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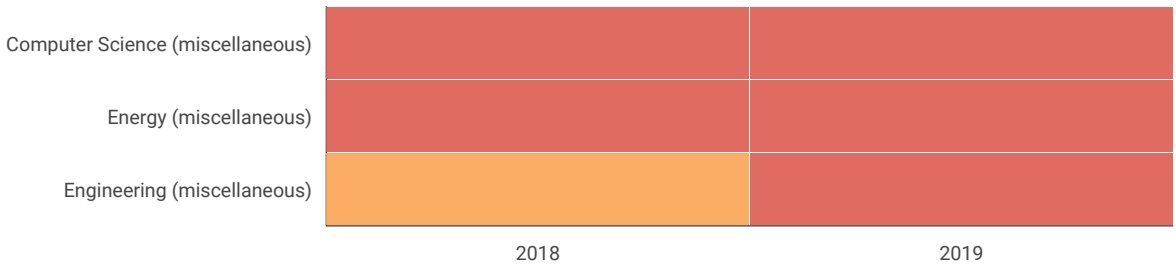

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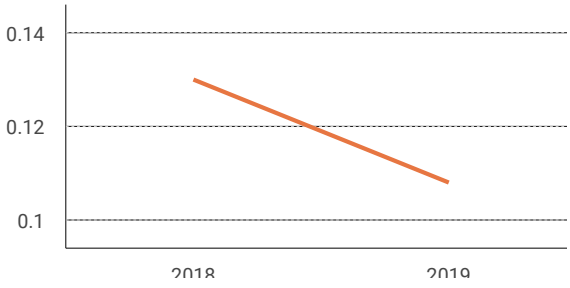

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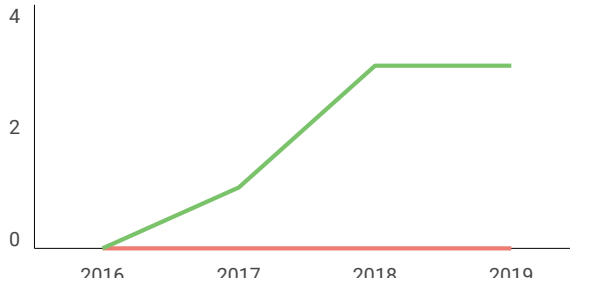

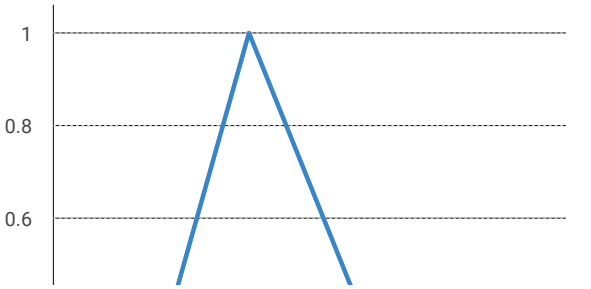

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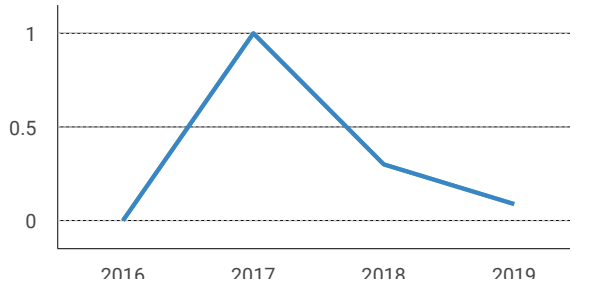

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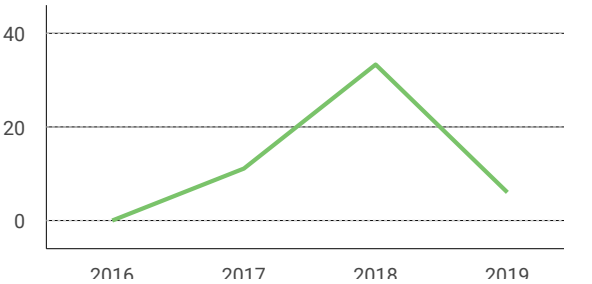

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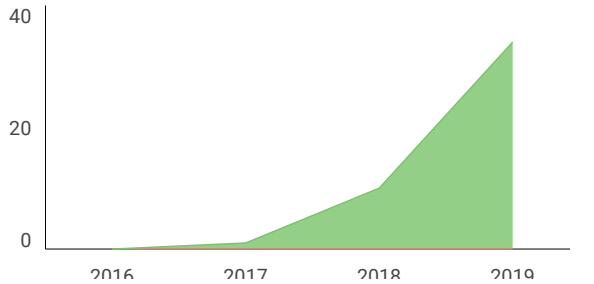

