

Exploring scientifically proven herbal aphrodisiacs

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ABSTRACT

Procreation was an important moral and religious issue and aphrodisiacs were sought to ensure both male and female potency. Sexual dysfunction is an inability to achieve a normal sexual intercourse, including premature ejaculation, retrograded, retarded or inhibited ejaculation, erectile dysfunction, arousal difficulties (reduced libido), compulsive sexual behavior, orgasmic disorder, and failure of detumescence. The introduction of the first pharmacologically approved remedy for impotence, Viagra (sildenafil) in 1990s caused a wave of public attention, propelled in part by heavy advertising. The search for such substances dates back millennia. An aphrodisiac is an agent (food or drug) that arouses sexual desire. The hunt for natural supplement from medicinal plants is being intensified mainly because of its fewer side effects. In this review, we have mentioned the pharmacologically tested (either in man or animal or in both) aphrodisiac plants, which have claimed for its uses.

Key words: Aphrodisiac plants, herbal aphrodisiacs, impotence, sex stimulants

INTRODUCTION

An aphrodisiac is defined as any food or drug that arouses the sexual instinct, induces veneral desire and increases pleasure and performance. This word is derived from *ĒAphroditeí* the Greek Goddess of love and these substances are derived from plants, animals or minerals and since time immemorial they have been the passion of man.^[1] A lot of natural substances have historically been known as aphrodisiacs in Africa and Europe, like yohimbine and the mandrake plant, as well as ground rhinoceros horn in the Chinese culture and “Spanish fly” which is actually toxic.^[2,3] Even in today’s culture, there are certain foods that are used as aphrodisiacs, including strawberries and raw oysters. Chocolate, coffee, and honey are also believed to have aphrodisiac potential. Although these natural items are claimed as aphrodisiacs, there is no or little scientific confirmation supporting those assertions.

In a recent study conducted in the Boston area, 52% of men between the ages of 40 and 70 reported some degree of erectile dysfunction (ED). Enhanced sexual behavior may provide increased relationship satisfaction and self-esteem in humans.^[4] The hunt for an effective aphrodisiac has been a constant pursuit throughout history. The role of various dopaminergic, adrenergic, and serotonergic agents has been intensively examined in both human and animal studies. Some of these drugs have been considered for their potential role for the treatment of sexual dysfunction, while some others have contributed to the basic neurophysiological processes in sexual arousal.^[5]

Aphrodisiacs can be classified by their mode of action into three types: Those that increase libido, potency, or sexual pleasure. Various substances of animal and plant origin have been used in folk medicines of different cultures to energize, vitalize and improve sexual function, and physical performance in men, out of these very few have been identified pharmacologically. For increasing libido, ambrein, a major constituent of *Ambra grisea*, is used in Arab countries. It contains a tricyclic triterpene alcohol which increases the concentration of several anterior pituitary hormones and serum testosterone. Bufo toad skin and glands contain bufotenine (and other bufadienolides), a hallucinogenic congener of serotonin. It is the active ingredient in West Indian “love stone” and the Chinese medication *chan su*. In traditional Chinese medicine, *Panax ginseng* is used as a sex stimulant. It works as an antioxidant by enhancing nitric oxide (NO) synthesis in the endothelium of corpora cavernosa (CC); ginsenosides also cause transmural nerve stimulation-activated relaxation associated with increased

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tissue cyclic guanosine monophosphate. For increasing sexual pleasure, cantharidin ("Spanish fly") from blister beetles, which have been used for millennia as a sexual stimulant.^[6]

CAUSES OF IMPOTENCE

Sexual dysfunction is a serious medical and social symptom that occurs in 10-52% of men and 25-63% of women. ED, the main reason of male impotence, is considered as one of the most important public health problems, since it affects a great percentage of men. ED is defined as the consistent inability to obtain or maintain an erection for satisfactory sexual relations. An estimated 20-30 million men suffer from some degree of sexual dysfunction.^[7] It occurs commonly in middle-aged and older men. Impotence occurs in 50% of men with diabetes mellitus. Atherosclerosis is the cause of approximately 40% of ED in men older than 50 years. Among the most commonly recognized conditions associated are high blood pressure, lipid problems (cholesterol, triglycerides), diabetes, and cigarette smoking.^[8,9] Endocrine disorders like low testosterone and thyroid problems also contribute to ED. Pelvic trauma, pelvic surgery (major prostate, bladder, and bowel operations) and pelvic radiation therapies are also connected with ED. Direct trauma to the perineum can cause vascular problems in the penis and lead to ED that may be treatable by penile artery bypass surgery. Sexual dysfunction is also caused by various factors such as psychological disorders like anxiety, depression, stress, fear of sex, neurological disorders, stroke, cerebral trauma and Parkinson's disease, penile diseases like phimosis, peyronies etc. Other organic causes include chronic renal failure, hepatic failure, multiple sclerosis, Alzheimer's disease, sleep apnea and chronic obstructive pulmonary disease. Chronic alcohol abuse and cigarette smoking also adversely affect sexual potency. Decrease in hormone level with age, systemic diseases like cancer also influence sexual ability. ED is also associated with some therapeutic agents like antihypertensives, antipsychotics, antidepressants, and drugs for diabetes mellitus.^[10-12]

