https://doi.org/10.20473/mgi.v19i2.158–163

EFFECTIVENESS OF MORINGA TEMPEH BURGERS IN INCREASING HEMOGLOBIN OF ANEMIC ADOLESCENT GIRLS

Tri Martya Ningrum[1*], Yulia Lanti Retno Dewi[2], Ratih Puspita Febrinasari[3]
[1]Postgraduate Program of Nutrition Sciences, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Department of Nutrition Science, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia
[3]Department of Pharmacology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia
Jl. Ir Sutami 36A, Surakarta, Central Java, Indonesia 57126
Email: inaqadzkia@gmail.com

ABSTRACT

Adolescent girls can avoid anemia by maintaining stable hemoglobin levels and consuming foods rich in nutrients and high in iron. Food sources with high iron content that can increase hemoglobin levels include Tempeh and Moringa. Tempeh and Moringa are notable sources of iron. Tempeh provides nutrients such as Fe, vitamin B12, and folic acid, while Moringa leaves contain 28.66 g of protein, 929.29 mg of calcium, 715.22 mg of phosphorus, 9.99 g of iron, and 2.32 mg of zinc per 100 g. This study investigated the effect of Moringa tempeh burgers on hemoglobin levels in anemic teenage girls. Using a quasi-experimental design, 51 anemic girls aged 13-15 were divided into three groups: a control group (K) given tempeh burgers without Moringa, treatment group 1 (P1) given tempeh burgers with 3g of Moringa leaf flour, and treatment group 2 (P2) given tempeh burgers with 12g of Moringa leaf flour. Each group included 17 participants who consumed the assigned burgers for 30 days. Results showed the average hemoglobin level changes before and after the intervention were 0.46 g/dl in K, 0.70 g/dl in P1, and 2.23 g/dl in P2. Statistical tests confirmed significant differences in hemoglobin levels pre- and post-treatment across all groups. The study concluded that Moringa tempeh burgers, particularly those with the highest amount of Moringa leaf flour, were most effective in increasing hemoglobin levels in anemic adolescent girls.

Keywords: *adolescent girls, anemia, moringa tempeh burger, hemoglobin*

INTRODUCTION

Anemia is a global and Indonesian public health problem. Global prevalence in women is 29.9% (WHO, 2019), and according to 2018 *Riskesdas* data, nationally, anemia is 27.2% in women and 20.3% in Men (Ministry of Health, 2018).

Adolescents are said to be anemic when they have hemoglobin levels <12g/dl (WHO, 2021). Adolescent girls have a higher risk of anemia (Ayuningtyas et al., 2020). One of the causes of anemia in adolescent girls is due to menstruation (Misroh Mulianingsih, 2021). Previous research showed that anemia in adolescent girls was higher than in adult women (Sari et al., 2022). In other research, adolescent girls who live in boarding schools are more likely to experience anemia due to a lack of knowledge, parental control, and ability to provide healthy food (Eka, 2018).

Adolescent girls can avoid anemia by maintaining stable hemoglobin levels (Junita & Wulansari, 2021) and consuming foods rich in nutrients and high in iron (Nisa et al., 2020). Several literatures have found that food sources with high iron content that can increase hemoglobin levels include tempeh (Rahayuni et al., 2020) and moringa (Hasniar et al., 2019).

Tempeh contains several nutrients, including Fe, vitamin B12, and folic acid. These three nutritional values in tempeh can increase blood hemoglobin (Pinasti et al., 2020).

Moringa leaves (*Moringa oleifera*) are local plants with rich nutrition content and food-rich nutrition. In 100 g, moringa leaves contain 28.66 g of protein, 929.29 mg of calcium, 715.22 mg of phosphor, 9.99 g of iron, and 2.32 mg of zinc (Irwan, 2020). Based on the Indonesian DKBM, moringa leaves contain 7.00 per 100 g of iron, this amount is more than the iron contained in

 Received 15-09-2023, Accepted 15-01-2024, Published online 30-05-2024.

beef, which is 3.00 per 100 g. On the other hand, moringa leaf flour can contain 28.66 g of calcium, 603.77 mg of protein, 12.84mg of phosphor, 264.96 mg of potassium, and 20.49 mg of iron (Manggara & Shofi, 2018). Research conducted by Fadliyah (2018) stated that giving chocolate cookies containing 8 g of moringa leaf flour to 19 teenagers during 30 days of treatment could increase Hb levels from before treatment 9.41+0.84 g/dl to 12.36+1 .51 g/dl after treatment.

