Herbal galactogogue supplementation on average zinc and iron levels in breast milk

Rini Mustikasari Kurnia Pratama[1], Ayu Mustika Handayani[2], Lili Andriani[3], Ahmad Yunus[4], Revi Gama Hatta Novika[5]

[1]Midwifery Study Program, Faculty of Mathematics and Natural Sciences, University of Bengkulu, Bengkulu, Indonesia
[2]Midwifery Study Program, Sekolah Tinggi Ilmu Kesehatan Keluarga Bunda Jambi, Jambi, Indonesia
[3]Pharmacy Study Program, Sekolah Tinggi Ilmu Kesehatan Harapan Ibu Jambi, Jambi, Indonesia
[4]Agrotechnology Study Program, Faculty of Agriculture, Sebelas Maret University, Surakarta, Indonesia
[5]Midwifery Study Program, Faculty of Medicine, Sebelas Maret University, Surakarta, Indonesia

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ABSTRACT

The problem often encountered concerning failed exclusive breastfeeding is the insight of the mothers into little or less milk production, causing fear of being incapable to satisfy the baby's needs. The quasi-experimental research design was used in this study. There was a control group and two intervention groups. The intervention group was given moringa leaf extract and banana flower extract for 14 days. Mother's milk was examined with atomic absorption spectrophotometry (AAS) at Labkesda (regional health laboratory) Jambi Province, Indonesia. Data were analyzed using 1-way-ANOVA. The zinc levels variable in breast milk obtained a p-value of 0.160, indicating that the zinc level in mother's milk between the control group, moringa leaf extract, and banana flower extract did not show any meaningful difference. The iron levels variable in breast milk obtained a p-value of 0.497, indicating that the Fe levels of mother's milk in the control group, moringa leaf extract, and banana flower extract did not show considerable distinctions. As a result, zinc and iron levels in the mother's milk showed no prominent differentiation in the control, moringa leaf extract, as well as banana flower extract groups.

Corresponding Author:

Rini Mustikasari Kurnia Pratama
Midwifery Study Program, Faculty of Mathematics and Natural Sciences, University of Bengkulu
WR. Supratman Street, Kandang Limun, Muara Bangka Hulu, Sumatera, Bengkulu 38371, Indonesia
Email: rini.mazin@gmail.com

1. INTRODUCTION

Mother's milk is the best baby food because the texture of breast milk is easily digested, and contains complete and balanced nutrition for growth and body immunity corresponding to the needs of babies. Breast milk also plays a pivotal role in increasing emotional intelligence between mother and baby, and contains fatty acids needed for brain growth and development [1]. The results of the WHO study of 3,000 researchers conclude that the most optimal period for breastfeeding is six months, known as exclusive breastfeeding. Exclusive breastfeeding is giving only breast milk without any other additional food for the baby, except for the administration of drugs and vitamins recommended by WHO [2]. According to Susenas, the Central Bureau of Statistics, Indonesia, the percentage of infants younger than six months who received exclusive breastfeeding is 66.69% in 2019, 69.62% in 2020, and 71.58% in 2021. In Jambi Province, there is an increase in the percentage of breastfeeding by 64.87% in 2019, 65.22 in 2020, and 71.37 in 2021. Despite this increase, exclusive breastfeeding coverage has not yet attained the national target of 100%. Data from

Jambi Provincial Health Office in 2019, the number of babies aged range between 0 to 6 months who are given exclusive mother's milk is 2,329 babies (44.43%) [3].

Solid foods presented before the age of 6 months to infants as a substitute for breast milk provide no health benefits. Babies must receive exclusive breastfeeding for the first six months after birth because mother's milk is the finest meal for babies [2]. Babies exclusively breastfed for the first six months are more protected from gastrointestinal infections than those given meals other than breast milk at 3-4 months of age [4]. One of the problems that arise as a result of babies not being exclusively breastfed for the first six months is stunting. Stunting is a condition of failure to thrive in children due to malnutrition in the first 1,000 days of birth. This condition has long-term effects on old age [5].

