Alcoholic extract	Mammals	Antispermatogenic properties	47
			Fruit	Alcoholic Extracts	Rat	Antifertility effect	48
				Ethanolic extract	Rat	Antifertility effect	49
			Bark	Benzene and ethanol extract	Rat	Structural and functional alteration	50
56.	*Tinospora cordifolia*	Neem giloy	Stem	70% methanolic extract	Rat	Antifertility effect	114

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