



Pharmacological Evaluation of the Effect of *Moringa Oleifera* Lam. Seed on Body Mass Index Using Pregnant Wistar Rats

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Abstract

Moringa oleifera is a medicinal plant extensively utilized in traditional medicine due to its nutritional, antioxidant, anti-inflammatory, and metabolic regulatory properties. Despite increasing pharmacological interest in *Moringa oleifera*, limited experimental evidence exists regarding the effect of its seed preparation on body mass index (BMI) during pregnancy and post-pregnancy conditions. This study evaluated the pharmacological effect of *Moringa oleifera* seed powder on body mass index (BMI) in pregnant albino Wistar rats. Phytochemical screening and acute toxicity evaluation of *Moringa oleifera* seed powder (MSP) were conducted using standard methods. Acute toxicity was determined using Lorke's method. Thirty-six pregnant albino Wistar rats were divided into six groups comprising one control group and five treatment groups and were treated with various doses of the MSP. Body weight and length measurements were taken at baseline and on Day 7, 14, 20, and 28. Phytochemical screening revealed the presence of alkaloids, saponins, carbohydrates, cardiac glycosides, flavonoids, tannins, terpenes, and terpenoids. Acute oral toxicity testing showed no mortality up to 5000 mg/kg. Mean BMI values varied slightly across treatment groups throughout the experimental period. There was no statistically significant difference in BMI among groups ($F = 1.403$, $p = 0.235$). *Moringa oleifera* seed powder demonstrated relative safety and produced mild increase in BMI in pregnant Wistar rats. The findings suggest that MSP may possess metabolic modulatory properties without causing severe alterations in body composition.

Keywords: *Moringa oleifera*; Body Mass Index; Wistar Rats; Phytochemical Screening; Pregnancy; Toxicity Study

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Introduction

Medicinal plants have remained an indispensable component of healthcare systems worldwide and continue to contribute significantly to drug discovery, and health promotion. (Omale *et al.*, 2026). According to the World Health Organization (WHO), approximately 80% of the global population relies partly on traditional herbal medicines for primary healthcare, particularly in developing countries where accessibility and affordability of conventional medicines remain limited. The growing scientific interest in medicinal plants is driven by their rich phytochemical composition, therapeutic potential, and comparatively lower incidence of adverse effects when appropriately used (World Health Organization [WHO], 2023). Consequently, extensive pharmacological investigations are being conducted to validate the efficacy, safety, and mechanisms of action of medicinal plants traditionally used for nutritional and therapeutic purposes.

Among the medicinal plants receiving increasing scientific attention is *Moringa oleifera* Lam., a fast-growing perennial tree belonging to the family Moringaceae. The plant is native to the Indian subcontinent but is now widely cultivated throughout tropical and subtropical regions of Africa, Asia, and South America because of its nutritional and medicinal importance (Leone *et al.*, 2021). Commonly referred to as the drumstick tree, horseradish tree, or miracle tree, *M. oleifera* has been used traditionally for the management of malnutrition, inflammation, diabetes mellitus, hypertension, infectious diseases, and reproductive disorders. Virtually all parts of the plant have been utilized in ethnomedicine (Saini *et al.*, 2022).

The pharmacological properties of *Moringa oleifera* are largely attributable to its rich array of bioactive compounds. Previous phytochemical studies have demonstrated that the seeds contain alkaloids, flavonoids, saponins, tannins, terpenoids, phenolic acids, glucosinolates, and cardiac glycosides, with antioxidant, anti-inflammatory, antimicrobial, hypoglycemic, antihyperlipidemic, and immunomodulatory activities (Olatunji & Afolayan, 2023; Saini *et al.*, 2022). These phytochemicals have been shown to modulate several biochemical pathways involved in energy metabolism, lipid homeostasis, oxidative stress regulation, and endocrine function (Situmorang *et al.*, 2025). Consequently, *M. oleifera* has increasingly been investigated as a potential therapeutic agent for obesity, metabolic syndrome, diabetes, and cardiovascular diseases (Vergara-Jimenez *et al.*, 2023).

Recent studies (Louisa *et al.*, 2022; Munir *et al.*, 2025; Mokgalaboni *et al.*, 2026) have highlighted the beneficial effects of *Moringa oleifera* on metabolic health. Experimental and clinical evidence suggests that extracts of the plant may reduce serum cholesterol and triglyceride levels, improve insulin sensitivity, suppress oxidative stress, and regulate adipogenesis, thereby contributing to the prevention and management of obesity and other metabolic disorders (Falowo *et al.*, 2022; Vergara-Jimenez *et al.*, 2023). However, while the leaves of *M. oleifera* have been extensively investigated, relatively fewer studies have focused on the pharmacological and toxicological properties of the seeds, especially about their effects during pregnancy.

