

ARTICLE

THE COMPOSITION OF NUTRITIOUS BISCUITS OF SWEET POTATO AND TEMPE FLOUR ENRICHED WITH VITAMIN A OF RED PALM OIL

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ABSTRACT

Background: One of the efforts to tackle the problem of malnutrition among children under five can be done through the processed variety of nutritious food available in the local area. **Methods:** This paper is based on an experimental research with a completely randomized design that aimed to develop biscuit mixture of sweet potato flour and tempeh (soy bean) flour enriched vitamin A of red palm oil, and to analyze the composition of its nutrients content. Development of biscuit consists of 3 treatments with variations in the composition of sweet potato flour and flour of tempeh. Research activities were carried out in the IKM Laboratory of Faculty of Public Health University of Sumatera Utara, analysis of nutrients carried in the Chem-mix Pratama Laboratory in Jogjakarta and PT Saraswanti Laboratory in Bogor. **Results:** The results obtained by nutrient composition of biscuit includes protein from 8.84 to 14.48%, fat from 27.70 to 30.64%, carbohydrates 42.70 to 51.53%, calcium from 0.29 to 0.35%, iron from 4.18 to 5.59 mg, zinc from 4.29 to 7.60 mg, beta carotene from 14.93 to 17.28 mg and folic acid 331.12 mcg. As many as 100 g biscuits can contribute protein of 34-55.8% of adequacy for children aged 1-3 years and amounted to 25.3-41.4% of adequacy for children aged 4-6 years. **Conclusions:** The content of protein, iron, zinc and beta carotene which were relatively high in biscuits, allowing it to be used as an alternative for overcoming the problem of PEM, iron deficiency anemia, zinc deficiency, and vitamin A deficiency in the various communities malnutrition.

INTRODUCTION

The high rate of the malnutrition problems in the society in Indonesia due to the lack of energy and protein and vitamin A deficiency of the children under five required an assessment in the form of a model of intervention. It seeks to improve the status of energy and protein while meeting the needs of vitamin A and other micronutrients. In 2006, it was found 11% children deficient in vitamins A. Many studies have linked the use of red palm oil for overcoming problems of children nutrition in society who are less vitamin A; among other snack food products made from modified cassava flour (mocaf) with the addition of red palm oil. Thus, red palm oil contains a lot of components in the form of provitamin A carotenoids, which comprises 54.4% of beta-carotene, alpha-carotene 36.2%, 3.3% gamma-carotene, lycopene xantofil 3.8% and 2.2% [1]. Carotenoids that are found in palm oil containing a high bioavailability, so that the provitamin A is easily absorbed by the digestive tract selmucosa [2].

Rice and Burns have made recommendations based on the evaluation of study results in Africa, Asia and Latin America that the red palm oil may be proposed for its use as a fortune in food products to address the problem of vitamin A deficiency in the at-risk populations [3]. The use of red palm oil and synthetic beta carotene in biscuits is equally effective in improving the vitamin A status of primary school children. In addition, red palm oil has the advantage of not containing Tran's fatty acids and rich sources of antioxidants that can serve as an excellent alternative fortificant to overcome vitamin A deficiency [4].

Additionally, sweet potato biscuit which is modified by catfish giving an effect to children under five in increasing intake of energy and protein as well as the improvement of the nutritional status. The sweet potato has a chemical composition which rich in carbohydrates, minerals and vitamins. Vitamin A in the sweet potato formed of provitamin A 7,000-SI / 100 g or two and a half times greater than the average human needs, especially the sweet potato tuber flesh-colored orange. Likewise, for vitamins B1, B6, niacin, and vitamin C are sufficient in number to the sweet potato. Sweet potatoes contain between 2.0 to 6.7% of sugar and amylose of 9.8 to 26%. The high sugar content gives a strong sweet taste, while amylopectin giving properties soft.

