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Submission date: 25-Apr-2023 01:49PM (UTC+0700)

Submission ID: 2074890835

File name: Artikel_OAMJMS_Beetroot_Juice_and_Red_Spinach.pdf (296.42K)

Word count: 3352

Character count: 16975



Beetroot Juice and Red Spinach Juice to Increase Hemoglobin Levels in Anemic Adolescent Girls

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Abstract

Edited by: Saaho Stoleski
Citation: Purba RB, Paruntu OL, Ranti IN, Harikedua V, Langi G, Sineke J, Laoh JM, Pesak E, Tomastola Y, Robert D, Salman S. Beetroot Juice and Red Spinach Juice to Increase Hemoglobin Levels in Anemic Adolescent Girls. Open Access Maced J Med Sci. 2021 Sep 17; 9(E):857-860. https://doi.org/10.3889/oamjms.2021.6871

Keywords: Anemia; Adolescents; Beetroot juice; Red spinach juice

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Received: 18-Jul-2021

Revised: 19-Aug-2021

Accepted: 07-Sep-2021

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Funding: This research did not receive any financial support
Competing interests: The authors have declared that no competing interests exist
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BACKGROUND: The problem of iron (Fe) deficiency anemia in adolescents often occurs due to incorrect food habits caused an imbalance in nutritional intake and the recommended dietary adequacy. Spinach and beetroot are alternative plants to meet the Fe needs of anemic adolescents. The content of Vitamin C or ascorbic acid in beets and spinach can help absorb Fe in the body. Beetroot also contains relatively sufficient Fe beneficial in overcoming anemia caused by Fe deficiency.

AIM: This study aimed to determine the effect of beetroot juice and red spinach juice on increasing hemoglobin (Hb) levels in anemic adolescents.

METHODS: It was a Quasi Experiment with a pretest-posttest, non-equivalent control group design. The research subjects were twenty people per group of anemic adolescent girls.

RESULTS: In this study, after 2 weeks of beetroot juice intervention to anemic adolescent girls, there was an increase in Hb levels from 11.47 g/dl to 12.02 g/dl. The increase in Hb levels was statistically different (Paired t-test) ($p < 0.05$). However, the 2 weeks of red spinach juice intervention also experienced an increase in Hb levels, from 11.4 g/dl to 12.08 g/dl. The increase in Hb levels was statistically significant ($p < 0.05$).

CONCLUSION: An effect of beetroot juice and red spinach juice consumption on Hb levels of anemic adolescent girls.

Introduction

Anemia is one of the nutritional problems in Indonesia. Based on Basic Health Research (in Indonesian is Riset Kesehatan Dasar, abbreviated as RISKESDAS) in 2013, the prevalence of anemia in Indonesia was 21.7%, anemic aged 5–14 years was 26.4%, and aged 15–24 years was 18.4%, it was tended to increase in the elderly [1]. Anemia in North Sulawesi is lower when compared to other provinces in Indonesia, about 8.7% in women.

Adolescents are risky to anemia due to their period of growth, so they need more micronutrients and macronutrients. The problem of nutritional anemia in adolescents often occurs due to incorrect food habits causes an imbalance in nutritional intake with the Recommended Dietary Adequacy [2]. The iron (Fe) supplementation program for anemic adolescents in Bogor has not been running effectively [3].

Research on anemic adolescent girls in Kudus resulted in red spinach on hemoglobin (Hb) levels [4].

Likewise, the research in Kediri on anemic pregnant women shows an improvement in Hb levels after obtaining spinach juice. One food that may increase Hb levels in the blood is spinach stew [5]. Spinach is one of the alternative plants to fulfill the Fe needs of adolescents with anemia. Furthermore, one of the natural food ingredients that can overcome anemia is beetroot [6]. This beet fruit is classified as a functional food due to its good impact on health. This food ingredient is often used as a natural dye in various types of processed food because of its unique purple or purplish color [7]. Apart from being a colorant, beetroot can also be consumed raw or processed into drinks such as juice. Some of the benefits of beetroot juice are lowering blood pressure, increasing the amount of oxygen, improving stamina, preventing congenital disabilities, and overcoming menstrual problems [8]. The active substance contained in red spinach and beets that can increase Hb is Fe. In 100 g of red spinach contains 7.0 mg of Fe and 62 mg of Vitamin C. The role of Vitamin C is to help the absorption of non-heme Fe. Likewise with beetroot which contains 1.0 mg of Fe and 10 mg of Vitamin C [9].

