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Article Review

Effect of Moringa Leaves (Moringa oleifera) on Anemia, Hormones and Breast Milk Production in Women of Childbearing Age: Literature Review

Luh Putu Widiastini*, I Gusti Agung Manik Karuniadi
Study Program of Midwifery, Institute of Health Science-Bina Usada, Bali, Indonesia
*Corresponding author: enick.dilaga@gmail.com

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ABSTRACT

This study was conducted to analyze the effect of moringa leaves on anemia, hormone production and breast milk production in women of childbearing age. The method used was a literature study, by summarizing scientific evidence about the potential of moringa leaves for women's reproductive health. This literature study was conducted in May and June 2023, utilizing databases from Google Scholar, PubMed, and ScienceDirect. The number of articles obtained was 12 articles that fit the criteria, namely, research with the provision of moringa leaf interventions to women. The articles used were in English and Indonesian with the limitation of the year of publication 2019-2023. The population in this study varied, one study on rat norvegicus wistar strains, two studies using white rabbits and nine studies providing interventions in humans. The number of samples ranged from 30-100 respondents. The high content of nutrients makes Moringa have functional properties for health and overcomes nutritional deficiencies in women of childbearing age, such as maintaining the balance of reproductive hormones, increasing hemoglobin levels, reducing the incidence of anemia, and increasing breast milk production. Further research is needed to ensure the optimal dose, duration of administration so as to improve reproductive health in women.

INTRODUCTION

Reproductive health is a condition of whole physical, mental, and social well-being, not merely the absence of sickness or impairment, in all aspects about the reproductive system and its functions and processes.[1] The quality of the next generation will be determined by the health condition of the mother before and during pregnancy will be closely related to the quality of pregnancy and the baby to be born. According to research by Laikodat et.al. (2021), problems related to women's reproductive health in Indonesia are increasingly complex, such as cervical cancer, breast cancer, menstrual disorders, anemia, fertility disorders, and breast milk production, which over the years have always made women the main target.[2]

According to reasearch by Miraturrofi'ah (2020) and Alam., *et.al* (2021) nutritional status is significantly associated with reproductive health.[3,4] Women of childbearing age (WUS) are one of the important target groups in nutrition improvement programs. According to reasearch by Maedy, *et.al* (2022) Women who are undernourished or overnourished and obese are at risk of decreased hypothalamic function, which leads to decreased production of luteinizing hormone and follicle stimulating hormone.[5] The impact of malnutrition on women of childbearing age includes menstrual disorders, anemia, infertility, pregnancy disorders, fetuses, and decreased

milk production during breastfeeding. Utilization of natural materials can be developed to improve nutritional status, thereby enhancing reproductive health, one of which is Moringa leaves.

Moringa plants are one type of tropical plant that is easy to breed because it does not require intensive care and have high drought tolerance. The high nutritional content makes Moringa has functional properties for health and overcoming dietary deficiencies. According to reasearch by Widiastini *et.al* (2021), moringa is a useful plant that is widely used as a medicinal plant and food so it is called the Amazing Tree and the Miracle Tree.[6] Moringa oleifera, according to Purba (2020) has several pharmacological potentials, namely antimicrobial, antioxidant, food nutrition, anticancer and antidiabetes.[7] Moringa is reported to contain about 90 different types of nutrients, including essential vitamins, minerals, amino acids, anti-aging compounds, and anti-inflammatory compounds. According to Ekawati, *et.al.* (2022), moringa contains 539 compounds known in traditional African and Indian medicine and has been used in traditional medicine to prevent more than 300 diseases.[8]

According to research by Widiastini *et.al* (2021), the results of phytochemical tests conducted on Moringa leaves in the South Denpasar area of Bali found that ethanol extracts of Moringa Oleifera leaves have antioxidant capacity, including phenolics, flavonoids, tannins, vitamin C, alkaloids, and saponins.[6] Based on the above problems, the author conducted a literature review to determine the utilization of Moringa oleifera for reproductive health in women of childbearing age.

