

THE FORMULATION OF ANALOG SAUSAGE WITH HIGH PROTEIN AND CORK SEA FIBER (*Channa Striata*), AND OYSTER MUSHROOM AS THE HEALTHY SNACKS FOR THE SCHOOL CHILDREN

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ABSTRACT: The nutritional problems experienced by Indonesia today are multiple nutritional problems. The problem of malnutrition has begun to be overcome, but on the other hand, the prevalence of over nutrition or obesity has reached 9.2% in school children. Children who are obese are at high risk when they are adults and have the potential to experience degenerative diseases in adulthood. One of the main causes of obesity in children is food intake high in calories and fat and low fiber intake, while protein is one of the important nutrients for school children, especially for school children to support their growth and development. One of the efforts that can be done to overcome Nutritional problems in school children is through healthy, high protein and fiber product innovation approaches. Innovative products that have the potential to be developed are analog sausages.

Objective: Determine the analog sausage formula made from sea cork fish with the addition of oyster mushrooms, assess the organoleptic properties of sausages in semi-trained panelists, assess the acceptance of sausages in school children, analyze the physical and chemical properties of analog

sausages and calculate the contribution of nutrients (protein, fiber and water) analog sausage

Method: The experimental design used was a Completely Randomized Design (CRD) with two repetitions consisting of one factor, namely the proportion of the addition of oyster mushrooms to the ingredients of cork fish. The additional factor of oyster mushroom consists of five levels, namely F1 (10%), F2 (20%) and F3 (30%) of the total ingredients of sea cork fish used for making sausages. The study was conducted for three months starting from July to October 2017 in the nutrition food laboratory.

Results: From the results of data analysis, it is known that analog sausage formulations made from sea cork fish with the addition of oyster mushrooms favored by trained panelist are sausage formula (F2) which is 77% sea cork fish and 20% oyster mushroom flour. Analog sausages contain 11.8% protein content with fiber content of about 7.2% potassium levels of 46.12% and water content of 70.58%. The nutritional content of sausages per 100 grams contains 377 calories of energy, 17.5 grams of protein, 19 grams of fat, carbohydrates of

24.45 grams and calcium of 123.2 grams and 1.58 fiber of food.

Keywords: analog sausage, oyster mushroom, sea cork fish

INTRODUCTION

Nutritional problems experienced by Indonesia today are multiple nutritional problems. In Indonesia, the number of cases of malnutrition in 2012 was 42,702 cases which experienced a decrease of 14%, but in recent years the decline has been very sloping. The problem of malnutrition has begun to be overcome, but on the other hand, the prevalence of over nutrition or obesity has reached 9.2% in school children. Children who are obese are at high risk when they are adults and have the potential to experience degenerative diseases in adulthood. One of the main causes of obesity in children is food intake high in calories and fat and low fiber intake, while protein is one of the important nutrients for school children, especially in school children to support their growth and development.

Obesity is a pathological condition, namely by the presence of the excessive accumulation of fat than is necessary for normal body function. However, there are still many opinions in the community who think that fat children are healthy, so many mothers feel proud that their children are very fat, and on the one hand there are mothers who are disappointed to see their children are not as fat as their neighbors (Soetjningsih, 1995). Adult age and have

risk factors for metabolic diseases and degenerative diseases (Lailani and Hakimi, 2003). Obesity will affect its physical and psychological health. The effects of obesity can cause hyperlipidemia, hypertension, and infertility. One of the main causes of obesity in children is food intake high in calories and fat and low fiber intake, while protein is one of the important nutrients for toddlers, especially in infancy is a golden period for human life.

One effort that can be done to overcome the problem of nutrition in school children is through a healthy protein and fiber product innovation approach. Bengkulu Province as an area that is located on the sea coast, is very potent as a marine fish producing area, besides that cork fish (*Channa Striata*) and oyster mushrooms are still very underutilized as snacks. The use of marine fish in Bengkulu Province is usually only processed into dried fish, while oyster mushrooms are usually used for vegetables and side dishes.

Innovative products that have the potential to be developed are analog sausages. Sausage is food that is preferred by children and can be used as a snack for possible protein sources that are ready to eat. Analog sausages have several advantages compared to sausages in general. One of them is fiber content that is beneficial to health. Adding oyster mushrooms to processed cork fish products can increase the fiber content of the product.