Reducing stunting is the main goal of the six goals of the 2025 Global Nutrition Targets. Stunted conditions are seen after babies are two years old. Toddlers under five with a z-score value <-2.00 standard deviation (SD) are called stunted, and <-3.00 SD are called severely stunted [3]. Globally, 165 million children under-five are stunted, and in South Asia, 39% are stunted. Children with stunting are at a high risk of experiencing severe acute malnutrition and even death [6]. The problem often encountered related to failure in exclusive breastfeeding is the mother's perception of little or less milk production, causing fear of not being able to meet the needs of the baby. This situation is called perceived insufficient milk (PIM) [7], [8]. Researchers have tried to make mothers' milk production sufficient for babies so mothers do not feel worried that their babies are starving by innovating to increase breast milk production using local plants that contain lactogogues, such as banana flowers and moringa leaves in powder form packaged into capsules. Lactogogue is a plant that has lactogenic properties, namely a hormone that produces the hormone prolactin which secretes breast milk. By administering lactogogue it is hoped that breast milk production will increase [9].

Babies who do not receive exclusive breastfeeding at the beginning of their growth period have a 61 times tendency to suffer from stunting than those who receive exclusive breastfeeding. Diarrhea can also be experienced in infants who are not exclusively breastfed. Breastfeeding reduces postpartum hemorrhage and depression risks for the mother. Improper breastfeeding techniques and complementary feeding for infants can increase the incidence of non-communicable diseases, such as malnutrition during the two years of a baby's life. Factors inhibiting exclusive breastfeeding include swollen breasts or sore nipples, work schedules, work, the influence of family support, health workers and health facilities, and low milk production [4], [5]. The nutritional content of breast milk is specific and perfect, which is needed by babies for their growth process. The digestive system in babies easily digest the mothers' milk. The nutritional content of a mother's milk is more dynamic, not uniform, depicting the mother's food intake [10].

Breast milk contains a small amount of iron at 0.4 mg/L. Of the 68 babies born prematurely at 32-35 weeks gestation, 38.2% have iron depletion and iron anemia, and 30.9% at six weeks postpartum. The iron concentration in the colostrum of humans is around 0.8 µg per 1 mL, whereas, in mature mother's milk, it ranges from 0.2-0.4 µg per 1 mL [11]. Some studies assume that low iron concentrations in mothers' milk are independent of the iron concentrations of the mothers [12], [13]. Iron supplements are beneficial for maintaining the iron concentrations which are pivotal for the physical and neurological development of the baby. Iron intake is stored in the spinal cord and muscles. Inadequate iron causes iron stores in the spinal cord used to produce hemoglobin to decrease. This situation causes an increase in the free protoporphyrin erythrocytes, causing reduced heme synthesis, and the erythrocytes become microcytic, resulting in iron anemia. Iron deficiency also lowers the immune system, so that infectious diseases easily enter the body. This condition can have a long-term impact on children's linear growth, one of which is stunting [14].

In addition to iron, zinc content in breast milk also plays a prominent role for babies. Zinc deficiency can impair immune function, impair neutrophil and lymphocyte function, and reduce the capacity of the baby's spleen and thymus. Zinc deficiency (ZnD) has health consequences, such as stunted growth or stunting. At birth, neonates have large stores of zinc, accounting for 25% of the total zinc in the body. These zinc stores diminish to a steady level up to four months of age. The primary source of zinc is the mother's milk. The highest zinc content in breast milk is contained in colostrum, around 8 mg per 1 L, and decreases speedily in the early week of lactation, up to 50% of the initial concentration on the 7th day of lactation, 2 mg per 1 L at two months, 1 mg per 1 L at six months and becomes 0.5 mg/L at 12 months [15], [16]. The regulation of zinc concentration in the mother's milk comes from the maternal serum, which is carried to be synthesized in the production of the mother's milk in the mammary glands. Low zinc levels can also be caused by the disruption of zinc transporters [17].

