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Review Article

MALE FERTILITY REGULATION WITH PLANT PRODUCTS: A REVIEW

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ABSTRACT

Population explosion is one of the greatest problems all over the world especially in developing countries with its inevitable consequences on economic development, public health and environment. Therefore, there is pressing need for control of fertility by encouraging the couples to participate in family planning programmes. Compared with female contraceptive methods male alternatives are limited including vasectomy and condoms. Prevailing situation demands the development of more contraceptive options for males that will encourage more couples to adopt them. Several potential approaches for fertility control have been investigated over a long period including chemical, hormonal and immunological approaches. However, no suitable method has emerged that is effective, reversible and free from side effects. Medicinal plants provide an alternative offer for development of male contraceptives. Numerous herbs have been used historically to reduce fertility in both male and females. The research on medicinal plants for the search of male antifertility agent is being intensified because of their lesser side effects, ready availability and reduced cost. The present review includes a brief account of research reports on medicinal plants with male antifertility activity published between the years 2000 to present. This study provides an information on botanical name, family, parts used,extract used, dose, duration and their possible male antifertility effects in various animals.

Keywords: Antifertility, Antispermatogenic, Medicinal plants, Sperm quality, Testosterone.

INTRODUCTION

Population explosion is one of the greatest problems all over the world with its inevitable consequences on economic development, human health and environment. High fertility rate and rapid decline in death rates or mortality rate and immigration from neighboring countries are considered as the determining factor for population growth.[1]A large number of pregnancies are unintended and attributed to a failure to use contraceptives due to restricted choices as well as access to available methods or method failure[4]. Prevailing situation demand the development of more new contraceptive options both for male and female to encourage more couples to adopt them[2, 3].

Despite the significant advancement in contraceptive options for women, the choice for male contraceptive is restricted to either condom or vasectomy. However, despite the limited options the use of male based contraceptive methods account for approximately 14% of the contraceptive worldwide[5]. Several potential contraceptive for fertility control in males have been investigated over a long period, including chemical, hormonal and immunological approaches[2, 6]. However, yet no suitable reversible method has emerged that is highly effective and free from side effects[7, 8].

Concern over the possible adverse effects of the hormonal contraceptives have led to focus research on medicinal plants for development of male contraceptive agents based on natural products, because of the better cultural acceptability, lesser side effects, easy availability and low cost[9].Since time immemorial men have relied on plants and their products as source of drugs and therapeutic agents as they are rich in

bioactive phytoconstituents. Ancient Indian literature also abounds in information of plants reported to have sterilizing, abortifacient and *emmenagogue* properties[10, 11]. 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 compound[12].A large number of plants have been screened during the last few years for their anti-fertility activity in males. Some of these plants have shown antifertility effect by virtue of different mechanism like, anti-spermatogenic effect[13-15],alteration in serum testosterone level[16-21], spermatotoxic effects[22], poor sperm quality[23-27], alteration in antioxidant defense mechanism[28] and spermicidal activities[29, 30].

Medicinal plants are rich in various phytoconstituents they show inhibitory effect on male fertility by virtue of their individual or synergistic activity Many plants containing flavonoids, tannins, terpenes, quinines, diterpenoid lactones have been reported to induce male antifertility effects by different mechanism[31-33].

In the present review,research papers published during the last few years (w.e.f. year 2000) on male antifertility inducing plants are compiled in the Table-1.

CONCLUSION

Based on the above review of literature it may be concluded that a large number of medicinal plants have been investigated science the year 2000 to present, for their antifertility activities in order to develope a male contraceptive agent of herbal origin. Out of these, some plants have shown promising results. However, most of the studies have been carried out on crude extracts and due to ecological variations their phytoconstitutents are not properly defined. Information regarding exact mode of action and safety is yet not properly known. Needless to say, further studies on the isolation, characterization of active principle(s) and their efficacy and safety of these plant preparations requires further investigation in depth.

