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Review Article

Exploring the Male Antifertility Potential of Medicinal Plants: A Comprehensive Review

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ABSTRACT

Population growth is one of the biggest issues facing by the globe today, particularly in developing nations where it will certainly have an impact on the environment, public health and the economy. In market numerous birth control methods available, but due to the harmful effects associated with synthetic and allopathic medicines, herbal alternatives are getting more popular due to their lower cost, easier availability and less side effects. Numerous plants have the ability to act as male contraceptives. Research on medicinal plants is being accelerated in an effort to find a male antifertility drug. This review explores the antifertility potential of medicinal plants, focusing on their effects on male reproductive health. There are several studies which highlight the ability of plant-derived compounds to modulate spermatogenesis, alter hormone levels and impact sperm function. This review reveals a concise overview of research publications of the last decade (2014 to 2024) on medicinal plants that have been shown to exhibit antifertility effects in males. This review also provides details on the botanical names, parts used, types of extracts, doses, durations and the potential antifertility effects of medicinal plant observed in males across various animal studies.

Keywords: Contraception, Hormone, Male Antifertility, Medicinal plants, Population.

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INTRODUCTION

The world population is growing in an unconfined manner. The current statistics have shown that the world's population has increased to 8.2 billion as of 2024 and expected to reaching a peak of around 10.3 billion people in the mid-2080s, increasing from 7 billion in 2010, 6 billion in 1998 and 5 billion in 1986. The average yearly population growth rate was approximately 1.1% from 2015 and 2020. Currently, India with population of 1.38 billion is the second most populous country of the world. Moreover, India is going to become the world's most populous country by the year 2027 by exceeding China.[1-3] The rapid growth of the human population is driving up the demand for natural resources, putting immense pressure on resource, especially given that these resources are limited.[4]

The rate of population growth is mainly determined by fertility and mortality. With the advent of advanced new medical technologies and the better public health measures, the level of mortality has been brought down throughout the world and the life expectancy has increased. As a consequence, the gap between fertility rate and mortality rate have changed the growth in population. Fertility has now emerged as the most determining factor in population growth.[5]

Fertility control is a major public health concern at both the international and national levels. Fertility management is required for the conservation of life-sustaining resources as well as the reproductive health. The development of Female hormonal contraception in the 1950s, a wide range of contraceptive methods are available for women today which include oral hormonal contraceptive pills, implants, morning after pills, intrauterine devices, cervical caps, diaphragm, female condom and tubal ligation. Men have employed various contraceptive methods, including periodic abstinence, non-vaginal ejaculation, condom use and vasectomy. However, for male contraception, reversible methods have been inconsistent and the only reliable method, vasectomy, is not intended as reversible. Furthermore, the scarcity of reversible male contraception restricts men's autonomy over their reproductive health. The evolution of innovative, effectual and reversible man contraceptive methods is crucial to addressing this gap. Current research focuses on developing new male contraceptive methods that are both effective and reversible.[6-9]

There are multiple target sites in the male reproductive physiology for functional disruption in order to develop novel male contraceptives. These include (i) suppression of spermatogenesis in testes (ii) disruption of maturation of sperm in the epididymal compartment (iii) Preventing sperm from reaching the egg in

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the female reproductive system. (iv) interference with sperm capacitation (v) disturbance of sperm functions necessary for normal fertilization.[8,10]

Men's birth control options currently come in two forms: temporary and permanent solutions. Temporary solutions, like condoms, are reversible but not reliable, leaving room for unintended pregnancies. Permanent solutions, like vasectomy, offer lifelong protection but are irreversible, making them a significant, one-time decision. Essentially, men face a trade-off between flexibility and reliability.[11] There is a growing need for more reliable and accessible male contraceptive alternatives to address the global demand for family planning and reproductive health.

In recent decades, many plant/herb species mentioned in "Old Materia Medica" Ayurvedic literature and folklore have been screened and investigated by scientists with the aim to develop a novel male contraceptive agent of phytochemical origin because of easy availability, low toxicity, minimum side effects and relatively low cost. Many research/review articles appeared in the literature time to time describe a large number of plants/herbs and their active principles possessing male antifertility activities but only a few have shown promising results. Furthermore, these still requires further investigation for their efficacy and safety evaluation and to elucidate their exact mode of action.[12-15]

CURRENT AND EMERGING OPTIONS FOR MALE CONTRACEPTION

Natural Methods

Natural male contraception methods include practices like withdrawal (pulling out), Lactational Amenorrhea and fertility awareness, where couples avoid intercourse during a woman's most fertile days. These methods rely on accurate timing and control, but their effectiveness varies widely compared to other forms of contraception. While they don't require medical intervention and intrinsically safe, these methods have lower acceptance because of less reliable, inflexibility and higher risk of failures, especially Lacking of proper awareness.[9,10]

Condom

One of the most readily accessible and popular methods of male contraception is the usage of Condoms. They work by physically blocking sperm from getting to the egg. Condoms offer a safe, affordable and easily accessible method of contraception that is fully reversible and under the user's control. They also provide protection against sexually transmitted infections, including HIV. Condoms are generally a safe and side-effect-free contraceptive option. However, their effectiveness can be compromised by human error, such as inconsistent or improper use and occasional breakage-which happens in about 4% of cases.[16] Additionally, some individuals may experience allergy symptoms to latex condoms, modified from rubber trees. This may lead to Mild skin irritation, Redness, Itching, severe allergic reactions (anaphylaxis). Though rare, these allergic reactions can be a concern for those affected.[17]

Vasectomy

The tubes that deliver sperm from the testicles, call as the vas deferens, can be cut or blocked during a permanent surgical surgery called a vasectomy. It effectively prevents pregnancy by blocking the mixing of sperm and semen during ejaculation. Although vasectomy is typically considered as irreversible, it is highly effective method for permanent control of fertility in man (with a failure rate less than 1%) and being preferred by 2.7% couples pursuing contraception. Men who have no interest for future fertility are best suited for vasectomies. Nevertheless, 3% to 5% of men who have vasectomy later ask for reversal.[18,19]

The primary drawbacks of vasectomy are the delayed onset of azoospermia, limited reversibility of fertility when desired and its unsuitability for younger men.[18] Additionally, postoperative discomfort might be an issue. Although most operation pain fades rapidly, 10-15% of men experience chronic testicular discomfort following vasectomy also it does not offer protection against Sexually Transmitted Infections (STIs).[20]

In recent years, there has been substantial improvement global research into various male contraception methods, including hormonal, chemical, immunological, vas-based and herbal approaches. These efforts aim to provide men with more options for contraception, offering alternatives to traditional methods like condoms or vasectomy.

