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Proximate, Mineral and Vitamin Analysis of Rebon Shrimp Diversification Products as an Indonesian Local Product: Supplementary Food for Malnourished Children

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Abstract

BACKGROUND: Rebon shrimp (*Acetes* sp.) is a local food in the coastal areas of Southeast Asia that has good nutritional potential. It is a nutrient-rich food, high in protein, and beneficial to human health, but the utilization of rebon shrimp is still very low.

AIM: This study aims to measure the proximate and mineral analysis of various rebon shrimp products that can be used as supplementary food, expected to be popularly used and consumed by the Indonesian people, particularly those of low economic income.

METHODS: The diversified products in this study are meatballs, floss, nuggets, fish sticks, and fish cakes made from Rebon Shrimp (*Acetes* sp.). The proximate levels were analyzed referring to the AOAC method, The mineral content Fe and Zn were analyzed using the Atomic Absorption Spectrophotometry method. Vitamins A and Vitamin C were determined by spectrophotometric methods and titrimetry methods.

RESULTS: This study revealed that rebon shrimp could be used in making children's healthy snacks. Snacks with rebon shrimp contributed to moisture (8.79–72.58%), ash (5.06–10.29%), crude protein (20.41–27.93%), crude fat (3.09–47.16%), and crude fiber (0.35–3.36%). In addition, these foods also contained several important minerals and vitamins for the body, such as iron (9.47–56.13 ppm), zinc (4.05–40.02 ppm), Vitamin A (0.016–0.045%), and Vitamin C (0.11–0.19%).

CONCLUSION: Therefore, Lebon shrimp may be used as an alternative to local ingredients to improve the nutritional value of children's foods.

Introduction

Indonesia has various nutritional problems. Several studies also mention that nutritional problems in Indonesia tend to increase, unlike some other ASEAN countries such as Malaysia or Thailand. Indonesia is included in 17 countries that have three nutritional problems at once [1]. The three are stunting (short), wasting (thin), and overweight (obese). Nutritional problems are common, especially in Indonesia. Nutritional problems arise because there is an imbalance or disturbance between the intake received and the body's needs [2], [3], [4]. This imbalance can mean excess or lack of nutrition. Currently, nutritional problems in Indonesia are increasingly common and must be taken seriously. Several factors cause nutritional problems in Indonesia, including [1] consumption of food that does not meet the amount and composition of nutrients that meet the requirements of balanced nutrition. Then, [2] infectious diseases related to the high incidence of infectious diseases, especially diarrhea, intestinal worms, and acute respiratory diseases, due to an unhealthy environment and quality of life [3]. Availability of food in the family, parenting, and access to nutrition and health information [4]. The level of poverty so that it cannot meet nutritional needs.

Children and teenagers still need balanced nutrition to maximize their growth. Because physiological changes during adolescence affect nutritional needs, it is unfortunate when the nation's young generation is already experiencing nutritional problems. They are the ones who are expected to become future leaders of the nation who are healthy and productive. Thus, it is hoped that efforts to improve nutritional status are expected. One of them is through the procurement of complementary food.

Efforts to provide complementary foods to children, especially in developing countries, should be fortified with micronutrients, especially iron, calcium, and zinc. Nutritional intake of toddlers can be obtained

from the family food menu and supplementary feeding (in Indonesian: *Pemberian Makanan Tambahan*, abbreviated as PMT). Provision of Supplementary Food (PMT) is intended to help meet the needs of malnourished toddlers, which can be sourced from local food ingredients [5], [6], [7].

Rebon shrimp is a nutrient-rich food, high in protein, and beneficial for human health [8]. As an archipelagic country, Indonesia has abundant marine products. One of the abundant fishery commodities is rebon shrimp. Compared to other shrimp, rebon is cheaper and has a high nutritional content, which is potential to be processed into highly nutritious food products, but the utilization of these products is still low.

