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The Effects of Consumption Habits of Vegetables Rich in Galactagogue on Breastfeeding Intensity

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ABSTRACT
Providing breast milk to babies becomes one of the keys to growth and development. Breast milk contains various crucial nutrients needed for the growth and development period of babies. To analyze the effect of consuming local vegetables containing galactagogues on breastfeeding intensity. This study was a cross-sectional study conducted at 38 Community Health Centers in Tasikmalaya Regency in 2024. The population was 5971 people. The sampling technique is proportional sampling. The study sample was 450 breastfeeding mothers. The independent variables were consumption behaviros of galactagogue vegetables, such as katuk leaves, moringa, spinach, young papaya, and banana blossoms. The dependent variable was breastfeeding intensity measured by the frequency and duration of breastfeeding. Bivariate analysis used chi-square and multivariate analysis used multiple logistic regression. The results of the study showed that consumption of katuk leaves and banana flowers would increase the frequency of breastfeeding (aOR: 0.40; p value=0.000; 95%CI: 0.23 - 0.61 and aOR: 2.23; p value=0.004; 95%CI: 1.30 - 3.85) and extend the duration of breastfeeding (aOR: 3.67; p value=0.000; 95%CI: 1.99 - 6.77 and aOR: 3.01; p value = 0.026; 95%CI: 1.14 - 7.98). Breastfeeding mothers can consume local foods made from processed banana blossoms and katuk leaves in an effort to increase breast milk production by utilizing local foods.

INTRODUCTION

Providing breast milk to babies becomes one of the keys to growth and development.[1] Breast milk contains various crucial nutrients needed for the growth and development period of babies, such as carbohydrates, proteins, fats, vitamins, minerals, digestive enzymes, and hormones.[2] In addition, breast milk is rife with immune cells, such as macrophages and stem cells that function to protect babies from infections.[3] The coverage for exclusive breastfeeding in Indonesia is still in the range of 50.0% to 60.0%. In 2020, the coverage reached 66.1%. However, there was a decrease to 50.7% in 2021.[4]

The cause for the decrease in the coverage for exclusive breastfeeding is due to the irregular breast milk production for postpartum mothers, in which the prevalence of breast milk insufficiency is estimated to reach 23.0 to 63.1% in the first 4 months after delivery.[5] The lack of breast milk production is yet to be the main reason for the cessation of exclusive breastfeeding.

The lack of breast milk intake might result in an increased risk for diseases and death, malnutrition, stunting, obesity caused by excessive sugar consumption in formula milk,[6] vulnerability to both infectious and non-infectious diseases, and even long-term effects on the child's health and cognitive abilities.[7] Several attempts have been made to increase breastfeeding coverage. One of which is ensuring that postpartum mothers can maximize breast milk production by providing food supplements and increasing the intskr foods containing galactagogues, including pharmaceutical agents, foods, or herbal supplements that can increase breast milk production.[8] Women can utilize galactagogues to induce, increase, and maintain breast milk production through a mechanism that stimulates the formation of the hormone prolactin and inhibits the adenohypophysis. Prolactin is a peptide hormone synthesized and secreted by the anterior pituitary. This stimulates breast milk production and aids secretion in the mammary glands.[9]

Previous research conducted by Ryan et al 2023 reported that galactagogue use can increase milk production in the United States population. Reported galactagogue use was higher among participants who reported first breastfeeding (yes: 66.7% vs no: 49.3%; p-value = 0.001).[10] A narrative review from Grzeskowiak also supports these results that consuming galactagogues can change and modulate prolactin levels, so that the process of transitioning breast milk becomes faster, the acceleration process towards mature breast milk will increase the volume of breast milk because colostrum is only produced in small amounts, while mature breast milk is produced longer and in large quantities.[8]

