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Effectiveness of Curcuma-Black Cumin Honey on Hemoglobin Levels, Iron, and Folate Intake in Stunted Children at Cirebon

Siti Pandawangi TW[1], Akrom[2], Nurkhasanah[3], Ahmad Azrul Zuniarto[4]

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Abstract: Chronic malnutrition, especially iron and folate intake, is one of the causes of anemia. Children who are stunted often suffer from anemia, a condition where hemoglobin levels are below normal. Honey is rich in nutrients. Curcuma can increase appetite and black cumin can improve the immune system. This research aimed to determine the effectiveness of Curcuma-black cumin honey in increasing hemoglobin (Hb) levels, and iron and folate intake. This type of research is quasi-experimental research with a pre-test-post-test design. The population is stunted children in Tegalwangi, the working area of the Karangsari Cirebon Community Health Center. Samples aged 24-60 months were divided into a control group (no treatment) and a treatment group (consuming honey once a day for 4 months). The research was carried out from February to May 2023. Data on iron and folate intake was obtained from Nutrition recall results which were converted to Nutrisurvey software. Hemoglobin data from blood sample analysis. There was an increase in hemoglobin levels, iron intake, and folate intake in the treatment and control groups. Based on the Independent Sample T-Test, the difference in hemoglobin levels in pre-test and post-test samples was $P < 0.05$, and in controls $P > 0.05$. The difference in sample iron intake was $P < 0.05$, control group $P > 0.05$ The difference in folate intake in the sample group was $P < 0.05$, and the control group was $P < 0.05$. In this research, the effectiveness of maducurcuma-black cumin on hemoglobin levels and iron and folate intake.

Keywords*: Curcuma-Black Cumin Honey; Hemoglobin; Stunting.*

INTRODUCTION

Hemoglobin is a protein that is rich in iron. Hemoglobin can form an oxyhemoglobin (HbO2) bond due to its affinity for O2. Through this function, O2 can be transported from the lungs to the tissues (1). Hemoglobin functions to carry oxygen and carbon dioxide, give blood its red color, and maintain the shape of red blood cells (2). Hemoglobin is a bond between protein, iron, and substances color. Hemoglobin can be measured chemically and the amount of Hb/100 ml of blood can be used as an index of the oxygen-carrying capacity of red blood (3). Hemoglobin engages in several functions, is a polyfunctional molecule, such as catalytic (nitrite reductase, NO dioxygenase, monooxygenase, lipoxygenase, alkyl hydroperoxide, esterase); nitric oxide metabolism; metabolic reprogramming; pH regulation and maintaining acid-base balance (4).

Hemoglobin deficiency is well-known as anemia (5). Anemia influences one-third of the global population and is associated with increased morbidity and mortality rates, decreased work productivity, and impaired neurodevelopment (6). Many stunted children suffer from iron deficiency anemia, wherein this anemia is the most common in the world (7). Low hemoglobin levels can be caused by a poor diet, which is not balanced with adequate nutritional sources. Lack of intake of energy, protein, carbohydrates, fat, vitamin C, and food sources containing iron and folic acid can lower hemoglobin levels (8).

Nutrients containing iron (Fe) and folate are needed for the formation of Hemoglobin. Hemoglobin (Hb) is a heme-containing globulin protein, with the main function of oxygen transport (9). Iron is one of the essential minerals needed by various important body processes (10). Iron or Fe is the raw material for making hemoglobin in the blood as a binder for oxygen and carbon dioxide gases. It is also useful as myoglobin in muscles (11). This mineral can be obtained from foods such as kale, spinach, chicken liver, shellfish, tempeh, and beef. The majority of the iron in the body is bound to hemoglobin in erythrocytes. Iron from aged red blood cells is processed by macrophages in the spleen, liver, and bone marrow (12, 13). Iron deficiency causes suppression of hemoglobin (Hb) synthesis and causes metabolic disorders. Conversely, excess iron not only reduces the efficiency of iron utilization but also induces oxidative stress (14, 15). Excess Fe triggers catalysis causing cell death and is linked to various diseases (16, 17).