Shrimp contains high protein and calcium which are needed for the growth process. In addition, shrimp also contains bioactive compounds such as chitosan and chitin. The results showed that chitosan and chitin are beneficial for the body. Both substances function to suppress cell aging, prevent circulatory diseases, strengthen the immune system, increase the secretion of cholesterol in the body, suppress the proliferation of cancer cells, and reduce excess weight [9], [10]. With the abundance of rebon in Indonesia and its nutritional content, this food can be one of the basic ingredients for additional food products or nutritious side dishes for children. Rebon shrimp can be processed into products that are popular with children, such as meatballs, floss, nuggets, fish sticks, and fish cake.

This study aimed to provide data on the nutritional content of processed products based on rebon shrimp. Then, it is hoped that this product can be popularly used and consumed by the Indonesian people, especially people with less economic status.

Materials and Methods

Samples preparation

The ingredients of this research were Rebon Shrimp (*Acetes sp.*) This fishery product is an abundant local seafood in South Sulawesi, cheap in price, but still underutilized. Rebon was limited to only made as shrimp paste or dried. The rebon shrimp (*Acetes sp.*) used for this works were collected from South Sulawesi, Indonesia. The rebon shrimp collected were virtually of the same size as variability in size stands to affect the proximate composition and the mineral elements concentration. All the samples were collected fresh and were first processed into surimi before adding to this study's healthy food production process. Then in the making of surimi, a leaching process was carried out to remove fishy odors, blood, increase elasticity, and increase protein coagulation of raw materials. This would also affect the quality and durability of the product made. Without leaching, the smell and blood of rebon shrimp led the product to quickly spoiled.

Product preparation

Rebon shrimp surimi preparation

Rebon shrimp was cleaned and washed. The leaching process was then carried out by adding 3% salt by weight and adding water and ice until it reached 5°C. Pressing was carried out to reduce the water content and then mixed 1% sugar into the dough. The resulting product was then packaged for further use in the process of making diversified rebon shrimp products.

Meatballs preparation

The meatballs in this study were made using the following materials: 4 kg of Rebon surimi, 25% starch, 3% salt, 0.5% finely ground pepper, 1% sugar, two eggs, and 15% finely chopped garlic. Making meatballs was done by mixing these ingredients until evenly mixed. Furthermore, it formed in a round shape and then boiled until cooked. It was cooled, then packaged and frozen.

Fish cake preparation

The ingredients used were 2.5 kg of rebon surimi, 30% starch, 3% salt, 1% sugar, 0.5% flavoring, 1% cooking oil, 15% finely chopped garlic, and scallions. The fish cake in this study was made by mixing these ingredients evenly. Furthermore, the dough was molded into an elongated oval and boiled until cooked. Then, it was cooled, packaged, and frozen.

Nugget preparation

The ingredients used were 1.5 kg Surimi Rebon, 300 g wheat, 3% salt, 15% finely chopped garlic, 0.5% pepper, and Bread Flour. In this study, nuggets were made by mixing surimi rebon, flour, salt, garlic, and pepper. Then the mixture was molded and steamed. The steamed nuggets were slices into a square then coated with breadcrumbs, continued by packaging, and frozen.

Fish stick preparation

The ingredients used were 1.5 kg surimi rebon, 300 g wheat, 3% salt, 15% finely chopped garlic, 0.5% pepper, shredded carrots, scallions, and bread flour. In this study, dragon legs were made by mixing ingredients such as rebon surimi, flour, salt, onions, pepper, shredded carrot, and scallions. Then the dough was molded into a round-shaped and steamed. After cooked, it was added to a wooden stick and covered

with breadcrumbs. The finished product was packed and then frozen.

Floss preparation

The ingredients used are 5 kg of rebon, 500 g of red onion, 300 g of garlic, 30 g of ginger, 50 g of lemongrass, 50 g of galangal, 20 pieces of bay leaf, 20 lime leaves, 50 g of coriander, salt, and sugar to taste. The floss in this study is made by steaming rebon for 30 min, then drained to dry. Furthermore, the rebon is then coarsely ground without water. After that, mix the ground spices and coarsely ground rebon. Then marinate the product in the refrigerator for 30 min. After that, fry the floss ingredients in oil until they are brown. Once cooked brown, remove and dry with a special dryer for floss. After that cool and pack with airtight plastic.

Chemical Analysis

Proximate analysis

The proximate levels of moisture, ash, crude protein, crude fat and crude fiber in nuggets, fish stick, meatballs, and fish cake were analyzed referring to the Association of Official Analytical Chemists method [11].

