

Conference Paper

Potential Compounds of Long Bean Leave (*Vigna sinensis* L.) as a Natural Galactagogue in Breastfeeding Mothers

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ABSTRACT

Insufficient breast milk production remains a common issue among breastfeeding mothers in Indonesia, often compromising infant nutrition. Long bean leaves (*Vigna sinensis* L.) contain polyphenols and key macronutrients such as carbohydrates, proteins, fats, dietary fiber, and iron, which may serve as natural galactagogues and support maternal nutrition. This study evaluated the potential of long bean leaves as a lactation-promoting food ingredient through the development of green noodles. A quasi-experimental study with a non-randomized control group pretest–posttest design was conducted among 20 breastfeeding mothers with infants aged 0–6 months and no lactation disorders. The intervention group consumed green noodles containing 5% long bean leaf flour (100 g/serving, twice daily) for 14 days, while the control group consumed plain noodles. Proximate analysis showed that green noodles had higher iron (2.82 mg/100 g), protein (5.04%), carbohydrates (32.78%), and polyphenols (384.55 mg/kg) than plain noodles. Sensory evaluation indicated that the 5% formulation was the most acceptable. Wilcoxon analysis revealed a significant increase in infant urination frequency in the intervention group ($p = 0.032$) compared with the control group ($p = 0.039$), suggesting improved breast milk production. These results highlight the potential of 5% long bean leaf green noodles as a functional food to enhance lactation and provide nutritional benefits for breastfeeding mothers.

Keywords: Breastfeeding, breastmilk, galactagogue

Introduction

Long bean leaves (*Vigna sinensis* L.), or well-known as Lembayung leaves by many locals in Indonesia, are a very popular vegetable, rich in vitamins and minerals, and a great potential to be developed as an additional nutrition in food (Sumiati et al., 2022). Long bean leaves are affordable, easy to obtain, and abundant. The leaves have a galactagogue effect, which helps stimulate the hormones oxytocin and prolactin through alkaloids, saponins, polyphenols, steroids, and flavonoids, which can help to improve the problem of breast milk deficiency (Nurakilah et al., 2024). Increasing breast milk production in breastfeeding mothers is critical in supporting the growth and development of babies, especially in the first 6 months of life when babies depend entirely on breast milk as the primary source of nutrition. Breast milk provides energy and macronutrients, contains immunological factors that protect babies from infectious diseases, and has bioactive content that supports the development of the baby's nervous and digestive systems (Kim & Yi, 2020). However, not a few breastfeeding mothers experience problems with insufficient breast milk production, which can be caused by various factors such as stress, lack of nutritional intake, and hormonal disorders. Leaves have a galactagogue effect, namely the ability to increase breast milk production by stimulating oxytocin and prolactin. Polyphenols, flavonoids, and alkaloids work as natural antioxidants that can protect mammary gland cells from oxidative damage so

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that the lactation process can take place optimally (Nurhidayah et al., 2022). In addition, flavonoids also play a role in increasing the expression of genes related to breast milk production through the JAK2/STAT5 pathway, which is essential in regulating milk secretion in the mammary glands (Abidah et al., 2022).

Polyphenols are a group of secondary metabolite compounds that are abundant in plants and have high antioxidant activity. These compounds can capture free radicals, thereby reducing oxidative stress and improving vascular endothelial function and the immune system. In the context of breastfeeding mothers, polyphenols help maintain mammary gland cells' health, improve breast milk's quality, especially fat and protein content, and support the overall physiological function of the mother's body (Kelleher et al., 2024). The high polyphenol content in Long bean leaves makes this plant a potential functional food ingredient for breastfeeding mothers. In addition to polyphenols, leaves contain flavonoids that act as phytoestrogens, which have compounds with a structure similar to the hormone estrogen. Phytoestrogens can help increase the sensitivity of prolactin receptors, and then the breast milk production process becomes more effective. Flavonoids are also known to improve blood circulation in the mammary glands, support the transport of nutrients to the breast alveoli, where breast milk is produced, and help maintain the integrity of the mammary gland tissue (Miranda et al., 2022). Consumption of food made from Long bean leaves also has added value to food security. Long bean leaves, which are easy to cultivate and available throughout the year in Indonesia, can be an alternative local solution to overcome the problem of low breast milk production. In addition, using these leaves as a raw material for innovative food products, such as Long bean green noodles, has the prospect of developing a functional food industry that supports maternal and child health. Long bean green noodles are a food innovation that combines the benefits of Long bean leaves with a noodle form that is popular among the public. This green noodle product is expected to be an alternative daily consumption for breastfeeding mothers in meeting the needs of energy, protein, iron, and fibre while obtaining the benefits of polyphenols and flavonoids as natural galactagogues. Based on previous research, green noodles with 5% Long bean leaves contain polyphenols up to 384.55 mg/kg, potentially increasing breast milk production (Nurhidayah et al., 2024). Iron and protein deficiencies in breastfeeding mothers can interfere with breast milk production. These nutrients are essential in forming enzymes, hormones, and haemoglobin that support the body's metabolism. Low haemoglobin levels in breastfeeding mothers can reduce endurance and cause fatigue, reducing breastfeeding frequency (Husnah, 2024). Therefore, consuming green noodles from lemayung leaves, with high levels of iron, protein, carbohydrates, and fibre, can help meet the nutritional needs of breastfeeding mothers.