Cookies substitutions of soybean (*tempeh* in Indonesian) flour takes effects to the growth of children under five are malnourished. As it is known that tempeh is soybean product enriched by protein which easy to digest. Sweet potato, tempeh and red palm oil are food material that easy to obtain, have properties and nutritional composition that complete each other. So the writer is interested in to develop biscuit by using these material foods. It is a biscuit base that been known as a popular food and preferred by children and adult.

METHODS

An experimental research of biscuit development was conducted in a completely randomized design. It used the material of honey sweet potato and *tempeh*. The materials were purchased in two traditional markets (*Melati Market* and *Tanjung Rejo Market*) in Medan City. Those were then made into flour. Red palm oil was obtained from the oil palm Laboratory Studies Center of Medan City. The test of biscuit production used three (3) steps with the compositions as the following table below:

KEY WORDS
biscuit, sweet potato flour,
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Table 1: Composition of Biscuit Production

No.	Ingredient	Content
1.	Sweet potato flour	175 g;125g;75g
2.	Tempeh flour	175 g;125g;75g
3.	Palm oil	150g
4.	Wheat flour	200 g

Research activity was done in IKM Lab of Faculty of Health of North Sumatra University for about six (6) months, and the analysis of nutrients was done by sending the 250 gram of biscuit sample to two different Labs; Chem-mix Pratama Jogjakarta and PT. Saraswanti Bogor. The differences of three biscuits with and without red palm oil can be seen [as shown in Table 1 below]; biscuit C with potato flour composition 75g potatoes and *tempeh* flour 175g compared to the treatment biscuits (A & B) using fewer soybean flour and sweet potato flour. The sample of biscuit C was mixed with sweet potato and tempeh flour substituted by red palm oil. This method tried to offer an alternative food for children in society with many children were in the less nutrition and protein.

RESULT AND DISCUSSION

Based on the trial result development of sweet potatoes biscuits and *tempeh* substituted red palm oil and the organoleptic test with the panelists; students of Faculty of Health of University of North Sumatra Medan, Indonesia, the derived biscuits that have a characteristic brown color, aroma mixture of soybean and palm oil red, sweet and savory, and crisp texture. The three treatments showed the sampled biscuits have a good acceptance or costumers' preference.

The nutrient content of biscuit

Based on the examination results of laboratory that had been conducted at the Laboratory of Primary Chemix Jogjakarta and PT Saraswanti Bogor, obtained nutrient content were shown in [Table 1]. In [Table 1] we, can see the content of nutrients in general are most numerous in biscuits treatment C, namely biscuits with potato flour composition 75g potatoes and *tempeh* flour 175g compared to the treatment biscuits using fewer soybean flour and sweet potato flour more (A and B Treatment). The fiber content of food at the lowest biscuits at 12.42% (biscuits A) and the highest was 16.52% (biscuit C). The analysis also indicates that it contains inulin about 1.2 to 1.30%.

Table 2: Nutrient composition of sweet potato biscuits and tempeh substituted by red palm oil

No.	Nutrition	Sample Code		
		A	B	C
1	Water (%)	4,90	4,76	4,95
2	Protein (%)	8,84	12,48	14,48
3	Fat (%)	27,70	29,74	30,64
4	Carbohydrate (%)	51,53	47,22	42,70
5	Calcium (%)	0,29	0,32	0,35
6	Iron (mg/100g)	4,18	4,90	5,59
7	Zn (mg/100g)	4,29	6,02	7,60
8	Beta Carotene (mg/100g)	14,93	15,92	17,28
9	Vitamin B ₁₂ (ppb)	Tt	tt	Tt
10	Folic Acid mcg/100g	Tt	331,12	Tt
11	Inulin (%)	1,24	1,20	1,30
12	Dietary Fiber (%)	12,42	14,48	16,52

Water, Protein, Fat and Carbohydrate Ingredients on Biscuits

The content of protein in the biscuit was lower about 8.84% (biscuits A) and the highest was 14.48% (biscuit C). The fat content is contained in the biscuit was lower around 27.70% (biscuits A) and the highest was 30.64% (biscuit C). The carbohydrate content in the biscuit was lower approximately 42.70% (biscuit C) and the highest was 51.53% (biscuits A). The water found in biscuits is 4.76 to 4.95%. The comparison of composition of water, protein, fat and carbohydrates in the three types of biscuits depicted in the graph shown in [Fig. 1].

