ORIGINAL ARTICLE

Effectiveness of Biscuit Formulations with Different Dates Substitutes in Treating Anemia among Female Workers in Makassar, Indonesia

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ABSTRACT

Background and Objective. Nutritional anemia has become a national public health problem, particularly among female workers, who are a high-risk group. Dates can be formulated into functional food to treat anemia in this group. This study aimed to examine the effectiveness of date biscuits formulated with 10% (A1) and 20% (A2) substitutes in treating anemia among female workers in Makassar, Indonesia.

Methods. Experimental research design using a Randomized Controlled Trial (RCT) with a pre-test post-test randomized group was used. The population of this study were female workers in Makassar City, with a total sample of 61 participants. The study randomly divided the sample into three groups: the intervention group that received formula A1 date biscuits (10%), the intervention group that received formula A2 date biscuits (20%), and the control group that did not receive any intervention. The researchers administered 20 grams of biscuits for 60 days. Hemoglobin levels were measured twice, at baseline and after the intervention. The study further performed a bivariate test by comparing the hemoglobin examination results before and after the intervention using the paired t-test, and analyzed differences between groups using the ANOVA test. The significance value was set at $p < 0.05$.

Results. The results showed that A1 date biscuits reduced the case of anemia by 23.8%, from 38.1% to 14.3%. Meanwhile, provision of A2 date biscuits reduced the case of anemia by 13.7%, from 36.4% to 22.7%.

Conclusion. The provision of A1 date biscuits is more effective than A2 for women with anemia. Date biscuits should be specifically provided to workers or women with anemia as they are less effective for those with normal hemoglobin levels. To further increase hemoglobin levels, female workers should also be given additional nutrient-rich foods.

Keywords: dates, biscuit, hemoglobin, woman, worker

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INTRODUCTION

Iron deficiency is considered the most common cause of anemia worldwide, although other conditions such as deficiency of folic acid, vitamin B12 and vitamin A, chronic inflammation, parasitic infections, and congenital disorders can all cause anemia.[1] Anemia is a health problem in various countries, especially developing countries. A report from WHO states that anemia occurs in 42% of pregnant women and 30% of non-pregnant women aged 15-40 years.[2] A study evaluating the prevalence of anemia in women of childbearing age in the Asian region found a fairly high prevalence of anemia. The study found that anemia was more common in rural areas and the incidence varied across countries.[3,4] In India, the prevalence of anemia in women of childbearing age is 54.2%, in Nepal, the prevalence is 42.6%, in the Maldives, the prevalence is 55.6%, and in Timor

Leste is 24.7%.[3] In Indonesia, the prevalence of anemia among women aged 15-25 years is 39.93%.[4]

Female workers were observed to be more prone to iron deficiency anemia.[5] Several studies have also found that anemia in female workers is quite high. Anemia prevalence among female workers varies across industries, with 64% of workers at the North Lampung plywood factory, 42.6% in the Printing and Packaging Department at UD X Sidoarjo and in the Bandung Canning area, and 39.5% in the CV. Surya Medika Qabelle.[6-9] These findings highlight the significant burden of anemia among female workers in various sectors.

Anemia reduces productivity in female workers, making them more susceptible to illness, workplace accidents, and higher rates of absenteeism. A statistically significant positive relationship has been found between workers' hemoglobin (Hb) levels and efficiency of task implementation. In addition, a relationship hass also been found between Hb levels and workers' salaries, which is a proxy measure of worker productivity. Workers with anemia have lower performance and earn less income compared to those without anemia.[10] During pregnancy, anemia also increases the probability of having Low Birth Weight (LBW) infants.[3]

Several efforts have been made to overcome anemia, including iron supplementation, fortification, and food diversification. Supplementation involves giving iron preparations to anemia sufferers, while fortification is carried out by adding iron to commonly consumed food. However, the problem that is often found in giving iron supplementation is unpleasant side effects, resulting in low compliance with iron supplement intake. One of the efforts that can be made to overcome the problem of anemia in female workers is to provide them with iron-rich foods. Date (*Phoenix dactylifera*) is the suitable option.