Research on the potential of lemayung leaves as a galactagogue is still limited, especially in processed foods such as green noodles. This study aims to explore the nutritional content and bioactive compounds in green noodles from lemayung leaves and analyze the effect of their consumption on the frequency of infant urination as an indicator of breast milk adequacy. This research is expected to provide scientific contributions to developing locally sourced functional food products that support exclusive breastfeeding programs and improve the nutritional status of infants in Indonesia. In addition to nutritional benefits, the use of lemayung leaves also supports the achievement of the Sustainable Development Goals (SDGs), especially SDG 2 (Zero Hunger) and SDG 3 (Good Health and Wellbeing). SDG 2 aims to end Hunger, achieve food security, and improve nutrition, while SDG 3 emphasizes the importance of maternal and child health. Utilizing local resources such as lemayung leaves is expected to enhance the quality of life of breastfeeding mothers and their babies and support national food security (UNICEF, 2018). The development of green noodle products from lemayung leaves also aligns with the current trend of functional foods prioritizing natural raw materials with high health value. This product has broad commercial potential, considering the high consumption of noodles in Indonesia and the increasing public awareness of the importance of healthy food. This study is the first step to prove the benefits of lemayung leaves in increasing breast milk production so that it can be recommended as one of the natural galactagogue options for breastfeeding mothers in Indonesia.

Material and Methods

Research design

This study employed a quasi-experimental method with a non-randomized control group pretest–posttest design. The respondents were breastfeeding mothers of infants aged 0–6 months who did not

present breastfeeding-related problems such as mastitis, breast abscesses, or a history of breast surgery.

Setting and duration

The study was carried out at the Jatinegara Health Center, Indonesia, between August and November 2025.

Population and sample

The study population consisted of breastfeeding mothers with infants aged 0–6 months. A total of 20 participants were recruited and divided into intervention and control groups.

Instruments and procedures

Data collection was conducted using an observation sheet to record green noodle consumption and infant urination frequency. Observations were performed daily by researchers and health cadres, both directly and through WhatsApp groups. The intervention group consumed green noodles enriched with long bean leaf flour (100 g/serving, twice daily) for 14 consecutive days, while the control group received plain noodles without long bean leaf content. Breast milk adequacy was assessed by comparing infant urination frequency before and after the intervention.

Green noodle preparation

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Sensory evaluation

A hedonic test was conducted by three trained nutritionists to evaluate taste, odor, texture, and color. The formulation containing 5% long bean leaf flour was found to be the most acceptable compared with the 8% and 10% formulations.

Phytochemical analysis

Proximate analysis and phytochemical testing of the green noodles were conducted at the Saraswati Genomic Institute (SGI) laboratory. Tests included carbohydrate, calorie, protein, fat, and ash content, as well as iron and polyphenols, to determine their potential as galactagogue compounds.

Data analysis

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Results and Discussion

In this study, different formulations of green noodles were developed to optimize both appearance and nutritional value. The green coloration of the noodles was naturally derived from long bean (Lembayung) leaves. Among the formulations, the noodles containing 5% leaf flour displayed a bright green color, while those with 10% leaf flour showed a darker, more concentrated green. In contrast, plain noodles appeared white, similar to commercial varieties, as they contained no leaf extract (Figure 1).

