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A Systematic Review On Consequential Interventions Of *Mucuna Pruriens* In Male Infertility

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***Abstract*:**

There are several possible contributing factors to the complex illness process that underlies male infertility. In order to treat the infertility we are experimenting on the seeds of a medicinal plant – *Mucunapruriens*, a tropical legume of Fabaceae family also known as Velvet beans. It is used to change the biochemical levels and semen profiles in infertile men's seminal plasma. Levodopa, also known as L-dopa and a precursor to dopamine, is found naturally in it. The experimental evidences suggest that infertile subjects treated with *M. Pruriens* seed powder (at a dose of 5g per day) orally were showed effective recovery. L-dopa recovers spermatogenic loss by combating ROS or reprogramming mitochondrial metabolism. Infertile men treated with M. pruriens showed decreased levels of FSH and prolactin and increased levels of testosterone, LH, dopamine, adrenaline, and noradrenalin. Men who were infertile showed a considerable improvement in their sperm count and motility. However, it also inhibits lipid peroxidation, elevated Spermatogenesis with decreased seminal plasma glutathione (GSH), SOD and elevated ascorbic acid content. It is used as Aphrodisiac that enhances sexual desire and improves conjugal relationships. On the other hand, studies suggested that *M. pruriens* helps in regulation of anti-oxidant defense system and works efficiently on stress management.

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Keywords: Infertility, L-dopa, M. Pruriens, Sperm count, Stress

Introduction

The failure to establish a clinical pregnancy after 12 months or more of regular, unprotected sexual activity is the definition of infertility, according to the World Health Organization (WHO) International Committee for Monitoring Assisted Reproductive Technology [1]. Approximately 50% of infertile couples experience considerable psychosocial and marital stress as a result of a male factor [2]. The main causes of male infertility can be categorized into three aspects:

Hormonal and Sexually Transmitted Problems – The hypothalamic-pituitary-gonadal axis is the name given to the male reproductive hormone axis. It is composed of the pituitary, hypothalamus, and testicular glands as its three main constituents [3]. In order to supply the proper hormone concentration for male sexual development, the axis operates on a highly regular basis [4]. These illnesses cause a shortage of testosterone and cease sperm production if the brain is unable to create the GNRH hormone [5]. Hypogonadotrophic-hypoigonadistic disorders are a set of conditions caused by GnRH [6]. There are psychological and physical aspects to sexual difficulties. Problems with sexual relations include impotence, or erectile dysfunction, early ejaculation, and incapacity to ejaculate [7].

Genetic Disorders – 15% of male infertility cases have genetic components, which can be divided into two categories: single gene mutations and chromosomal disorders [8]. Chromosome abnormalities are present in around 14% of men with azoospermia and 2% of men with oligospermia, which is significantly higher than the general population [9]. About 14% of male infertility cases are caused by Klein Filter Syndrome, the most prevalent genetic cause of azoospermia in aneuploid sex chromosomal instances [10].
Physical and lifestyle causes – Physical issues can cause obstructions in the ejaculatory route and interfere with sperm production. Varicocele, or enlargement of the sperm vessels, affects around 40% of men and is one of the most common causes of male infertility. Male infertility can also frequently result from both acute and chronic genital tract infections [11]. Male infertility can also result from STDs like chlamidia and gonorrhea because they restrict the epididymis [12]. Men are exposed to dangerous materials on a daily basis at work and in other subordinate settings. Smoking and alcohol use can cause infertility in male domains, whereas radiation exposure can decrease sperm production [13, 14]. Poor nutrition and irregular diet measurement can also lead to unsaturated and decreased sperm motility. Excessive determinal ejaculation can lead to lower sperm count [15].
Scientist and researchers have approved some common and viable treatment for male infertility among which the VELVET BEANS (*Mucuna pruriens*) is a main ingredient to cure this disorder.