MECHANISM INVOLVED IN APHRODISIAC POTENTIALS

Penile erection occurs as a result of smooth muscle relaxation in the penis mediated by a spinal reflex and involves central nervous processing and integration of tactile, olfactory, auditory, and mental stimuli. The reflex involves both autonomic and somatic afferents and modulated by supraspinal influences peripherally. The balance between the factors leading to contraction and relaxation, control the tone of the penile vasculature and smooth muscle of the CC. This determines the functional state of the penis; detumescence and flaccidity, tumescence, and erection.^[12,13]

During arousal NO synthase is activated for the release of NO from the axons of parasympathetic nerve endings in the walls of the arteries and sinusoids of the penile CC.^[14,15] NO stimulates soluble guanylate cyclase (GC) and the activated GC then catalyze the conversion of guanosine triphosphate to cyclic Guanosine Mono Phosphate (cGMP), which activates cGMP-dependent protein kinase (cGKI) and to a lesser extent protein kinase A. Activated cGKI and protein kinase A phosphorylate phospholamban, a protein that normally inhibits the Ca²⁺ pump within the membrane of the sarcoplasmic reticulum. The Ca²⁺ pump is then activated and as a result the level of free cytoplasmic Ca²⁺ is reduced, resulting in smooth muscle relaxation. In the same way, the protein kinases activate the cell-membrane Ca²⁺ pump, leading to a decreased sarcoplasmic Ca²⁺ concentration which induces a loss of contractile tone of the penile smooth muscle and an increased blood flow in cavernous body resulting in erection.^[16-19]

Another mechanism which causes penile erection is through cyclic adenosine monophosphate pathway (cAMP). Corporal smooth muscle relaxation is mediated via cAMP. The activated membrane-bound adenylyl cyclase, which generates cAMP, it activates protein kinase A and to a lesser extent, protein kinase G. Prostaglandin E₁ also increases the intracellular concentrations of cAMP in the corpus cavernosum smooth muscle cells. The generation of cAMP activates the Ca²⁺ pump and consequently, the level of free cytoplasmic Ca²⁺ is reduced, resulting in smooth muscle relaxation. Similarly, the protein kinase activates the cell-membrane Ca²⁺ pump, leading to a decreased sarcoplasmic Ca²⁺ concentration which induces a loss of contractile tone of the penile smooth muscle and increase of blood flow in the cavernous body resulting in erection.^[18-21]

One of the mechanisms by which cyclic nucleotides induce the relaxation of smooth muscle is through the opening of potassium (K⁺) channels, which leads to the efflux of K⁺ from the smooth muscle cell, down their electrochemical gradient. This results in hyperpolarization and an inhibitory effect on trans membrane Ca²⁺ flux and eventually, smooth muscle relaxation.^[22,23]

After cessation of erotic stimuli, NO release from the parasympathetic nerves of the penis declines and the cGMP level in the smooth muscle cells falls because of a decrease in synthesis coupled with the ongoing degradation of cGMP by phosphodiesterase type 5. These muscle cells return to the more contracted state and the penis becomes more flaccid because of the reduced amount of blood in the corpora. Alteration in either psychological, hormonal, neurological, vascular, or cavernosal factors can cause some degree of ED.^[24-26]

The past 20 years of research on erectile physiology revealed the biochemical factors and intracellular mechanisms

responsible for corpus cavernosal smooth muscle contraction and relaxation, and revealed that ED is predominantly a disease of vascular origin. Despite the increasing availability of effective conventional medical treatments, plant derived and herbal remedies continue to provide a popular alternative for men seeking to improve their sexual life.^[27]

The available drugs and treatments have limited efficacy, unpleasant side effects, and contraindications in certain disease conditions. There are many herbal drugs that have been used by men with ED with varying degrees of success. According to Ayurveda, some herbs have been traditionally used as *Vajikaran Rasayana* herbs because of their putative positive influence on sexual performance in humans.^[28]

