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The effect of combination syrup of dates (*phoenix dactilyfera*) and bee pollen on erythrocyte index in female adolescents with anemia

Bosyahamu Mony
Midwifery Study Program, Graduate School Hasanuddin University, Makassar, Indonesia
E-mail: monyb20p@student.unhas.ac.id; bosyahamumony28@gmail.com

Sartini Sartini
Department of Pharmacy, Science & Technology, Faculty of Pharmacy, Hasanuddin University, Indonesia
E-mail: sardj@farmasi.unhas.ac.id

Veny Hadju
Department of Nutrition, Faculty of Medical, Hasanuddin University, Indonesia
E-mail: phuunhas@gmail.com

Andi Nilawati Usman
Department of Midwifery, Postgraduate School, Hasanuddin University, Indonesia
E-mail: andinilawati@pasca.unhas.ac.id; wardihans@gmail.com

Andi Wardihan Sinrang
Department of Midwifery, Postgraduate School, Hasanuddin University, Indonesia
E-mail: andinilawati@pasca.unhas.ac.id; wardihans@gmail.com

Yuyun Widaningsih
Departement of Clinical Pathology Laboratories, Hasanuddin University Hospital, Indonesia
E-mail: yuyunwidaningsih5979@gmail.com; yuyun.widaningsih@yahoo.com

***Abstract*---**Introduction: Anemia is a public health problem in developing and emerging countries worldwide. Anemia is defined as an abnormal decrease in the number and size of erythrocytes and the hemoglobin and hematocrit concentrations below normal. In addition to blood (Fe) tablets, one alternative functional food is dates and bee pollen, which can increase hemoglobin and erythrocyte levels. Objective: To assess the difference in changes in erythrocyte index

before and after the intervention between the group-administered combination syrup (dates and bee pollen) and the group-administered date syrup. Method: This experimental study employs a non-equivalent control group design. The sample consisted of 26 female adolescents with anemia who were taken using a total sampling technique, 13 in the date syrup and 13 in the combination syrup (dates and bee pollen). Data were analyzed using Paired T-Test, Independent Sample T-Test, Wilcoxon Test, and Mann-Whitney Test. Results: The combination syrup (dates and bee pollen) affected the increase in erythrocyte index (MCV, MCH, MCHC) in anemic female adolescents, with a pre-post significance value of P<0.05. The results of the analysis of the large difference between each group showed MCV with a P-value =0.087 with an increase of 8.32±9.75 in the date syrup group, 9.07±10.46 in the combination syrup group (dates and bee pollen); MHC with a P-value =0.072, with an increase of 2.28±4.64 in the date syrup group, 3.60±3.88 in the combination syrup group (dates and bee pollen); MCHC P-value =0.014 (P<0.05), with an increase of 0.47±2.24 in the date syrup group, 1.25±1.66 in the combination syrup group (dates and bee pollen). Conclusion: The increase in erythrocyte index in the combination syrup group (dates and bee pollen) was higher than in the date syrup group.

Keywords*---*Dates, Bee Pollen, Anemia, Erythrocyte Index, Female Adolescents

Introduction

Anemia is a common public health problem found not only in developing countries but also in emerging countries.[1] Anemia is a disorder of the decrease in the number and size of erythrocytes, or the concentration of hemoglobin and hematocrit below a specific threshold value, thereby reducing the capacity of the blood to carry oxygen adequately in the body to peripheral tissues.[2,3,4]

Over the last two decades, the prevalence of anemia among non-pregnant women of reproductive age worldwide has consistently increased. About a third of them were anemic, with annual estimates ranging from 29.4% to 33.3%. [5] Data from the World Health Organization (WHO) in 2018 showed an increasing number of women with anemia, from 464 million in 2000 to 578 million in 2016. This condition is a moderate and severe public health problem in 141 countries, including Southeast Asia, with the highest prevalence at more than 35%.[5] In Indonesia, the prevalence of anemia in adolescents is 32%, meaning that 3 to 4 out of 10 adolescents suffer from anemia.[6]

Some causes of anemia are iron deficiency, vitamin B12, vitamin C, folic acid, chronic diseases, parasitic infections, and other congenital diseases. However, the leading cause of anemia worldwide is iron deficiency due to a lack of iron levels needed to produce red blood cells.[1,7,2]

