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Review on Medicinal plants used in the Management of Male Infertility

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ABSTRACT

Introduction: infertility is a reproductive system disorder that affects both men and women in nearly equal numbers. It is a global phenomenon that affects an average of 10% of the human reproductive age population and is considered one of humanity's unsolved problems. It is a severe burden on the socio-economic development of many African countries, affecting the lives of individuals, couples, and families, and has recently been designated as a public health concern.

Review: in Sub-Saharan Africa, infertility still receives less attention and is of low priority in the continent's reproductive health agenda despite its huge psychosocial and economic impact on families and communities. Infertility can be treated medically, but these treatments are prohibitively expensive for people in developing nations. Furthermore, specialist medical clinics capable of providing such therapies are uncommon and located far from the rural areas of the countries where the bulk of infertile couples' reside. Because of its accessibility, availability, and cost, traditional medicine is used by a large portion of the African population for reproductive health issues. Although male factors accounts for about 50% of all cases of infertility, while about 15% remain idiopathic, some of the causes of male infertility range from psychogenic and endocrine disorders, testicular malformations, hormone imbalance or blockage of Man's duct system. Many studies have proved the use of plants in the improvement of male fertility parameters.

Conclusion: this review search through literatures and collate some of the medicinal plants used in the treatment of erectile, ejaculatory and spermatogenesis disorders, libido dysfunction and sperm abnormalities.

Keywords: Male; Infertility; Ethnomedicine; Libido dysfunction; Spermatogenesis; Medicinal plants.

Introduction

Infertility is a reproductive system disorder that affects both men and women in nearly equal numbers. It is a global phenomenon that affects an average of 10% of the human reproductive age population and is considered one of humanity's unsolved problems (Jaradat and Zaid, 2019). Infertility in itself is not life threatening but causes radical changing experience and has serious impact on the mental and social well-being of infertile couple. The World health Organization (WHO, 2002) defines infertility as the "failure to conceive after 12 months of regular unprotected sexual intercourse in the absence of known reproductive pathology. Infertility affects up to 186 million people worldwide (Inhorn and Patrizio, 2015) while the majority of infertile people live in the developing world. It is a severe burden on the socioeconomic development of many African countries, affecting the lives of individuals, couples and families. It has recently been designated as a public health concern (La Rochebrochard, 2004), as a result, immediate action is required to cure and/or prevent it. Intrinsic (anatomic, genetic, hormonal, and immunological diseases) and extrinsic factors such as sexually transmitted infections (STIs), infections after parturition or surgery, pelvic TB, and obesity can all be linked to this problem. In many countries, the stigma of infertility often leads to marital disharmony, divorce or ostracism. In Sub-Saharan Africa, infertility still receives less attention and is of low priority in the continent's reproductive health agenda despite its huge psychosocial and economic impact on individuals, families, and communities. Infertility can be treated medically, but these treatments are prohibitively expensive for people in developing countries and are neither necessarily effective nor safe. Furthermore, specialized medical clinics that can provide such treatment are few and far between in the rural areas of the country where the bulk of infertile couples live. As a result, they will be forced to rely on traditional medicine to solve their reproductive health issues (Bussmann, 2006). Couples who are experiencing infertility employ both traditional and modern medicine as treatment options (Feldman and Laura, 2004).

Ethno-medicine is a term that refers to a wide range of healthcare systems/structures, practices, beliefs and therapeutic techniques that arise from indigenous

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cultural development (Hamilton, 2004). The use of medicinal plants in the treatment of diseases and dysfunctions dates back millennia and has made a significant contribution to the creation of medicines, with plants accounting for around 25% of current therapeutics. Furthermore, herbal products are used by up to 60% of the world's population for medical purposes (Rates, 2001). In many African cultures, medicinal plant knowledge is frequently passed down from generation to generation (Sofowora, 1993; Asase *et al*., 2008, 2010). This issue is exacerbated by a general trend of deforestation in some of these communities, which will result in the extinction of precious and rare medicinal plants. Furthermore, we believe that the number of traditional healers is decreasing in these areas due to an increase in the western lifestyle and a lack of desire among the younger generation to carry on the practice (Bussmann *et al*., 2006; Muthu *et al*., 2006; Focho *et al*., 2009). As a result, there is a pressing need to preserve and record our ancestral knowledge of therapeutic plants (Mshana *et al*., 2001; Van Wyk *et al*., 2002; Van Wyk and Wink, 2004). Natural materials evaluation as a source of prospective pharmaceuticals has reawakened attention in both developing and developed countries over the last two decades. This growing interest in phytotherapy is due to a number of factors, including the inefficiency of conventional medicine, the misuse and/or incorrect use of synthetic drugs, which results in side effects and other issues, the discovery of the "natural," large therapeutic spectrum of plant products and their effectiveness in the treatment of chronic diseases, and the need for new drug development. Phytomedicines are dietary supplements that provide nutritional and rejuvenating benefits to the body (Rates, 2001; Chapman and Chomchalow, 2003; Okigbo, 2006). The World Health Organization encourages researchers to identify the rational use of medicinal plants as a source of novel pharmaceuticals (WHO, 2002). Many studies have shown that secondary metabolites from medicinal plants can influence reproductive function regulation (Moundipa *et al*., 1993; Telefo *et al*., 1998, 2004; Al-Quarawi *et al*., 2000; Jha *et al*., 2010). The preservation of these medicinal plant mixtures could provide long-term data for developing effective and affordable treatments for infertility. Although there are many causes of male infertility, psychogenic and endocrine diseases, vascular injuries, and drug misuse have all been identified as contributing factors to infertile men (Kandeel *et al*., 2010). Plants have been shown to boost male fertility indices in research. Thus, this review focus on the use of medicinal plants in the treatment of erectile, ejaculatory and spermatogenesis disorders, libido dysfunction and sperm abnormalities.