A very well-known benefit of this beet is to overcome anemia, or even known as anti-anemia. A study was conducted on adolescent girls in India who suffered from anemia, whether mild, moderate, or severe [8]. The content of Vitamin C or ascorbic acid in this beet can help absorb Fe in the body. This beet also contains relatively sufficient Fe to overcome anemia caused by Fe deficiency [10]. More attention should be paid to combining daily food, consisting of a mixture of Fe sources derived from animals and plants and other nutrients that can help absorption in the body.

This study aimed to determine the effect of beetroot juice and red spinach juice on Hb improvement in anemic adolescent girls.

Methods

Design and sampling

This was a Quasi Experiment with a pretest-posttest, non-equivalent control group design, conducted in June - November 2020 in Manado, North Minahasa, and Bitung. The population was adolescent girls aged 14–19 years, suffered from anemia identified by Hb levels of <12 g/dl. The number of samples used was 25 people per group of adolescent girls suffering from Fe deficiency anemia (met the inclusion and exclusion criteria). The sampling technique used was simple random sampling. Subject inclusion criteria were: (1) Anemic adolescent girls (Hb level <12 g/dl); (2) In good health can read and write; (3) Willing to participate in research. Subject exclusion criteria are teenage girls who are menstruating.

Interventions and observations

First, it was screening of anemic adolescent girls through examination of blood samples. The previous sample was willing to be a sample by signing the informed consent. Health professionals took blood samples from capillaries, and then, Hb was determined using Family Dr, Hb <12 g/dl would be identified anemic. Selected samples would be rechecked for Hb level after 2 weeks of consuming beetroot juice or red spinach juice.

Red spinach and beetroot used as main research materials were obtained from the market or supermarket. The juices were prepared in the following ways; red spinach leaves and beetroot were weighed and washed under running water, then drained. It was brewed with boiling water for about 5 min, then mashed with a blender and filtered. Honey was added to the juice as a natural sweetener. Then, it was packaged in plastic cups and ready to be distributed to the respondent once a day every morning for 2 weeks. Hb level observations

were conducted a day before (day 0) and a day after (day 15) after the intervention/treatment.

Respondents who were selected as research subjects were anemic adolescent girls (Hb levels <12 g/dl) who met the research criteria. The respondents were divided into three groups by purposive sampling technique. The experimental Group I (n = 25) received 150 ml of beetroot juice, the experimental group II (n = 25) received 150 ml of red spinach juice, and the control group (n = 25) did not receive any intervention. The Hb level of the sample was measured as a pretest (when selected as a sample, day 0) and post-test (day 15).

This research protocol was approved by the Health Polytechnic Ethics Committee of the Manado Health Ministry (No. KEPK.01/04/026/2020).

Data analyses

The data were analyzed by paired t-test, which was previously tested for normality of data distribution.

Results

The study results show that the average age of the beetroot juice group was 14–15 year (10 people). In the red spinach juice group, the average age of the sample was mainly in the 18–19 year age group (16 people). Meanwhile, in the control group, mostly at the age of 16–17 years (10 people) (Table 1).

Table 1: Age characteristics by respondent group

Age group (years)	Respondent		
	Beetroot juice group	Spinach juice group	Control
14 – 15	10	3	8
16 – 17	4	4	10
18 – 19	6	16	2
Total	20	23	20

Beetroot juice and red spinach juice intervention on Hb levels

After 2 weeks of intervention of beetroot juice to anemic adolescent girls, there was an increase in Hb levels from 11.47 g/dl to 12.02 g/dl. The increase in Hb levels was statistically different (Paired t-test) ($p < 0.05$). The 2 weeks intervention of red spinach juice also experienced an increase in Hb levels, from 11.4 g/dl to 12.08 g/dl. The improvement in Hb levels was statistically significant ($p < 0.05$) (Table 2).

Table 2: Differences in average Hb levels (pre and post)

Intervention group	Pre-test		Post-test		p-value
	Average Hb (gr/dl)	SD	Average Hb (gr/dl)	SD	
Beetroot juice	11.47	0.661	12.02	0.583	0.000*
Spinach juice group	11.4	0.58	12.08	0.565	0.000*

Hb: Hemoglobin.

Differences in Hb levels of beetroot juice group and control group

The intervention of beetroot juice to the Hb levels of anemic adolescent girls showed different results compared with the control group. After being tested statistically (independent t-test), it turned out that there was a significant difference ($p < 0.05$) (Table 3).