Another research conducted by the author was to determine the effect of adding moringa leaf flour to tempeh burgers. The results of this research show that the nutritional content of tempeh burgers without the addition of moringa leaf flour is 2.41 mg of iron, 1.76 mg of folic acid, and 0.70 mg of vitamin C. After adding 3 g of moringa flour, the iron value increased to 2.51 mg (4.14%) and folic acid value to 1.78 mg (1.13%). Meanwhile, 12 g of moringa leaf flour increased the iron value to 2.98 mg (23.6%) and folic acid to 1.90 mg (7.95%). The conclusion of this research shows that moringa leaf flour can increase the levels of iron and other minerals in tempeh burger products (Ningrum et al., 2023).

This follow-up research aims to analyze the effectiveness of giving moringa tempeh burgers to anemic adolescent girls in increasing hemoglobin levels.

METHODS

This research used a quasi-experimental pre-test and post-test control group design. This research was conducted at the Khairukum Islamic Boarding School, Daar el Manshur Islamic Boarding School, Mafaza 4 Islamic Boarding School, and Darut Tafsir Al Husaini Islamic Boarding School in Depok City in July - August 2022.

A total of 282 adolescent girls from four Islamic boarding schools were the sample in this study. The inclusion criteria in this study were adolescent girls studying at junior high school aged 13-15 years, having a hemoglobin level <12g/dL, living in an Islamic boarding school, and following the research procedures by signing informed consent. Exclusion criteria include adolescent girls who are sick during screening or intervention, such as tuberculosis, worms disease, HIV, and malaria, based on a doctor's diagnosis and who are allergic to tempeh and moringa.

Calculation of sample size was using the Sastroasmoro formula (2014):

$$n = 2 \left(\frac{(Z_\alpha + Z_\beta)s}{X_1 - X_2} \right)^2$$

Where:

n = sample size
Zα = alpha significance/confidence level
Zβ = conventional beta value/power
S = Standard deviation
X1-X2 = expected clinical differences (Sastroasmoro, 2014)

Alpha significance/confidence level used in this study was 95% (Zα = 1.65) or α = 0.05 with conventional beta value (power) 90% (Zβ = 1.28), standard deviation 1.105 and clinical difference value of 1,27g/dl (Novianti et al., 2019). The sample size calculation above shows that the number of subjects in this study was 13 subjects per group, so the total in the three groups was 36 subjects. Anticipating the possibility of dropping out or being lost to follow-up is around 20%, and corrected using the calculation formula n'=n/(1-f), n' is the final sample size after correction, n is the calculated sample size, and f is the estimated number of drops out (Sastroasmoro et al., 2014). The result of this calculation is n'=13/(1-0.2)= 16.25 rounded up to get 17 subjects in each group with a total number of subjects in the three groups of at least 51 subjects.

The research began by making moringa tempeh burgers with three different moringa leaf flour concentrations: 0g (control), 3g, and 12g. The selection of the moringa tempeh burger product was obtained through the Hedonic Organoleptic Test which had been carried out previously, to find out the moringa tempeh burger with the most preferred formulation by research respondents, namely the moringa tempeh burger product with the addition of 3g and 12g of moringa leaf flour.

Moringa tempeh burgers were analyzed to find the nutritional value at the Center for Agro-Based Industry (*Balai Besar Industri Agro)* in Bogor. The nutritional value calculated includes analysis

to check energy, carbohydrates, fat, protein, Fe (iron), vitamin C, vitamin B9 (Folic Acid), and crude fiber.

Research subjects filled out informed consent, personal biodata, and parental consent before the research began. This research has received approval from the Ethics Commission of the Faculty of Medicine, Sebelas Maret University, Surakarta, with Number 51/UN27.06.11/KEP/EC/2022.