A hedonic test was conducted to evaluate noodle quality, including color, odor, taste, and texture, across four formulations: plain noodles and noodles with 5%, 8%, and 10% long bean leaf content. The results, presented in Figure 2, indicated that the 5% formulation was the most acceptable to panelists. Consequently, this formulation was selected for application in the respondent trial.

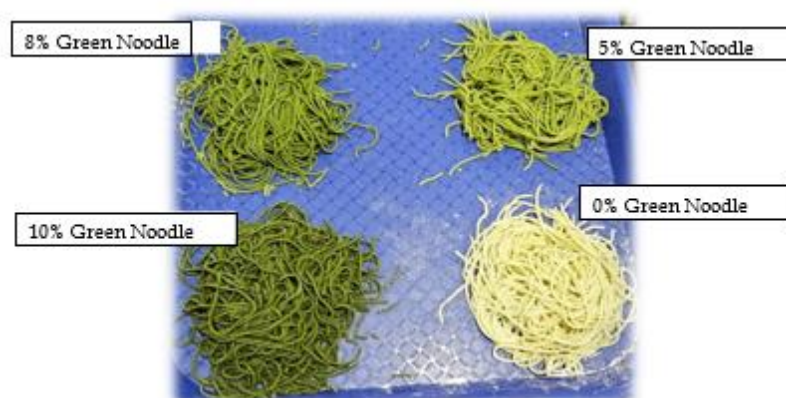


Figure 1. The differences of the 4 green noodle color formulas

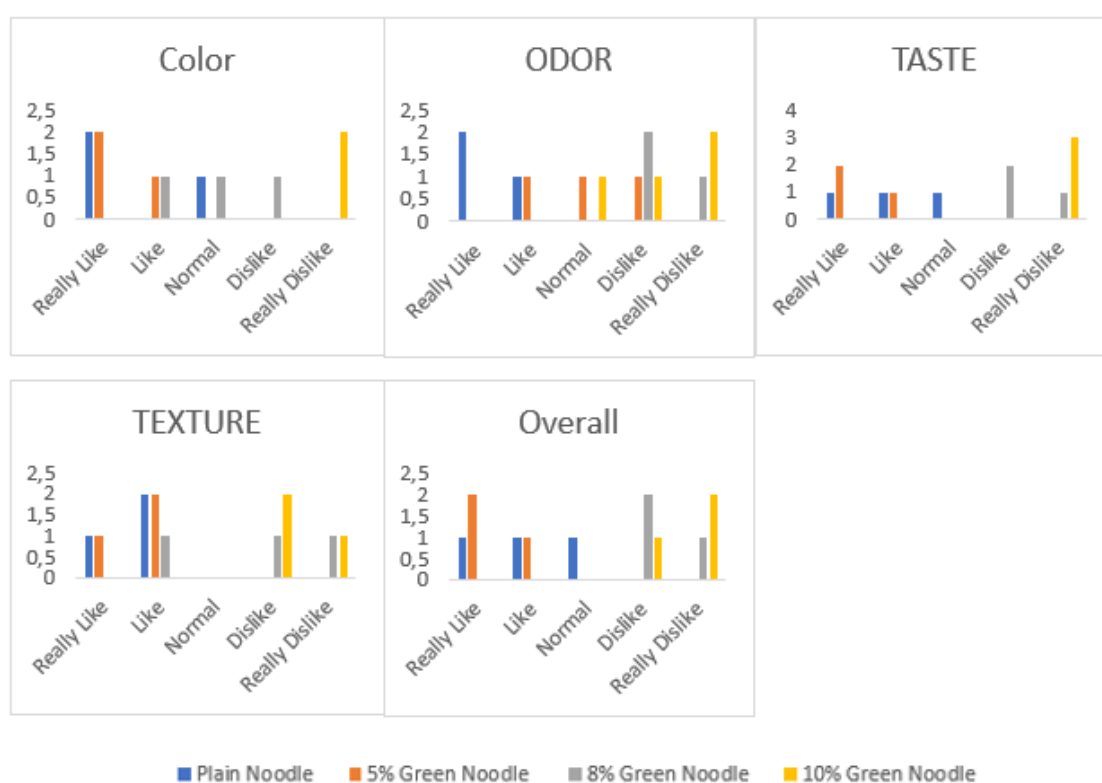


Figure 2. Hedonic analysis of the noodle

To further confirm the nutritional benefits of the green noodles, proximate analysis was carried out at the Bogor SIG Laboratory, comparing the composition of the 5% formulation with plain noodles. The results are presented in Tables 1 and 2. The analysis demonstrated that noodles enriched with long bean leaves contained higher levels of essential nutrients, including iron and polyphenols, supporting their potential role as functional food products for lactating mothers.

