Journal of Educational Technology and Innovation
Homepage: http://jurnal.unipar.ac.id/index.php/jeti/
Vol 8 No 1, 2025, pp 95-105 .
DOI: https://doi.org/10.31537/jeti.v8i1.2461
P - ISSN 2621-2137
E - ISSN 2621-2080

The Effect of Moringa Leaf Juice, Lemon and Honey Intervention on Breast Milk Production Volume in Postpartum Mothers: An Experimental Study Based on Education Level in Kalisat District

Umi Kulsum Trisiyawati[1], Anik Sri Purwanti[2]
Institut Tekhnologi, sains, dan Kesehatan RS dr. Soepraoen Malang, Indonesia

Email : umikulsum8789@gmail.com,[1] aniksri@itsk-soepraoen.ac.id [2]
*Coresponding Author

Article History: Received: Mei, 16 2025; Accepted: Juni, 10 2025; Published: June, 30 2025.

ABSTRACT
Maternal education significantly influences breastfeeding knowledge, nutritional adherence, and intervention outcomes. This study investigates the effect of a combination of moringa leaf juice, lemon, and honey on breast milk volume in postpartum mothers. A quasi-experimental design was employed to evaluate the intervention's effectiveness in increasing breast milk production. The study population was 100 postpartum mothers on days 2 to 10, Data analysis used the Paired t-test to compare changes in groups, and the Independent t-test and two-way ANOVA to compare between groups and test interactions with education level, an increase in breast milk volume from pretest to posttest with varying magnitudes. Participants with higher education in the intervention group (ID 1, 3, and 4) experienced an increase of 31.8 ml, 27.3 ml, and 32.6 ml, secondary education (ID 5) showed a more substantial increase of 30.1 ml, education level as a covariate factor did not show a significant effect on the measured outcome ($F = 1.17$, $p = 0.315$), the interaction effect between group and education level ($F = 0.22$, $p = 0.805$). The absence of statistical significance in the education factor indicates that variations in educational background do not contribute meaningfully to variability, The results of the study showed that providing intervention in the form of moringa leaf juice combined with lemon and honey was able to significantly increase the volume of breast milk production in postpartum mothers
Keywords: Postpartum Mothers, Moringa Leaf Juice, Honey

INTRODUCTION

Breast milk is the main nutrition for postpartum babies and has been proven to provide long-term health benefits for both babies and mothers—from reducing the risk of infection to supporting the baby's neurological development. However, low breast milk production is still a major challenge in achieving exclusive breastfeeding for the first 6 months of life. (Melinda et al., 2023)
Moringa oleifera leaves are known to be rich in phytosterols and active glycosides that can stimulate prolactin secretion and the formation of mammary gland alveoli. A double-blind randomized clinical trial showed that consuming moringa capsules increased breast milk volume by 47% compared to placebo, although the results were not significant on the third day postpartum (Fungtammasan & Phupong, 2022). In addition, consumption of moringa tea has also been shown to be significant in increasing the daily volume of breast milk in breastfeeding mothers for 6 months. .
Lemon is a source of vitamin C and important antioxidants that support maternal health and breast milk quality. Honey, with its antimicrobial properties and natural energy content, is believed to improve the nutritional quality of breast milk and increase maternal stamina.(Ayuningtiyas et al., n.d.) Although both are widely used in traditional practice as lactagogums, experimental studies combining moringa, lemon, and honey are still very limited..

Maternal education greatly influences breastfeeding knowledge, nutritional compliance, and intervention success. Studies in Indonesia show that the majority of mothers have low levels of education, which is associated with low lactation knowledge. However, the interaction between herbal interventions and educational background has been minimally studied, especially in areas such as Kalisat District.

This quasi-experimental study aims to examine the effects of a combination of moringa leaf juice, lemon, and honey on breast milk volume in postpartum mothers in Kalisat District, stratified by maternal education level (low, middle, high). Education level plays a critical role in influencing maternal health behavior, including lactation practices and nutritional compliance, which may modulate the effectiveness of nutritional interventions (Fikree et al., 2005; Kavle et al., 2019). Moringa oleifera is rich in galactagogue compounds that, when combined with vitamin C from lemon and natural sugars in honey, may synergistically enhance lactation (Eng et al., 2018; Ito & Tadaka, 2022).

. The method used is a quasi-experimental design with control and intervention groups, and breast milk volume measurements for 14 days using standardized measuring cups.

The results of this study are expected to enrich the literature on natural galactagogues and provide evidence on how maternal education status mediates responses to nutritional interventions. Practically, these findings can be used as a basis for designing in-depth and effective community-based lactation programs at various educational levels, as well as supporting local health policies and exclusive breastfeeding promotion strategies..

THEORETICAL FRAMEWORK

Previous studies on the effects of Moringa oleifera leaves on lactation.