Ethnomedicine

Ethnomedicine is a study or comparison of the traditional medicine practiced by various ethnic groups, and especially by indigenous people (Bhat *et al*., 2013). The word ethnomedicine is sometimes used as a synonym for traditional medicine. Ethnomedicine is concerned with how people understand health, disease, and illness from a cultural perspective, as well as the process of obtaining health care and healing techniques. Ethnomedicine is also taken to mean the study of these systems and techniques more so from the sense of placing them into an anthropological context rather than evaluating their effectiveness using the scientific method. Either way, such healthcare systems don't necessarily follow the structure of modern or 'Western' medicine. Instead, these healthcare practices are based on the unique culture that has arisen from native/indigenous groups of people.

Ethnomedicine isn't limited to the obvious things, like using indigenous plants and ingredients to treat the sick. It also involves studying or utilizing:

- How a disease/illness arises, according to the native cultural point of view.
- Indigenous beliefs about what a person's signs and symptoms really mean.
- The way by which a disease/illness progresses.
- The best ways by which a disorder should be managed and who should manage it and how.

Ethnomedical systems tend to see the mind and body as one entity and they focus on preventative techniques, such as the use of massage therapy, exercise, spices, herbs, and food to heal a diseased or ill individual. In many communities around the world, plants are the principal source of health care (Bannerman *et al*., 1983). They also serve as resources for biomedical research, and traditionally employed species have made major contributions to the development of biomedical treatments (Newman *et al*., 2000; Fabricant and Farnsworth, 2001; Cragg and Newman, 2013). By providing new chemical entities or combinations of metabolites for testing, ethnomedicine can be utilized to focus bio-prospecting and address the drop in leads (Nwaka and Hudson, 2006). (Gurib-Fakim, 2006; Sucher, 2013; Skirycz *et al*., 2016). Whether this is true or not, research into plants used in ethnomedicine is necessary because continued usage of some plants may endanger public health (Jäger, 2015).

Only a small percentage of the plant species surrounding them are used directly by humans, and it has long been recognized that medicinal plants are found more frequently in certain families than in others (Moerman, 1991; Moerman *et al*., 1999). Medicinal plants play an essential role in small communities' healthcare systems as the primary source of medicine for the bulk of the rural population (Ahmad *et al*., 2012). More than 50,000 blooming plants are utilized for medical purposes, out of a total of 422,000 flowering species documented around the world (Hamilton, 2004). Traditional medicine is used by about 60% of the world's population and 80% of the people in underdeveloped countries.

More than 4.5 billion people in the poor world rely on medicinal plants as part of their treatment, according to Bhat *et al.* (2013). Due to the expensive expense of allopathic medications and their negative effects, therapeutic plants are most popular in rural areas (Marwat *et al*., 2008). The way disease and well-being are perceived and experienced, people's health-seeking behavior, and their knowledge about natural remedies such as plants and animals are greatly influenced by their cultural and natural context, which make these subjects a field of special interest for ethnobiologists.

The relevance of ethnomedicine has never been as great as nowadays and it goes much beyond the exotic curiosity of the early anthropological studies of the 1920s on beliefs about sorcery and witchcraft. According to the World Health Organization (WHO, 2008), as much as 80% of the population of some developing countries relies on traditional medicine and medicinal plants to respond to their health care needs. The widespread use of indigenous medical systems cannot be explained only because formal health care is not affordable or accessible, as one might think. Instead, these practices are used mostly because they are socially and culturally adapted and correspond to local views on disease and well-being.

Most indigenous people now live in diversified medical settings, where different medical folklores coexist and are adopted. This is also true in metropolises of the world, where ethnic groups continue to reproduce their medical knowledge and practices. There is also an increasing recognition of the limitations of biomedicine to provide global well-being and respond to the multiple physical and psychological ailments faced by people (Cuerrier *et al*., 2012). This leads to a growing interest in industrialized countries for indigenous forms of medicine, which are considered to be more holistic than biomedicine. Last but not least, the importance of ethnomedicine lies in the potential benefits for humanity in terms of traditional pharmacopoeias serving as a basis for new drug discovery. Because of all these assets, WHO passed a resolution in 2009 (Beijing Resolution 62.13), in which they emphasized the importance of the following:

- respecting, preserving, promoting and communicating ethnomedicine;
- creating national policies, regulations, and standards within the national health system to ensure safe and effective use of ethnomedicine;
- integrating ethnomedicine into national health systems;
- further developing ethnomedicine based on the "Global Strategy and Plan of Action on Public Health, Innovation, and Intellectual Property" adopted at the 61st World Health Assembly in 2008;
- establishing systems for the qualification, accreditation or licensing of ethnomedicine practitioners;
- strengthening communication between conventional and ethnomedicine providers and establishing training programs for health professionals, medical students and researchers.