Galactagogues are substances believed to initiate, maintain, or increase breast milk production. They may be pharmacological or natural, including herbs and vegetables traditionally consumed by breastfeeding mothers.[7] The mechanism involving: (1) Hormonal Modulation. Some galactagogue vegetables contain phytoestrogens, sterols, or bioactive compounds that may enhance prolactin secretion or increase mammary gland sensitivity to prolactin. By supporting prolactin activity, these compounds may promote milk synthesis at the cellular level.[9] (2) Mammary Gland Function: Polyphenols and other bioactive compounds in galactagogue-rich vegetables may modulate key signaling pathways in the mammary gland. These include the Stat5 signaling pathway, which is vital for milk synthesis, and the mTOR pathway, which regulates cellular energy production.[8] (3) Anti-inflammatory Effects: Some galactagogues possess anti-inflammatory properties that can support lactation by reducing inflammation in the mammary glands. Curcumin, found in turmeric, has been shown to downregulate inflammatory signaling pathways (e.g. NFκB, STAT3) and maintain tight junction integrity in mammary epithelial cells, which is beneficial for sustained milk production.[9]

Indonesia has various local food ingredients that are believed to be capable of increasing breast milk production and have been scientifically proven to contain galactagogues, such as katuk leaves, young papaya, banana flower, and moringa leaves.[11] A study in an Asian population reported by Yimyam showed that banana flower (Musa x paradisiaca) drink can increase milk production (both milk flow and milk volume) in mothers undergoing cesarean section who breastfeed their babies in the first three days after delivery, because this period is the time of lactogenesis II. The results showed that mothers undergoing cesarean section in the experimental group had significantly higher milk flow levels at

Day 2 (p-value=0.017), Day 3 (p-value=0.005) and milk volume at Day 2 (p-value=0.005), and Day 3 (p-value=<0.001) than those of the control group.[12] Several ingredients have even been extracted and made into commercial products. However, some of the other ingredients have never been tested and analyzed for their natural relationship to increased breastfeeding intensity. People in West Java, especially in Tasikmalaya, have a high level of vegetable consumption despite its exceptionally simple processing, namely by boiling or stir-frying, especially after giving birth, various local vegetables that are indicated to be able to facilitate the process of breastfeeding if consumed regularly are often cooked. This research aims to analyze the effects of consumption habits of vegetables rich in galactagogue on breastfeeding intensity.

MATERIAL AND METHOD

Study Design and Sample

This research used a cross-sectional design and was conducted in Tasikmalaya Regency. The researchers selected the locations of 38 of 40 community health centers in Tasikmalaya Regency considering that the community health centers must have a population as a whole and that some samples met criteria according to the research objectives, namely breastfeeding mothers who consume vegetables rich in galactagogues every day. The research was conducted in May 2024. The study population consisted of breastfeeding mothers with babies aged 0-6 months, totaling 5,971 individuals. Using the Slovin formula ($n = N / (1 + (N*e^2))$ with a margin of error 5% (0.05), the minimum sample size was calculated to be 375. We are adding a 20% non-response rate (75 people), and the total sample size increased to 450 (375 + 75). The researchers used proportional random sampling to select the research subjects. Divided the 450 samples among 38 community health centers witj 10-12 people. Enumerators will look for people who meet the inclusion criteria to be selected for this study.

The inclusion criteria in this research were (1) healthy breastfeeding mothers who had babies aged 0-6 months when the data were collected; (2) They also must have no contraindications in breastfeeding for mothers such as breast infections, mastitis, postpartum depression that endangers the safety of the baby, hepatitis, tuberculosis; (3) Contraindication for babies, such as Classical galactosemia (babies cannot digest galactose, which is part of the lactose in breast milk); (4) Exclusively breastfeed when working (mother who pumps her breast milk, there are no standard times or requirements for a mother to visit her baby while working); and (5) regularly consume local vegetables that contain galactagogue. Before the research was conducted, subjects were given explanations of the research's objectives and procedures. Those who agreed to participate in the research signed an informed consent. Ethical Clearance: DP.04.03/F.XXVI.20/208/2024 Politeknik Kesehatan Tasikmalaya.