Moisture (AOAC 930.15)

First, the porcelain cup is dried for about 1 h in an oven at 105°C, then cooled in a desiccator for 15 min and weighed. Carefully weighed approximately 1 g and put into a porcelain cup. Then the porcelain dish and the samples in it were put in an oven at 105°C to be dried for 8 h or overnight. Then cooled in a desiccator for 30 min, then weighed.

Ash content (AOAC 942.05)

First, the porcelain cup is dried for about 1 h in an oven at 105°C, then cooled in a desiccator for 15 min and weighed. Carefully weighed approximately 1 g and put into a porcelain cup. Then the cup with the sample in it is put in a furnace at a temperature of 600°C then left for 3 h until it turns completely into ash. Allowed to cool then put in a desiccator for hour, then weighed.

Crude protein (AOAC 983.13)

Grind the sample using a suitable tool or grinder. Weigh the sample 0.2–0.5 g into the khjedhal tube. Adding a certain amount of catalyst (Selenium mix). Added 6 ml of H2SO4, homogenized. Samples that have been homogenized are then destroyed for ± 1.5 h until they are clean yellow. After completion of digestion, cool until the sample is completely cold. Samples were analyzed using the Foss tool (KJELTEC). Record the results of the analysis obtained. After finishing analyzing, the tool is then turned off.

Crude fat (AOAC 920.39)

Weigh approximately 1 g sample. Put it into a 10 mL scale test tube. Add chloroform close to scale. Close tightly then shake and leave overnight. Filter with tissue paper into a test tube. Then pipette 5 mL into a cup of known weight. Bake at 100°C for 8 h or leave overnight. Put it in a desiccator for about 30 min, then weighed.

Crude fiber (AOAC 962.09)

Weigh the sample 0.5 g and then put it in a test tube. Add 30 mL of 0.3 N H_2SO_4 and reflux for 30 min. Add 15 mL of 1.5 N NaOH then reflux for 30 min and filtered using a sintered glass while sucking with a vacuum pump. Wash using 50 cc of hot water, 50 cc of 0.3 N H_2SO_4, 50 cc of hot water and 50 cc of alcohol. Dry in the oven at 105°C for 8 h or leave overnight and then cool in a desiccator for 30 min then weighed. Put it in the Muffle furnace for 3 h then put it in a desiccator for 30 min and then weigh it.

Mineral and vitamin analysis

The mineral content, Fe, and Zn minerals levels were analyzed using the Atomic Absorption Spectrophotometry (AAS) method [12]. However, Vitamins A and Vitamin C were determined by spectrophotometric methods [13] and titrimetry methods [14].

AAS method

First, clean porcelain cup in the oven at 105°C for 2 h. Cool it in desiccator for an hour then weigh it. Into the porcelain cup weighed ± 1 g of the sample. The porcelain cup with the sample in determining the water content is inserted into the electric furnace. The temperature of the furnace is set to 600°C, then left for 3 h until it turns to ash. Let it cool a bit then put it in the desiccator for an hour. Ash in a porcelain cup at the determination of the ash content is added 3–5 ml of concentrated HCl. Dilute with distilled water until the volume is close to the lip of the cup and let it stay overnight. Pour into a 100 ml volumetric flask. Rinse with distilled water until the line marks then shake until homogeneous (ready for mineral determination). Filter using filter paper. Inject into AAS tool. Create a standard curve according to the metal to be analyzed.

Spectrophotometric methods

First, weighed 1 g of sample, then added 10 ml of acetone. Extraction results are filtered using whatman

filter paper no.1. Then the content of the pigment beta carotene was measured using a spectrophotometer at a wavelength of 460 nm. Create standard curves using pure beta carotene.

Titrimetry methods

First, weigh ± 10 g sample and put in the 100 ml volumetric flask. Add aquadest up to 100 ml line mark then whisk and let stand for 30 min. Then filter it. Pipette 5–25 ml of the filtrate and put in the 125 ml Erlenmeyer. Add 2 ml 1% amilum and add 20 ml aquadest if needed. Then titration with 0.01 Iodine N.

