Analysis of the Nutritional Quality of Cookies with Various Food Commodities in Management of Malnutrition

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Abstract Fulfillment of needs can be done by seeking to use diverse sources of food, which is called food diversification. The process of diversifying food involves using resources in form of local food processed into intermediate products such as flour from food commodities like red beans, taro, catfish and forte. The resulting flours from these crops can in conjunction with some other food additives can be subsequently made into cookies. This study is an experimental study with a completely randomized design (CRD). This study was carried out in stages and it involved determining the proximate composition and sensory quality of the food ingredients utilized in this study for the production of cookies. Five different formulations (A, B, C, D and E), for the production of cookies was explored in this study, the sensory characteristics of the cookies from each formulation as well as the nutrient content was also determined. The results of the proximate composition for formulation indicated that it contains 23.5% carbohydrate, 23.5%, protein 57.3%, fat 58.04%, and energy 33.07%, still below the AKG requirement while the mineral content of calcium, zinc and iron (fe) was > 100% of the 2019 AKG requirement.

Keywords: cookies, nutritional, sensory, formula, food

1. Introduction

Various types of food are produced to increase the quantity and quality for the needs of society. Fulfillment of needs can be done by seeking the use of diverse food sources. The process of diversifying food should use resources in form of local food. For example, utilization of unpopular tubers and beans that are less desirable. These local food can be made in the form of snacks such as cookies, dry bread's, meatballs, wet noodles (meal), cakes and biscuits [1]. Cookies are a type of dry cake with a savory or sweet taste and crunchy with different shapes and sizes. The basic ingredients include flour, margarine, sugar and eggs which are mixed to form a dough and then baked in the oven at specific baking temperature and duration. Cookies can be produced from various food ingredients such as taro flour, red bean flour, catfish flour and forte. [2]

One of the food sources of energy for non-cereal starchy foods such as from tubers is taro (Colocasia esculenta (L) Schott)which can be used as an ingredient in the food industry to make flour and often used by the community as a snack ingredient's. [3] Taro flour can be an alternative ingredient to replace wheat flour in making cookies so that it can reduce the amount of imported wheat flour in the formulation. Taro has the potential to be used as raw material for flour because it has a high starch content of 70-80%. [4,5] based on laboratory examination, oven drying obtained 9.89% moisture content, 9.29% protein content, 0.8% fat content, 26.56% carbohydrate content, and 14.3% fiber content. [5]

Red bean's (Phaseolus vulgaris L.) is a potential source of vegetable protein as well as a relatively high source of energy. In year 2019, Indonesia had an annual production output of 61,520 tons. But what happens in society, red beans are often only consumed as a mixture of meat (rendang), snack food (es campur) and salads [6,7]. Red beans have a protein content of 22.3 g/100 g and 502 mg/100 g calcium. Red bean protein actually has essential amino acids of 76.16 mg/100 g. [7]

Catfish (Clarias gariepinus) is quite popular in the community including the black to gray jumbo catfish groups. The advantages are that it very tasty, rich in leucine and lysine and highly nutritious containing protein (17.7%), fat (4.8%), minerals (1.2%), and water (76%). [8] According to Nastiti 2019 catfish has a complete amino acid content and it is cheap. The nutritional content of catfish body meal/100 g has been reported to contain 9 g fat, 56g protein, 27g carbohydrates and providing 413 kcal of energy [9].

Tempe in general for the people of Indonesia, covered with white mycelium is relatively cheap. [10] Tempe

products can be varied by processing them into different formulations for different products for product diversification and improvement in nutrition suitable for infants, young children, adult population etc. The nutritional value in 100g of forte flour has a protein content of 21.7%, a fat content of 13.66%, a fiber content of 5.18%. [11]

2. Research Methods

2.1. Research Design

This study is an experimental study with a completely randomized design (CRD). In this study, it was carried out in stages starting from the manufacture of red bean flour, taro flour, catfish flour and tempe formula flour), analyzing sensory quality and proximate tests of various types of food ingredients with five (5) formulations (P1, P2, P3, P4 and P5), making cookies and testing the characteristics of the sensory properties of cookies and determining their nutritional content.

2.2. Production of Red Bean Flour

The red beans are sorted to get whole red beans, then the red beans are washed using potable water, after washing they are soaked for 24 hours in water, then washed with running water and drained, then boiled and dried in the dryer cabinet with a capacity of 10 kilograms as much as four drying pans at a temperature of 50oC for 1-2 hours, after drying they were ground into flour and sifted with a 100 mesh sieved.