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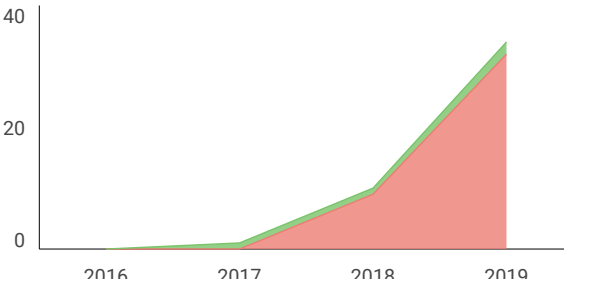

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The Potential of "SUJAKAJU" as Source of Nutrients in the Prevention of Chronically Malnourished among Children

Laksmin Kadir, Wirnangsi D. Uno, Syam S. Kumaji

Abstract

Milk is an exclusive drink to be consumed to fulfill protein supply for human's body.Milk is dairy from cows, goats,and camels. In its fulfillment, not all people can consume milk due to the high price in which most Gorontalo people are in poverty. One of the ways that can be carried out in order to anticipate malnutrition problem is by consuming various foods. Corn is one of the carbohydrate sources that is able to be utilized as the alternative to rice because it has almost the same calories as rice. In the form of corn kernels, it can also be processed into milk. The purpose of this study is to analyze the product of mung bean corn milk (Susu Jagung Kacang Hijau, henceforth called as SUJAKAJU) whichis able to enhance the nutritional and immune system of children who drink SUJAKAJU. The improvement of immune system through the measurement of body weight, hemoglobin, leukocytes, and platelets. The output of this research is to produce and develop the aforementioned productthat has a good nutritional value to increase children's nutritional status and body endurance, so that it can help the government overcome the issues of malnutrition, expensive milk, and poverty in Gorontalo.

Keywords: Corn, Mung bean, Nutritional Status, Body Endurance

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The Potential of "SUJAKAJU" as Source of Nutrients in the Prevention of Chronically Malnourished among Children

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Abstract

Milk is an exclusive drink to be consumed to fulfill protein supply for human's body.Milk is dairy from cows, goats,and camels. In its fulfillment, not all people can consume milk due to the high price in which most Gorontalo people are in poverty. One of the ways that can be carried out in order to anticipate malnutrition problem is by consuming various foods. Corn is one of the carbohydrate sources that is able to be utilized as the alternative to rice because it has almost the same calories as rice. In the form of corn kernels, it can also be processed into milk. The purpose of this study is to analyze the product of mung bean corn milk (Susu Jagung Kacang Hijau, henceforth called as SUJAKAJU) whichis able to enhance the nutritional and immune system of children who drink SUJAKAJU. The improvement of immune system through the measurement of body weight, hemoglobin, leukocytes, and platelets. The output of this research is to produce and develop the aforementioned productthat has a good nutritional value to increase children's nutritional status and body endurance, so that it can help the government overcome the issues of malnutrition, expensive milk, and poverty in Gorontalo.

Keywords: *Corn, Mung bean, Nutritional Status, Body Endurance*

1. Introduction

Milk is an exclusive drink to be consumed that can fulfill protein supply for human's body [1]; [2], [3]. Milk produced these days is animal-based milk such as from cows, goats, and camels [4]; [5]. In its fulfillment, not all people can consume such beverage due to the high price in which most Gorontalo people are in poverty. Thisis based on the data from Central Bureau of Statistics in 2013 revealing that Gorontalo is among the top 5 poorest regions in Indonesia of 18.01% after Papua (31.53%), Papua Barat (27.14%), NTT (20.4%), and Maluku (19.27%).

One of the ways that can be carried out in order to anticipate malnutrition issues is by consuming various foods [6]. By this way, the lack of nutrient from one type of food substances will be supplemented by nutrition from other foods [7].

Corn is one of the carbohydrate sources that is able to be utilized as the alternative to rice because it has almost the same calories as rice [8]. In addition to foods and fodders, corn is often used in industries of foods, beverages, chemistry, and pharmacy. In the form of corn kernels, it can also be processed into cornflour, corn rice, and snacks (popcorn and

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corn confectionery or jagung marning) as well as cooking oil, margarine, and food formulas. Cornstarch can be used as raw material for the pharmaceutical and food industries, such as ice cream, cake, and milk [9]; [10]; [11].