Results

The results of this study indicate that rebon has a fairly good nutritional content, especially protein, Fe, and Zn. The results of the proximate analysis on Table 1 shows that fish cake had the highest water content among the five processed types, about 72.58%, and the lowest was floss, it is about 8.79%. The highest ash content was Floss, about 10.29%, and the lowest was nugget (5.06%) and fish stick (5.35%). Then, meatballs had the highest protein content of 27.93%, and the lowest was nuggets at 20.41%. Meanwhile, the highest fat content was floss, about 47.16%, and the lowest was meatballs at 3.09%. In addition, floss also had a high fiber content of 5.14%, and the lowest fiber content was a nugget of 0.35%.

Table 1: Proximate content of rebon shrimp-based products

Product	Parameter test				
	Moisture (%) (AOAC 930.15)	Ash (%BK) (AOAC 942.05)	Crude protein (%BK) (AOAC 984.13)	Crude fat (%BK) (AOAC 920.39)	Crude fiber (%BK) (AOAC 962.09)
Nugget	43.38	5.06	20.41	14.59	0.35
Fish stick	53.10	5.35	26.35	10.49	0.98
Meatballs	67.23	7.23	27.93	3.09	1.62
Fish cake	72.58	7.33	25.11	3.87	3.36
Floss	8.79	10.29	21.67	47.16	5.14

Moisture per 1 g, Ash per 1 g, Crude Protein per 0.5 g, Crude Fat per 1 g, Crude Fiber per 0.3 g.

Table 2 shows that the test parameters for mineral and vitamin content in 5 types of processed foods. Nugget had high Fe and Zn content, about 56.13 mg/kg and 40.02 mg/kg. Unfortunately, the vitamin content was low for all processed products. The Vitamin A and Vitamin C content was low for all processed products, less than 1%.

Table 2: Mineral and Vitamin content of rebon shrimp-based products

Product	Parameter test			
	Fe (mg/kg)	Zn (mg/kg)	Vitamin A (%)	Vitamin C (%)
Nugget	56.13	40.02	0.044	0.11
Fish stick	41.12	20.28	0.017	0.13
Meatballs	50.31	32.25	0.018	0.11
Fish cake	23.05	13.04	0.045	0.12
Floss	9.47	4.05	0.016	0.19

Discussion

Providing additional food for school children can be done easily by improving the quality of their snacks. Snacks are consumed between main meals, favored by children and adults. It is generally consumed approximately 2–3 h between main meals, around 10 am and 4 pm. According to the type of snack widely circulated in the market today is a snack that contains monosodium glutamate (MSG), calories, fat, and other harmful substances. Consumption of snacks with high MSG content, accompanied by snacking activities every day, can contribute to gaining weight. This is because most of our society does not know the types of healthy snacks. People are starting to realize the importance of the quality of the food they eat to maintain health. Consumption of healthy snacks can provide extra energy for activities and help meet energy needs until it is time for the main meal. The criteria for healthy snacks are Vitamins, protein, and dietary fiber. Our study, the food with rebon shrimp addition, showed the positive content of those three nutrient criteria.

Rebon shrimp (Acetes) is a type of small shrimp that lives in the waters of Southeast Asia. This type of local food sourced from these waters is generally traded in dry form in the market. So far, rebon shrimp is only used as raw material for making shrimp paste. Terasi is a traditional processed product with the principle of processing by fermentation, one of the kitchen spices widely used by the people of Southeast Asia [15], [16], [17].

Rebon is a source of protein but not as well known as beef, fish, or other chicken and shrimp. 100 g dried rebon contains 59.4 g of protein. In contrast to its high protein content, this type of shrimp has a low-fat content of 3.6 g of fat in 100 g of dried rebon. The advantages of rebon are in its calcium, phosphorus, and iron. 100 g dried rebon contains 2306 mg of calcium, equivalent to 16 times the calcium content of 100 g of cow's milk. The phosphorus content of dry rebon is 625 g, and iron is 21.4 g, equivalent to 8 times the nutritional content of 100 g of beef [18].