Table 1. Proximate analysis of 5% green noodle

No	Parameter	Unit	Simplo	Duplo
1	Iron (Fe)	mg / 100 g	2.82	2.86
2	Ash Content	%	0.54	0.56
3	Calorie From Fat	Kcal/100 g	21.42	20.52

4	Total Fat	%	2.38	2.28
5	Moisture Content	%	59.26	59.80
6	Total Calories	Kcal/100 g	172.70	169.96
7	Carbohydrate (By Difference)	%	32.78	32.18
8	Protein Content	%	5.04	5.18
9	Dietary Fiber%		5.78	5.52

Table 2. Proximate analysis of the plain noodle

no	parameter	unit	simplo	duplo
1	Iron (Fe)	mg / 100 g	2.58	2.61
2	Ash Content	%	0.56	0.54
3	Calorie From Fat	Kcal/100 g	21.6	20.70
4	Total Fat	%	2.40	2.30
5	Moisture Content	%	62.09	62.50
6	Total Calories	Kcal/100 g	161.40	159.34
7	Carbohydrate (By Difference)	%	29.91	29.47
8	Protein Content	%	5.04	5.19
9	Dietary Fiber	%	2.68	2.57

Statistical testing using the Wilcoxon method revealed significant differences before and after intervention in both the intervention and control groups, with p-values of 0.032 and 0.039, respectively. A comparison of these values indicated that the intervention group demonstrated stronger significance, suggesting that green noodles enriched with long bean leaves were more effective in supporting lactation outcomes than plain noodles.

Table 3. Wilcoxon analysis: Intervention and control group

	Control Group	Intervention Group
Z	-2.060 ^b	-2.145 ^b
Asymp. Sig. (2-tailed)	.039	.032

Breastfeeding is not only important in supporting infant growth and development but also in preventing malnutrition. Breast milk is the optimal source of nutrition for infants during their first six months. Breastfeeding helps maintain the exact nutrition for infants, reducing the risks of being underweight or overweight (Li et al., 2022; Triana & Haniyah, 2020; American Academy of Pediatrics, 2023). Beyond infant health, breastfeeding also benefits mothers by lowering the risk of chronic diseases such as diabetes, hypertension, and cardiovascular disorders (Muro-Valdez et al., 2023).

From a broader perspective, breastfeeding is closely aligned with the Sustainable Development Goals (SDGs), particularly those addressing health and nutrition. Specifically, SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being) emphasize the importance of breastfeeding to achieve global targets for maternal and child health (UNICEF, 2018). These connections highlight the need for endless support for breastfeeding mothers.

One effective approach to achieve this is to provide nutritionally rich and safe foods that can improve lactation. In this study, green noodles fortified with long bean leaves were introduced to breastfeeding mothers with infants aged 0–6 months to improve milk production. The effect of green noodle supplementation of breast milk was assessed indirectly through infant urination frequency.

To ensure product quality and safety, the noodle formulation underwent a structured development process, including hedonic and nutrient content testing. A well-formulated product should demonstrate desirable sensory qualities—such as color, taste, shape, texture, and odor, which are best evaluated through sensory panels. Sensory evaluation requires panelists who are familiar with the type of food being tested, as individuals who dislike a product may provide biased results. Panelists are typically

classified as trained or untrained (Rochmawati, 2019). In this study, three trained panelists, all nutritionists with advanced academic backgrounds (two holding master's degrees and one holding a bachelor's degree), were engaged to evaluate the sensory properties of the green noodles.

The hedonic test is designed to evaluate consumer preference for a product (Mareta, 2019). In this study, panelists assessed the noodles using a five-point scale: "really like," "like," "neutral," "dislike," to "really dislike." Each sample was presented in coded containers with three-digit random codes to prevent bias. This method allows researchers to assess product quality, improve formulations, compare new products with existing ones, and test modifications of recipes.