Studies indicate that dates *(Phoenix dactylifera)* effectively increase haemoglobin levels in experimental animals.[9,10] Likewise, they have also shown benefits for young women and toddlers.[11-16] Research conducted on young women showed that giving dates can increase hemoglobin levels from 10,786 g/dl to 11,143 g/dl.[17] Similarly, research conducted in Pontianak demonstrated that giving dates can overcome anemia in young women.[18] Giving Ajwa dates to pregnant women has an effect on increasing hemoglobin levels in pregnant women in trimesters.[19-21] Likewise, giving dates can increase hemoglobin levels in children.[22] Dates (*Phoenix dactylifera*) are a fruit native to the Middle East and Africa. They are commonly consumed as a functional food to improve body health.[13] Dates contain useful macro and micro nutrients. Apart from that, dates also contain phenolics, B Glucans and anthocyanins which are antioxidants and antimicrobials.[13] Dates can also function as anticancer, hepatoprotective, neuroprotective, antidiabetic, antihyperlipidemic, and improve fertility.[13] Dates have the potential as iron preparations because of their high iron content, which is 0.10-1.5 mg/100 grams.[14]

Biscuits are a type of pastries generally consumed as snacks by people across various economic and age groups. Biscuits do not require complicated preparations, are easy to distribute, have a long shelf life, and can be easily consumed. Adding dates to the biscuits can enhance their nutritional content, transforming them into functional foods.[23] The hypothesis of this study was that there was a significant difference in the effectiveness of date biscuit formula A1 (10%) and date biscuit formula A2 (20%) when 20 grams of biscuits were administered for 60 days in reducing anemia among female workers. The aim of this research was to evaluate the effectiveness of consuming biscuits with different dates substitutes in treating anemia among female workers in Makassar, Indonesia, as well as to assess the potential of date biscuits as a nutritional intervention to treat anemia.

MATERIALS AND METHODS

Study Design

This study employed an experimental research design using a Randomized Controlled Trial (RCT). The population of this study consisted of female workers in Makassar City. Participants were randomly assigned to either the treatment or control group. Hemoglobin levels were measured in both groups at baseline and after the intervention to evaluate the effectiveness of the treatment.

Sample Size and Sampling Technique

By using a power of 70% and a significance level of 0.05 (5%), the number of samples for each group was determined to be 22 people. This study adopted a power of 70 due to limitation of samples that could be recruited according to research needs.

The sample recruitment process begun by conducting outreach and explaining the research to potential respondents. The researchers explained the research objectives and process, the rights and obligations of respondents as well as the treatment that would be received by the respondents if they experience side effects as a result of the intervention provided. Finally, the respondents were asked to sign an informed consent for the research once they agree to participate.

Sampling was carried out using a purposive method based on the following: Inclusion criteria: willing to take part in physical examinations (anthropometry, upper arm circumference, and hemoglobin), not in a state of illness, willing to participate in the study as evidenced by filling out the informed consent; Exclusion criteria: has suffered from complications of the disease and is pregnant. The study randomly divided the sample into three groups: the intervention group that received formula A1 date biscuits (10%), the intervention group that received formula A2 date biscuits (20%), and the control group that did not receive any intervention. The researchers administered 20 grams of biscuits for 60 days. They measured twice at baseline and end line. Drop out: did not consume any of the given date biscuits, withdrew, and changed places of work. During the research, four respondents from the control group changed places of