Local corn in Gorontalo consists of several kinds, including waxy corns, kiki corns, hybrid corns, and sweet corns. Many corn farmers plant these kinds on their field. Corn as the primary food is able to be processed into health drinks or mostly known as corn milk. In an effort of food fortification and the fulfillment of the lack of amino acids from corn, corn milk can be combined with Mung beans. Mung beans are foodstuffs derived from nuts that can be classified as almost-perfect protein sources [12].

Llimiting amino acids in cornand Mung beans are lysine and methionine respectively. Limiting amino acid is very less contained in foodstuff in which consist of the combination of several foodstuffs can supplement the content of amino acid and other nutrients [13].

Children's health is important to their family. It is to say that their health is parents' happiness. It is reasonable if parents are at a loss when their children are not willing to drink milk, catch a cold, get a fever, or other problems [14]. Healthy children are characterized by being active, cheerful, having a good appetite, and able to play and learn along with body weight increases every month,and children's development is appropriate to their age [15].

In maintaining children's health, nutritional fulfillment does influence their health and endurance. "If the nutrition is good, the risk of being affected by diseases is reduced". Even if they are exposed to germs, children will not get sick, but only affected by symptoms since they have an excellent body endurance. For instance, they will get temporary diarrhea which then be healed [16].

Body endurance is mostly obtained from high-protein foods because the factor of body endurance will not be formed without protein. There is a direct correlation between nutrition and body endurance. The worse the nutrition, the worse body endurance, the more often infected, the lower the appetite and body endurance[17] [18].

In consequence, this study will examine whether or not SUJAKAJU product is able to enhance children's nutritional status and body endurance in Gorontalo. The problem discussed in the first yearwas the best nutrient content of SUJAKAJU out of some local corn kinds in Gorontalo (hybrid corns, waxy corns, kiki corns, and sweet corns) combined with Mung beans which were formulated into milk. Based on the findings, from the combination of the aforementioned corn kinds and Mung beans, the nutrient content in the form of carbohydrate, protein, and fat had a fairly good average number. However, it was statistically investigated the combination of waxy corns and Mung beans was the best product to be used as milk in the ratio of 150:50, compared to the combination of other corns in which the highest carbohydrate and protein content and the lowest fat content were in the treatment ratio of 50:50 and 100:50.

2. Method of Study

This pre-experimental study employed "One Group Pretest-Posttest Design" in which pre-test was given before the treatment, and post-test was distributed after the treatment.

The main product in this study was SUJAKAJU tested on children with malnutrition that was taken by purposive sampling technique based on the researchers' needs, among others:

a) Malnutrition

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b) Do not suffer from diseases

c) Male and female

d) Age: 7-12 years old

e) Not consuming supplements of any kinds.

SUJAKAJU was provided to children living in Butu Village, Bono Bolango Regency, Gorontalo Province for 30 days in the morning and at night.

The research parameters measurement included body weight, hemoglobin, leukocytes, and platelets carried out before and after giving SUJAKAJU.

A. Analysis of Hematology

Analysis of hematology was performed as in line with the method from Aboderin and Oyetayo (2006). The analysis procedures were as follows: a blood sample was inserted into a tube containing EDTA. The analysis was conducted by utilizing the Hemavet HV950FS multispecies hematology analyzer. The analyzed parameters were the level of hemoglobin, the number of leukocytes and platelets [19].

B. Statistical Analysis

The collected data were analyzed statistically by using paired T-test in order to determine the difference between before and after treatments.

3. Result and Discussion

SUJAKAJU is fortified milk that has various nutrition needed for children's growth. The result of this study indicates that the content of protein, carbohydrate, and fat in this product achieves 10.9%, 0.19%, and 10.4% respectively [20]. The high content of protein and fat in such fortified milk is able toenhance children's nutritional status and immune system that is viewed by the improvement of all parameters measured in this study.

A. Body Weight

The measurement of children's body weight is conducted to find out the influence of fortified milk of SUJAKAJU towards the body's physiological responses as well as being able to reflect their nutritional status.

The measurement result presented in Figure 1 shows that the children's average body weight prior to giving the product was 18.7 kg. Meanwhile, it increases to 21.70 kg after the product is provided. Therefore, the increased average of body weight after distributing the product arrives at 3.53 kg. The result of statistical analysis by employingT-test also reveals that the average body weight before and after giving the product is in a significant difference (p=0,000).

