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Dose-Response Moringa Oleifera Extracts on Lactation Outcomes In Breastfeeding Women

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Abstract

Introduction: Herbal galactagogues such as Moringa oleifera are traditionally used to enhance breast milk production. However, evidence regarding optimal dosage is limited. This study aimed to evaluate the effects of three different doses of Moringa oleifera extract (250 mg, 650 mg, and 800 mg) on breast milk production in breastfeeding mothers. Methods: a quasi-experimental pretest-posttest was conducted among 89 postpartum women from three Primary Health Centre areas in Semarang, Central Java, Indonesia. Participants received 250 mg (n=28), 650 mg (n=30), or 800 mg (n=31) of Moringa oleifera extract once daily for 14 days. Outcomes were infant weight gain, bowel-movement frequency, and urination frequency. Data were collected from October 2024 to March 2025 and analysed using paired t tests and Kruskal-Wallis tests ($p<0.05$). Results: All dosage groups showed improvements in indicators of breast milk production. No statistically significant differences were observed between groups ($p>0,05$). The 650 mg group recorded the highest mean infant weight gain, whereas the 250 mg group showed the greatest increases in bowel movements and urination frequency. Conclusions: Moringa oleifera extract at 250, 650, and 800 mg/day over 14 days supported breast-milk production. Further studies are needed to clarify the dose-response relationship.

Introduction

Breastfeeding has been identified as a vital component of maternal and infant health, providing essential nutrients, bioactive immune protection, and psychosocial bonding that fosters long-term well-being (Purkiewicz *et al*., 2025). The World Health Organization advocates breastfeeding as the sole source of nutrition for the initial six months of an infant's life (UNICEF-WHO, 2021; WHO, 2025). This practice has been shown to strengthen immune systems and reduce the risk of common infections and respiratory illnesses. In addition, it has been associated with a lower likelihood of developing asthma and decreased growth faltering, including stunting.(Kartasurya *et al*., 2023; Mohamed *et al*., 2023; Muro-Valdez *et al*., 2023). Furthermore, it has been established that initiating breastfeeding within the first hour of birth is associated with a reduced probability of neonatal death.

Although the benefits of exclusive breastfeeding are well-documented, its global coverage remains far from optimal (Giang *et al*., 2023; WHO, 2025). In Indonesia, for instance, it was reported by the Ministry of Health that in 2023, only 63.9% of infants aged 0–6 months were exclusively breastfed, a figure that was seen to drop slightly in Central Java, to 63.4%.(Kemenkes RI, 2023). Interestingly, the rate of exclusive breastfeeding in Semarang City has increased to 68.22% in the last three years. However, this figure has not yet reached the national target of 80% (Dinas Kesehatan Kota Semarang, 2023). The existence of a gap in exclusive breastfeeding practices is indicative

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of the various ongoing challenges faced by breastfeeding mothers. The predominant factors contributing to this phenomenon include perceived or actual low milk supply(Quebu *et al*., 2023), a lack of maternal confidence (Giang *et al*., 2023), difficulties in breastfeeding techniques (Nugraheni *et al*., 2022), and inadequate social support (Irmawati *et al*., 2024; Vesel *et al*., 2023). These challenges are not only individual in nature, but are also influenced by the social, cultural, and health systems that either support or hinder the breastfeeding process.

To overcome these obstacles, various strategies have been implemented, both pharmacological and non-pharmacological (Zen Rahfiludin *et al*., 2020). Although pharmacological galactagogues can effectively increase milk production, their long-term use is often limited by potential side effects (Grzeskowiak *et al*., 2019). Therefore, non-pharmacological approaches are increasingly becoming the preferred choice. Methods such as lactation counseling, skin-to-skin contact between mother and baby, oxytocin massage, hypnobreastfeeding, and the use of herbal galactagogues are gaining popularity due to their high accessibility and generally favorable safety profiles(Ulya *et al*., 2023).

Among various herbal options, Moringa oleifera (moringa) has stood out as one of the plants that is rich in nutrients and has the potential to increase breast milk production (Ammar *et al*., 2025). Moringa leaves contain polyphenols (Cao *et al*., 2023), alkaloids, and phytosterols (such as campesterol, β-sitosterol, and stigmasterol) (Hajar *et al*., 2024) which are thought to support the release of oxytocin and prolactin, two key hormones in breast milk production (Muro-Valdez *et al*., 2023; Sibeko *et al*., 2021). Additionally, moringa provides essential amino acids, calcium, and other important micronutrients, which are not only beneficial for maternal health but also support optimal infant growth (Thorat *et al*., 2025).