HERBAL APHRODISIACS

Chlorophytum borivilium

Tuberous roots of *Chlorophytum borivilium* (CB) (commonly known as safed musli) (family Liliaceae) possess immunomodulatory and adaptogenic properties and are used to cure impotency, sterility, and enhance male potency. Mayank *et al.* studied the effect of lyophilized aqueous extracts obtained from the roots of *C. borivilium*, on sexual behavior in male albino rats and compared with untreated control group animals. They observed a significant variation in the sexual behavior of animals as reflected by reduction of mount latency (ML), ejaculation latency (EL), post-ejaculatory latency, intromission latency (IL), and an increase of mounting frequency (MF). Improvement in sexual behavior of extract treated animals achieved by enhanced penile erection and reduced hesitation time. The observed effects appear to be attributable to the testosterone like effects of the extracts. NO based intervention may also be involved as observable from the improved penile erection. The present results, therefore, support the folklore claim for the usefulness of these herbs and provide a scientific basis for their purported traditional usage.^[29]

Kenjale *et al.* designed a study to evaluate the aphrodisiac and spermatogenic potential of the aqueous extract of dried roots of CB in rats, and it observed a marked aphrodisiac action, increased libido, sexual vigor and sexual arousal. Similarly, at the higher dose, all the parameters of sexual behavior were enhanced, but showed a saturation effect after day 14. On day 60 the sperm count increased significantly in both the CB groups, 125 mg/kg and 250 mg/kg, in a dose dependent manner. They concluded that the roots of CB can be useful for the treatment of certain forms of sexual inadequacies, such as premature ejaculation and oligospermia.^[30]

Mondia whitei

Mondia whitei is from the Periplocaceae family has been used by many traditional medicine practitioners for the management of ED. It is used to increase libido and also

for the management of low sperm count. Lampiao *et al.* investigated motility parameters on aqueous administration to human spermatozoa *in vitro*. Results showed significantly enhanced total motility as well as progressive motility in a time-dependent manner. These support the use of *M. whitei* especially in men affected with asthenozoospermia.^[31] According to Suresh-Kumar *et al.* the aqueous and hexane extract of *M. whitei* showed sexual enhancement in sexually inexperienced male rats. This is due to the reduction of the hesitation time of the sexually inexperienced males towards receptive females as indicated by the significant decrease in the ML. This suggest that the aqueous and hexane extract of *M. whitei* may act by inducing changes in levels^[32] of neurotransmitters, modulating the action of these neurotransmitters on their target cells or by increasing androgen levels. It confirms the demonstration of adrenergic effect of aqueous and hexane extracts of *M. whitei* on chronic administration *in vivo* in rats.^[33,34]

Tribulus terrestris

Tribulus terrestris (TT) is a flowering plant belongs to the family Zygophyllaceae, native to warm temperate and tropical regions. Administration of TT to humans and animals improves libido and spermatogenesis. Neychev *et al.* investigated the influence of *T. terrestris* extract on androgen metabolism in young males. The findings of study predict that *T. terrestris* steroid saponins possess neither direct nor indirect androgen-increasing properties.^[28,35]

It is also found to increase the levels of testosterone, leutinizing hormone, dehydroepiandrosterone, dihydrotestosterone, and dehydroepiandrosterone sulfate.^[36,37] The corpus cavernosal tissues obtained from New Zealand White rabbits following treatment with TT were tested *in vitro* with various pharmacological agents and electrical field stimulation and was found to have a proerectile effect. A study by Gauthaman *et al.*^[38] showed the androgen releasing property of the TT extract and its relation to sexual behavior and intracavernous pressure using castrated rats.

Crocus sativus

Crocus sativus L., commonly known as saffron, is a perennial stem less herb belongs to the family Iridaceae and is widely cultivated in Iran and other countries, including India and Greece. In traditional medicine, saffron is recommended as an aphrodisiac agent. Madan *et al.* studied the effects of saffron stigma extract and two active constituents, crocin and safranal, on sexual behaviors in male rats.^[39,40]

Hosseinzadeh *et al.* studied the aphrodisiac activities of *C. sativus* stigma aqueous extract and its constituents, safranal and crocin, in male rats. The aqueous extract crocin, safranal, sildenafil as a positive control and saline were administered intraperitoneally to male rats. MF, intromission frequency (IF), erection frequency (EF), ML, IL, and EL were the factors evaluated during the sexual behavior study. It

was found that Crocin, at all doses, increased MF, IF and EF behaviors and reduced EL, IL and ML parameters. Safranal did not show aphrodisiac effects. The present study revealed the aphrodisiac activity of *C. sativus* aqueous extract and its constituent crocin.^[41]