Based on the result analysis in [Fig. 1], it shows that protein content in biscuit C is highest than others. The protein content of 14.48% is expected to contribute to protein intake for infants and children, school children, pregnant women and nursing mothers. Every chip of biscuit has weight about 10 g, if every toddler consumes 10 chips of biscuit or 100g per day so the biscuit can contribute protein about 8,84-14,5 g or 34-55,8% Dietary Allowances of protein for children aged 1-3 years old and 25,3 - 41,4% Dietary Allowances of protein for children aged 4-6 years old.

A high protein in biscuit is contributed by *tempeh* flour; known as high protein, it is about 45,05%. Moreover, protein in *tempeh* is categorized as easy digested, so allowing it to be uses to support the growth process of children more optimal. Therefore, it is expected that biscuit mixed sweet potato and *tempeh* flour substituted by red palm oil can be one of alternative food for children in society who were less nutrition and protein. Besides has enough good quality protein, it also contains carbohydrate and fat in biscuit.

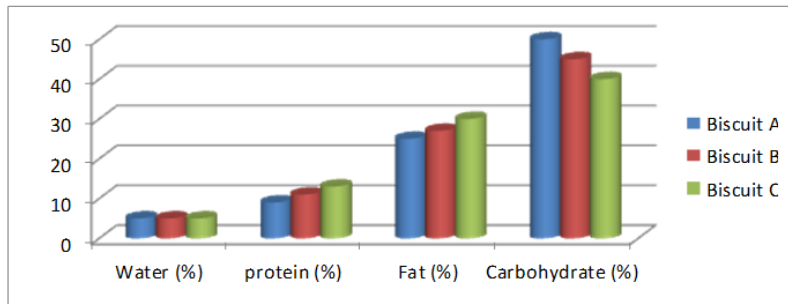


Fig. 1: The composition of water, protein, fat and carbohydrates in the sweet potato biscuits and flour were substituted *tempe* red palm oil.

The Content of Mineral and Vitamin in Biscuit

The content of micro nutrition include mineral is calcium (0,29-0,35%), iron (4,18-5,59 mg), zinc (4,29-7,60 mg) and vitamin; beta carotene (14,93-17,28 mg) and folic acid is about 331,12 mcg (biscuit B). Moreover, biscuit also contains around 1, 20-1, 30% of inuline. The composition of mineral and vitamin of the three of biscuit is shown in [Fig. 2] and [Fig.3].

