Amerta Nutrition
e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Siahaan et al. | Amerta Nutrition Vol. 9 Issue 2 (June 2025). 237-247

RESEARCH STUDY
English Version
OPEN ACCESS

Effectiveness of Baby Crab and Mung Bean Nuggets on Blood IGF-1, Albumin, Zinc, and Haemoglobin Levels in Pre-Menarche Adolescents

Efektivitas Pemberian Nugget Baby Crab *dan Kacang Hijau terhadap Kadar* IGF-1*,* Albumin*, Seng, dan Hemoglobin Darah pada Remaja Pra-*Menarche

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ARTICLE INFO

Received: *13-09-2024*
Accepted: *20-01-2025*
Published online: *20-06-2025*

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DOI:
10.20473/amnt.v9i2.2025.237-247

Available online at:
https://e-journal.unair.ac.id/AMNT

Keywords:
Nuggets, IGF-1 Levels, Albumin, Zinc, Hemoglobin

ABSTRACT

Background: The pre-menarche phase is a transition period from childhood to adolescence. The period of early preparation for an adolescent girl towards self-maturation and maturation of reproductive cells. The pre-menarche period requires nutrients, for the growth and development process. Nugget is a snack food that is favored by all age groups, can be made from fish, crabs, nuts and eggs that are easy to obtain.
Objectives: To analyze the effectiveness of baby crab and mung bean (BC Cangi) nuggets on IGF-1, albumin, zinc and hemoglobin levels in pre-menarche adolescents.
Methods: Type of quasi-experimental research with pre and post test one goup design. The population was pre-menarche adolescent girls at SMP Negeri 3 Lubuk Pakam totaling 42 people and willing to be a sample of 34 people. BC Cangi nuggets were given for 15 days as much as 100 g (4 pieces) during school breaks. Before being analyzed, data normality test was conducted using Kolmogorov Smirnov, then T-dependent statistical test.
Results: The results of the T-dependent statistical test showed that there was an effect of giving BC Cangi nuggets on IGF-1, albumin, zinc, and Hb levels (p-value=0.001) as well as zinc levels (p-value=0.005). BC Cangi nuggets contain high levels of protein, Fe, and zinc which play a role in activating the IGF-1, also contain albumin and protein to maintain the presence of zinc.
Conclusions: The administration of BC Cangi nuggets to pre-menarche adolescent students had a significant effect on the increase in IGF-1, albumin, zinc, and hemoglobin levels.

INTRODUCTION

Adolescence is one of the rapid and fast growth and development processes, especially physically. Changes in adolescence towards adulthood are usually followed by changes in reproductive cells, marked by the first menstruation (*menarche*), and breast growth, while for male adolescents it is marked by wet dreams, mustache growth, and voice changes. At the stage of growth and development, things related to psychic, physiological, and physical growth are things that require maximum attention because they require macro and micronutrients for the growth and development process[1,2].

The pre-*menarche* period in adolescent girls has health problems, especially nutritional problems related to the ability to determine the quantity and quality of food needed for the process of preparing for puberty. The results of 2018's Basic Health Research showed the prevalence of stunting based on the Body Height/Age index in adolescents aged 5-12 years was 16.9% and at the age of 13-15 years was 18.5%. The prevalence of anemia at the age of 5-14 years was 26.8% and at the age of 15-24 years was 32%. Based on the measurement of the Mid Upper Arm Circumference, it was found that adolescent girls who experienced Chronic Energy Deficiency (CED) were 36.3[3]. Nutritional problems such as anemia, CED, and stunting can worsen the condition of adolescent girls if they occur before the *menarche* process. In addition to having an impact on growth and development, it also has an impact on the learning ability of an adolescent girl, because she cannot concentrate well during the teaching and learning process[4]. Nutritional problems can be identified by various measurements including anthropometry and also blood biochemical examinations including IGF-1, albumin, zinc, and hemoglobin (Hb). The biochemical nutritional status examination can determine the condition of health problems and nutritional problems both at present and in

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the past. Low albumin indicates a long-term protein deficit while zinc can predict daily zinc intake[5]. Molecular examination can be done by detecting growth hormones including IGF-1 to see adolescents who experience delays in physical and cognitive maturity which are usually associated with puberty status[6].

In addressing nutritional problems such as stunting, anemia, and chronic energy deficiency, the government provides iron supplementation tablets which are given routinely once a week. In some schools, this has become a routine, either because of the school's independent policy or recommendations from the government through related health institutions. In addition to supplementation, other efforts made are the Provision of Additional Food in the form of green bean porridge, bread, nuggets, pudding, milk, or other foods formulated according to the availability of food ingredients that are high in nutrients, cheap, easy to obtain and based on local food. This is intended so that local foods that are less popular but contain high nutrients for the growth and development of adolescents are used as much as possible[7].

Snacks or often called side dishes are usually eaten 2 to 3 hours before the main meal, except for breakfast. Snacks are very popular, from children to adults. One of the snacks that are widely available on the market and are popular is nuggets that have been modified from various ingredients, both animal and vegetable foods. Nuggets available on the market are usually made from chicken and fish[8]. Modifications to nuggets can be made from less popular foods that may have an unpleasant texture, taste and smell, but have nutritional potential. In this study, a preliminary study of the formulation of nuggets processed from baby crab (*Portunus Pelagicus*) measuring 6×4 was conducted. Modifications were made by adding mung beans (*Vigna Radiata L*) as a source of vegetable protein and fiber that increases the nutritional content, especially protein, zinc, Fe, and other vitamins[9].