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Table 1: Medicinal plants possessing male antifertility activity

Name of the plant I	Part used II	Type of plant extract III	Animal model IV	Doseduration and route V	Observations & results VI	Reference
Abrus precatorius (Fabaceae)	Seeds	Aqueous extract	Mice	250 and300 mg/kg b. wt./day for 30 days,orally	Reduction in testicular sperm countand suppression of sperm motility in cauda epididymis.	25
”	Seeds	Ethanol extract	Mice	20 and 60 mg/kg b.wt./day for 20 days, intraperitoneal	Highly significant decrease in daily sperm production.Plasma testosterone level decreased significantly. Reversibility in sperm production was observed in all the treated animals.	17
Actinidia chinensis (Grossulariaceae)	Whole plant	50% Ethanol extract	Rat	75,100,150 mg/kg b. wt./day for 50 days, orally	Decrease in sperm count, motility, blood levels of testosterone and estradiol.	34
Adiantum lunulatum Burm(Adiantace ae)	Whole plant	50% Ethanol extract	Rat	100,250,500m g/kg b.wt./day for 30,60 and 90 days,orally	Deformation in the germ cells of testis,Leydig cells were atrophied. No spermatozoa could be seen in the seminiferous tubules.Withdrawal of treatment results in the restoration of the changes.	35

Aegle marmelos (Rutaceae)	Leaves	Aqueous extract	Rat	200 mg/kgb.wt./day for 60 days,orally	A highly significant decrease in the weights of testes, epididymis, seminal vesicle, ventral prostate and vas deferens was observed. Sperm motility as well as sperm density in the cauda epididymis was reduced significantly.Serum testosterone levels also reduced significantly in the experimental group.	36
”	”	Aqueous extract	Rat	50 and 100 mg/kg b.wt./day for 28 days,orally	Germ cell number in different generations at stage VII reduced significantly.	37
Allium sativum(Amaryllidaceae)	Bulb	Aqueous extract	Rat	5%, 10% and 15% in diet for 30 days	Significant decrease plasma and intratesticular testosterone levels.Induced a spermatogenetic arrest.	38
”	Cloves	Aqueous extract	Rat	500 and 1000 mg/kg b.wt./day,orally	Percentage of morphologically normal spermatozoa and sperm concentration were significantly reduce, also caused a significant reduction in SOD activity in the blood.Reduction in testosterone concentration and alteration in spermatogenesis was also noticed.	39
Albizia lebbeck L. benth. (Fabaceae)	Pods	Methanol extract	Rat	50, 100 and 200 mg/kg b. wt./day for 60 days,orally	Sperm motility and density were significantly reduced. There was a marked reduction in the number of primary and secondary spermatocytes and spermatids. The Sertoli cells count was significantly decreased.	23
Aloe vera (Asphodelaceae)	Leaves	Aqueous extract	Rat	30 ,70 and 100 mg/kg b.wt./day for 56 days,orally	Decrease in sperm motility and testicular weight was observed in treated rats.	40
Alstonia macrophylla(Apocynaceae)	Leaves	95% Methanol and n-butanol fraction	Goatspermatozoa	600 µg/ml 100 µg/ml (in-vitro)	Inhibition of sperm forward motility.	41
Alstonia scholaris R.br.(Apocynaceae,)	Stem bark	Ethanolextract	Rat	200 mg/kg b.wt./day for 60 days, orally	Weights of testes, epididymies, seminal vesicle and ventral prostate was significantly reduced. The seminiferous tubule and Leydig cell nuclear area were reduced significantly	42
Althaea rosea(Malvaceae)	Flowers	Methanol extract	Rat	100 mg/kg b.wt./day for seven weeks, orally	Increase in the activities of glucose-6-phosphatase-dehydrogenase and 5-beta hydroxysteroid dehydrogenase in the Leydig cells.Hyperplasis of the interstitial tissue was also seen.	43
Andrographis paniculata wall.exnees (Acanthaceae)	Leaves	Aqueous extract	Rat	100 and 200mg/kg b.wt./day for 45days,orally	Significant decrease in the weights of testis, epididymes and seminal vesicle was observed. Reduction in the testicular and epididymal sperm count, motility and increase in the abnormal sperm count was also observed.	26
”	Leaves	Andrographilode	Rat	150 and 200 mg/kg b. wt./day for 48 days, orally	Sperm count decreased, sperm were non-motile. Seminiferous epithelium thoroughly disrupted.Sertoli cell damage and spermatotoxic effects were also apparent.	22
Austroplenckia populnea(Celastraceae)	Stem	Hydro-methanol extract	Rat	500 mg/kg b.wt./day for 70 days ,orally	Number of intromissions, latencies to first mount and ejaculations were significantly decreased. Epididymal sperm concentration reduced.	44