Anemia in adolescents can harm physical abilities, development, performance, and immunity and cause long-term effects in the elderly. These effects can also occur in women of childbearing age at risk of increasing pregnancy complications, such as low birth weight (LBW), premature birth, and neonatal death, and childbirth complications such as bleeding and infection during delivery.[8,9] To prevent complications due to anemia, the Indonesian government launched a program for administering blood-booster tablets (Fe) to female adolescents and women of childbearing age. The program is stated in the Circular Letter of the Director General of Public Health, Ministry of Health of the Republic of Indonesia, number HK.03.03/V/0595/2016, regarding the administration of blood-booster tablets to female adolescents and women of childbearing age.[9]

Another alternative to blood-booster tablets (Fe) is food that has the potential to increase hemoglobin levels, such as dates and bee pollen. Dates (*Phoenix dactylifera*) are rich in nutrients, such as carbohydrates (glucose and fructose), vitamins A, B complex, and C, and minerals such as calcium, magnesium, copper, sodium, phosphorus, zinc, selenium, fluorine, potassium, and iron.[10, 11,12,13]

Several studies have concluded that dates effectively prevent and control iron deficiency anemia (IDA).[14,13] One study [15] concluded that consuming one date fruit for seven days can increase Hb levels by 1.2 g/dL and prevent anemia in a female adolescent during menstruation. (Ridwan et al., 2018) Another study [14] concluded that consumption of dates for two months significantly increased hemoglobin, hematocrit, and serum ferritin levels in elementary school female students with iron deficiency anemia (IDA).

Bee pollen is a mixture of flower pollen with honey bee secretions and nectar collected by honey bees[16,17] that contains amino acids, lipids, flavinoids, micronutrients, and is rich in fat-soluble vitamins, such as vitamins A, E, and D, and vitamins that soluble in water, such as B1, B2, B6, and C.[18] Bee pollen is also a dietary supplement that can repair damaged cells/tissues through cell reproduction to replace dead cells (replication), repair damaged cells (rehabilitation), and optimize cell function.[11] Several studies[19] concluded that bee pollen significantly increased hemoglobin (Hg), hematocrit (HCT), and Mean Corpuscular Volume (MCV) in male rabbits (bucks).

In this case, the combination of dates and bee pollen offers many advantages as a food additive, especially for female adolescents and women of childbearing age. One of the essential minerals in dates and bee pollen is iron and several other active substances that can play a role in curing anemia[20], such as vitamins A, C, B6, B9, and B12, and flavonoids. Vitamin A is implicated in iron homeostasis[21], and vitamin C helps increase iron absorption[22] and regulates iron homeostasis by inhibiting hepcidin expression[21]. Meanwhile, vitamins B6, B9 (folic acid), and B12 are needed for the production and maturation of red blood cells (erythrocytes)[23,24], while flavonoids play a role in replacing, repairing, and optimizing cells.[11,17]

Thus, one of the functional food alternatives that are effective in increasing the erythrocyte index is dates and bee pollen. However, the ability of the combination syrup to increase the erythrocyte index in anemic adolescents has not been

determined. Therefore, this study aims to determine the effect of syrup from a combination of dates (*phoenix dactilyfera*) and bee pollen on erythrocyte index and hematocrit in female adolescents.

Method

This quantitative study uses a quasi-experimental method with a non-equivalent control group design approach. Pretest and posttest were carried out on the date syrup group and the combination syrup group (dates and bee pollen). Sampling was carried out using a total sampling technique. Total sampling is a technique where the number of samples equals the total population. The use of total sampling was caused by a population of less than 100. The number of samples was determined after the initial screening to diagnose anemia symptoms in respondents based on the results of a digital Hb examination (easy touch) on 298 female adolescents at three Islamic boarding schools in North Polongbangkeng Subdistrict, Takallar Regency. Based on the examination results, 35 teenage girls were detected as having anemia. Furthermore, the health analyst then took venous blood for examination of the hematology analyzer at the Clinical Pathology Laboratory of Hasanuddin University Hospital as a diagnosis of anemia based on hemoglobin and hematocrit levels and erythrocyte index. Thus, the sample consisted of 26 anemic female adolescents divided into two groups, 13 samples in the date syrup group and 13 samples in the combination syrup group (dates and bee pollen).