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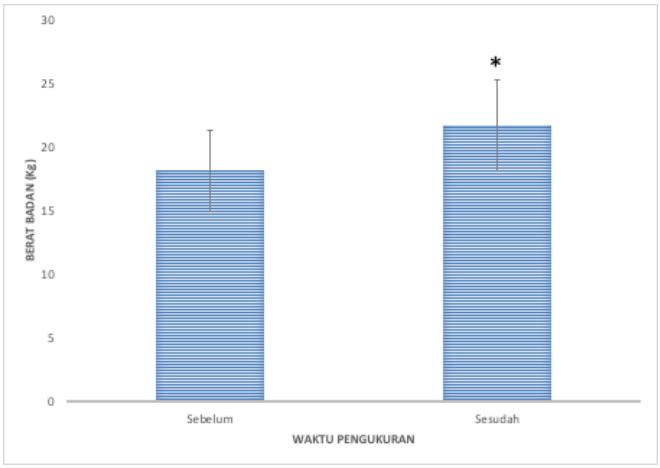

Figure 1. The measurement result of body weight before and after providing SUJAKAJU to the subjects of study. The sign (*) indicates the significant difference

Weight gain after giving SUJAKAJU product shows that there is an improvement in the nutritional status of the children who are given the treatment. Weight gain is strongly affected by the balance between the amount of nutrient intake and the calories needed for physical activities. Matali et al. (2017) argue that if the number of calories in the body is not in accordance with the number of the released calories, it will influence one's tissue mass buildup. Conversely, if the number of calories in the body is more than the number of the needed calories, it will cause an increase in body mass. Such a weight gain is caused by the high protein and fat content in SUJAKAJU product given to the children [21].

Further, it is widely known that the content of lysine amino acids as the constituent of protein sourced from Mung beans in SUJAKAJU also has an effect on weight gain. Llysine is one of the essential amino acids that is very necessary as the raw material for the formation of antibodies, hormones, enzymes, and collagen as well as tissue repair. Besides, lysine amino acidsare also functioned as the basic framework for vitamin B1 (niacin). The lack of lysine amino acids can lead to depression, lack of appetite, and excessive release of norepinephrine and serotonin, causing a change in physical behavior, such as picking food, feeling afraid, anxious, and less appetite. It is also acknowledged that the lack of lysine in human's body will cause loss of taste and smell senses that contribute to reducing appetite [22].

Fortified milk of SUJAKAJU containing lysine amino acids is assumed to gain one's weight through appetite recoveryand nutrient needs fulfillment containing in this product for recovery after the condition of malnutrition or stunt experienced by this research subjects.

B. Hemoglobin Level

Hemoglobin (Hb) is an erythrocyte pigment that is very responsible in the process of transporting oxygen and carbon dioxide. Structurally, hemoglobin consists of conjugated globin proteins containing iron in the heme group. Heme group is a metallic compound that contains one iron atom and causes a red color in the blood (Guyton and Hall, 1995). Kulisaar etal., (2001) in Astawan (2012) note that iron absorbed from the intestinal lumen will bind directly with the ovotransferrin which carries iron to the liver cell for the formation of hemoglobin [23].

The measurement result of hemoglobin level before and after providing SUJAKAJU as shown in Figure 2 indicates that the distribution of this product can significantly increase

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the Hb level of this research subjects. The average Hb level before giving SUJAKAJU is 9.3 gr/%. On the other hand, the average Hb level after providingsuch a product goes up to 11.2 gr/%. Moreover, the result of statistical analysis by employing paired t-test also reveals that the average Hb level before and after providing the treatment is in a significant difference (p=0,000).

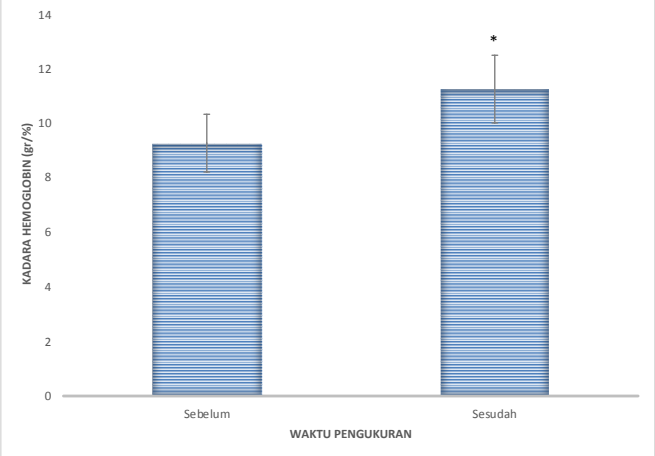

Figure 2. The measurement result of Hb level of the subjects of study before and after giving SUJAKAJU. The sign (*) indicates the significant difference

