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Some medicinal plants with aphrodisiac potential: A current status

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ABSTRACT

Aphrodisiac is the word derived from Aphrodite, the Greek goddess of sexual, love and beauty. An aphrodisiac is defined as an agent (food or drug) that arouses sexual desire. Current sexual dysfunction therapy lack satisfactory success due to adverse effect, hence patients are seeking complementary and alternative medicine to treat sexual dysfunction. Ayurveda and other Indian literature mention the use of plants in various human ailments. India has about more than 45 000 plant species and among them several thousand are claimed to possess medicinal properties. Researchers conducted in the last few decades on the plants mentioned in ancient literature or used traditionally for sexual dysfunction. This review reveals that some plants and their extract have aphrodisiac activity, which are helpful for researcher to develop new herbal aphrodisiac formulations. In the recent years, interest in drugs of plant origin has been progressively increased.

1. Introduction

Aphrodisiac is the word derived from Aphrodite, the Greek goddess of sexual, love and beauty. An aphrodisiac is defined as an agent (food or drug) that arouses sexual desire. From time immemorial man's endeavour have been to increase his sexual powers. When man did not know metals and used only stones he exhibited his sexual powers by ritual dances accompanied by hunting. This lead early man was motivated by his quest for food, sex and self-preservation. The possibility of bioactive aphrodisiacs which may be derived from plants, animals or minerals, has been attractive throughout recorded history. Aphrodisiac are mentioned there as Vajikaranas, the word vaji meaning horse and karanta meaning making i.e. Measure to excite lust by charms etc. Many natural substances have historically been known as aphrodisiacs in Africa and Europe, such as Yohimbine and the Mandrake plant, as well as ground Rhinoceros horn in the Chinese culture and "Spanish fly" which is actually toxic. Sexual relationships are some of the most important social and biological relationship in human life. Male impotence also called erectile dysfunction (ED or SD) is a common medical condition that affects the sexual life of millions of men worldwide. Erectile dysfunction is defined as the persistent inability to obtain and maintain an erection sufficient for naturally satisfactory intercourse. Sexual dysfunction is a serious medical and social symptom that occurs in 10%-52% of men and 25%-63% of women. Erectile dysfunction is adversely affected by diabetes mellitus, antihypertensive, antipsychotic, antidepressant therapeutic drugs. Organic causes of ED like Hypogonadism, hyperprolactinaemia, and neurological disorders. Treatment of ED involves several natural aphrodisiac potentials. Aphrodisiac is described as any substance that enhances sexual pleasure. Sexual dysfunction caused by various factors such as psychological disorders like Anxiety, depression, stress, fear of sex, neurological disorders, stroke, cerebral trauma, Alzheimer, Parkinson's disease and chronic disorders-diabetes, hypertension, vascular insufficiency, Atherosclerosis, penile disease-phinosis, peyronies, life style-chronic alcohol abuse, cigarette smoking, aging, decrease in hormone level with age. Systemic diseases - cardiac, hepatic, renal, pulmonary, and cancer. Since introduction of sildenafil citrate to treat erectile dysfunction, there has been renewed and vigorous interest in medicinal herbs with folkloric

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reputation for sexual disorders. The Ayurvedic system of medicine addresses the problem of sexual deficiencies by treatment with specialized therapy known as Rasayana therapy. Vajakarna therapy includes aphrodisiacs for erectile dysfunction, causes of infertility, spermatogenesis, semenogenesis, reproduction, methods of correcting defective semen and sexual satisfaction[1,2].

Ayurveda has a whole science of Aphrodisiacs. It is one of the seven branches of its medical system. Ayurvedic Aphrodisiacs (Vajikarana in Sanskrit) are more than substances exiting sexual activity; they are tonics that nurture and give direct sustenance to the reproductive tissues. Others help promote the creative transformation of sexual energy for the benefit of the body-mind. Sexual desire is controlled and regulated by the central nervous system which integrates tactile, olfactory, specific auditory and mental stimuli. The aphrodisiac drugs act by altering the level of specific neurotransmitters or specific sex hormones into the body. Most of the aphrodisiacs agent acts by altering the testosterone and progesterone concentration in the body[3,4].

This review will discuss the current research done on the most popular natural aphrodisiacs and examine the weight of evidence to support the use of any of them to enhance sexual desire and/or function.

2. Mechanism involved in aphrodisiac potentials

Sexual desire is controlled and regulated by the central nervous system which integrates tactile, olfactory and mental stimuli[4].

First: Some aphrodisiac simply provide a burst of nutritional value improving the immediate health or well being of the consumer and consequently improving sexual performance and libido.

Second: This group includes the purported aphrodisiac have more specific physiological affects but are not psychologically active. They may affect blood flow; increase duration of sexual activity by numbing the genital area.