Pregnancy is a complex physiological state characterized by profound hormonal, metabolic, and anatomical adaptations necessary to support fetal growth and maternal health. One of the important indicators of these physiological changes is body mass index (BMI), an anthropometric parameter derived from body weight and body length or height. BMI serves as a valuable index for assessing nutritional status, body composition, and metabolic health in both humans and experimental animals (Okechukwu *et al.*, 2021). During pregnancy, alterations in BMI may reflect changes in maternal energy balance, fat deposition, nutrient utilization, fetal growth, and fluid retention. Abnormal BMI values have been associated with adverse pregnancy outcomes including gestational diabetes, fetal growth restriction, preterm birth, and maternal morbidity (Khammarnia *et al.*, 2024).

Despite the extensive utilization of *Moringa oleifera* as a nutritional supplement and herbal remedy, concerns have been raised regarding the safety of some of its preparations during pregnancy. While the plant is generally regarded as safe and possesses significant nutritional value, emerging evidence suggests that certain parts, particularly the seeds and roots, may exhibit reproductive and developmental effects at high doses. Experimental studies have reported alterations in reproductive hormones, implantation rates, fetal development, and histopathological changes following administration of *Moringa* seed extracts in laboratory animals (Attah *et al.*, 2022). Similarly, Abdu *et al.* (2023) demonstrated that extracts from *Moringa stenopetala*, a closely related species, produced adverse effects on fetal and placental development in pregnant Wistar rats. These findings underscore the need for further investigations into the safety and pharmacological effects of *Moringa* seed preparations during pregnancy. Although several studies have examined the effects of *Moringa oleifera*

leaves on lipid metabolism, body weight regulation, and glucose homeostasis, there is limited information regarding the influence of *Moringa oleifera* seed powder (MSP) on body mass index during pregnancy. Therefore, the present study was designed to evaluate the pharmacological effect of *Moringa oleifera* seed powder on body mass index (BMI) in pregnant albino Wistar rats.

Materials and Methods

Plant Material Collection and Identification

Moringa oleifera seeds were collected from a local agricultural source and authenticated by a plant taxonomist in the Department of Biological Sciences, University of Jos with the Herbarium No: UJH17000282. The seeds were cleaned by removing the shells, air-dried for 8 weeks, and pulverized into fine powder using a laboratory grinder.

Animals

Thirty-six healthy pregnant albino Wistar rats weighing between 130 g and 200 g were used for the study. The animals were obtained from the Animal House Facility of department of Pharmacology and Toxicology, University of Jos and acclimatized for two weeks under standard laboratory conditions with free access to feed and water. The study was conducted in accordance with Guide for The Care and Use of Laboratory Animals of Institute for Laboratory Animal Research, Washington Dc (Institute of Laboratory Animal Resources (US). Committee on Care & Use of Laboratory Animals, 1986).

Phytochemical Screening

Qualitative phytochemical screening of *Moringa oleifera* seed powder was performed using standard methods described by Evans (2009), for detection of alkaloids, tannins, flavonoids, saponins, terpenoids, cardiac glycosides, carbohydrates, anthraquinones, and phlobatannins.

Acute Toxicity Study

Acute toxicity testing was conducted using Lorke's (1983) method.

Experimental Design

The animals were randomly assigned into six groups and treated as follows:

Control Group 1 5 ml/kg of Normal Saline
Group 2 50 mg/kg of MSP

Group 3 100 mg/kg of MSP
Group 4 200 mg/kg of MSP
Group 5 500 mg/kg of MSP
Group 6 1000 mg/kg of MSP

Anthropometric Measurement

Body weight and body length measurements were recorded using weighing scale and meter rule respectively on Day 2 (baseline), Day 7, Day 14, Day 20, and Day 28 after pregnancy.

Determination of Body Mass Index (BMI)

BMI was calculated using the formula:

$$\text{BMI} = \frac{\text{Weight (g)}}{(\text{Length (cm)})^2}$$

Statistical Analysis

Data were expressed as mean $\pm$ standard deviation (SD). Statistical analyses were performed using SPSS software version 25. One-way ANOVA, Duncan post hoc tests, LSD multiple comparison tests, and Student's t-test were employed. Statistical significance was considered at $p < 0.05$.

Results

Phytochemical analysis of *Moringa Oleifera* Seed Powder (MSP)

Phytochemical analysis revealed the presence of several bioactive constituents including alkaloids, saponins, carbohydrates, cardiac glycosides, flavonoids, tannins, terpenes, and terpenoids. Anthraquinones and phlobatannins were absent. (Table 1)

Acute Toxicity (LD_{50}) of MSP

No mortality was observed in rats administered MSP up to 5000 mg/kg body weight. The oral LD_{50} was therefore estimated to be greater than 5000 mg/kg,

Effect of MSP on body length

The highest reduction in body length was observed in at the dose of 1000 mg/kg, where body length decreased from 14.92 ± 0.49 cm to 14.43 ± 1.06 cm on Day 28 (Table 2).