METHODS

This literature study was conducted in May-June 2023 by utilizing databases from google scholar, pubmed, science direct with the keywords Moringa oleifera, reproductive health, women. The number of articles obtained was 12 articles that fit the criteria, namely research with the provision of Moringa leaf interventions to women. The articles used were in English and Indonesian with the limitation of publication years 2019-2023. The population in this study varied, one study on rat norvegicus wistar strains, two studies using white rabbits and nine studies providing interventions in humans. The number of samples ranged from 30-100 respondents. The procedure of searching and reviewing literature could be seen in Figure 1

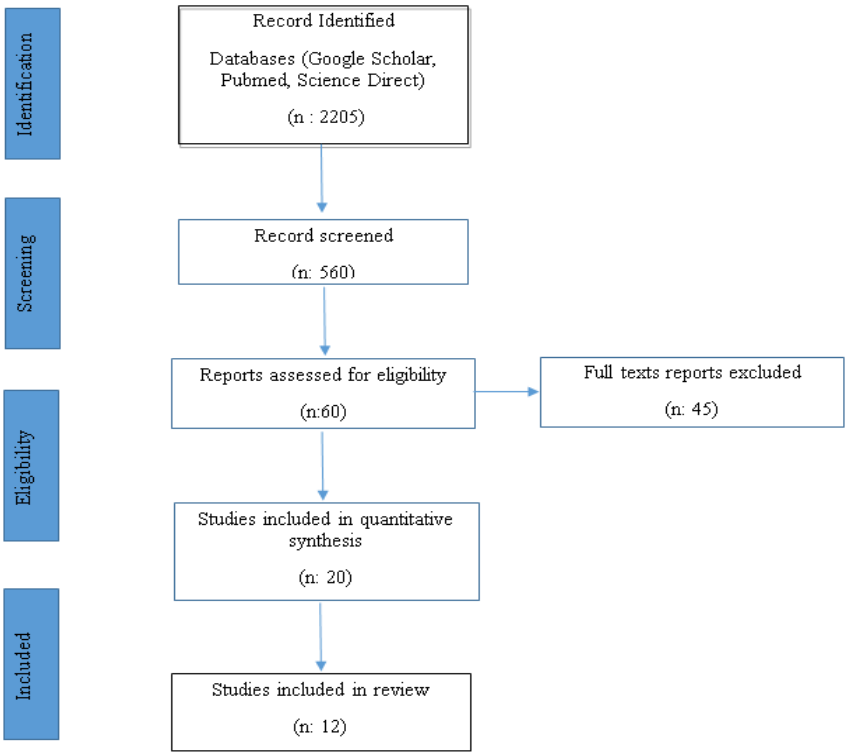

Figure 1. Flowchart based on PRISMA statement

Research implementation:
There were 2,205 journals selected from three big database sources, Google Scholar, PubMed, and Science Direct, with the keywords Moringa oleifera, reproductive health, and women, from 2019 to 2023. Through the screening of abstracts and full text, there were 45 research articles. However, only 12 articles met the inclusion criteria, which were then reviewed.

