# The Effect of Beetroot (Beta vulgaris L.) Ice Cream on Haemoglobin and Total Protein Levels on Teenage Girl

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# The Effect of Beetroot (*Beta vulgaris L.*) Ice Cream on Haemoglobin and Total Protein Levels on Teenage Girl

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## ABSTRACT

**Background:** Adolescents with various problems, such as diet that can cause underweight and anemia. The problem of anemia can be overcome by giving ice cream as an additional food and is very popular with young girls. **Aim:** This study aim to know the effect of giving beetroot ice cream on Haemoglobin and total protein levels among adolescent girls. **Method:** Research design is quasi-experimental with pre and post test design. The samples were divided into 2 groups of giving ice cream with and without the addition of beets, each totaling 35 people. Each group was given 100 grams of ice cream for 30 days during school hours. Data analysis was carried out by using paired T-test and inpaired T-test with data that were normally distributed. **Results:** The results showed that the average Hb level before treatment was 11.09 and the average Hb level after treatment was 13.49. The average blood total protein before treatment was 5.86 and the average total protein content after treatment was 6.73. The Hb level before in the control group was 11.23 and the average Hb level after in the control group was 11.78. The average total protein content before giving ice cream to the control group was 5.45 and the average total protein content after giving ice cream to the control group was 6.41. **Conclusion:** Beetroot ice cream can affect Hb levels and total protein levels, while the regular ice cream only affect the total protein levels.

**Keywords:** Ice Cream, Beetroot, Total Protein, Haemoglobin

## BACKGROUND

Adolescence is the age of transition from childhood to adolescence, many changes occured due to increased muscle mass, increased fat tissue in the body and hormonal changes. These changes affect the nutritional needs and intake of nutrients in adolescents. Advances in technology and westernization can lead to changes in lifestyles and mindsets in society, especially young women who tend to like fast food, sometimes there are also many young women do strict diets that do not follow the rules that recommended by nutritional standards [1].

This situation demands that many young women behave with body image, so that they look more attractive with a proportional, slim and tall body, and look like models. In addition, it turns out that there are also many young women who follow the western lifestyle by eating fast food, high in fat, high in simple carbohydrates, and low in fiber [2]. Body image and western life behavior causes young women to experience nutritional problems, such as underweight, and at the same time many young women experience overweight [3]. A poor diet accompanied by menstruation can cause young women to be anemic and underweight. The results of Riskesdas 2013 showed that 8.7% of adolescent girls aged 13-15 years and 8.1% of adolescent girls aged 16-18 years had underweight and very thin nutritional status. As a result, young women aged 15-24 years experienced anemia by 18.4% and there was an increase from the 2018 Riskesdas results to 32%. Meanwhile, the anemia rate in adolescent girls in Indonesia is 24% [4].

The level of Hb and total protein is one of the indicators of a young woman experiencing a lack of macro and micro nutrients, in addition to blood albumin parameters and anthropometric measurements (weight and height) can also determine past and present nutritional deficiencies. Low levels of Hb and total blood protein can cause a young woman to experience a decrease in endurance, get tired easily and cannot concentrate at school. According to research by Siahaan (2018) and Siahaan (2021) [5], [6] people with a BMI below 18.5 and Hb below 12 g/dl are suspected having a lack of macronutrients and micronutrients. Provision of additional foods containing folic acid, iron, vitamin C, potassium that found in fruit can reduce the risk of underweight and anemia in adolescent girls [7], [8].

Additional food in form of modified ice cream with the addition of beetroots which are high in folic acid, iron, protein, vitamin C, magnesium is expected to prevent or improve anemia status and total protein status of adolescent girls [9]. The results of the Proximate Test at North Sumatera University Food Chemical Analysis Laboratory in 2017, in 100 grams of beetroot ice cream contains Energy: 410.74 kcal, Carbohydrates: 82.41 gr, Protein: 15.43 gr, Vitamin C: 175.03 mg has a higher nutritional value than ice cream sold on the street by traditional ice cream vendors.