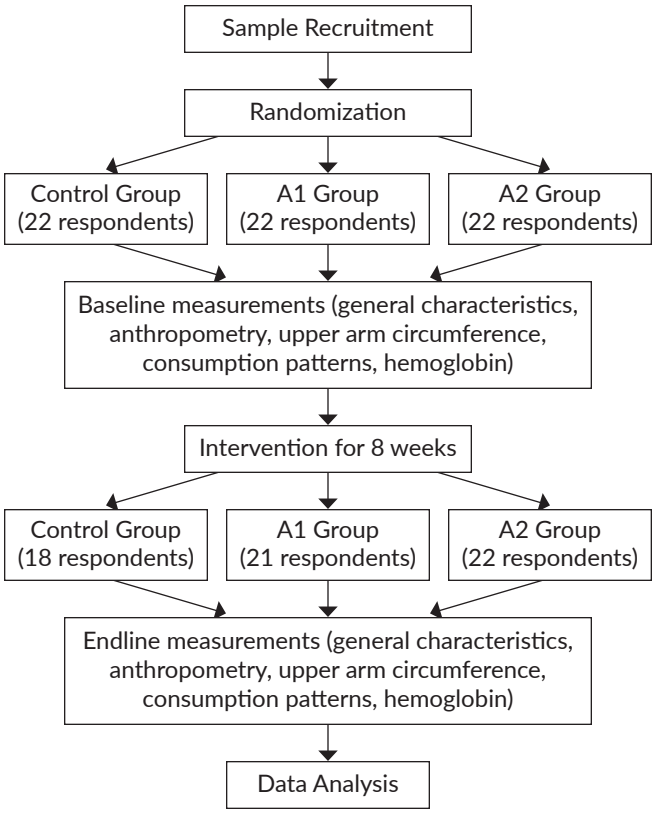

Figure 1. Research flow.

work and one respondent in group A1 was pregnant. The respondents who continued until the end of the study were 18 respondents in the control group, 21 respondents in group A1, and 22 respondents in group A2 (Figure 1).

Research Instrument

The study measured sociodemographic variables using a characteristic questionnaire, assessed nutritional intake using a 24-hour food recall, measured anthropometry with weight scales and a microtoise, measured Upper Arm Circumference with arm circumference tape, and determined hemoglobin levels using a digital hemoglobinometer.

Data Analysis

Data processing was carried out using SPSS with univariate, bivariate, and multivariate tests. A univariate test was performed on each variable to see an overview of its distribution and frequency. To test differences in hemoglobin levels before and after intervention in each group, the paired t test was used, while to test differences in hemoglobin levels between all groups, the Anova test was used. The significance value used was $p < 0.05$.

Compliance with Ethical Standards

The Health Research Ethics Committee of the Faculty of Medicine and Health Sciences Universitas Islam Negeri Alauddin Makassar No. B1.001a/KEPK/FKIK/IV/2023 declared the research to be ethically appropriate in accordance with seven WHO 2011 standards.

RESULTS

Characteristics of Respondents

Respondents in this study were predominantly in the age group of 19-29 years, mostly having completed senior high school education and were not married yet, and their family income varied from 1-2 million to >3 million Indonesian Rupiah per month (Table 1).

Comparison of Nutritional Status, Hemoglobin, and Intake in the Intervention and Control Groups

Before the intervention, there were differences in the respondents' weight, with those in the A2 group having the highest weight among all groups. Similar trends were also seen for BMI and upper arm circumference. However, there were no significant differences in height and hemoglobin. Fat intake varied among respondents, where respondents in the control group had the highest fat intake. Meanwhile, energy, protein, and carbohydrate intakes showed no significant differences (Table 2).

After a 60-day intervention, significant changes were observed in nutritional status, upper arm circumference, and fat intake. It can be seen that respondents in both the A1 and A2 intervention groups experienced weight increases. Equally, upper arm circumference was higher in the intervention group compared to the control group. However, fat intake in both A1 and A2 intervention groups, were significantly lower than in the control group (Table 3).

It can be seen that upper arm circumference has increased significantly in all groups. The control group had the highest increase in upper arm circumference. Changes in hemoglobin levels can also be seen in all groups. However, the control and A2 groups had no significant increase, while hemoglobin level of A1 group showed the highest and most significant increase among all groups (Table 4).

Comparison of Anemia Prevalence and Nutritional Status in the Intervention and Control Groups

Figure 2 showed that the A1 group experienced the highest reduction in anemia, from 38.1% to 14.3%. In the A2 group, there was also a decrease in anemia, but the decrease was not as high as in the A1 group. Meanwhile, the control group experienced the smallest reduction in anemia.

Figure 3 showed that based on nutritional status, many respondents in both the A1 and A2 groups were overweight. Over the 2-month intervention period, there were no significant changes in nutritional status. In the A1 group, the number of overweight respondents increased. However, in the A2 and control groups, the number of overweight respondents decreased.