2. RESEARCH METHOD

This research has gone through an ethical review procedure at the University of Jambi and was declared feasible to be carried out with a Certificate of Passing the Ethics Review Number: 1976/UN21.8/PT.01.04/2022. The research design used a quasi-experiment consisting of control (A) and intervention groups. Furthermore, the intervention group was divided into two, the group given moringa leaf extract (B) and the group given the banana flower extract (C). The total sample was 30 respondents, in which each group consisted of 10 respondents; 10 respondents as the group of control, 10 respondents as the intervention group with moringa leaf extract, and 10 respondents as the intervention group with banana flower extract. The sample could be representative to observe the minimum effect size using three different treatment groups [18]. The sample inclusion criteria are as follows: postpartum mothers on days 1 to 7; breastfeeding their babies exclusively; history of normal delivery; upper arm circumference ≥23.5 cm; babies born at term; infant's weight ≥2,500 grams; willing to participate in this study. The criteria for sample exclusion are mothers with smoking profiles, consuming alcohol; mothers taking herbs or medicines to increase the production of breast milk; mothers in an emergency; babies with congenital abnormalities, and emergency departments. Moringa leaves (*Moringa oleifera*) and banana flowers (*Musa Paradisiaca L.*) extracts were produced by experts at the Pharmaceutical Chemistry Laboratory of Harapan Ibu Jambi Health and Sciences Institution. The extraction results were delivered to respondents for consumption.

This study aimed to determine the distinction in the production of breast milk in the control group, the group consuming extract from moringa leaves, and the group consuming extract from banana flowers, as well as to analyze the content of iron and zinc in the breast milk of each group. Iron and zinc analysis in breast milk was carried out at the Regional Health Laboratory in Jambi Province using the atomic absorption spectrophotometry (AAS) method. Data were analyzed using 1-way-ANOVA. Group A as the control group was not given any treatment. Group B and group C as the treatment group of moringa leaf and banana flower extracts, respectively, consumed them 500 mg/day for 14 days. Evaluation of the results was obtained on the 15th day of the intervention on milk production and iron and zinc contents in the mother’s milk. Evaluation of the milk production was observed from: the frequency of breastfeeding; baby's weight; baby’s pee and poop; and baby’s bedtime.

3. RESULTS AND DISCUSSION

3.1. Respondents’ characteristics

The respondent characteristics in this study were observed from the mother's age, last education, parity, frequency of breastfeeding, baby's weight, baby's pee and poop, and number of hours of sleep. The results of the analysis of the respondent characteristics are exhibited in Table 1. It is known from the table that the age of most respondents with age not at risk was 21 respondents (70%). The most recent education characteristics were secondary education, and junior/senior high school, with a total of 25 respondents (84%), the parity characteristics of most respondents experiencing multipara parity were 20 respondents (67%), the characteristics of the frequency of breastfeeding were mostly with a good frequency of breastfeeding (≥ eight times/day) as many as 21 respondents (70%), the characteristics of the baby's weight mostly experienced an increase in body weight were 29 babies (97%), the characteristics of the most baby’s poop had good bowel movements (2-5 times/day) in 25 babies (83%), the characteristics of baby’s pee were mostly having good bowel movements (6-8 times/day) in 26 babies (87%), the characteristics of the number of hours of sleep mostly experienced hours of sleep >3 hours after breastfeeding as many as 24 babies (80%).

Adequacy of breast milk for infants is very necessary because this method is the most appropriate way to reduce mortality due to illness in infants. Factors related to the results of the adequacy of breast milk are the mother’s age, last education, parity, frequency of breastfeeding, baby’s weight, baby’s bowel movements, and the number of hours the baby sleeps. The understanding of the mothers regarding the adequacy of breast milk corresponds to age, parity, and mother’s education. Reproductive age allows mothers to find out and seek new experiences related to the need of the babies, including the sufficiency of the mother’s milk. The higher the mother’s education level, the more open she is to new information. Mothers with multigravidas understand more about signs of insufficient breast milk than primigravidas because mothers know from previous experience. Signs of insufficient breast milk are the frequency of breastfeeding ≥8 times, the baby’s weight increases, the baby defecating 2-5 times/day, the baby urinating 6-8 times/day, the baby sleeping ≥ hours the baby sleeping after feeding. The results showed that most babies consume adequate breast milk [2], [5].

