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ANTIFERTILITY ACTIVITY AND CHEMICAL CONTENT OF MORINGA OLEIFERA LAM PLANT EXTRACT ON THE REPRODUCTIVE SYSTEM OF MALE AND FEMALE WHITE RATS

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ABSTRACT

Research shows that Moringa extract possesses anti-fertility effects on the reproductive systems of male and female rats. This study investigates Moringa's active chemical compounds and their impact on reproductive parameters such as sperm concentration, motility, morphology, and seminiferous tubule diameter, along with hormone levels (progesterone, LH, FSH), estrogenic activity, and the estrous cycle. The research, a literature review, compiles findings from quality international (Scopus) and national (SINTA) journals, Translation and proofreading: there are 8 articles that meet the research inclusion criteria, selected within a range from the year 2010 to 2024. Key active compounds identified in Moringa include alkaloids, tannins, flavonoids (kaempferol and quercetin), and benzyl isothiocyanate, all of which demonstrate anti-fertility effects. These compounds were observed to reduce sperm concentration, motility, and morphology, and to decrease seminiferous tubule diameter in males, while also impacting hormone levels and the estrous cycle in females. The findings support Moringa's potential as an anti-fertility agent, highlighting its impact across various reproductive parameters in both genders.

Keywords: antifertility; moringa oliefera lam; progesterone; spermatozoa

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INTRODUCTION

Fertility control is a strategic effort to curb high population growth rates, especially in developing countries. Various modern hormonal contraceptive methods widely used today have certain drawbacks, including side effects that can impact the long-term health of user. Therefore, the need for safer, more affordable, and side-effect-minimizing contraceptive alternatives is increasing. One promising alternative is the use of medicinal plants with antifertility effects(Kemenkes RI, 2021;Abebe et al., 2020)Efforts to succeed in family planning programs include sourcing "antifertility drug ingredients with minimal side effects" that still offer maximum benefits, "including antifertility drugs derived from plants," given that Indonesia is rich in various plants that can be utilized as raw materials for antifertility drugs. Currently, raw materials are still being imported from other countries, making it crucial to achieve self-sufficiency in the supply of antifertility drug components. In Rajasthan, a semi-arid region of India, parts of this plant are commonly used in many dishes prepared in household kitchens (Kumar et al., 2017).. The plant contains significant metabolites such as quercetin, kaempferol, zeatin, campesterol, and sitosterol, which offer various medicinal benefits, including antihypertensive, anticancer, hepatoprotective, anti-inflammatory, and cholesterol-lowering properties.(Bhattacharya et al., 2018; Gopalakrishnan et al., 2016). In India, the moringa plant is traditionally used as an antispasmodic, stimulant, expectorant, and diuretic agent However, moringa also has antifertility activity (Dixit et al., 2016;Stohs & Hartman, 2015). Phytochemical screening has shown that moringa leaves contain vitamins,

carotenoids, polyphenols, phenolic acids, flavonoids, alkaloids, glucosinolates, isothiocyanates, tannins, saponins, oxalates, and phytates (Dhakad et al., 2019). Phytochemical screening conducted on a 90% ethanol extract of moringa leaves and an infusion of moringa leaves found the presence of alkaloids, saponins, and steroids. Tannins were also found in the 90% ethanol extract(Pareek et al., 2023).

The moringa plant (Moringa oleifera Lam) is known as a plant with many health benefits, ranging from antioxidant to anti-inflammatory effects, and is considered a "miracle tree" . In addition to these benefits, several studies have shown that Moringa oleifera contains bioactive compounds, such as flavonoids, saponins, and alkaloids, which can influence the reproductive system and have potential as an antifertility agent (Anzano et al., 2021;Alfina et al., 2023). The chemical compounds in the leaves, seeds, and roots of the moringa plant are thought to inhibit fertilization or affect sperm quality and the reproductive cycle in test animals (Mehta et al., 2016). Moringa extract influences several parameters related to antifertility. Moringa water extract is reported to have anti-implantation activity in the reproductive organs of female rats and also has antifertility activity, found in their study that water extract of Moringa oleifera Lam leaves can affect the production of FSH hormone in both male and female rats(Vijayan & Vijaya Lakshmi, 2018).Several studies have tested the effects of Moringa oleifera extract on the reproductive function of test animals, particularly white rats. For example, research by (Jikah & Edo, 2023) showed a decrease in sperm quality in male rats after administration of moringa leaf extract. Additionally, this extract is suspected of inhibiting ovulation and disrupting the estrous cycle in female rats(Prabsattroo et al., 2015).The aim of this study is to evaluate the antifertility activity of the chemical components in Moringa oleifera Lam leaf extract on the reproductive systems of male and female white rats, as well as to analyze the impact of Moringa extract on reproductive function, fertility, and physiological changes in the reproductive organs of both sexes.