The consumption needs of sea cork fish in Bengkulu continue to increase due to the increasing popularity in the community. Sea cork fish production in Bengkulu in recent

years has increased significantly from around 6,000 tons in 2014, to 17,000 tons in 2015 and continued to increase. However, awareness of fish consumption among the community is still relatively low, especially children whereas the recommendation from WHO on the consumption of fish for toddlers and children is 50 grams per day. Based on the research by Widayani and Bambang (2012) the amount of fish consumption in the community is still very far from the recommendation of only 19.9gper days.

In Bengkulu Province, there are currently no analog sausage products available using sea cork fish and oyster mushrooms. Therefore, it is necessary to make analog sausages to present sausage products as a nutrient-rich snack that is good for school children.

Based on this background, the researchers wanted to make analogous protein and fiber sausage formulations made from sea cork fish (*Channa Striata*) and oyster mushrooms as healthy snacks for school children.

RESEARCH METHODS

This research is experimental research. Experimental or experimental research (Research Experiment). The experimental design used was a completely randomized design (CRD) with three repetitions consisting of factors namely the proportion of oyster mushrooms namely F1 (10%), F2 (20%) and F3 (30%) of the total sea cork fish flour used in this research. In this study the treatment carried out was the

manufacture of analog sausage formulas from sea cork fish and oyster mushrooms with three formulas.

Table 1 Experiment Design

Formulat ion	Ingredients	
	Sea cork fish (%)	Sea cork fish (%)
I	80	10
II	77	20
III	74	30

The study was conducted in July-October 2017 in the Food Technology Laboratory of the Nutrition Department of the Health Polytechnic of the Bengkulu Ministry of Health and the chemical laboratory of the Faculty of Mathematics and Natural Sciences, University of Bengkulu. This study includes several stages, namely: making finely ground sea cork fish meat, oyster mushroom flour, sausage making, and organoleptic tests.

The population in this study was elementary school year in the city of Bengkulu, amounting to 120 people. Sampling with purposive sampling, which is taking samples based on predetermined criteria. The sample inclusion criteria in this study were schoolchildren aged 10-12 years with good nutritional status, not suffering from infectious diseases and willing to become respondents.

The statistical analysis used is the mode score. To determine the effect of treatment on the addition of oyster mushrooms to the acceptability of trained panelist performed the non-parametric statistical analysis. An

organoleptic test was processed using the Kruskal Walls test if it was significant $p < 0.05$, then continued with the Man Whitney Test. Meanwhile, to determine the effect of adding oyster mushrooms to

RESULTS

Analogous sausage formulation made from sea cork fish with the addition of oyster mushrooms

Mushroom flour preparation begins with the first step done by weighing oyster mushrooms that have been cleaned by washing with 1 liter of clean water and slicing it with a width of ± 0.8 cm. The process of making analog sausages is divided into several stages. The first stage in making sausages is the process of mixing ingredients. In the dough formation stage, the dough-forming material consists of the ground meat of sea cork fish which is ground and made of dough (fish filet and salt), then the mixture is added with garlic, powdered pepper, STPP, skim milk and ice (half portion).

Furthermore, oyster mushroom flour (10%, 20%, and 30%) was added from the total filler stirred at low speed for 3–5 minutes until all ingredients were well mixed. It is because high-speed stirring and for too long will increase the temperature of the dough so that it affects the stability of the emulsion. According to Essien (2007), the temperature of the mixture more than 180C will cause the emulsion to break and increase a cooking loss. The addition of filler and filler material is carried out in the

physical properties, nutrient content, a different test of independent sample t test was carried out. If the results obtained are significantly different then proceed with the Duncan test.

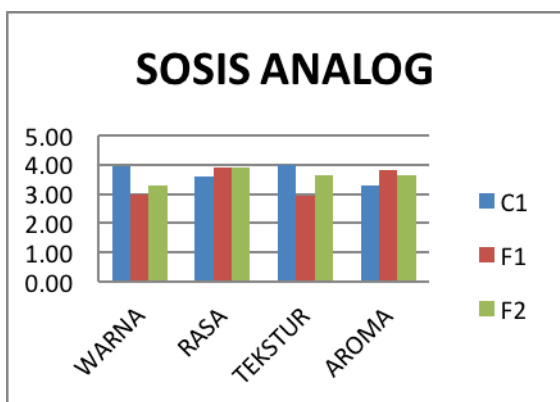
final stage because it is to improve the stability of the emulsion (Essien 2007).

