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Research Article

The Impact of Moringa Honey on Pregnant Women's Nutrient Intake and Malondialdehyde(MDA) Levels in Maros Regency

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Abstract: The aim of this research was to see how Moringa honey affected nutritional intake and malondialdehyde levels in pregnant women.The study was an experimental study using a randomized controlled trial (RCT) design. The study was conducted in Maros regency, Indonesia, specifically in Turikale and Lau Community Health Center (Puskesmas). A total of 42 2nd trimester pregnant women were recruited, dividing into two groups of intervention; Moringa honey group (n=21) and control group (n=21) who received 15 ml of honey per day. In addition, pregnant women were given blood-boosting vitamins (Fe) to consume in the night. The intervention was given to the mothers for 8 weeks. Urine samples were collected to assess malondialdehyde levels using the ELISA method.The majority of respondents (30.9%) were between the ages of 26 and 30, had more than one child (45.2%), and earned between Rp 1.000.000 - Rp 3.000.000 (47.6%). The finding shows that the intervention group had an average difference in energy 1418 ± 584 kcal, 98 ± 61g of protein, 320 ± 134g of carbohydrates, 321 ± 46mg of iron, 97 ± 53mg of vitamin C, compared to those in the control group (1260 ± 696kkal, 65 ± 18.31g, 193 ± 87g, 105 ± 50mg, 89 ± 46mg, respectively; p value=0.001. In addition, the increase of MDA levels in the intervention group was not significantly higher than in control group (8.32 ± 6.80 vs 6.46 ± 14.80; p=0.606). In conclusion, the moringa honey has a greater nutritional content than regular honey, resulting in a higher nutrient intake, but was not difference in contributing to MDA level.

Keywords: Moringa Honey, Nutrient Intake, Malondialdehyde Levels, Pregnant Women.

1. Introduction

Complications during and after pregnancy are the most common causes of maternal death. The maternal mortality rate is still quite high, with 830 women dying every day due mainly to illness and complications throughout the world. Bleeding, infection, hypertension, abortion, anemia, and heart disease are all common pregnancy problems (organization, 2018). The MMR in Indonesia remains high, at 305 per 100,000 live births. Bleeding, pre-eclampsia, infection, circulatory system problems, anemia, metabolic disorders, and other factors can contribute to MMR (Riskesdas, 2018). In 2019, the maternal mortality rate in Maros Regency was 45 persons (Maros, 2019).

Increased DNA damage has been linked to pregnancy problems by many countries. From early pregnancy until the development of the placenta and embryo, DNA damage can have impacts on several physiological processes associated with pregnancy health. Moreover, pregnant women's DNA repair ability has been demonstrated to be reduced. This renders them more vulnerable to disease-causing environmental contaminants and endogenous causes (F & S, 2019; Winarsi, 2007).

Given the impact of macronutrient and micronutrient deficiencies on pregnant women, attention to maternal consumption during pregnancy is important (Sari A. P., 2015). Fulfilling the nutritional needs of mothers apart from the food consumed daily also requires additional intake of types of food (Muliawati, 2012). Multiple micronutrients (MMN) can be consumed during pregnancy in the hope of reducing the incidence of anemia. Perinatal maternal MMN causes a decrease in the incidence of LBW (Ramakrishnan, Gonzalez-Cassio, Neufeld, Rivera, & Marottel, 2003).

Research conducted by VeniHadju et al. in the Jeneponto district showed that giving Moringaoleifera leaf powder supplementation 2 grams per day for 2 months during the third trimester of pregnancy was effective for improving indicators of the health status of pregnant women and increasing infant birth weight in pregnant women with moderate anemia (Hadju, et al., 2020). Research conducted in Makassar City (Iskandar, Hadju, As'ad, & Natsir, 2015)(Nadimin, V, S, & A, 2015)(Muis, Hadju, Russeng, Naiem, & Faculty, 2014) showed an improvement in the weight of pregnant women, reduced stress, and prevention of DNA damage in mothers who received Moringa leaf extract. Research conducted by Samarhandian et al. found that honey, besides being a good nutrient for health, also contains phenolic compounds and works as an antioxidant, antibacterial, antitumor and anti-inflammatory effect(Samarghandian, Farkhondeh, & Samini, 2017). Furthermore, honey has also demonstrated the implications of oxidative stress and inflammation in the pathogenesis of complications of several diseases during pregnancy, such as diabetes mellitus and hypertension (Erna, 2012)(Baskhara, 2008).