METODE

The design of this research is a literature review of the antifertility activity and active chemical components of Moringa oleifera Lam extract, focusing on its effects on the reproductive systems of male and female white rats. This review is based on various sources. The literature review method involves collecting data from journal articles to address the research question by tracing previously published works. In this study, the researcher used a literature review data collection approach structured thematically. The thematic structure organizes and discusses sources according to their themes or topics. By grouping themes and research topics, it highlights significant topics and strengthens the research focus. For the literature review, several methods were used, including searching for journals or articles based on broad topic outlines, grouping articles based on relevance to the topic and publication year, and arranging the explanation structure and comparing data related to the research topic. The search for journal articles covered the past 14 years due to the limited literature related to this research topic. Translation and proofreading: there are 8 articles that meet the research inclusion criteria, selected within a range from the year 2010 to 2024. Articles were found using title keywords such as “antifertility activity testing of the chemical components in Moringa oleifera Lam extract, sperm concentration reduction, sperm motility, sperm morphology, seminiferous tubule diameter, serum progesterone concentration, Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH), estrogenic activity, and estrous cycle,” identified based on journal content relevance and its connection to the research topic.

RESULT

Chemical Compounds of Moringa oleifera Lam as Antifertility Agents

Table 1.
Test Materials and Chemical Components of Moringa oleifera Lam Extract

Material	Chemical Content	References
Ethanol extract of Moringa leaves	Alkaloid dan flavonoid	(Valdez-Solana et al., 2015) Susetyarini (2009)
Moringa leaf extract	kaempferol dan quercetin	Mónica A. Valdez et al., 2015
Moringa flower extract	kaempferol, quercetin terpenoid dan steroid	G. Mishra, P et al., 2011
Moringa seed extract	fenolat dan flavonoid	Mbikay (2012)
Ethanol extract of Moringa leaves	kaempferol, dan quercetin	Leone et al., (2015)
Ethanol extract of Moringa stem	Vanillin, ß-sitosteron	Patel et al.,(2014)

According to the table above, several studies have been carried out to identify secondary metabolites in different parts of the Moringa oleifera Lam plant, including its leaves, flowers, roots, seeds, and bark. These studies have revealed that Moringa contains a variety of phytochemicals, such as vanillin, omega fatty acids, carotenoids, ascorbate, tocopherol, beta-sitosterol, moringin, kaempferol, and quercetin. These compounds are found in the flowers, roots, fruits, and seeds, with the leaves particularly rich in phenolics and flavonoids, which are associated with various biological activities. Moringa oleifera Lam has thus been identified as a valuable source of polyphenols and antioxidants. Further studies have shown that Moringa also contains plant pigments with strong antioxidant properties, including carotenoids such as lutein, alpha-carotene, and beta-carotene, as well as xanthine and chlorophyll. Other potent antioxidants found in the plant include kaempferol, quercetin, rutin, and caffeoylquinic acid, along with essential vitamins C, E, and A. Additionally, the extract of Moringa oleifera Lam seeds contains various compounds, including terpenoids, alkaloids, phenols, glycosides, and steroids. Among the different seed extracts, the ethyl acetate extract is primarily composed of terpenoids, steroids, and fluorescent compounds.

Results of Literature Review on Moringa Oleifera Lam Plant Extract as Antifertility Activity in Female Rats

Table 2.
Research Subjects and Test Parameters of Moringa Oleifera Lam Plant Extract in Female Rats from the Literature Review Results

Author	Subject	Methode & Parameter	Result
Zade and Dabhadkar (2014)	Alcoholic Extract of Moringa oleifera Bark on the Estrous Cycle and Estrogenic Activity in Female Albino Rats	1. Abortifacient activity 2. Estrogenic activity and estrous cycle	1. The abortifacient effect in rats showed abortifacient activity. A dose of 100 mg/kg body weight demonstrated significant abortifacient activity. 2. Shows estrogenic activity in rats and has a negative impact on the estrous cycle, as it reduces the number of ovulated eggs during the proestrus and estrus phases.
Onyewuchi, and Siminialayi, (2018)	Ethanol Extract of Moringa oleifera Skin on the Reproductive Biology of Wistar Albino Rats	1. Serum progesterone concentration 2. Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH). The ovaries, uterine tubes, and fallopian tubes of rats were examined for	1. There was a non-significant decrease in progesterone and estradiol concentrations in rats given EBMO compared to the control groups (100, 200, and 400 mg/kg). 2. No changes were observed in serum prolactin, LH, and FSH levels

		histological changes.	after EBMO treatment. Additionally, there were no changes in the histology of the three organs in rats given EBMO compared to the control group.
Atolani et al., (2016)	In Vivo Antifertility Profile and Safety of Kenya Moringa oleifera Lam. Seed Extract (Moringaceae) Extract	1. Toxicity study in mice 2. Acute toxicity test	1. Shows a reversible antifertility effect at 800 mg/kg. Physiological tests conducted on rats revealed that the extract suppressed the estrus cycle. 2. Acute and chronic toxicity evaluations of the extract at 800 mg/kg established safety at this concentration.
(Agrawal et al., 2018)	Antifertility Effect of Ethanol Extract of Moringa oleifera Lam. Leaves on Female Wistar Rats	1. Uterine tissue 2. Estradiol levels 3. Progesterone levels	1. Shows a decrease in uterine tissue localized estradiol and progesterone levels. 2. Decrease in estradiol levels in uterine tissue and progesterone levels at doses of 100, 250, and 500 mg/kg.