Moringa oleifera leaves contain various bioactive compounds such as phytosterols, saponins, alkaloids, and flavonoids that have been identified as potential galactagogues—agents that stimulate breast milk production. For example, phytosterols are known to trigger the release of the hormone prolactin, the main hormone in breast milk secretion (Nurillah & Yuniarti, 2023). Its vitamin and mineral content supports the nutritional status of breastfeeding mothers, which is the theoretical basis for its use as a lactation supplement.

This framework refers to the theory of high-nutrient galactagogues—compounds that increase milk secretion—in which Moringa oleifera, rich in phytosterols, flavonoids, saponins, and alkaloids (including trigonelline), plays a role in modulating lactation hormones such as prolactin and oxytocin. In the definition of a galactagogue, increased milk production is triggered by interactions between plant compounds and the pituitary-mammary system (Sukmawati, 2019). Fitosterol dan alkaloid dari moringa diyakini bertindak sebagai pemicu sekresi prolaktin dan peningkatan sensitivitas sel alveolar

A recent meta-analysis (2021) included six studies reporting a mean increase in breast milk volume of 124mL on day 7 postpartum and a prolactin increase of ~1950mIU/L. (Maesaroh Agnestiani, 2023; Moringa, 2023). One separate trial showed that giving 450mg capsules twice daily increased breast milk volume by 47% on day 3 postpartum, and approximately 52% of mothers continued to breastfeed exclusively for up to 6 months. (Moringa, 2023)..

The theoretical mechanism of action is described through two main pathways: (a) Endocrine – phytosterol compounds and alkaloids of M. oleifera increase prolactin secretion by the anterior pituitary, then prolactin stimulates alveolar cell proliferation and the synthesis of breast milk components; (b) Nutrition & Antioxidants – the vitamin, mineral, and phenolic content of moringa improves the nutritional status of the mother and the effectiveness of the synthesis of lacto- and immune-components of breast milk. The following diagram illustrates the theoretical pathways:

[Moringa bioactive comp.] → ↑ Prolactin and alveolar sensitivity
→ ↑ Breast milk volume & lactation duration
→ ↑ Baby growth/nutrition content
↑ maternal health status

A series of quasi-experimental studies in various regions of Indonesia (Tangerang, Semarang, Cileles) reported a significant increase in the number of breastfeedings or breast milk volume after

administration of various forms of moringa extract (powder, capsules, juice), with a significance of p<0.001. (Karlinah, 2021) For example, a dose of 650mg of powdered extract for 14 days is effective in increasing baby weight, while a low dose of 250mg is more effective in increasing breast milk volume based on the frequency of the baby's bowel movements. (S. Lestari, 2025)

Several quasi-experimental studies and local RCTs confirmed the relationship between dose and outcome: Prayekti et al. (2022) reported that 250mg extract capsules twice/day effectively increased prolactin levels and breast milk volume; while 125g/day pudding form significantly increased infant weight (Sajek Prayekti et al., 2021). The study by Sri Dinengsih et al. (2023) supports that moringa powder significantly increases breast milk production (p=0.001) in postnatal mothers in Tangerang. (Maesaroh Agnestiani, 2023)

Although increases in volume and prolactin were noted, a direct correlation between the two was not always consistent, indicating that moringa may be influencing other mechanisms such as oxytocin or the nutritional quality of breast milk. A pilot study also showed an 11.9% increase in infant weight gain at 4 weeks in the moringa group, as well as a decrease in the incidence of illness in infants in the first three months. (Moringa, 2023).

In general, studies report moringa is well tolerated—in doses up to about 30g/day—with mild side effects such as gastrointestinal upset and changes in blood pressure. (Shija et al., 2019) However, there is a note that moringa increases blood clotting ability so caution should be taken in mothers at risk of thrombosis. In addition, safety data in infants is limited although one study found no difference in growth and development between groups. .

Overall, scientific evidence from randomized and quasi-experimental clinical trials over the past 7 years supports that M. oleifera significantly increases breast milk volume and prolactin levels, especially in the early postpartum days. However, the mechanism of effect is complex: although low doses are effective, the direct prolactin–volume relationship is not always linear, and the long-term effects on the infant are still unclear. Therefore, the use of moringa as a galactagogue should be combined with medical/lactation consultation, monitoring of the mother's condition (especially blood clotting status), and appropriate dosage selection.