Research Variables and Instruments

The independent variable in this research is the habit of consuming local vegetables rich in galactagogue, whereas the dependent variable is the intensity of breastfeeding. The instrument for this research is divided into 3, including: (1) To measure the habit of consuming local vegetables rich in galactagogue is the frequency of consuming local vegetables with a galactagogue content of per 100g (Indonesian Standard Food Composition/*Tabel Komposisi Pangan Indonesia (TKPI),* 2017); (2) The demography data we used the master table and data from the community health center. This data were also carried out on confounding variables, precisely demographics (age, education, occupation, and family income), parity, medical history, smoking history, anemia status, and BMI. The variable data for demographics, parity, medical history, and smoking history were obtained through interviews using questionnaires; (3) Food Frequency Questionnaire (FFQ) and Questionnaire for duration and intensity. (4) The questionnaire for intensity and duration of breastfeeding, we use two experts for validity. The average of breastfeeding frequency is 8 times and categorized into < 8 times per day and ≥ 8 times per day. The duration of breastfeeding is categorized with a cut-off based on the average is 10 minutes, namely 1-10 minutes per breastfeeding and > 10 minutes for each breastfeeding.

Variable Coding

Age is the total time that has passed since the respondent was born until data collection is conducted, which is categorized into risky age (< 20 years and > 35 years) and healthy reproductive age (20-35 years). Education is the level

of formal schooling that has been passed and declared to have been completed. It is categorized into elementary school, middle school, high school, and college. Occupation is an activity with the intent of receiving money and in this research, occupation is categorized into employed and unemployed. Family income is the amount of wealth in Rupiah earned within 1 month (30 days) and is categorized with a cut-off point of IDR. 1.500.000 (Indonesian Rupiah). Parity, on the other hand, is the number of pregnancies that have occurred in a woman and is categorized into primipara if she has been pregnant only once and multipara if she has been pregnant between 2-4 times. The variable data on anemia status were obtained by examining Haemoglobin (Hb) using capillary blood samples, which were analyzed with Hemocue or laboratory tests by competent operators with the category of anemic if the Hb level was < 12.0 g/dL and non-anemic if the Hb level was ≥ 12.0 g/dL. Nutritional status is measured by dividing a person's weight by their height (in meters) and then is categorized as underweight (<17.0), normal (18.5 - 22.9), overweight (23 - 24.9), or obese (>25). The characteristics of respondents and supporting data are obtained through reviewing the documents from the community health center.

Data Analysis

The characteristics of respondents will be analyzed univariately through frequency distribution. The relationship between the dependent and independent variables will be analyzed bivariately using the chi-square test. Univariate analysis is used to describe the independent variables (vegetable consumption) and the dependent variables (frequency and breastfeeding intensity), as well as the confounding variables (demographics, anemia status, BMI, and habits), using a frequency distribution table. We are using SPSS (Statistical Package for the Social Sciences) version 26 for analysis. Multivariate analysis will be conducted using multiple logistic regression. Multivariate analysis was used to control for confounding variables that affect the study's results. The categorized data made the author choose to use multiple logistic regression.

RESULTS

All respondents (450 people) completed the research and were included in this study. According to the characteristics of the table, it was discovered that the majority of the respondents are of reproductive age which is between 20 to 35 years (72.4%), educated at high school or equivalent (41.3%), have income below IDR1.500.000 (Indonesian rupiah) (36.9%), have parity of more than 1 or multiparity (60.4%), and do not have history of degenerative diseases as well as smoking history (Table 1).

Table 1. Respondent Characteristics

Characteristics	n = 450	%
Age (Years)		
< 20	25	5.6
20 – 35	326	72.4
> 35	99	22
Education		
Elementary school	79	17.6
Junior high school	147	32.7
Senior high school	186	41.3
College/University	38	8.4
Occupation		
Employed	34	7.6
Unemployed	416	92.4
Family Income (in Rupiah)		
< 1500000	166	36.9
1500000 - 2500000	142	31.6
2500000 - 3500000	96	21.3
> 3500000	46	10.2
Parity		
Primipara	146	32.4
Multipara	272	60.4
Grande Multipara	32	7.2
Maternal Medical History (HIV, TBC, or Hepatitis B)		
Present	3	0.7
Not present	447	99.3
Smoking History		
Smoke	13	2.9
Do not Smoke	437	97.1
Anemia Status		
Anemic	196	43.6
Non Anemic	254	56.4
Body Mass Index (BMI)		
Underweight	25	5.6
Normal	263	58.4
Overweight	70	15.6
Obesity	92	20.4