The magic Velvet Beans (*Mucuna pruriens*)

M. pruriens is a member of the Fabaceae family of legumes that may grow both annually and perennially and has a variety of medicinal uses. In traditional medicine, m.pruriens seeds are traditionally used to preserve male infertility. It is extensively utilized as a strong spermatogenic and aphrodisiac [16].
1.MucunaPruriens (L), a plant belonging to the Fabaceae family, is also referred to as chiporro bean, velvet bean, itching bean, and mucuna. [21].
2. The plant has fuzzy hairs that cover virtually all of its surface, but as it ages, those hairs almost entirely disappear. The leaves have an ovate rhombus form and are tripinnate [22].
3. Ayurveda, an age-old conventional medicinal science that has been practiced in India since the Vedic era (1500–1000 BC), makes extensive use of this plant [23].
4. A wide variety of phytochemical compounds, including alkaloids, glycosides, reducing sugars, and tannins, are also present in Mucunapruriens seeds, opening up possibilities for further research and development [24].
5. There have been indications that M.pruriens seed powder acts as a restorative, boosts semen secretion, and provides some degree of stress relief [25].

History of Velvet Beans

The robust annual climbing legume M. pruriens is native to eastern India and southern China [17]. It is widespread throughout the planet in tropical and subtropical regions. It is found in the eastern regions of India. Given that M. pruriens is a member of the fabaceae family, its applications are diverse, and its mechanisms are well-established. In the eastern Himalayan foothills and lower highlands as well as in mauritious areas, M. Pruriens was widely farmed as a green vegetable during the 18th and 19th centuries.
In Guatemala and Mexico, both the ripe beans and the green pods were boiled and consumed. For at least a few decades, velvet beans have been ground and roasted to form a coffee replacement. In the area, the seeds are well-known as Nescafe [18]. Popular Indian medicinal plant Pruriens has been used to treat a variety of illnesses, including Parkinsonism, in traditional Ayurvedic Indian medicine. since the Vedic era (1500–1000 BC) in India. It has been used to treat arthritis and a number of nerve illnesses [19]. It is believed that the bean, when applied as a paste to a scorpion's sting, will absorb the venom, and it does. [20]. The major aim of this review is to investigate the effects of *Mucuna pruriens* in the action towards male infertility and to assess the changes or consequences in the components of semen sample after treatment to establish the beneficial effects

of the plant extract on male reproductive system for social welfare.

Mode of action of velvet bean

To understand the mechanism of action of velvet beans in the treatment of male infertility there are several interventions in treating the unproductivity of male dopamine's.

Experiment:Using a rat model, the experiment was carried out in Dr. SitthichaiIamsaard's laboratory. The M. Pruriens seed extract has been shown to be completely phenolic with no toxicity to the male reproductive system and to possess antioxidant properties [26].32 mature male Sprague-Dawley rats weighing between 270 and 300 grammes were purchased from Siam Nobura Corporation in Pathumwan, Bangkok, Thailand.
All rats were housed in plastic cages in Thailand University's experimental room, which had a 12-hour light/dark cycle, a temperature of 23 ± 2 °C, and a humidity of 30–60% RH. When compared to the CS (chronic stress) group, the relative weights and morphology of the testis, epididymis, and vas deferens were considerably higher in the TMP (Thai Mucunapruriens) treated groups. It's interesting to note that, in comparison to the CS group, TMP extracts may considerably raise the sperm concentration. Furthermore, CS raised the proportion of sperm morphological abnormalities, which improved with TMP seed extract treatment. In conclusion, the antioxidant and L-DOPA-containing TMP seed extract may enhance the characteristics of sperm. Whereas dopamine cannot pass across the blood-brain barrier, levodopa can. Levodopa cannot be converted to dopamine in the peripheral when a portion of the peripheral dopa decarboxylase inhibitor is introduced. This allows more levodopa to cross the blood-brain barrier. Aromatic-L-amino-acid decarboxylase transforms levodopa into dopamine once it crosses the blood-brain barrier. Additionally, in the CS situation, a few key testicular proteins raise levels of testosterone.
Because of their binding, dopamine and testosterone have a reciprocal relationship in which dopamine increases testosterone and vice versa. The MHBS (mammalian hormone behavior system) in the brain stimulates male sexual behavior during this phase, which raises testosterone levels [27]. This is due to the stimulation of the pituitary-gonadal axis. Gonadotropin-releasing hormone (GnRH) is secreted by the brain, and it causes the pituitary gland to release luteinizing hormone (LH), which in turn causes the gonads to release testosterone [28]. In a male fertility clinic, the seeds of this plant should be suggested as a potential dietary supplement and alternative therapeutic value to improve male reproductive activities in CS conditions [29].