2.3. Production of Taro Flour

Belitung taro tubers are sorted, peeled and washed with potable clean water, sliced (with a thickness of 0.20 cm), soaked in a solution of table salt with a ratio of 1:4 for 2 hours, washed with water, and then dry in a cabinet dryer and type tray dryer with acapacity of 5 kiligrams as many as six drying pans at 60°C, for ± 48 hours until dry with a water content of 12% then ground to a powder and sifted with a 100 Mesh sieve, then stored in a closed plastic container.

2.4. Manufacture of Catfish Flour

20 kilograms of catfish was washed in potable clean water and cleaned (head and only the entrails guts were removed) followed by soaking in lime juice for 30 minutes then on presto steamed for 30 minutes until tender and yellowish in colour. The steamed catfish was then drained after being placed on a baking sheet for 6 pans and dried in the last cabinet with a temperature of 60° for 6 hours. After drying it was ground to a powder and sifted with a 60 mesh sieve.

2.5. Production of Tempeh Flour

150 grams of tempeh was cut into small pieces into boiling water boiled for 10 minutes, drained, and crushed powdered sugar 40 grams of salt stirred until blended. The whole ingredients are mixed with 2,5 grams baking powder and 1 grams ovalette, stirred until it becomes a dough, placed on a baking sheet that has been greased with oil with a thickness of 1 cm. spred on a greased baking sheet, baked in the oven until cooked. 180°C and baking time for 20 minutes until cooked this is followed by dry dough then the dough is dried in the last cabinet as much as 3 drying pans at 60°C for 6 hours then ground into flour and sieved with a 100 mesh sieved.

2.6. Production of Cookies and Procedures for Making Cookies

The recipe for making cookies is done with some modifications. First of all, 80 g of powdered sugar, 35 g of margarine blueband cake, 20 g of butter blueband cake, 15 g of white dancow milk flour and 30 grams of egg yolk then stir were thoroughly blended using a Mixer for ± 5 to 10 minutes until smooth to obtain a dough followed by the addition of 35 grams of red bean flour, 15 grams of taro flour 40 grams of catfish flour and 10 grams of tempeh formula flour. Then add 15 grams of corn cornstarch Starch 1.4 grams of baking soda and 2.4 grams of salt then stir until it becomes a dough then mold the dough with a weight of 10 grams per piece then bake using a Hock oven at a temperature of approx. 100°C for 20 - 25 minutes

2.7. Organoleptic Characteristics

Based on the results of the acceptability of the cookies using the sensory test method using the hedonic scale on the texture, scent, taste and color components, it was found that treatment A was the most preferred with an average value of 3.63. Treatment A obtained based on the panelist test has a material composition consisting of35 grams of red bean flour, 15 grams of taro flour, 40 grams of catfish flour, and 10 grams of forte flour. For more details can be seen in Table 1.

Table 1. Recipe Cookies treatment A

Material name	Unit	gr
Red bean flour	gr	35
Taro flour	gr	15
Catfish flour	gr	40
Tempeh formula flour	gr	10
Milk Flour	gr	15
Sugar Flour	gr	80
Margarine	gr	35
Butter	gr	20
Baking powder	gr	1,4
Salt	gr	2,4
Egg yolk	gr	30
Cornstarch	gr	15

Source: Food Technology Laboratory, Department of Nutrition Polkesmed 2021.

2.8. Test the Content of Nutrients

The organoleptic results tested by the panelists chose treatment A then proceed with testing the content of nutrients, carbohydrates, protein, ash, calcium and energy with 3 repetitions A1, A2, and A3.can be seen in Table 2.

Table 2. Chemical Composition of Developed Cookies

Parameter Name	Unit	Deuteronomy 1	Deuteronomy 2	Deuteronomy 3	Average	% AKG
Water content	g/100g	4.62	5,21	4.84	4.89	0 %
Ash content	g/100g	3.48	3.41	3.5	3.46	0 %
Carbohydrate	g/100g	50.8	50.24	52.41	51,15	23.5 %
Proteins	g/100g	12.81	13.27	12.66	12.91	57.37 %
Fat	g/100g	28.28	27.85	26.59	27,57	58.04 %
energy	kcal/100g	509.00	504.75	499.59	504,44	33.07 %
Calcium	mg/Kg	2764.65	4074,11	4377,17	3738,64	453.16 %
zinc	mg/Kg	19.33	17,74	15.49	26,28	657 %
Fe	mg/Kg	15,19	12,24	14.55	13.81	162 %

Source: M Brio Laboratory Bogor 2021.