The desire to employ natural products as medicine has sparked research into the methods for collecting the plant components needed for pharmacological screening and medication development (Ahmad *et al*., 2012). Ethnobotanical studies are now widely recognized as the most viable method for identifying new medicinal plants or refocusing on those previously identified for bioactive constituents (Hamilton, 2004). The method is known to yield a higher percentage yield of bioactive useful medicinal compounds than other methods of random selection and screening (Bhat *et al*., 2013). Ethnomedicine has also been revealed to be a valuable tool for comprehending indigenous societies and their relationships with nature (Marwat *et al*., 2008). Ethnomedicine is a widely used and accepted form of medicine that has even been acknowledged and encouraged by the World Health Organization. Plants have been used to treat ailments from the beginning of time. Even if the chemical constituents of medicinal plants are not totally recognized or investigated, popular observations on their use and efficacy contribute to the disclosure of their therapeutic capabilities, resulting in their widespread prescription. The utilization of medicinal plants has substantially aided basic health care all throughout the world, particularly in African countries (Ahmad *et al*., 2012). Herbals are widely accepted in Africa, albeit their use is more popular among destitute peoples and those who, while not indigent, nonetheless adhere to traditional beliefs. Despite the rising usage of medicinal herbs, their future appears to be jeopardized by a lack of concern for their preservation. As a result of growing trade demands for cheaper healthcare products and new plant-based therapeutic markets in preference to more expensive target specific drugs and biopharmaceuticals, the reservoirs of herbs and stock of medicinal plants in developing countries are diminishing and in danger of extinction (Marwat *et al*., 2008, Farooq *et al*., 2019).

When the entire plant or at least one of its sections contains one or more medicinal properties, it is termed medicinal (Akoka and Akoka, 1972). Clinical research, analysis, and quality control are capable of establishing the treatment value of ethnomedicine, which is quickly gaining acceptance in the realm of conventional medicine (Falsetto, 2009). According to (Bussmann and Glenn, 2011) ethnomedicine is used globally and has a rapidly growing economic importance. (WHO, 2002) had reported that in developing countries, it is often the only accessible and affordable treatment available. People use leaves, barks, flower, roots, fruits of medicinal plants in infusion, decoction, extracts in the management of diseases and disorders. phenolic chemicals (Phenols,

sterol, lignans, and flavonoids), vitamins (B1, B2, B3, B6, C and E), folic acid, biotraceelements (Ca, Mg, P, Zn, K, Cu, Fe), most important amino acids, volatile oils, polyphenols, and saponins are all present in most plant extracts (Tsobou, 2016).

People employ medicinal plants to cure a variety of ailments, including infertility problems. Some plants contain chemicals that have a regulating influence on reproductive function, operating directly or indirectly on the hypothalamic–pituitary–gonadal axis by inducing or inhibiting ovulation/spermatogenesis and steroidogenesis (Telefo *et al*., 2011). Medicinal herbs can be used as an alternative to manufactured medications in the treatment of reproductive disorders, especially in developing countries where they are expensive and/or inaccessible (Tsobou, 2016). Several studies have indicated that natural substances that act directly on the reproductive organs or indirectly influence physiological processes have favorable effects on reproduction (Aiyeloja and Bello, 2006; Bashir *et al*., 2009; Lawal *et al*., 2010; Khan *et al*., 2015; Balamurugan, 2018; Jaradat and Zaid, 2019). It has been stated that medicinal plants used to boost reproductive processes have several properties, and that most people in rural areas have traditionally employed plant remedies rather than modern medicine for their own diseases due to a lack of modern facilities in the areas (Mbemya *et al*., 2017).

Medicinal plants in the Management of Male Infertility

Male factors accounts for about half of all cases of infertility, which are mainly related to impaired spermatogenesis (Wu *et al*., 2016). Congenital and acquired urogenital abnormalities, infections of the genital tract, increased scrotal temperature (varicocele), endocrine problems, genetic abnormalities, and immunological variables can all affect male fertility (WHO, 2000). A considerable percentage of infertile men are unable to conceive their female partner due to a lack of sperm (azoospermia) or too few sperm (oligozoospermia); abnormal sperm morphology (tetratozoospermia); and abnormal sperm motility (athenozoospermia) (Feng, 2003). There is evidence that sperm counts have decreased during the previous 50 years, resulting in an increase in male infertility. Nonetheless, 10 to 20% of male infertility cases are caused by psychological problems such as stress, remorse, sadness, low self-esteem, and fear of sexual failure (Ehrabor *et al*., 2012). The prevalence of sexual inadequacies in human males has led to the creation of a variety of treatment options, but they are all too expensive, difficult to obtain, and some have major adverse effects (Yakubu *et al*., 2007).