The increased Hb level after distributing SUJAKAJU is also impactful on the increased nutritional status of the children. As seen in the measurement result before giving this product, the average value of this research subjects is below the Hb normal range reference value of 5 to 11-year-old children which according to WHO is 11.5 gr/dL (Masrizal, 2007). The low Hb level is assumed to be a clinical manifestation of the malnutrition condition experienced by the subjects. SUJAKAJU product, in contrast,is able to increase the average Hb level closed to the normal threshold of Hb level as claimed by WHO. The increase in the average Hb level after providing the product also influences the efficiency of oxygen transport which is requiredfor body metabolism. Guyton and Hall (1995) argue that normal people have 15 gram of Hb in every 100 mL of blood, with the maximum ability of binding for 1 gram of Hb is approximately 1.34 mL of oxygen. In addition, Hb is also responsible for the carbon dioxide transport produced by the body during the process of metabolism. Thus, the increased Hb level after distributing SUJAKAJU product can push children's growth which is also viewed by the increase in their body weight after having the product [24]

C. Leukocytes and Platelets Levels

The measurement of leukocytes and plateletsnumber carried out in this study is intended to investigate the immune response of this research subjects before and after having SUJAKAJU. Thisis conducted because the number of leukocytes and plateletsis able to reflect the children's immune system after providing the treatment.

The measurement result of leukocytesnumber as presented in Table 1 shows that the average number of leukocytes before and after distributing SUJAKAJU is 8,750 µL and 9,973 µL respectively. The same pattern is also figured out in the average number of platelets of 248,133 µL before the product is given, and the measurement is increased after providing the product with the average value of 287,266 µL. The result of statistical analysis by using paired T-test in both parameters also indicates the significance before and after giving SUJAKAJU, both for leukocytes parameter (p=0,000) and platelets parameter (p=0,000) in the significance level of 0.05.

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Table I
The Measurement Result of Immune Parameter Before and After Giving Sujakaju

Measurement Time	Leukocytes (µL)	Platelets (µL)
Before	8790 ± 1433	248133 ± 59401
After	9973 ± 1339*	287266 ± 65840*

The sign (*) indicates the significant difference

Leukocytesplay an important role in body cellular and humoral defenses against unfamiliar objects entering the body. The changes either in the form of the increase or decrease in the leukocytesnumber can be caused by physiological and pathological factors. Ministry of Health of the Republic of Indonesia (2011) states that the value of the normal threshold of leukocytes is 3,200-10.000/mm3 or 3.2-10.0 x 109/L. The increase in the leukocytes number known as leukocytosis is caused by physiological factors, such as muscle activity, fear stimulation, and emotional disorder as well as the effect of pathology caused by an apathological process in response to disease attacks (Ganong, 2002). Furthermore, the increase in a totalnumber of leukocytes in blood is due to the increased permeability of blood vessel wall that leads the leukocytes to migrate into tissues that experience injury or infection. The infection will stimulate a release of adrenalin hormone that affects the increase in leukocytes circulation. Generally, leukocyteshave two functions, i.e., destroying attack agent by the process of phagocytosis and forming antibodies (Guyton and Hall, 1995).

Plateletsare the smallest element in blood vessel activated after having contact with the surface of the endothelial wall. Platelets formation occurs in the bone marrow with a life period of about 7.5 days. Out of all platelets in the body, about 2/3 of them are in the circulatory system. Meanwhile, 1/3 of the total platelets are in the lymph. Platelets are responsible for the process of wound closure. The value of the normal threshold of platelets is 170-380.103/mm3 (Ministry of Health, 2011).

The increase in leukocytesvalues in the subjectsof this study is assumed to be a reflection of the immune system recovery from the state of stunting or malnutrition.One of the factors assumed to be a trigger for stunting is worm infection in the gastrointestinal tract of the children. The increase in leukocytes values that are offset by an increase in platelets values is a strong indication of gastrointestinal tract recovery after the stunting condition experienced by the children. The increase in leukocytes values in this research subjects is assumed to be the form of the body's humoral defense against worm infection. Meanwhile, the increase in platelets values is the form of wound closure in the gastrointestinal tract, taken place simultaneously with the process of destroying worm toxic in the body by leukocytes [25].

4. Conclusion

The purpose of this study is to analyze the product of mung bean corn milk (*Susu Jagung Kacang Hijau,* henceforth called *as SUJAKAJU*) whichis able to enhance the nutritional and immune system of children who drink SUJAKAJU. The improvement of immune system through the measurement of body weight, hemoglobin, leukocytes, and platelets. The result of study revealed that

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SUJAKAJU is a functional health drink that can help people gain weight, increase hemoglobin along with the number of leukocytes and platelets in activating immune cells

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