Results of the Literature Review on Moringa Oleifera Lam Extract as Antifertility Activity in Male Rats

Table 3.
Research Subjects and Test Parameters of Moringa Oleifera Lam Plant Extract in Male Rats from Various Literature Review Results

Author	Subject	Methode & Parameter	Result
Sekadde-kigondu & Ecsa (2016)	The Extract of Moringa Oleifera Seeds (Radish) on the Reproductive System of Wistar Albino Rats	1. Sperm count (SC), sperm motility (SM), sperm morphology (SMO), and serum testosterone levels (TT) 2. Luteinizing hormone (LH) and follicle-stimulating hormone (FSH)	1. A significant decrease ($P < 0.05$) was observed in sperm count, sperm motility, and sperm morphology. Additionally, there was a decrease in testosterone levels, although this was not statistically significant ($P \leq 0.05$). 2. The serum luteinizing hormone (LH) levels significantly decreased ($P > 0.05$). There was an increase in FSH levels, although this was not statistically significant ($P \geq 0.05$).
Nasr-Eldin et al., (2018)	Ethanol extract of Moringa oleifera leaves on the histopathology of alcohol-induced testes in prepubertal Wistar albino rats	1. Histopathology of alcohol-induced testes 2. Histopathology of testes induced by M. Oleifera extract and Vitamin C	1. Alcohol causes significant atrophy in the testes and damages spermatogenic cells. 2. M. oleifera and vitamin C demonstrate protective and reversible effects. M. oleifera significantly affects testis weight without any significant difference in body weight. M. oleifera improves alcohol-induced testicular toxicity with its antioxidant properties, comparable to vitamin C.
Nkpurukwe et al., (2022)	Improvement in some Reproductive Parameters of Male Wistar Rats	1. sperm cells, sperm cells with normal morphology and	1. The findings of this study indicated that the extract of Eugenia uniflora significantly

	Administered with Leaf Extract of Eugenia uniflora	actively motile sperm 2. cells as well as, sperm count	elevated serum testosterone levels, as well as the percentage of viable sperm cells, sperm with normal morphology, and actively motile sperm, in addition to increasing sperm count. 2. The extract also mitigated reproductive toxicity induced by lead exposure. These results suggest that the extract enhances both sperm quality and quantity, while also protecting male reproductive function from the harmful effects of environmental toxins like lead.
Cajuday & Pocsidio (2010)	The effect of Moringa oleifera Lam. (Moringaceae) leaves on the reproduction of male mice (Mus musculus)	1. Male mouse body weight and reproductive organs 2. Histology of testes and epididymis 3. Serum levels of LH and FSH	1. At doses of 0.5, 5, and 50 mg per 30 g of body weight, testis weight increased at medium and high doses, epididymis weight increased at all doses, seminal vesicle weight increased at the high dose, and the diameter of the seminiferous tubules increased at all doses. 2. Epididymal wall thickness increased at medium and high doses, lumen formation was higher at the high dose, and epididymal maturation occurred at all doses. No other significant effects were noted. 3. No changes were observed in serum LH and FSH levels in male mice.

In Table 3, the results of the literature review are discussed, focusing on several studies related to Moringa oleifera Lam, which have shown antifertility activity in the male rodent reproductive system. It is known from previous research that Moringa oleifera Lam has a significant impact on antifertility activity in male rodents. This can be seen from the parameters tested in the table above, which have been examined by previous researchers who studied the antifertility effects of Moringa oleifera Lam. The researcher attempts to discuss several results from the literature review that are interconnected with the research topic mentioned above.

DISCUSSION

Mechanism of Action of Moringa oleifera Lam. Bark Extract as an Abortifacient and Estrogenic Activity in Female Albino Rats

Research conducted by Valdez-Solana *et al.*, (2015) investigated the effects of oral administration of an alcohol extract of Moringa oleifera bark at doses of 25, 50, and 100 mg/kg body weight. The results indicated dose-dependent adverse effects on fertility indices and the number of uterine implantations in female rats, marked by an increase in post-implantation embryo loss. All experimental extracts demonstrated pregnancy-interceptive effects. Specifically, when administered at 100 mg/kg orally for seven days, the alcohol extract induced vaginal cornification in all animals and significantly increased uterine weight ($P < 0.001$) in young rats compared to controls. Additionally, the administration of Moringa