Folic acid (FA), also known as folate, is a vitamin that is essential for optimal health at any age as it plays a role in the biosynthesis of nucleotides, amino acids, neurotransmitters, and certain vitamins. Folate is a soluble

[1]*Faculty of Pharmacy, YPIB University of Majalengka, Indonesia, Email: sitipandanwangitw@gmail.com*
[2]*Faculty of Pharmacy, Ahmad Dahlan University, Yogyakarta, Indonesia, Email: akrom@pharmuad.ac.id*
[3]*Faculty of Pharmacy, Ahmad Dahlan University, Yogyakarta, Indonesia, Email: nurkhasanah@pharmuad.ac.id*
[4]*Faculty of Pharmacy, YPIB University of Majalengka, Indonesia, Email: aazuniarto@gmail.com*

vitamin that is used to treat megaloblastic anemia (18). Folate, an essential micronutrient is an important cofactor in one-carbon metabolism. Humans cannot synthesize folate and rely on supplementation to maintain normal levels (19). Folate is needed by the body; its deficiency can cause damage to the neural tube which will cause disorders of the nervous system (20). Folate is also needed in insignificant amounts for the sense of sight, so a deficiency will affect vision (21). Folate together with iron and vitamin B12 is useful in the process of forming hemoglobin (Hb). Plants that contain lots of folate include legumes, green vegetables, nuts, and orange juice. Apart from that, folate is found in beef liver and snakehead fish (22).

Stunting is a disability characterized by a reduced growth rate caused by nutritional deficiencies (23). Stunting has been identified as a risk factor for chronic diseases related to malnutrition, suboptimal growth, and development of children, as well as reduced health and productivity throughout life (24). Honey is renowned for its extraordinary nutritional and healing properties. Honey contains important minerals that may help in hemoglobin production (25). If honey is consumed every day, anemia sufferers can experience a significant increase in energy levels, then Honey helps increase calcium absorption, and hemoglobin levels and therefore can treat or prevent anemia due to nutritional factors (26, 27) Curcuma contains many chemicals compounds such as curcumin and starch (28). Curcuma contains the active substance curcumin which can increase the activity of digestive enzymes, thereby increasing a child's appetite. The antibiotic content in Curcuma can also increase the body's endurance (29). Javanese people use Curcuma as the main ingredient in traditional medicine which is useful for treating many diseases as well as maintaining and improving health (26). Black cumin (*Nigella sativa*) contains flavonoid compounds that have anti-inflammatory properties, as well as efficacious properties as a stimulant, carminative, emmenagogue, galagtoga, and diaphoretic. Furthermore, black cumin also has quite strong antioxidant properties, can reduce blood pressure, and increases the hemoglobin level (30). Thymoquinone, dithymoquinone, and thymol contained in black cumin seed oil can reduce free radicals and maintain hemoglobin structure (31).

There has been no previous research that has conducted direct testing on stunted children regarding the effectiveness of black cumin curcuma honey in increasing folate and iron intake and hemoglobin levels.

MATERIALS AND METHODOLOGY

Study design:

The design we use is a quasi-experimental pre-test and post-test control group design. The research location was conducted in the stunting locus area of Cirebon Regency, precisely in Tegalwangi Village, Weru District. Research time from January-June 2023.

Sample size:

The research population was stunted children under five in the health monitoring area of the Karangsari Community Health Center, in Indonesia *Pusat Kesehatan Masyarakat* or *Puskesmas*, Cirebon Regency. Indonesia. The research subjects were 67 children under five who met the selection criteria for potential subjects and expressed their willingness to volunteer. The sample with inclusion criteria was age 2-5 years, not being sick, and not disabled, while the exclusion criteria were parents who did not fill in the informed consent and changed domicile. Samples that meet these criteria will be separated into two groups, namely Group 1 as the sample/treatment group and Group 2 as the control group.

Material Used

Taking children's blood using a disposable syringe 1 cc, needle 25, tourniquet, a tool for measuring hemoglobin levels using a semi-automatic Mindray Hema analyzer. A tool to collect data on folate and iron intake using a food recall questionnaire. The research material used ginger-black cumin honey.

Interventions

1. Subject Recruitment

Subject data was obtained from the Karangsari Community Health Center where Tegalwangi is a health monitoring area under the Community Health Center. Based on this data, we invited parents and their children to the Tegalwangi Village Hall. At the Village Hall, we explain this research. Parents who agree to their children as research subjects will be given a consent form to sign.

2. Division of Treatment and Control Groups

Sampling techniques were used to divide the research subjects into groups. The sampling technique used is purposive sampling, where children with odd numbers will be included in the treatment group, while children with even numbers will be included in the control group. The treatment group will receive black cumin ginger herbal honey to consume once a day for 4 months. Meanwhile, the control group will only receive honey after completing the research.