Probable molecular mechanism

The d2 receptor helps to enhance the dopamine level.It has been reported that dopamine type 2 receptors (DRD2) are present in a wide range of mammalian sperm, which suggests a role for dopaminergic signaling in variuseventaulization such as fertilization, capacitation, and sperm motility. It also enhances the dopamine level. So before exploring the mechanism of action in dopamine level we need to know how and where does this d2 receptor work. Therefore, we have presented some clinical interventions and evidences for these mechanism. The production of dopamine neurons and their ability to produce and absorb dopamine are both heavily dependent on doamine D2-autoreceptors. The timing and taste of dopamine at the terminal points (somatodendritic and axonal sites) are regulated by autoreceptors, who also regulate the transmission of dopamine neurons and targets [30]. Presynaptically, D2-receptors speed up the uptake of dopamine by expanding the DAT (dopamine transporter) volume and plasma membrane content, as well as by directly interacting with DATs to boost their activity [31]. A significant role for Gi/o-coupled inhibitory receptors is to shape dopamine transmission. Human semen and fallopian tubes have been shown to contain catecholamines, including dopamine, whereas the sperm midpiece area has dopamine D2 receptors (D2DR).
From this point the nerve transmitters gets energised and through this synaptic neural transmission the dopamine system regulates either its uptake or decreases state and also the d2 receptor binds with dopamine cells to enrich the concentration and thespermiogenic materials in it [32][46].

Biological Active Componenets of M pruriens

In the past, the mode clarified the words and L-Dopa's compositional method. It's also noteworthy that ascorbic acid affects male infertility through another important route. Because of flaws and anomalies in their spermatogenesis process, the majority of men who have teratozoospermia (the existence of sperm with aberrant morphology) [33][34][48] are unable to become pregnant. The aberrant morphology of sperm in semen is a characteristic of teratozoospermia. In every ejaculation, they are expressed in over 70% of sperm cells [35].

Research suggests that ascorbic acid can shield teratozoospermia from reactive oxygen species (ROS), which are naturally occurring byproducts of oxidative metabolism in cells. ROS are known to affect a variety of processes, including cell survival, death, differentiation, signaling, and the production of factors related to inflammation. Additionally, ascorbic acid increases sperm viability, motility, and Interatozoospermic samples, DNA integrity throughout incubation [36]. Male infertility and unproductivity may be attributed to sperm cell DNA fragmentation caused by apoptosis and/or reactive oxygen species (ROS). Ascorbic acid, a well-known antioxidant, guards against DNA damage to sperm cells. Here, we discovered that DNase I, one of the primary endonucleases involved in DNA fragmentation during apoptosis (programmed cell death), can be inhibited by ascorbic acid [37]. However, ascorbic acid did not appear to have a significant impact on the acrosome reaction. Well-known water-soluble antioxidant ascorbic acid interacts with ROS to prevent oxidative damage to cell components including proteins, lipids, and nucleic acids [38][47][49]. Supplementing with oral ascorbic acid can enhance sperm motility, concentration, and shape [39].