oleifera seed extract alongside ethinylestradiol led to a significant increase in uterine weight ($P < 0.01$) compared to controls, though the uterotropic response was lower than that induced by ethinylestradiol alone ($P < 0.001$) (Zade & Dabhadkar, 2014)Onyewuchi et al., (2018) found a non-significant reduction in progesterone and estradiol concentrations in rats treated with Moringa oleifera ethanol bark extract (EBMO) compared to controls. No changes were observed in serum prolactin, LH, or FSH levels following EBMO treatment, nor were there histological changes in the organs of EBMO-treated rats compared to controls. This study suggests that subacute exposure to Moringa oleifera ethanol bark extract may not impact serum progesterone and estradiol levels in non-pregnant rats. Previous reports concluded that the bark of the plant increases estrogen levels in pregnant rats, resulting in an abortifacient effect (Zade & Dabhadkar, 2014). In other studies, low progesterone levels have similarly been associated with inducing abortion at certain pregnancy stages, potentially explaining the abortifacient activity of antiprogestin agents such as mifepristone (Ganong, 2015). Earlier studies showed that Moringa oleifera ethanol leaf extract increased FSH and LH levels in male albino rats (Dafaalla et al., 2016). Our findings showed no changes in serum FSH and LH levels following extract administration in female rats, likely due to normal estrogen and progesterone levels observed post-treatment, as these hormones regulate gonadotropin release, particularly LH (Ganong et al., 2014).

Research by Atolani et al., (2016) showed that the administration of Moringa oleifera Lam ethyl acetate seed extract up to a dose of 4000 mg/kg did not produce mortality or signs of toxicity. However, mild toxicity was observed at 5000 mg/kg, including hypoactivity, reduced appetite, and piloerection. These symptoms were comparable to the negative control. At 5000 mg/kg, toxicity was observed only in the first hour post-administration; by the second hour, most rats had returned to normal activity and appetite. Given that the active antifertility concentration of the extract is 800 mg/kg, it can be concluded that the extract is safe at active concentrations. Previous reports indicate that Moringa oleifera bark alcohol extract showed no acute toxicity in rats (Zade & Dabhadkar, 2015).In the study by Agrawal *et al.*, (2018) Moringa oleifera Lam demonstrated a localized decrease in estradiol and progesterone levels in uterine tissue compared to the control group. At doses of 100, 250, and 500 mg/kg, estradiol levels in uterine tissue were reduced by 82.93%, 75.98%, and 58.58%, respectively, while progesterone levels decreased by 84.07%, 77.56%, and 62.20%, compared to the control group. Furthermore, expressions of the IL-11, VEGF, and LIF genes in uterine tissue after artificially induced decidualization were significantly lower in the Moringa oleifera Lam ethanol leaf extract treatment groups than in the control group. Specifically, the expression levels of IL-11 at doses of 100, 250, and 500 mg/kg were 87.0%, 66.48%, and 54.15%, respectively; VEGF expression was 88.8%, 70.8%, and 56.80%; and LIF levels were 87.00%, 64.33%, and 52.83%, compared to the control group, indicating disruption of cytokine signaling pathways.

The ethanol leaf extract of Moringa oleifera exhibited antifertility effects at doses of 100 and 250 mg/kg, and complete antifertility activity at 500 mg/kg when administered orally from days 1 to 7 post-coitus. Implantation loss exceeded post-implantation loss at all doses, suggesting that the extract disrupts the implantation process in Wistar rats. Further studies explored the effect of Moringa oleifera ethanol leaf extract on progesterone- and 17β-estradiol-induced decidualization, as well as sesame oil-induced artificial decidualization. The findings showed reduced proliferation of deciduoma cells in the treated groups compared to the controls, indicated by larger lumen spaces and reduced uterine biomass.These findings align with previous research indicating that *Moringa oleifera* extract exhibits antiestrogenic and antiprogestogenic effects (Khofifah & Mardiana, 2023). Further examination of IL-11,

LIF, and VEGF expressions in uterine tissue showed marked reductions compared to the control. These cytokines and their receptors play a crucial role in various stages of implantation. VEGF is vital for angiogenesis, which is necessary for implantation, decidualization, and placentation. IL-11 is crucial for decidualization, though not for attachment, while LIF is essential for blastocyst activation and implantation. Both IL-11 and LIF are part of the IL-6 family and share the signaling glycoprotein gp130. Uterine hormones regulate LIF and VEGF expression, with disturbances in LIF expression leading to lower COX-II levels. Recent studies indicate that Moringa oleifera extract, particularly at a dose of 500 mg/kg, shows antifertility effects by disrupting implantation and decidualization, likely through its antiestrogenic and antiprogestogenic properties. This interference disrupts the cytokine cascade involving COX-II, VEGF, LIF, and IL-11. However, the exact bioactive components in Moringa oleifera ethanol leaf extract responsible for these effects remain unidentified, and further research is needed to isolate these active constituents for comparison with conventional antifertility drugs.