The addition of vegetable protein sources aims to complement and perfect the amino acid protein values in nuggets so that the proteins needed during growth and development can be obtained from snacks consumed daily. The content of other nutrients will also increase with the combination of baby crab and green beans, including the nutrients albumin, calcium, iron, fiber, and zinc. BC Cangi nuggets were first tested through organoleptic tests regarding color, taste, aroma, and texture so that BC Cangi nuggets were obtained that were liked and contained the nutrients needed by pre-*menarche* adolescents. In 100 g of BC Cangi nuggets that have been examined at the Chemistry Laboratory of Faculty of Mathematics and Natural Sciences and the Agricultural Product Technology Laboratory at Brawijaya University Malang, a protein content of 10.7 g, Fe 6.36 mg, zinc 8.11 mg, and albumin content of 2.81 g/dl was obtained. The uniqueness of nuggets with baby crab as the basic ingredient is also a stimulator in increasing body immunity and nerves in the brain[10]. Based on the descriptions above, the researcher aims to determine the effectiveness of administering BC Cangi nuggets on the levels of IGF-1, albumin, zinc, and blood hemoglobin in pre-*menarche* adolescents.

METHODS

Quasi-experimental was a type of research, using a pre and post-test one-group design. The location of research was conducted at SMP Negeri 3 Lubuk Pakam, on junior high school students in grades 7 and 8 who had not experienced *menarche*. The population in this study were all pre-*menarche* female adolescents at SMP Negeri 3 Lubuk Pakam totaling 42 students. The sampling was determined based on inclusion and exclusion criteria. Inclusion criteria include being willing to fill out informed consent, not being sick, and not being allergic to seafood. Exclusion criteria include not attending the briefing, not obtaining parental permission, menstruating at the time of the research, and not liking the type of fish. Based on the inclusion criteria that have been set by the researcher, a sample of 34 people was obtained. Data were collected by the researcher assisted by 4 enumerators from Semester 6 and 8 students majoring in nutrition at the Medan Health Polytechnic.

BC Cangi nuggets were made from food ingredients, 50 g baby crab, 25 g mung beans, and a mixture of 20 g wheat flour while breading. The spices used include garlic, shallots, spring onions, celery, and lime leaves which are ground first, then mixed, and then fried (1 pcs 25 g). Furthermore, 100 g of BC Cangi nuggets (4 pcs) were checked for nutritional content in the Chemistry Laboratory of the Faculty of Mathematics and Natural Sciences and the Agricultural Product Technology Laboratory of Brawijaya University Malang. The tools used to make nuggets consist of scales, blenders, pressure cookers, cutting boards, knives, steamers, baking sheets, frying spoons, oil strainers, and cauldrons (can be seen in Figure 1). The ingredients used to make nuggets can be seen in Figure 2, while the procedure for making BC Cangi nuggets can be seen in Figure 3.

Figure 1. BC Cangi Nugget Making Tools

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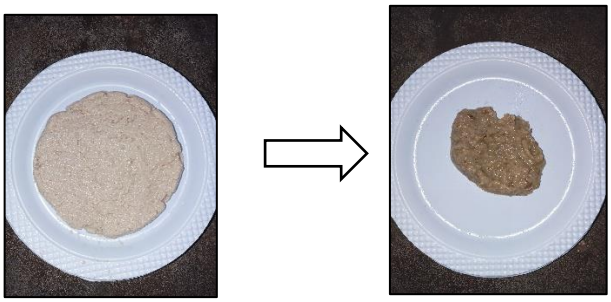
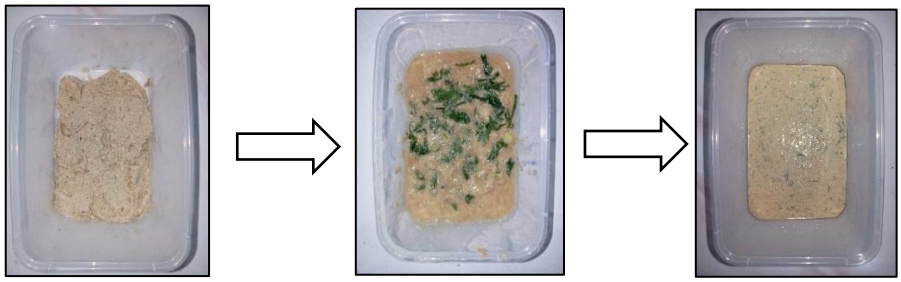
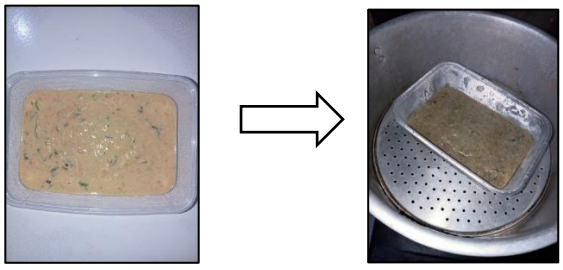
Figure 2. Ingredients for Making BC Cangi Nuggets



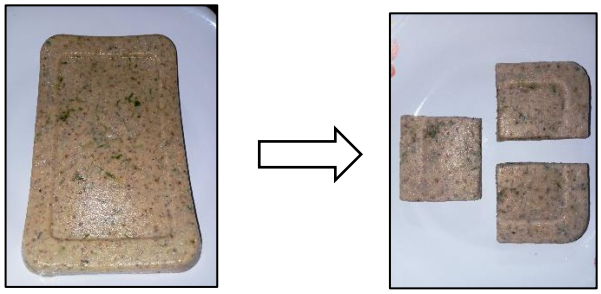
1. Puree the pressure-cooked baby crab and mung beans using a blender.