Effect of diabetes in Male Infertility

Numerous studies have reported that men with severe diabetes experience reduced ejaculate volume, poor sperm motility, and erectile dysfunction. These symptoms ultimately lead to a loss of sperm production. Diabetes-related nerve damage and problems with blood circulation are the main causes of erectile dysfunction (ED), a condition in which men are mostly unable to create quality sperm and maintain sperm. It usually affects men who have untreated or long-term diabetes, which affects 50% of males with diabetes. Diabetes raises blood sugar levels, or hyperglycemia, which can impair erections by causing blood flow to the penis. It can eventually lessen the synthesis of nitric oxide (NO), which facilitates the relaxation of penile muscles and improves blood flow. Males with diabetes may be more susceptible to hormonal imbalances that lead to ED, such as low testosterone. Men's sexual drive is caused by these erection issues. Sperm quality can be harmed by type 1 and type 2 diabetes. Moreover, diabetes may harm sperm's DNA integrity and motility, or ability to move. Sperm quality may be impacted by obesity, a significant factor that is directly linked to diabetes [40][51]. In essence, it is a pancreatic metabolic disorder characterized by abnormally high blood sugar (hyperglycemia) due to either insufficient insulin production by the body, or an excess of the hormone produced by the islet of Langerhans beta cells, which regulate blood sugar levels [41][50]. According to studies and experiments, the MucunaPruriens seed extract (200 mg/kg) is useful in regulating blood glucose levels in diabetic rats. Given that rats belong to the mammalian family, it will undoubtedly work on male humans as well. In comparison to the diabetic group, there was a significant improvement in serum insulin and cholesterol levels ($p > 0.05$) [42]. The extract was administered continuously, and the blood glucose level significantly decreased in response to the dose ($P<0.001$). Additionally, was demonstrated that the methanolic and ethanolic fractions of the extract include the antidiabetic activity of M. pruriens seeds [43][44].

Conclusion

From the above discussed reports it can be concluded that the Mucunapruriens helps human fertility (both in male and females), improves stress management and enhances physical and mental stability. The contents of Mucunapruriens helps to insert the inert qualities that make M.pruriens useful and beneficial to human beings and it can improve certain diagnosis techniques by its aseptic methods. All the above specific mechanism about the L-dopa, Ascorbic acid, alkaloids, DNA specification, Diabetic control and other mentioned mechanism help human body and physiological processes in various ways. The main aim is to increase the male domainity and fertility in the contents of the spermatogenic characteristics that can contribute to its next generation. The hormones and the dopamine level can ultimately leads to such cases. So if we can put the theory of increasing the levels of dopamine and the hormonal levels it can ultimately result in the effective increase in the fertility constant - which can be done by the use and extraction seed materials of Mucunapruriens. The treatment must include all the diagnostic methods, medication and if needed possible surgery methods are used and taken into action by the process resourcesment. Apart from the strict restrictions, check-up and maintenance towards diabetes may be one of the vital step towards the increase functioning of Mucunapruriens. Hence we can strongly conclude that its way more effective and useful to use M.pruriens in order to treat the male infertility from the point of review. Though more experiments, demonstrations and clinical trials are very crucial for the establishing the action of the Mucunapruriens extract for the treatment of male infertility along with the detailed molecular mechanism to eliminate the hazardous effects and to enhance the beneficial consequence for human welfare.

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Conflict of interest

All authors declare that there are no conflicts of interest.

Data availability statement

No data was used for the research described in the article.

Author's contribution

ManojitBysack (MB) and RajenDey (RD) participated in the conception of the study. AyanSengupta (AS), PriyanshuGanguly (PG), PreetiPatra (PP) and AnkitaBallav (AB) participated in literature searches and extraction. Banashree Ash (BA) andShayani Das (SD) wrote the manuscript for submission to this journal.