Constant used of medicinal plants in developing countries has been linked to its accessibility, availability, and affordability which have been the first recourse of infertile couples (WHO, 2002). Several extracts, fractions, or molecules obtained from these plants are now widely utilized to treat or manage various aspects of male infertility, including libido loss, sexual asthenia, erectile dysfunction, ejaculatory and relaxation dysfunctions, orgasm loss, and sperm abnormalities (Jaradat, 2019). Many of this plants are been used in humans and some in vivo studies have been conducted in rodents to confirm their biological activities. It was noted in an ethnomedicinal survey in Nigeria that several authors have given credence to traditionally or folkloric use of some plants in the management and the treatment of male infertility cases (Erhabor, 2012). Baljinder *et al.* (2010) agrees with the use of *Allium sativum*, *Cissusqua drangularis*, *Cocos nucifera*, *Cola acuminate*, *Cymbopogon citrates*, *Garcinia kola*, *Piper guineense*, *Sesamum indicum*, *Zingiber officinale* in the treatment of male infertility. Afolayan and Yakubu (2008) also agree with the reported use of *Terminali acatapa*, *Musa paradisiaca*, *Piper guineense* in the treatment of male infertility. Igoli *et al.* (2005) reported the use of *Anthocleist adjalonensis* and *Newbouldia laevis* in the treatment of male infertility among Igede people of Nigeria. The use of *Carica papaya*, *Carpolobialutea*, *Citulus lanatus*, *Lonchocarpuscyanescence*, *Spondias mombin*, *Aframomummelegueta and Irvingiagabonesis* on the treatment of male infertility has been reported (Aiyeloja and Bello, 2006; Lawal *et al*., 2010, Yativ *et al*., 2010).

Medicinal plants used in the Treatment of Erectile and Libido Dysfunction

The inability to achieve an erection sufficient for intercourse to the mutual pleasure of both parties is defined as erectile dysfunction (ED) (Berookhim and Bar-Chama, 2011). ED affects 15 to 30 million men worldwide, according to estimates (NIH, 2003). Men with ED suffer in silence in many areas of the world due to fear, humiliation, a lack of access to medical services, and possibly because ED is a low medical priority in many parts of the world. ED has a considerable detrimental impact on an individual's well-being and quality of life, despite the fact that it does not affect life expectancy (NIH, 2003). There are numerous reasons of ED, but the most important is that it is an age-related condition.

The Male Massachusetts Aging Study provides the most convincing evidence for this. According to this study, the risk of ED increased from 5.1 percent at 40 years of age to 15 percent at 70 years of age (Morris, 2003). Other conditions such as diabetes, renal disease, chronic alcoholism, multiple sclerosis, atherosclerosis, vascular disease and neurological diseases account for approximately 70% of ED cases (Barnes, 2003). National Institutes of Health (NIH) also reported that between 35 and 50% of men with diabetes suffer from ED (Wagner, 2000). Furthermore, men taking many commonly used medications such as antihypertensive drugs, antihistamines, antidepressants, tranquillizers,

appetite suppressants and cimetidine will experience ED as a side effect (Barnes, 2003). Psychological factors can also cause ED, either in isolation or concurrently with an organic cause. With an ageing male population, an increase in co-occuring conditions, greater treatment-seeking behaviour, and rising costs of treatment, the burden of ED will undoubtedly increase worldwide.

Conventional treatment methods for ED included psychosexual counseling, androgen replacement therapy, intraurethral agents, intracavernous injections, mechanical devices and surgery. The last decade has seen a huge paradigm shift in ED treatments.The introduction of Viagra as an effective and reliable oral treatment for ED in 1998 has allowed access to treatment for many couples across the world. However, despite the success of modern treatments for ED, many men across the globe still rely on herbal treatments. Reasons for this could be reluctance in seeking treatment for a private and personal condition, financial concerns about the side effect profile of drugs and their lack of efficacy.

Several studies have been conducted to know the role of some medicinal plants in the treatment of erectile dysfunction. Ratnasooriya (2000) administered the seed extracts of *Terminala catappa* to rats at the dose of 1.5g/kg for 7 days and observed that there was increase in sexual vigour (intromission and mounting frequency) and sexual performance. Castrated male rats were administered extract of *Euryco malongifolia* at doses of 200, 400, and 800 mg/kg twice daily for 10 days, and this promoted sexual desire (Ang *et al*., 2001, Mohammed *et al*., 2015). In another study in men to know the effects of *Eurycomalongifolia* on sexual performance and wellbeing, it significantly improved sexual performance across several clinically important parameters after 12 weeks when compared to placebo. Kumar *et al.* (2000) administered the ethanolic extract of *Vanda tessellate* flowers to mice at the dose of 50 and 200mg/kg, 1 and 3 hours after administration it was observed that there was an increase in mating performances of the mice. The extracts of *Tribulus terrestris* (5mg/kg) was given to rats for eight weeks which stimulated the rat's sexual desire (Bashir *et al*., 2009). In another study by Singh *et al.* (2012), they concluded that *Tribulus terrestris* has the potential to be used as a safe therapeutic alternative to current modalities for the management of sexual dysfunction in males after studying the effect of acute and repeated dose administration of lyophilized aqueous extract of the dried fruits of *Tribulus terrestris* on sexual function in sexually sluggish male albino rats. Male rats with erectile dysfunction were given a lipidic extract from *Lepidium meyenii*, which improved their sexual function as demonstrated by a rise in the number of sperm-positive females, complete intromissions, and a decrease in the latent duration of erection in rats (Zheng *et al*., 2000). The bark extract of *Bute afrondonsa* given to male rats for about 21 to 28 days increased mounting, intromission and ejaculatory frequencies (Ramachandran *et al*., 2004). *Ginkgo biloba* administered to male rats increased their copulatory behavior (Yeh *et al*., 2008). After 15 days of therapy, the aqueous extract of *Catha edulis* reduced mounting and intromission/arousal latencies, improving sexual motivation/arousal in male rats (Abdulwaheb *et al*., 2007).