Effect of MSP on Maternal body Weight

The dose of 1000 mg/kg caused the highest reduction ($p < 0.05$) in body weight from 136.32 ± 5.31 g to 112.48 ± 5.38 g on Day 28 (Table 3).

Effect of MSP on Body Mass Index

There was no significant difference in BMI across the groups (Table 4). The 1000 mg/kg group showed the greatest reduction ($P > 0.05$) in BMI by Day 28 (0.34 ± 0.11 g/cm²).

Table 1: Phytochemical constituents of MSP

S/No	Phytochemicals	Results
1.	Alkaloids	+
2.	Anthraquinones	-
3.	Saponins	+
4.	Carbohydrates	+++
5.	Cardiac glycosides	++
6.	Flavonoids	++
7.	Phlobatannins	-
8.	Tannins	++
9.	Terpenes	+
10.	Terpenoids	+

- Absent + = Present ++ = Highly Present +++ = Very Highly Present

Table 2: Effect on body length

Treatment Groups	Dose (mg/kg)	Length (cm) on Day 2	Length (cm) on Day 7	Length (cm) on Day 14	Length (cm) on Day 20	Length (cm) on Day 28
Control	5 ml/kg	17.03 ± 0.52	17.17 ± 0.44	17.77 ± 0.45	18.61 ± 0.24	18.17 ± 0.30
Group 2	50	17.25 ± 0.47	17.25 ± 1.35	17.50 ± 1.00	17.44 ± 0.50	17.42 ± 0.56
Group 3	100	14.5 ± 0.75	18.67 ± 0.93	17.5 ± 0.28	18.34 ± 0.69	17.72 ± 0.49
Group 4	200	14.25 ± 0.52	18.28 ± 0.27	17.25 ± 0.45	17.93 ± 0.78	18.00 ± 0.48
Group 5	500	16.08 ± 0.20	17.82 ± 0.74	17.53 ± 0.57	17.86 ± 0.54	17.49 ± 0.49
Group 6	1000	14.92 ± 0.49	17.3 ± 0.55	17.38 ± 0.45	17.47 ± 0.35	14.43 ± 1.06

Table 3: Table of maternal body weight

Treatment Groups	Dose (mg/kg)	Weight (g) on Day 2	Weight (g) on Day 7	Weight (g) on Day 14	Weight (g) on Day 20	Weight (g) on Day 28
Control	5 ml/kg	167.07 ± 9.03	167.97 ± 7.03	171.05 ± 7.02	175.22 ± 7.46	167.5 ± 8.21
Group 2	50	155.5 ± 15.77	156.4 ± 19.69	157.7 ± 22.08	163.98 ± 25.17	155.48 ± 15.56
Group 3	100	173.62 ± 12.36	156.15 ± 9.22	174.23 ± 15.34	177.53 ± 13.24	173.68 ± 12.61
Group 4	200	163.9 ± 15.68	160.22 ± 9.19	162.75 ± 12.99	167.68 ± 15.41	163.07 ± 8.63
Group 5	500	162.02 ± 18.21	146.12 ± 19.35	150.57 ± 25.78	156.32 ± 25.87	158.35 ± 23.51
Group 6	1000	136.32 ± 5.311	122.6 ± 7.29	126.32 ± 10.46	131.3 ± 7.53	112.48 ± 55.38

Table 4: Effect on Body Mass Index

Treatment Groups	Dose (mg/kg)	BMI on Day 2 (g/cm ²)	BMI on Day 7 (g/cm ²)	BMI on Day 14 (g/cm ²)	BMI on Day 20 (g/cm ²)	BMI on Day 28 (g/cm ²)
Control	5 ml/kg	0.52 ± 0.04	0.57 ± 0.05	0.55 ± 0.09	0.54 ± 0.05	0.51 ± 0.07
Group 2	50	0.52 ± 0.05	0.50 ± 0.06	0.51 ± 0.04	0.51 ± 0.06	0.51 ± 0.07
Group 3	100	0.51 ± 0.02	0.45 ± 0.03	0.57 ± 0.04	0.51 ± 0.05	0.55 ± 0.05
Group 4	200	0.49 ± 0.05	0.46 ± 0.05	0.50 ± 0.09	0.52 ± 0.04	0.51 ± 0.04
Group 5	500	0.49 ± 0.06	0.46 ± 0.07	0.49 ± 0.07	0.49 ± 0.06	0.49 ± 0.06
Group 6	1000	0.49 ± 0.04	0.45 ± 0.03	0.42 ± 0.09	0.43 ± 0.08	0.34 ± 0.11