Table 1. Characteristics of Respondents

Characteristics	Treatment group					
	Control (n=18)		A1 (n=21)		A2 (n=22)	
	n	%	n	%	n	%
Age (years)						
19-29	17	94.40	0	0.00	8	36.36
30-49	1	5.60	18	85.71	12	54.54
50-64	0	0.00	3	14.29	2	9.10
Education						
Elementary school	0	0.00	15	71.43	7	31.81
Junior high school	0	0.00	4	19.05	10	45.46
Senior high school	11	61.10	2	9.52	4	18.18
Bachelor	7	38.90	0	0.00	1	4.55
Marital status						
Single	17	94.40	1	4.76	1	4.55
Married	1	5.60	17	80.95	17	77.27
Widow	0	0.00	3	14.29	4	18.18
Family income (Rp)						
1-2 million	8	44.44	16	76.19	16	72.72
2-3 million	5	27.78	5	23.81	5	22.73
>3 million	5	27.78	0	0.00	1	4.55

Table 2. Differences in Nutritional Status, Hemoglobin, and Intake at Pre-Intervention

Nutritional Status, Hemoglobin, and Intake	Control (n=18)	A1 (n=21)	A2 (n=22)	*P**
	Mean ± SD			
Nutritional status				
Body weight (kg)	52.44 ± 11.50	61.14 ± 9.72	59.67 ± 10.24	0.029
Height (cm)	151.78 ± 7.50	151.32 ± 4.20	151.50 ± 5.44	0.970
BMI (kg/m^2)	22.64 ± 3.84	26.69 ± 4.04	25.97 ± 4.11	0.006
UAC (cm)	22.72 ± 2.59	29.47 ± 2.79	29.18 ± 2.88	0.000
Hemoglobin (g/dl)	12.00 ± 1.26	12.37 ± 0.98	12.21 ± 0.83	0.541
Nutritional intake				
Energy (kcal)	1166.80 ± 575.20	1145.20 ± 508.72	1024.40 ± 390.28	0.605
Protein (grams)	47.00 ± 26.07	35.67 ± 14.33	38.50 ± 19.28	0.203
Fat (grams)	55.28 ± 31.98	23.30 ± 15.62	25.12 ± 14.70	0.000
Carbohydrate (grams)	159.00 ± 101.76	194.81 ± 100.68	169.10 ± 71.54	0.449

**ANOVA*

Table 3. Differences in Nutritional Status, Hemoglobin, and Intake at Post-Intervention

Nutritional Status, Hemoglobin, and Intake	Control (n=18)	A1 (n=21)	A2 (n=22)	*P**
	Mean ± SD			
Nutritional status				
Body weight (kg)	52.37 ± 10.60	62.12 ± 9.58	58.53 ± 9.79	0.013
BMI (kg/m^2)	22.63 ± 3.51	27.15 ± 4.18	25.50 ± 4.00	0.003
UAC (cm)	24.76 ± 2.52	28.63 ± 2.93	28.61 ± 2.89	0.000
Hemoglobin (g/dl)	12.53 ± 1.00	13.10 ± 1.09	12.58 ± 0.84	0.134
Nutritional intake				
Energy (kcal)	1295.97 ± 573.17	1272.30 ± 1147.00	1028.95 ± 276.65	0.458
Protein (grams)	42.07 ± 18.48	32.66 ± 13.20	36.97 ± 18.51	0.230
Fat (grams)	61.75 ± 46.90	24.06 ± 22.07	27.12 ± 17.39	0.000
Carbohydrates (grams)	185.05 ± 120.70	168.00 ± 69.12	164.50 ± 57.93	0.724

**ANOVA*

Table 4. Differences in Nutritional Status, Hemoglobin, and Intake during Pre- and Post- Intervention

Nutritional Status, Hemoglobin, and Intake	Control			A1			A2		
	Pre	Post	*P**	Pre	Post	*P**	Pre	Post	*P**
Nutritional status									
Body weight (kg)	52.44	52.37	0.94	61.14	62.12	0.32	59.67	58.53	0.290
BMI (kg/m^2)	22.64	22.63	0.98	26.69	27.15	0.29	25.97	25.50	0.290
UAC (cm)	22.72	24.76	0.01	29.47	28.63	0.05	29.18	28.61	0.040
Hemoglobin (g/dl)	12.00	12.53	0.09	12.37	13.10	0.01	12.21	12.58	0.100
Nutritional Intake									
Energy (kcal)	1166.80	1296.00	0.46	1145.20	1272.30	0.64	1024.40	1028.95	0.940
Protein (grams)	47.00	42.00	0.45	35.67	32.66	0.21	38.50	36.97	0.570
Fat (grams)	55.28	61.75	0.61	23.30	24.06	0.83	25.12	27.12	0.520
Carbohydrates (grams)	159.00	185.00	0.34	194.81	168.00	0.23	169.10	164.50	0.770