REFERENCES

1. Zegers-Hochschild, F., Adamson, G. D., de Mouzon, J., Ishihara, O., Mansour, R., Nygren, K., Sullivan, E., Vanderpoel, S., International Committee for Monitoring Assisted Reproductive Technology, & World Health Organization (2009). International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) revised glossary of ART terminology, 2009. *Fertility and sterility*, *92*(5), 1520–1524. https://doi.org/10.1016/j.fertnstert.2009.09.009
2. Katz, D. J., Teloken, P., &Shoshany, O. (2017). Male infertility-the other side of the equation. *Australian family physician*, *46*(9), 641-646.
3. Corradi, P. F., Corradi, R. B., & Greene, L. W. (2016). Physiology of the hypothalamic pituitary gonadal axis in the male. *Urologic Clinics*, *43*(2), 151-162.
4. Kuiri-Hänninen, T., Sankilampi, U., &Dunkel, L. (2014). Activation of the hypothalamic-pituitary-gonadal axis in infancy: minipuberty. *Hormone research in paediatrics*, *82*(2), 73-80.
5. Lucas, X. (2014). Clinical use of deslorelin (GnRH agonist) in companion animals: a review. *Reproduction in domestic animals*, *49*, 64-71.
6. Cejko, B. I., Żarski, D., Judycka, S., Kucharczyk, D., Sarosiek, B., & Kowalski, R. K. (2014). Effect of two commercial preparations containing different GnRH analogues with dopamine antagonists on barbelBarbusbarbus (L.) sperm quantity and quality. *Aquaculture International*, *22*, 97-109.
7. Katib, A. (2015). Mechanisms linking obesity to male infertility. *Central European journal of urology*, *68*(1), 79.
8. Guney, A. H. M. E. T., Javadova, D., Kirac, D., Ulucan, K., Koc, G., Ergec, D., ...&Tarcan, T. U. F. A. N. (2012). Detection of Y chromosome microdeletions and mitochondrial DNA mutations in male infertility patients. *Genetics and Molecular Research*, *11*(2).
9. Pylyp, L. Y., Spinenko, L. O., Verhoglyad, N. V., &Zukin, V. D. (2013). Chromosomal abnormalities in patients with oligozoospermia and non-obstructive azoospermia. *Journal of assisted reproduction and genetics*, *30*, 729-732.
10. Groth, K. A., Skakkebæk, A., Høst, C., Gravholt, C. H., &Bojesen, A. (2013). Klinefelter syndrome—a clinical update. *The Journal of Clinical Endocrinology & Metabolism*, *98*(1), 20-30.
11. Sengupta, P., Agarwal, A., Pogrebetskaya, M., Roychoudhury, S., Durairajanayagam, D., & Henkel, R. (2018). Role of Withaniasomnifera (Ashwagandha) in the management of male infertility. *Reproductive biomedicine online*, *36*(3), 311-326.
12. Sun, X. L., Wang, J. L., Peng, Y. P., Gao, Q. Q., Song, T., Yu, W., ... & Dai, Y. T. (2018). Bilateral is superior to unilateral varicocelectomy in infertile males with left clinical and right subclinical varicocele: a prospective randomized controlled study. *International Urology and Nephrology*, *50*, 205-210.
13. Krausz, C., &Riera-Escamilla, A. (2018). Genetics of male infertility. *Nature Reviews Urology*, *15*(6), 369-384.

