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The effectiveness of Moringa leaf extract capsules since preconception on Docosahexaenoic acid (DHA) levels in breast milk of three months breastfeeding mothers

Suci Qardhawijayanti

Midwifery Study Program, Graduate School, Hasanuddin University, Makassar, Indonesia

Email: qardhawijayantis20p@student.unhas.ac.id

Mardiana Ahmad

Department of Midwifery, Graduate School, Hasanuddin University, Makassar, Indonesia

Corresponding author email: mardianaahmad@pasca.unhas.ac.id

Veni Hadju

Department of Nutrition, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia

Email: phunhas@gmail.com

Andi Nilawati Usman

Department of Midwifery, Graduate School, Hasanuddin University, Makassar, Indonesia

Email: andinilawati@pasca.unhas.ac.id

Healthy Hidayanti

Department of Nutrition, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia

Email: hhidayanti@yahoo.com

Sri Ramadhani

Lecturer of the Medical Profession Study Program, Hasanuddin University, Makassar, Indonesia

Email: sriramadhanifk@gmail.com

Handayani Halik

Hasanuddin University Medical Research Center, Hasanuddin University Hospital, Indonesia & Megarezky University

Email: handayanihalik@gmail.com

Abstract---Introduction: Moringa leaf extract is a local food source that can affect the level of DHA in the breast milk of nursing mothers. This study aims to analyze the effectiveness of Moringa leaf extract capsules on levels of Docosahexaenoic Acid (DHA) in the breast milk of 3 months breastfeeding mothers. Method: This quantitative study is an observational study with a retrospective Cohort study approach (follow-up study). The design used was post-test control by analyzing the difference in DHA levels in the group given Moringa leaf extract capsules + Iron-Folic Acid (IFA) and the Iron-Folic Acid (IFA) group with 32 respondents (nursing mothers). In detail, 16 respondents given Moringa leaf extract capsule + Iron-Folic Acid (IFA) and 16 respondents given Iron-Folic Acid (IFA). Besides, the breast milk samples were examined by using Enzyme-Linked Immunosorbent Assay (ELISA) technique and were then analyzed using SPSS version 23. Results: The results indicated that there were differences in the levels of Docosahexaenoic Acid (DHA) in the breast milk of breastfeeding mothers for three months between the group given Moringa leaf extract capsules + Iron-Folic Acid (IFA) 3046 ± 1716 and the group given Iron-Folic Acid (IFA) 1188 ± 1026 . The changes in the two groups indicated a significant difference with the p-value of 0.001 ($p=0.001$). In other words, the average DHA level in the group given Moringa leaf extract capsules + Iron-Folic Acid (IFA) was higher with a P-value was lower than 0.05 ($P < 0.05$). Conclusion: The administration of Moringa leaf extract capsules from preconception to pregnancy effectively increased the levels of Docosahexaenoic Acid (DHA) in the breast milk of 3 months breastfeeding mothers.

Keywords---Moringa leaves, DHA levels, breastfeeding mothers, breast milk.

Introduction

Moringa leaves (*Moringa Oleifera*) is a local Indonesian plant that has the potential to be developed as a culinary for nursing mothers. The compound contains phytosterols (included in the steroid group), which increase and accelerate milk production (lactogogum effect)^{1,2}. *Moringa Oleifera* is referred to as "The Mother's Best Friend" because of its ability to increase the production of breast milk and prolactin hormones and is helpful as a nutritious plant and medicine.³⁻⁶ Moringa leaf extract is a local source that can affect the level of DHA in the breast milk of nursing mothers³. A study⁷ stated that the concentration of DHA in breast milk was positively related to maternal DHA intake during pregnancy.

Moringa leaves can increase the volume of breast milk (ASI) by increasing prolactin and providing essential nutrients⁸⁻¹⁰. Previous studies have proven that Moringa leaf extract capsules can prevent malnutrition and low birth weight in babies^{11,12}. Moringa leaves have also been shown to improve the quality of breast milk¹³. The food consumed by the mother strongly influences the production and quality of breast milk (ASI).

The level of DHA in breast milk is primarily determined by the mother's blood level and is influenced by the mother's intake¹⁴. DHA has essential health benefits for pregnant and lactating women. Breastfed babies with a higher DHA content will have better vision and neurodevelopment, motor skills, and cognitive development^{14,15}. DHA deficiency can cause defects in the central retinal cones that adversely affect eye health¹⁶. DHA deficiency can also impact reducing Intelligence Quotient (IQ) scores in children¹⁷.

Breast milk contains the fatty acid Docosahexaenoic acid (DHA) needed for brain development¹⁸. Infants who were not exclusively breastfed had a 3.824 times higher prevalence of developing into infants with cognitive abnormalities than those who were exclusively breastfed¹⁹. A study conducted by Sarih et al. (2020) showed that DHA level in exclusively breast milk was significantly associated with cognitive development scores. Moringa leaf extract can be a choice to replace iron-folic acid for the fulfillment of ALA and LA fatty acids for pregnant and lactating women.