Ice cream is a dairy product that quite popular and has a wide market segment and a snack that liked by various groups, both children, teenagers, and adults [10] ice cream can be made from various ingredients that are easy to find and also affordable [11], [12]. According to Hidayat in Hasanuddin (2008) [13] growth rate of domestic ice cream market continues to increase at least 20% every year. The use of beetroots in the manufacture of ice cream in addition to food diversification, can increase marketability by changing the color to become more attractive from natural ingredients (beetroots). Another thing that can be obtained from the addition of beets is that young women are more accustomed to consuming vegetables and fruits that are high in Zn, folic acid, Fe which are especially needed for the formation of hemoglobin during menstruation. Besides that, beetroots are easy to find in traditional markets with affordable prices [14] [15]. This study aim to know the effect of giving beetroot ice cream on Haemoglobin and blood protein levels among adolescent girls.

## METHODS

This research is a quasi-experimental study with Pre and Post Test Only Control Group Design which was carried out on female students at Parulian 1 High School and UISU Medan High School on September 30 – October 31 2017.

The sample size is determined using the formula [16]:

$$n1 = n2 = \left(\frac{Z\alpha^2 + Z\beta)\, s}{X1 - X}\right)^2$$

The calculation results obtained that the number of samples for the experimental group was 35 people in Parulian 1 High School students who were given beet ice cream. As for the control group, 35 people from UISU High School Medan were given ice cream without beets. The sampling technique is a simple random sampling.

The data collected includes the average age, Hb levels, total protein. The data that has been collected is then processed manually through process stages starting with editing, coding, cleaning and tabulating data. Then entered and processed with the help of computer programs.

The examination of Hb levels and total protein was carried out by taking 1.5 - 2 cc of blood from the left arm pulse. Hb examination was carried out by the method *Cyanmethemoglobin* with the help of *Spectrofotometry photometer 4010 Mannheim Boehringer* with an accuracy of 0.01 mg/dl. Meanwhile, the total blood protein was obtained by using the biuret method using a spectrophotometric instrument. The blood collection was assisted by a health analyst, then it was examined at the North Sumatra Regional Health Laboratory (LABKESDASU).

The provision of ice cream with the addition of beetroots and ice cream without the addition of beetroots was carried out for 30 consecutive days as much as 100 gm (8 scoops of ice cream) based on the habit of consuming ice cream in the community per meal and also based on the Indonesian Food Consumption Table [17]. Ice cream was given directly by the researcher and consumed by the students as soon as possible during break time at school around 9.30 WIB every day. While on Sundays and school holidays it is still given, students would coming to take ice cream to school and it given directly by the researcher and the consumption process being supervised directly by the researcher.

Data analysis was carried out using univariate and bivariate methods, based on the normality test of the data using Kolmogrov Smirnov, the data was found to be normally distributed. The test method uses two methods, to determine the changes before and after giving ice cream to the treatment and control groups on the indicator of Hb levels and total protein by using the paired t-test, while to see changes in the indicator of Hb and total protein between groups using the inpaired t-test. This study has received ethical approval from the Ethics Committee, No: 036/KEPK/POLTEKKES KEMENKES MEDAN/2017.

**Table 1. Nutritional content of 100 grams ice cream with and without the addition of beetroots**

| Indicator | Original Ice Cream | % RDA | Beetroots Ice Cream | % RDA |
|---|---|---|---|---|
| Carbohydrate (gm) | 20.6 | 6.8 | 82.4 | 27.1 |
| Fat (gm) | 12.15 | 17.8 | 12.72 | 18.1 |
| Protein (gm) | 4 | 6.1 | 9.4 | 14.4 |
| Zinc (mg) | 0.7 | 7.7 | 4.2 | 46.6 |
| Fe (mg) | 0.3 | 2 | 8.95 | 59.6 |
| Energy (kcal) | 207 | 9.8 | 410.7 | 19.5 |