Third: The third group of aphrodisiac is made up compounds that are psychopharmacological, i.e. they actually cross the blood brain barriers and stimulates some area of sexual arousal. This category includes a wide range of neurotransmitters, hormones, pheromones and drugs that interfere with the normal function of these molecules. This category is most difficult to study because knowledge of both sexual arousal and the mechanisms of the psychoactive properties of drugs are limited. Only the most general information about sexual arousal and the brain is understood[5]. Possible mode of action of aphrodisiac potential of medicinal plants is given in Figure 1[3,6].

2.1. Adverse effects of current treatments used in sexual dysfunction

Side effects include drowsiness, insomnia, headaches, nasal congestion, headaches, dizziness, tachycardia and weight loss[7].

Figure 1. Possible mode of action of aphrodisiac bioactive principles in male rats[3,6].

3. Some medicinal plants with aphrodisiac potential

Some of the medicinal plants have proven to possess a traditional as well as scientifically proven aphrodisiac that can enhance passion, increase libido, enhance sexual performance and help to increase the intensity of lovemaking. A brief report of plants has been tested for aphrodisiac potential are documented.

Abelmoschus manihot (*A. manihot*) (L.) (Malvaceae)

A. manihot (L.) commonly reffered to as "Junglee bhindi". Two doses i.e. 100and 200 mg/kg b.w. of ethanolic extract administered to Swiss albino mice, showed pronounced anabolic and spermatogenic effect in animals of respective groups. There was a remarkable increased in sperm count and penile erection index and also improved sexual behavior of male mice by increased mount and intromission frequency. Further it was noticed that a 200 mg/kg b.w. dose of *A. manihot*, the performance rate enhances without any side effect [8].

Anacyclus pyrethrum (*A. pyrethrum*) (Compositae)

Aqueous extract of the roots was studied for its effect on sexual behavior, spermatogenesis, and sperm count. Fructose levels in seminal vesicles of albino rats were also recorded. Two doses i.e. 50 and 100 mg/kg of aqueous extract on administration in albino rats showed pronounced anabolic and spermatogenic effect in animals of respective groups.

The sperm count and fructose levels in seminal vesicle were markedly increased. Improvement in sexual behavior of male rats was characterized by increased mount and intromission frequency and reduced mount and intromission latency[9].

Argyreia nervosa (*A. nervosa*) Syn. (Convolvuaceae)

Etahnolic extract of *A. nervosa* on male mice exhibited significant aphrodisiac behavior at 200 mg/kg p.o., single dose. Significantly increase mounting behavior[10].

Asparagus racemosus (*A. racemosus*) Willd. (Liliaceae)

Hydro-alcoholic and aqueous extracts at higher concentration (400 mg/kg body weight) showed significant aphrodisiac activity on male wistar albino rats as evidenced by an increase in number of mounts and mating performance. On the other hand, hydro-alcoholic extract at lower dose (200 mg/kg. body weight) and aqueous extract (400 mg/kg body weight) showed moderate aphrodisiac property.

Asparagus racemosus is commonly known as Shatavari. Milk and aqueous decoction of roots of *A. racemosus*, were studied for aphrodisiac activity in male albino rats and compared with untreated control group animals. The rats were evaluated for effect of treatments on anabolic effect. Six measures of sexual behavior were evaluated. 200 mg/kg body weight of milk decoction showed a significant difference in the sexual behavior of animals as reflected by reduction of mount latency, ejaculation latency, post ejaculatory latency, intromission latency, and an increase of mount frequency. Penile erection (indicated by Penile Erection Index) was also considerably enhanced. Reduced hesitation time (an indicator of attraction towards female in treated rats) also indicated an improvement in sexual behavior of extract treated animals. The observed effects appear to be attributable to the testosterone-like effects of the milk decoction of *A. racemosus*. Nitric oxide based intervention may also be involved as observable from the improved penile erection[11].

Asteracanta longifolia (*A. longifolia*) (Acanthaceae)

Ethanolic extract of seeds of *A. longifolia* at 100, 150 and 200 mg/kg, p.o in male rats for a period of 28 d. Significantly increase in the sexual behavior such as mating performance and MF. A Significant increase in the sperm count as well as fructose levels of seminal vesicles was noted[12].

Blepharis edulis (*B. edulis*) Linn. (Acanthaceae)

Effect of etanolic extract of Seeds of *B. edulis* Linn. at 100, 250 & 500 mg/kg p.o. for 7 d on mice significantly increase MF, IF, IL, erections as well as aggregate of penile reflexes and caused significant reduction in ML & PEI. Hormonal parameter like testosterone was evaluated. The most appreciable effect of the extract was observed at the dose of 500 mg/kg[13]

Butea frondonsa (*B. frondonsa*) Koen (Papillionaceae)

Aphrodisiac study was performed on bark of *B. frondonsa* Koen. The extract (400 mg/kg body wt./day) was administered orally by gavage for 28 d. The extract reduced significantly ML, IL, EL and PEI. The extract also increased significantly MF, IF and EF. These effects were observed in sexually active and inactive male rats[4].