Azadirachta excels (Meliaceae)	Leaves	Aqueousextract	Mice	250 mg/kg b.wt./day, for 21 days, orally	Seminiferous tubules indicating mixing of the germ cell types in stages of spermatogenesis, atrophy of the spermatogenic elements,and absence of the spermatozoa in the lumen.	45
Azadirachta indica (Meliaceae)	Seeds	95% Ethanol extract	Mice	100 mg/kg b.wt./day for 15 days ,orally	Significant reduction in fertility rate.Decline in ATPase activity in caput and cauda epididymis, However, the extract did not cause any change in the body and organ weights.	46
”	Leaves	Aqueous extract	Mice	50, 100, and 200 mg/kg b.wt./day, for 28 days, orally	The affected seminiferous tubules showed intraepithelial vacuolation, occurrence of giant cells, mixing of germ cell types and degenerated appearance of germ cells.	47
”	”	Aqueous extract	Rat	250 and 350mg/kg b.wt./day for 30 days,orally	A significant decrease in the weights of testis, epididymis and seminal vesicle was observed. A dose related reduction in the testicular sperm count, epididymal sperm count and motility with an increase in abnormal sperm count was observed.	48
”	”	Aqueous extract	Rat	500 and 0.25 mg/kg b. wt./day for 30 days,orally	Atrophic seminiferous tubules with widening intercellular spaces, regression of Leydig cells were seen in treated rats.	49
”	”	Aqueousextract	Rat	50, 100 and 150 mg/kg b. wt./day for 15 days, orally	Decrease in mean epididymalsperm counts and significant increase in sperm head abnormality when compared with the control group.There was a significant decrease in serum testosterone level also.	20
Barleria prionitis L. (Acanthaceae,)	Root	Methanol extract	Rat	100mg/rat/day for 60 days, orally	The population of preleptotene spermatocytes were decreased. Sertoli cells and mature Leydig cell numbers were significantly reduced.	50
Bougainvillea spectabilis (Fabaceae)	Leaves	Aqueous extract	Mice	800 mg/kg b.wt./day for 30 days, orally	Reduction in the size of seminiferous tubules, decrease in weight of testis and sperm count, and testosterone level was observed.	18
Calendula officinalis L. (Asteraceae)	Whole plant	Aqueous extract	Rat	150 and 300 mg/kg. b.wt./day for 60 days,orally	Induced a significant decrease in the weight of testes, epididymis, seminal vesicle and prostate. A dose related reduction in the testicular sperm count, epididymal sperm count and motility was also evident. Serum testosterone was also declined after the treatment.	51
Calotropis procera (Asclepiadaceae)	Flower	Aqueous and ethanol extract	Mice	5 or 10 mg/mouse/alternate day for 20 day, orally	Inducedfunctional sterility. Testes contained degenerating and necrotic germ cells.Testis weight was significantly reduced.	52
”	Fresh leaf	Aqueous extract	Rat	2mg/gm b.wt./day for 7,14,21,28 and 35 days, orally	Desquamation of epithelial cells of seminiferous tubule, collection of pinkish fluid in accessory glands.	53
Cananga odorata Lam (Annonaceae)	Root bark	50% Ethanol extract	Rat	1g/kg b.wt./day for 60 days, orally	Epididymal sperm motility and sperm count reduced.However, morphological abnormalities in the spermatozoa increased. Serum testosterone was significantly decreased in treated group.	24
Capparis aphylla Roth.(Capparidaceae)	Whole plants	95% Ethanol extract	Rat	50,100,200 mg/kg b. wt./day for 55 days, intraperitoneal	Resulted in complete loss of fertility attributed to decline in epididymal sperm counts and motility.	54
Carica papaya(Caricaceae)	Seed	Aqueous extract	Rat	0.5 mg/kg b.wt./day for 7	Significant reduction in protein and sialic acid in epididymal fluid and sperm pellet. Altered epididymal	55