Male Hormonal Contraception

Hormonal contraception for men involves using synthetic hormones like testosterone or progestin to temporarily reduce sperm production. Since the 1970s, studies suggest that external testosterone therapy, even at low levels, can effectively suppress sperm production, offering a new avenue for male contraception. The goal is to lower sperm count to a level that prevents pregnancy while being reversible. Hormonal methods, including pills, gels and injections, are still in clinical trials and not widely available, but they show promise for providing men with an additional contraceptive option that can be adjusted or stopped as needed.[21,22]

Weekly intramuscular administration of injectable testosterone esters with a prolonged half-life, like Testosterone Enanthate (TE), have been used for the majority of hormonal contraceptive regimens. Several male contraceptive trials have combined administering injections of progestins and testosterone in an attempt to increase the percentage of azoospermia. These drugs may have direct anti-spermic effects on the testes and additively reduce pituitary FSH and LH. A combination of testosterone and Medroxyprogesterone Acetate (DMPA) injections achieved significant sperm reduction in most study participants, with half

reaching complete sperm absence. However, this regimen failed to prevent pregnancies, even when combined with additional birth control methods.[23]

GnRH (Gonadotropin Releasing Hormone) antagonists or agonists are used to suppress the hypothalamus-pituitary-gonadal axis, effectively reducing sperm count to levels that prevent fertilization. Studies have shown that GnRH agonists do not result in sufficient gonadotropin and spermatogenesis suppression.[24,25]

Researchers have made significant progress in developing convenient, self-administered male hormonal contraceptives. Recent focus has shifted to oral and topical methods, enhancing user ease. Several promising drugs dimethandrolone undecanoate, 11β-methyl-19-nortestosterone17-beta-dodecylcarbonate and 7α-methyl-19-nortestosteron are currently undergoing clinical trials. If proven effective and safe, these agents hold tremendous potential for real-world application.[26]

Male Non-Hormonal Contraception

Non-hormonal male contraception is a method of birth control that does not use hormones or solution that affect testosterone level. These contraceptives can have fewer side effects than hormonal contraceptives because they don't impact testosterone concentrations. Non-hormonal male contraceptives primarily work by targeting specific molecules, such as proteins, enzymes, ion channels, or transporters essential for sperm development and function. These targets are often proteins uniquely expressed in the testes (within germ, Sertoli, or Leydig cells), on the sperm surface, or in the epididymis. By disrupting their function with antagonist compounds, these methods impair sperm production, maturation, or mobility. Recent development in proteomics and genomic research as well as technological advancement have also helped in the characterization and identification of specific proteins and genes expressed special in the testes, epididymis or other part of the male fertility system, which could serve as potential drug targets for developing non-hormonal male contraceptives in the future.[27]

Normally, the non-hormonal methods for male contraception focus either on preventing sperm production (spermatogenesis), interrupting sperm maturation within the epididymis, or blocking sperm transport through the male reproductive system. These methods work without involving the use of testosterone, progestins or other hormone and does not disturb the hypothalamus-pituitary axis. Non-hormonal ways of male contraception may be better acceptable for human use because the activities of androgen-dependent organs such as the prostate would most likely not be affected. Furthermore, these procedures may cause an early onset of infertility and rapid reversibility.[9,28,29]

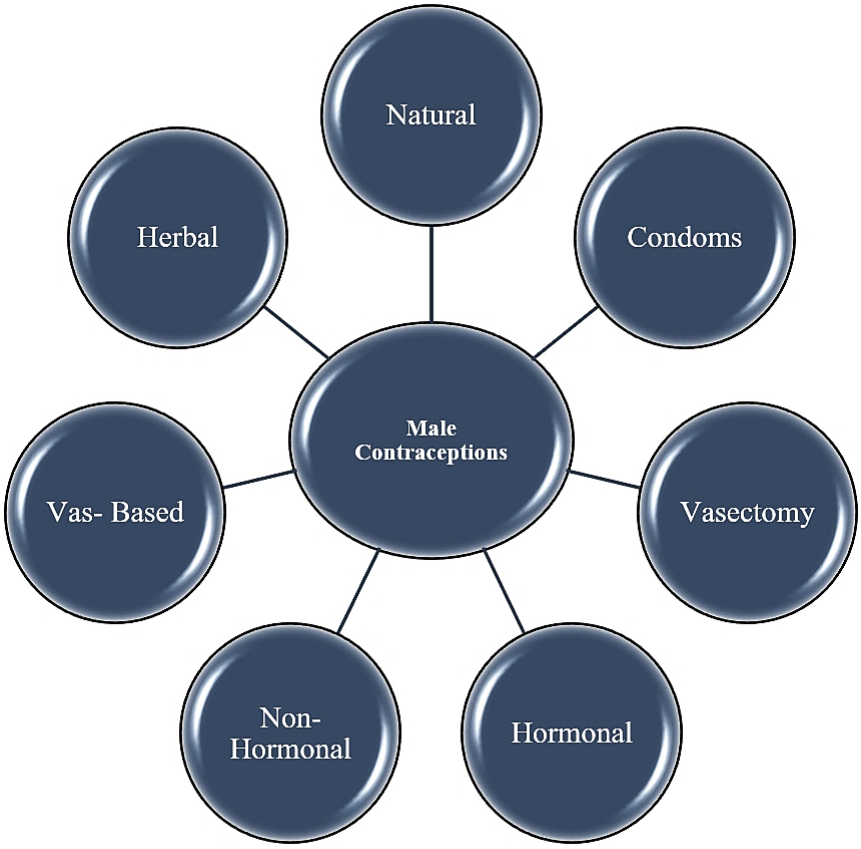

Figure 1: Various methods of Male Contraception.

Some non-hormonal male contraceptives function in following manner

- Inhibiting sperm proteins: Non-hormonal contraceptives can block proteins involved in sperm production, release, or function.[30]
- Reversibly occluding the vas deferens: This method prevents sperm transport to the ejaculate.[31]
- Inhibiting retinoic acid biosynthesis and function: this approach effectively halts sperm maturation without altering hormone levels.[32]

Vas-Based Methods

Vas-occlusion method is one of the important approaches being perused for the creation of male contraceptive option with the purpose of finding suitable alternative of vasectomy showing high efficacy as well as easy reversibility. Vas-occlusion methods were first developed by Chinese researchers. Zhou (1990) performed "percutaneous delivery of Medical Grade Polyurethane Elastomer (MPU) plugs into the vas deferens of native men and reported a 98% azoospermia rate after one year." But due to the uncertainty about the safety of the MPU, further studies were stopped. In another study, Zhou *et al*., (1992) examined the effectiveness of percutaneous injection of medical-grade silicone in Chinese men and reported significant fall in sperm counts (≤1 million sperm/mL) after 8-9 months.[33,34]