Chenopodium album (*C. album*) (Chenopadiaceae)

Ethanolic extract *C. album* at 100, 250 & 500 mg.kg, p.o. in male albino mice showed significant increase in the MF, IF, IL, erection as well as aggregate of penile reflexes and caused in significant reduction in the ML and post ejaculatory interval. More over 500 mg/kg, p.o. was found to be most active[14].

Chlorophytum borivilianum (*C. borivilianum*) (Liliaceae)

Lyophilized aqueous extracts of *C. borivilianum* at 200 mg/kg, p.o. showed significant enhancement of body weight and reproductive organs, penile erection, MF, whereas significant variation in reduction of ML, EL, IL, reduced hesitation time indicates an improvement in sexual behavior of extract treated animals[15].

Crossandra infundibuliformis (*C. infundibuliformis*) Linn. (Acanthaceae)

Effect of petroleum ether extract of *C. infundibuliformis* Linn. on male rat exhibited significant aphrodisiac behavior at 200 & 400 mg/kg p.o. Significantly increase MF, IF & ejaculatory latency & reduced ML & IL and Significantly increase in serum testosterone[16].

Curculigo orchioides (*C. orchioides*) Gaertn. (Amaryllidaceae)

Ethanoilc extract of rhizomes of *C. orchioides* Gaertn. at 100 mg/kg, p.o. in rats was found to be change significantly the sexual behavior such as penile erection, mating performance, MF, ML & increase of penile erection index and weight of reproductive organs[4,39].

Dactylorhiza hatagirea (*D. hatagirea*) (D.Don) (Orchidaceae)

Aqueous extract of *D. hatagirea* (D.Don) Causes significant anabolic effect. Penile erection index (PEI) was also considerably enhanced and significantly reduce mount latency in extract treated group[17].

Durio zibenthinus (*D. zibenthinus*) Linn. (Bombacaceae)

Aphrodisiac activity of petroleum ether extract and isolated compound 3- β - hydroxyl-21-normethyl-19-vinylidenylursane of *D. zibenthinus* Linn. Were screened for different dose level & it was found that 400 mg/kg, p.o. was most active in the mice & have better aphrodisiac activity than all other treated dose[18].

Glycyrrhiza glabra (*G. glabra*) (Leguminoaceae)

In the present study aphrodisiac activity of aqueous extract of *G. glabra* roots & rhizomes was investigated. The extract (150 mg/kg & 300 mg/kg body wt./day) was administered orally by gavage for 28 days. Mount latency (ML), intromission

latency (IL), mounting frequency (MF), intromission frequency (IF), weight of animals (gm) were the parameters observed before and during the sexual behavior study at day 0, 7, 10, 14, 21, and 28. The extract reduced significantly ML & IL. The extract also increased significantly MF & IF. These effects were observed in sexually active male rats[19].

Hybanthus enneaspermus (*H. enneaspermus*) (L) F. Muell (Violaceae)

Orally administered ethanol (300 mg/kg) and aqueous (300 mg/kg) extracts of *H. enneaspermus* (L) F. Muell were evaluated for its aphrodisiac activity in sexually inactive male rats both in a single dose regimen and in a chronic regimen as a daily dose for 28 d. Mount and intromission latency and number of mounts, intromissions and ejaculations were the parameters used for assessing sexual arousal and performance. Following a single dose administration, the aqueous extract produced a decrease in the mounting and intromission latency, with an increase in the ejaculatory and intromission frequency. In the chronic model, both the alcohol and aqueous extracts increased the number of mounts, ejaculations and intromissions with decrease in the mounting and intromission latency. Treatment with aqueous extract also elevated the testosterone levels in sexually inactive male rats[20].

Leptadenia reticulate (*L. reticulate*) Linn. (Asclpiadaceae)

Effect of Chloroform extract of *L. reticulate* Linn. at 50, 100, 250 mg/kg, p.o. on male rats for a period of 28 days. Significantly increase in mount, intromission interval, number of ejaculations and decreased latency of first mount as well as the increase in post ejaculation time. Significant weight gain in testis, seminal vesicles, prostate gland, vasdeferences, epididymis[21].

Mimusa pudica (*M. pudica*) Linn. (Mimosae)

Effect of etanolic extract of roots of *M. pudica* Linn. at 100, 250 & 500 mg/kg p.o. for 7 days on mice significantly increase MF, IF, IL, erections as well as aggregate of penile reflexes and caused significant reduction in ML & PEI. Hormonal parameter like testosterone was evaluated. The most appreciable effect of the extract was observed at the dose of 500 mg/kg[22].

Mucuna pruriens (*M. pruriens*) Linn. (Papilionaceae)

Ethanolic extract of *M. pruriens* Linn. showed significant increase in the MF, IF, EL & decrease the mount latency, IL, PEI & Intromission interval at 150, 200, 250 mg/kg, p.o. dose in wistar albino rats [23].