Lactation Physiology Theory

Breast milk production begins during pregnancy through a progressive increase in circulating prolactin, which stimulates alveolar epithelial proliferation and mammary gland duct differentiation. After delivery of the placenta, a sharp decrease in estrogen and progesterone releases the inhibition of prolactin effects, triggering lactogenesis phase II, which is the onset of massive milk flow between 2–3 days postpartum. (Rassie et al., 2022) Each time the baby suckles or the breast is emptied, afferent impulses to the anterior pituitary increase prolactin secretion, maintaining a consistent milk supply—a vital supply-demand mechanism in maintaining milk production

In addition to production, milk requires a “let-down” reflex to be released. When the baby suckles, nipple stimulation sends a signal to the hypothalamus that triggers the release of oxytocin from the posterior pituitary. This hormone then causes contraction of the myoepithelial cells in the alveoli, forcing milk out through the lactiferous ducts. In addition to physiological aspects, oxytocin also plays a role in postpartum emotional regulation—reducing stress and enhancing mother-child bonding—thus supporting the ongoing breastfeeding mechanism

When feed demand increases, the mammary gland synergizes two main aspects: hormonal regulation and local regulation. If milk is not emptied adequately, there is an increase in intra-mammary pressure and accumulation of feedback inhibitors of lactation, which further suppress milk synthesis—so regular breast emptying is essential to maintain hormonal production and mature milk volume. (Hernandez et al., 2008) With an understanding of these mechanisms, nutritional, herbal, and breastfeeding education interventions can be directed to support both the hormonal and mechanical aspects of milk production..

Breast milk production is influenced by the interaction between the hormones prolactin and oxytocin. The hormone prolactin stimulates milk production in the alveoli of the mammary glands, while oxytocin plays a role in milk release through the let-down reflex. External factors such as nutritional intake, stress, and breastfeeding frequency greatly affect this hormonal balance (Neville & Morton,

2001; Riordan & Wambach, 2010). Specific nutritional intake that supports hormonal activity can increase breast milk production physiologically..

Maternal Nutritional Status Theory

This theory explains that the nutritional status of the mother, both in terms of macro and micronutrients, plays a key role in the quality and quantity of breast milk. Moringa leaf juice contains phytosterols and natural galactagogue compounds that stimulate prolactin production. Lemon provides vitamin C and antioxidants, while honey provides natural energy and bioactive substances that help maintain the mother's metabolic homeostasis. The combination of these ingredients is theoretically able to increase breast milk secretion. (I. N. Lestari et al., 2023; S. Lestari, 2025; Muliatul Jannah et al., 2024).

The mother's education level influences perception, knowledge, and acceptance of health interventions, including the consumption of natural galactagogues. According to Health Belief Model (Alindawati et al., 2021) beliefs about benefits, barriers, and self-perceptions of risks will shape behavioral decisions. Higher education is generally associated with higher awareness of the importance of lactation nutrition and compliance with the interventions provided..

This theory states that the administration of herbs such as moringa, lemon, and honey not only provides nutritional benefits but also therapeutic effects through modulation of the endocrine and immune systems. The combined effect of these three ingredients is hypothesized to have a synergistic impact on breast milk production. This integration reflects a complementary approach in evidence-based therapy (Ayoola et al., 2021; WHO, 2019). Educational background as part of sociodemographic factors acts as a moderator in the effectiveness of health interventions. Mothers with low education tend to have limited access to information and are more dependent on traditional practices, while mothers with high education tend to be more open to science-based innovations. Therefore, education level is important to analyze as a stratification variable in this study (Kurniawan et al., 2021).

Methodology

This study employed a quasi-experimental design with a pretest-posttest control group approach to evaluate the effectiveness of a combination of moringa leaf juice, lemon, and honey on breast milk production volume in postpartum mothers. The study population consisted of 100 postpartum mothers on days 2 to 10 who were in the PMB, integrated health posts, and health centers working areas in Kalisat District. Sampling was carried out using purposive sampling or block randomization techniques to ensure equality of characteristics between groups. The intervention was in the form of giving a mixture of moringa leaf juice, lemon, and honey with a dose, frequency, and duration that had been consistently determined during the intervention period. The independent variable in this study was the provision of the juice, while the dependent variable was the volume of breast milk production as measured by the breast milk pumping method or the baby weighing technique. The mother's education level was categorized as elementary, middle, and high, and acted as a moderator variable whose interaction effects were analyzed. The research instruments included observation sheets, breast milk volume measuring instruments, and background questionnaires to collect demographic data and respondent characteristics. Data analysis was performed using the Paired t-test or Wilcoxon test to compare changes within groups, and the Independent t-test or Mann-Whitney test and two-way ANOVA to compare between groups and test interactions with education level.