The next process is to add the mixture to the sausage sleeve. The dough is made a little dense to produce sausages that appear to blend with the sleeve. The dough is inserted into the sleeve using a food prosessor machine and then tied to the end. The dough on the sleeve is then divided into several parts by binding to the sleeve at several points using a woll thread so that some parts of the sausage with the same length (± 15 cm) are obtained. The division of the dough on the sleeves also considers the dough is cooking loss to get a 25 g sausage cooking weight per stick. The next step is boiling for 30 minutes at a temperature of 100C. After boiling, there is a change in the texture of the sausage, which is from liquid to semi-solid (chewy) and the development of size due to the absorption of water.

Organoleptic Properties of Analog Sausages in Semi-Trained Examiners

The purpose of the organoleptic testing was to determine the selected formula for sea cork fish sausage with the addition of oyster mushrooms to be used for further research. Analog sausages are presented with three treatments according to the stages of the study. On picture. One shows that the texture, color, taste, and aroma of the preferred analog sausage is the softest texture (F2).

Figure 1. Organoleptic's Respondents



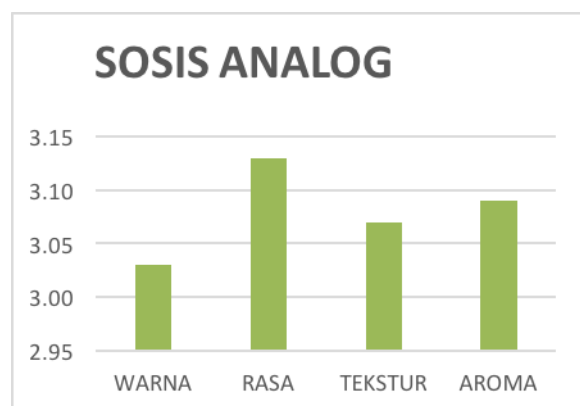
Description: 1 = dislike; 2 = rather like; 3 = likes; 4 = really like it

Taste preference scores F2 (3.9), and aroma (3.8) are also the most preferred by panelist. and for color the highest analogous sausage C1 score (3.93) so that the F2 organoleptic formula by semi-trained panelist is the most preferred and used for advanced researchers. The lowest assessment was obtained in the F1 treatment. This low evaluation was caused by the fact that most of the panelists did not like the aroma of fish which was still very bad, which still gave a distinctive aroma.

Assessing organoleptic properties in school children

Testing of advanced organoleptic properties carried out in SD Kota Bengkulu which aims to determine the acceptability of the selected formula of sea cork fish sausage with the addition of oyster mushrooms to be used is formula 2 (F2). The results of the acceptance test for elementary school children showed the mean results for color (3.03), taste (3.13), texture (3.07) and aroma (3.09), as shown in the graph in Figure 2.

Figure 2. Organoleptic's Respondents



Description: 1 = dislike; 2 = rather like; 3 = likes; 4 = really like it

Analysis of physical and chemical properties of analog sausages

Physical characteristics are one of the factors supporting the acceptance of a product by consumers. Physical analysis of hedonic quality organoleptic test results can be seen in Table 1.

Table 2

Hedonic analog sausage quality test results with the addition of oyster mushrooms.

ATTRIBUTES TEST	MODUS
Surface color	Light brown
Inner color	Creamy chocolate
Aroma	Medium
Savory taste	Medium
Salty taste	Medium
Aftertaste	Medium
Bite texture	Soft rather rough
Press texture	Normal

Nutrient content of selected formula sausage products was analyzed using chemical analysis and evaluation of nutritional value. Chemical analysis and evaluation of nutritional values include water content and protein content by the method of difference, crude fiber content, potassium levels in vitro.

Table.3

Results of chemical tests of analog sausages with the addition of oyster mushrooms

Components	Unit	Analog Sausage (sea cork fish and Oyster Mushroom)	SNI 01-3820 1995
Water content	%	70,58	Maximal 67%
Protein	%	11,8	Minimal 13%
Fiber	%	7,2	-
Potassium	%	46,12	-

Analysis conducted at the University of Bengkulu chemical laboratory showed that analog sausages contained 11.8% protein content with the fiber content of around 7.2% potassium content of 46.12% and moisture content of 70.58%

Information and Contribution of analogous sausage (protein and fiber) nutrients to school children

The nutritional value of the sea cork analog sausage with the addition of 20% of oyster mushrooms is determined based on the calculation of the energy and nutrient content per 50 g serving on the adequacy of energy and nutrients recommended for general consumers in ALG. The nutrient content calculated in this study focuses on protein, total fat, total carbohydrate, potassium, and dietary fiber.