Myristica fragrans (*M. fragrans*) Houtt. (Myristicaceae)

Effect of 50% etanolic extract of dry kernel of *M. fragrans* Houtt. at 100, 250 & 500 mg/kg p.o. for 7 d on male rat significantly increase MF, IF, IL, erections as well as aggregate of penile reflexes and caused significant reduction in ML & PEI[24].

Nymphaea stellata (*N. stellata*) Willd. (Nymphaeceae)

The extract (150, 250 and 500 mg/kg) was administered orally once a day for 7 d. Mating behaviour test, orientational activities, test for libido and test for potency were assessed in male rats. Results and Discussion: There was an overall increase in sexual behaviour as evidenced by an increase in MF (Mounting Frequency), IF (Intromission Frequency), EL (Ejaculatory Latency) and a decrease in ML (Mounting Latency), IL (Intromission Latency) and PEI (Post Ejaculatory Interval). Increase in orientational activities, weight of primary and accessory sex organs, libido and potency were also observed. These results were statistically significant. The study showed that the extract certainly has aphrodisiac activity particularly at the dose level 500 mg/kg[25].

Ocimum gratissimum (*O. gratissimum*) (Lamiaceae)

Effect of etanolic extract of leaves of *O. gratissimum* at 100, 250 & 500 mg/kg p.o. for 7 d on mice significantly increase MF, IF, IL, erections as well as aggregate of penile reflexes and caused significant reduction in ML & PEI. A dose of 500 mg/kg showed maximum effect without any conspicuous gastric ulceration and adverse effect[26].

Paederia foetida (*P. foetida*) Linn. (Rubiaceae)

Ethanolic extract of the leaves (50, 100 and 200 mg/kg body weight) was studied for their effect on body and secondary sexual organ weight, sexual behavior, spermatogenesis and serum testosterone level in male albino rats. Oral administration of the extract in albino rats showed pronounced anabolic and spermatogenic effects in animals in the treated groups. The extract significantly increased both mount and intromission frequency[27].

Passiflora incarnate (*P. incarnate*) Linn. (Passifloraceae)

Effect of methanolic extract of *P. incarnate* Linn. on male mice exhibited significant aphrodisiac behavior at 75, 100 & 150 mg/kg, p.o. among these, the highest activity was observed with the 100 mg/kg p.o dose. When the mounting were calculated about 95 min after the administration of test extract[28].

Pedalium murex (*P. murex*) Linn. (Pedaliaceae)

Fruits and roots of *P. murex* Linn. were reported for its aphrodisiac activity. Ethanolic extract of *P. murex* fruits possesses aphrodisiac property. Petroleum ether extracts of *P. murex* roots were possesses aphrodisiac property.

Petroleum ether extract of *P. murex*, family Pedaliaceae. Doses of 200 and 400 mg/kg of PEPM showed a significant increase in mating and mounting behaviour. The effect on fertility factors such as total body weight, percentage of pregnancy, litter size were also significantly increased in comparison with the ethanol-treated group. Significant increases in sperm motility and count were observed in PEPM

treated groups in a dose-dependent manner as compared with the ethanol-treated group. Similarly, reductions in the percentage of abnormal sperm were noted in animals treated with PEPM 400 mg/kg. The effects of PEPM on total protein, total cholesterol and testosterone were satisfactory, the levels being increased significantly for protein, cholesterol and testosterone by 400 mg/kg PEPM. Microtome sections of the testes of animals treated with 400 mg/kg PEPM exhibited restoration and recovery of germinal cells and the luminal spermatozoa and were comparable with the control group animals[1,29].

Piper guineense (*P. guineense*) (Piperaceae)

Aqueous extract of dry fruits of *P. guineense* two doses (122.5 & 245 mg/kg p.o. for 8 d and 122.5 mg/kg p.o. for 55 d) Significant increase in the level of testosterone in the serum & testes, cholesterol in testes, α-glucosidase in the epididymis in the seminal vesicles after 8 d of treatment, while 55 d treatment the levels of cholesterol in the testes increases by 75%. Aqueous extract of *P. guineense* at both doses had a positive effect on the male reproductive function[30].

Polygonatum verticillatum (*P. verticillatum*) (Liliaceae)

Aqueous extract of *P. verticillatum* leaf dose (500 mg/kg body weight/d) and L-dopa (100 mg/kg body weight/d) were administered orally by gavages for 28 d. Mount latency (ML), intromission latency (IL), ejaculation latency (EL), mounting frequency (MF), intromission frequency (IF), ejaculation frequency (EF) and post ejaculatory interval (PEI) were the parameters observed before and during the sexual behavior study at day 0, 7, 14, 21 and 28. *P. verticillatum* leaf aqueous extract reduced significantly ML, IL, EL and PEI. The extract also increased significantly MF, IF and EF[31].