				days, orally	microenvironment.	
"	"	Chloroform extract	Langur monkey	50 mg/kg b.wt. for 360 days, orally	Decreased the sperm concentration since days 30-60 of treatment with a total inhibition of sperm motility.A decreasein sperm viability and an increase in sperm abnormality was also recorded.	56
"	"	Ethanol extract	Rat	100 and 250 mg/kg b.wt./day for 90 days, orally	Results showed reduced and zero pregnancy outcomes in the females mated with treated males.Histopathological analysis showed a moderate to highly depleted germinal epithelium.	57
Cassia alata L. (Caesalpinaceae)	Flowers	95% Ethanol extract	Rat	500 mg/kg b.wt./day for 60 days, orally	Decrease in epididymal sperm count, motility and fertility was recorded. Reduction in the diameters of seminiferous tubules and Leydig cell's nucleus was also observed.	58
Cassia angustifolia (caesalpinaca)	Leaves	Aqueous extract	Rat	50 and 100 mg/rat/day for 45 days ,orally	The weights of reproductive organ like testis, epididymis, seminal vesicle and ventral prostate was decreased significantly. Sperm motility and count were also reduced significantly with an increase in abnormalities of sperm.	27
Cassia fistula (Fabaceae)	Leaves	Ethanol extract	Rat	60 mg/kgb. wt./day for 48 days, orally	Sperm count, sperm vitality, sperm motility were significantly decreased.	59
Cestrum parqui(Solanaceae)	Leaves	Aqueous extract	Human	40-250 µg/ml (in vitro)	Spermicidal activity was observed.	30
Chenopodium album (Amaranthaceae)	Seeds	Aqueous decoction	Rat and rabbit	0.25,0.5,1.0,1.5 and 2.0 mg/ml (in-vitro)	Immobilization of spermatozoa. Disintegration of sperm plasma membrane and dissolution of acrosomal membrane.	60
Chromolaena odorata (Asteraceae)	Leaves	Alkaloid Extract	Rat	250, 500 and 1000 mg/kg b.wt./day for 60 days,orally	The serum LHand FSH levels, as well as testicular and serum testosterone levels decreased significantly. There was a significant decrease in the sperm count,motility, and density.Morphological changes in the sperm cells were also observed.	61
"	"	Aqueous extract	Rat	250 and 500 mg/kg b. wt./day for 14 days, orally	Resulted in reduction in testicular weight, acid phosphatase activity, protein, sialic acid and testosterone concentration.	62
Chrysophyllum albidum (Campodeoid)	Root bark	Ethanol extract	Rat	100 and 200 mg/kg b. wt./day for 21 days, orally	Decrease in the cauda epididymal sperm count, significant reduction of serum testosterone, LH and FSH concentration. and sperm production in treated rats.	21
Citrus limonum (Rutaceae)	Seeds	Alcoholic extract	Rat	200 mg/kg b.wt./day for 30 and 60 days, orally	Significantly decreased the sperm count,size and weights of the testis and epididymis. Induced atrophic changes in testis and epididymis. Drastic effect on sperm motility and morphology leads to inhibition of fertility.	63
Citrullus colocynthis Schrad (Cucurbitaceae)	Fruits	50% Ethanol extract	Rat	100 mg/kg b.wt./day for 60 days, orally	Significantly reduced cauda epididymis sperm motility, density, and circulatory levels of testosteronewas observed in extract treated rats.	64
Colebrookia oppositifolia Sm. (Tiliaceae)	Leaves	Ethanol extract	Rat	100 and 200 mg/kg b. wt./day for 8-10 weeks,	Seminal vesicles and ventral prostate showed a significant reduction in the weights at the higher dose only. Treated animals also showed a notable	65