3. Discussion

3.1. Water Level

Water is one of the vital components in the manufacture of food products because it can affect the texture and taste of food. The water content in food ingredients contributes to the acceptability and freshness of these ingredients. [1] Based on the laboratory results, it can be seen that none of the five treatments met the cookie quality standards according to SNI.01-2973-2011 with a maximum moisture content of 5%. In research (Nurlita, 2017) states that the amount of water content in Cookies products will affect the texture and taste. the more air that is bound to the coarse fiber, the higher the water content in the cookies because the water which evaporates quickly during the drying process in the oven is free water that is not bound to the food matrix, while the air which is bound to the coarse fiber takes longer to evaporate from the material. There was still bound air in the cookies which ranged from 2.33-4.06%. [11]

3.2. Ash Content Level

Examination of the ash content test was carried out by the thermogravimetric method from the cookie sample treatment A with 3 repetition with an average of 3.46g of ash. The ash content is an inorganic residue after the material is burned at high temperature (deposited). Ash content has to do with the minerals of a material, this can be divided into two types of salts, like an organic salts, for example, mollic acid, oxalate acetate, pectic and inorganic salts, namely phosphate, carbonate and sulfate salts. The higher the ash content of cookie products, the better the product because the ash content will affect the stability level of cookies in Nurlita (2017). Ash in food shows the total minerals contained in the food. The contribution of the high ash content comes from red beans, tempeh formula and catfish. Based on the analysis of the ash content, it increased with increasing the ratio of red bean flour and decreasing the ratio of added taro starch. This was because red beans have a higher mineral content than taro [12]. The mineral content in 100 g of red beans contained of 0.5 g of calcium; phosphorus 0.43 g; 10.3 mg iron and 0.40 mg thiamine; while the mineral content in 100 g of sago starch was calcium 0.091 g; phosphorus 0.16 g ; iron 2.2 mg ; and thiamine 0.04 mg [13].

3.3. Carbohydrate Content

Examination of carbohydrate content with the different test from the sample cookies treatment A with 3 repetitions. An average of 51.15 g was obtained and contributed to 23.5% carbohydrate in the developed cookies for children aged less than five years. The carbohydrate content in cookies comes from taro flour, cornstarch, and sugar. Carbohydrate content of around 23.5% can contribute to meeting the needs of children under five, if the need for carbohydrates in the daily menu is also available [14]. Carbohydrates are macro nutrients that contribute to blood glucose levels. The process of carbohydrate metabolism will produce glucose as an energy source for stunted children's cells and body tissues to meet their nutritional needs as the main energy source, so that when the carbohydrate source is met, other sources of nutrients such as protein are not broken down into energy sources. The high contribution of carbohydrates to energy is thought to be caused by the composition of the formula which does not only use taro flour but also contains sugar, flour and corn starch which contributed to the total carbohydrate content [14].

3.4. Protein Content

Examination of the protein content test using the Kjedhal method from the cookies sample treatment A with 3 repetitions with an average strength of 12.91 g contributed 57.37% for the category of children under five. Most of the protein content will be denatured at a temperature of 55-77°C, cookies are made by roasting at a fairly high temperature, namely 150-160°C. The protein content in cookies comes from catfish, taro flour, and red beans. Protein is a food substance that is very important for the body, because this substance besides functioning as fuel in the body also functions as a building and regulatory substance. [11] According to Naura (2013) among vegetable products, red beans have a fairly large role in fulfilling protein. Stunted children need protein because it affects the regulation of the IGF-1 hormone and builds and maintains body tissues and strengthens the stunted child's immune system. The hormone IGF-1 which is increasing due to high protein intake will play a role in bone modeling and the acquisition of peak bone mass so that children under five are prevented from stunting [15]. With the protein content in cookies, these cookies can be used as an alternative and additional food even though

they have a relatively low protein content, but we can fulfill them by consuming other foods because their main function is as a building agent for the growth and maintenance of body tissues [16].