14. Gaur, D. S., Talekar, M. S., &Pathak, V. P. (2010). Alcohol intake and cigarette smoking: impact of two major lifestyle factors on male fertility. *Indian journal of Pathology and Microbiology*, *53*(1), 35.
15. Onyije, F. M. (2012). Drug: a major cause of infertility in male. *Asian J Med Pharm Res*, *2*(2), 30-37.
16. Rai, S. N., Birla, H., Singh, S. S., Zahra, W., Patil, R. R., Jadhav, J. P., ... & Singh, S. P. (2017). Mucunapruriens protects against MPTP intoxicated neuroinflammation in Parkinson's disease through NF-κB/pAKT signaling pathways. *Frontiers in Aging Neuroscience*, *9*, 421.
17. Lampariello, L. R., Cortelazzo, A., Guerranti, R., Sticozzi, C., &Valacchi, G. (2012). The magic velvet bean of Mucunapruriens. *Journal of traditional and complementary medicine*, *2*(4), 331-339.
18. Walczak–Jedrzejowska, R., Wolski, J. K., &Slowikowska–Hilczer, J. (2013). The role of oxidative stress and antioxidants in male fertility. *Central European journal of urology*, *66*(1), 60.
19. Jalalpure, S. S., Alagawadi, K. R., Mahajanshetty, C. S., Salahuddin, M., & Shah, B. (2006). In vitro antihelmintic property of various seed oils.
20. Jalalpure, S. S., Alagawadi, K. R., Mahajanashetti, C. S., Shah, B. N., Singh, V., &Patil, J. K. (2007). In vitro Anthelmintic Property of Various Seed Oils AgainstPheritimaposthuma. *Indian journal of pharmaceutical sciences*, *69*(1).
21. Longhi, J. G., Perez, E., Lima, J. J. D., &Cândido, L. M. B. (2011). In vitro evaluation of Mucunapruriens (L.) DC. antioxidant activity. *Brazilian Journal of Pharmaceutical Sciences*, *47*, 535-544.
22. Annals of the Missouri Botanical Garden, 100(3), 170-176, (16 March 2015)
23. National library of medicine, j tradit complement med. 2012 oct-dec
24. National libarary of med,3 biotech, 2012 jun. doi: 10.1007/S13205-020-02253x
25. Rao, A., Shakeel, M., Trinidade, A., Rao, G., Pearce, A., & Ah-See, K. W. (2012). The importance of complementary and alternative Medicine Education in Medical School. *Journal of Evidence-Based Complementary & Alternative Medicine*, *17*(3), 191-198.
26. Iamsaard, S., Arun, S., Burawat, J., Yannasithinon, S., Tongpan, S., Bunsueb, S., ...&Sukhorum, W. (2020). Evaluation of antioxidant capacity and reproductive toxicity of aqueous extract of Thai Mucunapruriens seeds. *Journal of Integrative Medicine*, *18*(3), 265-273.
27. Dominguez, J. M., & Hull, E. M. (2005). Dopamine, the medial preoptic area, and male sexual behavior. *Physiology & behavior*, *86*(3), 356-368.
28. Li, S. O. N. G. Y. U. N., & Pelletier, G. E. O. R. G. E. S. (1992). Role of dopamine in the regulation of gonadotropin-releasing hormone in the male rat brain as studied by in situ hybridization. *Endocrinology*, *131*(1), 395-399.
29. Lapyuneyong, N., Tangsrisakda, N., Choowong-In, P., Chaisiwamongkol, K., Uabundit, N., Sawatpanich, T., ...&Iamsaard, S. (2022). Seed extract of Thai Mucunapruriens reduced male reproductive damage in rats induced by chronic stress. *Pharmaceutical Biology*, *60*(1), 374-383.
30. Ford, C. P. (2014). The role of D2-autoreceptors in regulating dopamine neuron activity and transmission. *Neuroscience*, *282*, 13-22.
31. Suaud-Chagny, M. F., Ponec, J., &Gonon, F. (1991). Presynaptic autoinhibition of the electrically evoked dopamine release studied in the rat olfactory tubercle byin vivo electrochemistry. *Neuroscience*, *45*(3), 641-652.
32. Kanno, H., Kurata, S., Hiradate, Y., Hara, K., Yoshida, H., &Tanemura, K. (2022). High concentration of dopamine treatment may induce acceleration of human sperm motility. *Reproductive Medicine and Biology*, *21*(1), e12482.
33. Prakash, AbhishekNiranjan, SK Tewari, D. (2001). Some nutritional properties of the seeds of three Mucuna species. *International journal of food sciences and nutrition*, *52*(1), 79-82.
34. Keshtgar, S., Fanaei, H., Bahmanpour, S., Azad, F., Ghannadi, A., &Kazeroni, M. (2012). In vitro effects of α-tocopherol on teratozoospermic semen samples. *Andrologia*, *44*, 721-727.
35. Brahem, S., Elghezal, H., Ghédir, H., Landolsi, H., Amara, A., Ibala, S., ...& Mehdi, M. (2011). Cytogenetic and molecular aspects of absolute teratozoospermia: comparison between polymorphic and monomorphic forms. *Urology*, *78*(6), 1313-1319.
36. Aitken, R. J. (2006). Sperm function tests and fertility. *International journal of andrology*, *29*(1), 69-75.
37. Hughes, C. M., Lewis, S. E., McKelvey-Martin, V. J., & Thompson, W. (1998). The effects of antioxidant supplementation during Percoll preparation on human sperm DNA integrity. *Human reproduction (Oxford, England)*, *13*(5), 1240-1247.
38. Song, G. J., Norkus, E. P., & Lewis, V. (2006). Relationship between seminal ascorbic acid and sperm DNA integrity in infertile men. *International journal of andrology*, *29*(6), 569-575.

