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Proximate Analysis of the Processing of Milkfish (*Chanos chanos*) Cookies with the Addition of Moringa Leaves (*Moringa oleifera*) as Complementary Food for Stunted Children and Toddlers in Nunukan Regency, North Kalimantan

Analisis Proksimat pada Pengolahan Cookies Ikan Bandeng (*Chanos chanos*) dengan Penambahan Daun Kelor (*Moringa oleifera*) Sebagai Makanan Pendamping Stunting pada Balita di Kabupaten Nunukan, Kalimantan Utara

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ABSTRACT

The case of malnutrition in Indonesia is still one of the problems that the government must resolve. This is because, in recent years, cases of malnutrition among the Indonesian population, especially babies and children, have still occurred in several areas. The problem, especially stunting, in Indonesia is a national concern. The stunting reduction target for 2024 is 14%, while 2022 is still 24%. The Indonesian government has made various efforts to deal with stunting but has been unable to reduce it significantly. One of the efforts to prevent stunting is providing complementary foods for toddlers. Therefore, it is necessary to process food that has high nutritional content. One of the essential nutrients needed by the human body is protein. The urgency of this research is food processing in the form of cookies to prevent stunting, especially in Nunukan Regency, North Kalimantan Province. Processed cookies are very important for toddlers to consume to fulfill optimal nutritional requirements. This research aims to make or process cookies made from milkfish (*Chanos chanos*) with the addition of Moringa oleifera leaves to overcome the problem of malnutrition, especially stunting, especially in Nunukan Regency, North Kalimantan. This research aligns with the Regional Government's work program, the Regional School Children's Nutrition Program Plus (ProGasDa Plus). ProGasDa Plus is an effort to increase the nutritional intake given to students by providing nutritionally balanced additional food, accompanied by education on balanced nutrition, preventing worms, and providing supplements. Complementary foods will be analyzed proximately to see the nutritional content contained in the cookies.

Keywords: Stunting, Cookies, Milkfish, Moringa Leaves

ABSTRAK

ABSTRAK

Kasus gizi buruk di Indonesia masih menjadi salah satu permasalahan yang harus diselesaikan oleh pemerintah. Hal ini disebabkan karena dalam beberapa tahun terakhir kejadian kasus gizi buruk pada penduduk Indonesia, terutama bayi dan anak-anak masih terjadi di beberapa daerah. Permasalahan khususnya stunting yang ada di Indonesia merupakan permasalahan yang telah menjadi perhatian nasional. Target penurunan stunting pada tahun 2024 sebesar 14%, sedangkan di tahun 2022 masih diangka 24%. Berbagai upaya penanganan stunting telah banyak dilakukan oleh Pemerintah Indonesia, akan tetapi belum bisa menekan penurunan stunting secara signifikan. Salah satu upaya yang dilakukan untuk pencegahan stunting adalah dengan memberikan makanan pendamping bagi balita. Oleh karena itu, diperlukan pengolahan makanan yang memiliki kandungan gizi yang tinggi. Salah satu zat gizi esensial yang dibutuhkan oleh tubuh manusia adalah protein. Urgensi dari penelitian ini adalah pengolahan makanan berupa cookies untuk pencegahan stunting khususnya di Kabupaten Nunukan, Provinsi Kalimantan Utara. Cookies yang telah diolah sangat penting dikonsumsi oleh balita dalam pemenuhan kecukupan gizi yang optimal. Tujuan dari penelitian ini adalah pembuatan atau pengolahan cookies yang terbuat dari ikan bandeng (*chanos-chanos*) dengan penambahan daun kelor (*moringa oleifera*) ini sebagai upaya untuk mengatasi permasalahan kasus gizi buruk terutama tentang stunting, khususnya di Kabupaten Nunukan, Kalimantan Utara. Penelitian ini selaras dengan program kerja Pemerintah Daerah yang disebut Program Gizi

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Anak Sekolah Daerah Plus (ProGasDa Plus). ProGasDa Plus adalah sebuah upaya peningkatan asupan gizi yang diberikan kepada peserta didik melalui pemberian makanan tambahan bergizi seimbang, disertai edukasi gizi seimbang serta pencegahan kecacingan dan pemberian suplemen. Makanan pendamping akan dianalisis proksimat untuk melihat kandungan gizi yang terdapat di cookies tersebut.