2. Mix the baby crab, mung beans, and ground spices, then add the spring onions, celery leaves, and lime leaves that have been thinly sliced, and stir the mixture until evenly mixed.



3. When it is evenly mixed, steam the mixture for approximately 25-30 minutes.



4. After the dough is cooked, let it cool and cut it into nugget shapes.

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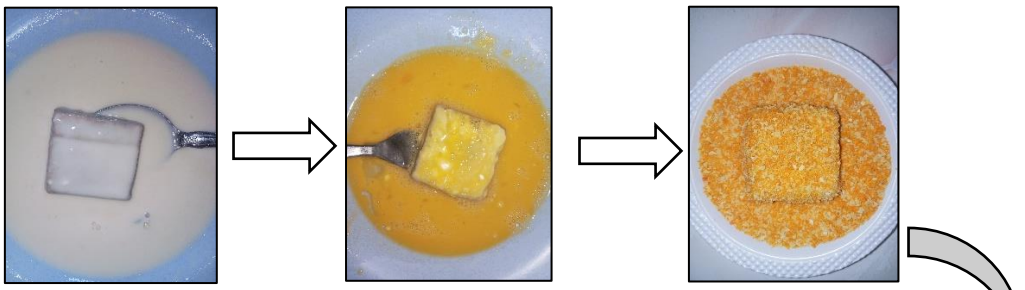

5. Dip the nuggets in flour and egg, then coat the nuggets in breadcrumbs.

6. Nuggets are ready to be fried.

Figure 3. BC Cangi Nugget Making Procedure

The provision of BC Cangi nuggets as a treatment began on January 8-27th, 2024. The nutritional content of BC Cangi nuggets in 100 g can be seen in Table 1. Before and after the provision of BC Cangi nuggets as a treatment, blood was taken from the upper left arm using a 2.5 cc pipette syringe by a medical laboratory technology analyst. Then the blood was put into a tube containing *Ethyl Diamine Tetra Acetic acid* (EDTA) acid solution to avoid clotting in the tube.

IGF-1 examination was carried out at the Molecular Laboratory of the Faculty of Medicine, Brawijaya University, using the *Enzyme-linked Immunosorbent Assay* (ELISA) method with a spectrophotometer. While the examination of albumin and Hb was carried out at the Prima laboratory Medan, Albumin was examined using the *Brom Cresol Green* (BCG) method using a Shimadzu spectrophotometer, and Hb levels were examined using cyanmethemoglobin with a spectrophotometer. As for blood zinc levels, they were examined at the Laboratory of the Faculty of Agricultural Product Technology, Brawijaya University using the *Atomic Absorbance Spectrophotometry* (AAS) examination method. The normality of the data distribution was then tested using the *Kolmorgov Smirnov* method and the data was found to be normally distributed. Then continued with univariate analysis for each variable, to see the effect of BC Cangi nuggets on changes in the components of the studied variables IGF-1, albumin, zinc, and hemoglobin using the Paired t-test statistical test and analyzed using IBM SPSS Statistics version 16. This study has obtained approval from the ethics commission issued by the Medan Health Polytechnic with the number: 01.25.257/KEPK/POLTEKKES KEMENKES MEDAN, November 14th, 2023. The nutritional content of BC Cangi nuggets in 100 g of ingredients and the manufacturing process can be seen in Table 1.

Table 1. Distribution of Nutrient Content of BC Cangi Nuggets and Its Contribution to Pre-*Menarche* Adolescents Based on RDA 2019*

Nutrient	Examination Result	Contribution Based on RDA 2019*			
		10-12 Years Old	%	13-15 Years Old	%
Protein	10.7 g	55 g	19.4	65 g	16.4
Iron (Fe)	6.36 mg	8 mg	79.5	15 mg	42.3
Zinc (Zn)	8.11 mg	8 mg	101.3	9 mg	90.1
Albumin	2.81 g/dl	≥3.5 g/dl	80.2	≥3.5 g/dl	80.2

* Recommended Dietary Allowances 2019

Table 1 showed the organoleptic test results of one BC Cangi nugget treatment consisting of 60 g baby crab + 20 g mung beans + 20 g wheat flour, then the selected treatments were examined in two laboratories at Brawijaya University Malang. Fe and Zn content were examined at the Faculty of Mathematics and Natural Sciences and protein and albumin were examined at the Faculty of Agricultural Product Technology, Brawijaya University. Based on the 2019 Nutrient Adequacy Rate, the contribution of nutrient content for protein for 10-12 year old girls was 19.4%, 13-15 year old girls were 16.4%. For Fe intake, female students aged 10-12 years contributed 79.5% and female students aged 13-15 years amounted to 42.3%. While the Zn intake of 10-12 year old

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female students contributed 101.3% and 13-15 year old female students amounted to 90.1%. Albumin is an indicator of determining nutritional status which is also needed for growth and development, 10-12 year old and 13-15 year old schoolgirls both contributed 80.2%.

RESULTS AND DISCUSSIONS

Sample Characteristics

In this study, the sample characteristics taken by researchers consisted of only two variables, namely age and class. Age showed the period of life that can be measured by a benchmark scale of years, while class showed the existence of the level of the learning process of students following the education program. The distribution of samples based on characteristics can be seen in Table 2.