There are many studies on honey and Moringa extracts that have been carried out to improve the nutritional status of pregnant women. In this study, researchers combined the two components. Moringa honey is the honey produced by the moringa juices-fed bees. Moringa honey research has never been done before.

2.Objectives Of The Study

The aim of the study was to examine the effect of giving Moringa honey on nutrient intake and malondialdehyde(MDA) levels compared to regular honey (honey only) during pregnancy.

3.Research methodology

This research was conducted in Maros Regency, specifically located in Turikale Community Health Center (Puskesmas) and Lau Community Health Center. All pregnant women with anemia in the second trimester of gestational age 20-27 weeks who are registered in both Puskesmas since February 2021 has been considered the study population.

3.1. Intervention materials

MoringaOleifera (MO) leaves used in the study were washed and then blended until smooth. After that, the MO leaves mixed with 1 kg of granulated sugar, which has been dissolved in 500 ml of water. After all the ingredients are mixed, the Moringa juice is given to the bees nested in the Faculty of Forestry, Hasanuddin University.

3.2. Experiment Design

The study was a randomized control trial (RCT), which randomly allocated participants into one of two groups, moringa honey and honey only groups. Mothers were instructed to drink a cup of 15 ml per day for moringa honey or honey only for 8 weeks.

Eligibility criteria were 20 – 27 weeks gestation, had a hemoglobin level of 9-10g/dl, parity one to three, and singleton pregnancy. Those who were eligible (n=42) were randomly allocated into two groups. Randomization sequences were made by hand and allocation to each group was carried out by field researchers, with mothers being asked to take small pieces of paper with the letters A or B from the tin. If the mother takes the paper with the letter A, she receives honey from bottle A and vice versa. The treatment given in letters A and B was only known by the main researcher (VH). Mother was given a bottle containing 100 ml of honey coded A or B according to the letter she took at the randomization stage.

The study began in February 2021 when all pregnant women in the second trimester of gestational age 20 – 27 weeks who came to the Health Center were screened for eligibility in the study. Four field researchers (DS, RM, FM and FK) screened 80 mothers; 50 were eligible to participate and agreed to participate in this study. Pertinent written information was received from each mother. During the intervention, eight subjects dropped out. The first is due to family problems and the other refuses to consume honey. Thus, the total subjects in this study were 42; 21 in the Moringa Honey group and 21 in the regular honey group. Data for these subjects were included in the analysis.

At the end of each week, adherence to the intervention was assessed by field researchers through the amount of honey. The amount of honey consumed and the reason for the mother's refusal were written on a standard form. The field investigator sends a short electronic message to the mother every morning to remind the mother to take honey. Mothers were asked to respond to the messages, otherwise the field workers would call to encourage honey consumption. All mothers included in the analysis consumed all honey (100%).

3.3. Outcome variables

The main outcome variables, measured before and after the intervention, were nutrient intake and urine malondialdehyde concentration. All measurements were carried out by field researchers. Maternal characteristics were assessed at baseline using a standardized questionnaire. This is related to the socioeconomic status of the family, including the education and occupation of the mother and father, monthly family income, and the number of family members.

Nutritional intake was measured through a nutrition survey with 24-hour food recall data filled out by pregnant women through a questionnaire sheet, before and after giving Moringa honey and regular honey. Urine malodialdehyde concentration was measured using the MDA Human ELISA Kit (Bioassay Technology Laboratory). Mothers were given sputum to collect 5 ml of their urine in the morning before breakfast. After that, the field researchers collected the sputum and brought it to a certain room before being taken to the laboratory at Hasanuddin University, Makassar. According to the standard, the normal value of MDA in the morning is 31.25–2000 nmol/ml.