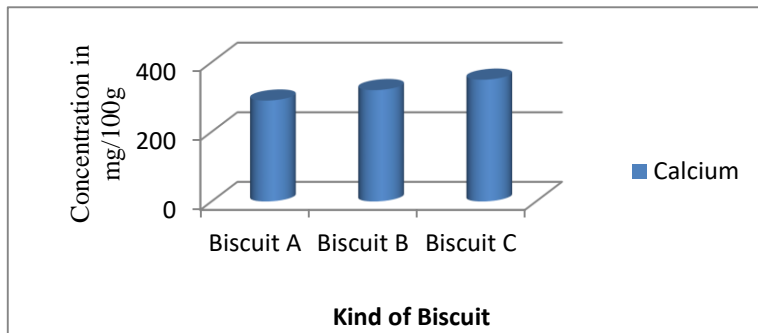


Fig. 2: The content of calcium biscuits

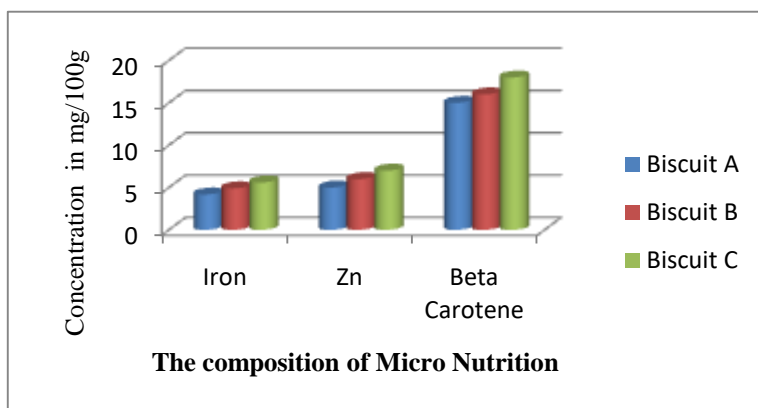


Fig. 3: The content of iron, zinc and beta carotene in biscuits.

Based on a test analysis, the content of calcium biscuit on [Fig. 2], it is found that the content of calcium in biscuit C is the highest one, that is 350 mg and the lowest is in biscuit A; 290 mg, while biscuit B is 320 mg. If it was assumed, toddler consumed 10 chips of biscuit or 100g/day, so they would get 53,8% of calcium and 35% each for children aged 1-3 and 4-6 years old.

The content of iron in biscuit A is about 4,18 mg, biscuit B is 4,90 mg and biscuit C is 5,59 mg. If it was assumed, toddler consumes 100g of biscuit so they would get minimal 59,7% of each iron and 52,3% of Dietary Allowances and maximal 79,9% and 69,9%. Based on the content of zinc in biscuits A,B and C is

about 4,29mg, 6,02mg and 7,60mg., So it is accounted the contribution of Dietary Allowances of iron is minimally 100,07% (children aged 1-3 years old) and 152,00% (children aged 4-6 years old).

Similarly, with the analysis result of the content of beta-carotene is quite high in biscuit, which is 14,93mg to 17,28mg. Based on the calculation result, if children consume 100g of biscuit, the contribution of vitamin A in biscuit is 37 - 43,2 times of Dietary Allowances of vitamin A for children aged 1-3 years old and 33,2 - 38,4 for children aged 4-6. If a nursing mother consumes 100g of biscuit, it is predicted that vitamin A contribute 17,6 - 20,33 times of Dietary Allowances. It is only for pregnant women should be considered because a high vitamin A may cause a fetal damage.

Marjan et al. suggested that the red palm oil can be used as a source of beta-carotene and antioxidant substances, so its substitution on food products can be a functional high functional antioxidant food alternative in preventing atherosclerosis [5]. According to Zeba et al, red palm oil which is given in Regular small amounts are very effective in lowering the problem of vitamin A deficiency, and may be considered for use as a dietary vitamin A supplement [6].

The composition of folic acid is only detected in biscuit B that is 331,12mcg. If see the number, biscuit A and C also contribute folic acid because it uses the same materials, just the proportion is different. The content of folic acid is 331,12mcg in 100g of biscuit, it means that if it is consumed 100g of biscuit/day so it contributed 2, 21 times of Dietary Allowances of folic acid for children aged 1-3 years old, 1, 7 for children aged 4-6, 0,6 for pregnant women and 0,7 for nursing mother.

The inulin in biscuit is expected to be as prebiotic which has several functions in digestion, such as prevent indigestion and help improve mineral absorption in the gastrointestinal tract. The component of dietary fiber contained in biscuit is also important in help the function of digestion in the process of spending the rest of food is not absorbed in the digestive tract.