3.5. Fat Content

Examination of fat content was carried out using the Soxhlet method from samples of cookies treated A with 3 repetitions an average of 27.57 g contributing 58.0% for the categories of children under five.Fat in cookies comes from red beans, margarine, catfish, forte flour, butter, egg yolks and milk flour. Vegetarian community food ingredients such as soybeans, flaxseed seeds, pumpkin seeds, and others, are able to increase insulin action, reduce fat absorption and increased fat oxidation thereby reducing triglyceride accumulation through inhibition of adipogenesis which affects the action of fatty acid synthesis genes, namely: Sterol Regulatory Element Binding Proteins. [17] Fat is also a source of energy, where 1 g of fat produces 9 kcal/g. Fat also serves as a source of flavor and gives a soft texture to the product (Nurlita, 2017). Fat in stunted children is needed as a source of essential fatty acids needed for the growth of adipocytes and to prevent children from excessive inflammation when the child is sick, so fat is needed as a maintenance process for stunted children. [18]

3.6. Calcium Content

Examination of the calcium content test was carried out using the flame atomic absorption spectrometry method from the cookie sample treatment A with 3 repetitions to obtain an average3738.64 has a contribution of 453.16% for the category of children under five. Calcium is also needed information of bones and teeth and regulate biological processes in the body. Padmasuri (2015), states that the greatest need for calcium is during growth, also that calcium needs are still continued even though they have reached adulthood, in bone formation, when new bones are formed, old bones are destroyed simultaneously. Calcium in cookies comes from red beans, forte, catfish, and flour, milk and butter. Calcium is an important element that is needed by the body, because calcium functions in the body's metabolism, the formation of bones and teeth. Low calcium intake can lead to low mineralization of the new bone deposited matrix which affects osteoblast work, if low calcium can lead to the prevalence of stunting. [19]

3.7. Energy Content

Examination of the energy content test from the cookie sample treatment A with 3 repetitions was obtained an average of 504.44 g contributing 33.07% for the category of children under five. The amount of energy can be calculated by converting the chemical content (carbohydrate content, protein content, fat content) with the conversion factor of each ingredient. Carbohydrates and proteins each have a conversion of 4 kcal/g, while fat has a conversion factor of 9 kcal/g. Energy is needed by stunted children for the physiological processes of growth and development as well as energy unit processes needed by toddlers. Meeting the energy needs of toddlers will prevent the process of protein catabolism as an energy source [14].

3.8. Determination of Zinc Content in Developed Cookies

Examination of the zinc content was carried out using the flame atomic absorption spectrometry method [20] from the cookie sample treatment A with 3 repetitions to obtain an average of 26.28 gram which contributed 65.7% for the toddler category. Zinc is a mineral with great potential in preventing infections in toddlers because it is a modulator of T cells in the cellular immune system [21].

Research conducted in Tanzania by Syed et al. showed that zinc was able to increase pituitary secretion as a basic ingredient for growth hormone (growth hormone). Regulation of growth hormone to work optimally is usually also assisted by sufficient albumin levels available, especially during the growth and development period of toddlers.

The protector against stunting in children is the level of insulin-like growth factor - 1 (IGF – 1 and increases if albumin and zinc levels are sufficient so that growth becomes good [15].

Zinc acts as a cellular part in growth and development and also helps cell replication, such as DNA and RNA synthesis [19]. Fulfilling the need for zinc in children under five can prevent stunting [22]. The zinc content in the developed cookies came from catfish, forte, taro flour, and red beans. Low levels of zinc in the blood of children under five can affect growth, immune response, reduce brain function and slow wound healing. [15]

3.9. Determination of Iron Content in Developed Cookies

Fe content examination carried out by the method of flame atomic absorption spectrometry [23] from the cookie sample treatment A with 3 repetitions was obtainedaverage 13.81 gr contributed 162 % for the toddler category. The content of Fe in cookies comes from catfish, taro flour, forte and red beans. The effect of iron on baby's birth length is possible because iron is one of the minerals that has a direct effect on the formation of bone structure and metabolism. [24] if you consume cookies that contain > 100% of the 2019 RDA requirements, stunting in a toddler during his growth and development period can be minimized. Mineral iron (Fe) is a group of minerals needed as the core for the formation of hemoglobin as the main element in red blood cells. Part of the increase in Fe in the blood for the manufacture of Hb is met from iron reserves in the form of ferritin and can also be obtained from the absorption of Fe in the digestive tract. In consuming food sources of Fe, it is better to pay attention to the amount of iron contained in food while still paying attention to the quality of Fe as seen from its absorption power, its biological value, so that it can contribute to the adequacy of Fe for the body of children under five years of age so that they can contribute sufficient nutrients to their body. [25]

4. Conclusion

The results of the nutritional composition for formula A nutrients found that carbohydrate nutrients contributed 23.5%, protein 57.3%, fat 58.04%, and energy 33.07% which were still below the RDA requirement [26] Meanwhile, the nutritional content of calcium, zinc and iron (fe) is > 100% of the 2019 RDA requirement.

Acknowledgments

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