The Effect of Moringa Seed Extract on the Male Reproductive System: Sperm Count, Sperm Motility, Sperm Morphology, Serum Testosterone, Luteinizing Hormone (LH), and Follicle-Stimulating Hormone (FSH)

Research conducted by Iorjiim *et al.*, (2020) showed a significant increase ($P \leq 0.05$) in body weight in rats administered *Moringa oleifera* seeds compared to the control group, suggesting that *Moringa oleifera* seeds enhance the metabolic processes in test animals. These results are supported by Saha et al., (2022) who reported that oral toxicity tests, both acute and chronic, in rats using *Moringa oleifera* and *Moringa oleifera stenopetala* seeds revealed no toxic effects but rather an increase in body weight. FSH levels in the test and control groups increased compared to the baseline group, although this change was statistically insignificant ($p \geq 0.05$). This observation is consistent with findings by Cajuday & Pocsidio (2010) who studied the effects of *Moringa oleifera* on the reproduction of male mice (*Mus musculus*) using a hexane extract of the leaves. Data on body weight, reproductive organ weight, seminiferous tubule diameter, maturity stages, and FSH and LH levels were analyzed. Significant findings included an increase in the thickness of the epididymal wall (at moderate and higher doses), higher scores for lumen formation (at high doses), and epididymal inactivity (at all doses). However, rats administered *Moringa oleifera* seeds did not exhibit a significant decrease ($p < 0.05$) in testicular weight or serum testosterone levels.

In a study by Bassey *et al.*, (2013) *Moringa oleifera* and subsequently alcohol showed areas with numerous seminiferous tubules containing live myoid cells, spermatogenic cells, spermatogonia, spermatocytes, spermatids, and spermatozoa, as well as lumen containing semen. Among the seminiferous tubules were Leydig cells and interstitial tissue, with minimal cellular changes in the connective tissue. Alcohol had minimal effects on testicular histology. However, in this study, testicular atrophy and distortions in spermatogenic cells were observed in the group treated with alcohol. These findings improved in the group treated with *Moringa oleifera* and vitamin C, which displayed a morphological status comparable to the control group. Research has shown that alcohol abuse in men can cause testosterone production disorders and testicular atrophy. Such changes may result in impotence, infertility, and decreased secondary male sexual characteristics.Sugiantari et al., (2020)demonstrated that an infusion of *Moringa oleifera* leaves significantly decreased spermatozoa concentration ($P \leq 0.05$) but had no effect on seminiferous tubule epithelium thickness, causing germinal epithelium loosening as many epithelia detached into the lumen. Thus, *Moringa oleifera* leaf infusion may reduce sperm concentration with minimal germinal epithelial toxicity. Infusions of *Moringa oleifera* leaves at doses of 36 mg/kg BW and 72 mg/kg BW significantly reduced

sperm concentration in male white rats. Doses of 18 mg/kg BW, 36 mg/kg BW, and 72 mg/kg BW had no significant effect on seminiferous tubule thickness but caused the release of germinal cells. The concentration of spermatozoa in test groups administered *Moringa oleifera* extract at doses of 200 mg/kg, 400 mg/kg, and 600 mg/kg compared to the control group depicted decreased spermatozoa production in the seminiferous tubules. According to Fernandez *et al.*, (2016) a decrease in sperm count in male Sprague-Dawley rats depends on the level of disturbances during spermatogenesis, which is influenced by endogenous and exogenous factors (Ghasani, 2016)

Research by Alfina *et al.*, (2023) The results indicate that coconut husk is a superior alternative. As an abundant raw material, coconut husk presents a novel option for this project. With an experimental efficiency of approximately 92%, coconut husk has proven highly effective in treating industrial-grade turbid water. The results were validated using an artificial neural network (ANN), where the predicted values closely matched the actual values for the same treated water. Graphs comparing predicted versus experimental values, plotted with the same dosage, showed minimal deviation. Based on these findings, the 90% ethanol extract of Moringa oleifera leaves demonstrates antifertility effects, suggesting the need for further development.. According to Widiastini *et al.*, (2022) The findings of this study indicated that aged Wistar rats (R. norvegicus) treated with 50 mg/kg BW of Moringa oleifera leaf ethanol extract for 30 days had significantly higher counts of spermatogonia, spermatocytes, and spermatids compared to the control group, which received only 0.5 mL of 0.5% CMC. This difference was statistically significant, with a p-value of 0.000 ($p < 0.05$). These results suggest a notable increase in spermatogonia, spermatocyte, and spermatid counts in the group treated with Moringa leaf ethanol extract compared to the untreated control. Consequently, it can be concluded that Moringa leaf ethanol extract significantly enhances spermatogonia, spermatocyte, and spermatid counts, the sperm concentration in rats aged 3 months, 12 months, and 24 months showed a significant decrease with age. The reduction in sperm concentration with the 90% ethanol extract of *Moringa oleifera* leaves is suspected to be due to benzyl isothiocyanate, alkaloids, and flavonoids content.

In the study conducted by Lilibeth A. Cajuday Meireles *et al.*, (2020), the administration of *M. oleifera* hexane fraction at any dose did not alter animal body weight. Male mice receiving the plant extract at moderate ($p = 0.011$) and high ($p = 0.001$) doses had significantly higher relative testis weights than the control group. Epididymal weight increased significantly in all groups treated with *Moringa oleifera*, compared to the control group. A dose of 50 mg/30 g BW of *Moringa oleifera* extract also significantly induced the relative weight of seminal vesicles in male mice. This weight increase may indicate a selective effect of *Moringa oleifera*, as reported in *Boesenbergia rotunda* (San et al., 2022) and *Lepidium meyenii*, and reflects the activation of spermatogenesis due to the presence of elongated spermatids in the seminiferous tubules(Kayalvizhi & Antony, 2015).In this study, the body weight of animals treated with Moringa oleifera remained stable, suggesting that the selected doses were well-tolerated and did not disrupt normal metabolic functions. The effect of Moringa oleifera Lam. on enhancing male reproductive health was observed across all treatment groups when compared to the control. Notably, rats given moderate and high doses of the plant extract demonstrated improved reproductive performance and larger seminiferous tubule diameters, supporting this finding. It was also observed that the ethanol extract of B. rotunda did not alter sexual behavior or serum androgen levels but led to an increase in the size of seminiferous tubules, testes, and seminal vesicles in treated male rats.(Kayalvizhi and Antony, 2015;Villarruel-López *et al.*, 2018).