Source: Primary Data, 2024

Bivariate Analysis

According to the results of the bivariate analysis, as shown in Table 2, it is discovered that moringa leaves and banana flowers have a significant impact on breastfeeding intensity with parameters of increasing frequency (katuk leaves OR=0.3; p value=0.000; 95%CI=0.23-0.51 and banana flower OR=1.67; p-value=0.048; 95%CI=1.01-2.75) as well as breastfeeding duration (katuk leaves OR=2.79; p-value=0.000; 95%CI=1.63-4.80 and banana flower OR: 2.96; p-value=0.022; 95%CI=1.15-7.26). Moringa leaves and young papaya affect breast-feeding frequency but not its duration. On the other hand, spinach does not have a significant effect on either the frequency or the duration of breastfeeding.

Multivariate Analysis

According to the result of multivariate analysis in Table 3, it is discovered that consuming katuk leaves as well as the banana flower will affect the frequency of breastfeeding (aOR= 0.40; p-value=0.000; 95%CI=0.23-0.61, and aOR=2.23; p-value=0.004; 95%CI=1.30-3.85), and the duration of breastfeeding (aOR=3.67; p-value=0.000; 95%CI=1.99-6.77, and aOR= 3.01; p-value=0.026; 95%CI=1.14-7.98).

Table 2. Bivariate Analysis

Consumption of Local Vegetable	Breastfeeding Intensity				p-value	OR (95%CI)	Breastfeeding Duration				p-value	OR (95%CI)
	< 8 Times per Day (n = 209)		≥ 8 Times per Day (n = 241)				1 – 10 Minutes (n = 66)		> 10 Minutes (n = 384)			
	n	%	n	%			n	%	n	%		
Katuk Leaves												
No	60	13.3	130	28.9	0.000*	0.3 (0.23-0.51)	42	9.3	148	32.9	0.000*	2.79 (1.63 – 4.80)
Yes	149	28.9	111	24.7			24	5.3	236	52.4		
Moringa Leaves												
No	153	33.8	195	43.3	0.043*	0.63 (0.40-0.98)	55	12.2	292	64.9	0.209	1.57 (0.79 – 3.13)
Yes	57	2.7	46	10.2			11	2.4	92	20.4		
Spinach												
No	22	4.9	41	9.1	0.056	0.57 (0.33-1.00)	8	1.8	55	12.2	0.848	0.82 (0.37 – 1.82)
Yes	187	41.6	200	44.4			58	12.9	329	73.1		
Young Papaya												
No	125	27.8	177	39.3	0.003*	0.53 (0.36-0.80)	39	8.7	263	58.4	0.156	0.66 (0.38 – 1.14)
Yes	84	18.7	64	14.2			27	6.0	121	26.9		
Banana Flowers												
No	180	40.0	190	42.2	0.048*	1.67 (1.01- 2.75)	61	13.6	309	68.7	0.022*	2.96 (1.15 – 7.26)
Yes	29	6.4	51	11.3			5	1.1	75	16.7		

Source: Primary Data, 2024
*Significant p-value < 0.05

Table 3. Multivariate Analysis

Consumption of Local Vegetable	Breastfeeding Intensity			Breastfeeding Duration		
	Adjusted Odds Ratio	95% Confident Interval	p-value	Adjusted Odds Ratio	95% Confident Interval	p-value
Katuk Leaves	0.40	0.23 – 0.61	0.000*	3.67	1.99 – 6.77	0.000*
Moringa Leaves	0.71	0.44 – 1.16	0.173	1.06	0.50 – 2.21	0.886
Spinach	0.77	0.43 – 1.41	0.401	0.72	0.31 – 1.64	0.432
Young Papaya	0.66	0.43 – 1.02	0.061	0.39	0.22 – 0.73	0.003*
Banana Flowers	2.23	1.30 – 3.85	0.004*	3.01	1.14 – 7.98	0.026*