RESULTS

Table 1. Articles reviewed

No	Researcher Name and year	Research Title	Journal	Research Methods	Results
1	El-kashef. 2022 [9]	Evaluation Of Using Moringa Oleifera Leaves Meal On Physiological Response, Hormonal Changes and Variance In Reproductive Activity Outcomes On Female Rabbits	Egyptian Poultry Science Journal	Design an experiment, 40 Six-month-old New Zealand White (NZW) rabbits were randomly assigned to one of four equal treatment groups. Their average body weight was 2500 100 g. A basal diet was given to group 1 (the control). The second, third, and fourth treatments each received a base diet supplemented with 2.5, 5 or 7.5% MOLM. The diets were made available for use during the investigation. Each female rabbit was given a blood draw at the conclusion of the experiment at the age of nine months from a vein in her marginal ear for biochemistry, hematological, and hormonal testing.	In addition to blood constituents, particularly serum FSH, LH, estrogen, and progesterone hormones, using moringa leaves up to 7.5% in rabbit feed can improve reproductive performance, including sexual receptivity, fertilization rate, litter size, weight at birth, and milk production. It also helps maintain health and integrity.
2	Valence B. Mutwedu, Albert W. Nyongesa, Jafred M. Kitaa, Rodrigue B. B. Ayagirwe, Chasinga Baharanyi and James M. Mbaria 2022 [10]	Efects of Moringa oleifera aqueous seed extracts on reproductive traits of heat-stressed New Zealand white female rabbits	Sec. Animal Reproduction journal	The following four treatment groups—temperature, relative humidity, temperature humidity index, and M. oleifera seed extract—were each given twenty-eight 6-month-old female rabbits at random: T0: ambient temperature (18–24 C), 59–0.48%, 23.6–1.52; T1, T2, and T3: 35–36 C, 64–0.6%, 32.5–0.7; then 100–200 and 0 mg/kg b.w. of M. oleifera seed extract, respectively. Each rabbit cage received artificial warmth from 08:00 to 16:00. At the conclusion of the 80-day experiment, all animals were slaughtered, and blood was taken for hormonal analysis and ovarian tissues for histology.	Moringa oleifera seed water extract has high antioxidant activity that functions to minimize the adverse effects of heat stress that cause reproductive disorders in female rabbits
3	L P Wulandari, A Hapsari, 2019 [11]	The Effect of Moringa oleifera Leaf Extract on Theca Cell in Polycystic Ovary Syndrome Model	Surabaya International Health Conference	Three-month-old female Wistar Rattus norvegicus rats weighing 100-130 grams totaling 40 were divided into 5 groups (n=8). PCOS model was obtained by injecting testosterone propionate for 28 days, followed	Moringa oleifera leaf extract as an antioxidant was shown to reduce the thickness of the teka cells of female PCOS model rats.

No	Researcher Name and year	Research Title	Journal	Research Methods	Results
		with Insulin Resistance		by metformin therapy and Moringa oleifera leaf extract 250 and 500 mg/KgBB for 14 days. Then, we analyzed theca cell thickness. Statistical analysis using One Way Anova was performed with IBM SPSS Statistics version 24.00. Ovarian histology examination showed that Moringa oleifera leaf extract 500 mg/KgBB (0.931±0.457) decreased theca cell thickness significantly ($p<0.05$) compared to the PCOS control group.	
4	Intani Ega Rarassari, Ribkha Itha Idhayanti, Siti Chunaeni, 2021 [12]	The Effectiveness Of Green Tea and Moringa Tea On The Level Of Dysmenorrhea Pain In Adolescents	Midwifery and Nursing Research (MANR) Journal	This research design uses a quasi-experimental approach with a two group pretest-posttest design approach. Population 40 and sample 32 respondents with accidental sampling technique. sample 16 respondents in the intervention group were given green tea and 16 respondents in the intervention group were given moringa tea.	The results of statistical tests using Mann-Whitney obtained a value = 0.031 (value≤0.05), with a mean rank of green tea = 13.31 and moringa tea = 19.69 so that it can be stated that moringa tea on dysmenorrhea pain levels in adolescents is more effective than green tea intervention.
5	Wilda Rezki Pratiwi 2020 [13]	Effectiveness of Moringa Leaf Tea on Menstrual Cycle and Hemoglobin in Anemic Adolescents	Jurnal Kesehatan Poltekkes Palembang	The type of research used is quantitative research using the pre-experimental method. This research was conducted with the design of the one group pretest-posttest design. Sampling purposive sampling with inclusion and exclusive criteria with a total sample of 30 anemic adolescents.	The results of the Mann Whitney U test on the menstrual cycle with the Hb category before giving moringa tea showed a p value of 0.417, while the menstrual cycle with the Hb category after giving moringa tea showed a p value of 0.82. There is an effectiveness of moringa tea administration on the menstrual cycle and haemoglobin increase in anemic adolescents in Sidrap Regency.
6	Dewi Indah Sari, Afni Yulianti, Ninik Wahyuni 2020 [14]	Effectiveness of Cookies produced from Moringa Oleifera Leaves on Hemoglobin Levels in Students at Miftahul Hayat	The 7th International Conference on Public Health Solo	This was a quasi-experimental study. The sample was 37 students of MTS Miftahul Hayat, Serang, Banten, and were randomly allocated into two groups: intervention and control groups. The dependent variable was the increase in hemoglobin value. The independent variable was anemic students.	Hemoglobin levels before consuming cookies produced from Moringa leaves (Mean = 10.5 gr / dl; SD = 0.56; $p < 0.001$). hemoglobin levels after consuming cookies produced from Moringa Oleifera leaves (Mean = 13 gr / dl; SD = 0.85). The difference in