CONCLUSION

Based on existing research, Moringa oleifera has various effects on the male reproductive system, particularly in rats and mice. The administration of Moringa oleifera seed and leaf extracts positively affects body and reproductive organ weights, as well as enhances metabolic activity without causing significant toxicity. This extract also supports spermatogenesis, as seen through improvements in reproductive parameters like epididymal wall thickness and seminal vesicle weight. However, at certain doses, Moringa oleifera has negative effects on sperm concentration, sperm morphology, and seminiferous tubule diameter, which may indicate potential antifertility effects. Additionally, Moringa oleifera did not show significant effects on LH and FSH levels in some studies, but it benefited the histological structure of the testes by minimizing changes induced by alcohol consumption. Overall, the effects of Moringa oleifera vary depending on the dose and specific components used, where its positive effects on certain reproductive aspects need to be balanced with the potential decrease in sperm concentration and quality at higher doses. This antifertility potential opens opportunities for further development of Moringa oleifera as a natural agent that could be explored for male contraceptive applications.

REFERENCES

Abebe, M. S., Afework, M., & Abaynew, Y. (2020). Primary And Secondary Infertility In Africa: Systematic Review With Meta-Analysis. Fertility Research And Practice, 6(1), 1–11. Https://Doi.Org/10.1186/S40738-020-00090-3

Agrawal, S. S., Vishal, D., Sumeet, G., Shekhar, C., Ashish, N., Parul, D., Ankita, S., Prakash, A., Prakash, T., Kumar, P., & Varun, S. (2018). Antifertility Activity Of Ethanol Leaf Extract Of Moringa Oleifera Lam In Female Wistar Rats. Indian Journal Of Pharmaceutical Sciences, 80, 565–570. Https://Api.Semanticscholar.Org/Corpusid:55624490

Alfina, S., Nikhil, N. A., Akhilesh, V. S., Anandhu, S., & Anu, N. (2023). Production Of Natural Coagulant From Plant Materials And To Evaluate The Efficiency For Water Treatment Along With Its Validation By Ann Bt - Advanced Engineering Optimization Through Intelligent Techniques. South African Journal Of Botany, 129, 447–456.

Anzano, A., Ammar, M., Papaianni, M., Grauso, L., Sabbah, M., Capparelli, R., & Lanzotti, V. (2021). Moringa Oleifera Lam.: A Phytochemical And Pharmacological Overview. Horticulturae, 7(10), 1–25. Https://Doi.Org/10.3390/Horticulturae7100409

Atolani, O., Olabiyi, E. T., Issa, A. A., Azeez, H. T., Onoja, E. G., Ibrahim, S. O., Zubair, M. F., Oguntoye, O. S., & Olatunji, G. A. (2016). Green Synthesis And Characterisation Of Natural Antiseptic Soaps From The Oils Of Underutilised Tropical Seed. Sustainable Chemistry And Pharmacy, 4. Https://Doi.Org/10.1016/J.Scp.2016.07.006

Bassey, R. B., Bala, D. N., Edagha, I. A., & Peter, A. I. . (2013). The Effect Of Ethanolic Extract Of Moringa Oleifera On Alcohol-Induced Testicular Histopathologies In Pre-Pubertal Albino Wistar Rats. Biology And Medicine, 40(5).

Bhattacharya, A., Tiwari, P., Sahu, P. K., & Kumar, S. (2018). A Review Of The Phytochemical And Pharmacological Characteristics Of Moringa Oleifera. Journal Of Pharmacy And Bioallied Sciences, 10(4). Https://Journals.Lww.Com/Jpbs/Fulltext/2018/10040/A_Review_Of_The_Phytochemical_And_Pharmacological.2.Aspx

Cajuday, L. A., & Pocsidio, G. L. (2010). Effects Of Moringa Oleifera Lam. (Moringaceae) On The Reproduction Of Male Mice (Mus Musculus). Journal Of Medicinal Plants Research, 4(12), 1115–1121.

Dhakad, A. K., Ikram, M., Sharma, S., Khan, S., Pandey, V. V, & Singh, A. (2019). Biological, Nutritional, And Therapeutic Significance Of Moringa Oleifera Lam. Phytotherapy Research, 33(11), 2870–2903. Https://Doi.Org/Https://Doi.Org/10.1002/Ptr.6475

Dixit, S., Tripathi, A., & Kumar, P. (2016). International Journal Of Education And Science Research Review. International Journal Of Education And Science Research Review, 3(2), 173–185.