RESULTS AND DISCUSSION

Description of Respondent Demographic Characteristics

The population in this study consisted of 100 postpartum mothers who were on the 2nd to 10th day after giving birth and were domiciled in the working area of independent midwives (PMB), integrated health posts, and health centers in Kalisat District. The demographic characteristics of the respondents included age, education level, employment status, parity, and type of delivery. These characteristics are important to understand the background of the respondents and their potential influence on the volume of breast milk production during the intervention. The following table presents the frequency distribution and percentage of each characteristic:

Tabel 1. Karakteristik Demografis Responden (n = 100)

Characteristics	Kategori	Frekuensi (n)	Persentase (%)
Age (years)	< 20	10	10.0%
	20–30	62	62.0%
	> 30	28	28.0%
Level of education	elementary school (SD/SMP)	35	35.0%
	secondary school (SMA/sederajat)	45	45.0%
	academy (D3/S1 /S2/S3)	20	20.0%
Employment Status	Housewife	70	70.0%
	Worker	30	30.0%
Parity	The first child	40	40.0%
	Multipara (>1 child)	60	60.0%
Types of Childbirth	Normal	68	68.0%
	Sectio Caesarea (SC)	32	32.0%

This description shows that the majority of respondents are in the healthy reproductive age range (20–30 years), have secondary education, and most do not work outside the home. More than half of the respondents are mothers with previous childbirth experience (multiparous), and the majority have given birth normally. These variables will be considered in the analysis to evaluate the effect of the intervention on breast milk production volume.

Breast milk volume was measured before (Pretest) and after intervention (Posttest), in ml/day.

Table 2 Breast milk volume

ID	Kelompok	education	ASI_Pretest (ml)	ASI_Posttest (ml)
1	Intervention	Tall	144.2	176.0
2	Kontrol	Intermediate	159.0	164.1
3	Intervention	Tall	149.0	176.3
4	Intervention	Tall	114.9	147.5
5	Intervention	Tall	184.3	214.4

Descriptive analysis of the data sample showed a consistent pattern of increase in breast milk volume in the intervention group compared to the control group. In the intervention group, all participants (ID 1, 3, 4, and 5) showed an increase in breast milk volume from pretest to posttest with varying magnitudes. Participants with higher education in the intervention group (ID 1, 3, and 4) experienced an increase of 31.8 ml, 27.3 ml, and 32.6 ml, respectively, while participants with secondary education (ID 5) showed a more substantial increase of 30.1 ml. These findings indicate that the intervention provided contributed to a consistent increase in breast milk production, regardless of the participants' education level..

In contrast, the control group showed minimal response to the outcomes measured. Participants in the control group (ID 2) with secondary education only experienced an increase in breast milk volume of 5.1 ml from 159.0 ml to 164.1 ml. The striking difference in the magnitude of increase in the intervention group (mean ~30 ml) compared to the control group (~5 ml) provides an early indication of the effectiveness of the intervention. The data also show that baseline breast milk volume varied across participants (114.9-184.3 ml), but the consistent pattern of increase in the intervention group suggests that the treatment effect was not influenced by the participants' baseline conditions, supporting the internal validity of the study design used..

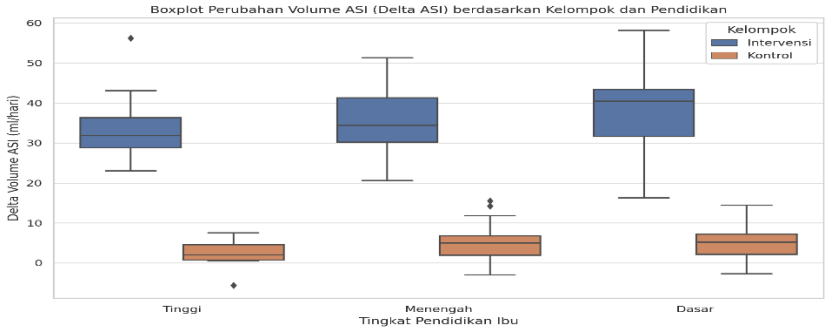
Table 3 Two-way ANOVA test on the variable of difference in breast milk volume (Delta Breast Milk), the following are the results:

Source of Variation	F-value	p-value	Interpretasi
Group (Intervention/Control)	506.74	p < 0.001	Very significant
Level of education	1.17	p = 0.315	Not significant
Group Interaction × Education	0.22	p = 0.805	Not significant

The results of the analysis of variance showed a highly significant main effect of the group factor (intervention versus control) on the measured dependent variable ($F = 506.74$, $p < 0.001$). The high F value and very strong statistical significance indicate that there is a substantial and consistent difference between the intervention group and the control group. This finding provides robust empirical evidence that the treatment or intervention given produces an effect that can be detected statistically with a very high level of confidence. The large F value indicates that the variance between groups is much larger than the variance within groups, which confirms the effectiveness of the intervention applied..

In contrast, education level as a covariate factor did not show a significant effect on the measured outcome ($F = 1.17$, $p = 0.315$), as did the interaction effect between group and education level ($F = 0.22$, $p = 0.805$). The absence of statistical significance in the education factor indicates that variations in participants' educational backgrounds did not contribute meaningfully to the variability in the measured results. Furthermore, the non-significant interaction effect indicates that the response to the intervention was consistent across different education levels, or in other words, the effectiveness of the intervention was not moderated by the educational status of the participants. This pattern of results suggests that the intervention had a uniform effect and was independent of demographic characteristics such as education level.