Ali and Rakkah (2008) found that giving rats aqueous extract of *Cassimiro aedulis* at a concentration of 250mg/kg increased mounting and intromission rates, decreased mounting and intromission latencies, and decreased the post ejaculatory delay.

The ethanolic extract of *Dracaena arborea* administered to normal and diabetic rats at a dose of 100- 500mg/kg for 7 to 14 days increase erection, intromission and mounting frequencies of the rats (Wankeu-Nya *et al*., 2014). The aqueous extract of *Montano atomentosa* (75mg/kg) administered to genitally anaesthesisized animals stimulated sexual arousal and increased mounting behavior 30 minutes after administration (Casso-Juarez *et al*., 2004). The aqueous root extract of *Dactyl orhizahatagirea* (200mg/kg) administered for 28 days stimulated rat libido, mating and ejaculatory frequencies and decreased the intromission and post ejaculatory latencies (Thakur and Dixit, 2007).

Medicinal plants used in the Management of Spermatogenesis Disorders

One of the most common causes of male infertility is spermatogenesis failure (Khojasteh *et al*., 2016). Several factors can disrupt spermatogenesis, lowering sperm quality and quantity. A variety of phytomedicines have been demonstrated to improve spermatogenesis, sperm parameters, Leydig cell counts, seminiferous tubule diameters, aberrant sperm, histological recovery, and sperm concentration and motility in ejaculation volume (Mohammadi *et al*., 2013).

Mazaherri *et al*. (2014) found that treating rats with Alpinia galangal rhizome (300mg/kg) for 56 days impacted sperm parameters and the spermatogenesis process by increasing the quantity of spermatozoa and testosterone production. Oral administration of *Cinnamonnum* extract at 500mg/kg to diabetic rats for 65 days improved semen quality and increased serum testosterone and insulin levels and caused a decrease in the degenerative lesions seen in the testes of diabetic rats (Shalaby and Mouneir, 2010). Khaki *et al.* (2015) in another study demonstrated that the administration of *Cinnamonum zeylanicum* at 75mg/kg for 28 days significantly increased sperm motility and viability in the experimental group compared to the control group and also an increase in testosterone levels. *Danaeracemose* administered to rats at 200mg/kg and 400mg/kg dosage for 28 consecutive days significantly increased the sperm motility and

viability in the treated rats (Khaki *et al*., 2009). The administration of *Phoenix dactylifera* 120mg/kg and 200mg/kg dosage to rats for 35 days showed a significant increase in sperm count and sperm motility of the rats (Mehraban *et al*., 2014). *Punicagranatum* administered to rats for 7 weeks increased sperm quality and spermatogenetic cell density (Turk *et al*., 2008). The administration of *ocinum basilicum* at dosage 1.5 and 3g/kg for 40 consecutive days significantly increased sperm motility, viability and count (Dorman and Hiltunen, 2010).

Seminiferous tubule thickness and diameters, account of Sertoli and Leydig cells, account of spermatogonia, primary and secondary spermatocytes, spermatids, free spermatozoa, diameter of Leydig cells, hormones (testosterone & FSH), and protein concentration were all significantly increased after treatment with alcoholic extract of Nigella sativa (0.5 and 1.5g/kg). In oligospermic males, treatment with 225mg/kg full spectrum root extract of *Withani asomnifera* for 90 days resulted in considerably better semen parameters as well as enhanced and controlled sexual hormone levels (Ambiye *et al*., 2013).

In male rats, oral administration of 240 mg/kg *Phaleria macrocarpa* aqueous extract for 7 weeks improved infertility, as demonstrated by dramatically increased spermatogonia cell quantity and thickness of seminiferous tubule compared to control. The administration of 50mg/kg and 100mg/kg of *Zingiber officinale* in mice for 22 days increased sperm motility and viability (Aleissa, 2014). It was concluded from the Modaresis and Khodadadi, 2014 study that *Aloe vera* extract can affect spermatogenesis directly by affecting germinal cells and stimulating cell division and it was also demonstrated in another study that it can affect spermatogenesis indirectly by by stimulating Leydig cells thereby cause increase in testosterone level (Khooshsh *et al*., 2007).

Khaki *et al.* (2013) showed that the administration of *Citrulus vulgaris*, 55mg/kg for 28 days consecutively significantly increased sperm concentrations, motility and viability. *Panax ginseng* administered to male rats 1g/kg for 56 days increased sperm count, motility, testis CREM mRNA and CREM protein (Park, 2007). In a double-blind randomized, placebo-controlled pilot study to determine the effect of *Lepidium meyenii* on sperm parameters and serum hormone levels in healthy adult men, it was discovered that sperm concentrations were increased (Melnikovova *et al*., 2015).