Fernandez, C. D. B., Fernandes, G. S. A., Favareto, A. P. A., Perobelli, J. E., Sanabria, M., & Kempinas, W. D. G. (2016). Decreased Implantation Number After In Utero Artificial Insemination Can Reflect An Impairment Of Fertility In Adult Male Rats After Exogenous Leptin Exposure. Reproductive Sciences, 24(2), 234–241. Https://Doi.Org/10.1177/1933719116653678

Ghasani, A. A. (2016). Uji Aktivitas Ekstrak Etanol 90% Daun Kelor (Moringa Oleifera Lam) Terhadap Konsentrasi Spermatozoa Morfologi Spermatozoa, Dan Diameter Tubulus Seminiferus Pada Tikus Jantan Galur Sprague-Dawley. In Analisa (Vol. 4, Issue 2).

Gopalakrishnan, L., Doriya, K., & Kumar, D. S. (2016). Moringa Oleifera: A Review On Nutritive Importance And Its Medicinal Application. Food Science And Human Wellness, 5(2), 49–56. Https://Doi.Org/Https://Doi.Org/10.1016/J.Fshw.2016.04.001

Iorjiim, W. M., Omale, S., Bagu, G. D., Gyang, S. S., & Alemika, E. T. (2020). Moringa Oleifera Leaf Extract Extends Lifespan And Ameliorate Haart Drug-Induced Locomotor, Reproductive, And Antioxidant Deficits In Drosophila Melanogaster. Journal Of Complementary And Alternative Medical Research, 11(August 2019), 33–46. Https://Doi.Org/10.9734/Jocamr/2020/V11i430194

Jikah, A. N., & Edo, G. I. (2023). : A Valuable Insight Into Recent Advances In Medicinal Uses And Pharmacological Activities. Journal Of The Science Of Food And Agriculture, 103(15), 7343–7361. Https://Doi.Org/Https://Doi.Org/10.1002/Jsfa.12892

Kayalvizhi, V., & Antony, U. (2015). Microbial A Nd Physico-Chemical Changes In Tomato Juice Subjected To Pulsed Electric Field Treatment. African Journal Of Agricultural Research, 6(30), 6348–6353. Https://Doi.Org/10.5897/A

Kementerian Kesehatan Ri. (2021). Profil Kesehatan Indonesia. In Kesehatan Indonesia. Jakarta.

Khofifah, N., & Mardiana, M. (2023). Biskuit Daun Kelor (Moringa Oleifera) Berpengaruh Terhadap Kadar Hemoglobin Pada Remaja Putri Yang Anemia. Action: Aceh Nutrition Journal, 8(1), 43. Https://Doi.Org/10.30867/Action.V8i1.614

Kumar, Y., Thakur, T. K., Sahu, M. L., & Thakur, A. (2017). A Multifunctional Wonder Tree: Moringa Oleifera Lam Open New Dimensions In Field Of Agroforestry In India. International Journal Of Current Microbiology And Applied Sciences, 6(8), 229–235. Https://Doi.Org/10.20546/Ijcmas.2017.608.031

Leone, A., Spada, A., Battezzati, A., Schiraldi, A., Aristil, J., & Bertoli, S. (2015). Cultivation, Genetic, Ethnopharmacology, Phytochemistry And Pharmacology Of Moringa Oleifera

Leaves: An Overview. International Journal Of Molecular Sciences, 16(6), 12791–12835. Https://Doi.Org/10.3390/Ijms160612791

Mbikay, M. (2012). Therapeutic Potential Of Moringa Oleifera Leaves In Chronic Hyperglycemia And Dyslipidemia: A Review. Frontiers In Pharmacology, 3 Mar(March), 1–12. Https://Doi.Org/10.3389/Fphar.2012.00024

Meireles, D., Gomes, J., Lopes, L., Hinzmann, M., & Machado, J. (2020). A Review Of Properties, Nutritional And Pharmaceutical Applications Of Moringa Oleifera: Integrative Approach On Conventional And Traditional Asian Medicine. Advances In Traditional Medicine, 20(4), 495–515. Https://Doi.Org/10.1007/S13596-020-00468-0

Nasr-Eldin, M., Abdelhamid, A., & Baraka, D. (2018). Antibiofilm And Antiviral Potential Of Leaf Extracts From Moringa Oleifera And Rosemary (Rosmarinus Officinalis Lam.). Egyptian Journal Of Microbiology, 0(0), 129–139. Https://Doi.Org/10.21608/Ejm.2017.1439.1027

Nkpurukwe, C. I., Obiandu, C., Owhorji, B. I., Opubo, A. T.-, Obiandu, A. C., & Okari, K. (2022). Improvement In Some Reproductive Parameters Of Male Wistar Rats Administered With Leaf Extract Of Eugenia Uniflora. Scholars Journal Of Applied Medical Sciences, 10(5), 793–797. Https://Doi.Org/10.36347/Sjams.2022.V10i05.020