Table 2. Distribution of Samples Based on Characteristics in Pre-*Menarche* Adolescents

Indicator	n	%
Age		
11 years old	5	14.7
12 years old	21	61.8
13 years old	7	20.6
14 years old	1	2.9
Class		
VII	28	82.4
VIII	6	17.6

Table 2 showed the characteristics based on age, dominated by samples aged 12 years as many as 21 people (61.8%), and samples aged 14 years are the smallest percentage of 1 person (2.9%). The pre-*menarche* adolescent is someone who is in a phase of rapid growth and development before *menarche*. This is in accordance with Sri Hayati's statement (2018) which stated that the age of an adolescent girl experiencing her first menstruation (*menarche*) is ≥15 years old and pre-adolescent girls who have not menstruated range from 12-14 years old[11,12,13].

Results of Biochemical Examination Analysis Before and After BC Cangi Nugget Intervention

Blood biochemical examination is one of the measures to determine nutritional status. IGF-1 indicates the presence of growth hormone, while albumin, zinc, and hemoglobin can indicate the status of the ability of organs such as the liver to produce blood biochemicals[5]. The distribution of minimum, maximum, and mean values of IGF-1, albumin, zinc, and hemoglobin can be seen in Table 3.

Table 3. Minimum, Maximum, Mean Values of IGF-1, Albumin, Zinc, and Haemoglobin in Pre-*Menarche* Adolescents

Indicator		n	Min	Max	Mean	SD	p-value
IGF-1 (ng/ml)	Before	34	76.94	315.12	135.404	53.05	0.001*
	After	34	169.87	515.89	310.881	80.84	
	Difference				175.478		
Albumin (g/dl)	Before	34	4.50	4.0824	3.00	0.36	0.001*
	After	34	5.50	4.5706	3.90	0.35	
	Difference				0.90		
Zinc (µg/kg)	Before	34	1.97	0.09700	0.02	0.57	0.005*
	After	34	8.98	0.25882	0.14	1.51	
	Difference				0.12		
Haemoglobin (g/dl)	Before	34	8.10	14.60	12.83	1.33	0.001*
	After	34	8.10	15.80	13.52	1.46	
	Difference				0.7		

*) Paired t-test, significant p-value<0.05

Table 3 showed that there are differences before and after the administration of BC Cangi nugget treatment in pre-*menarche* adolescents. In the IGF-1 level indicator, there was an increase of 175.4778 ng/ml, albumin levels increased by 0.90 g/dl, zinc levels increased by 0.12 µg/kg and hemoglobin levels increased by 0.7 g/dl. Normal levels for each variable, IGF-1 with a normal percentile ≤84 ng/ml for women aged 12-14 years, normal reference value 3.5-5 g/dl[14], serum zinc normal value 57 µg/dl (15), normal Hb levels <12 g/dl for women[5].

When reviewed based on the categories that can be seen in Table 4, changes in IGF-1 with a low category decreased from 38.2% to 14.7%, and albumin levels for the low category decreased from 10% to 0%. Meanwhile, the hemoglobin indicator with a low category from 17.6% decreased to 8.8%. There was a significant difference before and after the administration of BC Cangi nugget treatment based on the T-Paired p-value <0.05, which means that the administration of BC Cangi nuggets can affect the indicators of IGF-1, albumin, zinc, and blood hemoglobin variables in adolescent girl.

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Effect of BC Cangi Nugget Treatment

IGF-1

IGF-1 is thought to affect growth, and cell metabolism and is a polypeptide hormone that has a function as a mitogen and stimulator of cell proliferation and plays an important role in the process of tissue regeneration and repair. IGF-1 is measured low in newborns then increases sharply in adolescence up to 7 times and decreases by about 50% when entering the age of 60 years (16). IGF-1 also mediates the protein anabolic mediation process by increasing Growth hormone (GH) activity for linear growth[17].

In this study, BC Cangi nuggets were able to increase blood IGF-1 levels in pre-*menarche* adolescents. This is because 100 g of ingredients contain protein which contributes to the achievement of 16.4%, albumin 80.2%, and zinc 90.1%. Baby crab and mung beans are sources of essential amino proteins such as *tryptophan, leucine, and isoleucine* which affect the increase in IGF levels in the blood serum in adolescents. The presence of amino acids in the main ingredients of nuggets can increase IGF-1 by 5 times[18]. IGF-1 is a growth hormone produced in the liver and mediates or can stimulate the presence of GH which will regulate somatic growth and development of organs such as bone and brain[19]. Pre-*menarche* adolescents who have IGF-1 levels <84 ng/ml will be at risk of being frail and experiencing a decrease in bone mass and as a result can affect the growth of an adolescent girl. IGF-1 levels are also known to be able to affect the innervation system in the brain so that if IGF-1 levels are high in a person, his brain ability is also well developed[20]. Another thing to know, IGF-1 is needed in an adolescent, especially during puberty so its presence before *menarche* is needed to stimulate steroid hormones, especially the formation of hormones such as androgens, estrogens, and prolactin[6,17,21].

This research was in line with Suksesty's research in 2020, in which her research provided additional food combinations of mung bean juice and eggs. These two food ingredients are rich in amino acids that function to build bone matrix and affect bone growth. The process occurs by modifying the secretion and osteotropic action of the hormone IGF-1 so that there is the potential for peak bone mass [22].