3.2. Average levels of iron and zinc in breast milk

The mean levels of iron and zinc in the mother’s milk were assessed build upon the analysis of the mother’s milk samples using the AAS. Breast milk samples were obtained after given of moringa leaf and banana flower extracts for 14 days. Breast milk samples were obtained on the 15th day for the control and the intervention groups. The difference in mean levels of iron and zinc in the mother’s milk is calculated using 1-way ANOVA data analysis as presented in Table 2.

Table 1. Respondent characteristics (n=30)

Characteristics	f	%
Age		
Risk	9	30
No risk	21	70
Total	30	100
Last education		
No school/elementary school	2	6
Junior/senior high school	25	84
Diploma/bachelor/master/other	3	10
Total	30	100
Parity		
Primipara	10	33
Multipara	20	67
Total	30	100
Breastfeeding frequency		
Good (≥8 times/day)	21	70
Not good (<8 times/day)	9	30
Total	30	100
Baby's weight		
Increase	29	97
Not Increasing	1	3
Total	30	100
Baby's Poop		
Good (2-5 times/day)	25	83
Not good (1 or >5 times/day)	5	17
Total	30	100
Baby's Pee		
Good (6-8 times/day)	26	87
Not Good (<6 times or >8 times/day)	4	13
Total	30	100
Baby bedtime		
≥ 3 hours of sleep after being breastfed	24	80
< 3 hours of sleep after being breastfed	6	20
Total	30	100

Table 2. Average based on the studied variables (n=30)

Variable	Group	Mean ± SD	p-values
Zinc levels in breast milk	Control	0.037420 ± 0.0144486	
	Moringa leaf extract	0.026890 ± 0.0037153	0.160
	Banana flower extract	0.026480 ± 0.0052958	
Fe levels in breast milk	Control	0.053020 ± 0.0101707	
	Moringa leaf extract	0.072640 ± 0.0972192	0.497
	Banana flower extract	0.042340 ± 0.0055928	

Table 2 presents the mean Zn levels in breast milk, 0.037420 for the control group, 0.026890 for the moringa leaf extract group, and 0.026480 for the banana flower extract group. Meanwhile, the average Fe content in breast milk was 0.053020 for the control group, 0.072640 for the moringa leaf extract group, and 0.042340 for the banana flower extract group. The analysis results with the 1-way-ANOVA test on the variable levels of zinc in the mother's milk in the control group were higher than the moringa leaf extract and banana heart extract groups. The p-value of the statistical test results was 0.160. This result indicates that there is no considerable distinction in zinc levels in breast milk among the control, moringa leaf extract, and banana flower extract groups. However, the iron levels in the mother's milk in the moringa leaf extract group were higher compared to the banana flower extract and control groups. The p-value of the statistical test results was 0.49. This figure indicates that there is no considerable distinction in iron levels in breast milk among the control, moringa leaf extract, and banana flower extract groups.

Zinc (Zn) is a pivotal nutrient, especially in the early growth of newborns. Zinc affects the immune system functions and is necessary for the growth of the baby. In addition, zinc also serves as a cofactor in various enzymes that work in the body. The average absorption of zinc in breast milk by the baby's body is about 50%. Thus, the baby's zinc needs are at least fulfilled in the early few months, even though the amount of zinc moved from the mammary glands to the breastfed baby declines as the lactation period proceeds [19], [20]. Furthermore, zinc is considered the initial limiting nutrient in mother's milk because of the effect of a very large reduction in zinc levels from colostrum to mature breast milk. The zinc levels are around 4 mg per day on the initial day postpartum, which decreases to around 0.7 mg per day when the breast milk is mature at six months postpartum [21]. Zinc deficiency does not show specific symptoms, such as decreased immune response, growth failure in infants, lack of appetite, dermatitis, and irritability. Diagnosing zinc deficiency is still very difficult because zinc does not have a sensitive biomarker causing differentiation to increase the incidence of stunting [11], [22], [23]. In the first 4-6 months of lactation periods, the zinc content of the mother's milk is higher in maternal plasma. However, the zinc secretion transportation mechanism in the mother's milk cannot be explained. Zinc is absorbed from the food consumed by women around 31% but can be doubled during breastfeeding in reaction to the excretion of zinc in the mother's milk [15], [24].