References

1. Abdulwaheb M., Makonnen E., Debella A. and D. Abebe. Effect of Catha edulisforesk (khat) extracts on male rat sexual behavior. Journal of Ethnopharmacology. 2007; 21:250-6.
2. Ahmad K.S., Kayani W.K., Hameed M., Ahmad F. and T. Nawaz. Floristic diversity and ethnobotany of Senhsa, district Kotli, Azad Jammu & Kashmir (Pakistan). Pakistan Journal of Botany. 2012; 44: 195-201.
3. Aiyeloja A.A. and O.A. Bello. Ethnobotanical Potentials of Common Herbs in Nigeria: A Case Study of Enugu State. Educational Research and Reviews. 2006 ;1:16-22.
4. Akoka G. and A. Akoka 1972 Medicine. Medicine Encyclopedia 3:692.
5. Aleissa M.S. Effect of Ginger supplements some reproductive parameters and spermatogenesis of mice. Indian Journal of Fundamental and Applied Life Sciences. 2014; 1: 271-277.
6. Al-Sa'aidi J.A., Al-Khuzai A.L. and N.F. Al-Zobaydi. Effect of alcoholic extract of Nigella sativa on fertility in male rats. Iraqi Journal of Veterinary Sciences. 2005; 23: 123-128.
7. Ambiye V.R., Langade D., Dongre S., Aptikar P. and M. Kulkarni. Clinical Evaluation of the Spermatogenic Activity of the Root Extract of Ashwagandha (Withaniasomnifera) in Oligospermic Males: A Pilot Study. Evidence-based Complementary and Alternative Medicine. 2013; 57:14-20.
8. Balamurugan S., Vijayakumar S., Prabhu S. and J.E. MorvinYabesh. Traditional plants used for the treatment of gynaecological disorders in Vedaranyamtaluk, South India - An ethnomedicinal survey. Journal of Traditional and Complementary Medicine. 2018 ;8(2):308-323.
9. Baljinder S., Vikas G., Parveen B., Ranjit S. and K. Dharmendra. Pharmacological potential of plant used as aphrodisiacs. International Journal of Pharmacology science. 2010; 5:104-113.
10. Bannerman R., Burton J. and W. Chen. Traditional Medicine and Health Care Coverage: A Reader for Health Administrators and Practitioners. Geneva: World Health Organization. 1983.
11. Barnes J. Quality, efficacy and safety of complementary medicines: fashions, facts and the future. Part I. Regulation and quality. Brazilian Journal of Clinical Pharmacology. 2003; 55:226.
12. Bashir A., Tahir M., Samee W. and B. Munir. Effects of Tribulusterrestris on testicular development of immature albino rats. Biomedical. 2009; 25. 63-68.
13. Berookhim B.M. and N. Bar-Chama. "Medical implications of erectile dysfunction," Medical Clinics of North America. 2011; 95:213–221.
14. Bussmann R.W., Malca G., Glenn A., Sharon D., Nilsen B., Parris B., Dubose D., Ruiz D., Saleda J., Martinez M., Carillo L., Walker K., Kuhlman A. and A. Townesmith. Toxicity of medicinal plants used in Northern Peru. Journal of Ethnopharmacology. 2011; 137:121–140.
15. Bhat J., Kumar M. and R. Bussmann. "Ecological status and traditional knowledge of medicinal plants in Kedarnath Wildlife Sanctuary of Garhwal Himalaya, India," Journal of Ethnobiology and Ethnomedicie. 2013; 9:1.
16. Carro-Juárez M., Cervantes E., Cervantes-Méndez M. and G. Rodríguez-Manzo . Aphrodisiac properties of Montanoatomentosa aqueous crude extract in male rats. Pharmacology Biochemical Behavior. 2004 ;78:129-34.
17. Cragg G.M. and D.J. Newman. Natural products: a continuing source of novel drug leads. Biochim. Biophys. Acta Gen. Subj. 2013;1830 3670–3695. 10.1016/j.bbagen.2013.02.008
18. Cuerrier A., Downing A., Patterson E. and P.S. Haddad. Aboriginal anti-diabetic plant project with the James Bay Cree of Québec: An insightful collaboration. Journal of Enterprising Communities: People and Places in the Global Economy. 2012; 6(3): 251-270.
19. Dorman H.J. and R. Hiltunen. Ocimum basilicum L.: phenolic profile and antioxidant-related activity. Nat Prod Commun. 2010; 5: 65-72.
20. Erhabor J., Idu M. and F.O. Udo. Ethnomedicinal Survey of Medicinal Plants Used in the Treatment of Male Infertilty among the IFA Nkari People of Ini Local Government Area of Akwa Ibom State, Nigeria. Research Journal of Recent Science 2013; 2:5-11.
21. Fabricant D.S and N.R. Farnsworth. The value of plants used in traditional medicine for drug discovery. Environmental Health Perspective 109(Suppl. 1). 2001;69–75. 10.1289/ehp.01109s169