Four formulations were tested: plain noodles and green noodles with 5%, 8%, and 10% long bean leaf flour. Panelists expressed the highest preference for the 5% formulation, with two selecting "really like" and one selecting "like." Therefore, this formulation was chosen for further testing in the intervention group.

The selected green noodles were then analyzed for proximate composition and iron content at the SIG Laboratory in Bogor, West Java. The analysis showed that the green noodles contained higher levels of iron, carbohydrates, and fiber, but lower fat compared with plain noodles. This nutrient profile is advantageous for breastfeeding mothers, as adequate nutrition is essential for maintaining milk production, promoting postpartum recovery, strengthening immunity, and preserving maternal stamina. Sufficient fluid intake is also critical since breast milk is composed primarily of water (Jannah, 2024).

Breastfeeding mothers have higher energy and nutrient requirements than non-pregnant women—approximately 330 kcal/day in the first six months and 400 kcal/day in the following six months. Additional daily intake should include 20 g of protein in the first six months, 15 g in the second six months, and 2 g of fat, with a minimum of 1,800 kcal/day (Segura et al., 2016). Iron intake is also particularly important to restore maternal iron stores depleted during pregnancy and prevent anemia (Nadiya et al., 2019). Laboratory findings confirmed that the 5% green noodles provided protein, fat, iron, and carbohydrates, making them a valuable dietary supplement for lactating mothers.

Breast milk itself is composed of approximately 87–88% water and 124 g/L of macronutrients: about 7% carbohydrates (60–70 g/L), 1% protein (8–10 g/L), and 3.8% fat (35–40 g/L) (Kim & Yi, 2020). Maternal diet significantly influences both the composition and quantity of breast milk. For example, lactose concentration decreases after carbohydrate-rich diets but increases after protein-rich diets. Riboflavin content has been shown to decline when diets are high in carbohydrates and proteins compared to balanced diets. Conversely, protein-rich diets increase milk volume compared with carbohydrate-rich diets, which in turn alters amino acid and lactose content (Öner Sayar & Köseoğlu, 2025). Similarly, a 14-day high-fat diet has been linked to higher breast milk fat levels compared with a low-fat diet. Both high-fat and high-sugar diets increased triglyceride concentrations, whereas cholesterol increased only after a high-sugar diet (Petersohn et al., 2023).

Among macronutrients, carbohydrates are the most abundant in breast milk, playing a key role in infant nutrition, gastrointestinal development, and microbiota balance. Proteins regulate cellular functions and are vital for infant growth and organ development. Fat, including triglycerides (95–98%), linoleic acid, and alpha-linolenic acid, supports immune responses, growth, and inflammatory regulation. Colostrum contains 15–20 g/L of fat, which increases over time (Kim & Yi, 2020).

Iron requirements are also elevated during breastfeeding due to its role in forming new cells and hemoglobin. Insufficient iron can lead to anemia, which endangers maternal health and increases the risk of mortality (Husnah, 2024). Thus, green noodles enriched with long bean leaves, which provide iron and other essential nutrients, may help meet the increased demands of lactating mothers.

The findings of this study confirm that green noodles containing 5% long bean leaves have significantly higher polyphenol levels (384.55 mg/kg) compared with plain noodles (85.39 mg/kg) (Nurhidayah et al., 2024). Polyphenols are well known for their diverse biological activities, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anti-aging, antitumor, and cytotoxic effects. Among them, flavonoids act as powerful antioxidants that stimulate prolactin secretion, thereby enhancing mammary gland function and promoting galactagogue activity, which in turn supports increased breast milk production (Kelleher et al., 2024; Nurhidayah et al., 2022).

Adequate energy and nutrient intake is crucial during lactation to meet both maternal and infant macro- and micronutrient needs. The quantity and quality of breast milk largely depend on maternal nutrition (World Health Organization [WHO], 2013; Huang & Hu, 2020). Beyond physical health, the postpartum period is often associated with memory, emotional, and attention disturbances, which may

hinder maternal well-being. Polyphenol-rich foods, with their neuroprotective properties, can help stabilize maternal mood, improve postpartum recovery, and enhance the nutritional quality of breast milk, particularly its fat content. Breast milk fat plays an essential role in infant brain development and cognitive function (Miranda et al., 2022).