Spilanthes acmella (*S. acmella*) (L.) Murr. (Asteraceae)

Ethanolic extracts of the *S. acmella* flower and its effect on general mating pattern, penile erection and serum hormone levels of normal male Wistar albino rats were investigated and compared with sildenafil citrate. The animals were evaluated on various parameters of sexual behavior, anabolic effects, testosterone level and *in-vitro* sperm counts. The aphrodisiac potential of an ethanolic Spilanthes acmella extract was demonstrated *in vitro* and *in vivo*[32].

Syzygium aromaticum (*S. aromaticum*) (L) Merr. & Perry (Myrtaceae)

S. aromaticum (L) Merr. & Perry. (clove) in three doses (15, 30 & 60 mg/kg body weight p.o) in male mice significantly increase MF, IF, IL, erections as well as aggregate of penile reflexes. Hexane extract of *S. aromaticum* (L) flower bud as an aphrodisiac[33].

Tinospora cordifolia (*T. cordifolia*) (Menispermaceae)

In this study, the total extracts were tested for their constituents and tested for aphrodisiac activity in experimental rats. Hydroalcoholic extract of *T. cordifolia* stem at higher concentration (400 mg/kg body weight) showed significant aphrodisiac activity on male wistar albino rats as evidenced by an increase in number of mounts and mating performance. On the other hand hydroalcoholic extract at lower dose (200 mg/kg body weight) and aqueous extract (400 mg/kg body weight) showed moderate aphrodisiac property[34].

Tribulus terrestris (*T. terrestris*) Linn. (Zygophyllaceae)

T. terrestris Linn. is commonly known as "Ghokhru". The lyophilized powder of the dried fruits of *T. terrestris* was studied for sexual behavior effects of acute and subchronic administration in male albino rats, and comparison has been made with standard sexual stimulant drug, sildenafil citrate. The animals were evaluated on various parameters of sexual behavior, anabolic effects, testosterone level and *in-vitro* sperm counts. Oral administration of 100 mg/kg of test drug has proven anabolic effect as evidenced by body weight gain in the body and reproductive organs. Improvement in sexual behavior of male rats was characterized by increased amount and intromission frequency. Penile erection index (PEI) was also considerably enhanced without any noticeable toxicity, and the testosterone level and sperm count also significantly increased, and the results are comparable to that of standard drug, sildenafil citrate[35].

Trichopus zeylanicus (*T. zeylanicus*) Gaerton. (Trichopodaceae)

Administration of ethanolic extract of *T. zeylanicus* Gaerton. leaves to male mice increased the number of mounts & mating performance. The pups fathered by the extract treated mice were normal with regard to fetal growth, litter size and sex ratio. Although oral administration of a single dose (200 mg/kg p.o.) was effective, daily administration of the extract were for 6 d was more effective. The aqueous as well as *n*-Hexane extracts of the leaves were found to be inactive[36].

Turnera aphrodisiaca (*T. aphrodisiaca*) Ward (Turneraceae)

Chloroform extract exhibited significant activity at a dose of 200 mg/kg, p.o. while methanol extract showed aphrodisiac activity at a lower dose, i.e., 50 mg/kg, p.o.. Volatile oil of T. aphrodisiaca was found to be devoid of aphrodisiac activity. Qualitative phytochemical screening showed the presence of alkaloids in chloroform and methanol extracts. Therefore, the alkaloidal fraction was isolated from aerial parts of *T. aphrodisiaca*, and tested for aphrodisiac activity at dose levels of 25, 50, 75, or 100 mg/kg, p.o.[37].

Vanda tessellate (*V. tessellate*) (ROXB.) HOOK.EX DON (Orchidaceae)

Alcoholic extract of flowers of *V. tessellata* at doses of 50 and 200 mg/kg, p.o. were found to be increase mating performance, and tend to increase the male/female ratio resulting offspring. The alcohol extract was devoid of any

conspicuous general toxicity[38].

Orchis latifolia (*O. latifolia*) Linn. (Orchidaceae)

Aqueous extract of *O. latifolia* at dose 200 mg/kg, p.o. for 28 d were found to be evaluated for their efficacy against STZ and alloxon induced sexual dysfunction. It was observed that hyperglycemia has an adverse effect on overall sexual behavior[41].

Cinnamomum camphora (*C. camphora*)

C. camphora (Camphor) at dose of 2.5, 12.5 and 50 mg/kg for 7 d were evaluated for mount latency, mount frequency (MF), intromission latency (IL) and intromission frequency(IF) of male rats in the presence of sexually receptive female rats. Camphor at dose of 50 mg/kg reduce the ML and IL relative to that of control. Camphor has sexual desire and sexual performance enhancing properties[43].