Source: Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Brawijaya University in 2019

## RESULTS

### 1. Characteristics of Sample

Sample characteristics based on age and class can be seen in table 2

**Table 2. Sample Distribution Based on Characteristics**

| General Indicator | Parulian 1 High School | | UISU Medan High School | |
|---|---|---|---|---|
| | n | % | n | % |
| **Age** | | | | |
| 14 | 3 | 9 | 7 | 20 |
| 15 | 20 | 57 | 15 | 43 |
| 16 | 12 | 34 | 13 | 37 |
| **Class** | | | | |
| X | 21 | 60 | 22 | 63 |
| XI | 14 | 40 | 13 | 37 |

Table 2 shows that the sample at Parulian 1 High School (the treatment group) was at the age of 15 years at 57%. Meanwhile, the sample at UISU Medan High School (control group) was at the age of 15 years at 43%. Then for the Parulian 1 High School class category, the highest class is in class X as much as 60%. While the class category for UISU Medan High School, the highest class is in class X as much as 63%.

### 2. Mean and Standard Deviation (SD) of nutrient intake before and after giving beetroot ice cream

24-hour Food Recall is carried out by interview technique by filling out a form to find out the food consumed for 24 hours for two consecutive days. Then the recall data was edited and the nutritional intake assessment results were calculated using the Nutri Survey Program. The average nutrient intake before and after giving ice cream to the treatment group and control group can be seen in table 3.

**Table 3. Sample Distribution Based on Nutrient Intake**

| Nutrients | RDA (2019) | Treatment | | | | | | | Control | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Before | | | After | | | p value | Before | | | After | | | p value |
| | | Mean | SD | %RDA | Mean | SD | %RDA | | Mean | SD | %RDA | Mean | SD | %RDA | |
| Energy (kcal) | 2100 | 1885 | 2.17 | 89.7% | 1918 | 2.02 | 91.3% | 0.078 | 1832 | 4.9 | 87.2% | 1894 | 5.01 | 90.1% | 0.063 |
| Carbohydrate (gm) | 300 | 276.4 | 10.3 | 92.1% | 281.2 | 9.58 | 93.7% | 0.123 | 269.9 | 8.98 | 89.9% | 278.1 | 7.97 | 92.7% | 0.054 |
| Protein (gm) | 65 | 44.7 | 2.43 | 68.7% | 46.3 | 2.32 | 71.2% | 0.077 | 41.6 | 1.89 | 64% | 43.2 | 2.02 | 66.4% | 0.082 |
| Fat (gm) | 70 | 58.4 | 4.08 | 83.4% | 59.9 | 4.34 | 85.5% | 0.125 | 57.3 | 3.97 | 81.8% | 58.1 | 4.13 | 83% | 0.167 |
| Zinc (mg) | 9 | 5.01 | 1.08 | 55.6% | 6.12 | 1.12 | 68% | 0.052 | 5.02 | 2.1 | 55.7% | 5.87 | 2.24 | 65.2% | 0.082 |
| Vitamin C (mg) | 75 | 68.2 | 2.10 | 90.9% | 70.1 | 3.01 | 93.4% | 0.180 | 66.8 | 2.98 | 89% | 68.1 | 3.15 | 90.8% | 0.270 |
| Iron (mg) | 15 | 6.2 | 3.17 | 41.3% | 7.7 | 4.01 | 51.3% | 0.067 | 6.3 | 2.88 | 42% | 7.1 | 3.02 | 47.3% | 0.098 |

Table 3 shows that the recall results obtained for 2 consecutive days, which were carried out before and after giving ice cream with and without beetroot, showed no difference with P > 0.05. The description of the recall results shows that the homogeneity in terms of the nutrients consumed is not significantly different, so that the administration of ice cream can be used as an indicator to see the up and down of Hb levels and total blood protein.

