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Original Research

Effectiveness of soybean extract on breast milk production adequacy among postpartum mothers

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ABSTRACT

Background: Exclusive breastfeeding remains a global public health priority, yet its coverage in Indonesia has declined in recent years. In Central Kalimantan, the prevalence of exclusive breastfeeding was only 55.78% in 2023, with some districts reporting even lower rates. One of the major barriers is inadequate breast milk production, which is often influenced by maternal physiology, psychological well-being, and nutritional status. Soybean extract, rich in isoflavones, proteins, and bioactive compounds, has been suggested as a natural galactagogue that stimulates prolactin and oxytocin release, thereby enhancing lactation.

Objective: This study aimed to evaluate the effectiveness of soybean extract in improving breast milk adequacy among postpartum mothers.

Method: A pre-experimental one-group pretest–posttest design was applied, involving 15 postpartum mothers (7–14 days after delivery) recruited through purposive sampling in the working area of Tumbang Talaken Health Center, Central Kalimantan. Participants consumed 220 ml of standardized soybean extract twice daily for seven consecutive days. Breast milk adequacy was assessed using a structured dichotomous questionnaire covering maternal (breast engorgement, milk leakage) and infant indicators (urination frequency, weight gain, sleep duration). Data were analyzed using McNemar's test, with a significance level of $p < 0.05$.

Result: Prior to the intervention, only 4 mothers (26.7%) reported adequate milk production, while 11 (73.3%) experienced insufficiency. After seven days of soybean extract consumption, 13 mothers (86.7%) achieved adequate production, and only 2 (13.3%) remained insufficient. McNemar's test confirmed a statistically significant improvement ($p = 0.004$).

Conclusion: Soybean extract significantly improved breast milk adequacy among postpartum mothers. As an affordable, accessible, and culturally acceptable intervention, soybean extract shows promise as a nutritional strategy to address lactation challenges and support national goals for improving exclusive breastfeeding coverage.

1. Introduction

Breast milk is universally recognized as the optimal source of nutrition for infants during the first six months, offering a balanced nutrient composition and immune protection. As a species-specific form of nourishment, it is uniquely adapted to meet infants' biological and developmental needs (Nuzzi et al., 2021). This is supported by numerous studies

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demonstrating that breast milk contains all essential macronutrients (fats, proteins, carbohydrates) and micronutrients (vitamins, minerals) in concentrations that support infant growth and development (Kent et al., 2013). Breast milk also contains immunoglobulins, particularly Secretory Immunoglobulin A (SIgA), which provides the first line of defense against intestinal antigens. In addition, it includes bioactive molecules such as enzymes, cytokines, and lactoferrin, which protect against infections and contribute to immune system maturation (Harmancıoğlu & Kabaran, 2019; Palmeira & Carneiro-Sampaio, 2016).

The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life, followed by continued breastfeeding with appropriate complementary foods up to two years of age or beyond (Bilgen et al., 2018; Meek & Noble, 2022). In Indonesia, exclusive breastfeeding coverage has shown a gradual decline, from 69.7% in 2021 to 67.96% in 2023 (Hidayati et al., 2024; Madur et al., 2024). This downward trend underscores the urgent need for effective interventions to improve breastfeeding practices and sustain maternal commitment to exclusive breastfeeding.

Low breast milk production among nursing mothers is a multifactorial issue influenced by physiological, psychological, and nutritional factors. Nipple pain is a common problem, with incidence rates reaching up to 90%, often leading to early breastfeeding cessation. This is frequently caused by improper breastfeeding techniques that result in mechanical stress on the nipple–areolar complex (Douglas, 2022; Heller et al., 2012). Reports indicate that 79.3% of mothers experience nipple trauma, 55–68% develop fever and breast engorgement, 38–63% face lactation insufficiency, and 35% suffer from mastitis (Aini & Vidayati, 2019; Amaliah et al., 2023; Nisa, 2023; Rahayu et al., 2022; Sutarno, 2018; Tifanni et al., 2024). These conditions not only affect maternal health but also threaten the continuation of exclusive breastfeeding.

In Central Kalimantan, exclusive breastfeeding coverage in 2023 reached only 55.78%, while in Gunung Mas District it was even lower at 53.84% (BPS, 2024; Kemenkes, 2023). Data from Puskesmas Tumbang Talaken (a community health center) indicated a further decline from 53.73% in 2022 to 48.84% in 2023, underscoring the urgent need for effective interventions to improve breast milk production. This effort is particularly critical since perceived insufficient milk supply is a common reason for early breastfeeding discontinuation, which may negatively impact infant health outcomes.