Discussion

This study evaluated the pharmacological effects of *Moringa oleifera* seed powder (MSP) on body mass index (BMI) in pregnant albino Wistar rats. The findings revealed that MSP contains numerous phytochemicals, including alkaloids, saponins, flavonoids, tannins, terpenes, terpenoids, carbohydrates, and cardiac glycosides. The presence of these compounds is consistent with previous reports which identified *Moringa oleifera* seeds as rich sources of bioactive constituents with nutritional and pharmacological significance (Adebayo *et al.*, 2021; Attah *et al.*, 2022). These phytochemicals have been associated with antioxidant, anti-inflammatory, antimicrobial, hypoglycemic, and reproductive activities (Hossain *et al.*, 2025), which may explain both the beneficial and adverse biological effects. Adebayo *et al.* (2021) observed that the biological activities of *Moringa oleifera* are largely attributable to its rich phytochemical composition. While these compounds may provide nutritional and medicinal benefits, some have also been implicated in reproductive toxicity and endocrine disruption when consumed at high concentrations (Dutta *et al.*, 2023).

The present study further demonstrated dose-dependent effects of MSP on maternal anthropometric parameters. Pregnant rats in the control group and low-dose treatment groups maintained relatively stable BMI values throughout gestation. This observation suggests that lower doses of MSP may not adversely affect maternal nutritional status or pregnancy-associated physiological weight gain. Pregnancy is normally characterized by progressive increases in maternal body weight and BMI due to fetal growth, placental development, expansion of maternal tissues, and increased fluid volume (Khammarnia *et al.*, 2024). Therefore, the maintenance of normal BMI among rats receiving lower doses of MSP may indicate that these doses do not significantly interfere with normal gestational physiology. In contrast, rats exposed to higher doses of MSP (500 mg/kg and 1000 mg/kg)

exhibited significant reductions in body weight and BMI, particularly at the later stages of pregnancy. The finding suggests a dose-dependent adverse effect of MSP on maternal nutritional status and reproductive outcomes. The observed decline in BMI may reflect impaired nutrient utilization, reduced food intake, altered metabolism. The present findings support earlier studies that have raised concerns regarding the safety of *Moringa* seed preparations during pregnancy. Attah *et al.* (2022) reported that administration of *Moringa oleifera* seed extracts produced alterations in reproductive parameters and histopathological changes in reproductive organs of experimental animals. Similarly, Abdu *et al.* (2023) demonstrated that extracts from *Moringa stenopetala*, a related species, exerted toxic effects on fetal and placental development in pregnant Wistar rats. These observations suggest that although *Moringa* species are widely consumed for nutritional and medicinal purposes, certain constituents may exert reproductive toxicity when administered at high doses. Flavonoids and alkaloids, for example, have been reported to influence estrogenic and progesterone-mediated pathways that are essential for implantation and maintenance of pregnancy (Vašková *et al.*, 2023). Saponins and tannins may also interfere with endometrial receptivity and embryonic development through oxidative stress mechanisms or alterations in uterine physiology (Attah *et al.*, 2022). Consequently, high concentrations of these compounds may compromise implantation and fetal survival and reductions in maternal body weight.

The results of this study have important public health implications, particularly in developing countries where *Moringa oleifera* is widely consumed as a nutritional supplement by women of reproductive age. While the plant is generally regarded as safe and nutritionally valuable, the findings suggest that excessive consumption of seed preparations during pregnancy may pose risks to maternal and fetal health.

Given the increasing popularity of herbal medicines and dietary supplements, there is a need for evidence-based guidelines regarding the safe use of *Moringa* products during pregnancy. Hence the essence of this study.

Conclusion

The findings indicate that MSP exhibits dose-dependent effects on maternal BMI and pregnancy outcomes. Lower doses appear relatively safe and do not significantly alter maternal anthropometric parameters, whereas higher doses may induce adverse reproductive effects, including reductions in BMI and possible pregnancy loss. These results highlight the necessity for further toxicological, pharmacokinetic, and clinical investigations to establish safe dosage ranges and elucidate the mechanisms underlying the reproductive effects of *Moringa oleifera* seed preparations. Further studies involving more biochemical analyses, histopathological evaluations, and longer treatment durations are recommended to elucidate the mechanisms underlying its metabolic effects. Also, clinical studies in humans are necessary to establish safe consumption levels and fully understand its toxicological effects during pregnancy.

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Conflict of interest

The authors declare no conflict of interest.

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