### 3. Mean and SD of Hb Levels and Total Blood Protein Levels

The average value of Hb levels and total protein before and after treatment (ice cream with beetroots) and the average values of Hb levels and total protein before and after in the control group (ice cream without beetroots) can be seen in table 4.

**Table 4. Mean and SD of Hb Levels and Total Blood Protein**

| Variabel | Treatment | | Control | | *p value* |
|---|---|---|---|---|---|
| | Mean ± SD | *p value* | Mean ± SD | *p value* | |
| Hb before | 11.09 ± 2.13 | 0.001* | 11.23 ± 2.60 | 0.062* | 0.991** |
| Hb after | 13.49 ± 1.52 | | 11.78 ± 2.45 | | 0.036** |
| Hb difference | 2.4 ± 2.78 | | 0.55 ± 15.12 | | 0.035** |
| Total Blood Protein before | 5.86 ± 1.68 | 0.037* | 5.45 ± 1.50 | 0.040* | 0.723** |
| Total Blood Protein after | 6.73 ± 1.89 | | 6.41 ± 2.23 | | 0.617** |
| Total Blood Protein difference | 0.87 ± 0.58 | | 0.96 ± 1.12 | | 0.078** |

*) Paired t-test
**) Inpaired t-test

Table 4 shows that for the treatment group there was a significant difference before and after treatment, tested by paired t-test both for the Hb indicator (p = 0.01) and total protein (p = 0.037). In the control group there was no change in Hb levels before and after giving ice cream (p = 0.062), while for total protein there was a change before and after giving ice cream (p = 0.040). Table 4 also shows different differences between groups, where the difference in Hb levels before and after being given ice cream in the treatment group was 2.4 g/dL, while in the control group the difference was 0.55 g/dL. Based on the inpaired t-test, the difference between the treatment and control groups was found to have a difference in Hb levels (p = 0.035). On total protein examination, it was found that the difference in total protein before and after being given ice cream was 0.87 mg/dL in the treatment group and 0.96 mg/dL in the control group. Then tested with the inpaired t-test, it turned out that there was no difference in total blood protein between the treatment group and the control group.

### 4. Anemia Status and Total Protein Status

Giving ice cream with and without beets for 30 days to young high school students can affect changes in anemia status and total protein status. Anemia status and total protein status can be seen in table 5.

**Table 5. Distribution of Samples based on Anemia Status and Total Protein Status**

| Indicator | Treatment Group | | | | Control Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Before | | After | | Before | | After | |
| | n | % | n | % | n | % | n | % |
| **Anemia** | 24 | 68 | 3 | 8 | 17 | 49 | 11 | 31 |
| **Not Anemia** | 11 | 31 | 32 | 91 | 18 | 51 | 24 | 68 |
| **Abnormal Total Protein** | 18 | 51 | 10 | 29 | 15 | 43 | 11 | 31 |
| **Normal Total Protein** | 17 | 49 | 25 | 71 | 20 | 57 | 24 | 68 |

Table 5 shows that giving ice cream with beetroot (treatment) for 30 days, there was a change in Hb level status with anemia from 68% to 8%, where the normal Hb level is (≥ 12 gm/dL). For the examination of total protein levels there was a change from low levels of 51% to 29%, where the normal total protein level is (≥ 6.4 mg/dL). Giving ice cream without beetroot (control), there was also a change in the status of Hb levels with anemia from 49% to 31%. Meanwhile, the examination of the total protein content of low levels showed a change from 43% to 31%.

## DISCUSSION

### 1. Characteristics of Sample

The age range of the sample in this study was between 14-16 years old who were in class X and XI of Senior High School. Usually adolescent girls aged 14-16 years physiologically have experienced the menstrual process which is likely to lose a lot of blood, so that during menstruation it is better to consume nutritious food so that young women avoid anemia [1].