Safarinejad *et al.* conducted an open label, randomized, fixed-dose, crossover study comparing efficacy and safety of sildenafil citrate and saffron for treating ED in men naïve to treatment. The findings do not support a beneficial effect of saffron administration in men with ED.^[42]

Myristica fragrans

The dried kernel of broadly ovoid seeds of *Myristica fragrans* Houtt. (Nutmeg) of the family Myristicaceae has been mentioned in Unani medicine to be of value in the management of male sexual disorders. In a study by Tajuddin *et al.*, it was found that administration of 50% ethanolic extract of a single dose of Nutmeg and Clove, and Penegra resulted in the increase in the mating performance of the mice. It was found that out of 6 control animals only 2 males mated (inseminated) 2 females and the remaining 4 males mated 1 female each during the overnight experimental period. Whereas, Nutmeg treated male animals mated 3 females each except 2 which mated 5 females each. In the Clove treated male animals 3 mated 2 females each, 2 mated 4 females each and remaining 1 mated 3 females each. In the Penegra treated animals 4 mated 5 females each and 2 mated 3 females each.^[43]

Phoenix dactylifera

Phoenix dactylifera (date palm) of the family Palmae is a native to North Africa has been extensively cultivated in Arabia and Persian Gulf. The date palm pollen (DPP) is used in the traditional medicine for male infertility. In an experimental study by Bahmanpour *et al.* investigated the effect of *P. dactylifera*, pollen, on sperm parameters and reproductive system of adult male rats. They observed that the consumption of DPP suspensions improved the sperm count, motility, morphology, and DNA quality with a concomitant increase in the weights of testis and epididymis. The date palm contains estradiol and flavonoid components that have positive effects on the sperm quality. The comparative evaluation between control and experimental groups revealed that consumption of DPP suspensions improved the sperm count, motility, morphology, and DNA quality with a concomitant increase in the weights of testis and epididymis. It did not significantly affect the weight of the prostate and the seminal vesicle or the histology of the reproductive tissues. From the study, it was concluded that DPP seems to cure male infertility by improving the quality of sperm parameters.^[44]

Lepidium meyenii

Lepidium meyenii (Maca) belongs to the family Cruciferae is a Peruvian hypocotyl that grows exclusively between

4000 m and 4500 m in the central Andes. Maca is traditionally employed in the Andean region for its supposed aphrodisiac and/or fertility-enhancing properties. Bo Lin *et al.* determined the effect of oral administration of a purified lipidic extract from *L. meyenii* on the number of complete intromissions and mating in normal mice, and on the latent period of erection (LPE) in rats with ED. Oral administration enhanced the sexual function of the mice and rats, as evidenced by an increase in the number of complete intromissions and the number of sperm-positive females in normal mice, and a decrease in the LPE in male rats with ED. The study revealed for the first time an aphrodisiac activity of *L. meyenii*.^[45]

Gonzales *et al.* conducted a 12-week double-blind, placebo-controlled, randomized, parallel trial in which active treatment with different doses of Maca Gelatinizada was compared with a placebo. The study aimed to test the hypothesis that Maca has no effect on serum reproductive hormone levels in apparently healthy men when administered in doses used for aphrodisiac and/or fertility-enhancing properties. Data revealed that when compared with placebo Maca had no effect on any of the hormones studied nor did the hormones show any changes over time. Multiple regression analysis showed that serum testosterone levels were not affected by treatment with Maca at any of the times studied (*P*, not significant). In conclusion, treatment with Maca does not affect serum reproductive hormone levels.^[46]

Gonzales *et al.* conducted a 12-week double blind placebo-controlled, randomized, parallel trial in which active treatment with different doses of Maca Gelatinizada was compared with placebo to demonstrate if effect of Maca on subjective report of sexual desire was because of effect on mood or serum testosterone levels. An improvement in sexual desire was observed with Maca since 8 weeks of treatment. Serum testosterone and estradiol levels were not different in men treated with Maca and in those treated with placebo. Logistic regression analysis showed that Maca has an independent effect on sexual desire at 8 and 12 weeks of treatment.^[47]

Cicero *et al.* evaluated the effect of Maca after oral administration on rat sexual behavior. The following sexual performance parameters were acutely decreased, 1st mount, 1st intromission, ejaculation, intercopulatory interval and copulatory efficacy. Moreover, chronic Maca treatment induced an apparently not dose-related increase in rat locomotion, during the second 10-min period of observation in the activity cage. Thus, they concluded that both acute and chronic Maca oral administration significantly improve sexual performance parameters in male rats.^[48]