Phoenix dactylifera (*P. dactylifera*) (Arecaceae)

Aqueous extract of Phoenix dactylifera at doses of 35 mg/kg, 70 mg/kg, 105 mg/kg, 140 mg/kg and 350 mg/kg were found significantly increased mount, ejaculation, intromission frequencies and ejaculation latency in comparison to controlled ones. Mount and intromission latencies significantly reduced. Maximum effect was observed in dose 140 mg/kg. This extract was found to enhance Testestrone, Estradiol and the orientation of males toward female ones by increasing mounting and ano-genital investigatory behavior[42].

Corchorus depressus (*C. depressus*) Linn. (Tiliaceae)

C. depressus Linn. has been used as aphrodisiac in traditional Indian medicine to treat male sexual dysfunction and impotency. The petroleum ether, chloroform, ethyl acetate, *n*-butanol and aqueous fractions of 95% methanol extract of *C. depressus* were screened initially for their in vitro aphrodisiac activity on rabbit corpus cavernosum smooth muscle. The chloroform fraction (CDC) was found to be the most active and therefore investigated further on general mating behavior, libido and potency of normal male Wistar albino rats in comparison with the standard drug, Sildenafil citrate. Chloroform fraction of methanolic extract of *C. depressus* significantly reduced ML, IL, PEI and III. There was a significant increase in the MF, IF and EL and serum testosterone levels throughout the study period. The potency test significantly increased erections, quick flips, long flips and total reflex. In vitro aphrodisiac activity was significantly higher in chloroform fraction at a concentration of 25.0 mg/mL, which induced 71.4% relaxation. The combined results of above mentioned models indicate that chloroform fraction of *C. depressus* produces a significant increase in sexual activity as exhibited by 25 mg/mL *in vitro* and 400 mg/kg *in vivo*. In comparison with the control, all the drug-treated groups have shown drug-induced effects for a few parameters. *In vitro* and *in vivo* studies provide with valuable experimental evidence that chloroform fraction of methanolic extract of *C. depressus* possesses aphrodisiac property. This study further substantiates the ethnopharmacological claims of *C. depressus* as a sexual stimulating agent and offers a significant potential for studying the effect on male sexual response and its dysfunctions[44].

Crocus sativus (*C. sativus*) Linn. (Iridaceae)

Effect of aqueous extract of *C. sativus* stigma (80, 160 and 320 mg/kg, i.p.), crocin (100, 200 and 400 mg/kg, i.p.), safranal (0.1, 0.2 and 0.4 mL/kg, i.p) on male rats were investigated. Crocin and extract increased MF, IL and erection frequency behaviors and reduced ML, IL and EL, whereas safranal did not show any aphrodisiac effect[45].

Diodia scandens (*D. scandens*) (Fabaceae)

Ethanol extract of *D. scandens* on pregnant guinea pig uterus was investigated and found to induce concentration dependent increase in the force of contraction and tonus. *D. scandens* was shown to acting via muscarinic receptors. Acetylcholine (Ach) was 2.5×10(5) times more potent. It also induced vasodilatation in the rat hindquarters and depressed the blood pressure in the anaesthetized cat[46].

Hibiscus sabdariffia (*H. sabdariffia*) (Malvaceae)

Aqueous extract of *H. sabdariffia* at dose of 1.15, 2.30, 4.60 g/kg, p.o. for 12-week on the rat testes did not show any significant change in the absolute and relative testicular weights. However, it showed a significant decrease in the epididymal sperm counts and induced resticular toxicity in rats[47].

Kaempferia parviflora (*K. parviflora*) (Zingiberaceae)

The alcoholic, hexane and aqueous extracts of *K. parviflora* showed no effect on the weights of reproductive organ, fertility or sperm motility even in 5-week male rats. However, alcoholic extract at a dose of 70 mg/kg, p.o significantly decreases mount and ejaculatory latencies and increases blood flow to the testis. Whereas, Hexane and water extracts had no influence on any sexual behavior parameters[48].

Lepidium meyenii (*L. meyenii*) (Brassicaceae)

The clinical trial of *L. meyenii* for aphrodisiac activity was done for 12 weeks in double-blind, placebo controlled, randomized, parallel trial with 1 500 mg/kg or 3 000 mg/kg, p.o. doses in form of tablets on men aged between 21 and 56 years. It had no effect on serum levels of luteinizing hormone, follicle stimulating hormone, prolactin, 17-alpha hydroxyprogestrone, testosterone and 17- beta estradiol[49].

Litsea chinensis (*L. chinensis*) (Lauraceae)

Ethanolic bark extract of *L. chinensis* on male sexual behavior in rats at 500 mg/kg, p.o. produced a significant increase in penile erection index, homosexual mounting and facilitated sexual behavior and orientation activity, as shown

by increased mounting performance, anogential sniffing, intromission and ejaculation frequencies[50].