				orally	depression of spermatogenesis.	
Crotalaria juncea L. (Fabaceae)	Seeds	Petroleum ether, benzene and ethanol extracts	Mice	25 and 100 mg/kg b.wt./day for 30 day, intraperitoneal	Decrease in the number of spermatogonia, spermatocytes and spermatids in testis along with reduced caudal spermatozoa.Degeneration of Leydig cells indicate inhibitionof steroidogenesis.	16
Curcuma longa(Zingiberaceae)	Rhizome	Aqueous extract	Mice	600 mg/kg b.wt./day for 56 and 84 days, orally	Degenerative changes in the seminiferous tubules, suppression of spermatogenesis and fertility.	66
Cyamposis psoralioides (Leguminosae)	Pods	Ethanol extract	Mice	200 and 400 mg/kg b.wt./day for 40 days, orally	Weight of the testis and other accessory reproductive organs decreased significantly,Reduction in the caudal epididymal sperm counts was also noticed.	67
Dendrophthoe falcate(Loranthaceae)	Stem	Methanol extract	Rat	100 mg/kg b.wt./day for 60 days,orally	Weight of the testes, epididymis, seminal vesicles and ventral prostate showed a significant reduction. Testosterone level also declined significantly.	68
Echinacea purpurea(Asteraceae)	Root	Ethanol extract	Rat	50 mg/kg b.wt. for 4 and 8 weeks,orally	Resulted in a significant reduction in the percentage of testicle and body mass, inhibition of spermatogenesis.	69
Echino psechinatus Roxb.(Asteraceae)	Root	Petroleum ether extract	Rat	30 and 60 mg/kg b. wt./day for 8 days, orally	Reduction in reproductive organ weights. Decrease in serum testosterone and epididymal sperm count was observed.	70
Euphorbia hirta (Euphorbiaceae)	Leaves	Aqueous extract	Rat	400 mg/kg b. wt./day for 14 days ,orally	Resulted in testicular degradation and reduction in seminiferous tubular diameter.	71
***Eurycoma longifolia* Jack (El)** (Simaroubaceae)	Whole plant	Aqueous dried extract	Rat	8 mg/kg b.wt./day for 14 days, orally	Showed inhibitory effects on testosterone production and spermatogenesis.	19
Feroni aelephantum(Rutaceae)	Leaf and bark	95% Ethanol extract	Rat	400 mg/kg b.wt./day for 14 days, orally	Increasd serum level of FSH and estrogen but decreased the levels of LH and testosterone.	72
Ficus bengalensisL. (Moraceae)	Leaves	Ethanol extract	Mice	200 and 500 mg/kg b. wt./day for 35 days, orally	Suppression of the spermatogenesis and adverse effects on sperm quality and fertility was noticed.	73
Gossypium herbaceum(Malvaceae)	Seeds	Gossypol	Human	10 and 12.5 mg every other day for 16-18 months, orally	Sperm motility and density reduced to infertile levels,Serum levels of potassium, FSH, LH and testosterone were not significantly changed.	74
,,	,,	,,	Hamster	2.5 µg-60 µg/ml for 15 min. (*in- vitro*)	Inhibition of acrosin and aryl sulfatase activity.	75
,,	,,	,,	Mice	5 to 80 µL (*in- vitro*)	Gossypol irreversibly inhibited T-type ca^{2+}currents in the spermatogenic cells, inhibit capacitation and the acrosome reaction in mammalian sperms.	76
Hibiscus-rosa-sinensis (Malvaceae)	Flowers	Aqueous extract	Rat	150 and 300 mg/kg b.wt./day for 15,30, 45 & 60 days, orally	Showed change in germinal epithelium of the testis ranging from mild damage to near total sloughing, depending upon the duration of the treatment.	77
Hibiscus sabdariffa (Malvaceae)	Calyx	Aqueous extract	Rat	1.15,2.30 and 4.60 g/kg for 12 weeks,	Distortion of tubules,hyperplasia of testis and disintegration of sperm cells.	78

				orally		
Hymeno cardiaacida (Euphorbiaceae)	Stem bark	Aqueous ethanol extract	Rat	100, 200 and 400 mg/kg b. wt./day for 8 weeks, orally	Significant reduction in the weights of testes, epididymis, ventral prostrate, seminal vesicles and vasa differentia was observed.	79
Lepidium meyenii(Brassicaceae)	Hypocotyle	Aqueous extract	Rat	2g/kg b. wt./day for 14 and 42 days, orally	Resulted in a reduction in epididymal sperm count, induced testicular disturbances and reduced spermatogenesis.	80
Leptadenia hastate pers.(Cyperaceae)	Leaves and stem	Aqueous extract	Rat	100, 200,400 and 800 mg/kg b.wt. for 60 days, orally	Significant reduction in the number of sperms in the testis and the cauda epididymis. Showed a decrease in the weight of testes and epididymis.Suppression of Spermatogenesis was also observed.	81
Madhuca latifolia (Roxb.) Macbride (Sapotacee)	Seeds	Aqueous extract	Rat	2gm/b. wt./day for 21 days, orally	Significant decrease in sperm count and decrease in the weights of testes,epididymis, and other sex accessory glands was observed.	82
Malvaviscus conzattii (Malvaceace)	Flowers	Alcohol extract	Mice	30 and 50 doses (one dose = 50 mg/day/mouse), orally	Resulted in a significant decrease in absolute weights of testes, epididymes, vas deferens and seminal vesicles. Epididymal epithelium was regressed. Fructoseconcentration in seminal vesicles declined and reduction in spermatogenesis.	83
Mangifea indica (Anacardiaceae)	Leaves	Methanol extract	Rat	1g/kg b. wt. /day for 28 days, orally	Reduction in sperm count motility,morphology,live death ratio,and number of litter size in treated rats.	84
Martynia annua(Lamiaceae)	Root	50% Ethanol extract	Rat	50,100 and 200 mg/kg b. wt./day for 60 days, orally	Significant decrease in the weights of testes, epididymis, seminal vesicle and ventral prostate and reduction in the testicular and epididymal sperm count and motility was observed. Spermatogenesis arrested at the secondary spermatocyte stage.	85
Menthe arvensis L.(Lamiaceae)	Root	Petroleum ether extract	Mice	10 and 20 mg/mouse/day for 20,40 and 60 days, orally	Significant decrease in the weight of testisand accessory sex organs, spermcount,motility and viability.	86
Mimusops elengi L. (Sapotaceae)	Seeds	Aqueous extract	Rat	2g/b.wt. for 21 days, orally	Significant decrease in sperm count and serum testosterone level .The decrease in the weight of accessory sex organsand inhibition of spermatogenesis was also noticed.	87
Momordica charantia (Cucurbitacea)	Seeds	Aqueous extract	Rat	50 mg/kg b.wt./day for 16 week, orally	Significant reduction in serum testosterone concentration due to the destruction of the Leydig cells and decreased sperm production.	88
Mondia whitei L.(Apocynaceae)	Root bark	Aqueous extract	Rat	400 mg/kg b.wt./day for 55 days, orally	Induced testicular lesions.Degenerative changes in seminiferous tubules and epididymis. Increase in protein content of testes and epididymis. However Testicular concentrations of testosterone remained unchanged at all the time.	89
Morinda lucida(Amaryllidaceae)	Leaves	Methanol extract	Rat	400 mg/kg b.wt./day for 4 and 13 weeks, orally	Increase in testicular weight and testosterone level.However,a significant decline in progressive sperm motility was observed.	90
Mucuna urens L.(Fabaceae)	Seeds	Aqueous extract	Guinea pig	70 and 140 mg/kg b. wt./day for 8 weeks, orally	No pregnancy in females mated with treated males was observed. Complete degeneration of sperm and spermatids in seminiferus tubules was observed.	91