The composition of breast milk besides zinc is iron, which has an important role even though it is secreted in small amounts in breast milk. Newborn full-term babies possess a Fe content of around 75 mg per kg which causes the baby's hemoglobin level to be proportional to their body weight and have a high blood volume. Infants who receive exclusive breast milk have the main source of iron, which derives from their body deposits. This may is caused by the iron content in the mother's milk is still too small. Based on the Institute of Medicine Dietary Reference Intakes (DRIs), babies aged less than six months have an average iron level in breast milk of 0.27 mg/day [11], [13], [25]. Compared to iron levels in the mother's serum, the content of iron in the mother's milk was lower. The iron level in colostrum was around 8 µg/ml; in mature mother's milk, around 0.2-0.4 µg/ml [12], [14]. Adequate iron levels within the body present a pivotal role in the neurological and physical development of the baby. Iron deficiency in the body develops through three stages, namely iron depletion, iron deficiency erythropoiesis, and iron deficiency anemia. The development of central conditions in infants is greatly affected by the role of iron during infancy. The deficiency of iron in infancy can result in lower cognitive value than babies with normal iron levels [26].

There are signs of insufficient milk in breastfeeding babies, namely the baby looks bored, restless, and fussy, the skin color becomes slightly yellowish, makes clicking sounds, urinates little, and the color of urine is yellowish [27], [28]. An increase in the mother's milk production can be known from the increased baby's weight, breastfeeding frequency, long hours of baby sleep, urination and defecation frequencies, and the mother's rest [29]. Breastfeeding with a frequency of feeding the baby more than eight times or more in 24 hours, the baby's weight is increasing, the baby's poop is 2-5 times in 24 hours, baby's peeps 6-8 times in 24 hours can guarantee sufficient milk [30], the baby will sleep peacefully and soundly for 2 to 3 hours after feeding or no less than three hours [29]. Adequacy of breast milk can be achieved by consuming nutritious foods, getting enough fluids daily, and eating foods or vegetables that contain lactogogum (galactagogue). Moringa leaves (*Moringa oleifera*) and banana flower (*Musa paradiciasa L.*) are herbal galactogogues that can increase the amount of breast milk [31], [32]. This herbal galactogogue can be selected for breastfeeding mothers as the best option for increasing breast milk. Lactogogum is a substance or drug capable of promoting and facilitating the secretion of the mother's milk. Increased mother milk production is affected by the availability of polyphenols and steroids, which will stimulate the prolactin reflex to excite the alveoli, which work actively in influencing the hormone oxytocin, which makes more milk be produced compared to before consuming herbal galactogogue. There will be stimulation of neurohormonal on the mothers' nipples and aerola when the baby suckles on the mother's nipple. This stimulates the prolactin hormone to produce breast milk, called the prolactin reflex. Stimulation that occurs will be transmitted to the pituitary through the vagus nerve, which will be forwarded to the anterior lobe. In the anterior lobe, the hormone prolactin will be secreted, causing breast milk to be produced. The prolactin hormone will enter the circulation of the blood and reach the mammary glands to secrete milk [33], [34].

This study has research limitations. This limitation leads to a small sample size, which may limit the representativeness of the study findings. Large samples require high costs and relatively long investigation. Meanwhile, this study is limited in time and cost. Limitations on the selection of sample criteria because we use breast milk, which some prospective respondents refuse to become respondents because they are embarrassed and worried about the capsules provided by the researchers even though they have been given counseling, so they have to be eliminated. Another limitation of this study is that only one AAS is used to analyze iron and zinc levels, requiring long queues with other researchers.