Kata Kunci: Stunting, Cookies, Ikan Bandeng, Daun Kelor

INTRODUCTION

Stunting is a condition where a child experiences growth disorders so that the child's height does not correspond to his age due to chronic nutritional problems, namely lack of nutritional intake for a long time. According to 2020 UN Statistics, more than 149 million (22%) toddlers worldwide experience stunting, of which 6.3 million are young children or stunted toddlers, namely Indonesian toddlers. Based on data from the Ministry of Health (2019), in Indonesia, the percentage of babies under 6 months old who received exclusive breast milk in 2018 is The occurrence of malnutrition in babies is also caused by the consumption of MP-ASI (complementary breast milk food), which is low in energy and causes an imbalance between intake and output of nutrients (nutritional imbalance). One of the districts in North Kalimantan is Nunukan. The stunting rate in Nunukan Regency is the highest in North Kalimantan. To date, the number of stunting cases in Nunukan has reached 1,101 children under five and spread across 21 villages. This research was carried out in support of Presidential Regulation Number 72 of 2021 concerning the Acceleration of Stunting Reduction, Nunukan Regent Regulation Number 45 of 2019 concerning Stunting Reduction Interventions, the Regent's Decree concerning Acceleration of Stunting Reduction Teams at Regency to Village/Subdistrict Levels, as well as the Regent's Decree concerning Village Locus of Reduction Stunting. Cases of malnutrition in society are caused by two factors, namely direct causes and indirect causes.

Of these several causes, the quantity and quality of food are the leading causes of malnutrition (Oktavia et al., 2017.). The level of daily food consumption influences a person's nutritional status. Good dietary or optimal nutritional status occurs when the body obtains enough nutrients that are used efficiently, thereby allowing optimum physical growth, brain development, workability, and general health. Malnutrition occurs when the body experiences a deficiency of one or more essential nutrients. One of the vital nutrients needed by the human body is protein. Milkfish is a food ingredient whose use is currently limited to smoking or pressure cooking, even though in terms of its nutritional value, milkfish is high in protein and Omega-3 at an affordable price compared to other fish (Sari et al., 2020). This commodity is also one of the leading commodities in Nunukan Regency. This fish is a source of high protein and Omega-3, which children need to support growth and intelligence and increase body endurance.

Meanwhile, Moringa leaves contain twice as much protein as yogurt, three times more potassium than bananas, and four times more vitamin A than wortel, so stunted toddlers must consume them to meet their vitamin needs (Mirna, 2023.). Cookies are snacks made from wheat flour and other food ingredients widely consumed by the public. Cookies are famous because they are economical, practical, nutritious, long-lasting, and easy to consume. These cookies are generally used as a fortification medium by adding other ingredients to enrich the nutrients in the cookies so that they are more nutritious to consume and as a substitute, such as in this research replacing some of the wheat flour with milkfish flour. Already implemented. Apart from nutritional factors, it is also necessary to consider cost factors by using raw materials efficiently (Sari et al., 2020)

MATERIALS AND METHOD

Time and place of research

The research was conducted at the Nunukan State Polytechnic Fishery Products Technology Laboratory, Nunukan, North Kalimantan, in March-August 2024.

Experimental design

This research was carried out experimentally using a factorial Completely Randomized Design (CRD) with three replications and the formulation was as follows: F0 (150 g of wheat flour: 100 g of fish meal: 0 g of Moringa leaf flour), F1 (150 g of wheat flour: 150 g wheat flour: 0 g wheat flour: fish meal 80 g: Moringa leaf flour 20 g), F2 (wheat flour 150 g: fish meal 85 g: Moringa leaf flour 15 g), F3 (wheat flour 150 g: fish meal 90 g: Moringa leaf flour 10 g). The experimental design used in this research was a factorial Completely Randomized Design

(CRD) consisting of two factors: milkfish flour substitution and Moringa leaf protein isolate substitution.

Procedures

The first stage is making milkfish flour. The process stages start with weeding the milkfish, then the process of steaming the milkfish (this process includes cooking the fish by boiling it in a steamer at a temperature of around 100^{o}C for 20 minutes and then steaming the fish until fish meat is obtained enzyme activity is reduced/inactive due to this process. After that, the meat is separated from unused parts (bones, spines, and skin). Then, the process of drying the fish meat in a drying oven at a temperature of 150^{o}C for 7 hours is continued. The following process is to add flour to the milkfish meat (this process is to get fish flour). More uniform and delicate, for the size of the milkfish flour, sift it using an 80 mesh sieve. Next, grind the milkfish meat (this process is done by grinding the meat using a blender to get a smoother result. Then it is dried again in the oven at 50^{o}C) for 30 minutes to remove any remaining water still attached to the fish flesh. Then, the milkfish flour is sifted and packaged.