Onyewuchi, C., Aprioku, J., & Siminialayi, I. (2018). Evaluation Of The Effect Of Ethanol Bark Extract Of Moringa Oleifera On Reproductive Biology Of Non-Pregnant Wistar Albino Rats. Journal Of Complementary And Alternative Medical Research, 5(2), 1–7. Https://Doi.Org/10.9734/Jocamr/2018/40118

Pareek, A., Pant, M., Gupta, M. M., Kashania, P., Ratan, Y., Jain, V., Pareek, A., & Chuturgoon, A. A. (2023). Moringa Oleifera: An Updated Comprehensive Review Of Its Pharmacological Activities, Ethnomedicinal, Phytopharmaceutical Formulation, Clinical, Phytochemical, And Toxicological Aspects. International Journal Of Molecular Sciences, 24(3). Https://Doi.Org/10.3390/Ijms24032098

Prabsattroo, T., Wattanathorn, J., Iamsaard, S., Somsapt, P., Sritragool, O., Thukhummee, W., & Muchimapura, S. (2015). Moringa Oleifera Extract Enhances Sexual Performance In Stressed Rats. Journal Of Zhejiang University: Science B, 16(3), 179–190. Https://Doi.Org/10.1631/Jzus.B1400197

Saha, B. U. F., Choumessi, A. T., Ayamo, A. M., Kuagny, R. B. M., Teta, I., Nantia, E. A., & Ejoh, R. A. (2022). Nutritional Quality Of Three Iron-Rich Porridges Blended With Moringa Oleifera, Hibiscus Sabdariffa, And Solanum Aethiopicum To Combat Iron Deficiency Anemia Among Children. Journal Of Food Quality, 10(01), 4309892. Https://Doi.Org/10.1155/2022/4309892

San, H. T., Khine, H. E. E., Sritularak, B., Prompetchara, E., Chaotham, C., Che, C. T., & Likhitwitayawuid, K. (2022). Pinostrobin: An Adipogenic Suppressor From Fingerroot (Boesenbergia Rotunda) And Its Possible Mechanisms. Foods, 11(19). Https://Doi.Org/10.3390/Foods11193024

Sekadde-Kigondu, C. B., & Ecsa, F. (2016). Ethical Considerations In Clinical Chemistry And Laboratory Medicine. International Federation Of Clinical Chemistry And Laboratory Medicine, January, 1–15.

Stohs, S. J., & Hartman, M. J. (2015). Review Of The Safety And Efficacy Of Moringa Oleifera. Phytotherapy Research, 29(6), 796–804. Https://Doi.Org/Https://Doi.Org/10.1002/Ptr.5325

Sugiantari, I. A. P., Suaskara, I. B. M., & Suarni, N. M. R. (2020). Concentration Of Spermatozoa And The Thickness Of The Seminiferous Tubules Of Male White Rats After Administration Of Moringa Leaf (Moringa Oleifera L.). Metamorfosa: Journal Of Biological Sciences.

Valdez-Solana, M. A., Mejía-García, V. Y., Téllez-Valencia, A., García-Arenas, G., Salas-Pacheco, J., Alba-Romero, J. J., & Sierra-Campos, E. (2015). Nutritional Content And Elemental And Phytochemical Analyses Of Moringa Oleifera Grown In Mexico. Journal Of Chemistry, 2015. Https://Doi.Org/10.1155/2015/860381

Vijayan, V., & Vijaya Lakshmi, S. V. (2018). Formulation And Characterization Of Sustained Release Matrix Tablets Of Indomethacin Using Moringa Oleifera Gum " Formulat Ion And Opt Imizat Ion Of Sustained Release Tablet S Of T Ramadol And Dalfam… Formulation And Characterization Of Sustained Release . Iosr Journal Of Pharmacy Www.Iosrphr.Org, 8(4), 57–65. Www.Iosrphr.Org

Villarruel-López, A., López-De La Mora, D. A., Vázquez-Paulino, O. D., Puebla-Mora, A. G., Torres-Vitela, M. R., Guerrero-Quiroz, L. A., & Nuño, K. (2018). Effect Of Moringa Oleifera Consumption On Diabetic Rats. Bmc Complementary And Alternative Medicine, 18(1), 1–10. Https://Doi.Org/10.1186/S12906-018-2180-2

Widiastini, L. P., Agung, I. G., Karuniadi, M., & Tangkas, M. (2022). Antioxidant Effect Of Moringa (Moringa Oleifera) Leaf Ethanol Extract On Spermatogenesis In Old Wistar Rats (Rattus Norvegicus). Jurnal Bioteknologi & Biosains Indonesia, 9(December). Http://Ejurnal.Bppt.Go.Id/Index.Php/Jbbi

Zade, V., & Dabhadkar, D. (2014). American Journal Of Advanced Drug Delivery Antifertility Effect Of Alcoholic Extract Of Moringa Oleifera Stem Bark On Estrous Cycle And Estrogenic Activity Of Female Albino Rat Zade. American Journal Of Advanced Drug Delivery, 1–13. Www.Ojadd.Com