Albumin Levels

Albumin is a storage protein in the body and is often associated with changes in a person's nutritional status. Albumin is also the main transport protein for micronutrients, so nutrients in the blood will be bound in albumin such as zinc[23]. The presence of albumin in the body is much influenced by food intake that contains high protein, especially those containing essential and non-essential amino acids. Albumin in determining nutritional problems that occur in a person, is one of the parameters to determine long-term protein deficiency[24].

In this study, the provision of BC Cangi nuggets was able to increase albumin levels of pre-*menarche* adolescent girls, this was because 100 g of ingredients contained a protein with an achievement contribution of 16.4%, albumin 80.2%. Baby crab, which comes from animal products mixed with mung bean vegetable products, can complement the presence of amino acids which are nutritional substances that form albumin[23]. Animal protein sources have good quality because they contain almost all essential amino acids in one source, in contrast to vegetable protein foods such as mung beans which only contain some essential amino acids. This causes the combination of both animal and vegetable protein sources to increase the presence of essential amino acids which are directly supplied to form albumin[25]. The process of albumin formation occurs in the liver with a half-life of about 14-21 days after consuming protein nutrients. Albumin is also able to work as a scavenger against oxidants and free radicals and can increase the body's immune ability. If this happens, pre-*menarche* children will not get sick easily so growth and development go well. Baby crab is a source of animal protein from the sea that contains Branched Chain Amino Acid (BCAA) and is needed for muscle building and stimulates the work of reproductive hormones, which are needed by pre-*menarche* adolescents[26].

This study was in accordance with Ria's research in 2022 which provides cork fish nuggets and can increase albumin levels which are tissue protein formers so that they can repair damaged tissues and muscles in people with HIV / AIDS in Medan. Other studies where the source of albumin comes from cork fish have also been able to increase blood albumin in hypoalbuminemia patients, to improve the nutritional status of sufferers, and automatically the catabolic process can be avoided. When associated with pre-*menarche* adolescents, the presence of protein can form new connective tissue and muscles so that growth and development can take place perfectly[27]. Other research that is not in line and conducted by Irma in 2019, which provides nutri rice does not contribute to the increase in albumin, this is because the treatment given relies on energy sources derived from carbohydrates so in her research changes occur in muscles marked by an increase in mid-upper arm circumference[25].

Zinc Levels

Zinc is needed by the body because it is a mineral that helps balance metabolism, which is related to the immune response. Zinc has immune functions including T cell function and antibody formation by B cells, as well as non-specific defences[28]. Zinc is needed to activate and synthesize growth hormone, in this case, GH, and zinc also plays a role in the DNA transcription process[29].

In this study, the provision of BC Cangi nuggets was able to increase serum zinc levels, this was due to the fact that 100 g of BC Cangi nuggets contained protein with a contribution to the need of 16.4%, albumin 80.2%. Baby crab is a type of mollusca that mixed with mung bean vegetable products can increase endogenous zinc in the body. The high albumin content in BC Cangi nuggets, it turns out, is also able to increase serum zinc levels in the blood because albumin can help the process of zinc metabolism and also the process of regulating the use of zinc in the body. If there is zinc deficiency due to low zinc intake, there will be a process of tissue catabolism that will free zinc in supporting tissue protein synthesis. This will result in the growth and development of a pre-*menarche* adolescent girl to be inhibited[26]. Zinc plays an important role in stimulating growth hormone synthesis,

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secretion, and production of IGF-1 in the liver. Zinc is also involved in the activation of IGF-1 in bone cartilage, so zinc deficiency from dietary intake is associated with reduced IGF-1 synthesis and activity and consequently stunted height in adolescence. Serum zinc concentration is the most widely used biomarker of zinc status. Serum zinc concentration can reflect the state of zinc stores in the body as well as the quality of intake because it can change dozens of times a day to maintain zinc homeostasis in the body[15].

This research is in line with Hendrayati's research in 2021 which provides a polymeric formula made from mung beans and fresh anchovies. This formula is intended for stunted toddlers for growth and development and the results obtained can increase serum zinc[30]. This research was supported by other research by Doloksaribu in 2023 which provides cookies made from red beans that can increase serum zinc levels in toddlers[31].

Hemoglobin Levels

Iron is the main mineral needed to form red blood cells (hemoglobin). It also acts as a component to form myoglobin (a protein that carries oxygen to muscles), collagen (a protein found in bones, cartilage, and connective tissue), and enzymes so it is also needed for adolescent growth and development. Iron along with zinc is a mineral that functions in the body's defense system so that children do not get sick easily[32].

In this study, the provision of BC Cangi nuggets was able to increase the hemoglobin levels of pre-*menarche* adolescent girls, this is because 100 g of BC Cangi nuggets contain protein with an achievement contribution of 16.4%, Fe 42.3%, and zinc 90.1%. BC Cangi nuggets consist of a mixture of baby crab animal products from the sea and mung beans which are high in protein content. Protein plays an important role in iron transport in the body. Low protein intake results in inhibited iron transport to the bone marrow, resulting in the formation of hemoglobin. In addition, proteins in the form of transferrin and ferritin aid the absorption of iron in the small intestine. Other proteins in the form of transferrin function to carry iron to the bone marrow in the process of hemoglobin formation[33]. Iron stores in the body (*ferritin* and *haemosiderin*) are found in the liver 30%, bone marrow (30%), and the rest is stored in the spleen and muscles. Iron consumed from both animal and plant products in sufficient quantities will contribute to preventing anaemia in pre-*menarche* adolescents[34].