Lycium barbarum (*L. barbarum*) (Solanaceae)

Effect of *L. barbarum* polysaccharides at 10, 50, 100 and 200 mg/kg, p.o. per day on damaged rat testis showed that LBP provided a protective effect against the testicular tissue damage induced by heat exposure. LBP significantly increased testis and epididymis weights, improved superoxide dismutase (SOD) activity, and raised sexual hormone levels in the damaged rat testes. LBP had a dose-dependent protective effect against DNA oxidative damage of mouse testicular cells induced by H_2O_2. LBP improved the copulatory performance and reproductive function of hemicastrated male rats, such as shortened penis erection latency and mount latency, regulated secretion of sexual hormones and increased hormone levels, raised accessory sexual organ weights, and improved sperm quantity and quality[51].

Microdesmis keayana (*M. keayana*) (Pandaceae)

Effects of aqueous extract of *M. keayana* root and major isolated alkaloids on sexual behavior of male rats revealed that it stimulates sexual parameters in rats and safe at dose of upto 2 g/kg, p.o.[52].

Peganum harmala (*P. harmala*) (Nitariaceae)

Treatment of *P. harmala* seeds at 100 mg/kg, p.o. for 56 d in male rats was found to be significantly change gonad and accessory gland weight and function, semen quality and histology of the organs involved in reproduction without affecting metabolic function[53].

Turnera diffusa (*T. diffusa*) (Turneraceae)

Effect of *T. diffusa* at 20-80 mg/kg, p.o. in sexually exhausted male rats significantly increased the percentage of males achieving one ejaculatory series and resuming a second one. In addition, Turnera diffusa significantly reduces the PEI[54].

Terminalia catappa (*T. catappa*) (Combretaceae)

Aphrodisiac potential of *T. catappa* seeds at a dose of 1 500 mg/kg or 3 000 mg/kg, p.o for 7 d in rats had a marked improvement of aphrodisiac action, sexual vigour. In contrast, the higher dose (3 000 mg/kg, p.o.) reversibly inhibited all the parameters of sexual behavior other than mounting and intromission frequency and copulatory efficiency[55].

Massularia acuminate (Rubiaceae)

Androgenic potential of aqueous extract of Massularia acuminate stem at 250, 500 and 1 000 mg/kg p.o. for 21 days in male rats was shown in significantly increase in testes body weight ratio, testicular protein, glycogen, sialic acid, Cholesterol, testosterone, luteinizing and folic stimulating hormone concentrations throughout the period of administration[56].

Mondia whitei (*M. whitei*) (Asclepiadaceae)

Effect of aqueous extract of *M. whitei* on human spermatozoa *in vitro* has significantly enhanced the total motility as well as progressive motility in a time dependent manner. This study signifies uses of *M. whitei* especially in men affected with asthenozoospermia[57].

Montanoa tomentosa (*M. tomentosa*) (Compositae)

Aqueous extract of Montanoa tomentosa at the dose of 38, 75 and 150 mg/kg, p.o. facilitates expression of sexual behavior in sexually active male rats and significantly increases mounting behavior in genitally anesthetized animals and induces the expression of sexual behavior in non copulating males. It also exerted a pro-ejaculatory effect and produced an increase in the number of discharges in the ejaculatory motor patterns in the spinal rats[58].

Allium sativum (*A. sativum*) (Alliaceae)

Aphrodisiac effect of *A. sativum* extacts at 0.57, 1.13 and 2.25 ml/kg, p.o. for 28 d on male mice was investigated and it was found that it increased sexual behavior in dose dependent manner[59].

Allium tuberosum (*A. tuberosum*) (Alliaceae)

The aphrodisiac activity of *n*-butanol extract of Allium tuberosum seeds was investigated in male rats at 500 mg/kg, p.o. for 40 days, and it was found that the extract significantly reduced ML, IL, EL and increased MF, IF & EF[60].

Alpinia calcarata (*A. calcarata*) (Zingiberaceae)

Hot water extracts of *A. calcarata* at a dose of 150, 250 and 500 mg/kg, p.o. in rats was found to prolong the EL. Moreover, the EL and IL were reduced, indicating a strong aphrodisiac action. At 500 mg/kg, p.o., it elevates the serum testosterone level and was found non toxic[61].

Cnestis ferruginea (*C. ferruginea*) (Connaraceae)

Aqueous root extract of Cnestis ferruginea at a dose of 13, 26 and 52 mg/kg b.w p.o. and reference herbal drug Powmax M at a dose of 7.14 mg/kg b.w p.o. once daily for 5 d. The extracts progressively reversed the trends of MF, IF, EF, ML, IL, EL and PEI in paroxetin treated animals towords the control values throughout the exposure period. Aqueous extract of *C. ferruginea* root at the dose of 13, 26 and 52 mg/kg body weight restored sexual competence[62].