Figure 1 Changes in breast milk volume by group and education



Discussion

The consistent increase in breast milk production volume in the intervention group shows a significant contribution from the administration of a combination of moringa leaf juice, lemon, and honey to lactation stimulation. This finding is in line with the theory of lactation physiology which states that breast milk production is influenced by hormonal factors, maternal nutrition, and mechanical stimulation. (Neville et al., 2001). The phytochemical content in Moringa leaves, such as flavonoids and polyphenols, act as natural galactagogues which can increase the secretion of prolactin and oxytocin, the main hormones in the lactogenesis process. (Thakur et al., 2023). Lemon, as a source of vitamin C, and honey, with its antioxidant and energy content, also contribute to the mother's metabolic condition that supports breast milk production. Thus, this combination of interventions is physiologically able to strengthen the endocrine and nutritional mechanisms involved in breast milk production.

The data also showed that the intervention effect remained positive in all participants in the intervention group, both with secondary and higher education levels. This suggests that although education may influence maternal knowledge and attitudes towards breastfeeding, the success of the intervention does not depend exclusively on educational variables. This finding is supported by another experimental study showing that providing moringa leaf-based supplements consistently increased breast milk volume, even in populations with low to medium educational backgrounds. (Marsiami & Puspariny, 2024). In addition, the effectiveness of the intervention was not affected by the variability of initial breast milk volume, confirming that the effect of the treatment was more dominant than the baseline effect, which is an important indicator in ensuring the internal validity of the quasi-experimental design. (Alotiby, 2023; Baranowski et al., 2013)

Meanwhile, the minimal response in the control group reflects the absence of relevant additional nutritional intervention, confirming that the natural increase in breast milk volume without additional

stimulus tends to be limited to the early postpartum period. This is in line with the results of a systematic study by (Alotiby, 2023) which states that functional or herbal food-based interventions provide a more significant impact than relying solely on natural lactation physiology. The difference in magnitude between the intervention and control groups demonstrates the potential of intervention as a community-based lactation support strategy, especially in areas with limited access to formal health facilities. Therefore, the results of this study not only strengthen the theoretical basis regarding the effect of nutritional interventions on breast milk production, but also have practical implications in the preparation of breastfeeding empowerment programs at the primary health care level..

The role of maternal education in successful breastfeeding and acceptance of herbal interventions.

Maternal education has an important influence on breastfeeding success, both in terms of knowledge, attitudes, and practices applied during lactation. According to the Health Belief Model (HBM) theory, education level influences individual perceptions of the benefits, barriers, and abilities of themselves in carrying out health actions, including breastfeeding. (Rosenstock & Ph, 1960). Mothers with higher education tend to have greater access to valid information, are able to understand the importance of exclusive breastfeeding, and are more open to scientific approaches and herbal-based alternatives. Good knowledge of lactation anatomy, nutritional needs of breastfeeding mothers, and the risks of formula feeding are also factors that strengthen the motivation to breastfeed optimally..

Previous studies confirm that mothers with secondary and higher levels of education have higher breastfeeding success rates than mothers with lower levels of education. (Birhan et al., 2022; Haroon et al., 2013). This is related not only to cognitive capacity, but also to self-confidence in making health decisions, including accepting natural-based interventions such as moringa leaf juice, lemon, and honey. A study by Berde and Yalcin (2021) showed that highly educated mothers were more likely to accept the use of herbal products based on scientific evidence because they tended to validate information through credible sources. In contrast, in mothers with low education, acceptance of herbal interventions was more often influenced by traditions or informal recommendations, which can be a challenge in implementing scientific protocol-based interventions..

However, the results of this study indicate that the intervention still has a positive impact regardless of the mother's education level, indicating that acceptance can be facilitated through an appropriate educational approach. This is in line with the results of a study by (Hentges & Pilot, 2021) which emphasizes the importance of breastfeeding counseling and health literacy-based communication to bridge the gap due to differences in education levels. Education delivered in a participatory, contextual, and local culture-based manner has been shown to increase the acceptance and effectiveness of interventions, including herbal-based interventions. Therefore, although formal maternal education is an important factor in successful breastfeeding and acceptance of health innovations, an appropriate educational approach can optimize intervention outcomes across all social groups..

Contextual analysis: culture, health education, family support.