Zinc content in BC Cangi nuggets acts as an ingredient for heme synthesis and is found in erythrocytes which have a role in oxygen exchange. Zinc also interacts with iron directly, where zinc acts as a cofactor for the enzyme *Amino Levulinic Acid* (ALA) dehydratase. As for other functions in this process, zinc can synthesize heme while in the cytosol of bone marrow cells[32].

Research conducted by Thalib in 2021 provided anchovy biscuits with the addition of tempeh. This product contains high iron and was found to be able to increase the Hb levels of adolescent girls in Mamuju Regency[35]. Other research in line with this study was also conducted by Adfar in 2023. The researcher gave a combination of iron tablets and biscuits containing animal and vegetable proteins that were able to increase the Hb levels of pregnant women[34].

The advantage in this study was that the research was conducted on junior high school adolescent female students who have not experienced puberty and menstruation, whereas so far research has always focused on adolescent girls who have menstruated. Another uniqueness of this study was that it discusses biomedical and molecular variables associated with the growth and development of an adolescent girl. Another discussion is how this article tries to be a study of the process of preparing oneself before the second rapid growth and development process after infancy. The weakness of this study is that the number of samples obtained, especially those have not menstruated in female students at SMP Negri 3 Lubuk Pakam, is still insufficient, although in terms of the minimum number of samples ≥30 people has been fulfilled.

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Table 4. Distribution of IGF-1, Albumin, Zinc, and Hemoglobin Levels Based on Categories Before and After Treatment in Pre-*Menarche* Adolescents

	IGF-1 (ng/ml)				Albumin (g/dl)				Zinc (µg/kg)				Hemoglobin (g/dl)			
	Before		After		Before		After		Before		After		Before		After	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Normal	21	61.8	29	85.3	27	79.4	34	100	19	55.9	28	82.4	28	82.4	31	91.2
Low	13	38.2	5	14.7	7	20.6	0	0	15	44.1	6	17.6	6	17.6	3	8.8

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CONCLUSIONS

The administration of BC Cangi nuggets as an alternative snack food to pre-*menarche* adolescent girls given as much as 100 g/day for 15 consecutive days is effective in increasing blood IGF-1, albumin, zinc, and hemoglobin levels.

ACKNOWLEDGEMENT

The authors would like to thank the Director of the Medan Health Polytechnic of the Ministry of Health and the Principal and Vice Principal for Student Affairs of SMP Negeri 3 Lubuk Pakam for permitting this research. The researcher also expressed appreciation to the students of SMP Negeri 3 Lubuk Pakam for their cooperation as samples as well as respondents and also enumerators of students majoring in Nutrition at the Medan Health Polytechnic.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

All authors involved in this research have no conflict of interest in this article. This research is an independent research funded by the researcher himself and fellow lecturers and several students.

AUTHOR CONTRIBUTIONS

GS: idea initiator, conceptor, license holder, and lead author; EN: data processing, license holder, editor of the paper and methodology used and concurrently finance; YAS and GNPH: financial contribution, enumerators, and co-assistant lead author; GAV: data editing, data processing, and financial contribution.

REFERENCES

1. Fatmawaty R. Memahami Psikologi Remaja. J Reforma **VI(02)**:55-65 (2017). https://doi.org/10.30736/rfma.v6i2.33.
2. Martony O. Junk Food Makanan Favorit dan Dampaknya Terhadap Tumbuh Kembang Anak dan Remaja. J Chem Inf Model. **53(9)**, 1689-99 (2020). https://doi.org/10.33758/mbi.v13i4.641.
3. RISKESDAS. Riskesdas (KEMENKES RI). (Kementerian Kesehatan Republik Indonesia, 2018).
4. Desi Wildayani, Widya Lestari, Winda listia Ningsih. Desminore : Asupan Zat Besi, Kalsium dan Kebiasaan Olahraga. (Pustaka Galeri Mandiri, 2023).
5. Supariasa NDI, Bakri B, Fajar I. Penilaian Status Gizi (Penerbit EGC Jakarta, 2020).
6. Collett-Solberg PF, Ambler G, Backeljauw PF, Bidlingmaier M, Biller BMK, Boguszewski MCS, u. a. Diagnosis, Genetics, and Therapy of Short Stature in Children: A Gowth Hormone Research Society International Perspective. Hormone Research in Paediatrics. **92(1)**, 1-14 (2019). https://doi.org/10.1159/000502231.
7. Waroh YK. Pemberian Makanan Tambahan Sebagai Upaya Penanganan Stunting Pada Balita di Indonesia. Embrio Jurnal kebidanan. **11(1)**, 47-54 (2019). https://doi.org/10.36456/embrio.vol11.no1.a1852.
8. Hayati R, Mayani N, Husna R, Sulaiman I. Pengolahan Nugget Ayam dan Penerimaannya Melalui Uji Organoleptik di Desa Krueng Lam Kareung Kecamatan Indrapuri Aceh Besar. J Pengabdi Mahakarya Masyarakat Indonesia. **1(1)**, 19-24 (2023). https://doi.org/10.24815/pemasi.v1i1.30198.
9. Purbowati, Novita L, Septiani, Sari FYK. Daya Terima dan Kandungan Zat Gizi Sereal Singkong Kacang Hijau. J Med Indones. **1(1)**, 7-15 (2022). https://ejr.umku.ac.id/index.php/JMI/article/view/1556.
10. Sayuti M, Purnamasari HB, Sumandiarsa IK, Sipahutar YH, Masengi S, Dharmayanti N, u. a. Pelatihan Pengolahan Baby Crab Krispi di Provinsi Banten. JMM (Jurnal Masyarakat Mandiri). **6(6)**, 4587 (2022). https://doi.org/10.31764/jmm.v6i6.10938.
11. Laili AN, Choirin M. Audio-Visual Media and Flayers to Reduce the Anxiety of Elementary School Students in Dealing with Menarche. Poltekkes Kemenkes Surabaya. 883-7 (2018). https://doi.org/10.33846/hn.v2i8.293.
12. Hayati S, Agustin S, Maidartati. Faktor-Faktor Yang Berhubungan Dengan Dismenore Pada Remaja di SMA Pemuda Banjaran Bandung. J Keperawatan BSI. **8(1)**:132-42 (2020). https://ejurnal.ars.ac.id/index.php/keperawatan/article/view/262.
13. Silalahi V. Efektifitas Pendidikan Kesehatan dengan Media Audiovisual dan Leaflet Terhadap Sikap Remaja Putri Menghadapi Menarche. J Keperawatan Muhammadiyah. **6(2)**, 17-23 (2021). https://doi.org/10.30651/jkm.v6i2.8183.
14. Anggaini S, Angaini DI, Mayasari D, Sari RDP. Effect of Chronic Energy Deficiency to Albumin Serum Levels of Pregnant Woman in Bandar Lampung. Majority. **8(1)**, 115-9 (2019). http://repository.lppm.unila.ac.id/16662/1/2019_Majority_Maret_Sonia_DIA_Diana_RDP.pdf.
15. Suryaningtyas R dan BP. Hubungan Asupan Fitat dengan Status Seng Serum pada Anak Sekolah Dasar. Journal of Nutrition College. **5(2)**, 77-84 (2016). https://doi.org/10.14710/jnc.v5i2.16364.
16. Tamayo A, Mulyana R, Maartini DR. Perbedaan Kadar Insulin-Like Gowth Factor-1 dan Tumor Necrosis Factor-α Serum pada Berbagai Derajat Sarkopenia Pasien Lanjut Usia: Studi Potong Lintang. J Penyakit Dalam Indones. **10**, **3** (2023). https://dx.doi.org/10.7454/jpdi.v10i3.1482.
17. Rismiati M, Flora R, Sriwijaya Sumatera Selatan U. Hubungan Kadar Insulin Gowth Factor 1 dengan