The second stage is making Moringa leaf flour. Making Moringa flour begins with selecting suitable raw materials for a quality product. The washed Moringa leaves are drained to reduce the amount of water in the moringa leaves, then dried using sun drying for 6 hours at a temperature of ± 30^{o}C. After drying, grinding and sieving were carried out using an 80 mesh sieve to obtain Moringa leaf flour.

The third stage is processing milkfish cookies with the addition of moringa leaves. This is done starting by preparing the ingredients according to the measurements, namely, 10 g egg yolk, beaten with 100 g powdered sugar, then add 15 g butter, 0 g baking powder, 2 g salt, 1 g, margarine 125 g, and milk powder 5 g, vanilla 1 g beat using a mixer for 5-10 minutes. After mixing thoroughly, add 250 g of flour, consisting of the following F0 (150 g wheat flour: 100 g fish meal: 0 g Moringa leaf flour), F1 (150 g wheat flour: 80 g fish meal: 20 g Moringa leaf flour), F2 (150 gr wheat flour: 85 g fish meal: 15 g Moringa leaf flour), F3 (150 g wheat flour: 90 g fish meal: 10 g Moringa leaf flour). Stir evenly, then print. After printing, add chocolate chips as decoration. Then, put it in a preheated oven to bake at 150°C for 30 minutes or until the sweet pastry is brownish-yellow.

The cookies are tested for their physical and chemical properties in the testing phase. The chemical properties analyzed include water, ash, fat, protein, and carbohydrate content.

RESULT AND DISCUSSION

proximate testing of milkfish cookies with moringa leaves as a complementary food for stunting in toddlers in Nunukan Regency - North Kalimantan. Based on the results of the data analysis, the highest protein levels in cookies were F2, F3, F1, and F0 (control), respectively. The nutritional content of cookies meets SNI 01-7111-2005 standards (complementary foods for breast milk (MP-ASI)), namely water and protein. Those not meeting the requirements are ash, carbohydrate, and fat levels. Meanwhile, the nutritional content of cookies following SNI 2973.2022 (biscuits) meets the quality requirements. A product is said to have passed the test if it meets quality requirements (Table 1).

Water content analysis is a method used to calculate the water content in a product (Purnamasari et al., 2017). Water content influences the food ingredient's acceptability, freshness, appearance, and taste. Water content is removed to extend the shelf life of a material (Winarno, 2004). The test analysis showed that the average water content in milkfish cookies with moringa leaves after three repetitions was 4.82, 4.67, 4.53, and 4.48. This water content still follows the maximum limit required in SNI 01-7111-2005 and SNI 2973-2022, namely a maximum of 5 (mass fraction, %). Test result data shows that treatments F0, F1, F2, and F4 successively experienced a decrease in water content. The comparison of ingredients containing protein sources influences a product, and protein can bind water molecules due to its hydrophilic nature. (Purnamasari et al., 2017). Wheat flour is also added to the product. Wheat flour contains starch. Starch has hydrophilic properties like protein to bind large amounts of free water (Hp et al., 2013). However, adding protein and starch can reduce the water absorption capacity. This is demonstrated by the results of the test analysis data, which shows that the reaction by substituting milkfish with the addition of moringa leaves further reduces the water content of a product. According to Astuti & Anayuka (2019), the combination of protein and starch will make the surface of the granule particles complex, reduce viscosity and reduce gel strength. Starch and protein form a starch-protein matrix and harden the cookies due to hydrogen interactions between amino and hydroxyl groups. The formation of a starch-protein matrix will cause the water absorption capacity of the product to become lower.

Ash content is an analysis to determine the mineral content contained in a food ingredient. Ash content is

an inorganic substance from the remains of burning organic material (Permatasari et al., 2020). This is also related to the mineral content contained in a product. Ash content also shows the purity and hygiene of the food produced (Kartika et al., 2014). The ash content test analysis results showed 4.74, 4.99, 5.09, and 5.1, respectively. The quality requirements that must be met according to SNI 01-7111-2-2005 are that the ash content is not more than 3.5 g/100 g, so the resulting ash content does not meet the standards. The analysis shows that the higher the addition of milkfish flour, the higher the ash content is produced. This is due to the mineral constituents of milkfish meal, especially the phosphorus element contained in 100 g of milkfish meal, namely 150 mg (Syifa et al., 2013).