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One potential approach to enhance breast milk production is through the consumption of foods rich in galactagogues, such as soybeans. Herbal galactagogues have been shown to stimulate prolactin and oxytocin, the key hormones regulating milk production and secretion (Hanifa et al., 2021). Soybeans contain 35–43% protein, isoflavones, alkaloids, polyphenols, and steroids, all of which are known to stimulate prolactin and oxytocin release—two essential hormones in lactation (Devina et al., 2024; Ida & de Camargo, 2022; Maria Stefanie Dwiyanti, 2020; Modgil et al., 2021; Mostrom & Evans, 2011). Previous studies have demonstrated the effectiveness of soybean extract in increasing breast milk volume among postpartum mothers (Devina et al., 2024; Husna & Sihombing, 2024; Juliani et al., 2023; Rauda & Harahap, 2023). However, most research has been limited to specific communities, raising questions about its generalizability across different populations.

A preliminary study conducted in the Puskesmas Tumbang Talaken in April 2024 revealed that among 13 interviewed postpartum mothers, 9 reported inadequate milk production as the primary reason for not practicing exclusive breastfeeding. This highlights the urgent need for evidence-based, practical, and affordable interventions. Soybean extract was selected as the intervention due to its wide availability, affordability, and ease of preparation and consumption. This study therefore aimed to analyze the effectiveness of soybean extract on breast milk production adequacy among postpartum mothers in the Puskesmas Tumbang Talaken service area.

2. Method

Research Design

This study employed a pre-experimental design using a one-group pretest–posttest model. This design was chosen for reasons of feasibility and ethics, as establishing a control group in a community health setting was not practically possible. In this design, observations were conducted on the same group of participants before (pretest) and after (posttest) receiving the soybean extract intervention.

Participants

The target population included all postpartum mothers (day 7–14 after delivery) in the working area of Tumbang Talaken Community Health Center during the period of March–April 2024 (N = 58). Samples were recruited using purposive sampling according to the following inclusion criteria: (a) postpartum mothers within 7–14 days; (b) absence of delivery

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complications or health conditions limiting breastfeeding; (c) willingness to participate indicated by signing informed consent; and (d) exclusive breastfeeding without providing formula milk. Based on these criteria, 15 participants were successfully recruited and were able to complete the study.

Data Collection

The intervention consisted of soybean extract administration at a dosage of 220 ml, consumed twice daily (morning and afternoon) for seven consecutive days. The soybean extract was prepared in a standardized manner according to the study's: 300 g of soybeans were soaked for 2 hours, boiled with 1000 ml of water, 2 pandan leaves, and 100 ml of liquid sugar until softened, then blended and filtered to obtain the extract. Compliance with the intervention was monitored by the researchers. Data on breast milk production adequacy were collected using a structured dichotomous (yes/no) questionnaire with five indicators covering maternal aspects (breast engorgement, milk leakage) and infant aspects (weight gain, urination frequency, sleep duration after breastfeeding). Breast milk adequacy was categorized as "Adequate" (≥4 "Yes" responses out of 5) or "Inadequate" (>1 "No" response). This dichotomous categorization was employed to provide a clear, simple, and practical measure for assessing the change in status (adequate/inadequate) from baseline to post-intervention within the research setting. The questionnaire was administered twice: at baseline (pretest) and after 7 days of intervention (posttest).

Data Analysis

Data were analyzed using IBM SPSS Statistics version 26. Statistical analysis was conducted in two stages. First, descriptive analysis was applied to describe participants' characteristics and to present the frequency distribution of the outcome variable, breast milk adequacy, at both baseline and post-intervention. Results were presented in frequency and percentage tables. Second, inferential analysis was used to test the study hypothesis and evaluate the effectiveness of the intervention. Given the dichotomous outcome scale (Adequate/Inadequate) and the paired measurements from the same participants, McNemar's test was selected as the most appropriate method. This test determined whether there was a statistically significant change in the proportion of adequate breastfeeding before and after soybean extract administration. The level of statistical significance (α) was set at $p < 0.05$.

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Ethical Consideration

This study received ethical approval from the Research Ethics Committee of Universitas Sari Mulia (No. 302/KEP-UNISM/VI/2024, dated June 27, 2024). All participants signed informed consent after being informed of the study objectives, procedures, and benefits. Data confidentiality was strictly maintained by omitting personal identifiers in reporting. The principles of beneficence and justice were upheld to ensure that participants received potential benefits from the study and that fairness was maintained in recruitment.