39. Ko, E. Y., SabaneghJr, E. S., &Agarwal, A. (2014). Male infertility testing: reactive oxygen species and antioxidant capacity. *Fertility and sterility*, *102*(6), 1518-1527.
40. Rooney, K. L., &Domar, A. D. (2018). The relationship between stress and infertility. *Dialogues in clinical neuroscience*, *20*(1), 41–47. https://doi.org/10.31887/DCNS.2018.20.1/klrooney.
41. Manderson, L., Cartwright, E., &Hardon, A. (Eds.). (2016). *The Routledge Handbook of medical anthropology*. Routledge.
42. Rother, K. I. (2007). Diabetes treatment—bridging the divide. *The New England journal of medicine*, *356*(15), 1499.
43. Soumya, D., &Srilatha, B. (2011). Late stage complications of diabetes and insulin resistance. *J Diabetes Metab*, *2*(9), 1000167.
44. Guerranti, R., Aguiyi, J. C., Neri, S., Leoncini, R., Pagani, R., &Marinello, E. (2002). Proteins from Mucunapruriens and Enzymes fromEchiscarinatus Venom: CHARACTERIZATION AND CROSS-REACTIONS. *Journal of Biological Chemistry*, *277*(19), 17072-17078.
45. Al-Daghistani, H. I., & Abdel-Dayem, M. (2002). Hyperprolactinemia and hypergonadotropins in infertile males with severe oligospermia and azoospermia. *Internet J Endocrinol*, *3*, 1540-2606.
46. Misra, L., & Wagner, H. (2007). Extraction of bioactive principles from Mucunapruriens seeds.
47. Islam,& Trainer. (1998). The hormonal assessment of the infertile male. *British journal of urology*, *82*(1), 69-75.
48. Shukla, K. K., Mahdi, A. A., Ahmad, M. K., Jaiswar, S. P., Shankwar, S. N., &Tiwari, S. C. (2010). Mucunapruriens reduces stress and improves the quality of semen in infertile men. *Evidence-Based Complementary and Alternative Medicine*, *7*, 137-144.
49. Shukla, K. K., Mahdi, A. A., Ahmad, M. K., Jaiswar, S. P., Shankwar, S. N., &Tiwari, S. C. (2010). Mucunapruriens reduces stress and improves the quality of semen in infertile men. *Evidence-Based Complementary and Alternative Medicine*, *7*, 137-144.
50. Orth, A. B., Royse, D. J., &Tien, M. I. N. G. (1993). Ubiquity of lignin-degrading peroxidases among various wood-degrading fungi. *Applied and environmental microbiology*, *59*(12), 4017-4023.
51. Chang, A., & Shin, S. H. (1999). Dopamine agonists both stimulate and inhibit prolactin release in GH4ZR7 cells. *European journal of endocrinology*, *141*(4), 387-395.
52. De Rosa, M., Zarrilli, S., Di Sarno, A., Milano, N., Gaccione, M., Boggia, B., ...&Colao, A. (2003). Hyperprolactinemia in men: clinical and biochemical features and response to treatment. *Endocrine*, *20*, 75-82.