Nelumbo nucifera (Nymphaeacae)	Seeds	50% Ethanol extract	Rat	50, 100 and 200 mg/rat/day for 60 days, orally	Weights of reproductive organs decreased significantly along with significant suppression of cauda epididymal sperm count, motility, and concentration of testosterone in blood.	92
Ocimum gratissimum L. (Lamiaceae)	Leaves	Aqueous extract	Mice	11 – 88 mg/kg daily for 1, 2 and 4 weeks, orally	Sperm count and motility were decreased. Percentage of abnormal sperm cells, sperm debris and primordial cells were increased.No significant effects on the serum levels of testosterone, LH and FSH was observed.	93
Ocimum Sanctum (Lamiaceae)	Leaves	Aqueous extract	Rabbit	2 g/rabbit for 30 days, orally	Resulted in a significant decrease in the sperm count. Serum testosterone levels showed marked increase,while FSH and LH levels were significantly reduced	94
,,	Leaves	Benzene extract	Rat	250 mg/kg b.wt./day for 48 days, orally	Sperm count, motility and forward velocity decreased, while percentage of abnormal sperms increased.Fructose content in plasma of cauda epididymis was reduced.	95
Opuntia dilleni haw. (Cactaceae)	Phyllo clade	Methanol extract	Rat	50 mg/kg b.wt./day for 30 days, orally	Caused significant decrease in the weight of testes, epididymis, seminal vesicles and ventral prostate.Production of spermatid was also reduced.Motility of the cauda-epididymal spermatozoa was diminished significantly.	96
Phyllanthus niruri(Euphorbiaceae)	Whole plant	Aqueous extract	Rat	100,200,250,300mg/kg b.wt./day for two weeks, orally	Decrease in the fructose level of the seminal fluid. Decline of sperm motility, count and viability of the sperm in treated groups was alsoobserved.	97
Piper betel L. (Piperaceae)	leaves	95% Ethanol extract	Rat	50 mg/kg b.wt./day for 15days,orally	Resulted in a reduction in the caudal epididymal sperm count, sperm motility as well as sperm viability,and serum level of testosterone.	98
,,	Leaf-stalk	Alcohol extract	Mice	Initially, 500 mg extract for 30 days and then 1000 mg/kg b.wt./day for next 30 days, orally	Induced a suppression of cauda epididymal sperm count, motility and an increase in cholesterol content of testes but did not show any marked alterations in testosterone content in serum.	99
Piper nigrum L. (Piperaceae)	Fruits	Aqueous extract	Mice	25 and 100 mg/kg b.wt./day, for 20 and 90 days, orally	Histologically,testes in treated mice showed non-uniform degenerative change in the seminiferous tubules. The treatment also had adverse effects on sperm parameters.	14
Plumeria bicolor (Apocynaceae)	Leaves	Benzene extract	Rat	500 mg/kg b.wt./day, for 60 days, orally	Significant decline in the weight of testes,epididymis , seminal vesicle and ventral prostate of rats.The sperm count and motility of cauda epididymal spermatozoa were also reduced significantly.	100
Polygala rosmarinifolia (Polygalaceae)	Whole plant	Ethanol extract	Rat	100 and 200 mg/kg b.wt./day for 14 days, orally	The relative wegiht of the testes and epididymis,epididymal sperm count and motility were reduced significantly in treated rats. There was an increased in serum levels of FSH and estrogen but decrease in the levels of LH and testosterone.	117