Kaempferia parviflora

Kaempferia parviflora belongs to the family Zingiberaceae is a native plant of Southeast Asia, is traditionally used to enhance male sexual function. However, only few scientific data in support of this anecdote have been reported. The

results showed that all extracts had virtually no effect on the reproductive organ weights even after 5 weeks. However, administration of the alcohol extract significantly decreased mount and ejaculatory latencies when compared with the control. By contrast, hexane and water extracts had no influence on any sexual behavior parameters. It has no effect on fertility or sperm motility. On the other hand, alcohol extract produced a significant increase in blood flow to the testis without affecting the heart rate and mean arterial blood pressure. In a separate study, an acute effect of alcohol extract of *K. parviflora* on blood flow to the testis was also investigated. The results indicated that alcohol extract had an aphrodisiac activity probably via a marked increase in blood flow to the testis.^[49]

Eurycoma longifolia

Eurycoma longifolia (commonly called tongkat ali or pasak bumi) is a flowering plant in the family Simaroubaceae, native to Indonesia, Malaysia, and to a lesser extent, Thailand, Vietnam, and Laos. It has gained notoriety as a symbol of man's ego and strength by the Malaysian men because it increases male virility and sexual prowess during sexual activities. The butanol, methanol, water, and chloroform extracts of the roots of *E. longifolia* Jack were studied by Ang *et al.* using various tests of potency of treated male rats. The results showed that *E. longifolia* produced a dose-dependent, recurrent and significant increase in the episodes of penile reflexes as evidenced by increases in quick flips, long flips and erections of the treated male rats during the 30 min observation period. These results provide further evidence that *E. longifolia* increases the aphrodisiac potency activity in treated animals.^[50]

In another study by Ang *et al.*, the aphrodisiac effect of *E. longifolia* Jack (0.5 g/kg) was evaluated in noncopulator male rats using an electrical cage. Fractions of *E. longifolia* Jack decreased the hesitation time of noncopulator male rats, throughout the investigation period. Furthermore, it possessed a transient increase in the percentage of the male rats responding to the right choice, more than 50% of the male rats scored "right choice" after 3 weeks post-treatment and the effect became more prominent after 8 weeks post-treatment using the electrical copulation cage. Hence, this study lends further support to the use of the plant by indigenous populations as a traditional medicine for its aphrodisiac property.^[51]

Ang *et al.* again evaluated the effects of butanol, methanol, water, and chloroform fractions of *E. longifolia* Jack on the levator ani muscle in both uncastrated and testosterone stimulated castrated intact male rats after dosing them for 12 consecutive weeks. Results showed that all the fractions increased the levator ani muscle, when compared with the control (untreated) in the uncastrated intact male rats and testosterone-stimulated castrated intact male rats. Hence, the proandrogenic effect as shown by this study further

supported the traditional use of this plant as an aphrodisiac.^[52]

Satureja khuzestanica

Satureja khuzestanica Jamzad belongs to the family Lamiaceae is an endemic plant that is widely distributed in the Southern part of Iran. Sulmaz *et al.* studied the effect of *Satureja khuzestanica* essential oil (SKEO) in male rat fertility. SKEO was administered orally at doses of 75, 150, and 225 mg/kg/day for 45 days through drinking water. Treated and control rats were mated with female on day 45 of treatment. SKEO significantly improved all the parameters evaluated such as potency, fecundity, fertility index, and litter size.^[53]

According to Rezvanfar *et al.* coadministration of SKEO significantly improved cyclo phosphamide (CP)-induced changes in plasma testosterone, sperm quality, spermatogenesis and fertility, toxic stress, and DNA damage. It is concluded that CP-induced toxic effects on androgenesis and spermatogenesis is mediated by free radicals. SKEO protects reproductive system from toxicity of CP through its antioxidant potential and androgenic activity. Moreover, concentrations of FSH and testosterone were significantly increased in SKEO-treated groups. Also the weights of testes, seminal vesicles, and ventral prostate weights were increased by SKEO. Histopathological analysis showed that in male rats treated with SKEO the number of spermatogonium, spermatid cords, Leydig cells, and spermatozooids was increased. Furthermore, in these groups, the Sertoli cells were hypertrophic.^[54]