Rebon, besides being rich in protein, calcium, and iron nutrients, it turns out that there is one unique benefit of rebon shrimp: having a different skin. Rebon shrimp can be consumed, unlike other types of shrimp that only eat the flesh without the skin. Shrimp shell, besides containing calcium, also has the same unique substance found in insect shells and crab shells, namely chitosan. According to several studies, shrimp shells are very useful in binding cholesterol, so it is beneficial considering that eating seafood often harms and elevates blood cholesterol. Chitosan begins to work when mixed with stomach acid. This mixing will make a gel so that it binds cholesterol and fat from food. So that LDL decreases and changes in the ratio of HDL to LDL [19], [20], [21].

Toddler age is a period of very rapid growth and development. Therefore, the under-five age group needs attention, because it is a group that is prone to malnutrition. Provision of Supplementary Food (PMT) Recovery is a program carried out by the government for the toddler age group which is intended as an addition to the daily main food to overcome malnutrition. The PMT Recovery program is set to help meet nutritional adequacy for toddlers. Based on the technical guidelines for supplementary feeding, the main target for supplementary feeding is toddlers aged 6–59 months with a duration of 90 days eating according to the consumption rules. PMT Recovery is based on local food ingredients with regional special menus that are adapted to local conditions [22].

The results of the proximate test of rebon products showed that the content of the rebon products was very useful and had the potential to improve the condition of malnutrition in children. Protein needs for children aged 1–3 years is 20 g/day, and for children aged 4–6 years is 25 g/day. While the need of mineral Fe in children aged 1–3 years is 7 mg/day, and for children aged 4–6 years is 10 mg/day. The need for Zn in children aged 1–3 years is 3 mg/day, and for children aged 4–6 years that is 5 mg/day. For vitamins, the need for Vitamin A for children aged 1–3 years is 400 RE/day, and for children aged 4–6 years is 450 RE/day. The need of Vitamin C for children aged 1–3 years is 40 mg/day, and for children aged 4–6 years is 45 mg/day [23]. The provision of 3 pieces of rebon product per day as supplementary food product for malnourished children is very good to help meet the daily nutritional needs of children.

From the results of this study which was adjusted to the daily nutritional needs of Indonesian children age 1–3 and 4–5 years, set by the Indonesian Ministry of Health, it was found that there are 4 products that contain protein and minerals that are very good for children. The diversified products are nuggets, fish sticks, meatballs, and fishcakes. Every 3 pieces of nuggets (25 g/each) contains 15.30 g of protein, 8.4 mg of Fe, and 6 mg of Zn. For 3 pieces of Fish stick (25 g/each) contains 19.76 g of protein, 6.16 mg of Fe, and 3.04 mg of Zn. For 3 pieces of fish cake (25 g/each) contains 18.83 g of protein, 3.45 mg of Fe, and 1.95 mg of Zn. Meanwhile, every 8 meatballs (10 g/each) contains 22.34 g protein, 8 mg Fe, and 5.16 mg Zn. So from the results of proximate and mineral analysis, giving 3 pieces of rebon products a day (nuggets, fish sticks, fish cakes) and 8 pieces a day for meatballs, can help meet the daily nutritional needs of protein, Fe, and Zn in children.

Based on information on nutritional content, this food has the potential to be used as food to support child growth. These foodstuffs can be processed into various types of snacks that are interesting for children. Various studies show that the consumption of snacks in children in Indonesia tends to be high, where generally, these snacks only contribute to fat and energy. Through the addition of rebon shrimp, the possibility of improving child nutrition in Indonesia can be achieved. This study shows that the diversified food from rebon shrimp processing can contribute to macronutrients (water, minerals, fat, and protein) and micronutrients (iron, zinc, Vitamin A, and Vitamin C).

Conclusion

Based on the results of observations made in this study, it appears that rebon shrimp can be used in making children's high nutritions snacks in the form of nuggets, fish stick, meatballs, fish cake, and floss. Then, this research also reveals that use rebon shrimp could contribute to water, ash, protein, fat, fiber, Iron, Zinc, Vitamin A, and Vitamin C. Thus, rebon shrimp can be used as an alternative local ingredient to improve the nutritional quality of children's food. The provision of few pieces of rebon products per day as an additional food product for malnourished children is very good to help meet the daily nutritional needs especially for protein and minerals Fe and Zn.

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