Two vas-based male contraceptive approaches have undergone advanced clinical trials and possibly to be approved for clinical use by men. These are (i) The "Reversible Inhibition of Sperm Under Guidance (RISUG)" and (ii) the vasal gel. RISUG was developed by Dr. S. K. Guha and is under process of development in India for the last three decades. RISUG is a formulation consisting of the polymer "Styrene Maleic Anhydride" (SMA) mixed in solvent Dimethyl Sulfoxide (DMSO). When RISUG is administered into the vas deferens using a no scalpel technique, the SMA polymer precipitates and solidifies and produces the blockage to sperm transport by forming occlusion.[35,36]

Vasalgel is mechanistically similar to RISUG and comprises SMA acid dissolved in DMSO, instead of anhydride as used in RISUG. The polymers polymerize and becomes gel that becomes mechanical obstruction to the passage of sperm. The gel allows fluid from semen to pass but retains spermatozoa.[19,29]

Herbal Approach for Male Contraception

The herbal approach to male contraception focuses on the use of plant-based compounds that can naturally influence reproductive functions. Plant elements such as flavonoids, tannins, terpenes, quinines, diterpenoids and lactones are believed to have a contraceptive effect through a distinct mechanism.[37]

Herbal contraceptives work on specific aspects of male fertility, such as sperm production, motility, or viability, through a variety of mechanisms. Medicinal plants/herbs with medicinal properties are good sources of many novel bioactive phytochemicals with new chemical entities of wide structural diversity which can be used as bioactive compounds, as drug precursors or as drug prototype.[38-40]

Developing new fertility-regulating agents from medicinal plants is a promising approach because plant-based contraceptives are more affordable, widely accessible and tend to have fewer harmful side effects.[41,42]

One of the important breakthroughs in this field of plant based male contraceptive development was the discovery of gossypol (a polyphenolic compound extracted from cotton plant) and triptolide (a diterpenoid compound derived from *Trypterigium wilfordii*) by Chinese scientists. The results of the clinical studies suggested that gossypol as contraceptive for male was highly effective, however, due to narrow therapeutic window, frequent association with hypokalemia and poor recovery of spermatogenesis after cessation of the treatment.[43,44]

Herbal compounds often have reversible effects, meaning fertility could return once their use is stopped. This quality makes them an exciting option for research into safe, temporary male contraception. However, extensive clinical trials are essential to ensure these methods are both effective and safe for human use.[45]

Herbs are a remarkable source of nutrients that play a vital role in maintaining and promoting a healthy life. According to statistics from the World Health Organization (WHO), approximately 65-80% of the global population depends on plant-based remedies and healthcare products, primarily due to limited access to modern medical facilities and challenging living conditions. Herbal preparations have long been part of oral traditions and are gaining popularity in modern times. With the growing demand for natural remedies and medicines, people increasingly favour them, driven by the belief that they are free from adverse effects-making them a hidden blessing.[46,47]

Herbal products have drawn significant attention from scientists as a primary source of natural antifertility agents due to their minimal or negligible side effects. In India, for example, numerous medicinal plants have been identified with antifertility properties, which work by either suppressing spermatogenesis or preventing implantation.[38] Various methods of male contraceptives are illustrated in Figure 1.

Antifertility studies of medicinal plants

An overview of various plants reported in last decade (2014-2024) having antifertility effects in studies using different animal models, is provided in Table 1 and arranged year wise. These medicinal plants have been studied for their abilities to influence male reproductive functions, showing effects such as reduced sperm count, decreased motility, or inhibited spermatogenesis.

Table 1: Various Antifertility Studies of Medicinal Plants.