How to cite: *Siahaan, G., Nainggolan, E., Sitepu, Y. A. B., Hutauruk, G. N. P., & Veronica, G. A. (2025) Effectiveness of Baby Crab and Mung Bean Nuggets on Blood IGF-1, Albumin, Zinc, and Haemoglobin Levels in Pre-Menarche Adolescents: Efektivitas Pemberian Nugget Baby Crab dan Kacang Hijau terhadap Kadar IGF-1, Albumin, Seng, dan Hemoglobin Darah pada Remaja Pra-Menarche. Amerta Nutrition, 9(2), 237–247.*

Tingkat Kecerdasan pada Anak Sekolah Dasar di Kabupaten Musi Rawas Provinsi Sumatera Selatan. J Kesehat Poltekkes Palembang. **18(1)**, 81-6 (2023). https://doi.org/10.36086/jpp.v18i1.1725.

18. Flora R, Zulkarnain M, Fajar NA, Faisa AF, Nurlaili N, Ikhsan I, u. a. Kadar Zinc dan Kadar IGF-1 Serum pada Anak Sekolah Dasar di Kecamatan Tuah Negeri Kabupaten Musirawas. JPP (Jurnal Kesehat Poltekkes Palembang). **16(1)**, 1-6 (2021). https://doi.org/10.36086/jpp.v16i1.667.
19. Hakuno F, Takahashi SI. 40 years of IGF1: IGF1 Receptor Signaling Pathways. J Mol Endocrinol. **61(1)**, T69-86 (2018). https://doi.org/10.1530/JME-17-0311.
20. Doi T, Shimada H, Makizako H, Tsutsumimoto K, Hotta R, Nakakubo S, u. a. Association of Insulin-Like Gowth Factor-1 with Mild Cognitive Impairment and Slow Gait Speed. Neurobiol Aging. **36(2)**, 942-7 (2015). https://doi.org/10.1016/j.neurobiolaging.2014.10.035.
21. Fatani TH. Diagnostic Value of IGF-1 in Gowth Hormone-Deficient Children: Is a Second Gowth Hormone Stimulation Test Necessary? J Endocr Soc. **7(4)**, 1-6 (2023). https://doi.org/10.1210/jendso/bvad018.
22. Suksesty CE, Hikmah, Afrilia EM. Efektifitas Progam Pemberian Makanan Tambahan Menggunakan Kombinasi Jus Kacang Hijau dan Telur Ayam Rebus Terhadap Perubahan Status Gizi Stunting di Kabupaten Pandeglang. J IMJ Indones Midwifery J. **3(2)**:35-41 (2020). https://doi.org/10.1159/000362780.Interpretation.
23. Irna L, Sitorus RJ, Flora R. Hubungan Status Gizi Terhadap Kadar Albumin Serum pada Ibu Hamil: Literature Review. J Ners. **7(1)**, 783-92 (2023). https://doi.org/10.31004/jn.v7i1.14339.
24. Ria N, Siahaan G, Nasution Z, Saragih HS. Clinical Manifestation of BMI, Tlc, Albumin and CD4 After Provision of Snakehead Nugget and Colored Fruit Juice To People With Hiv. Media Gizi Indones. **17(1)**, 76 (2022). https://doi.org/10.20473/mgi.v17i1.76-81.
25. Irma I, Hadju V, Zainal Z. Pengaruh Konsumsi Nutri Rice Terhadap Kadar Albumin Berat Badan dan Lingkar Lengan Atas (Lila) Pada Remaja Kurang Energi Kronik (Kek) Di Pondok Pesantren Putri Yatama Mandiri Kabupaten Gowa. J Kesehatan Masyarakat Marit. **2(1)**, 121-31 (2019). https://doi.org/10.30597/jkmm.v2i1.10066.
26. Simanjuntak RR, Siahaan G, Sihotang U, Bakara L T. Sustainability of Freshwater Snakehead Fish Empowerment as Animal Protein in Increasing Albumin and Hemoglobin Levels of Breastfeeding Mothers. In The 6th International Conference on Argiculture, Evironment and Food Security (AEFS) 2023 1241. http://dx.doi.org/10.1088/1755-1315/1241/1/012100.