This research was carried out for 30 days, giving each subject moringa tempeh burger 100g daily. Moringa tempeh burgers were served during the first break or around 10 a.m. The dose given was moringa tempeh burger in tempeh petty dough and additional amounts of moringa flour (97 g tempeh and 3 g moringa flour for P1 and 88 g tempeh and 12 g moringa flour for P2), while the control group was given tempeh burgers without moringa leaf flour). In all treatments, they were given an additional 1 Fe tablet per week and moringa tempeh burgers were given for 30 days (Yuniwati et al., 2018). Giving deworming medication (Albendazole 400mg) to research subjects before starting to consume moringa tempeh burgers was done to ensure nutritional intake was not absorbed by worms (Ministry of Health, 2016).

Several secondary data such as subject characteristics in the form of age, parent's income, weight, height, nutritional status, study concentration and hemoglobin levels were collected by researchers to support the research results. Data on body weight and height were measured using tools and presented in the form of a Z-Score (BMI/U). 4) Nutrient intake data were obtained through direct interviews with respondents using a 24-hour food recall, during the pre-test and post-test and the Semi-Quantitative Food Frequency questionnaire (SQ-FFQ) which was conducted on the 15th day of the study. 5) Learning Concentration was obtained by direct interviews with respondents through questionnaire forms given on the pre-test and post-test on day 30. Blood sample data for hemoglobin examination before the research (pre-test) and after the research (post-test) was carried out by officers health and tested at the Bogor Regional Health Laboratory (LABKESDA).

SPSS Version 25 was used to carry out statistical tests. Normality tests used the Kolmogorov Test because the sample size was >50. Analysis before and after treatment used a paired test; the Wilcoxon test should be used if the data are not normally distributed. Data analysis to differentiate the effects of the three groups was tested using the one-way ANOVA test and ended with a post hoc test with the Tukey HSD test to see the location of the differences.

RESULT AND DISCUSSION

The characteristics of the research subjects were 13 - 15 years old and came from four Islamic boarding schools in the Depok City area, West Java. The subjects were 51 anemic adolescent girls,

Table 1. Respondent Characteristics Source: Secondary Data (2022)

	Control		P1		P2		p
Characteristic	**n**	**%**	**n**	**%**	**n**	**%**	
Age (years)							
13	5	29.4	3	17.6	3	17.6	
14	5	29.4	5	29.4	5	29.4	0.906
15	7	41.2	9	53.0	9	53.0	
Total	17	100	17	100	17	100	
Nutritional Status (IMT/U)							
Normal	11	64.7	14	82.4	13	76.5	
Overweight	4	23.5	3	17.6	4	23.5	
Obesity	2	11.8	0	0.0	0	0.0	
Total	17	100	17	100	17	10	0.292

consisting of 11 people aged 13 years, 15 people aged 14 years, and 25 people aged 15 years. The subject's education level was MTs or equivalent to junior high school.

Based on the table above, subjects in all intervention groups have various characteristics. This is in accordance with the results of the Chi Square test, namely that there is no difference between subjects in groups K, P1 and P2 with a value of p = 0.903 (p > 0.05) which means the subjects are homogeneous. This confirms the assumption of experimental studies where the baseline characteristics of the subjects are evenly mixed.

The Effect of Giving Moringa Tempeh Burgers on Increasing Hemoglobin

The Kolmogorov normality test had been carried out previously with pre-test results sig ρ = 0.020 (ρ > 0.05) and post-test sig ρ = 0.156 (ρ > 0.05), which means the pre-post was normally distributed, then continued with the paired t-test. The results show sig ρ = 0.000 (ρ < 0.05). It means that there is a significant difference between Hb levels before and Hb levels after treatment.

Giving moringa tempeh burgers was able to increase hemoglobin levels significantly in the treatment group. In the control and P1 treatments there was an increase in the average hemoglobin level but the hemoglobin level was still classified as mild anemia, while in the P2 group there was an increase in the hemoglobin level above the normal threshold, namely > 12 g/dL. This is in accordance with previous research that found that administering moringa leaf extract for 14 days can increase hemoglobin levels with an increase of 0.9 g/dL (p<0.05) (Hastuty & Medan, 2022).

The highest mean Hb level was in the P2 group (2.23 g/dL). These results are in line with other research that drinking moringa leaf tea for two weeks can increase hemoglobin by 1.3 g/dl (Hastuti & Novita 2022). Research conducted by Khofifah and Mardiana (2023) stated that consuming moringa leaf biscuits in teenagers could increase hemoglobin levels by 1.25 g/dl for 30 days, whereas in this study the largest increase was 2.23 g/dl for 30 days. This can explain that the moringa tempeh burger product is more effective in increasing hemoglobin levels.