No	Researcher Name and year	Research Title	Journal	Research Methods	Results
		Islamic Junior High School, Serang, Banten		Data were collected from checklists and analyzed using paired t-test.	hemoglobin levels (Mean = 2.5; SD = 0.88; p < 0.001), and statistically significant (p < 0.001). Conclusion: consumption of cookies produced from Moringa Oleifera leaves is beneficial for increasing hemoglobin levels in adolescents.
7	Manisha Choudhary, SP Singh and Chanchala Rani Patel, 2020 [15]	Effect of Dumstick Leaves Supplementation for Treating Iron Deficiency Anemia in Adolescence Girls	Journal of Pharmacognosy and Phytochemistry	This study uses a pre-experimental type, selected 20 adolescent girls who suffer from iron deficiency anemia. Based on signs and symptoms anemia was diagnosed by cyanmethemoglobin method. As an intervention 25gm of dried drumstick leaf powder was given daily for three months. After three months hematological levels were analyzed and recorded.	The results showed a significant increase in the average Hb level from 9.6 mg/dl before the intervention to 11 mg/dl after the intervention. This simple and cheap technology can be socialized to the community to prevent iron deficiency anemia.
8	Gusti Ayu Tirtawati, Kusmiyati Kusmiyat, Atik Purwandar, Amelia Donsu, Martha Korompis, Wahyuni Wahyuni, Fonnie Kuhu, Femmy Keintjem, Sjenny Tuju, Robin Rompas, Agnes Montolalu 2021 [16]	Moringa oleifera Teabags Increase Hemoglobin in Adolescent Females	Journal of Medical Sciences	The research design was one group pre-post-test, a research approach to ascertain the cause or impact of an intervention, was used in this study. a sample of 100 adolescent females were given M. oleifera teabags twice. the method of administration was one sachet (3g) of M. oleifera teabags added two teaspoons of sugar and 250 cc of hot water, taken in the morning and evening respectively. The treatment period lasted for 30 days. Specifically.	Results: Before the intervention, there was a 10.71 g/dl average increase in Hb (mean). Following a 15-day intervention, it rose to 11.03 g/dl. The average Hb (mean) value after the intervention was 11.63 g/dl, and this result, along with the p-value of 0.000 (p 0.05), shows a significant difference between Hb before and after the intervention.
9	M. B. Shinde, D. R. Waghchoure, S. A. Bhutada, S. B. Dahikar, and R. V. Kshirsaga. 2021 [17]	Efficacy of Moringa oleifera Leaf Extract for the Treatment of Anemia in Girls	Journal of Advances in Medical and Pharmaceutical Sciences	This type of study was experimental. 24 female college students were selected. The formulated moringa extract (Minrich Extract) was given to 10 girls for one month (10 g/day).	Moringa extract (Minrich Extract) has a significant effect on increasing hemoglobin level in girls. Administration of Moringa oleifera leaf extract on a regular basis helps maintain other blood parameters such as WBC, RBC, and platelets within the normal range.
10	Joyce M. Laiskodat, Rini Kundaryanti, Shinta	The Effect of Moringa Oleifera on	Nursing and health Science	Quasy Experimental research design with two group pre-test and post-test design. The study	The results showed that the average hemoglobin of pregnant women before