**Paired t-test*

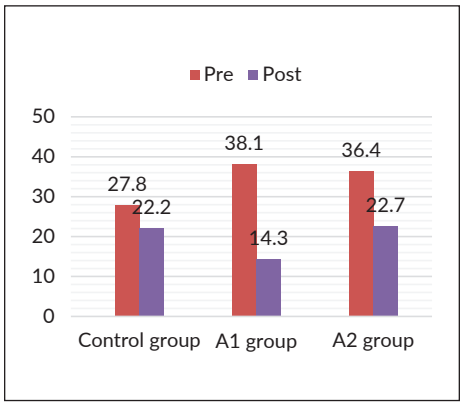

Figure 2. Changes in the status of anemia pre- and post-intervention.

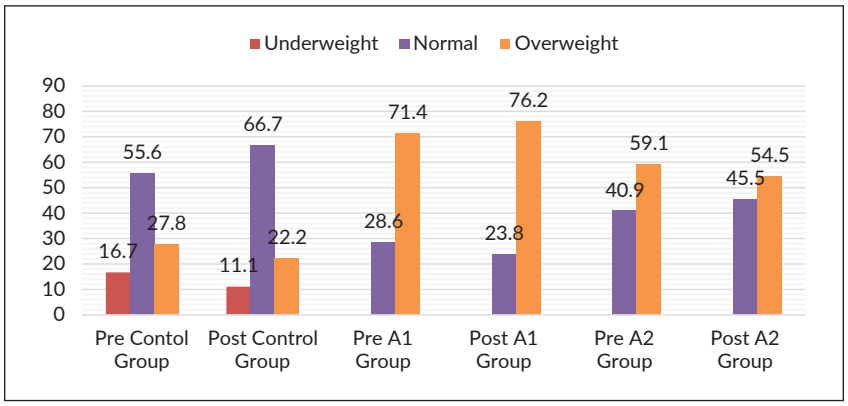

Figure 3. Changes in nutritional status pre- and post-intervention.

DISCUSSION

Makassar City, a prominent industrial hub in Indonesia, is home to a substantial workforce of women across various sectors. Despite their significant contributions to the economy, these female workers face various health challenges. Numerous studies have indicated a high prevalence of anemia among these female workers, which, in turn, negatively impacts their productivity.[18]

Anemia is a condition where the hemoglobin level is lower than normal.[19] Hemoglobin is needed to transport oxygen in the body. If hemoglobin levels are low in the blood, cells and tissues will lack oxygen.[20]

Anemia among women is strongly influenced by social determinants, including education, economic status, geographic disparities, and ethnicity. The anemia-focused articles demonstrate the high burden of anemia among women of reproductive age and emphasize the importance of contextual factors such as household wealth, education level, and regional inequalities. Meanwhile, although not directly related to anemia, suggests that improving the quality of higher education can enhance women's socioeconomic status, potentially increasing their access to nutrition and healthcare, thereby indirectly reducing anemia prevalence.[24-26]

Anemia in female workers is caused by various factors, such as energy intake, protein, iron, vitamin C, and the habit of consuming tea or coffee.[27] Apart from that, it can also be caused by blood loss. Research indicates that adults with inadequate nutritional intake are 1.517 times more likely to develop anemia compared to those with sufficient nutrition.[28] Increasing the intake of protein-rich foods significantly boosts hemoglobin levels in workers as protein has an important role in transporting iron into the blood. Protein also plays an important role in the process of forming blood cells.[29]