3. Result

The initial measurements indicated that most postpartum mothers experienced difficulties in breast milk production prior to the intervention, with only 4 respondents (26.7%) demonstrating adequate milk production compared to 11 respondents (73.3%) whose production was not adequate. Following the soybean extract intervention administered for seven consecutive days, a significant improvement was observed, 13 respondents (86.7%) reported adequate milk production, while only 2 respondents (13.3%) continued to experience difficulties, as presented in Table 1.

Table 1. Breast milk production adequacy before and after intervention

Breast milk adequacy	Frequncy (n)	Percentage (%)
Before intervention		
Adequate	4	26.7
Inadequate	11	73.3
Total	15	100
Setelah intervensi		
Adequate	13	86.7
Inadequate	2	13.3
Total	15	100

Based on the McNemar test results presented in Table 2, it was identified that among the 11 respondents with inadequate milk production before the intervention, 9 respondents (81.8%) improved to a adequate status following soybean extract administration, while 2 respondents (18.2%) remained in the inadequate category. All four respondents who initially had smooth milk production maintained their status after the intervention. The statistical test revealed a p-value of 0.004 ($p < 0.05$), confirming that the change in the proportion of adequate milk production after the intervention was statistically significant.

Table 2. Cross-tabulation and McNemar test results

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	After intervention		P value
	Inadequate	Adequate	
Before intervention			0.004
Inadequate	2	9	
Adequate	0	4	
Total	2	13	

4. Discussion

This study provides strong evidence of the effectiveness of soybean extract as a galactagogue in enhancing the adequacy of breast milk production among postpartum mothers. The statistically significant improvement in milk production adequacy, as demonstrated by the McNemar test ($p = 0.004$), indicates that the intervention of consuming 220 ml of soybean extract twice daily for seven days effectively shifted the majority of participants from inadequate to adequate lactation status. The nutritional benefits of soybeans, including their high protein content and essential bioactive compounds, may support maternal health, which is critical for optimal breastfeeding (Kim et al., 2021). The improvement observed in 81.8% of participants who initially experienced difficulties highlights the potential of nutritional interventions as a feasible strategy to address common and challenging barriers to exclusive breastfeeding, aligning with global public health goals to support infant nutrition and maternal well-being.

The pre-intervention data, which revealed that 73.3% of mothers experienced challenges in breast milk production, illustrates the magnitude of this problem within the studied community. This high prevalence is not unique to the study area but reflects a broader national concern, as national health data indicate that many mothers discontinue exclusive breastfeeding earlier than recommended (BPS, 2024; Kemenkes, 2023). This context underscores the importance of the present study, as it addresses a critical gap in postpartum care by testing a solution that is accessible, culturally acceptable, and affordable. The fact that inadequate milk production is the leading cause of exclusive breastfeeding cessation (Newby & Davies, 2016; Skaaning et al., 2024) highlights that this is not a minor inconvenience but a significant determinant of infant feeding practices. Therefore, effective interventions that directly target the key factors contributing to low exclusive breastfeeding coverage make this study highly relevant for both policy and practice.

The mechanisms by which soybean extract may enhance lactation can be attributed to

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its multifaceted nutritional and phytochemical profile. Soy milk is a rich source of high-quality protein, vitamins, and unsaturated fatty acids, making it an excellent nutritional supplement for lactating mothers (Ewe & Yeo, 2015; Olías et al., 2023). Soybean extract can stimulate the production of oxytocin and prolactin, the key hormones directly involved in milk secretion and ejection (Hasibuan et al., 2022; Lestiya et al., 2024). Isoflavones, which are phytoestrogens mimicking estrogenic activity, may also influence mammary gland function. Isoflavones in soy, such as genistein and daidzein, have been shown to interact with prolactin receptors, potentially enhancing prolactin signaling, which is essential for milk production (Nikkila Devi et al., 2023; Tsugami et al., 2017).