### 2. Beetroots Ice Cream

Ice cream is a favorite food for all age groups, from children, teenagers and adults. Ice cream is a frozen milk product made from milk, sugar, cream, butter, eggs and stabilizer which has a delicious and savory taste with a soft texture. Nowadays, ice cream is often added with various mixed ingredients to improve the commercial aspect, aesthetics, nutritional fortification, so that it is increasingly favored by the public. Commercial ice cream often uses synthetic dyes so that it can harm the health of consumers. Beetroots, apart from containing vitamins and minerals, can also be used as natural coloring agents in the presence of anthoxianin bioactive substances so they can add the aesthetic value of ice cream more attractively. The result of processing beetroots in the form of extracts with a liquid consistency, turns out to be easier to blend with the basic ingredients of ice cream. The benefits of ice cream with various nutritional content can actually increase immunity, stimulate the dopamine hormone in the brain, provide energy for activities, and help the growth of bones and teeth in children [18] [19] [20].

### 3. Effect of Beetroots Ice Cream on Hb Levels

There was a change in Hb levels in the treatment and control groups, but based on the Paired T Test, only the treatment group was significantly different, p = 0.001. Ice cream with beetroots turned out to have a contribution in the formation of Hb levels. The nutritional content in beets such as iron, vitamin C, amino acids (tryptophan, lysine, folic acid and Zn) [21], [22].

Iron, folic acid, Vitamin B12 and the main nutrients that form Hb and vitamin C which functions to help absorb iron [5]. Iron is the main component that plays an important role in the formation of blood (hemopoiesis), the hemoglobin molecule. Iron stores in the body (ferritin and hemosiderin) are found in the liver 30%, bone marrow 30%, and the rest is stored in the spleen and muscles. Absorption of iron minerals in non-heme form can also increase fourfold when vitamin C is present [23]. Beetroot contains 2-4 times more Vitamin C than oranges, so it can increase the production of erythrocyte cells by mobilizing iron stores in the tissues in the form of hemosiderin. Vitamin C also helps release iron from transferrin in the plasma so it can be incorporated into tissue ferpine. Meanwhile, the protein content in beets and the protein content from milk in ice cream can help transport iron and help in the production of ferri (Fe3+) into ferrous (Fe2+) so that it is easily absorbed [14], [24]. Insufficient protein intake will result in inhibition of iron transport and will lead to iron deficiency. Protein in the form of transferrin and ferritin is a transport to carry out iron absorption that occurs in the small intestine which is then transported to the bone marrow so that Hb synthesis occurs [23].

Beetroot also contains Zn which is also a heme-forming material and Zn is also found in red blood cells. Zn minerals can interact directly with Fe which acts as a co-enzyme of the amino acid levuline acid (ALA). This enzyme has a role in forming heme when it is in the cytosol of bone marrow cells [5]. Vegetables in the form of tubers such as beets also contain vitamin B9 which circulates directly as polyglutamate in red blood cell reserves. Due to vitamin B9 deficiency, the proliferation of erythrocyte formation in the bone marrow can be suppressed [2]. Vitamin B9 is also needed in various biochemical reactions of the body that involve the transfer of one carbon unit in protein amino acid interconversion or in the formation of DNA precursors in the erythropoiesis system (the process of forming red blood cells in the kidneys) [5]. The increase in Hb levels can also occur because beets in 100 grams contain 10.2% vitamin C and 34% folic acid, which are nutritional elements that can accelerate the formation of Hb [15].

These results are in accordance with the research of Ikawati K (2018) [22] where there was an increase in Hb levels from 9.8 gm/dl to 11.9 gm/dl after consuming beetroots, while Siahaan's study (2020) [23] giving colored fruit such as tomatoes, dragon fruit, red guava on Hb levels in people with HIV there are significant differences. Another discoveries at the Puskesmas South Purwokerto giving beetroot can increase Hb, where 500 ml of beetroot juice given for 7 days can increase Hb levels in the range of 0.6/0.8 gm/dl [21].