Source: Primary Data, 2024
*Significant p-value < 0.05

DISCUSSION

Significant Effect of Galactagogues Food Consumption

Research reports that banana flower or *Musa paradisiaca* has the highest odds ratio in terms of increasing the frequency and duration of breastfeeding as an indication of breast milk production. Mothers who consume banana flowers were 2 times more likely to have an increase in breastfeeding frequency and 3 times more likely to be able to breastfeed longer, both of which were statistically significant. These findings are consistent with a study conducted by Yimyam S and Pattamapornpong S, which reported that the efficacy of galactagogue in banana flower drinks can increase breast milk production without significant side effects. Compared to the control group, mothers in the experimental group, who consumed banana flower drink had significantly higher breast milk flow rates on Day 2 (p-value=0.017) and Day 3 (p-value=0.005) as well as higher breast milk volumes on Day 2 (p-value =0.005) and Day 3 (p-value<0.001). Similar results were also reported by Us HS, who confirmed that consumption of banana flowers significantly increased breast milk production (p= 0.002).[12,13]

Banana flower (*Musa paradisiaca*) is a plant containing galactagogues that may stimulate the hormones oxytocin and prolactin, such as alkaloids, polyphenols, steroids, and flavonoids, which could significantly increase and facilitate breast milk production.[14,15] *Musa paradisiaca,* commonly known as the scientific name for the banana tree in general, is an herbaceous plant cultivated for its fruit, especially in South Asia.[16] Moreover, *Musa paradisiaca* could be utilized to control blood sugar and even suppress free radicasl.[17] Parts of *Musa paradisiaca*, such as fruit, flowers, stem sap, and roots, have various health benefits.[18] The part that helps increase breast milk production is the banana flower.[19] The flower of *Musa paradisiaca* contains various components, such as flavonoids, tannins, saponins, and alkaloids.[20] These components have a role in providing the lactogenic effect of this plant by acting as antagonists against dopamine receptors.[21]

Research assessing the lactogenic effect of banana flower extract was conducted in 2012 on 20 Sprague-Dawley mice, which were administered the equivalent dose of 500 mg/kg body weight. The banana flower extract was given to the mice from day 5 to day 14 postpartum. Breast milk production was measured 12 hours after the action, from day 5 to day 15, using the weight-suckle-weight method. Side effects of banana flower consumption are rare. However, consuming very high doses of it would raise blood potassium levels.[22]

Consuming banana flowers would have a significant effect not only as a galactagogue but also because of their neutral taste and ease of processing into various types of food, making them much more delicious and preferred than green vegetables. Respondents usually processed banana flowers most simply, by boiling or making a vegetable dish, so that the amount consumed in one meal could be more than that of processed katuk leaves. Katuk (*Sauropus androgynous* (L.) Merr.) is a shrub in the Euphorbiaceae family and is widely known for improving breast milk production.[23] Katuk contains nutrients and several compounds that are useful for synthesis and can boost breast milk production by facilitating glucose metabolism for lactose synthesis..[24] Apart from that, phytosterol levels in its leaves are higher than in other kinds of vegetables. Phytosterols have estrogenic effects, elevating prolactin and increasing breast milk production.[25] Another compound found in katuk leaves is papaverine, which could stimulate the release of prolactin.[23]

The results of past research regarding the significance of katuk leaves in terms of improving breastfeeding intensity are in line with previous research which reports that supplementation of 173.6 mg/kg of S. androgynous leaf extract was able to increase prolactin and oxytocin gene expressions in lactating mice by 15.75 and 25.77 times, respectively, compared to the control group.[26] A similar result from another study also shows that S. androgynous leaf extract (6 mg/kg) increases breast milk production by up to 50,7% compared to placebo in breastfeeding female subjects.[27] S. androgynous acts as an inducer of gene expres-

sion required for good lactation, and thus, supports current practices during breastfeeding by boosting the production of breast milk.