Discussion

The erythrocyte index is an average value that can provide information about the average erythrocyte and the amount of hemoglobin per erythrocyte. Erythrocyte index is a parameter of hematological examination to determine the type of anemia based on morphology. The erythrocyte index examination consists of MCV, MCH, and MCHC. MCV (Mean Corpuscular Volume) is the Average Erythrocyte Volume expressed in femtoliter (fl) units. The normal value of MCV ranges from 82 – 92 fl, which is obtained from the hematocrit value (vol%) multiplied by ten and then divided by the number of erythrocytes (millions/ul). MCH (Mean Corpuscular Hemoglobin) is the average amount of hemoglobin in an erythrocyte expressed in picograms (pg). Normal MCH values range from 27 to 31 pg. MCH is obtained from the value of hemoglobin (g%) multiplied by ten and then divided by the number of erythrocytes (millions/ul). Meanwhile, MCHC (Mean Corpuscular Hemoglobin Concentration) is the average concentration of hemoglobin obtained per erythrocyte expressed in grams per deciliter (g/dl). The normal value of MCH ranges from 30-35 g/dl and is obtained from the hemoglobin value (g%) divided by the total hematocrit (vol%).[25,26,27]

A person with microcytic hypochromic anemia will experience a decrease in MCV, MCH, and MCHC values. The MCHC value will decrease if the anemia is long-standing or severe. The level change of the erythrocyte index is related to the severity and duration of anemia or the area of distribution of erythrocytes.[26] Wirahartari et al. (2019) stated that changes in erythrocyte size could affect the viscosity of blood fluids so that it can affect the function, activity, and smooth blood circulation.[28]

In this study, a combination of syrup (dates and bee pollen) was used as an alternative to increasing the erythrocyte index in adolescent girls with anemia. For 14 days, the syrup is given at a dose of 2x15 ml/day. The composition is 20 grams or the equivalent of 5 dates in the date syrup group and 20 grams or the equivalent of 5 dates and 1 gram of bee pollen in the combination syrup group (dates and bee pollen).

The results showed a change in the increase in the erythrocyte index (MCV, MCH, MCHC) at pre-post in adolescent girls with anemia in the combined syrup group (dates and bee pollen). The significance value is P<0.05. In the date syrup group, MCV increased significantly (P<0.05), while MCH and MCHC did not (P>0.05). Analysis of differences in MCV showed a value of 8.32±9.75 in the date syrup group and 9.07±10.46 in the combination syrup group (dates and bee pollen) with a P-value of 0.087. The MCH values were 2.28±4.64 in the date syrup group and 3.60±3.88 in the combination syrup group (dates and bee pollen), where the P-value was 0.072 (P>0.05 but P<0.1). Meanwhile, the MCHC value was 0.47±2.24 in the date syrup group and 1.25±1.66 in the combination syrup group (dates and bee pollen) with a P-value of 0.014 (P<0.05).

This result is in line with the study by El Hammady et al. (2017) regarding blood parameters in male rabbits that have been administered bee pollen. The study showed that Hemoglobin, HCT, and MCV levels were significantly increased (P<0.01).[19]

Another study by Aotari et al. (2020) investigated the effect of syrup from a combination of dates (Phoenix dactylifera) and bee pollen on the erythrocyte index. The results showed that MCH and MCHC increased significantly (P<0.05) in the group of Wistar rats (Rattus norvegiccus) administered bee pollen syrup and a combination syrup (dates and bee pollen).[11] Meanwhile, a study by Abuoghaba & Ismail (2018) showed that the mean of erythrocytes, leukocytes, and hemoglobin in chickens fed bee pollen increased significantly (P≤0.01) than in chickens in the control group.[29]

The increase in erythrocyte index in the combination syrup group (dates and bee pollen) was caused by the content of minerals such as iron and copper, vitamin C, and folic acid in bee pollen which stimulated the formation and maturation of erythrocytes and increased hemoglobin concentration.[29] It is strongly suspected that it is caused by the action of polyphenols which are part of flavonoids. This assumption is in line with the study by Jaiswal et al. (2014), who found that flavonoids can increase the number of erythrocytes, hemoglobin levels, and the percentage of blood hematocrit.[30] The antioxidant properties of oxygen in flavonoids can act as a hydrogen atom donor (H+) to free radicals to become stable, non-destructive free radicals. It aims to protect the lipid membrane of blood cells from free radicals. Antioxidants can protect a lipid constituent in cell membranes (PUFA) from oxidation and free radicals.[31] Meanwhile, the borderline difference (P-value of 0.05 to 0.1) in MCV and MCH between the combination syrup group (dates and bee pollen) and the date syrup group may be due to the limited sample size the expected significance value was not obtained.