Table.5. Comparison of analog sausage nutrition analysis with SNI 101-3820-1995 per 100 grams

Nutritional value	AKG	% AKG per serving (50 gram)	SNI 01-3144-1995	Formula F2 per serving (100 gram)	Formula F2 per serving (50)
Energy	2000 kkal	195 kkal	452 Kkal	377 Kkal	188,5KKal
Protein	25 gram	12 gram	14.5 gram	17,5 gram	87,5gram
Fat	62 gram	9.52gram	42.3gram	19 gram	8 gram
Carbohydrate	300 gram	1,47gram	42.3gram	24,45 gram	12,23 gram
Potassium	-	-	28 mg	123,2 mg	61,6 gram
Food fiber	7,64 gram	15,28gram	-	1,58 gram	0,79 gram

Selected analog sausages based on the calculation of nutritional value has an energy content of 377 Kal, 17.5 g of protein,

19 grams of fat, carbohydrates 24.45 grams and potassium 123.2 grams and 1.58 fiber of food per 100 g. So, in one dose aji 50 gram,

there are 188.5 calories of energy, 8.75 g of protein, and 8 grams of fat, 12.23 g of carbohydrates, 61.6 grams of calcium and 0.79 grams of dietary fiber.

DISCUSSION

Obesity is a condition caused by an imbalance of energy intake and energy expenditure based on unbalanced consumption patterns and low physical activity. Today's modern lifestyle tends to direct people to a fast, practical consumption pattern regardless of their nutritional content. Besides, the inclusion of cultures from the outside (western), especially the trend of consumption patterns of ready-to-eat foods high in calories and high in fat, has been entrenched and cannot be separated from the consumption patterns of the Indonesian people, including the province of Bengkulu. It is exacerbated by the low fiber consumption of Indonesian people, which is around 12 g per day or only 50% of what is recommended (Litbangkes Gizi 2010).

One form of effort taken to overcome the problem of obesity in school children is by utilizing and innovating food processing through the development of products with high nutrition that contain carbohydrates, proteins, fats, and dietary fiber. The types of food that can be

optimized for their presence in the manufacture of this product are sea cork fish and oyster mushrooms. The use of sea cork fish and oyster mushrooms is still minimal. Limited use of sea cork fish due to lack of variety in processing. The use of sea cork fish in Indonesia in general through fried or processed using spices while oyster mushrooms are usually used for vegetables and side dishes. According to Suprapti and Djarwanto (1992), white oyster mushroom (*Pleurotus ostreatus* Jacq.) Contains 11.5% fiber; protein is 26.40% and fat is 1.66%.

In the results of organoleptic tests conducted by trained panelists, the results of the most preferred sausage are F2 products, analog sausages which have the softest texture. The moisture content of analog sausages much influences the texture of this sausage. The harder texture is owned by fish sausages cooked with F1 formula. It is due to the lower water content of fish sausages (Table 4.2). The presence of water in an analog sausage will cause the texture to become soft. Saffle (1968) explained that the water content in processed meat products is very influential on meat tenderness. According to Charalambus (1995), the aroma component is closely related to the concentration of the aroma component in the vapor phase in the mouth. This

concentration is also influenced by the nature of volatile from the aroma itself. Another factor is the natural interaction between components of aroma and components of nutrients in eating such as carbohydrates, proteins, and fats as well as very relative consumer acceptance.

The results of research by Simon B. et al., 2002 showed that the cooking process had a significant effect on the quality of cork fish sausage seen from the physical-chemical quality. These differences include water content, protein content, fat content, and texture, except in water activities. The best treatment based on organoleptic quality is steaming cork fish sausage for 15 minutes at 100°C. Where this sausage has a water content of 66.46%, protein content of 60.35%, fat content of 6.29%, water activity (aw) 0.903, texture of 0.017 mm / g.detik, and a favorite value of taste 5.2 (rather like), aroma 4.75 (rather like), color 4.5 (somewhat like), and elasticity 4.75 (rather like).

The sausage color in the table SNI 1101-3820-1995 is normal, what is meant usually, in this case, is the color of the sausage derived from the base material is usually also influenced by the additional ingredients used such as dyes used. The excellent quality of sausage is determined

from the characteristic odor from the essential ingredients used according to SNI sausage, the meat smells normal, does not smell bad. Taste: Meat sausage in accordance with SNI 101-3820-1995 has a natural taste, meaning that the sausage taste is typical of the basic ingredients. Meat sausages have a good taste of meat, beef sausages, chicken sausages or other sausages must also be in accordance with the essential ingredients used.