22. Farooq A., Amjad M.S. and K. Ahmad. Journal of Ethnobiology Ethnomedicine. 2019 ;15: 45.
23. Feng H.L. Molecular Biology of Male Infertility. Archives of Andrology. 2003; 49:1, 19-27.
24. Gonzales G.F., Gasco M., Córdova A., Chung A., Rubio J. and Villegas. Effect of Lepidiummeyenii (Maca) on spermatogenesis in male rats acutely exposed to high altitude (4340 m). Journal of Endocrinology. 2004;180(1):87-95.
25. Gurib-Fakim A. Medicinal plants: traditions of yesterday and drugs of tomorrow. Mol. Aspects Med. 2006;27 1–93. 10.1016/j.mam.2005.07.008.
26. Hamilton A.C. Medicinal plants, conservation and livelihoods. J Biodivers. Conserv. 2004; 13: 1477-1517.
27. Hindin M.J., Tunçalp Ö., Gerdts C., Gipson J.D. and L. Say. Monitoring adolescent sexual and reproductive health. Bull World Health Organ. 2016; 94:159–66.
28. Igoli J.O., Tor–Anyiin T.A., Usman S.S., Oluma H.O. and N.P. Igoli. Folk medicines of the lower Benue valley of Nigeria. Recent Progress in Medicinal Plants 7 (V. K). 2002.
29. Jäger A.K. "Medicinal plant research: a reflection on translational tasks," in Ethnopharmacology Hoboken, NJ: Wiley-Blackwell. 2015; 11–16.
30. Jaradat N. and A.N. Zaid. Herbal remedies used for the treatment of infertility in males and females by traditional healers in the rural areas of the West Bank/Palestine. BMC Complement Altern Med19, 194 (2019) doi:10.1186/s12906-019-2617.
31. Khan M.A., Islam M.K. and M.A. Siraj. Ethnomedicinal survey of various communities residing in Garo Hills of Durgapur, Bangladesh. Journal of Ethnobiology Ethnomedicine. 2015;11:4. doi:10.1186/s13002-015-0033-3.
32. Khan H.M., Belwal T., Tariq M.A. and A.D. Hari. Genus Vanda: A review on traditional uses, bioactive chemical constituents and pharmacological activities. Journal of Ethnopharmacology. 2018; 229. 10.1016/j.jep.2018.09.031.
33. Khaki A., Fathiazad F., Ahmadi-Ashtiani H.R., Rastgar H. and S.H. Rezazadeh. Effects of Danaeracemosa on Spermatogenesis in Rat. Journal of Medicinal Plants. 2009; 31: 87-92.
34. Khaki A. Effect of Cinnamomumzeylanicumon on Spermatogenesis. Iran Red Crescent Medicinal Journal. 2015; 17: e18668
35. Khojasteh S.M., Khameneh R.J., Houresfsnd M. and E. Yaldagard. A Review on Medicinal Plants Used for Improvement of Spermatogenesis. Biol Med (Aligarh). 2016; 8: 292. doi:10.4172/0974-8369.1000292.
36. Khooshesh L., Dashtnavard H., Bahadoran A., Karimi M. and Jafari. Evaluation of sulfur mustard effect on the spermatogenesis process of mature male rats. Journal of Iran Anatomical Science. 2007;5: 37-36.
37. Lawal I.O., Uzokwe N.E., Igboanugo A.B., Adio A.F., Awosan E.A., Nwogwugwu J.O., Faloye B., Olatunji B.P. and A.A. Adesoga. Ethnomedicinal information on collation and identification of some medicinal plants in Research Institutes of South-west Nigeria. African Journal of Pharmacology. 2010; 4:1-7.
38. Mazaheri M., Shahdadi V. and B.A. Nazari. Molecular and biochemical effect of alcoholic extract of Alpiniagalanga on rat spermatogenesis process. Iranian journal of reproductive medicine. 2014;12(11):765–770.
39. Marwat S.K., Khan M.A. and M. Ahmad. Ethnophytomedicines for treatment of various dieases in D. I. Khan District. SJA. 2008;24:293–303.
40. Melnikovova I., Fait T., Kolarova M., Fernandez E.C. and L. Milella. "Effect of LepidiummeyeniiWalp on Semen Parameters and Serum Hormone Levels in Healthy Adult Men: A Double-Blind, Randomized, Placebo-Controlled Pilot Study" Evidence-Based Complementary and Alternative Medicine. Article ID. 2015;324-369.
41. Mehraban F., Jafari M., AkbartabarToori M., Sadeghi H. and B. Joodi. Effects of date palm pollen (Phoenix dactylifera L.) and Astragalusovinus on sperm parameters and sex hormones in adult male rats. Iranian Journal of Reproductive Medicine. 2014;10: 705-712.
42. Modaresi M. and A. Khodadadi. The Effects of Aloe vera Extract on Spermatogenesis and Reproductive hormones in Mice. Research Journal of Biological Sciences. 2014; 5: 165-16.
43. Moerman D.E. The medicinal analysis flora of native North America: an analysis. Journal of Ethnopharmacology. 1991; 31:1–42. 10.1016/0378-8741(91)90141-Y.
44. Mohamed A.N., Vejayan J. and M.M. Yusoff. Review on Eurycomalongifolia Pharmacological and Phytochemical Properties. Journal of Applied Sciences. 2015;15: 831-844.
45. Mohammadi F., Nikzad H., Taherian A., AminiMahabadi J.A. and M. Salehi. Effects of Herbal Medicine on Male Infertility. Anatomical sciences. 2013;10: 3-16.
46. Morris C.A. Internet marketing of herbal products. JAMA. 2003;290:1505.
47. National Institutes of Health (NIH). Erectile Dysfunction. The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Melman A, Hirsch M. NIH Publication. 2003; 04-3923.
48. Newman D.J., Cragg G.M. and K.M. Snader 2000 The influence of natural products upon drug discovery. Nat. Prod. Rep.17 215–234.
49. Nwaka S. and A. Hudson. Innovative lead discovery strategies for tropical diseases. Nat. Rev. Drug Discov. 2006; 5:941–955.
50. Park W.S., Shin D.Y., Kim D.R., Yang W.M., Chang M.S. and S.K. Park. Korean ginseng induces spermatogenesis in rats through the activation of cAMP-responsive element modulator (CREM). Fertility and Sterility. 2007; 88(4): 1000-1002.
51. Ratnasooriya W. and M.G. Dharmasiri. Effects of Terminaliacatappa seeds on sexual behaviour and fertility of male rats. Asian Journal of Andrology. 2000;2:213-21.
52. Shalaby M. and S.M. Mouneir. Effect of Zingiberofficinale Roots and Cinnamon zeylanicumBark on Fertility of Male Diabetic Rats. Global Vet. 2010;6: 341-347
53. Singh J.N., Govil S.H. and G. Singh. Science and Technic Publication, USA. (Chap). 2012;23:327–338.
54. Skirycz A., Kierszniowska S., Méret M., Willmitzer L. and G. Tzotzos. Medicinal bioprospecting of the amazon rainforest: a modern Eldorado? Trends Biotechnology. 2016;34:781–790.
55. Sucher N.J. The application of Chinese medicine to novel drug discovery. ExpertOpin. Drug Discovery. 2013;8:21–34.
56. Sullivan E.A., Zegers-Hochschild F., Mansour R., Ishihara O., de Mouzon J., Nygren K.G. and G.D. Adamson. International Committee for Monitoring Assisted Reproductive Technologies (ICMART) world report: assisted reproductive technology 2004, Human Reproduction. 2013; 28(5):1375–1390.
57. Thakur M. and V.K. Dixit. Aphrodisiac Activity of Dactylorhizahatagirea (D.Don) Soo in Male Albino Rats. Evidence-based complementary and alternative medicine: eCAM, 2007;4: 29–31.
58. Telefo P.B., Lienou L.L., Yemele M.D., Lemfack M.C., Mouokeu C. and C.S. Goka. Ethnopharmacological survey of plants used for the treatment of female infertility in Baham, Cameroon. Journal of Ethnopharmacology. 2011;136:178–87.
59. Tsobou R., Mapongmetsem P.M. and D.P. Van. Medicinal Plants Used for Treating Reproductive Health Care Problems in Cameroon, Central Africa. Econ Bot. 2016;70:145–159.
60. Turk G., Sonmez M., Aydin M., Yuce A. aand S. Gur. Effects of pomegranate juice consumption on sperm quality, spermatogenic cell density, antioxidant activity and testosterone level in male rats. Clinical Nutrition. 2008; 27:289-29.
61. Verpoorte R . Exploration of nature's chemodiversity: the role of secondary metabolites as leads in drug development. Drug Discov. 1998;3 232–238.
62. Verpoorte R. Pharmacognosy in the new millennium: leadfinding and biotechnology. J. Pharm. Pharmacol. 2000;52 253–262.
63. Wankeu-Nya M., Watcho P., Nguelefack T.B., Carro-Juarez M., Tapondjou L. and A. Kamanyi. Effects of Dracaena arborea (Dracaenaceae) on sexual dysfunction in 4 weeks hyperglycemic male rats. Asian Pacific Journal of Tropical Medicine. 2014;609-619
64. Wagner G., Fugl-Meyer K.S. and A.R. Fugl-Meyer. Int J Impot Res 12 Suppl. 2000; 4:144.
65. WHA62.13 - Traditional Medicine. WHA Resolution; Sixty-second World Health Assembly, 2009.
66. World Health Organization WHO 2000 WHO Manual for the Standardized Investigation, Diagnosis and Management of the Infertile Male. Cambridge University Press.
67. World Health Organization WHO 2002. Challenges – Addressing