Various nutritional content contained in Moringa leaves has been proven in several studies. Thus, Moringa leaves can be used as an herbal ingredient to help increase the nutritional adequacy of mothers and babies and the levels of DHA in breast milk. A study suggests that the steeping water of Moringa leaves affects increasing breast milk production in postpartum mothers²⁰. In addition, other studies also suggest that the consumption of Moringa cake can improve the quality of breast milk, especially protein levels¹³. This study aimed to analyze the effectiveness of Moringa leaf extract capsules on the levels of Docosahexaenoic Acid (DHA) in the breast milk of three-month-old breastfeeding mothers.

Method

This quantitative study is observational with a retrospective Cohort approach (follow-up study). The design used was a post-test control by analyzing the difference in DHA levels between the Moringa leaves extract capsule + iron-folic acid (IFA) group and iron-folic acid (IFA)group. This study was carried out in North Polombangkeng District, Takalar Regency, South Sulawesi Province, and at the Hasanuddin University Hospital Research Laboratory from February to March 2022 with ethical approval recommendation number 1320/UN4.14.1/TP.01.02/2022, which has been issued by the Faculty of Public Health, Hasanuddin University.

The subjects were 32 samples divided into two groups, 16 respondents in the Moringa leaf extract capsule + iron-folic acid (IFA)group and 16 respondents in the iron-folic acid (IFA)group. In the first group, breastfeeding mothers were given capsules of Moringa leaf extract + iron-folic acid (IFA)of 500 mg each, once per week during the preconception period and every day or at least 90 capsules during pregnancy. In the second group, breastfeeding mothers were given iron-folic acid (IFA)of 500 mg once per week during the preconception period and every day or at least 90 capsules during pregnancy. DHA examination employed the Elisa kit (Enzyme-Linked Immunosorbent Assay), which was carried out at the Hasanuddin University Hospital Research Laboratory. The data were analyzed using the SPSS application (Statistical Product and Service Solutions, version 22)

with descriptive statistics (mean, standard deviation, and percentage) and analytical tests using the Mann Whitne Test, Shapiro-Wilk Test, Fisher's Exact Test, and Chi-square Test.

Results

The results of statistical tests on all characteristics showed no significant difference in age, education, occupation, and the BMI of the mother between the Moringa leaf extract capsules + iron-folic acid (IFA)group and iron-folic acid (IFA)group ($p>0.05$). It means that all the characteristics that are sampled are homogeneous. In other words, the results of the study and the Moringa leaf extract capsules were not influenced by the characteristics of the sample. Table 2 below shows a difference in the mean value of DHA levels between the Moringa leaf extract capsule + iron-folic acid (IFA)group and the Iron Folic Acid (IFA)group. The mean DHA levels in the Moringa iron-folic acid (IFA) group were 3046 ± 1716 higher than the iron-folic acid (IFA) group of 1188 ± 1026 . From the statistical test using the Mann Whitney test, the p -value = 0.001 ($P < 0.05$). It showed a significant difference in the mean value of DHA levels between the Moringa leaf extract capsules + iron-folic acid (IFA)group and iron-folic acid (IFA)group.

Table 1 Characteristics of respondents on Moringa leaf extract capsules + Blood Enhancer Tablets Group and placebo capsules + Blood Enhancer Tablets Group

Characteristics of Respondents	Moringa Leaf Extract Capsules + IFA		IFA		Total		p-value
	n	%	n	%	n	%	
Age							
<20 and >35 years old	1	6,3	1	6,3	2	6,3	1,00 ^a
20-35 years old	15	93,8	15	93,8	30	93,8	
Education							
Junior High School	1	6,3	0	0	1	3,1	0,529 ^b
High School	11	68,8	11	68,8	22	68,8	
University/Higher Education	4	25,0	5	31,3	9	28,1	
Occupation							
Employed	5	31,3	3	18,8	8	25,0	0,685 ^a
Unemployed	11	68,8	13	81,3	24	75,0	
Breastfeeding							
Breast Milk	15	93,8	10	62,5	25	78,1	0,083 ^a
Breast Milk + Formula	1	6,3	6	37,5	7	21,9	

Milk Breastfeeding Frequency Sufficient	15	93,8	11	68,8	26	81,3	0,172 ^a
Insufficient	1	6,3	5	31,3	6	18,8	
Contraceptive Use							
1 Month Injectable Contraception	4	25,0	2	12,5	6	18,8	0,383 ^b
3 Months Injectable Contraception	5	31,3	4	25,0	9	28,1	
No Contraception	7	43,8	10	62,5	17	53,1	
Maternal BMI							
<18,5 (underweight)	6	37,5	2	12,5	8	25,0	0,110 ^b
≥18,5 - <25 (normal)	9	56,3	12	75,0	21	65,6	
≥ 25 - < 27 (overweight)	1	6,3	1	6,3	2	6,3	
≥ 27 (obesity)	0	0	1	6,3	1	3,1	

^aFisher's Exact Test

^bChi square test

Table 2 Differences in Docosahexaenoate (DHA) levels between the Moringa leaves extract capsule + Blood Enhancer Tablets group and placebo capsules + Blood Enhancer Tablets group

Study Group	n	DHA levels (pg/ml) Mean ± SD	P-Value*
Moringa leaves extract capsule + iron-folic acid (IFA)	16	3046 ± 1716	0,001
iron-folic acid (IFA)	16	1188 ± 1026	

*Mann Whitney Test.