Table 1. Frequency Distribution of Respondents' Characteristics

Respondents Characteristics	Date Syrup (n=13)		Combination Syrup (Dates and Bee Pollen) (n=13)		Total		P-Value
	n	%	n	%	N	%	
Age (Years)							
Early Adolescence (Ages 10 to 14)	5	38.5	7	53.8	12	46.2	0.695[a]
Late Adolescence (Ages 15 to 19)	8	61.5	6	46.2	14	53.8	
Education Level							
SMP/MTs (Middle School)	6	46.2	8	61.5	14	53.8	0.695[a]
SMA/MA (High School)	7	53.8	5	38.5	12	46.2	
Menarche							
Ages <12	3	23.1	3	23.1	6	23.1	0.461
Ages 12	5	38.5	7	53.8	12	46.2	[b]
Ages 13	1	7.7	2	15.4	3	11.5	
Ages 14	4	30.8	1	7.7	5	19.2	
Menstrual Duration							
3-7 days	10	76.9	11	81.6	21	80.8	0.507[a]
>7 days	3	23.1	2	15.4	5	19.2	
Menstrual Cycle							
<20 days	0	0	0	0	0	0	1.000[c]
20-35 days	12	92.3	12	92.3	24	92.3	
>35 Months	1	7.7	1	92.3	2	7.7	
Body Mass Index (BMI)							
Underweight	1	7.7	1	7.7	2	7.7	1.000[c]
Normal	12	92.3	12	92.3	24	92.3	
Overweight	0	0	0	0	0	0	
Obesity	0	0	0	0	0	0	
Upper Arm Circumference (UAC)							0.226[a]
Abnormal (<23,5 cm)	3	23.1	7	53.8	10	38.5	
Normal (≥23,5 cm)	10	76.9	6	46.2	16	61.5	

[a]*Chi-Square Test* [b]*Mann-Whitney Test* [c]*Fisher Exact Test*

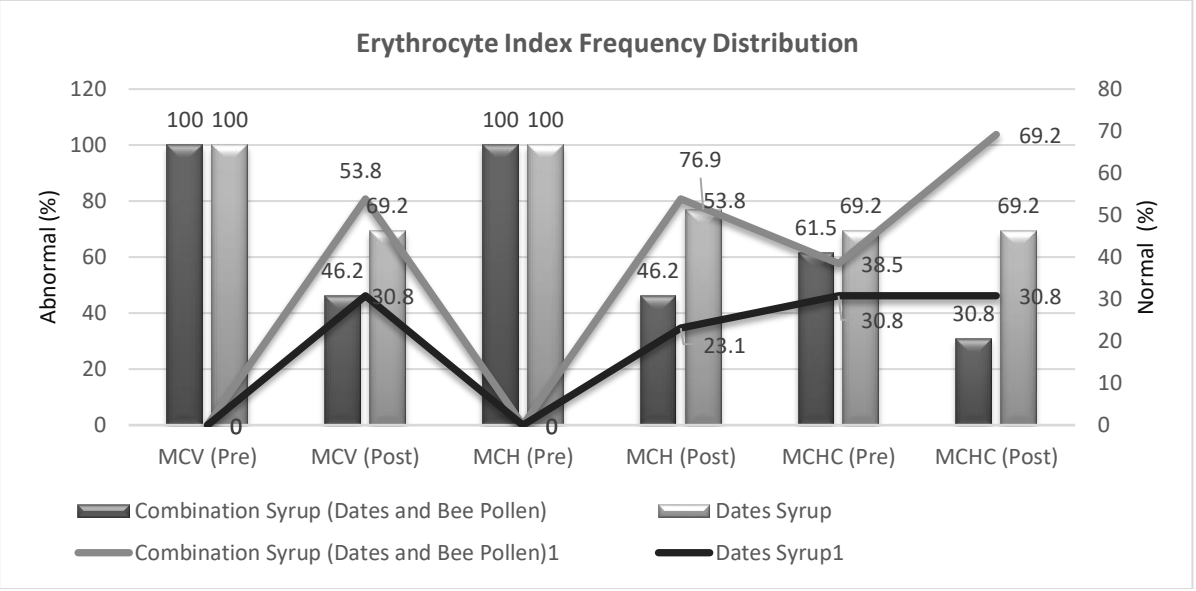

Figure 1. Distribution of Pretest and Posttest Frequency on Respondents' Erythrocyte Index based on the results of the hematology analyzer examination at the Clinical Pathology Laboratory, Hasanuddin University Hospital, Makassar