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Terminalia chebula (Retz.) (Combretaceae)	Bark	Aqueous extract	Albino Mice	300 mg/kg BW for 35 days, orally.	Research revealed significant declines in fructose levels within the seminal vesicles and sialic acid concentrations in the epididymis of treated mice. Moreover, fertility rates decrease in extract-treated mice compared to control groups. Additional findings indicated substantial reductions in sperm motility, viability and overall count in treated mice. Notably, the incidence of morphologically abnormal spermatozoa in the cauda epididymidis of Terminalia-treated mice was markedly higher than in control groups.	[48]
	”	Bark	Aqueous extract	Albino Mice	100, 300 and 500 mg/kg BW daily for 35 days, orally.	The testicular histology of treated mice exhibited degenerative changes. Key sperm characteristics, enzyme activities of 17β- and 3β-Hydroxysteroid Dehydrogenases (HSDs), protein expressions of Steroidogenic Acute Regulatory (StAR) and Androgen Receptor (AR) and AR immunoreactivity were significantly impaired. Moreover, serum testosterone levels were disrupted. Notably, treated males experienced substantial fertility suppression without evident toxic effects.	[49]
	Curcuma longa (Zingiberaceae)	-	Aqueous extract	Wistar Rat	150 mg/kg BW for 52 days, orally.	The study showed sustained increase in sperm abnormality parameters and a decline in sperm concentration, although these changes did not reach statistical significance. Morphological assessments of the testis and seminal vesicle showed no notable variations. Furthermore, curcumin supplementation did not exhibit a statistically significant impact on sperm quality, testicular morphology, morphometry and seminal vesicle weight.	[50]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Hibiscus-rosa-sinensis (Malvaceae)	Leaves	Aqueous, Ethanol and Benzene	Albino Mice	100 mg/kg BW for 35 days, orally.	Exposure to Hibiscus extract led to detrimental effects on sperm health, characterized by reduced motility, viability and sperm count in the cauda epididymidis. Moreover, the frequency of morphologically abnormal spermatozoa increased significantly. Concurrently, epididymal sialic acid and seminal vesicle fructose levels decreased substantially. Furthermore, fertility rates plummeted in male mice treated with the benzene extract	[51]
	Aloe barbadensis Miller (Asphodelaceae)	Gel and Leaves	Aqueous extract	Albino Rats	10, 30 and 70 mg/kg BW daily for 30 days, orally.	Both Gel and leaves cause significant decrease in testosterone levels and non-significant reduction in FSH levels observed and rising in LH levels also were non-significant observed. Histopathology in the testicular tissues of the rats in the treatment groups, reveal that there were no Leydig cells and just a few spermatozoa in the lumen of seminiferous tubules	[52]
	Momordica charantia L (Cucurbitaceae)	Fruits	Ethanolic extract	Mice	100, 80, 60 mg/100g BW for 35 days, orally.	Exposure to the treatment outcome were a dose-dependent decline in sperm numbers, motility and sperm viability with higher doses yielding more pronounced effects. Moreover, sperm morphology was only significantly altered at the highest dose.	[53]
	Cordia dichotoma Forst. (Boraginaceae)	Fruits	Hydroethanolic extract	Wistar Albino Rats	125, 250 and 500 mg/kg BW for 56 days, gastric tube.	Administration of the 500mg/kg extract significantly compromised sperm quality, evidenced by reduced total count, motility and viability. But, abnormal sperm morphology increased substantially (26.67% ± 0.54). Hormonal assays revealed notable decreases in Follicle-Stimulating Hormone (FSH), Luteinizing Hormone (LH) and testosterone levels compared with controls.	[54]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Butea monosperma (Lam.) *Taub.* (Fabaceae)	Flowers	Methanolic extract	Albino Rats	50 and 500 mg/kg BW for 30, 90 and 180 days, respectively (orally).	Prolonged exposure to 500 mg/kg of extract for 180 days resulted in marked reductions in testicular and epididymal weights. Sperm parameters, including count, motility and viability, exhibited significant declines. Histological assessments revealed disruptions in testicular germ cell architecture, affecting multiple stages of spermatogenesis	[55]
	Xylopia aethiopica (Annonaceae)	Seeds	Aqueous extract	Wistar Rats	250, 500 and 1000 mg/kg BW for 56 days, orally.	The research demonstrates significant increases in body and testicular weights in treated groups compared to controls. Conversely, sperm characteristics exhibited significant declines at 500 mg/kg and 1000 mg/kg extract doses. Histological examination of testicular tissue revealed extract-induced damage, characterized by reduced tubular density and atrophy.	[56]
	Mentha longifolia L. (Lamiaceae)	Leaves	Methanolic extract	Sprague Dawley Rats	50, 75 and 100 mg/kg BW for 28 days, orally.	All treatment groups produced significantly more reactive oxygen species. The level of FSH, LH and testosterone were significantly lower in a dose-dependent manner across experimental groups. In contrast to the control group, a significant decrease in daily sperm production rate was revealed in the 100 mg group. At higher dose, reduction in spermatogonial population, developed spermatids, seminiferous tubule diameter, luminal radius and height of epithelial were observed.	[57]
	Waltheria indica Linn. (Malvaceae)	Roots	Ethanolic extract	Wistar Rats	200, 500, or 1000 µg/kg BW for 15 consecutive days, orally.	The dichloromethane-soluble fraction (500 µg/kg) demonstrated a significant reduction in sperm concentration, testosterone levels and FSH levels. It also caused notable damage to the testicular interstitial and spermatogenic cells. Similarly, extract significantly decreased sperm motility.	[58]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Andrographis paniculata (Acanthaceae)	Leaves	Aqueous extract	Wistar Rats	250, 500 and 1000 mg/kg BW for 8 weeks, orally.	In comparison to the control group, extract treatment resulted in significantly lower sperm count, motility and viability levels. Extract treatment also altered spermatogenesis and lowered serum testosterone levels. The extract decreased malondialdehyde, nitric oxide, TNF α and IL-6 levels in the testes, as well as the activities of xanthine oxidase and myeloperoxidase. However, it increased the levels of reduced glutathione and superoxide dismutase.	[59]
	Spondias mombin (Anacardiaceae)	Leaves	Ethanolic extract	Guinea Pigs	100, 250 and 500 mg/kg BW for 60 days orally.	The extract-treated guinea pigs had significantly decreased sperm counts, sperm motility, normal morphology of sperm, sperm density, sperm survival and semen viscosity. Following administration of the extract, serum levels of LH, testosterone and estradiol decreased while FSH increased significantly. The extract decreased enzyme activity in a dose-responsive manner, including alkaline phosphatase, glutamate dehydrogenase, malic enzyme, 3-hydroxy-3-methylglutaryl coenzyme A reductase, 17-β-HSD, lactate dehydrogenase, catalase and superoxide dismutase. It also reduced concentration of testosterone, glycogen, total protein and ascorbic acid in the testes, with statistically significant changes from the control group.	[60]
	Citrullus colocynthis and *Delonix regia*	Fruits	Methanolic extract	Wistar Rats	100 mg/kg BW for 60 days, orally.	sperm density, testes weight, sperm motility and fertility indices were decreased significantly in rats treated with extract treatment in comparison with controls The Histopathological micrographs of testicular tissue section demonstrated regressive alterations in germinal epithelium, spermatocytes, spermatid and spermatozoa, with a significant decrease in the number of sperms following extract treatment.	[61]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Raphanus sativus (Brassicaceae.)	Roots	Aqueous extract	Wistar Albino Rats	1, 2 and 5 mL/100 gm BW for 30 days, orally.	Extract showed significantly reduced sperm numbers and sperm motility. Reduction in testis weight and epididymis was observed in extract treated groups compared with control. The percent sperm abnormalities were observed to be increased in treated group compared to the control group.	[62]
	Areca catechu (Arecaceae)	Seeds	Aqueous extract	Sprague Dawley Rats	50 mg/kg BW for 35 days, orally.	The testis weight in the extract-treated group was less compared to the control group. The histology of the testis revealed shrinkage, reduced radius of seminiferous tubules and cytolytic lesions in the germinal layer, resulting in lower total and progressive sperm numbers compared to the control group. There were no abnormalities in Leydig cell or interstitium tissue. Subsequently male rats were unable to fertilize female rats.	[63]
	Clerodendrum serratum (Lamiaceae)	Aerial parts of the plant	Methanolic extract	Albino Rats	100, 300 and 500 mg/kg BW for 30 days, orally.	A significant decreased in the weight of testis, epididymis and seminal vesicle was found in all treated groups compared to the control groups. When compared to control animals, extract markedly raised the levels of ascorbic acid and cholesterol in the testicular tissues of treated animals at all dosages. Extract showed very significant reduced in serum testosterone, FSH and LH levels as well as significantly improved the histological composition of the epididymis compared to control rats	[64]
	Anethum graveolens (Apiaceae)	Whole plant	Ethanolic extract	Rabbit	0.5 gm./kg B.W for 30 days, orally.	The ethanolic extract adversely affected sperm parameters, hormone levels (LH, FSH, testosterone) and testicular histology Including Sperm motility, count and viability decreased, while abnormal sperm percentage increased. Likewise histological changes included Sertoli cell vacuolation, suppressed spermatogenesis and interstitial tissue damage.	[65]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Abrus precatorious, *Ricinus communis* and *Syzygium aromaticum*	Seeds, Seeds, Fruits	Aqueous extract	Swiss Albino Mice	4.4 mg/kg BW for 42 days, orally.	Treatment significantly reduced testicular size and altered histology, characterized by decreased seminiferous tubules, Sertoli and Leydig cells and intra-luminal spermatozoa. Derangement of tubular structure, fibrosis and vacuolation were observed.	[66]
	Ficus sycomorus (Moraceae)	Leaves	Aqueous extract	Wistar Rats	500 and 1500 mg/kg BW for 56 days, orally.	Treatment induced significant reproductive harm, characterized by reduced testicular/epididymal weigh., sperm indices and motility. Histological changes included dose-dependent seminiferous tubule distortion and sperm depletion, leading to oligospermia (low dose) and azospermia (high dose).	[67]
	Asplenium dalhousiae Hook. (Aspleniaceae)	Leaves	Methanol extract	Sprague Dawley Rat	0, 50, 100, 150 mg/kg BW for 28 days, orally.	Treatment induced reproductive toxicity, evidenced by decreased sperm motility, viability and production. Hormone level decrease (testosterone, FSH) with testicular histological changes (disorganized seminiferous tubules, reduced spermatocytes) were observed. Antioxidant enzymes (catalase, superoxide dismutase, peroxidase) were also depleted.	[68]
	Allium sativum (Amaryllidaceae)	Bulb	Aqueous extract	Swiss Albino Mice	1000 mg/kg BW for 50 days, orally.	Exposure to the treatment led to detrimental effects on sperm parameters, including a marked decrease in sperm count. Seminal pH levels also showed a significant decline. Furthermore, sperm motility was severely compromised, suggesting impaired reproductive capacity.	[69]
	”	Bulb	Methanol extract	Swiss Albino Mice	500 and 1000 mg/kg BW for 13 days, orally.	A pronounced reduction in testicular sperm count and daily sperm production had elicited by the treatment, with highly significant effects recorded.	[70]