No	Researcher Name and year	Research Title	Journal	Research Methods	Results
	Novelia 2021 [2]	Hemoglobin Level in Pregnancy Joyce	Journal	population was all pregnant women. The sampling technique was purposive sampling. The research sample was pregnant women with mild anemia as many as 32 people.	intervention in the experimental group was 9.813 g/dl with a standard deviation of 0.57. The hemoglobin level of pregnant women after being given Moringa leaf soup in the experimental group was 11.494 g/dl with a standard deviation of 1.24. The average hemoglobin of pregnant women before intervention in the control group was 9.825 g/dl with a standard deviation of 0.61. The average hemoglobin of pregnant women after the intervention in the control group was 9.675 g/dl with a standard deviation of 1.28. Analysis using t-test obtained a significance value of 0.000 <0.05. It can be concluded that there is a significant effect between the administration of moringa leaf soup on hemoglobin levels in pregnant women TM III.
11	Arie Maineny, Taqwin, Putri Mulia Sakti, Asmawaty 2023 [18]	Combination of Breast Care and Moringa Leaf Tea to Increase Breast Milk Volume	Jurnal Aisyah: Jurnal Ilmu Kesehatan	The design of this study was pre-experimental one group pre-test and post-test. Purposive sampling was used to sample postpartum women on the first day. Wilcoxon test was used in univariate and bivariate analysis.	The results of the study on 15 respondents, 2 (13.3%) breast milk production was smooth and 13 (86.7%) were not smooth before getting breast care and moringa tea. Breast milk production was smooth 13 (86.7%), and substandard 2 (13.3%), after receiving breast care and moringa tea. Wilcoxon test value P = 0.001 (p < 0.05). Postpartum mothers produced more breastmilk on the first day when they combined breast care with moringa tea
12	Siraphat Fungtammasan, Vorapong Phupong 2022 [19]	The effect of Moringa oleifera capsule in increasing breast milk volume in early	European Journal of Obstetrics & Gynecology and	The experiment was randomized, double-blinded, and placebo-controlled. Randomization was used to assign eighty-eight postpartum women to either the study group,	On the third postpartum day, there was no change in the median volume of breast milk between the Moringa oleifera leaf group and the control group (73.5 vs

No	Researcher Name and year	Research Title	Journal	Research Methods	Results
		postpartum patients: A double-blind, randomized controlled trial	Reproductive Biology	which received oral Moringa oleifera capsules, or the control group, which received oral placebo capsules. herefore, a total of 88 women were used for this study.	50 ml, p = 0.19). However, there was 47% more breast milk in the Moringa oleifera group than in the control group. In this study, the Moringa oleifera group's exclusive breastfeeding rate at 6 months was 52.3%, exceeding the World Health Organization's targets. Conclusions: The leaf of the Moringa oleifera plant can be utilized as a galactagogue to enhance the amount of breast milk produced.

DISCUSSION

Moringa leaf utilization on female reproductive hormones

According to research by Simanjuntak (2022), Reproductive health in women of childbearing age is strongly influenced by the balance of reproductive hormones, which can affect menstrual disorders and cause infertility.[20] Based on research done by El-kashef (2022) [9], with the title "Evaluation of Using Moringa Oleifera Leaves Meal on Physiological Response, According to the Study: Hormonal Changes and Variance in Reproductive Activity Outcomes on Female Rabbits." Feeding female rabbits moringa significantly improved their reproductive performance metrics, increasing milk production and conception rates compared to the control group. Additionally, compared to the control group, moringa leaves had an impact on greater levels of reproductive hormones such as FSH, LH, estrogen, and progesterone, as well as a decrease in LDL cholesterol and total cholesterol. This is in line with research done by Mutwedu, *et.al.* (2022),[10] that moringa extract reduces reproductive disorders.