3.4. Statistical Analysis

The comparison between two groups was assessed using the chi-square test and independent t-test. Changes in each group (before and after the intervention) were analyzed using the Wilcoxon test, while the differences between groups were analyzed using the Mann-Whitney test. The General Linear Model (GLM) was used to perform ANOVA to assess differences in malondialdehyde levels. All analysis were conducted using SPSS (v.25).

3.5. Ethical Approval

Ethical approval for this research was granted by the Ethics Committee of the Faculty of Medicine, Hasanuddin University, Makassar, Indonesia, in May 2021 with protocol number UN4.14.1/TP.02.02/2021. Each mother gave written consent during study enrollment.

4.Results

Based on table 1 shows that the majority of respondents in intervention and control groups are 26-30 years of age (19.1% vs 30.9%), working as housewives with (45.2% vs 50%), high school graduated (23.8% in both groups). The two groups were not significantly different but parity status (p=0.030).

Table 1. Frequency Distribution of Respondents Characteristics

Characteristics	Control		Intervention		p value
	N	%	n	%	
Age					
20 – 25	6	14.2	8	19.1	0.251
26 – 30	13	30.9	8	19.1	
31 -35	2	4,8	5	11.9	
Parity					
Primigravida	8	19.1	2	4.8	0.030
Multigravida	13	30.9	19	45.2	
Education					
Elementary School	3	7.1	4	9.5	0.831

Secondary School	7	16.7	5	11.9	
High/Vocational School	10	23.8	10	23.8	
Diploma III	0	0.0	1	2.4	
Bachelor	1	2.4	1	2.4	
Job					
Housewife	21	50	19	45.2	0.350
Midwife	0	0.0	1	2.4	
Teacher	0	0.0	1	2.4	
Income					
<1 million	1	2.4	4	9.5	0.153
1 – 3 million	20	47.6	17	40.5	

Table 2 shows that the changes of nutrients intake between pre and post intervention in the intervention groups were significantly greater than in control group (p<0.05).

Table 2. Distribution of the level of nutritional adequacy of macronutrients and micronutrients in the intervention and control groups before and after treatment.

Nutrient	N = 42	Mean ± SD Pre	Mean ± SD Post	p value	Δ Mean ± SD	p value
Energy						
Intervention	21	1038 ± 359	2456 ± 1642	0,365	1418 ± 584	
Control	21	1312 ±678	2138 ± 1385	0,112	1260 ± 696	0,001
Protein						
Intervention	21	37 ± 15,99	135 ± 77	0,242	98 ± 61	
Control	21	51 ± 37	117 ± 55	0,121	65 ± 18,31	0,001
Carbohydrate						
Intervention	21	154 ± 51	454 ± 186	0,397	320 ± 134	
Control	21	179 ± 81	419 ± 68	0,240	193 ± 87	0,001
Iron						
Intervention	21	169 ± 65	534 ± 53	0,497	321 ± 46	
Control	21	377 ± 68	482 ± 104	0,222	105 ± 50	0,001
Vit. C						
Intervention	21	15 ± 23	112 ± 62	0,943	97 ± 53	0,001
Control	21	21 ± 30	110 ±61	0,464	89 ± 46	

The mean changes of MDA level from pre and posttest between the intervention and the control group were not significantly different (p=0.606). The Table 3 also shows that MDA level in the intervention was significantly increased from pre to post test (p=0.001), but not in the control group (p=0.059).

Table 3. Distribution of Differences in Malondialdehyde Levels of respondents before and after treatment in the control group and the intervention group

Malondialdehyde Levels	N=42	Mean + SD		P Value	Δ Mean ± SD	*P Value*
		Pre	Post			
Intervention	21	31,27 ± 7,26	39,59 ± 4,12	0,001	8,32 ± 6,80	0,606
Control	21	30,23 ± 11,91	36,69 ± 7,14	0,059	6,46 ± 14,80	

5.Interpretation of the result

This study showed that the nutrient intake showed significant differences in the group receiving Moringa honey and the group receiving honey only. There was no significant difference in malondialdehyde levels in the group receiving Moringa honey and the group receiving regular honey.