Portulaca oleracea (Portulacacea)	Leaves and stems	70% Methanol extract	Rat	25,50 and 75mg/kg b.wt./day for 50 days, orally	Caused a significant decrease in testosterone level, reduction in percentase of progressive sperm motility and an increase in percentage of abnormal sperm cells. Reduction of germinal epithelial cells in seminiferous tubules was also noticed.	101
Quassia amara L. (Simaroubaceae)	Stem wood	Methanol extract	Rat	50 and 100 mg/kg b. wt./day for 15 days, orally	A marked decreased in sperm count, motility and viability along with an increase in sperm abnormalitie and decrease of α-glucosidase activity in epididymis was also observed.	102
Rosmarinus officinalis L. (Lamiaceae)	Leaves	Ethanol extract	Rat	250 and 500 mg/kgb. wt./day for 63 days, orally	Significant decline in spermatogenesis in testes due to decrease in the number of primary and secondary spermatocytes and spermatids.Significant decrease in testosterone level was also observed.	103
Ricinus communis L. (Euphorbiaceae)	Root	50% Ethanol extract	Rat	50 mg/100 g.b. wt/day for 60 days, orally	Induced a reduction in the epididymal sperm count. Alteration in the motility, mode of movement and Morphology of the sperms was also observed.	104
Ruellia tuberosa L (Acanthaceae)	Tuberous roots	Aqueous extract	Rat	50 ,100 and 150 mg/kg b. wt./day respectively for 21 days, orally	Significant decrease in sperm count, sperm density and gradual increase in average anti-spermatogenic activity was observed in treated rats.	15
Ruta graveolens L. (Rutaceae)	Herb	Aqueous extract	Rat	5 mg/kg b.wt./day for 30 days, orally	A significant reduction in sperm motility, changes in morphology, viability, DNA integrity and testosterone levels was seen.	105
,,	Whole plant	Aqueous extract	Rat	500 mg/kg b.wt./day for 60 days, orally	Significant decrease in the weight of reproductive organs, level of serum testosterone and FSH with suppression of sexual behavior was observed in treated rats.	106
Sapindus mukorossi (Sapindaceac)	Fruit pericarp	Aqueous extract	Rat	50 mg/kg b.wt./day for45 days, orally	Significant inhibition of sperm motility in the caput, corpus and cauda regions of the epididymis, significant decrease in testicular weight and caudal sperm count was observed.	107
Sapindus saponaria (Sapindaceae)	Bark	-	Human	-	Showed spermicidal activity.	29
Salvadora persica (Salvadoraceae)	Sticks	Ethanol extract	Mice	800 mg/kg b.wt./day for 30 days, intragastrically	Weight of the testes and preputial glands were significantly increased and that of the seminal vesicles was significantly decreased in treated males.	108
Sarcostemma acidium roxb. (Apocynaceae)	Stem	Methanol extract	Rat	50 and 100 mg/kg b. wt./day for 60 days, orally	Treatment caused a significant reduction in sperm count, motility and suppression of fertility. A significant change in biochemical milieu and arrest of spermatogenesis was observed in treated rats.	13
Sedum praeltum (Crassulaceae)	Seeds	Crude Ethanol extract	Mice	10 ,20,40 and 50 mg/kg b. wt./day for 30 days, orally	Sperm viability reduced significantly.	109
Solanum lycoparum (Solanaceae)	Fruits	Aqueous extract	Rat and mice	60,120 mg/ml and 30,60 mg/ml daily, for 5 days	Significant weightloss of ventral prostate of mice indicates antiandrogenic activity.	110