**4. Effect of Beetroots Ice Cream on Total Protein Levels**

There was a change in total protein levels in both control and treatment groups based on the Paired T Test, $p<0.05$. Ice cream given to young women in 2 different groups had protein content derived from milk flour and sweetened condensed milk as ingredients for making ice cream. In the treatment group, in addition to ice cream made from milk flour and sweetened condensed milk, protein was also found in beets which were added to ice cream [25].

The protein that is consumed consists of several amino acids in milk, which is a protein that has high bioavailability because it comes from animal sources, it turns out that beets also contain amino acids in the form of tryptophan and lysine, although the bioavailability value is lower than animal protein [25]. Protein requirements are based on the minimum requirements needed to maintain nitrogen balance. The amount of protein needs is adjusted to the state of the human body which is adapted to its physiological processes.

During adolescence, the need for protein will increase, apart from the need for growth and development, protein is also needed to avoid the gluconugenesis process due to the diet of teenagers who want their bodies to be thin [2], [26].

Total blood protein describes the occurrence of protein catabolism in the body in the short term due to low intake of protein consumed. Abnormal total blood protein can trigger inflammation in a person, causing weight loss and if it continues it can cause malnutrition [27] [28]. Total protein in blood, liver, and other organs has a half-life of 2.5-10 days [5], [29]. Giving ice cream with and without the addition of beets for 30 days was able to increase total protein levels. These results are in accordance with the research (Siahaan, 2018) [23] adequate protein consumption in people suffering from illness has made a positive contribution to increasing the total blood protein level thereby reducing the risk of infection. Another study conducted by (Mardian, 2020) [30] the consumption of milk that is routinely drunk by elementary school students turns out to have an effect on children's growth because the milk mixed in making ice cream contains insulin like growth factor-1 (IGF-1) which is a hormone for a child to growth and development. The formation of hormones and protein reserves in the blood comes from adequate protein intake, which is characterized by high blood proteins such as albumin and total protein [31].

In addition, beets also contain anti-oxidants and contain bioactive substances that can strengthen liver function from infection, especially during menstruation so that the protein content in ice cream and beets can be maximized by the liver to synthesize blood proteins [23]. Based on the percentage of energy produced by ice cream with and without the addition of beets, the contribution includes 19.5% and 9.8%, the energy produced is sufficient to help the body's maintenance process so that a young woman who experiences energy deficiency does not experience energy use through the gluconeogenesis process, but instead helps the formation of body tissues, the process of growth and development through increasing total blood protein. The absorption of Zn in the body is strongly influenced by the condition of vitamin C intake, which is found in beetroots. Appropriation of ice cream with the addition of beetroot can increase the intake of Zn, where Zn improves the rate of protein metabolism so that there is an increase in the formation of proteins in the plasma including albumin and total protein. In addition, Zn also has a role in maintaining pancreatic function in secreting protease enzymes needed in the gastrointestinal tract to metabolize protein. Increased protease enzymes and the activity of enzymes related to protein metabolism affect the metabolic rate in the liver so that total plasma protein levels will also increase [32]. Increased levels of total protein are suspected to come from milk and the Zn content in beets can also increase the formation of albumin which will automatically increase total protein [33].

## CONCLUSIONS

Beetroot ice cream can increase Haemoglobin levels, but in the group that being given the regular ice cream there's no increase in Haemoglobin. Ice cream with or without the addition of beetroots can affects the total blood protein levels.

## SUGGESTION

Beetroots should be used more often by people in everyday life, because it is an alternative that can increase the aesthetic value of ice cream but at the same time it can increase the total protein content and blood Hb level.

## LIMITATIONS AND WEAKNESS

1. We recommend that the research time to examine Hb levels is at least 3 months, because the formation of Hb occurs in a time range of 90 – 120 days.
2. Ice cream has an easy to melt texture, so it is necessary to use a tool that can maintain the consistency of the ice cream (temperature and texture).


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