27. Pratiwi TA. The Potency of Snakehead Fish (Ophiocephalus Stratius) for Increasing Albumin Levels of Hypoalbuminemia Patient. JIMKI J Ilmu Mhs Kedokteran Indonesia. **8, 3** (2021). https://doi.org/10.53366/jimki.v8i3.254.
28. Nuryanto ES. Hubungan Asupan Protein, Seng, Zat Besi, dan Riwayat Penyakit Infeksi dengan Z-Score TB/U pada Balita. Journal of Nutrition College. **5(5)**, 520-9 (2016). https://doi.org/10.14710/jnc.v5i4.16468.
29. Ilmi VYA, Maharani N, Dieny FF, Fitranti DY. Asupan Protein, Zink, dan Defisiensi Zink Pada Santriwati Underweight. J Gizi Klinik Indonesia. **18(2)**, 69 (2021). https://doi.org/10.22146/ijcn.64951.
30. Hendrayati H, Adam A, Sunarto S. Analisis Zat Besi, Zink, dan Kalsium pada Formula Polimerik untuk Pencegahan Stunting. Media Gizi Mikro Indonesia. **13(1)**, 51-60 (2021). https://doi.org/10.22435/mgmi.v13i1.5315.
31. Doloksaribu B, Nainggolan ES, Siahaan G. The Effect of Red Bean Cookies' Admi nistration the Blood Calcium and Zinc Levels of Stunting Children. Azerbaijan Med J. **63(03)**, 8493-503 (2023). https://www.azerbaijanmedicaljournal.net/article/the-effect-of-red-bean-cookies-administration-the-blood-calcium-and-zinc-levels-of-stunting-children-hair.
32. Siahaan G, Siallagan RF, Purba R, Oppusungu R. Mikronutrien Penyebab Anemia pada Pengguna Narkoba Di Medan Tembung. Media Gizi Indonesia. **13(2)**, 183 (2018). https://doi.org/10.20473/mgi.v13i2.183-193.
33. Abby SO, Arini FA, Sufyan DL, Ilmi IMB. Hubungan Kepatuhan Konsumsi TTD, Asupan Zat Gizi, dan Status Gizi Terhadap Kejadian Anemia pada Remaja Putri Di SMPN 1 Gunungsari. Amerta Nutrition. **7(2SP)**:213-23 (2023). http://dx.doi.org/10.20473/amnt.v7i2SP.2023.213-223.
34. Adfar TD, Yanti R, Salsabila CL. The Effect intake of Fe tablets and Food Supplementation Biscuit on Changes of Hemoglobin level and LILA of Pregnant Women Who Have Chronic Energy Deficiency in Puskesmas Pauh Padang. Darussalam Nutr J. **7(1)**, 18-24 (2023). https://doi.org/10.21111/dnj.v7i1.9933.

How to cite: *Siahaan, G., Nainggolan, E., Sitepu, Y. A. B., Hutauruk, G. N. P., & Veronica, G. A. (2025) Effectiveness of Baby Crab and Mung Bean Nuggets on Blood IGF-1, Albumin, Zinc, and Haemoglobin Levels in Pre-Menarche Adolescents: Efektivitas Pemberian Nugget Baby Crab dan Kacang Hijau terhadap Kadar IGF-1, Albumin, Seng, dan Hemoglobin Darah pada Remaja Pra-Menarche. Amerta Nutrition, 9(2), 237–247.*

35. Thalib KU, Suryani As'ad, Healthy Hidayanti, Mardiana Ahmad, Andi Nilawati Usman. Efektivitas Pemberian Biskuit Ikan Teri Terhadap Peningkatan Kadar Hemoglobin pada Remaja Putri. Oksitosin J Ilmu Kebidanan. **8(1)**, 44-56 (2021) https://doi.org/10.35316/oksitosin.v8i1.828.

How to cite: *Siahaan, G., Nainggolan, E., Sitepu, Y. A. B., Hutauruk, G. N. P., & Veronica, G. A. (2025) Effectiveness of Baby Crab and Mung Bean Nuggets on Blood IGF-1, Albumin, Zinc, and Haemoglobin Levels in Pre-Menarche Adolescents: Efektivitas Pemberian Nugget Baby Crab dan Kacang Hijau terhadap Kadar IGF-1, Albumin, Seng, dan Hemoglobin Darah pada Remaja Pra-Menarche. Amerta Nutrition, 9(2), 237–247.*