Research shows that consuming date biscuits products can have a positive effect on hemoglobin levels. For example, a study shows that consumption of date-based products significantly increases hemoglobin levels in postpartum women. This study used pre-test and post-test methods to measure the effect of the date intervention, with results showing an increase in hemoglobin levels of 1.67 g/L.28 Other research also shows that giving milk cooked with dates can increase hemoglobin levels.[29,30] Likewise, research conducted on mice showed that giving date juice could

increase hemoglobin levels by 0.93-7 points.[29] The results of a systematic review show that administration of dates can improve hematologic parameters.[30]

Biscuits made from date palm (*Phoenix dactylifera L.)* have significant potential in increasing hemoglobin levels in female workers. Dates are known to be rich in iron, the main component in hemoglobin, as well as vitamin C which supports the absorption of iron in the body.[31-34] Moreover, the antioxidant content in dates also plays a role in reducing oxidative stress, which can have an impact on the formation of healthy red blood cells.[13]

Another study conducted found that consumption of Ajwa dates was also effective in increasing hemoglobin levels in pregnant and postpartum women.[38] This study used an experimental design with the intervention group given Ajwa dates for several weeks, resulting in a significant increase in hemoglobin levels of 1.58 g/dl in postpartum mothers.[31]

For female workers who frequently experience anemia due to high workloads and inadequate nutritional intake, date biscuits can act as an effective non-pharmacological intervention. Consuming date biscuits raises hemoglobin levels, which improves health, boosts work productivity, and enhances the quality of life for female workers.

This research highlights the importance of regular consumption of date biscuits as part of a balanced diet for working women. A duration of consumption of two weeks or more can produce optimal results, depending on the dose consumed. Thus, date-based food products, such as date biscuits, not only increase hemoglobin levels but also provide broader nutritional benefits for female workers.

This study aims to assess the effectiveness of giving date biscuits in enhancing hemoglobin levels of female workers. The results revealed that hemoglobin levels increased by 0.53 g/dl in the control group, 0.73 g/dl in Group A1, and 0.37 g/dl in Group A2. Based on the paired t test, it was found that hemoglobin levels were significantly different in group A1 (p=0.01). Based on anemia status, all groups experienced a decrease in the prevalence of anemia. However, the greatest decline occurred in group A1, namely 23.8%compared to the control group which was only 5.6%. Based on these results, it appears that giving date biscuits can reduce the prevalence of anemia in female workers. The findings further showed that in the control group, there was an increase in hemoglobin levels, although it was smaller compared to the group receiving the date biscuit intervention. The highest increase in hemoglobin levels was observed in the A1 formulation, while the lowest was in the A2 formulation. This suggests that a higher dose of date biscuits (20%) did not necessarily provide significant additional benefits in reducing anemia, and a moderate dose may be more effective.

Limitations of the Study

This study has two key limitations: Firstly, the control group exhibited a notably high dropout rate (>10%) resulting from institutional workforce transitions beyond researcher control. Secondly, the study did not account for participants' consumption of iron supplements or iron-absorption inhibiting substances such as tea and coffee. Researchers have reminded respondents not to consume tea and coffee during the research, but there were still respondents who did not comply.

This research used samples from informal companies in Makassar, whose characteristics may differ from those in other regions. However, it is expected that this research has provided sufficient intervention for two months. It is necessary to carry out further studies with a larger number of samples, lower dropout rate, and to control the consumption of iron supplementation and iron inhibitor substances, so that the effectiveness of date biscuits on hemoglobin levels in female workers is clearly known.

CONCLUSION

Biscuits substituted with 10% of dates are biscuits that are effective in increasing hemoglobin levels in female workers. Giving 20 grams of date biscuits for 60 days is quite effective in reducing the prevalence of anemia in female workers. Based on the research results, we recommend government policy for integration into public health programs by including date biscuits as part of nutritional interventions in worker health programs, especially for women who are susceptible to anemia, and establishing quality standards for date biscuit products to meet appropriate health and nutritional criteria to support increased hemoglobin levels. For health agencies, to conduct educational campaigns on the benefits of date biscuits as a nutritious supplementary food for female workers who are at risk of anemia. For the private sector, to provide date biscuits in the workplace, companies can include date biscuits as part of employee welfare programs, such as providing healthy food in the canteen or as supplementary food for female workers.

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Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

All authors declared no conflicts of interest.

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