Consumption of 10 g/day of polyphenol extract can increase the composition of milk lipids, including expanding the content of omega-3 fatty acids in breast milk by up to 30%. Fat production significantly increases from supplementation with natural antioxidants that increase plasma antioxidant capacity. Transport of antioxidants from plasma to breast milk requires phenolic compounds or increased secretion of antioxidant metabolites through MEC (mammary epithelial cells) to breast milk, so that it can reduce oxidative stress by significantly increasing Nrf2 expression, which is the primary regulator of antioxidant response elements. These results show that dietary phenolic compounds induce local effects on the mammary glands. The working process of polyphenols is absorbed into the bloodstream and directly affects the oxidative status of the mammary glands, thereby increasing cellular fat production (Hadaya et al., 2021). In addition, polyphenols can help improve the immune system in colostrum, which helps support infant health (Mei et al., 2024).

This mechanism can be seen through a fairly complex process. Polyphenols stimulate galactagogues by increasing prolactin. Prolactin binds prolactin receptor (Prlr) to signal through endocrine binding and prolactin to the hypothalamus-pituitary-gonad (HPG). Binding to PRLR results in stimulation of JAK2 tyrosine kinase activity and subsequent phosphorylation of several tyrosine residues and activation of signal transducer and activator of transcription (STAT) proteins, especially STAT5 (JAK2/STAT5 signalling) which is required for lobuloalveolar development and regulation of breast milk protein gene transcription in the mammary gland, so that breast milk production can be secreted properly (Abidah et al., 2022; Nurhidayah et al., 2022).

In addition, polyphenols affect the development of microbiota during the lactation phase. Polyphenols bound to indigestible fibre in the small intestine can provide beneficial health effects by releasing phenolic compounds after microbial fermentation in the large intestine. Therefore, fermentable fibre foods in the daily diet can provide various health benefits by releasing phenolic compounds that support the growth of beneficial gut microbiota and can act as prebiotics. Foods rich in fibre and polyphenols support the composition of maternal nutrition and are helpful for maternal health and infant development (Bolat et al., 2024). This is also due to the relatively complex content of green noodles; in addition to containing macronutrients, they also contain fibre, which is beneficial in supporting the health of mothers and babies.

The adequacy of breastfeeding can be assessed by observing the baby's behaviour, breastfeeding patterns 8-10 times in 24 hours, urine production and bowel movements, and by checking the baby's weight which increases by at least 500g per month using a growth reference chart, and baby's sleep patterns (falling asleep three to four hours after breastfeeding) (Widyastutik et al., 2021; Toronto Public Health, 2017; Brugaletta et al., 2020; National Health and medical Research council, 2012).

Meanwhile, if breast milk is insufficient, the baby does not feel full after breastfeeding, cries a lot, wants to breastfeed too often, breastfeeds for too long, and does not gain weight well (<20 grams/day). The number of wet diapers per day (less than six to eight diapers) and infrequent bowel movements, with little, dry, and hard stools, no urine production for 24 hours, and no meconium in the first week, and other clinical signs of dehydration (Sultana et al., 2013). Based on previous studies, it has been shown that breastfeeding duration and providing exclusive breastfeeding contribute to developmental protection and reduce the severity of UTIs (Urinary Tract Infections) in infants and children (Chamova et al., 2018). This is certainly supported by the content of breast milk, which is rich in antioxidants when combined with a high polyphenol diet, which can improve the welfare of children in the future. This study showed that the intervention group had a higher relationship strength than the control group after being given green noodles on the frequency of urination in infants. As the volume of breast milk increases, the baby's urine production will increase, and a sign that the baby is well hydrated is clear urine with a frequency of urination of six or more times every 24 hours. The average frequency of urination of babies is above 6 times, with the highest frequency of 10 times a day. This certainly showed that there was sufficient breast milk after consuming the green noodles.

Conclusion

Green noodles formulated with 5% long bean leaf flour were found to contain higher levels of key macronutrients—including carbohydrates, iron, fiber, and polyphenols—compared with plain noodles. These nutrients can serve as an additional source of maternal nutrition and support adequate breast milk production. The effectiveness of this intervention was reflected in the increased frequency of infant urination, indicating sufficient milk intake. Future studies should expand the sample size, extend the duration of intervention, and investigate additional factors to strengthen and validate these findings.

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