CONCLUSION

Providing moringa tempeh burgers daily during snack time for 30 days increased hemoglobin levels in anemic teenage girls in four Islamic boarding schools in Depok City.

Islamic boarding school students should not only rely on snacks or moringa tempeh burgers but also change their healthy lifestyle by applying the principles of balanced nutrition. By doing so, female students can get sufficient nutrition, including iron, vitamin C, animal protein, folic acid, and vitamin B12. Adequate nutrition can support adolescent girl's health, help them focus more on studying, and prevent anemia.

ACKNOWLEDGMENTS

Thanks to Prof. Dr. Yulia Lanti Retno Dewi, dr., M.Sc. as Main Supervisor and Dr. Ratih Puspita Febrinasari, dr., M.Si. as Companion Supervisor who has educated and developed the author so that he can complete this journal and assist in this research. Moreover, thanks to BPPSDMK, the

Table 3. The Effect of Giving Moringa Tempe Burgers on Hemoglobin

Group	n	Before	After	Δ Mean ± SD	ρ
		Mean ± SD	Mean ± SD		
Control	17	10.48 ± 1.32	10.95 ± 1.15	0.46 ± 0.37	0.000*
P1	17	10.49 ± 1.16	11.19 ± 1.05	0.70 ± 0.43	0.000*
P2	17	10.58 ± 0.87	12.81 ± 0.67	2.23 ± 0.67	0.000*
				0.000**	

Where:
Δ : The difference in hemoglobin levels before and after intervention
*) : Paired t-test result
**) : One Way Anova result

Ministry of Health of the Republic of Indonesia, which funded this research.

Thanks also to YBM PLN, who has facilitated the needs in carrying out this research. Furthermore, we thank the Islamic boarding schools and their female students who have received and welcomed this research.

REFERENCES

Augustyn, G. H., Tuhumury, H. C. D., & Dahoklory, M. (2017). Pengaruh Penambahan Tepung Daun Kelor (Moringa Oleifera) Terhadap Karakteristik Organoleptik Dan Kimia Biskuit Mocaf (Modified Cassava Flour). *AGRITEKNO, Jurnal Teknologi Pertanian*, *6*(2), 52–58. https://doi.org/10.30598/jagritekno.2017.6.2.52

Ayuningtyas, G., Fitriani, D., & Parmah. (2020). Hubungan Status Gizi dengan Kejadian Anemia pada Remaja Puteri di Kelas XI SMA Negeri 3 Tangerang Selatan Correlation of Nutritional Status With Anemia Case in Adolescent Girls At Grade Xi Senior High School 3 South Tangerang. *Prosiding Senantias 2020*, *1*(1), 877–886.

Eka, P. S. (2018). Perbandingan Kejadian Anemia pada Remaja Putri yang Tinggal di Pondok Pesantren Darussalam Kepung Kediri. *Jurnal Ilmiah Kebiadanan*, *4*(2), 114–119.

Fauziandari, E. N. (2019). Efektifitas Ekstrak Daun Kelor Terhadap Peningkatan Kadar Hemoglobin Pada Remaja Putri. *Jurnal Kesehatan Karya Husada*, *7*(2), 24–29. https://doi.org/10.36577/jkkh.v7i2.230

Halim, R., Lanita, U., Syukri, M., & Faisal, F. (2022). Pengaruh Penambahan Tepung Kelor Terhadap Nilai Gizi Dan Tingkat Kesukaan Produk Nugget Ikan. *Gema Wiralodra*, *13*(2), 739–751. https://doi.org/10.31943/gemawiralodra.v13i2.291

Hasniar., Muh, R., & Ratnawaty, F. (2019). Analisis kandungan gizi dan uji organoleptic pada bakso tempe dengan penambahan daun kelor. *Jurnal Pendidikan Teknologi Pertanian*, *5*(1), 189–200.

Irwan, Z. (2020). Kandungan Zat Gizi Daun Kelor (Moringa Oleifera) Berdasarkan Metode Pengeringan. *Jurnal Kesehatan Manarang*, *6*(1), 69–77.