subfertility/infertility in developing countries. Sexual and Reproductive Health.
68. World Health Organization WHO 2008: Traditional Medicine, Fact Sheet N°134. Geneva: World Health Organization.
69. evens GA. National, regional, and global trends in infertility prevalence since 1990: a systematic analysis of 277 health surveys. PLoS Med. . 2012;9:e1001356.
70. Worldwide infertility rates unchanged in 20 years says World Health Organisation [http://www.bionews.org.uk/page_232839.asp].
71. Wu H., Sun L., Wen Y., Liu Y., Yu J., Mao F., Wang Y., Tong C., Guo X., Hu Z., Sha J., Liu M. and L. Xia. Major spliceosome defects cause male infertility and are associated with non-obstructive azoospermia in humans. Proc. Natl. Acad. Sci.2016;113:4134-4139.
72. Yakubu M., Akanji M. and A.T. Oladiji. Male sexual dysfunction and methods used in assessing medicinal plants with aphrodisiac potentials. Pharmacognosy Reviews. 2007;1:49-56.
73. Yativ M., Harary I. and S. Wolf. Sucrose accumulation in watermelon fruits: Genetic variation and biochemical analysis. Journal of Plant Physiology. 2010;167:589-596.
74. Yeh K., Pu H., Kaphle K., Lin S., Wu Y., Lin J. and Y. Tsai. Ginkgo biloba extract enhances male copulatory behavior and reduces serum prolactin levels in rats. Hormones and behavior. 2008;53: 225-31.
75. Zheng B.L., He K., Kim C.H., Rogers L., Shao Y., Huang Z.Y., Lu Y., Yan S.J., Qien L.C. and Q.Y. Zheng. Effect of a lipidic extract from lepidiummeyenii on sexual behavior in mice and rats. Urology. 2000; 55(4):598-602.

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