Moringa honey is an alternative for improving nutritional status, especially in pregnant women. The nutritional content of Moringa honey includes protein (0,87%), carbohydrates (80,26%), polyphenols (0,06%), Flavonoids (289,82 Ppm), antioxidants (53,16 %), vitamin C (670 ppm), Potassium (0,14%), Beta Carotene (19,19 Ppm), Iron (307,22 Ppm), Calcium (302,86 Ppm), Sodium (0,28 ppm), Zinc (2,442 Ppm) and Magnesium (84,51 Ppm). While ordinary honey contains protein (0,84%), carbohydrates (80,23%), polyphenols (0,05%), flavonoids (167,82 ppm), antioxidants (42,34 %), vitamin C (460 ppm), potassium (0,01%), Beta Carotene (5,80 Ppm), Iron (185,28 Ppm), Calcium (46,88 Ppm), Sodium (2,81 Ppm), Zinc (1,305 Ppm) and Magnesium (2,82 Ppm).

Efforts are made to address risk prevention in pregnant women, among others, through the fulfilment of nutrients rich in macro and micro nutrients(Roberfroid, Huybregts, Lanou, Henry, Meda, & Menten, 2008). This is reinforced by the thought that develops in the community that during pregnancy pregnant women should consume about two portions of food from before pregnancy to maintain and defend the lives of two people, namely the mother and the fetus in her womb, so that pregnant women tend not to limit energy intake as has been recommended (Prihatini, 2017)(Kasuke, Spiegelman, Sankar, & Fawzi, 2011).

Honey contains essential minerals that help to produce haemoglobin. Honey have many benefits for our body, including increase energy, improve calcium absorption, and prevent anaemia. Previous studies found that honey extract was able to increase blood haemoglobin (Hb) levels in male white rats, as well as that the administration of date palm juice was able to increase haemoglobin levels in tourist strain male white rats fed a low iron diet (Zakaria, Hadju, As'ad, & Bahar, 2015)(Kou, Li, Olayanju, Drake, & Chen, 2018).

Iron is an active redox transition metal that is easy to catalyse various reactions and is destructive in cells (Sari, 2012)(Putri, Kalsum, & Fatmawati, 2019). Sreedhar conducted a study on female rats for 14 days with Fe, Fe and Zn, Zn treatment groups shows an increase of peroxidation. lipid levels of MDA in the single Fe group. Oral administration of iron supplements during anaemia causes oxidative stress in the intestinal organs resulting in decreased function integrity and death of mucosal cells (Rahardjani, 2016).

Iron plays a role in the formation of ROS, which initiates the formation of lipid peroxidation (Sinaga, 2016). Excess production of superoxide can cause biochemical disturbances that occur in the erythrocyte membrane. The increase in Fe has an effect on oxidative stress in the placenta so that it can cause cell damage (Yuslianti, 2018).

The body has a protective mechanism that neutralizes free radicals that are formed, including superoxide dismutase (SOD) enzymes, catalase, and glutathione peroxidation. However, under certain conditions, free radicals that exceed the body's defence system are known as oxidative stress. The balance between free radicals and the body's natural antioxidant capacity will be disturbed, resulting in tissue damage. Cell damage by free radicals is preceded by cell membrane damage (Adiga, D'souza, Kamath, & Mangalore, 2007)(Idonije, Festus, Okhiai, & Kpamu, 2011)(Adnyana, 2013).

In general, oxidative stress (OS) is an inability of detoxification and cell turnover to combat excessive reactive oxygen species (ROS). In pregnancy and the perinatal period, oxidative stress is a risk that needs to be considered because it can affect the condition of the mother and fetus through the placenta that occurs in early pregnancy as reflected by the extensive lipid peroxidation of pregnant women compared to non-pregnant women. During pregnancy, increased oxidative stress can reduce antioxidant capacity so that it can contribute to perinatal pathogenesis as well as postnatal disorders(Winarsi, 2007)(Burton & Jauniaux, 2011)(Cohen, Margaret, Michel, Robert, Olga, & Susan, 2015).