Table 2 shows the change in the mean MCV levels of respondents in the date syrup group from 66.63±9.09 to 74.95±10.59 with a mean difference of 8.32±9.75 and a P value of 0.010 (P<0.05). In the combination syrup group (dates and bee pollen), the change was from 73.13±4.95 to 82.20±10.16 with a mean difference of 9.07±10.46 and a P value of 0.009 (P<0.05). It means that date and combination syrup (dates and bee pollen) affect increasing MCV levels. The analysis of the differences in each group using the Independent Sample T-Test test obtained a P-value of 0.087 (P>0.05 but <0.1). In this case, there was no significant difference in MCV levels of erythrocytes between the date syrup group and the combination syrup group (dates and bee pollen).

Table 2. Analysis of differences in MCV (fl) erythrocyte index levels at pretest and posttest between the date syrup and combination syrup (dates and bee pollen) groups

Treatment Group	MCV Analysis Results (fl)				
	Pretest Mean ± SD	Posttest Mean ± SD	P-Value	Mean Difference ± SD	P-Value
Date Syrup	66.63±9.09	74.95±10.59	0.010[a]	8.32±9.75	0.087[b]
Combination Syrup (Dates and Bee Pollen)	73.13±4.95	82.20±10.16	0.009[a]	9.07±10.46	

[a]*Paired Sample T-Test* [b]*Independent Sample T-Test*

Table 3 shows the change in the average MCH level of respondents' erythrocytes in the date syrup group from 20.90±3.98 to 23.19±4.68 with a mean difference of 2.28±4.64 and a P value of 0.102 (P>0.05). It shows that date syrup does not affect increasing MCH levels. In the combination syrup group (dates and bee pollen), the change was from 23.05±2.43 to 26.65±3.84 with a mean difference of 3.60±3.88 and a P value of 0.013 (P<0.05). In this case, the combination syrup (dates and bee pollen) affects increasing MCH levels. Meanwhile, the analysis of the difference between the two groups using the Mann-Whitney test obtained a P-value of 0.072 (P>0.05 but <0.1). It means that there is no significant difference in erythrocyte MCH levels in the date syrup group and the combination syrup group (dates and bee pollen).

Table 3. Analysis of differences in erythrocyte index of MCH (pg) levels at pretest and posttest in the date syrup group and the combination syrup group (dates and bee pollen)

Treatment Group	Analysis Results				
	Pretest Mean ± SD	Posttest Mean ± SD	P-Value	Mean Difference ± SD	P-Value
Date Syrup	20.90±3.98	23.19±4.68	0.102[a]	2.28±4.64	0,072[c]
Combination Syrup (Dates and Bee Pollen)	23.05±2.43	26.65±3.84	0.013[b]	3.60±3.88	

[a]Paired T-Test, [b]Wilcoxon Test [c]Mann-Whitney Test

Table 4 shows the change in the mean MCHC levels of respondents in the date syrup group from 31.19 ± 1.98 to 30.71 ± 2.38 with a mean difference of 0.47 ± 2.24 and a P value of 0.458 (P> 0.05). It means that date syrup does not affect increasing MCHC levels. In the combination syrup group (dates and bee pollen), the change was from 31.43±1.36 to 32.68±1.22 with a mean difference of 1.25±1.66 and a P value of 0.019 (P<0.05). In this case, the combination syrup (dates and bee pollen) affects increasing MCHC levels. Meanwhile, the analysis of the differences between the two groups using the Independent Sample T-Test obtained a P-value of 0.014 (P <0.05). It means that there is a significant difference in MCHC levels in the date syrup group and the combination syrup group (dates and bee pollen).

Table 4. Analysis of differences in erythrocyte indices for MCHC levels at pretest and posttest in the date syrup group and the combination syrup group (dates and bee pollen)

Treatment Group	Analysis Results				
	Pretest Mean ± SD	Posttest Mean ± SD	P-Value	Mean Difference ± SD	P-Value
Date Syrup	31.19±1.98	30.71 ± 2.38	0.458[a]	0.47±2.24	0.014[b]
Combination Syrup (Dates and Bee	31.43±1.36	32.68±1.22	0.019[a]	1.25±1.66	

Pollen

[a]*Paired T-Test* [b]*Independent Sample T-Test*

Conclusion

Based on the results and discussion, it can be concluded that the increase in erythrocyte index (MCV, MCH, MCHC) in the combination syrup group (dates and bee pollen) was higher than in the date syrup group, where the P-value was lower than 0.05.

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