Galactagogue compounds found in moringa leaves, which come from phytosterol substances such as campesterol, stigmasterol, and B-sitosterol,[28] are capable of stimulating mammary gland secretory cells to raise serum prolactin levels.[29] This, in turn, encourages alveolar epithelial cells to produce a moderate amount of breast milk.[30] Other than increasing prolactin production, the polyphenol and flavonoid content in Moringa leaves can block dopamine receptors.[31] Trigonelline, an alkaloid found in moringa leaves, has a synergistic effect with the hormone oxytocin.[32]

Papaya plants have been widely used and known by people since ancient times. Active compounds such as papain enzyme, carotenoids, alkaloids, flavonoids, monoterpenoids, minerals, vitamins, glucosinolates, and carposides of vitamins C, A, B, and E, as well as minerals, could be found in this plant.[33] It is also reported that papaya has gastroprotective, antibacterial, and laxative effects, and the efficacy of galactagogue in this plant has been proven scientifically.[34] Galactagogue in papaya could be one of many ways to increase y the rate of secretion and production of breast milk as well as become a strategy to overcome the failure of exclusive breastfeeding caused by low breast milk production.

Aside from that, papaya fruit and its leaves also contain saponins as breast milk enhancers, stating that saponin content can produce prolactin and oxytocin hormones,[35] in addition to saponins from papaya leaves, namely potassium, which has the same function as saponins. Papaya fruit is also rich in firming hormones and vitamin A which could trigger the release of female hormones and stimulate the ovaries to release hormones.[36]

Non Significant Effect and Potential Bias

In this study, galactagogue foods were not significantly associated with breastfeeding intensity and duration. This finding suggests that galactagogue intake alone may not be a dominant determinant of breastfeeding success.[37] Breast milk production is a multifactorial physiological process influenced not only by dietary factors but also by hormonal regulation, breastfeeding practices, maternal health status, and psychosocial factors.[38] Therefore, the absence of a statistically significant association may reflect variability in the type, frequency, and quantity of galactagogues consumed by participants which may have diluted measurable effects. Traditional galactagogues are often consumed in small or inconsistent amounts, which may be insufficient to produce detectable physiological changes in prolactin or oxytocin levels. This aligns with existing literature suggesting that dietary galactagogues may enhance lactation only when combined with effective breastfeeding practices, such as frequent feeding and proper latch.

Several potential biases may have contributed to the non-significant findings. First, recall bias may have occurred if galactagogue consumption was assessed using self-reported dietary tools, such as a Food Frequency Questionnaire. Mothers may have difficulty accurately recalling the frequency or portion size of specific foods, leading to misclassification of exposure.

Our study still has limitations, as we analyzed only various local vegetables known to contain galactagogues; there is no stronger empirical evidenceFurthermore, the results, which provide initial evidence that banana flowers significantly increase breastfeeding intensity, will be followed up with clinical trials and analyzed for their effects on breast milk production and hormone levels directly related to breast milk. Furthermore, this study did not provide information regarding the socio-demographic context. Previous studies show that a diverse socio-demographic context is very helpful for understanding and supporting effective exclusive breastfeeding practices.[39] This study did not analyze any overlap or mixing in consumption patterns and how other combinations or dietary/environmental factors would influence breastfeeding intensity. The results show that some odds ratios (OR) and CI values appear unstable, suggesting potential data issues.

CONCLUSION AND RECOMMENDATION

The research found that katuk leaves and banana flowers have a significant effect on two breastfeeding intensity parameters: more fre-

quent frequency and longer duration. Moreover, this research reveals that consuming banana flowers has the most significant potential to increase breastfeeding intensity. The next research design can be a longitudinal or an experimental study to control for confounding factors and to assess the causal effects of galactagogue consumption.

AUTHOR CONTRIBUTIONS

NF, MZR, DL, and SW contributed to the conceptualization and design of the study. NF and MZR were responsible for data procurement and organization, while NF, DL, and SW jointly conducted the data analysis. All authors have read and approved the final version of the manuscript. NF = Nurul Fadhilah; MZR = Mohammad Zen Rahfiludin; DL = Daru Lestantyo; SW = Sri Winarni.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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