	Calotropis procera (Asclepiadaceae)	Aerial parts	Aqueous extract	Wistar Rat	5,10 and 15 mg/kg BW, for 4 weeks, orally.	Exposure significantly impacted reproductive health, decreasing body weight, testicular and epididymal weights and hormone levels. Meanwhile, sperm defects and seminiferous epithelial damage showed significant increases.	[71]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Chenopodium ambrosioides hook. (Chenopodiaceae)	Leaves	Methanol extract	Sprague Dawley Rat	0,50, 100 and 150 mg/kg BW for 28 days, orally.	A dose-dependent reduction in sperm quality was observed, characterized by decreased motility, viability and daily sperm production. Concurrently, oxidative stress increased in reproductive organs and histological disruptions occurred in testicular and epididymal tissues. Hormonal changes included decreased plasma testosterone, FSH and LH levels.	[72]
	Ceasalpinia bonducella (Caesalpiniaceae)	Seeds	Ethanolic extract	Swiss Mice	500 mg/kg BW every other day, totalling 10 doses per mouse, orally.	The treatment caused significant reproductive harm, evidenced by reduced testicular weight and sperm count. Testicular histology and flow cytometry revealed cellular abnormalities, including G1 arrest and impaired DNA synthesis.	[73]
	Ruellia tuberosa L. (Acanthaceae)	Roots	Powder	Swiss albino Mice	50 mg/kg BW for 15 days and 30 days, orally.	Exposure to root powder led to a substantial decline in sperm parameters, with motility and viability and sperm count plummeting to 19.24±1.74 million/mL from 55.12±4.63 million/mL in controls.	[74]
	Centella asiatica (Apiaceae)	Whole plant	Ethanolic extract	Sprague Dawley Rats	300 mg/kg BW for 42 days, by mouth.	Results indicated a substantial increase in male infertility within the treatment group, affecting 43.75% of subjects, whereas the control group reported an infertility rate of 18.75% Treatment resulted in a substantial decline in implantation sites, with treated groups exhibiting a mean count of 100.00±2.82, compared to 183.00±2.14 in controls. Proteomic profiling revealed distinct differences in protein expression between treatment and control groups, with 234 spots identified in treated groups versus 282 in controls.	[75]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Achyranthes aspera (Amaranthaceae)	Leaves	Methanolic extract	Albino Mice	25 and 50 mg/100 gm BW for 30 days, orally.	Treatment with leaf extracts significantly reduced testicular weight. Morphometric analysis revealed significant decreases in testicular diameter, seminiferous tubule diameter and Leydig cell count at 50 mg/100 gm body weight, compared to controls. Spermatogenic elements, including spermatogonia, spermatids and spermatocytes, showed significant reductions in treated testes. Similarly, Leydig cell counts decreased significantly. Biochemical analysis of treated testes revealed significant decreases in protein, glycogen and cholesterol content. Conversely, alkaline phosphatase activity increased, while acid phosphatase activity decreased, compared to controls.	[76]
	Annona squamosa (Annonaceae)	Leaves, Bark and Seeds	Ethanolic extract	Albino Rats	200 and 300 mg/kg BW for 28 days, orally.	Exposure to ethanolic extracts of plant leaves, bark and seeds showed a significant reduction in fructose levels in testis, vas deferens and seminal vesicles, as well as a decrease in sperm count and motility compared to control rats. The diminished fructose levels, sperm counts and motility has been found to be duration and dose responsive. The effects of various plant parts, including leaves, bark and seeds, were in the following order: leaf < bark < seed.	[77]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Juniperus sabina (Cupressaceae)	Fruits	Powder (Podophyllotoxin Extracted)	Sprague Dawley Rats	0.8 and 1.25 g/kg BW for 8 weeks, orally.	Treatment with podophyllotoxin induced significant reproductive toxicity in rats. Notably, motile sperm percentage from the caudal epididymis decreased substantially in treated groups compared to controls. Moreover, sperm morphology analysis revealed a marked increase in abnormal sperm types, including tailless, headless and broken sperms. Fertility was also severely impaired, with a significant decline observed in the 1.25g/kg dose-treated group comparison to controls. At the cellular level, podophyllotoxin restricted epididymal epithelial cell proliferation and promoted apoptosis. Molecular analysis revealed upregulation of pro-inflammatory cytokine TNF-α and key apoptotic markers, including cytochrome c, caspase-8, caspase-9 and caspase-3. These studies suggest that podophyllotoxin's reproductive toxicity is mediated by its ability to disrupt epididymal cell function and trigger apoptosis.	[78]
	Aegle marmelos (L.) *Corr.* (Rutaceae)	Leaves	Aqueous extract	Swiss Albino Mice	350mg/kg BW for 30 days, orally.	A highly signifying deterioration in sperm quality was observed, characterized by reduced count, altered seminal pH and impaired motility, accompanied by a marked rise in abnormal sperm morphology.	[79]
	Aloe vera (Asphodelaceae)	Leaves	Aqueous extract	Wistar Albino Rat	25 mg/kg BW for 30 days orally.	Seminal vesicle weight decreased significantly, accompanied by degenerative changes, including flattened secretory mucosal folds and a reduced muscular layer thickness.	[80]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	”	Leaves	Aqueous extract	Albino Rat	25 mg/kg BW for 30 days, orally.	Histopathological examination of testis revealed severe damage, characterized by atrophic tubules, germ cell debris and vacuolization of Sertoli cells. Moreover, seminiferous tubules were devoid of spermatozoa, indicating impaired spermatogenesis. Concurrently, serum levels of luteinizing hormone (LH), follicle-stimulating hormone (FSH) and testosterone exhibited significant decreases.	[81]
	Andrographis peniculata (Linn) (Acanthaceae)	Leaves	Methanolic extract	Sprague Dawley Rat	800 mg/kg BW for 14 days, orally.	Sperm quality was drastically compromised, with marked decreases in count, viability and motility. Histopathological analysis showed seminiferous tubules with reduced sperm density, regressed Leydig cells and compromised Sertoli cell function, leading to impaired spermatogenesis	[82]
	”	Whole plant	Aqueous extract	Albino Rat	20 mg/100 g BW for 30 days, orally.	The treatment leading to notable decreases in both body and testicular weights as well as sialic acid content and acid phosphatase activity were markedly reduced. These changes had far-reaching consequences for reproductive health.	[83]
	Plumeria rubra (Apocynaceae)	Bark	Methanolic extract	Sprague Dawley Rat	50, 100, 200 mg/kg BW for 60 days, orally.	The weight of the testes and accessory sex organs was reduced and the treatment slowed the process of spermatogenesis, which can lead to sterility in male rats.	[84]
	Taraxacum officinale (Asteraceae)	Whole plant and Leaves	Aqueous extract	Wistar Rat	1.06, 2.13, 2.30, 4.60 g/kg BW. for 60 days, orally.	Treated rats showed a significant reduction in weight of testis and seminal vesicle, a decrease in serum testosterone level, compromised sperm parameter and a reduction in pregnancy parameters. Structural alterations such as germ cell hypoplasia, decreased thickening of the germinal epithelium, arrest of spermatogenesis at the spermatid stage and a decrease in the number of Leydig cells were also seen.	[85]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Caesalpinia bonducella (Caesalpiniaceae)	Seeds	Ethanolic extract	Wistar Rats	200 and 400 mg/kg BW for 60 days, orally.	The weights of the testes and accessory sex glands were reduced in the treated rats. In both treatment groups' cauda epididymal sperm density, motility and viability were noticeably lower than those of the control group. Serum testosterone levels also decreased significantly. In addition, the extract lowered the reproductive rate and litter size in rats. The extract therapy also altered the biochemical environment of the reproductive organs.	[86]
	Tecomella undulata (Bignoniaceae)	Leaves	Petroleum Ether extract	Male Albino Rats	50, 100 and 200 mg/kg BW for 60 days, orally.	The weights of reproductive organs, including the testes, epididymides, seminal vesicles and ventral prostate, were significantly reduced in treated rats compared to controls. Sperm motility and density in the cauda epididymides also showed a marked decline, resulting in lowered fertility. Following treatment of leaf extract, levels of testosterone and LH hormones were significantly reduced. Protein, sialic acid, glycogen and cholesterol contents in the testes and accessory sex organs also dropped considerably. Histological examination of the testes revealed degenerative changes in the germinal epithelium, affecting all stages of spermatogenesis and aligning with the reduced sperm density observed in treated groups. Additionally, the intertubular space between seminiferous tubules increased compared to controls.	[87]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Coccinia indica (Cucurbitaceae)	Leaves	Ethanolic extract	Parkes Male Mice	200 and 500 mg/kg BW for 35 days, orally.	Exposure to Coccinia extract impaired male reproductive function in mice, leading to significant reductions in sperm motility, viability and count. Testosterone levels also decreased significantly in mice treated with the 500 mg dose, whereas the 200 mg dose had no effect. Moreover, epididymis and seminal vesicle function was compromised, as evidenced by reduced sialic acid and fructose levels. The treatment also inhibited 17β-HSD activity in the testis, further contributing to reproductive dysfunction. These dose-dependent effects underscore the potential risks of Coccinia extract to male reproductive health, emphasizing the need for caution and additional research.	[88]
	Salacia lehmbachii (Celastraceae)	Root and bark	Ethanolic extract	Albino Rats	250, 500 and 750 mg/kg BW for 56 days, orally.	Treated rats produced significant dose responsive reduction in weights and lengths of testes compared to control. The extract significantly decreased sperm count and fertilizing potential in all treated groups compared to control. Additionally primary and secondary sperm abnormalities were observed in treated rats and higher doses affected testicular cytoarchitecture.	[89]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Manilkara hexandra (Roxb.) *Dubard* (Sapotaceae)	Seeds	Aqueous extract	Albino Rats	2 g/kg BW for 21 days, orally.	The seed extract led to a significant reduction in the weights of the testes, epididymis, seminal vesicles and coagulating glands, vasa deferens and ventral prostate compared to controls. Treated rats showed diminished sperm counts relative to control rats, along with a notable decline in serum testosterone levels. Additionally, protein, cholesterol, alkaline phosphatase and acid phosphatase levels were significantly lower in both serum and testicular homogenate of treated rats. Histopathological analysis revealed that the crude extract effectively inhibited spermatogenesis, with some seminiferous tubules showing signs of necrosis and basement membrane rupture. The lumen diameter in treated rats was also larger than in controls.	[90]
	Barleria prionitis (Acanthaceae)	Roots	Methanolic extract	Albino Rats	5, 15 and 25 mg/kg BW for 60 days, orally.	The average weight of reproductive organs, serum levels of testosterone, FSH and LH, levels of protein, ascorbic acid, glycogen, fructose, sperm motility and sperm density were all considerably lower in treated group than in the control group. Furthermore, the cholesterol level rise sharply.Fecundity percentages were also reduced in treated groups. The BW remained unaltered.	[91]