3. Anthropometric measurements

Height, weight, arm circumference, and head circumference were measured for the children who were research subjects. Anthropometric measurements use tools according to Ministry of Health standards and are conducted by trained community health center officers or *posyandu* cadres. This measurement was conducted twice,

firstly when the children were first invited to come to the village hall for research (pre-test data) and secondly after 4 months of treatment (as postal data).

4. Hemoglobin measurement

Hemoglobin level analysis using a semi-automatic Mindray Hematology Analyzer by a medical analyst.

5. Measurement of Fe and Folate intake

Fe and Folate intake was obtained from filling out food recall questionnaires for mothers of research subjects. The food recall results were entered into the Nutrisurvey software to obtain Fe and Folate intake values from the research subjects.

Data Collection

Data was collected from measurements of the child's height, weight, and age. From this data, it was used to determine the z score of the research subjects in the category of stunted children. The next data is in the form of Nutrisurvey results in the form of Fedan Folate intake data. Other important data is the results of measuring hemoglobin levels.

Statistical Analysis

Data were checked for accuracy and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. The analysis entails a pre- and post-intervention comparability test between the treatment group and the control group. Data analysis uses univariate and bivariate. There was an increase in hemoglobin levels, iron intake, and folate intake in the treatment and control groups. Based on the Independent Sample t-test.

RESULTS

The research has been registered with the Health Development Policy Agency through the Indonesian Disease Registry with No. INA-Y6CT9L0. The study was conducted at Weru Sub-District, Cirebon District with the approval of the Cirebon District Health Service through the letter Number 423.4/3450.

Description of Stunting Toddlers as research subjects

The list of children at risk of stunting was obtained from the Karangsari Community Health Centre, and the work area involves Tegalwangi village. After the parents filled in their willingness to act as subjects, 50 stunted children were obtained based on informed consent signed by the mother.

Table 1. Division of treatment and control groups

Category	Groups		P value
	Treatment (n=26)	Control (n=24)	
Age (month)	45,92±11,049	39,71±10,622	0,894
Gender			
Boy	11	18	0,069
Girls	15	8	
Height (cm)	91,77±8,230	87,96±5,61	0,246
Weight (kg)	13,35±3,752	11,82±2,207	0,218
Height for Age	-2,10±1,490	-2,61±0,428	0,113
Weight for Age	-1,43±1,308	-1,56±1,244	0,692
Birth length	47,44±4,13	48,00±2,00	0,170
Mother's Education			
≤ Junior High School	15	15	0,506
> Junior High School	11	9	
Family Income			0,809
≤ Minimum Wage	8	7	
> Minimum Wage	18	17	
Mother's Employment Status			
Not Working	20	21	0,100
Working	6	3	

Based on Table 1 above, there are no significant differences between the characteristics of the control and treatment groups (P value>0,05)

Effectiveness Of Curcuma-Black Cumin Honey

This Curcuma-black cumin honey is given for 4 months, with the dose adjusted to the child's age. Curcuma-black cumin honey was consumed in the sample or treatment group, while the control group did not receive honey. Table 2 classifies Hb levels based on the degree of anemia. Group division was carried out before measuring Hb levels in the pre-test. Hb levels above 11 g/dL are considered normal in children aged ≤60 months. Mild anemia refers to Hb levels of 10-10.9 g/dL, moderate

anemia refers to Hb levels of 7-9.9 g/dL, while severe anemia refers to Hb levels <7 g/dL. In the treatment group, no one suffered from severe anemia, while in the control group, there was 1 child who suffered from severe anemia.

Table 2. Pre-test and Post-test Hemoglobin Levels in the Treatment and Control Group

Group	Pre-test		Post-test	
	N	%	N	%
Sample				
>=11 gr/dL	6	23.1	22	84.6
10-10.9 gr/dL	12	46.2	4	15.4
7-9.9 gr/dL	8	30.8	0	0
<7 gr/dL	0	0	0	0
Control				
>=11 gr/dL	8	33.3	16	66.7
10-10.9 gr/dL	8	33.3	5	20.8
7-9.9 gr/dL	7	29.2	2	8.3
<7 gr/dL	1	4.2	1	4.2

Intake data was obtained from the results of filling in a 3x24 hour food recall questionnaire which was then converted into Nutrisurvey software. Pre-test and post-test iron intake data for the sample and control groups can be seen in Table 3.