The previous study showed that Moringa oleifera supplementation can increase breast milk volume, support infant weight gain, and raise maternal prolactin levels (Fungtammasan & Phupong, 2021). However, most studies have only evaluated a single dose, so the optimal dose for maximum benefit remains unclear. To address this knowledge gap, the current study was designed to compare three daily doses of Moringa oleifera extract: 250 mg, 650 mg, and 800 mg over 14 days. This study not only measures the impact of dosage on breast milk volume but also observes indicators of breast milk adequacy in infants, such as weight gain, bowel movement frequency, and urination frequency. This study aims to identify whether there is a dose-dependent effect, a finding that could form the basis for evidence-based recommendations for breastfeeding mothers. The results of this study are expected to provide practical guidance for health workers and mothers in determining the most effective and safe dose of Moringa oleifera to support the lactation process.

Method

This study utilized a quasi-experimental design, in which pre-test and post-test approaches were implemented. To select respondents, purposive sampling was implemented to specify mothers who met the inclusion criteria in this study: the mothers must breastfeed exclusively, be willing to participate in a 14-day intervention of the study treatment, and not have a chronic disease or treatment with a pharmacologic lactogen. The exclusion criteria were as follows: past allergy to Moringa oleifera, unwillingness to continue intervention, and lack of follow-up data. Three intervention groups (Group A: 250 mg, Group B: 650 mg, and Group C: 800 mg Moringa oleifera extract daily) with 89 eligible participants. Moringa oleifera extract capsules were compiled using standard methods. Each patient was given the recommended dose for 14 days. The capsule was to be taken in the form of a single capsule daily at around the same time after breakfast with a glass of water. Compliance was monitored through daily logs and capsule counts at follow-up.

Primary outcomes were indicators of breast milk production adequacy, measured indirectly through infant weight, measured using a calibrated digital infant scale, frequency of bowel movements per day, and frequency of urination per day. Baseline measurements were recorded before the intervention, and

post-intervention measurements were taken on day 15. Infant weight was measured with the infant unclothed, while defecation and urination frequencies were recorded through maternal daily logs. SPSS version 26 was used to analyse the data. The Shapiro-Wilk test was used to assess for normality. Pre and post-intervention outcomes within groups were compared using the Paired-T test, while between-group comparisons were conducted using the Kruskal-Wallis test. The threshold for statistical significance was $p < 0.05$. The Ethics Committee of Health Polytechnic Semarang granted ethical approval under number 1283/EA/F.XXIII.38/2024

Results and Discussion

The baseline characteristics of the participants in the three intervention groups that received dosages of 250 mg, 650 mg, and 800 mg of *Moringa oleifera* extract are shown in Table 1. At the beginning of the investigation, there were no statistically significant differences between the groups, as all p-values for the assessed variables were more than 0.05

To examine the effects of different doses of *Moringa oleifera* extract on lactation outcomes, infant weight, urination frequency, and defecation frequency were measured before and after the 14-day intervention in each dose group. The comparative results are summarized in Table 2. The analysis revealed that the greatest average increase in infant weight was observed in the group receiving *Moringa oleifera* extract at a dose of 650 mg, with a mean weight gain of (4495±924.6) from baseline to post-intervention (5184±789.5gr) ($p < 0.001$). Exceeding the changes seen in both the 250 mg and 800 mg groups. In contrast, the largest improvements in infant excretion patterns were found in the 250 mg group. This group showed the highest average increase in urination frequency, rising from (8.40±1.33) to (11.35±1.50) times per day ($p<0.001$), and the greatest increase in defecation frequency, from (1.55±0.60) to (2.35±0.87) times per day ($p<0.01$). These changes were greater than those observed in the 650 mg and 800 mg groups.

To further evaluate dose response patterns of *Moringa oleifera* extract, we analysed mean changes in infant weight and in the frequencies of urination and defecation across the three intervention groups in Table 3. The largest average weight gain occurred in the 650 mg group (649.00 g), followed by the 800 mg (501.50 g) and 250 mg groups (481.25 g). These differences were not statistically significant (p=0.189). For urination frequency, the greatest mean increase was observed in the 250 mg group (0.86 times/day), then the 800 mg (0.73 times/day) and 650 mg groups (0.54 times/day), with no significant between-group difference (p=0.255). Defecation frequency showed a similar pattern; the 250 mg group had the highest mean increase (2.93 times/day), followed by the 650 mg (1.78 times/day) and 800 mg groups (1.69 times/day). Again, the differences were not statistically significant (p=0.143).