	Costus speciosus (Costaceae)	Rhizome	Aqueous extract	Balb/C Mice	275, 550, 1100 mg/kg BW for 14 days, orally.	The results showed that after treatment of the extract, there was a significant reduction in sperm count, percentage of viability, motility as well as abnormal morphology of spermatozoa as compared with control group. The sperm count was reduced considerably after treatment at doses 550 and 1100 mg/kg (39 and 40% respectively) The body weights, weights of testes, epididymides and seminal vesicles of the experimental group were same the control group.	[92]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Tephrosia purpurea (Fabaceae)	Fruits	Ethanolic extract	Albino Rats	50, 100 and 200 mg/kg BW for 60 days, orally.	Protein, sialic acid and fructose levels, as well as LH and testosterone hormone concentration, were significantly decreased in extract treated rats than in the control group. The body weight of the extract-treated rat did not change, but the weight of reproductive organs reduced dramatically as compared to the rats in the control group.	[93]
	Annona squamosa (Annonaceae)	Seeds	Aqueous extract	Rat	100 and 200 mg/kg BW for 60 days, orally.	The weights of the testes, epididymis, vas deferens, seminal vesicle and prostate glands decreased; histological analysis of the testes revealed a reduction in the diameter of seminiferous tubules as well as the thickening of germinal epithelial cells and the lumen of the tubules was discovered to be bereaved of sperm.	[94]
	Maytenus emargineta (Celastraceae)	Leaves	Aqueous Methanolic extract	Albino Rat	50,100,200 mg/kg BW for 60 days, orally.	Dose responsive reduction in the numbers and motility of the sperms in extract treated rats. significant decrease in seminal vesicles and testicular weight were also detected.	[95]
	Foeniculim vulgare Mill. (Apiaceae)	Seeds	Hydro-alcoholic extract	Wistar Rat	35, 70, 140 and 280 mg/kg BW for 60 days, orally.	The number of spermatogonia, primary spermatocytes, Sertoli cells and sperm count reduced significantly.	[96]
	”	Seeds	Aqueous extract	Rat	25, 70, 140 and 280 mg/kg BW for 60 days, orally.	The number of spermatogonia, Sertoli cells, numbers of primary spermatocytes and sperm counts reduced considerably in the treated groups, however the basement membrane thickened, as well as cell apoptosis also occurred. the germinal epithelium was organized irregularly.	[97]
	Phoenix dactylifera (Arecaceae)	Fruits	Aqueous extract	Wistar Rat	250, 500 and 1000 mg/kg BW for 35 days.	It resulted in the degeneration of spermatogenic cells, damage to seminiferous tubular membranes and destruction of Leydig cells. These effects were accompanied by a significant reduction in serum testosterone levels, as well as impairments in sperm count, motility and morphology.	[98]
	Opuntia elatior Mill. (Cactaceae)	Fruits	Methanol extract	Albino Wistar Rat	300, 900 mg/kg BW for 60 days, orally.	Epididymal spermatozoa count and motility was markedly decreased.	[99]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Cuminum cyminum (Apiaceae)	Seeds	-	Albino Rats	50 mg/day BW for 60 days, orally.	There were no significant changes in BW, but there were major spermatogenesis abnormalities, including reduced numbers of round spermatids, preleptotene spermatocytes and secondary spermatocytes. Both the quantity of mature Leydig cells and the overall surface area of Sertoli cells dramatically declined. The morphology, density and motility of the sperm all displayed poor fertility. Testosterone levels drastically plummeted.	[100]
	Aspilia africana (Asteraceae)	Leaf	Methanolic extract	Wistar Rats	100, 200, 300 and 400 mg/kg BW for 52 days, intragastrically.	The weight of the experimental rats' testicles, epididymis, seminal vesicle and prostate gland was considerably reduced by the leaf extract compared to control group. In the experimental groups, serum testosterone levels were significantly reduced. The testes of the extract treated animals showed signs of degeneration, including fibrosis, cytoplasmic anomalies and disordered epithelial cells in contrast to the control group.	[101]
	Piper betel L. (Piperaceae)	Leaf Stalk	Aqueous extract	Swiss Albino Mice	50 mg/kg BW for 10, 20, 30, 40 and 50 days, orally.	Significant reduction in sperm counts and motility of sperms also decreases in treated mice. The pH of seminal plasma also declines significantly in treated male.	[102]
	”	Leaves	Ethanol extract	Wistar Rat	50 mg/kg BW for 15days, orally.	Significant reduction in cauda epididymal sperm counts, motility, viability and blood testosterone levels were observed.	[103]
	Jussiaea repens (Onagraceae)	Shoots	Aqueous extract	Wistar Rats	200 mg/kg BW for 28 days, orally.	When comparing the treatment group to the control group, there was a substantial decrease in testicular and cauda epididymal weight, sperm motility, total cauda epididymal sperm counts, sperm viability and normal sperms. There was no significant change in body weight of experiment and control groups	[104]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Terminalia chebula (Combretaceae)	Fruits	Aqueous-ethanolic	Wistar Rat	60 mg/0.5 mL distilled water/day for 28 days, orally.	Significant reduction in spermatogenic profile and Plasma testosterone was observed. The seminiferous tubule diameter in the testes of the treated group rats' testicles significantly reduced according to a histology study.	[105]
	Dactyloctenium aegyptium (Poaceae)	Whole plant	Ethanolic extract	Albino Rats	200, 400 and 600 mg/kg BW for 30 days, orally.	All treatment groups exhibited a substantial decline in total sperm counts, an increase in motility and abnormalities in caput and caudal sperm as compared to control group. When compared to the control group, the weight of the testis, vas deferens, seminal vesicle, prostate and epididymis (caput and caudal) significantly declined in all treated groups. The extract dramatically raised serum estrogen levels while drastically lowered serum testosterone levels when compared to the control group.	[106]
	Citrus limon (Rutaceae)	Leaves	Ethanolic extract	Parkes Mice	500 and 1,000 mg/kg BW for 35 days, orally.	Citrus-treated group showed significant reductions in epididymal sperm parameters and serum testosterone levels compared to controls. Males treated with the extract also had reduced fertility. Treatment demonstrated negative effects on steroidogenic markers in the testicular tissue and caused germ cell death.	[107]
	Cuminum cyminum (Apiaceae)	Seeds	Hydro-methanolic extract	Wistar Albino Rats	30, 60 and 120 mg/100g BW for 28 days, orally.	Relative sex organ weights significantly decreased after treatment with the extract. Testicular cholesterol increased, & plasma testosterone levels, seminal fructose levels and androgenic key enzyme activity significantly decreased as compared to the control group. Lipid peroxidation end products in the testis, epididymis and sperm pellet were markedly increased in treated groups, whereas spermatological indices and anti-oxidative enzyme activities were drastically decreased.	[108]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Citrullus colocynthis Schrad (Cucurbitaceae)	Fruits	Ethanol extract	Albino Rat	25,50 and 75 mg/kg BW for 6 weeks.	Significant decrease of serum testosterone, LH and FSH concentration. Some seminiferous tubules have no spermatogenic cells at all. Relative testicular weight also has significantly decreased.	[109]
	"	Stem And Leaves	Methanol extract	Albino Rat	75 and 150 mg/kg BW for 60 days, orally.	significant decrease in sperm concentration and testicular weight. Spermatogenesis was impacted by a decline in serum levels of testosterone, FSH and LH. The quantity of spermatogonia remained extremely low and degenerative changes and disruptions of spermatogenesis were observed.	[110]
	Curcuma longa (Zingiberaceae)	Rhizome	Aqueous extract	Swiss Albino Mice	500 mg/kg BW for 10, 20, 30, 40 and 50 days, orally.	Sperm counts, sperm motility and seminal pH of the cauda epididymis all decrease significantly after 30 to 50 days of treatment.	[111]
	Ficus bengalensis (Moraceae)	Leaves	Ethanolic extract	Albino Mice	200 and 500 mg/kg BW for 35 days, orally.	Treatment significantly reduced motility, viability and sperm count in cauda epididymis compared to controls. The 500 mg dose of the extract dramatically reduced the fertility of male mice. Testes of mice treated with extract showed degenerative histological alterations in the seminiferous tubules. Body weight, normal histoarchitecture of the liver, kidney, adrenal gland and spleen and blood levels of creatinine, aspartate aminotransferase and alanine aminotransferase did not change significantly from controls in extract-treated mice.	[112]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Pistia stratiotes Linn. (Araceae)	_	Ethanolic extract	Mice	100 and 200 mg/kg BW for 45 days, orally and 50 mg/kg BW for 45 days of isolated saponin.	According to the results, the most active extract was the ethanolic extract, which was administered at a dose of 200 mg/kg body weight. The weight of reproductive organs, such as the testis, epididymis, seminal vesicle were reduced as well as Sperm count and sperm viability, significantly decreased following a 50 mg/kg body weight injection of isolated saponin. Additionally significant increase in the number of abnormal spermatozoa compared with that of the control group, When compared to the control group, the saponin-treated groups' serum testosterone levels drastically decreased.	[113]
	Jussiaea repens (L) (Onagraceae)	All parts except root	Aqueous extract	Wistar Albino Rats	200 mg/kg BW for 28 days, orally.	After treatment, there was a significant reduction in protein content, Zn, ATPase and LDH activities in the epididymis, indicating anti-gonadal activity. Aqueous extract reduced testicular ascorbic acid, glycogen, Δ5-3β and 17β HSD, G-6PDH, ATPase and LDH activities while increasing cholesterol levels. Although non-cholesterol and LDL levels dramatically increased, the treated group's serum triglycerides, LDH, VLDL and G-6PDH were significantly lower, HDL stayed the same and Zn content decreased marginally.	[114]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Piper betel L. (Piperaceae)	Leaf Stalk	Ethanolic extract	Albino Rats	150 mg/Kg BW for 15 days, orally.	Notably, a reduction in serum testosterone levels was found with lower reproductive organ weights. Lactate dehydrogenase activity was decreased in the testes and sexual accessories such as the epididymis and seminal vesicle and increased in the prostate gland. The enzymatic alterations were identified in comparison to male control rats. Decrease in Glu-6-phos. dehydrogenase activity was reported.There may be less energy available to sperm cells as a result of the notable decline in testicular glutamate dehydrogenase activity, a biochemical indicator used to identify mitochondrial damage. Additionally, it alters the chemical composition of prostatic fluid and seminal plasma, resulting in abnormalities in sperm.	[115]
	Phyllanthus amarus (Phyllanthaceae)	Leaves	Aqueous extract	Wistar Rats	150, 250, 350 mg/ kg BW for 28 days, orally.	LH and testosterone concentration in the tested groups decreased in a dose-dependent manner when compared to the control group, according to the extract's effect on reproductive hormones. FSH levels increased in treated groups in a progressive dose-responsive manner when compared to the control group. little rise in the test animals' body and organ weights as compared to the control group.	[116]
	Salsola imbricata (Amaranthaceae)	Whole plant	Ethanolic extract	Albino Rats	250 and 500 mg/ kg BW for 65 days, orally.	The sperm count decreased significantly in both treatment groups, but only the high dose group experienced a significant decrease in epididymal sperm motility. Morphological abnormalities were found in the sperm of treated animals. Serum FSH, LH and testosterone concentrations did not differ significantly.	[117]