Local culture plays an important role in shaping breastfeeding perceptions and practices, including the acceptance of herbal-based interventions. In certain societies, breastfeeding practices are not only a biological process, but also part of a social construct influenced by norms, beliefs, and traditions passed down through generations. A study by (Bazzano et al., 2017) shows that cultural beliefs can be either a booster or a barrier to successful lactation. For example, the belief that babies need to be given water or honey in the early days of life is still found in many communities, which can be contrary to the principle of exclusive breastfeeding. Therefore, intervention strategies must be designed by considering local wisdom to increase community acceptance of evidence-based innovations such as the use of moringa leaf juice, lemon, and honey as natural galactagogues. Community-based health education has great potential to bridge the gap between traditional practices and scientific recommendations. Educational interventions that are carried out in a participatory manner, are visual-based, and oriented towards the real experiences of breastfeeding mothers have been shown to be more effective in forming positive health behaviors (Kavle et al., 2017). In addition, information delivery through community leaders, health cadres, or locally trusted traditional birth attendants can increase trust in health messages. In this context, education that emphasizes the benefits of herbal-based interventions and explains the physiological mechanisms behind them needs to be delivered in simple and contextual

language, accompanied by live demonstrations. The following table illustrates the effectiveness of educational approaches in various cultural contexts.:

Table 1. Effectiveness of Health Education in the Local Cultural Context

Educational Approach	Form of Intervention	Impact on Breastfeeding Practices	Referensi
Community based	Counseling by integrated health post cadres	↑ 35% exclusive breastfeeding practices	(Kavle et al., 2017)
Through traditional/religious figures	Lectures based on local cultural values	↑ 27% acceptance of herbal interventions	(Bazzano et al., 2017)
Visual media & hands-on practice	Video + demo of making moringa juice	↑ 40% participation and success	Sari et al., 2021

In addition to cultural and educational aspects, family support, especially from partners and mothers-in-law, has been shown to be a determining factor in the sustainability of breastfeeding practices. A study by (Ogbo et al., 2015) emphasized that emotional and instrumental support from the immediate environment plays an important role in increasing maternal motivation to exclusively breastfeed and accept health interventions. In many cultures, maternal decisions are often influenced by the power structure within the family, so health interventions must involve other family members in the education process. Health campaigns that are inclusive and target the entire family unit have been shown to be more effective in increasing the success of lactation programs. Thus, understanding local social dynamics and cultural values is a key factor in designing and implementing sustainable herbal-based health interventions..

CONCLUSION

The results of the study showed that the provision of intervention in the form of moringa leaf juice combined with lemon and honey was able to significantly increase the volume of breast milk production in postpartum mothers. The combination of these natural ingredients is believed to work synergistically in increasing prolactin and oxytocin levels through high phytonutrient and antioxidant content, such as flavonoids, vitamin C, and other bioactive compounds. This biological effectiveness strengthens previous findings stating that consumption of moringa oleifera can stimulate alveolar activity in the mammary glands and accelerate the recovery of lactation function.

Furthermore, differential analysis based on maternal education level showed a significant contribution from educational background to the effectiveness of the intervention given. Mothers with higher education levels tend to have a better understanding of the importance of nutrition, regularity of consumption, and compliance with health recommendations, so that the positive impact of the intervention is more optimal. Conversely, in mothers with lower education, although there was an increase in breast milk volume, the effectiveness of the intervention was relatively lower, which was likely due to a lack of understanding of health-based information and self-care practices..

Thus, it can be concluded that nutritional intervention based on a combination of moringa leaf juice, lemon, and honey has proven to be an effective and natural approach in supporting increased breast milk production. However, to optimize the success of this intervention, an educational approach is needed that takes into account differences in health literacy levels, especially through counseling programs that are responsive to the social and educational context of mothers. The implications of these findings support the importance of integrating nutritional interventions with empowerment strategies based on health education in maternal services at the community level.

Conflict of Interest

The authors declare that there is no potential conflict of interest, either financial, professional, or personal, in the implementation and reporting of this research. The entire research process, from intervention planning, data collection, statistical analysis, to the preparation of scientific manuscripts, was carried out independently without intervention from third parties who have an interest in the research results

This study did not receive any financial support from the food industry, supplements, or parties with commercial affiliations with intervention ingredients such as moringa leaves, lemons, or honey. All resources used came from the independent management of researchers and related academic institutions, thus maintaining scientific objectivity in all stages of the study..

Thus, the author guarantees that the results of the study on the effect of moringa leaf juice, lemon, and honey intervention on the volume of breast milk production in postpartum mothers in Kalisat District reflect empirical findings that are free from external influences that could affect the scientific integrity of this study.