Water is one of the most critical nutritional components in sausage products because it can affect the main attributes of the physical properties of sausages, namely texture or elasticity. The water content of selected formula sausage products is 70.58%, the value is higher than the requirements of sausage moisture content according to SNI 01-3820-1995 which is a maximum of 67%. Independent samples t-test results showed that the selected sausage moisture content of the formula was significantly different ($p > 0.05$) with regular sausage. It is allegedly influenced by processing factors namely boiling. Moreover, the selected sausage formula mathematically has a higher water content with the addition of oyster mushrooms. The water content in 20% of the added oyster mushrooms is 3.58 g (89% moisture

content). According to the researchers, it is still acceptable because according to Muchtadi and Ayustaningwani (2010) it is known that high-temperature treatment will cause evaporation of water in foodstuffs. The higher the water content is free of food, the higher the rate of evaporation. However, when the frying rate of water evaporation occurred, it was also more significant than the control so that the water content of the control formula and the selected ones which were processed with the same frying pan produced moisture content that was not significantly different.

Protein is one of the primary macronutrients for the body related to its function as a building agent, regulator, and energy source. The protein content in sausages comes from tempeh, oyster mushrooms, and egg white. The results of the analysis in Table 7 show that the selected protein formula sausage levels were 11.8% and the standard protein content according to SNI 01-3820-1995 is at least 13%. Independent samples t-test results showed that the selected protein formula sausage levels were not significantly different ($p > 0.05$) with the standard. It is thought to be due to the relatively small oyster mushroom protein content (in 20% of the mushrooms added there are 0.085 g of

protein) so that the selected protein content of sausages is not significantly different from the SNI sausage standard.

Protein content in sea cork fish sausages with the addition of 20% oyster mushrooms is mostly sourced from sea cork fish, eggs and oyster mushroom flour. The protein is composed of various amino acids. According to Samaee et al. (2010), the content of essential amino acids found in eggs is leucine, lysine, isoleucine, valine, threonine, tryptophan, phenylalanine, histidine, and methionine. Meanwhile, limiting essential amino acids in tempeh is methionine (Song et al. 2008). The components of essential amino acids in eggs and tempeh make Tempe sausage products with the addition of oyster mushrooms to be a protein source product with complete essential amino acid content.

The contribution of analog sausage nutrition to sea cork fish with the addition of oyster mushrooms was calculated based on the AKG of school-aged children 10-12 years with the assumption that the child has an ideal body weight ranging from 35–38 kg and ideal height ranges between 138–145 cm. Nutrients calculated in this case focus on energy, protein, and dietary fiber. The AKG of school-age children 10-12 years for energy is 2050 Kal, protein is 50 g, and food

fiber is 25 g (WNPG 2004 in Almatier 2009).

CONCLUSION

a. Analog sausage formulations made from sea cork fish with the addition of oyster mushrooms favored by trained panelist are the preferred texture, color and flavor of analog sausage is the formula (F2), which is 77% of sea cork fish and 20% of oyster mushroom flour.

b. Organoleptic properties of analog sausages in semi-trained investigators were found to have a taste of F2 (3.9), and aroma (3.8) was also the most preferred by panelist. Moreover, for the color of the highest analogous sausage C1 score (3.93) so that the organoleptic F2 formula by semi-trained panelist is the most preferred.

c. Organoleptic properties of analog sausages in schoolchildren receiving primary school children showed the average results for color (3.03), taste (3.13), texture (3.07) and aroma (3.09).

d. Analog sausages contain 11.8% protein content with a fiber content of about 7.2% potassium levels of 46.12% and water content of 70.58%.

e. Nutritional value has energy content of 377 Kal, 17.5 g of protein, 19 grams of fat, carbohydrate 24.45 grams and calcium

123.2 grams and 1.58 fiber of food per 100 g so that in one dose of aji 50 grams there are 188.5 Kal energy, 8.75 g protein, and 8 grams of fat, 12.23 g carbohydrates, 61.6 grams of calcium and 0.79 grams of dietary fiber.

SUGGESTION

a. There is further research on additional ingredients to get sausages with better characteristics and shelf life of sea cork fish sausages and oyster mushrooms.

b. Difficulties during the implementation of research that still need to be solved, among others: the process of making oyster mushroom flour, the process of compacting the dough in casing, so that getting better results and this constraint requires further research.

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