Table 1. Proximate test results on milkfish cookies (*Chanos chanos*) with the addition of moringa leaves (*Moringa oleifera*)

No.	code	Analysis Parameters	analysis			Average
			1	2	3	
1	FO	water (g)	5.28	4.62	4.55	4.82
	F1		5.09	4.36	4.56	4.67
	F2		4.8	4.7	4.1	4.53
	F3		4.41	4.65	4.37	4.48
2	FO	ash (g)	4.24	4.64	5.35	4.74
	F1		4.02	5.42	5.53	4.99
	F2		5.09	5.08	5.09	5.09
	F3		5.08	5.04	5.19	5.1
3	FO	Fat (g)	19.55	18.87	19.28	19.23
	F1		18.7	18.8	18.5	18.67
	F2		18.8	18.1	18.9	18.6
	F3		18.5	18.8	18.7	18.67
4	FO	Protein (g)	20.5	20.3	20.2	20.33
	F1		20.8	20.4	20.5	20.57
	F2		20.8	20.8	20.7	20.77
	F3		20.8	20.5	20.9	20.73
5	FO	carbohydrate (g)	50.43	51.57	49.38	50.46
	F1		51.39	51.02	49.09	50.5
	F2		50.51	51.32	48.79	50.21
	F3		51.21	51.01	49.16	50.46

According to Hidayah (2015), phosphorus provides energy in fat and starch metabolism, plays a role in bone formation, supports healthy gums and teeth, and helps DNA synthesis. The heating process of products containing mineral ingredients at high temperatures will form higher ash content, and this follows the statement of Sholihah et al. in Rahim et al. (2023) that heating food ingredients containing minerals at High temperatures will produce more ash because ash is composed of minerals. During the processing process, heating occurs, namely during drying or roasting. Moringa leaves are a source of iron (Winahyu et al., 2023) and contain nutrients such as ascorbic acid, flavonoids, phenolics, and carotenoids. Moringa leaves contain more iron than other vegetables, namely 17.2 mg/100g (Yameogo et al., 2011), and are the largest supplier of iron from the vegetable group (9.9%) (Pratiwi et al., 2021). Moringa leaves are rich in minerals such as calcium, potassium, zinc, magnesium, iron, and copper. Vitamins such as vitamin A, B vitamins such as folic acid, pyridoxine and nicotinic acid, vitamins C, D, and E, and β-carotene (Berkovich et al., 2013) so the addition of Moringa leaf flour can cause an increase in ash content because the composition of Moringa leaves itself is rich in minerals. This causes milkfish cookies with added moringa leaves (Moringa oleifera) to further increase the ash content of the product.

The fat content helps to absorb fat-soluble vitamins (A, D, E, and K), stimulates metabolism, and makes hormones (Gita & Danuji, 2018). Apart from that, fat in food plays a role in improving the texture and taste of the product (Setyawati et al., 2021). Data from the treatment test results F0, F1, F2, and F3 by carrying out three consecutive repetitions showed the following: 19.23, 18.67, 18.6, and 18.67. Based on SNI 01-7111-2-2005, the quality requirements for fat content are between 6-18 g/100 g. So, the difference from the analysis data is 1.23 g, 0.67 g, 0.6 g, and 0.67 g. Treatment F0 (control) is the formulation with the highest fat content. If you look at other formulations with a difference of less than 1 gram, they almost meet the Indonesian National Standard (SNI) quality requirements. The data shows that treatment F0 (control, without the addition of moringa leaves) compared to other treatments, F1, F2, and F3 (with the addition of moringa leaf flour) can reduce the fat content in the product (cookies). The fat content in cookies is influenced by the ingredients that make up the product, including shortening, shortening, egg yolk, powdered milk, chocolate chips, and milkfish flour. Moringa leaves contain protein (28.66), Zn (2.32), phosphorus (715.32), Fe content (11.41), and Ca (1014.81) (Irwan, 2020), so that the

leaf material moringa is rich in protein, not fat.