Discussion

The characteristics of respondents in this study were age, education, occupation, breastfeeding, frequency of breastfeeding, contraceptive use, BMI, and nutritional intake of 3 months breastfeeding mother's diet consisting of energy, carbohydrates, protein, and fat. The majority of respondents consisted of 93.8% mothers aged 20-23 years, 68.8% of mothers' education was high school, 75% of mothers were unemployed, 78.1% of mothers gave breast milk, 81.3% of mothers breastfed with sufficient frequency, 53, 1% of mothers do not use contraception, and 65.6% of mothers have a normal BMI (18.5 - <25).

The study results found a significant difference ($p=0.001$) between the Moringa leaf extract capsule + iron-folic acid (IFA) group and the iron-folic acid (IFA) group. The mean level of Docosahexaenoic Acid (DHA) in the Moringa leaf extract capsule + iron-folic acid (IFA) group was higher than in the iron-folic acid (IFA) group. Thus, giving Moringa leaf extract capsules increased DHA levels in three months breastfeeding mothers. This result is supported by the results of a previous study conducted by Ary et al. (2021) which found a more significant increase in DHA levels in experimental animals given Moringa leaf extract than in the control group ($p < 0.05$).

Another study conducted by Sharmin et al. (2020) found that the addition of Moringa leaf flour can increase DHA levels and improve fatty acid levels in experimental animals due to the antihyperlipidemic activity of phenolic acids lipid homeostasis and fatty acid synthase enzymes. According to World's leading Experts on Lipids, the minimum DHA requirement for pregnant and lactating women is 300 mg per day. One of the basic parenting styles for babies less than six months old is caring for and providing adequate food. Breast milk contains a lot of DHA, which is needed for brain development in children, especially children under two years of age²³.

The results showed a difference in the mean levels of DHA in the breast milk of three months breastfeeding mothers, 3046 in the Moringa leaf extract + iron-folic acid (IFA) group, and 1188 in the iron-folic acid (IFA) group. The difference in mean in the two groups could be possible because the placebo capsules + Blood Enhancer Tablet group were not given Moringa leaf extract once per week before pregnancy and every day or at least 90 capsules during pregnancy. In addition, infants obtain most of their DHA through breast milk and/or formula during the first months, where breast milk DHA levels depend on maternal DHA stores and DHA intake while the mother is breastfeeding²⁴.

Moringa leaves contain ALA (linolenic acid), one of the essential fatty acids. There is a metabolic pathway linking ALA to DHA²⁵. The percentage conversion of ALA to DHA needs to be 0.14-0.22% to match the brain's DHA needs. This pathway involves a series of elongation and desaturation reactions catalyzed by enzymes. The elongation enzyme, called elongation, adds a carbon atom pair to the growing acyl chain, which converts an 18-carbon fatty acid to a 22-carbon acid, while the desaturase enzyme inserts a double bond into the acyl chain, which converts a fatty acid with three double bonds in the acyl chain into one fatty acid with six double bonds. These reactions occur mainly in the endoplasmic reticulum. It is

then translocated from the endoplasmic reticulum to peroxisomes, where it undergoes one round of ω -oxidation to form DHA^{25,26}.

Breastfeeding is a period of increasing nutritional needs²⁷. Several nutrients are needed to protect the health of the mother and baby²⁸. Adequate stores of maternal nutrition from preconception and pregnancy are necessary for the period of breastfeeding and good general health²⁹. During the last trimester of fetal life and the first two years of childhood, the brain undergoes a period of rapid growth. Optimal neurodevelopment requires nutrition of DHA through breast milk. The n-3 fatty acid docosahexaenoic acid (DHA, 22:6n-3) and the n-6 fatty acid arachidonic acid (AA, 20:4n-6) are derived from the essential fatty acid linolenic acid (ALA, 18:3n-3) and linoleic acid (LA, 18:2n-6), which are fundamental structural components in the brain and central nervous system that play an essential role in the growth and development of brain structures³⁰.

Conclusion

The administration of Moringa leaf extract capsules from preconception to pregnancy effectively increased the levels of Docosahexaenoic Acid (DHA) in the breast milk of 3 months breastfeeding mothers. Further research on the benefits of Moringa leaf extract capsules in pregnant women can investigate the effect of Moringa leaf extract on DHA and IQ levels in children.

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