F	Name of the plant	Part Used	Type of extract	Animal model	Dose, duration and route	Observation and results	References
	Lactuca sativa (Asteraceae)	Seeds	Aqueous and Hydro- alcoholic extract	Swiss NMRI Mice	hydro-alcoholic (200 mg/kg) aqueous extracts (50, 100mg/kg) daily for 10 days, intraperitoneally.	In comparison to the control group, sperm viability and sperm counts dramatically declined in the hydro-alcoholic and aqueous extracts 50 and 100 mg/kg groups. Furthermore, the aqueous extract 50 mg/kg group's blood testosterone levels significantly increased in comparison to the control hydro-alcoholic and aqueous extract (100 mg/kg) groups.	[118]
	Achyranthes aspera Linn. (Amaranthaceae)	Root	Hydroethanolic extract	Rats	100 and 200 mg/kg BW for 60 days, orally.	Extract treatment caused the testis's seminiferous tubules to shrink, spermatogenic disruption to occur and Leydig cell degeneration to occur. Spermatozoa in the epididymal lumen decreased as a result of the blocking of prostate secretions and seminal vesicles. The amount of testosterone in the blood dropped dramatically.	[119]
	Carica papaya (Caricaceae)	Root	Methanol extract	Wistar Rat	75 mg/kg BW for 60 days.	A significant decrease in sperm count was observed, accompanied by a notable increase in the percentage of defective sperm cells, indicating compromised spermatogenesis and potential fertility impairment.	[120]
	Eugenia singampattiana (Myrtaceae)	Leaves	Ethanol extract	Rat	5 mg/kg BW for 14 days, orally.	The testes and epididymis had relatively lower weight. Reduction in epididymal spermatozoa counts, motility was observed with decreased level of testosterone.	[121]
	Hibiscus-rosa sinensis (Malvaceae)	Flowers	Benzene extract	Albino Rat	200 mg/kg BW for 30 days, orally.	Treatment resulted in a pronounced and statistically significant decline in testicular sperm count, indicating a substantial impairment in sperm production and potentially compromising fertility.	[122]