Protein is a building and regulating substance in the body. As a building block protein, it constantly forms new tissues in the body and maintains existing tissues (Setyawati et al., 2021). Proximate testing for the protein content of milkfish cookies was carried out with four treatments (F0, F1, F2, and F3) and three consecutive repetitions, namely 20.33, 20.57, 20.77, and 20.73. Quality requirements according to SNI 2973:2022 (biscuits), minimum protein content of at least 4.5% so that the resulting cookie product meets product quality requirements. Meanwhile, according to SNI 01-7111-2-2005 (MP-ASI biscuits), the minimum protein content is 6 gr/100 gr, so cookies meet the specified standards. Based on the test results of treatment F0 (control) compared with treatments F1, F2, and F3, it shows that the higher the proportion of milkfish flour and the lower the addition of Moringa oleifera leaf flour, the higher the protein content of the cookies. They have produced, while the F0 (control) treatment cookies only used wheat flour and milkfish meal with a protein content 20.33. This is because milkfish meals have high protein, around 56.60%. Therefore, the higher the milkfish substitute, the higher the protein content in MP-ASI biscuits. According to Husain et al. (2020), protein content is related to the fat content in fish. On average, fish with a low-fat content have a high amount of protein. High protein contains various amino acids; in milkfish, there are around 17 types of amino acids; the highest amino acid composition is glutamic acid at 1.386%, lysine at 0.674%, and leucine at 0.782% (Hafiludin, 2015).

Moringa leaves contain protein (28.66), Zn (2.32), phosphorus (715.32), Fe content (11.41), and Ca (1014.81) (Irwan, 2020), so with the addition of Moringa leaf flour in treatments F2 and F3 also affected the protein content in the cookies but the difference was not significant. According to research by Hermawan et al. (2023), Moringa leaf cookies were produced with a protein content of 10.622%. Compared with test data for milkfish cookies with the addition of Moringa leaves, the average protein content was 20.6%, so it can be seen that the addition of milkfish flour has a very significant effect compared to without the addition of milkfish flour. Protein amino acids are needed during the growth and maintenance of body cells and stimulation of brain cells. In babies and children, growth occurs gradually, as seen from body size, namely weight and height. Babies' Protein requirements should be high quality (Nurhidayati, 2011).

Carbohydrates are a source of energy for humans. The brain needs energy for the thinking process. Carbohydrates play a role in capturing and storing data in the brain's memory. Carbohydrate needs depend on the energy requirements (Aning & Kristianto, 2020). Carbohydrates are also energy-producing compounds or function as food reserves and provide a sweet taste to food (Siregar, 2014). The test showed that milkfish cookies were substituted with Moringa leaf flour with four treatments and three consecutive repetitions: 50.46, 50.5, 50.21, and 50.46. The carbohydrate content in this proximate test does not meet the SNI carbohydrate standard for MP-ASI biscuits, namely no more than 7.5-30 g/100 g. The test results data show that the treatment in F2 (150 g wheat flour formulation, 90 g milkfish flour, and 15 g Moringa leaf flour) showed the lowest carbohydrate content, namely 50.21. There were no significant differences between the four treatments. Indonesian Food Composition Data (2018) states that Moringa leaf flour contains high carbohydrate content, namely 38.20 g/100 g. According to Simanjuntak (2018), wheat flour has a relatively high carbohydrate content, namely 77.3 g from 100 g of wheat flour, and milkfish flour has a carbohydrate content of 18.86 g from 100 g (Sari et al., 2020).

Additionally, substituting Moringa leaf flour also affects the carbohydrate content of the product. According to research by Hidayah (2015), MP-ASI biscuits substituted for African catfish flour do not meet the standard of 57.85% but can be declared to have met the standard because there has been a partial replacement of carbohydrates with high protein and low carbohydrate sources. Carbohydrate testing is influenced by other nutritional content such as fat and protein. The more nutrition (fat content and protein content) increases, the more carbohydrate content will decrease, and vice versa. The lower the nutrition (fat and protein), the more carbohydrate content will increase.

CONCLUSION

Based study conducted results are The first is processing milkfish cookies with the addition of moringa leaves (moringa oleifera) through three stages, namely making milkfish flour. Making Moringa leaf flour, processing cookies. The second is based on the analysis of the results, the average water content of milkfish cookies, respectively F2, F3, F1, and F0 (control), is 4.82; 4.67, 4.53, 4.48. The average ash content results were 4.74; 4.99; 5.09; 5.1. The average result of fat content is 19.23; 18.67; 18.6; 18.67. The average protein content was 20.33; 20.57; 20.77; and 20.73. The average results of carbohydrate levels are as follows 50.46; 50.5; 50.21,

and 50.46. The nutritional content of cookies meets SNI 01-7111-2005 standards (complementary foods for breast milk (MP-ASI)), namely water content and protein content. Those that do not meet the requirements are ash, carbohydrate and fat levels. Meanwhile, the nutritional content of cookies in accordance with SNI 2973.2022 (biscuits) meets the quality requirements.

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