This study indicates that supplementation with *Moringa oleifera* extract is associated with

TABLE 1. Baseline Characteristics of Participants Across Intervention Groups

Characteristics	**Group 250 mg (n=28)**	**Group 650 mg (n=30)**	**Group 800 mg (n=31)**	**p-value**
		Mean ±SD		
Breastfeeding frequency	9.10 ± 2.14	9.25 ± 1.99	8.95 ± 2.57	0.669*
Initial baby weight (grams)	4288 ± 913	4465 ± 956	3943 ± 982	0.098*
Initial baby urination frequency (per day)	8.50 ± 1.43	9.10 ± 1.57	9.45 ± 1.36	0.803*
Initial baby defecation frequency (per day)	1.38 ± 0.66	1.40 ± 0.78	1.53 ± 0.78	0.817*

Source: Primary Data

*Lavene test, p<0.05 significance value

TABLE 2. Pre and Post Intervention Infant Outcomes Across *Moringa oleifera* Dose Groups

Result	Group 250 mg Mean ± SD			Group 650 mg Mean ± SD			Group 800 mg Mean ± SD		
	Pre-test	Post-test	sig*	Pre-test	Post-test	sig*	Pre-test	Post-test	sig*
Baby weight (gram)	4571± 1105	5154± 1134	0.000	4495± 924.6	5184± 789.5	0.000	4448± 848.8	4987 ± 920.1	0.000
Baby urination frequency	8.40± 1.33	11.35± 1.50	0.000	9.12± 1.36	10.95± 1.66	0.003	9.45± 1.37	11.25± 1.74	0.002
Baby defecation frequency	1.55± 0.60	2.35± 0.87	0.001	1.40± 0.78	1.95± 1.26	0.031	1.55± 0.68	2.23± 1.20	0.004

Source: Primary Data
*Paired-T test, p<0.05 significance value

TABLE 3. Mean Changes in Infant Outcomes Across Moringa oleifera Dose Groups

Results	Group 250 mg	Group 650 mg	Group 800 mg	p-value
	Mean Delta ± SD	Mean Delta ± SD	Mean Delta ± SD	
Baby weight (gram)	481.25±420.00	649.00± 418.05	501.50 ± 255.42	0.186*
Baby's urination frequency	0.86±0.81	0.54± 0.94	0.73 ± 0.86	0.255*
Baby defecation frequency	2.93±2.04	1.78± 1.97	1.69 ± 1.72	0.143*

Source: Primary Data
* Kruskal-Wallis tests, p<0.05 significance value

favourable breastfeeding outcomes, evidenced by increases in infant weight and higher frequencies of urination and defecation across all dose groups. These observations align with prior reports linking *Moringa oleifera* leaf consumption to elevated maternal prolactin and greater milk production (Wahidah *et al*., 2023), although statistical significance is not consistently achieved. Animal studies involving goats (Kholif *et al*., 2015), rats (Dantas *et al*., 2024; Intan *et al*., 2024), and cows similarly suggest enhanced milk yield and quality largely attributed to increased protein content and antioxidant activity (Kekana *et al*., 2019). While human evidence remains limited, the accumulating literature supports the potential of *Moringa oleifera* as a natural lactation enhancer (Thorat *et al*., 2025b). Although between-group differences were not statistically significant, dose-specific patterns were apparent. The 650 mg group showed the greatest average gain in infant weight, suggesting that higher doses may better support growth, whereas the 250 mg group exhibited the largest increases in urination and defecation frequencies, implying potential benefits for hydration and gastrointestinal function at lower doses.

These trends are broadly consistent with evidence from randomized trials and systematic reviews. For example, one meta-analysis reported that *Moringa oleifera* supplementation increased blood prolactin by approximately 231.7 ng/mL and daily milk volume by up to 400 mL (Azmi *et al*., 2025). Similarly, quasi-experimental work has likewise found that a 250 mg dose raised prolactin by about 231.72 ng/mL (Sulistiawati *et al*., 2022). In another randomized trial, no difference in milk volume was observed on postpartum day 3. However, by six months, exclusive breastfeeding reached 52.3%, and milk production in the *Moringa oleifera* group was 47% higher than in the placebo group. (Fungtammasan & Phupong, 2021). Additional quasi-experimental research using *Moringa oleifera* leaf jelly reported increases in prolactin (23.3%) and milk volume (47%),

alongside improvements in infant indicators (weight, urination, and bowel movement frequency), whereas the control group showed declines. Mechanistically, bioactive constituents phytosterols, flavonoids, saponins, vitamins, and amino acids may stimulate prolactin and oxytocin release and support milk secretion, with downstream benefits for infant hydration and excretory function (Marsiami & Puspariny, 2024).

Conclusion

Among breastfeeding women, supplementation with *Moringa oleifera* extract was associated with improvements in infant outcomes, body weight, urine output, and stool frequency at all tested doses (250, 650, and 800 mg). Although between-group differences were not statistically significant, consistent patterns emerged: the 650 mg dose yielded the greatest mean gain in infant weight, whereas the 250 mg dose produced the largest increases in urination and defecation. These patterns suggest that dose may differentially influence specific breastfeeding outcomes, indicating a possible dose-response signal. Given its rich nutrient profile and well-documented galactagogue properties, *Moringa oleifera* appears to be a promising natural adjunct to support lactation.

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