4. CONCLUSION

There were distinctions in the mean levels of iron and zinc in breast milk among the control, the moringa leaf extract, and the banana flower extract groups. Zinc and iron are needed for the growth and development of the babies found in breast milk. The production of the mother's milk was optimized to meet the needs of the baby with the nutrients needed. Moringa leaves and banana flowers could be used as herbal galactogogues to overcome the problem of small amounts of breast milk production. There was no notable distinction in the mean levels of zinc and iron in the mother's milk among the control, moringa leaf extract, and banana flower extract groups. However, by consuming galactogogue herbs, breast milk production increased. The findings from this study could be used as a crucial point to increase public awareness about stunting prevention through the adequacy of breast milk by consuming herbal galactogogue, which is available easily in the surrounding environment. We recommended all relevant agencies help disseminate information about moringa leaves and banana flowers, containing substances to increase breast milk production, although the results of this study on zinc and iron showed no statistically significant difference. The policies that would be taken could intensify exclusive breastfeeding coverage and reduce the stunting event.

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BIOGRAPHIES OF AUTHORS

Rini Mustikasari Kurnia Pratama is a lecturer in the midwifery at the University of Bengkulu. She is interested in research and is still learning to fulfill her dream as a researcher. She has received research grants three times in a row starting from 2020 to 2022. Of the two researches in the novice lecturer research scheme funded by The Ministry of Research and Higher Education Technology (*Kemristek*/BRIN), and one research with a collaborative research scheme between universities, in collaboration with Eleven Maret University, which is funded by The Ministry of Education and Culture, Indonesia (*Kemdikbud*). She is currently preparing a research proposal for a future research grant. In this study, he was the lead researcher. She can be contacted at email: rini.mazin@gmail.com.

Ayu Mustika Handayani was born in Petran Jaya, May 15, 1992. Completed his studies at the Diploma in Midwifery at Sekolah Tinggi Ilmu Kesehatan Tri Mandiri Sakti in 2012, then continued his bachelor of midwifery program at the same place in 2013, graduated Master of Public Health at the Sekolah Tinggi Ilmu Kesehatan Bina Husada in 2016. Currently a permanent lecturer in the Midwifery Study Program Professional Program and serves as chair of the Institute for research and community service at the Sekolah Tinggi Ilmu Kesehatan Keluarga Bunda Jambi. Currently she also a regional administrator for the Indonesian Journal Volunteers Association Jambi. As a team of wrinters on the textbook of Postpartum Midwifery and Breastfeeding Care which has been compiled with the team and is currently in the process of being published. She can be contacted at email: ayu.muha@gmail.com.

Lili Andriani is a lecturer and a researcher at Sekolah Tinggi Ilmu Kesehatan Harapan Ibu Jambi. She is interested in exploring biological activities of Indonesia plants. She can be contacted at email: liliandriani116@gmail.com.

Ahmad Yunus is a professor of biotechnology at the Faculty of Agriculture and Vice Rector for Academic and Student Affairs at Universitas Sebelas Maret, Surakarta, Indonesia. Prof. Yunus is an active researcher, he has more than 90 Scopus indexed journal publications. He can be contacted at email: yunus@staff.uns.ac.id.

Revi Gama Hatta Novika is a Junior lecturer at Bachelor Midwifery, Faculty of Medicine and Master of Public Health at Sebelas Maret University since July 2020. She received her doctoral degree from Faculty of Medicine Airlangga University, Indonesia. Her research interest is on reproductive immunology. Dr. Revi is the COVID-19 consortium member of the Indonesian National Research and Innovation Agency (BRIN). She is an active junior researcher, every year, Dr. Revi receives research grants from both internal and external institutions. She has won a Gold and Diamond medal in 2021 British Invention Show, London and Gold Medal in 2021 International Invention, Innovation & Technology Exhibition, Malaysia. She can be contacted at email: revi.gama@staff.uns.ac.id.