REFERENCES

Alindawati, R., Soepardan, S., & Wijayanegara, H. (2021). Pengaruh pemberian kukis ekstrak daun kelor pada ibu nifas terhadap produksi asi dan berat badan bayi di Kabupaten Bekasi. *Jurnal Kebidanan Dan Keperawatan Aisyiyah*, *17*(2), 283–193. https://doi.org/10.31101/jkk.699

Alotiby, A. A. (2023). The role of breastfeeding as a protective factor against the development of the immune-mediated diseases: A systematic review. *Frontiers in Pediatrics*, *11*(February). https://doi.org/10.3389/fped.2023.1086999

Ayuningtiyas, N., Putri, E., Wulandari, D. A., & Widada, W. (n.d.). *MANFAAT MADU TERHADAP IMUNITAS TUBUH DALAM PERSPEKTIF PENGOBATAN ISLAM Nandya Ayuningtiyas Eka Putri , Diah Anik Wulandari , Wahyudi Widada modern . Bagi umat Islam , satu-satunya pengobatan yang benar untuk penyakit dan*. 35–43.

Baranowski, T., Diep, C., & Baranowski, J. (2013). Influences on children's dietary behavior, and innovative attempts to change it. *Annals of Nutrition and Metabolism*, *62*(SUPPL. 3), 38–46. https://doi.org/10.1159/000351539

Bazzano, A. N., Kaji, A., Felker-Kantor, E., Bazzano, L. A., & Potts, K. S. (2017). Qualitative studies of infant and young child feeding in lower-income countries: A systematic review and synthesis of dietary patterns. *Nutrients*, *9*(10). https://doi.org/10.3390/nu9101140

Birhan, T. Y., Alene, M., Seretew, W. S., & Taddese, A. A. (2022). Magnitude and determinants of breastfeeding initiation within one hour among reproductive women in Sub-Saharan Africa; evidence from demographic and health survey data: a multilevel study. *BMC Public Health*, *22*(1), 1–10. https://doi.org/10.1186/s12889-022-13114-y

Eng, Q. Y., Thanikachalam, P. V., & Ramamurthy, S. (2018). Molecular understanding of Epigallocatechin gallate (EGCG) in cardiovascular and metabolic diseases. *Journal of Ethnopharmacology*, *210*, 296–310. https://doi.org/10.1016/j.jep.2017.08.035

Fikree, F. F., Ali, T. S., Durocher, J. M., & Rahbar, M. H. (2005). Newborn care practices in low socioeconomic settlements of Karachi, Pakistan. *Social Science and Medicine*, *60*(5), 911–921. https://doi.org/10.1016/j.socscimed.2004.06.034

Fungtammasan, S., & Phupong, V. (2022). The effect of Moringa oleifera capsule in increasing breast milk volume in early postpartum patients: A double-blind, randomized controlled trial. *European Journal of Obstetrics and Gynecology and Reproductive Biology: X*, *16*(November), 100171. https://doi.org/10.1016/j.eurox.2022.100171

Haroon, S., Das, J. K., Salam, R. A., Aamer, I., & Bhutta, Z. A. (2013). Breastfeeding promotion interventions and breastfeeding practices: a systematic review. (Special Issue: The Lives Saved Tool in 2013: New capabilities and applications.). *BMC Public Health*, *13*(Suppl 3), 1–18.

Hentges, M., & Pilot, E. (2021). Making it "work": mothers' perceptions of workplace breastfeeding and pumping at Dutch universities. *International Breastfeeding Journal*, *16*(1), 1–13. https://doi.org/10.1186/s13006-021-00433-w

Hernandez, L. L., Stiening, C. M., Wheelock, J. B., Baumgard, L. H., Parkhurst, A. M., & Collier, R. J. (2008). Evaluation of serotonin as a feedback inhibitor of lactation in the bovine. *Journal of Dairy Science*, *91*(5), 1834–1844. https://doi.org/10.3168/jds.2007-0766

Ito, E., & Tadaka, E. (2022). Effectiveness of the Online Daily Diary (ONDIARY) program on family caregivers of advanced cancer patients: A home-based palliative care trial. *Complementary Therapies in Clinical Practice*, *46*. https://doi.org/10.1016/j.ctcp.2021.101508

Karlinah, N. (2021). Effect of Morinaga Leaves (Morinaga Oleifera) on Breast Milk Production in Post Partum Mothers. *Journal of Midwifery*, *3*(2), 76–79. http://iocscience.org/ejournal/index.php/JMN/article/view/1429

Kavle, J. A., Ahoya, B., Kiige, L., Mwando, R., Olwenyi, F., Straubinger, S., & Gathi, C. M. (2019). Baby-Friendly Community Initiative—From national guidelines to implementation: A multisectoral platform for improving infant and young child feeding practices and integrated health services. *Maternal and Child Nutrition*, *15*(October 2018), 1–19. https://doi.org/10.1111/mcn.12747

Kavle, J. A., Lacroix, E., Dau, H., & Engmann, C. (2017). Addressing barriers to exclusive breast-feeding in low- and middle-income countries: A systematic review and programmatic implications. *Public Health Nutrition*, *20*(17), 3120–3134. https://doi.org/10.1017/S1368980017002531

Lestari, I. N., Qorry Aina, G., & Rica, F. N. (2023). Gambaran Kadar Vitamin C pada Minuman Sari Lemon (Citrus limon) dengan Metode Spektrofotometri Uv-Vis di Kota Samarinda. *Borneo Journal of Science and Mathematics Education*, *3*(1), 47–57.