Another moringaoleifera study shows that moringa leaves act as an antioxidant and inhibitor that can inhibits oxidation. The content of vitamin C and beta carotene in Moringa flour functions as an antioxidant (Azzawi, 2014)(Nadimin, The Influence Provision Of Moringa Leaf Exctracy (Moringa Oleifera) Againts The Level of MDA (Malondialdehyde) In Pregnant Woman, 2016).

In addition, stress pregnant women can increase blood pressure (Singh, 2014). The occurrence of preeclampsia in pregnant women is caused by oxidative stress which causes a disturbance in the balance between oxidants and antioxidants which is characterized by increased lipid peroxide and decreased antioxidant activity (Tug, Celik, Cikim, Ozcelik, & Ayar, 2003)(Erisir, Benzer, & Kandemir, 2009)(Bakacak, Kılınç, Ercan, & F, 2015). Free radicals actively destroy cells so that there is a decrease in body function through the body's metabolism. This is indicated by the increased malondialdehyde levels. Malondialdehyde is a dialdehyde compound which is the end product of lipid peroxidation in the body (Candra, 2013)(Arkhaesi, 2008). Increased free radicals will cause oxidative stress. The increase in oxidative stress corresponds to an increase in MDA formation (Agarwal, 2012)(Ayala, Munoz, & Arguelles, 2014). Oxidative stress will cause damage and damage to trophoblast cells which will continue to lead to abortion and other complications(Patil, Kodliwadmath, & Sheela, 2007)(Gadoth & Gobel, 2011).

Micronutrients (vitamins and minerals) are required as cofactors for enzymes or as part of structural proteins (metalloenzymes) that play a role in DNA synthesis and repair, prevention of oxidative DNA damage and maintenance of DNA methylation (Khuzaimah, Hadju, As'ad, Abdullah, Bahar, & Riu, 2015)(Kushwaha, Chawla, & Kochhar, 2014)(S.Andraos, Seymour, Sullivan, & Kussmann, 2018). Iron (Fe) and other micronutrients (Zn, Se, folic acid, vitamin C, vitamin E, and Vitamin A) play pivotal roles in DNA maintenance. Iron (Fe) produces antioxidant enzymes, which are needed for nucleic acid metabolism, DNA synthesis and repair. Iron deficiency can impair biological pathways leading to oxidative stress, cell death, genetic instability and an increased risk of cancer (Atiba, Abbiyesuku, Oparinde, Niran-Atiba, & Akindele, 2016).

Iron was not the only nutrient that could have contributed to the increase observed in this study (Haider, Yakoob, & Bhutta, 2011). On the other (Iskandar, Hadju, As'ad, & Natsir, 2015)hand, vitamins A and C are micronutrients that increase iron absorption. Therefore, the combination of minerals, vitamins, and other bioactive compounds in MK appears to be synergistic in their effects on iron absorption and metabolism. Various studies using Moringa leaf extract and Moringa leaf powder in reducing MDA. Research conducted by Nadimin 2016 regarding the effect of Moringa leaf extract on MDA in pregnant women and the results obtained that administration of Moringa leaf extract can inhibit the increase in MDA levels in pregnant women .

However, there are also other studies that use iron on MDA levels such as the study by Zaka, 2016 in iron-deficiency anemia children with oral iron therapy. After eight weeks of daily iron therapy, Hb, MCV, MCH, MCHC, iron, transferrin saturation, and serum ferritin levels were significantly increased. However, even after iron administration the SOD, CAT, and GPx levels were lower in the non-anemic controls and the MDA levels in the anemic group were significantly higher than in the controls (Zaka, Adnan, Ahmad, & Islam, 2016).

6.Conclusion

Giving Moringa honey and honey only both gave changes in nutritional intake and there were significant differences between the two groups. The intervention and control group were not significantly different in MDA level.Moringa honey can be used as an intervention program to improve pregnancy outcomes. A further research needs to develop moringa honey-based products as a massive product, which can be produced everywhere.

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