Based on the research done by Wulandari and Hapsari (2019)[11], With the title The Effect of Moringa oleifera Leaf Extract on Theca Cell in Polycystic Ovary Syndrome Model with Insulin Resistance, it was found that moringa leaf extract as an antioxidant was proven to reduce the thickness of theca cells of female rats with polycystic ovary syndrome (PCOS), with the results significantly reducing the thickness of theca cells ($p<0.05$) compared to the control group.

Hormonal disorders in women of childbearing age can also affect menstrual disorders, one of which is dysmenorrhea. Dysmenorrhea is a symptomatic phenomenon during menstruation including pain in the lumbar region, lower abdomen, nausea and vomiting, headache, fatigue, dizziness, fainting, and diarrhea, as well as emotional instability. According to Kartini (2020) Pain during menstruation is a physiological process caused by an increase in prostaglandine hormones [21]. Dysmenorrhea causes physical effects in the form of activity interference due to the pain caused and psychological effects in the form of mood changes, anxiety and stress, these disorders can cause excessive sweating, weakness, sleep disturbances, and loss of appetite according to Marlanti (2021) [22]. Based on the research done by Rarasari, *et al.* (2021),[12] with the title The Effectiveness Of Green Tea and Moringa Tea On The Level Of Dysmenorrhea Pain In Adolescents, obtained the results of moringa effective in reducing dysmenorrhea pain. With the results of the Mann-Whitney test p-value = 0.031. So it can be concluded that moringa tea is more effective in reducing dysmenorrhea pain than green tea. This is in line with the results of research conducted by Pratiwi (2020),[13] with the title Effectiveness of Moringa Leaf Tea on Menstrual Cycle and Hemoglobin in Anemic Adolescents. The sample in this study were 30 adolescents who experienced menstrual cycle disorders and anemia, based on the results of the analysis on the menstrual cycle with the Hb category before giving moringa tea showed a p value of 0.417. In contrast, the menstrual cycle with the Hb category after giving moringa tea showed a p value of 0.82. So it is concluded that there is an effectiveness of moringa tea administration on the menstrual cycle and haemoglobin increase in anemic adolescents in Sidrap Regency.

Moringa leaf utilization against anemia

Women who are in their menstrual period can experience large amounts of iron loss. According to Rani, *et.al* (2019) Iron deficiency in the body can lead to various health problems, one of which is anemia.[23] Anemia is a disorder where the amount of red blood cells or the concentration of hemoglobin is lower than normal. If the amount of hemoglobin is too low or abnormal, the blood's ability to transfer oxygen to the body's tissues will be reduced. These symptoms include weakness, exhaustion, lightheadedness, and shortness of breath.[24] Anemia is a major health problem that occurs in the community and is often found throughout the world, especially in developing countries such as Indonesia according to reasearch by Budiarti (2020).[25] According to World Health Organization (2021),[26] The prevalence of anemia among women of childbearing age aged 15-49 years in Indonesia from 2015-2019 has increased from 28.2% to 31.2%. Moringa leaves are known to have a higher iron (Fe) content than spinach and have a high vitamin C content, so they can help the absorption of iron (Fe) in the body. According to Rani,

et.al. (2019) the recommended daily requirement for iron is around 10-20mg. An adult's daily iron requirement can be met by 100 grams of moringa leaves.[23]

Results of research conducted by Sari, *et.al* (2020) [14] with the title Effectiveness of Cookies Produced From Moringa oleifera Leaves on Haemoglobin Level in Students at Islamic Junior High School Miftahul Hayat, Serang, Banten, obtained the results of giving Moringa oleifera cookies routinely for 14 days increasing Hemoglobin Levels from mean = 10.5 gr / dl; SD = 0.56; to Mean 13 gr / dl; SD = 0.85, statically significant value (p <0.001). So it can be concluded that consuming cookies made from Moringa leaves is beneficial for increasing hemoglobin levels in adolescents.