Panax ginseng

For many years, *Panax ginseng* belonging to family Aralaceae has enjoyed a reputation as one of the finest aphrodisiacs in the world. The word *Panax*, in fact, means "all-healing" in Greek and is thus a reference to the roots supposed revitalizing properties for the whole human-body. As the neurotransmitter inducing penile erection, NO release was shown to be enhanced by GS in rabbit corpus cavernosum *in vitro*. Ginsenosides enhanced both acetylcholine-induced and transmural nerve stimulation-activated relaxation associated with increased tissue cGMP. The latter effect was eliminated by tetrodotoxin and was associated with decreased tissue cGMP. Ginsenoside-enhanced CC relaxation was attenuated by nitro-L-arginine and oxyhemoglobin, and enhanced by superoxide dismutase. It is postulated that cardiovascular protection by GS may be partly mediated by the release of NO, a potent antioxidant, and that the GS-enhanced release of NO from endothelial cells, especially from perivascular nitric oxidergic nerves in the CC, may partly account for the aphrodisiac effect of *P. ginseng* used in traditional Chinese medicine.^[55]

Pausinystalia yohimbe

Pausinystalia yohimbe of the family Rubiaceae is an evergreen tree native to West Africa, also present in Asia. It is the only herb listed in the Physician's index reference for sexual

function. Yohimbe has been widely used for more than 75 years as an accepted treatment for male ED. The US FDA approved yohimbe as the first plant-derived drug for treating impotency in late 1980s and was dubbed the “herbal viagra” in the February 1999 edition of Environmental Nutrition In Europe. Yohimbe is believed to be effective in dealing with ED, mainly due to its ability to stimulate blood flow by dilating blood vessels. The increase in the flow of blood to the penis helps in bringing about erections. Another manner in which Yohimbe relates to impotence is that it increases the body’s production of norepinephrine; which is essential in the formation of erections. Studies have shown that this herb can restore potency even to diabetic and heart patients that were suffering from impotency due mainly to their diseases. Yohimbe is also believed to act as a stimulant for the pelvic nerve ganglia and also to boost adrenaline supply to nerve endings. That leads to an increase in sexual sensation and stamina. In men without ED, Yohimbe in some cases appears to increase sexual vigor and prolong erections.

Adeniyi *et al.* conducted a study to know the effect of yohimbine in the treatment of men with orgasmic dysfunction. A 20-mg dose of yohimbine was first given to 29 men with orgasmic dysfunction of different etiology in the clinic. Patients were then allowed to increase the dose at home (titration) under more favorable circumstances. Of the 29 patients who completed the treatment, 16 managed to reach orgasm and were able to ejaculate either during masturbation or sexual intercourse. A further three achieved orgasm, but only with the additional stimulation of a vibrator. A history of preceding nocturnal emissions was present in 69% of the men in whom orgasm was induced but only 50% who failed treatment. Of the patients, two have subsequently fathered children (one set of twins) and another three men were also cured. Side effects were not sufficient to cause the men to cease treatment. It was concluded that yohimbine is a useful treatment option in orgasmic dysfunction.^[56]

Rumry injected yohimbine into adult mice and found no change in the reproductive rate of these animals. Later, Ludwig and von Ries reported that injections of small amounts of this drug into immature mice caused the development of a typical estrous condition. D’Amour, using prepuberal rats, was unable to confirm the results of Ludwig and von Ries. Hechter, Lev and Soskin, while studying the relation of hyperemia to estrin action, claim that yohimbine alone was capable of producing an estrous reaction in castrate mice. D’Amour was unable to obtain cornification of the vaginal epithelium of castrated rats.^[57]

Fadogia agrestis

Fadogia agrestis belongs to the family, Rubiaceae possess significant aphrodisiac potential. Yakubu *et al.* evaluated the aphrodisiac potential of the aqueous extract of *F. agrestis* in Male rats. Their sexual behavior parameters and serum

testosterone concentration were evaluated. The results showed a significant increase in MF, IF and significantly prolonged the ejaculatory latency and reduced mount and IL. There was also a significant increase in serum testosterone concentrations in all the groups in a manner suggestive of dose-dependence. The aqueous extract of *F. agrestis* stem increased the blood testosterone concentrations and this may be the mechanism responsible for its aphrodisiac effects and various masculine behaviors. It may be used to modify impaired sexual functions in animals, especially those arising from hypotestosteronemia.