Table 3: Differences in average Hb levels (pre and post) in the beetroot juice group with control

Intervention group	Pre-test			Post-test		
	Average Hb (gr/dl)	SD	p-value	Average Hb (gr/dl)	SD	p-value
Beetroot Juice	11.47	0.661	0.592	12.02	0.583	0.000*
Control	11.31	0.481		11.47	0.417	

Hb: Hemoglobin.

Differences in Hb levels of red spinach juice and control group

In the group of anemic adolescent girls who received and consumed red spinach juice, when compared to the Hb level with the control group, there was also a significant difference ($p < 0.05$) (Table 4).

Table 4: Differences in the mean Hb levels (pre and post) in the red spinach leaf juice group with control

Intervention group	Pre-Test			Post-Test		
	Average Hb (gr/dl)	SD	p-value	Average Hb (gr/dl)	SD	p-value
Spinach Juice	11.40	0.587	0.592	12.08	0.565	0.000*
Control	11.31	0.481		11.47	0.417	

Hb: Hemoglobin.

Discussion

Giving beetroot juice can accelerate Hb levels in anemic adolescent girls because beetroot has a high Fe content that can regenerate and reactivate red blood cells and bring fresh oxygen to the body. Beetroot (in 100 g) contains Vitamin C, Vitamin B, and 0.80 mg Fe, equivalent to 10% of the total daily Fe requirement. A very well-known benefit of this beet is to overcome anemia, or even known as anti-anemia. A study was conducted on adolescent girls in India who suffered from anemia, either mild, moderate, or severe. There is an effect of consumption of red spinach juice on the increase in hemoglobin levels in pregnant women in the second trimester [11]. The teenager was given one glass of beetroot juice for 20 days in the morning. The results showed that the average Hb level of the adolescents increased significantly [12].

This study indicates that giving beet juice to be consumed by anemic adolescent girls as much as 150 cc every day for 2 weeks can increase their Hb levels. Initially, the average Hb level was 11.47 g/dl and increased to an average of 12.02 g/dl. Statistically, there was a significant effect of giving beetroot juice on the increase in Hb levels of anemic adolescent girls ($p < 0.05$).

Other research shows that minimum Hb increase before and after the administration of Fe and beetroot juice to pregnant women was 17.7 gr% and the maximum Hb level was 0.8 gr% [13]. The result of a study by Suryandari and Happinasari (2015) and Wenda (2017) in the working area of Public Health Center, Pekanbaru, Indonesia, showed that the administration of beetroot juice was effective for Hb levels in pregnant women with anemia [14]. This study also follows a similar study from Al-About (2018), which found an increase in Hb levels in women after consuming beetroot for 20 days [15]. Likewise, girl soccer players who were given beetroot juice for 6 weeks showed a significant increase in Hb, Hematocrit, Fe, and ferritin levels ($p < 0.05$) [16]. The study of Chauhan *et al.* (2017) also revealed a significant increase in Hb levels after consuming beets for 30 days ($p < 0.001$) [17].

Spinach leaves contain high Fe to prevent anemia. The Fe content in spinach leaves can be useful for the process of forming Hb in the blood. If one can consume spinach leaves, a person will have blood Hb levels within normal limits and prevent anemia [18]. Spinach leaf is a vegetable food ingredient that contains the highest Fe, which is 3.9 mg/100 g compared to other types of vegetables, such as mustard greens of 2.9 mg, katuk leaves of 2.7 mg, kale of 2.5 mg, and cassava leaves of 2.0 mg [19].

The same result was also found by Kusumawati (2019), consumption of lime-spinach juice has a significant effect on Hb levels of anemic adolescent girls in a public senior high school (SMAN 5) in Kediri [20]. Besides, Suhada *et al.* (2019) revealed a significant effect of spinach on changes in Hb levels of adolescent girls at a junior high school (SMP 3) in Kalasan Sleman [21]. Red spinach juice also significantly increases pregnant women's Hb levels in the second trimester [22].

Food intake other than giving spinach is by consuming *Moringa* leaf extract which can increase Hb levels of adolescent girls and pregnant women. Consumption of tempeh and anchovies can also increase Hb in anemic pregnant women [23]. Consumption of *Moringa* leaf tea bags can also increase Hb in adolescent girls [24].

Conclusion

There was an effect of beetroot juice and red spinach juice on Hb improvement in anemic adolescents. Adolescent girls who are anemic may consume beetroot juice and or red spinach juice as an alternative food for therapy of Hb improvement and prevent anemia.

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