The presence of polyphenols in soy may further contribute to improved mammary gland function (Kelleher et al., 2024). Along with alkaloids, polyphenols may exert a calming effect, reducing maternal stress—an established inhibitor of the oxytocin-mediated let-down reflex. For example, polyphenols such as Epigallocatechin gallate (EGCG) from green tea have been shown to exert anxiolytic effects by enhancing GABA-A (Gamma-Aminobutyric Acid) receptor activity, similar to conventional anxiolytics like benzodiazepines (Chavan, 2024; de Lima et al., 2025; Isela García-Ríos et al., 2020; Kaur et al., 2024). These biochemical pathways suggest that soybean extract functions not only as a nutritional supplement but also as a bioactive agent that modulates the endocrine environment supporting lactation, thereby providing a plausible scientific explanation for the observed clinical outcomes.

This study reinforce and extend previous research, Abdullah et al. (2023) and Hasibuan et al. (2022) similarly reported an increase in breast milk volume following soybean extract supplementation. However, this study adds a new dimension by specifically measuring “adequacy of production,” an outcome that encompasses maternal perceptions (e.g., breast engorgement, milk leakage) and infant satisfaction (e.g., sleep duration, urination frequency). This holistic measurement goes beyond volume alone to assess the functional adequacy of breast milk production from both the maternal and infant dyadic perspective, making the findings more clinically meaningful. It confirms that an increase in quantity was accompanied by improvements in the quality and efficiency of the breastfeeding process as perceived by mothers—critical factors for maintaining maternal motivation and confidence.

The practical implications of this study are considerable for community midwives and public health nurses, particularly in resource-limited settings such as Gunung Mas District.

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The intervention is highly feasible; soybeans are inexpensive, readily available, and easy to prepare following the standardized procedure described. This makes the intervention both scalable and sustainable within community health programs such as Posyandu. Incorporating education on the preparation and benefits of soybean extract into postpartum counseling delivered by midwives and health cadres may serve as a powerful tool to empower mothers. This aligns with principles of health promotion and empowerment, enabling women to take an active role in addressing common lactation challenges through the use of local resources, thereby reducing dependence on commercial formula milk and improving infant nutritional outcomes.

Despite these promising results, the findings should be interpreted in light of the study's methodological limitations. The use of a pre-experimental one-group pretest–posttest design, while pragmatic and ethically appropriate in a community setting, inherently limits causal inference. The absence of a control group means that the observed improvements may have been influenced by confounding factors such as the natural progression of lactation over time, increased maternal confidence from study participation (Hawthorne effect), or concurrent breastfeeding support. Future research should employ randomized controlled trial (RCT) designs with control groups receiving placebo or standard care only. Such designs would more rigorously isolate and measure the specific effects of soybean extract, thereby strengthening the evidence base for its efficacy.

Another limitation concerns the measurement tool and sample size. The use of a self-reported dichotomous questionnaire may lack sensitivity and objectivity compared to direct measurement methods, such as weighing infants before and after breastfeeding to calculate precise milk output. In addition, the small sample size (n = 15), although meeting the minimum requirements for the chosen design, limits the statistical power and generalizability of the findings to broader populations. Future studies should target larger sample sizes to enhance statistical strength and representativeness. Moreover, employing a mixed-methods approach that combines quantitative measurement of breast milk volume with qualitative interviews exploring maternal perceptions and experiences would provide a more comprehensive and nuanced understanding of the intervention's impact.

Overall, this study makes a significant contribution to maternal and child health by scientifically validating a natural and traditional remedy to enhance breast milk production.

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It emphasizes the importance of integrating evidence-based nutritional strategies into postpartum care protocols. For community midwives and health cadres, the findings offer a practical, non-pharmacological option to recommend to mothers experiencing breastfeeding difficulties. For policymakers, the results highlight the potential of utilizing local food resources as effective and efficient public health interventions to address the decline in exclusive breastfeeding coverage. Ultimately, by addressing key barriers to breastfeeding, this study supports the fundamental right of every infant to receive optimal nutrition and every mother to achieve successful breastfeeding.

5. Conclusion

This study convincingly demonstrates that soybean extract significantly improves adequate breast milk production among postpartum mothers, as evidenced by the statistically significant increase in the proportion of mothers achieving adequate lactation following a seven-day intervention. These findings confirm that soybean extract, as a natural galactagogue rich in isoflavones and protein, represents an effective, affordable, and accessible nutritional intervention to overcome common barriers to exclusive breastfeeding. These findings suggest that incorporating education and support for soybean extract consumption into postpartum care and counseling may benefit midwives and community health workers. This strategy has the potential to empower mothers, improve infant nutrition, and contribute to increasing exclusive breastfeeding coverage, thereby supporting national and global public health goals for maternal and child well-being.

6. Conflict of interest

All authors declare no conflict of interest.

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