Yakubu *et al.* studied the effects of administration of aqueous extract of *F. agrestis* stem on some testicular function indices of male rats. Compared with the control, extract administration for 28 days at all the doses resulted in a significant increase in the percentage testes–body weight ratio, testicular cholesterol, sialic acid, glycogen, acid phosphatase and γ -glutamyl transferase activities while there was a significant decrease in the activities of testicular alkaline phosphatase, acid phosphatase, glutamate dehydrogenase and concentrations of protein.^[58]

Montanoa tomentosa

Montanoa tomentosa of the family Asteraceae has an extensive ethnomedical history of use as a traditional remedy for sexual impairment. Carro-Juárez *et al.* studied the copulatory behavior of sexually active male rats after oral administration of the aqueous crude extract of *M. tomentosa*. They also evaluated the effect extract on males with anesthetization of the genital area and on sexual behavior of sexually inactive male rats (noncopulators). Results showed that acute oral administration of crude extracts of *M. tomentosa* facilitates expression of sexual behavior in sexually active male rats, significantly increases mounting behavior in genitally anesthetized animals and induces the expression of sexual behavior in noncopulating males. Altogether, these data revealed a facilitatory action of this extract on sexual activity and particularly on sexual arousal. Present findings provided experimental evidence that the crude extract preparation of *M. tomentosa*, used as a traditional remedy, possesses aphrodisiac properties.^[59]

Carro-Juárez *et al.* again investigated the pro-sexual effect *M. tomentosa* and its possible pro-ejaculatory properties in spinal male rats. The data showed that the extract acts directly at the spinal system in charge of the expression of the ejaculatory motor patterns and suggest that the aqueous crude extract exerts its aphrodisiac properties by increasing sexual potency acting as an oxytocic agent.^[60]

Terminalia catappa

Terminalia catappa is a large tropical tree belongs to the family, Combretaceae a significant aphrodisiac potential. Ratnasooriya *et al.* observed that *T. catappa* seeds at dose of 1500 mg/kg or 3000 mg/kg, per oral for 7 days in rats had a marked

improvement of aphrodisiac action, sexual vigor. In contrast, the higher dose (3 000 mg/kg, p.o.) reversibly inhibited all the parameters of sexual behavior other than mounting.^[61,62]

Casimiroa edulis

The seed extract of *Casimiroa edulis* belongs to the family Rutaceae is consumed in many parts of the world, including Central America and Asia as an aphrodisiac. Ali *et al.* studied the aphrodisiac actions of the aqueous extract of the seeds of on the sexual behavior of normal male rats. In this investigation, healthy male albino rats were fed with *C. edulis* extract (test reference) and sildenafil citrate (standard reference). Both the groups exhibited a significant increase in MF, IF, and first and second ejaculatory latencies. Although a similar pattern of mating behavior was observed among the test and the standard groups, however, in all the cases as expected, sildenafil produced greater activity than the

C. edulis extract. These results suggest the possibility of a similar mode of action of *C. edulis* and sildenafil citrate on mating behavior in these animals. This research, thus provide preliminary evidence that the aqueous seed extract of *C. edulis* possesses aphrodisiac activity and may be used as an alternative drug therapy to restore sexual functions probably via a neurogenic mode of action.^[63]

Turnera diffusa

In folk medicine, *Turnera diffusa* or Damiana of the family Turneraceae is considered as an aphrodisiac. Estrada *et al.* conducted a study to determine whether *T. diffusa* recovers sexual behavior in sexually exhausted male rats and to identify the main components in an aqueous extract. *T. diffusa* (80 mg/kg) significantly increased the percentage of males achieving one ejaculatory series and resuming a second one. In addition, *T. diffusa* significantly reduced the post-ejaculatory