Research generated by Choudary, *et.al* (2020),[15] with the title Effect of Dumstick Leaves Supplementation for Treating Iron Deficiency Anemia in Adolescence Girls. Twenty respondents were given 25 grams of dried moringa leaf powder daily for three months. The results revealed that there was a significant increase in hemoglobin levels (9.6 mg/dl before intervention to 11 mg/dl after intervention).

The results of research conducted by Tirtawati, *et.al* (2021)[16] with the title Moringa oleifera Tea bags Increase Hemoglobin in Adolescent females. This study involved 100 adolescent girls. The treatment was carried out by giving Moringa oleifera tea bags 2 times a day. The treatment was given for 30 days. The results showed that after the intervention, the mean Hb (mean) value increased to 11.63 g/dl from 10.71 g/dl before, with a p-value of 0.000 (p 0.05). Therefore, it may be inferred that moringa leaf tea bags have a positive impact on teenage girls' Hb levels.

Research by Shinde *et.al* (2021)[17], with the title Efficacy of Moringa oleifera Leaf Extract for the Treatment of Anemia in Girls. Moringa leaf extract was formulated to 10 adolescent girls from the age group ranging from 17-21 years, this extract was continued for over a month. After a month the hematological examination was repeated. Hemoglobin after moringa extract administration increased significantly compared to before treatment, this is due to moringa extract containing minerals and vitamins. A research by Laiskodat, *et.al* (2021),[2] With the title The Effect of Moringa Oleifera on Hemoglobin Level in Pregnancy, the results showed that the average hemoglobin of pregnant women before intervention in the experimental group was 9.813 g/dl with a standard deviation of 0.57. The hemoglobin level of pregnant women after being given Moringa leaf soup in the experimental group was 11.494 g/dl with a standard deviation of 1.24. Analysis using t-test obtained a significance value of 0.000 <0.05. It can be concluded that there is a significant effect between the administration of moringa leaf soup on hemoglobin levels in pregnant women TM III.

Utilization of Moringa leaves on breast milk production

Moringa leaves are rich in phytosterols such as stigmasterol, sitosterol, and campesterol. These phytosterol compounds are precursors of estrogen hormone production. Increased production of estrogen hormone can stimulate the proliferation of mammary glands for milk production. According research by Rani, *et.al* (2019) the use of Moringa leaves in breastfeeding mothers can be one of the solutions to overcome malnutrition in children under 3 years of age [23]

A study by Maineny, *et.al* (2023) [18], with the title Combination of Breast Care and Moringa Leaf Tea to Increase Breast Milk Volume, the results obtained from 15 respondents used, there were 13 people (86.7%) smooth breast milk production, and 2 people (13.3%) were not smooth, after receiving breast care and moringa leaf tea. Wilcoxon test P value = 0.001 (p < 0.05). So it can be concluded, postpartum women produce more breast milk on the first day when they combine breast care with moringa tea. In line with the research conducted by Fungtammasan (2022),[19] When compared to the control group, the treatment group produced 45% more breast milk after taking moringa oleifera capsules. In this study, the Moringa oleifera group's exclusive breastfeeding rate at 6 months of age was 52.3%, exceeding the World Health Organization's target. To enhance breast milk volume, moringa leaves can be used as a galactagogue herb.

CONCLUSION

From 12 articles reviewed, it was concluded that the high nutritional content of moringa has properties for health and overcomes nutritional deficiencies in women of childbearing age such as maintaining the balance of reproductive hormones, increasing hemoglobin levels in reducing the incidence of anemia and increasing breast milk production. further research needs to be done related to the provision of antioxidants contained in moringa leaves and determining the dose in its administration, so as not to cause pro-oxidants in women's reproductive health.

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