Table 3. Data Analysis Using Independent T-Test Pre-Post Treatment And Control

Category	Groups	Mean ± SD		P value	P value
		Pre-test	Post-test		
Hemoglobin (g/dL)	Treament	9,765±2,280	11,700±0,975	0,000	0,163
	Control	10,396±1,270	11,129±1,786	0,125	
Folate (mcg)	Treament	54,088±25,95	86,804± 37,13	0,000	0,000
	Control	54,199±30,08	45,863± 15,86	0,083	
Iron (mg)	Treament	3,131±2,22	8,736±8,61	0,003	0,036
	Control	2,546±1,54	2,768±1,13	0,578	

DISCUSSION

Description of Stunting Toddlers as research subjects

Anthropometric measurements were conducted among the study subjects to confirm the stunting diagnosis by z score of -2 ≥ SD ≤ 2 SD (32). The number of short children was higher than noticeably short children. Meanwhile, based on the nutritional status of under-five children, most of the children had normal nutritional status (Weight for age), and only a small number of those had poor nutritional status.

Stunted children consisted of 21 girls (42%) and 29 boys (58%). 17 stunted children aged less than 3 years (24-36 months) (34%). There were 14 children aged 36-<48 months (28%) and 19 children aged 48-60 months (38%). There were 4 stunted children with Low Birth Weight, and 46 children were born with Normal Birth Weight. Based on the data, it was also shown that 3 children were born prematurely and 47 were born maturely (36 weeks).

There are 8% of under-five children with stunting had low birth weight and 42% had normal birth weight. Meanwhile, 3 (6%) of the stunted children were born prematurely and the remaining 44% were born maturely. Data on premature or low birth weight babies is needed because anemia is also related to Hb levels. According to a previous study, risk factors such as unbalanced diet, infection, gastrointestinal bleeding, low birth weight, and less than a month of birth were indicated. Furthermore, other factors that played a role were parenting style, type of food, and community perspectives on maternal and child health (33).

Boys were more dominant in number compared to girls.

Boys tend to be more physically active, so they spend more energy on activities and not on growth. In addition, in general, male children have faster growth after going through puberty, while female children experience faster growth than men before and during puberty (31).

In this study, toddlers as research subjects were more dominant at the age of 48-60 months because most of the parents who were willing to be research subjects had children aged 48-60 months. Those who have children under 3 years of age are not willing to be research subjects. These findings differ from previous research conducted by Mustaqim which stated that children aged 12-36 months had a greater risk of experiencing stunting (34). Apart from that, we look at the early detection factors of children experiencing stunting in the first thousand days of life, so the older they get, the easier it is to read (35).

Effectiveness Of Curcuma-Black Cumin Honey

The results of pre-test Hb levels assessment for both groups showed mean Hb levels that were lower than normal Hb. The mean Hb level for the treatment group was 10.1769 and for the control group, it was 10.3958 g/dL. The normal Hb level for children aged ≤5 years is 11. 0 g/dL (36). The majority of respondents were distributed with mild anemia. Such a finding is in line with a previous study that children with stunting had a risk of anemia 2.5 times higher than that of non-stunting children (37). A previous study showed that 62% of stunted children aged less than 5 years had anemia. Anemia can be caused by a lack of intake of Fe, Folate, and Vit B12 as raw materials to form Hemoglobin. It can be seen in the table above that there is a significant increase in the provision of black cumin ginger honey in the pre and post-test sample groups. Meanwhile, in the control group, although there was an increase, it was not significant. This could mean that the honey given can stimulate an increase in Hb levels. Curcuma-black cumin honey was administered for 4 months, by considering the hemoglobin formation process of 120 days (38). Giving honey aims to increase the intake of stunted children, especially the intake of iron, Folate, and vitamin B12 which are the main components in determining Hemoglobin levels (39). Curcuma-black cumin honey is a supplement to increase nutritional intake among under-five children with stunting. Increased intake may affect Hb levels. As explained in a previous study, nutritional management intervention could increase Hb levels among children with stunting (40).

There is an increase in iron and folate intake in stunted children, this also affects increasing hemoglobin levels. Previous research shows that giving black cumin honey can increase children's iron intake and hemoglobin levels. Apart from increasing honey, it can be an antioxidant that is useful for repairing cells including hemoglobin (41).

CONCLUSION

Based on the Independent Sample T-Test, the difference in hemoglobin levels in pre-test and post-test samples was P<0,05, and in controls P>0,05. The difference in sample iron intake was P<0,05, control group P>0.05 The difference in folate intake in the sample group was P<0,05, and the control group was P P<0,05. The effectiveness of Curcuma-black cumin honey on hemoglobin levels and iron and folate intake. The effectiveness of Curcuma-black cumin honey on hemoglobin levels and iron and folate intake.

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