Table 1: List of plants having aphrodisiac potential

Plant	Parts used	Chemical constituents	Probable mechanism of action
<i>Chlorophytum borivilianum</i> (Liliaceae)	Roots	Saponins, stigmasterol	Testosterone like effects
<i>Mondia whitei</i> (Periplocaceae)	Roots	Aldehydes and steroids triterpenes	Changes in levels of neurotransmitters, modulating the action neurotransmitters, or by increasing androgen levels
<i>Tribulus terrestris</i> (Zygophyllaceae)	Whole plant	Protodioscin	Increased the androgenic status both centrally and peripherally
<i>Crocus sativus</i> (Iridaceae)	Stigma	Crocin and safranal	Reducing the reactive oxygen species which are capable of damaging cell membranes and genetic content
<i>Myristica fragrans</i> (Myristicaceae)	Dried kernel	Alkaloids and sterols	Nervous stimulating property
<i>Phoenix dactylifera</i> (Palmae)	Pollen	Estradiol and flavonoid components	Positive effects on the sperm quality
<i>Lepidium meyenii</i> (Cruciferae)	Root and the lower part of the hypocotyl	Macaene and macamide, multi saturated fattyacids, and amides	Contains arginine sterols, such as campesterol, stigmasterol and sitosterol that enhance fertility
<i>Kaempferia parviflora</i> (Zingiberaceae)	Rhizomes	Flavonoids like 5-hydroxy 7-methoxy flavones, 5-hydroxy 3,7-dimethoxy flavone	Increased blood flow to the testis
<i>Eurycoma longifolia</i> (Simaroubaceae)	Roots	Alkaloids, lactones and phenolics	Proandrogenic effect
<i>Satureja khuzestanica</i> (Lamiaceae)	Essential oil	Carvacrol and flavonoids	Increases concentrations of FSH and testosterone
<i>Panax ginseng</i> (Araliaceae)	Root	Triterpene saponins like ginsenosides, essential oil-containing polyacetylenes and sesquiterpenes	Enhance both acetylcholine-induced and transmural nerve stimulation-activated relaxation associated with increased tissue cGMP
<i>Pausinystalia yohimbe</i> (Rubiaceae)	Bark	Yohimbine and its stereoisomers alpha-yohimbine, beta-yohimbine, allo-yohimbine	Blocking alpha-2 adrenergic receptors and increasing dilation of blood vessels
<i>Fadogia agrestis</i> (Rubiaceae)	Stem	Alkaloids, saponins, anthraquinones and flavonoids	Increases blood testosterone level
<i>Montanoa tomentosa</i> (Asteraceae)	Leaves and flowers	Diterpenes like montanol, and zoapatanol	By prosexual effects. Mechanisms also shows a steroid-like effect
<i>Terminalia catappa</i> (Combretaceae)	Seeds	Alkaloids, oils, amino acids and peptides	Receptor-mediated action in brain
<i>Casimiroa edulis</i> (Rutaceae)	Seeds	Flavonoids zapotin and zapotinin	Neuro sexual mode of action
<i>Turnera diffusa</i> (Turneraceae)	The leaves and other aerial parts	Flavonoids and arbutin	As an adaptogen

FSH=Follicle Stimulating Hormone, cGMP=cyclic Guanosine Mono Phosphate

Table 2: List of some herbal products available in market

Product	Ingredients
VigRX Oil™	Epimedium, cuscuta, ginkgo biloba, asian red ginseng, muira puama bark, catuaba bark, hawthorn berry
Maxoderm™	Aloe barbadensis, camellia sinensis, l-arginine, panax ginseng, muira puama, lamium album, serenoa serrulata, <i>Lepidium meyenii</i> , erthroxyllum catauba, rosmarinus officinalis.
Virility Pills VP-RX® ExtenZe®	Hawthorn, horny goat, catuaba, muira puama, ginkgo, chinese ginseng, damiana Black pepper, piper longum, ginger, yohimbe, <i>Tribulus terrestris</i> , korean ginseng, xanthroparmelia scabrosa, velvet deer antler horny goat weed, damiana, muira puama, pumpkin, stinging nettle, astragalus, licorice, l-arginine hydrochloride, ho shou wu
ProEnhance™	Ginseng, he shou wu, centella asiatica, saw palmetto, damiana
Virility Patch RX™	Ginseng, Fo-Ti, Saw Palmetto, Damiana

interval. The HPLC – ESI-MS analysis showed the presence of caffeine, arbutine, and flavonoids as the main compounds in the active extract. The results supported the use of *T. diffusa* as an aphrodisiac in traditional medicine and suggest possible therapeutic properties of *T. diffusa* on sexual dysfunction. The flavonoids present in active extract may participate in its pro-sexual effect, which is analogous to those produced by yohimbine, suggesting a shared mechanism of action.^[64] Table 1 shows the list of plants having aphrodisiac potential. Table 2 shows of some herbal products available in market.

CONCLUSION

The search for natural supplement from medicinal plants is being intensified probably because of its fewer side effects, its ready availability, and less cost. The available drugs and treatments have limited efficacy, unpleasant side effects, and contraindications in certain disease conditions. A variety of botanicals are known to have a potential effect on the sexual functions, supporting older claims and offering newer hopes. This review, while evaluating various factors that control sexual function, identifies a variety of botanicals that may be potentially useful in treating sexual dysfunction. All the plants in this review have exhibited significant pharmacological activity. Demands of natural aphrodisiacs require increasing studies to understand their effects on humans and safety profile. Due to unavailability of the safety data, unclear mechanisms, and lack of knowledge to support the extensive use of these substances, uses of these products may be risky to the human being. With more clinical data, exact mechanisms of action, safety profile, and drug interaction with other uses of these aphrodisiacs plant materials, treating sexual disorder can become fruitful.

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