Landolphia dulcis (*L. dulcis*)

Ethanol extract and methanol fraction of *L. dulcis* at a dose of at 500 and 1 000 mg/kg, the showed a significant increase in mount, intromission and ejaculation frequencies. This extract and fraction also significantly reduce the mount and intromission latencies and prolonged ejaculation latency compared with the control animals. The ethanol extract

and methanol fraction of *L. dulcis* also produced significant increase in serum testosterone concentration[63].

4. Other herbal plants with aphrodisiac potential

Other herbal plants with aphrodisiac activity are *A. heterophyllus* Linn., *Abrus preacatorium* Linn, *Abrus precatorius* L., *Abutilon indicum* (Linn.), *Acacia catechu* Willd., *Acorus calamus* Linn. *Aconitum heterophyllum*, *Achyranthes aspera* Linn.Wall. *Bombax ceiba* Linn., *Boesenbergia rotunda* L., *Amaranthus spinosus* L., *Bryonia laciniosa* Linn., *Bussea occidentalis*, *Carica papaya* L., *Cannabis indica* L., *Celastrus paniculatus* Willd., *Cola nitida* Schott & Endl., *Cucumis callosus*, *Curculigo orchioides* Gaertn., *Dalbergia sissoo* Roxb., *Daucus carota* L., *Emblica officinalis* Gaertn., *Eriodendron Anfractuosum* DC., *Euadenia eminens* Hook.., *Euphorbia hirta* L., *Eurycoma longifolia* Jack, *Ficus arnottiana* Miq., *Ficus retusa*, *Flueggea virosa* Roxb., *Garcinia afzelii* Engl., *Gmelina arborea* Roxb., *Hibiscus rosa-sinesis*, *Hygrophila auriculata* Schum., *Ipomoea mauritiana* Jacq., *Jatropha curcas* L., *Kaempferia parviflora*., *Linum usitatissimum* L., *Mallotus philippensis* Lam., *Mangifera indica* L., *Mezoneuron benthamianum*., *Morinda lucida*., *Orchis latifolia* Linn., *Papaver somniferum* L., *Punica granatum* L., *Rauvolfia vomitoria*., *Saccharum spontaneum* Linn., *Santalum album* Linn., *Scindapsus officinalis* Schtt., *Sida cordifolia* Linn., *Solanum nigrum* Linn., *Tamarindus indica* L., *Terminalia arjuna* Roxb., *Turrea heterophylla* Sm., *Valeriana jatamansi* Wall., *Wrightia tinctoria* (Roxb.), *Ziziphusabyss inica*., *Zingiber officinale*[40].

5. Discussion

Plants, since ancient times, have been used globally across varied cultures throughout the known civilizations as a valuable and safe natural source of medicines and as agents of therapeutic, industrial and environmental utilities. The medical historians have recorded plants that could be used as aphrodisiac. Sexual function is an important component of quality of life and subject for well being in humans. In modern time several factors like obesity, anxiety, stress conditions, various disease conditions and excessive use of medicines of synthetic origin has increased the risk of erectile dysfunction. Sexual problems are related to sexual desire and male erectile dysfunction. Successful treatment of sexual dysfunction may improve not only sexual relationships, but also the overall quality of life. Literature survey of the cited plants confirmed that potent aphrodisiac potential of above mentioned plants.

The medicinal plants discussed in this review have shown potent aphrodisiac activity. The synthetic formulations available in market, though they are showing excellent clinical and pharmacological activity in sexual dysfunction but they have significant adverse effect hence herbal drugs are preferred over synthetic drug to avoid serious side effects. Further investigation on the plants can increase the isolation of the newer molecules which will be helpful for the treatment of sexual dysfunction.

6. Conclusion

Current interest in traditional medicine has led to the rapid development and studies of many herbal remedies employed for sexual dysfunction. Novel information gathered from the current data is important in preserving folk indigenous knowledge as well as in the discovery of novel potential compounds with promising aphrodisiac potential. Therefore, this review has been prepared to provide a new compilation of plants with specific use as aphrodisiac only in different countries. Moreover, this review has incorporated latest data on new plant species/constituents which are not covered in previous reviews on aphrodisiac.

7. Future needs for this area of research

Majority of plants used as aphrodisiac agents, have not been thoroughly experimentally studied on humans. Present data also lacks information on exact mechanism of action and toxic effects of tested extracts. However, this is clearly one area that needs further investigation as findings in animals need to be translated to humans in order for a natural extract to be recommended for traditional use as aphrodisiac. Therefore, significant research into the chemical and biological properties of such less explored plants is still needed to determine their aphrodisiac efficacy and also will possibly define their exact mechanism of actions.

8. Limitations

The current article has been prepared by consulting the literature published in English language only, ignoring the studies published in other languages. The information mentioned in other language, if had been included, could make this review more interesting and also helpful in validating the presented data. Further, toxic studies on the cited plants/constituents is not available and not included, which otherwise, might be useful in selecting the plant for further investigation.

Conflict of interest statement

We declare that we have no conflict of interest. The authors alone are responsible for the content and writing of the paper.

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