Junita, D., & Wulansari, A. (2021). Pendidikan Kesehatan tentang Anemia pada Remaja Putri di SMA N 12 Kabupaten Merangin. *Jurnal Abdimas Kesehatan (JAK)*, *3*(1), 41. https://doi.org/10.36565/jak.v3i1.148

Kemenkes. (2016). Peraturan Menteri Kesehatan Republik Indonesia Nomor 51 Tahun 2016 - Tentang Standar Produk Suplemen Gizi. In *Peraturan Menteri Kesehatan Republik Indonesia* (Vol. 51, Issue Permenkes). https://doi.org/10.1088/1751-8113/44/8/085201

Kemenkes. (2018). Laporan_Nasional_RKD2018_FINAL.pdf. In *Badan Penelitian dan Pengembangan Kesehatan* (p. 198). http://labdata.litbang.kemkes.go.id/images/download/laporan/RKD/2018/Laporan_Nasional_RKD2018_FINAL.pdf

Manggara, A. B., & Shofi, M. (2018). Analisis Kandungan Mineral Daun Kelor (Moringa oleifera Lamk.) Menggunakan Spektrometer XRF (X-Ray Fluorescence). *Akta Kimia Indonesia*, *3*(1), 104. https://doi.org/10.12962/j25493736.v3i1.3095

Misroh mulianingsih, M. M. (2021). Factors Affecting Anemia Status in Adolescent Girls. *Journal of Health Education*, *6*(1), 27–33. https://doi.org/10.15294/jhe.v6i1.43758

Ningrum, T.M., Dewi, Y.L.R., & Febrinasari, R.P. (2023). Original article: The Effect of Giving Moringa Leaf Flour to Burger Tempeh on The Content Nutrition And Organoleptic. *International Journal of Human and Health Sciences (IJHHS)*, *07*(03), 220–232.

Nisa, J., Chikmah, A. M., Lorenza, K. A., Amalia, K. R., & Agustin, T. (2020). Pemanfaatan Kacang Hijau Sebagai Sumber Zat Besi Dalam Upaya Pencegahan Anemia Prakonsepsi. *Jurnal Surya Masyarakat*, *3*(1), 42. https://doi.org/10.26714/jsm.3.1.2020.42-47

Novianti., Asmariyah., & Suriyati. (2019). Pengaruh Pemberian Susu Tempe Terhadap Kadar Haemoglobin Pada Ibu Hamil Tm Iii Di Kota Bengkulu. *Journal Of Midwifery*, *7*(1), 23–29. https://doi.org/10.37676/jm.v7i1.770

Pinasti, L., Nugraheni, Z., & Wiboworini, B. (2020). Potensi tempe sebagai pangan fungsional dalam meningkatkan kadar hemoglobin remaja penderita anemia. *AcTion: Aceh Nutrition Journal*, *5*(1), 19. https://doi.org/10.30867/action.v5i1.192

Priyas Hastuti, A., & Novita Sari, A. (2022). Pengaruh Teh Daun Kelor (Moringa Oleifera L) Terhadap Peningkatan Kadar Hemoglobin Penderita Anemia. *Avicenna : Journal of Health Research*, *5*(1), 27–36. https://doi.org/10.36419/avicenna.v5i1.590

Rahayuni, A., Noviardhi, A., & Subandriani, D. N. (2020). Peningkatan Kadar Hemoglobin Remaja

Putri Dengan Pemberian Kudapan Berbasis Tepung Tempe. *Jurnal Riset Gizi*, *8*(1), 53–60.

Sari, P., Judistiani, R. T. D., Hilmanto, D., Herawati, D. M. D., & Dhamayanti, M. (2022). Iron Deficiency Anemia and Associated Factors Among Adolescent Girls and Women in a Rural Area of Jatinangor, Indonesia. *International Journal of Women's Health*, *14*(August), 1137–1147. https://doi.org/10.2147/IJWH.S376023

Sastroasmoro, S. (2014). *Metodologi Penelitian Klinis* (5th ed.). Sagung Seto.

WHO. (2015). *The Global Prevalence of Anaemia in 2011*.

WHO. (2021). *WHO Global Anaemia estimates, 2021 Edition*. https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children