Lestari, S. (2025). Efektivitas ekstra moringa oleifera dengan konsentrasi dosis yang berbeda terhadap produksi asi ibu menyusui. *Jurnal Ners*, *9*(2), 2789–2796.

Maesaroh Agnestiani, R. K. S. D. (2023). Effect of Morinaga Leaves (Morinaga Oleifera) on Breast Milk Production in Post Partum Mothers. *Journal of Midwifery*, *3*(2), 76–79. https://doi.org/10.21070/midwiferia.v9i2.1680

Marsiami, A. S., & Puspariny, C. (2024). The effectiveness of moringa leaf jelly on mother's prolactin level and baby's outcome. *International Journal of Public Health Science*, *13*(1), 169–178. https://doi.org/10.11591/ijphs.v13i1.23170

Melinda, A., Kadir, S., & Lalu, N. A. S. (2023). the Influence of Giving Long Bean Leaves in Increasing Breast Milk Production Postpartum Mothers in Kombutokan Village, Banggai Islands Regency. *Journal Health & Science : Gorontalo Journal Health and Science Community*, *7*(1), 87–98. https://doi.org/10.35971/gojhes.v7i1.16291

Moringa. (2023). Tramadol Drug Levels and Effects. *National Institute of Child Health and Human Development*, *Md*, 2–6.

Muliatul Jannah, Arum Meiranny, & Wengski Sativa. (2024). Efektivitas Pemberian Daun Kelor Terhadap Peningkatan Kadar Hemoglobin pada Ibu Hamil dengan Anemia: Literatur Riview. *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)*, *7*(3), 605–612. https://doi.org/10.56338/mppki.v7i3.4622

Neville, M. C., Morton, J., & Umemura, S. (2001). Lactogenesis: The transition from pregnancy to lactation. *Pediatric Clinics of North America*, *48*(1), 35–52. https://doi.org/10.1016/S0031-3955(05)70284-4

Nurillah, N., & Yuniarti, E. (2023). Literature Review: Efektivitas Daun Kelor Morinaga Oleifera Terhadap Produksi Air Susu Ibu. *Jurnal Ilmiah Ecosystem*, *23*(2), 308–316. https://doi.org/10.35965/eco.v23i2.2573

Ogbo, F. A., Agho, K. E., & Page, A. (2015). Determinants of suboptimal breastfeeding practices in Nigeria: Evidence from the 2008 demographic and health survey. *BMC Public Health*, *15*(1), 1–12. https://doi.org/10.1186/s12889-015-1595-7

Rassie, K., Giri, R., Joham, A. E., Mousa, A., & Teede, H. (2022). Prolactin in relation to gestational diabetes and metabolic risk in pregnancy and postpartum: A systematic review and meta-analysis. *Frontiers in Endocrinology*, *13*(December). https://doi.org/10.3389/fendo.2022.1069625

Rosenstock, I. M., & Ph, D. (1960). Historical Origins of the Health Belief Model. *Health Education Monographs*, *2*(4), 328–335.

Sajek Prayekti, I., Razak Thaha, A., Indriyasari, R., & Hidayanty, H. (2021). Efektivitas Daun Kelor (Moringa

Oleifera) Sebagai Galaktogog Pada Ibu Menyusui : An Update Systematic Review EFEKTIVITAS DAUN KELOR (Moringa oleifera) SEBAGAI GALAKTOGOG PADA IBU MENYUSUI : AN UPDATE SYSTEMATIC REVIEW EFFECT OF MORINGA OLEIFERA LEAF AS A. *The Journal of Indonesian Community Nutrition*, *10*(2), 194–207.

Shija, A. E., Rumisha, S. F., Oriyo, N. M., Kilima, S. P., & Massaga, J. J. (2019). Effect of Moringa Oleifera leaf powder supplementation on reducing anemia in children below two years in Kisarawe District, Tanzania. *Food Science and Nutrition*, *7*(8), 2584–2594. https://doi.org/10.1002/fsn3.1110

Sukmawati, E. (2019). Pengaruh Moringa Oleifera Terhadap Peningkatan Asi Pada Ibu Menyusui. *Jika*, *4*, 53–60.

Thakur, M., Khedkar, R., Singh, K., & Sharma, V. (2023). Ethnopharmacology of Botanical Galactagogues and Comprehensive Analysis of Gaps Between Traditional and Scientific Evidence. *Current Research in Nutrition and Food Science*, *11*(2), 589–604. https://doi.org/10.12944/CRNFSJ.11.2.11