CONCLUSION

In conclusion, extensive research over the past decade has focused on investigating the contraceptive properties of numerous medicinal plants, with the aim of developing an herbal-based male contraceptive. These studies have identified various plants capable of influencing key aspects of male reproductive health, such as hormone regulation, spermatogenesis and sperm function, without major impacts on general body health. This research highlights the potential of natural, plant-derived compounds as promising candidates for safe, effective and reversible male contraceptive agents. It was obvious that the aforementioned herb had considerable antifertility properties. The review revealed that several of the plants traditionally used to reduce fertility have promising use in birth control. As a result, it is noted that may focus the researcher's attention on clinical trials, which could pave the way for developing herbal-based male contraceptives, representing a significant scientific contribution to society.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

GnRH: Gonadotropin Releasing Hormone; **WHO:** World Health Organization; **HSDs:** hydroxysteroid dehydrogenases; **StAR:** Steroidogenic Acute Regulatory; **AR:** androgen receptor; **FSH:** follicle-stimulating hormone; **LH:** Luteinizing Hormone; **TNF:** Tumor necrosis factor; **IL:** Interleukin; **LDH:** Lactate dehydrogenase; **HDL:** High density lipoprotein; **G-6PDH:** Glucose-6-phosphate dehydrogenase; **ATPase:** Adenosine Triphosphatase; **VLDL:** Very low-density lipoprotein; **STI:** Sexually Transmitted Infections; **DMSO:** Dimethyl Sulfoxide; **BW:** Body Weight.

SUMMARY

Rapid population growth is a significant global challenge, particularly in developing nations. In market, numerous birth control methods are available, but due to their harmful effects, herbal alternatives are getting more popular because of their lower cost, easier availability and less side effects. Over the past decade, extensive research has focused on identifying medicinal plants with contraceptive properties to develop safe and effective herbal-based male contraceptives. Numerous plant species have demonstrated the ability to influence male fertility. This review explores the antifertility potential of medicinal plants, highlighting their impact on male reproductive health. Additionally, it emphasizes the need for multidisciplinary research to advance these findings toward clinical applications.

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