Sphenocentrum jollyanum (Menispermaceae)	Root	Methanol extract	Rat	50,100 and 150 mg/kg b. wt./day for 8 weeks, orally	Poor semen quality and quantity, degeneration of seminiferous tubule was evident.	111
Spondias mombin (Anacardiaceae)	Leaves	Ethanol extract	Rat	250 and 500mg/kg b. wt./day for 8 weeks, orally	Significant decrease in testicular and epididymal weight.Testis showed distortion in the arrangement of seminiferous tubules, low number of germ cells and sertoli cells. Significantly reduced serum levels of FSH, LH and testosterone was also recorded.	112
Stephania hernandifolia willd (Menispermaceae)	Leaves	Aqueous extract	Rat	2 or 4g leaves/ml distilled water/100g b.wt. for 28 days,orally	Diminution of the activities of testicular androgenic key enzymes and plasma testosterone level with spermatogenesis was seen.	113
Tabernaemontna divaricata (Loganiaceae)	Leaves	Ethanol extract	Rat	50,100 and 200 mg/kg b. wt./day for 60 days, orally	Reduction in the testicular and epididymal sperm count and motility.Significant reduction in serum concentration of LH and testosterone was observed. The weights of testes,epididymis, seminal vesicle and ventral prostate were also reduced significantly.	114
Tecoma stans (Bignoniaceae)	Leaves	Ethanol extract	Rat	500 mg/kg b.wt./day for 60 days, orally	The relative weights of testes, epididymis, vas deferens, ventral prostate and seminal vesicle decreased significantly. Declineof testosterone level and adverse impact on sperm parameters was also observed.	115
Telferia occidentalis (Cucurbitaceae)	Seed oil	Petroleum oil	Rat	400 and 800mg/kg b. wt./day for 56 days, orally	Significantly decreased serum testosterone level, sperm count and sperm motility.	116
Terminalia chebula (Combretaceae)	Nuts	Aqueous extract	Rat	500 mg/kg b.wt./day for 45 days, orally	Decreased sperm count and motility.Levelof glutathione and catalase activity was also reduced.	28
Tinospora cordifolia (willd)miers (Menispermaceae)	Stem	Methanol extract	Rat	100 mg/rat/day for 60 days, orally	Resulted in reduction of the weights of testes, epididymis, seminal vesicle and ventral prostate in a significant manner. Sperm motility as well as sperm density and fertility were also reduced significantly.	118
Trachyspermum ammi Linn. (Apiaceae)	Fruits	Ethanol extract	Rat	100, 200 and 400 mg/kg b.wt./day for 60 days,orally	Decreased testis weight, sperm count, sperm motility, and increased production of abnormal sperms.	119
Trichilia monadelpha (Rutaceae)	Stem bark	Aqueous extract	Rat	400 mg/kg b.wt./day, for 4 weeks, orally	A decrease in sperm count and the serum testosterone level was observed.	120
Tripterygium wilfordii Hook f. (Celastraceae)	Root	Triptolide	Rat	100 µg/kg b. wt. for 82 days, orally	Cauda epididymal sperm showed structural abnormalties,which included head-tail sepration,premature chromatin condensation.	121
,,	Root	Water choloroform-di-methylzylesterl and L-epicatechin	Mice	-	Inhibition of T-type ca^{2+} channels in spermatogenic cells.	122
Tropaeolum tuberosum (Tropaeolaceae)	Tubers	Aqueous extract	Mice	780 mg/kg b.wt./day for 7, 14 and 21 days, orally	Progressive sperm motility decreased and immobile sperm count increased significantly.	123

Vitex negundo (Verbenaceae)	Stem bark	Petroleum ether, chloroform, and methanol extracts	Mice	200 mg/kg b.wt./day for 21 days ,orally	Induced a significant reduction in motility and viability of sperms.Reduction in the weight of the testis and epididymis was also evident.	124
Withania somnifera (Solanaceae)	Stem	Ethanol extract	Rat	25,50 mg/kg b. wt./day, for 60 days, orally,2-10mg/million sperm (*in-vitro*)	The weight of testes & accessory sex organs decreased. A dose depended reduction in epididymis sperm count and percentage motility wasobserved. *In-vitro*spermicidal effect (100%) at 10 ± 0.066 mg/million sperm was also reported	125
Xylopiaa ethiopica (Aannonaceae)	Dried fruits	Ethanol extract	Rat	0.5mls and 1.0mls daily for 28 days, orally	Caused a significant dose depended reduction in sperm count & motility but does not affect the morphology.Arrest of spermatogenesis and degenerative changes in seminiferous tubules.No effect on blood testosterone and FSH level was observed.	126

FSH= Follicle-stimulating hormone; LH =Luteinizing hormone; ATPase= Adienosine triphosphate; SOD=Super oxide dismutase; b.wt.=Body weight

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