The Content of Amino Acid in Biscuits

Based on the result of lab analysis, it showed 18 kinds of the content of amino acid in biscuits; 10 kinds of essential amino acid and 8 kinds of non-essential amino acid. The composition of amino acid in the three biscuits is shown in the [Table 2]. The graphical description of amino acid composition in biscuit is shown in Fig. 4 and 5.

Table 3: The Composition of Amino Acid in the Biscuit of Sweet Potato and Tempeh Flour Substituted by Red Palm Oil

NO	The Composition of Amino Acid (mg/100g)	Sample Code		
		A	B	C
1	Histidin	297,69	422,35	462,78
2	Treonin	584,51	780,29	864,52
3	Prolin	743,94	930,78	1010,99
4	Tyrosine	410,22	555,26	585,63
5	Leusin	955,22	1251,36	1454,18
6	Aspartat acid	1015,03	1334,10	1548,63
7	Lisin HCl	508,44	744,91	944,25
8	Glisin	456,99	603,59	711,94
9	Arginin	605,86	871,80	1016,88
10	Alanin	487,57	636,76	732,53
11	Valin	530,19	704,69	801,01
12	Isoleusin	518,98	688,54	810,96
13	Fenil alanin	703,84	960,69	1005,90
14	Glutamate acid	2716,63	3368,61	3790,82
15	Serin	753,52	971,91	1090,68
16	Metionin	170,23	188,92	250,19
17	Sistin	44,61	60,86	64,29
18	Tryptophan	99,62	129,41	134,26

In [Table 2], the composition of amino acid in biscuit is categorized as complete composition, because it contains all of kind of essential amino acid that needed by body. In [Fig. 4] shows that the content of glutamate acid is the highest composition among another amino acid, then followed with the composition of aspartic acid and leucine.

As it is known that the role of amino acid is very important in supporting the process of growth and development of children especially in toddler year which relatively needs essential amino acid in sufficient quantities so that the growth and development of children is optimal. Toddler year is an important moment includes the process of physical growth especially to prevent stunting and brain growth which is influenced to brain development and the intelligence of children.

[Fig. 5] shows that 10 kinds of essential amino acid in sweet potato biscuit and tempeh flour substituted by red palm oil, leusine is the highest composition, and then continued by arginine, fenile alanine and the last is tryptophan which is the lowest composition.

Glutamine is the highest component of amino acid in biscuit. Glutamine of amino acid in baby's food has a role as immunity booster and increasing the length of children [7]. The component of glutamine naturally exists in tempeh flour which has properties in food taste that make delicious.

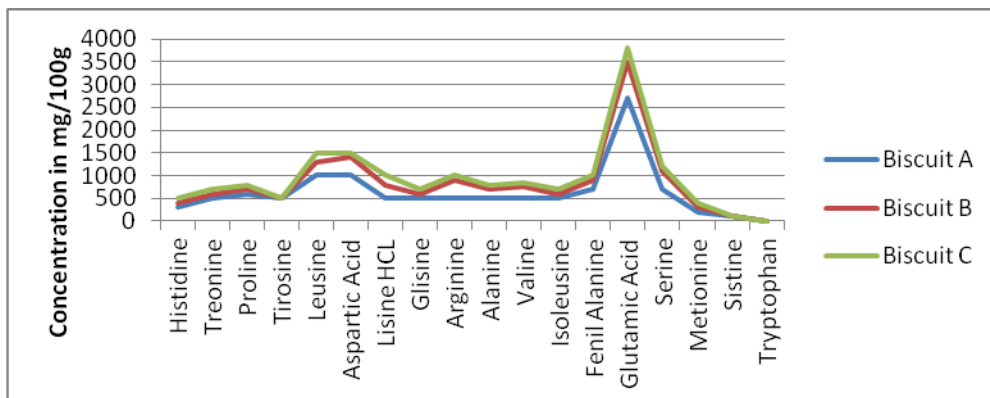


Fig. 4: The Composition of Amino Acid in Sweet Potato Biscuit and Tempeh Flour Substituted by Red Palm Oil.

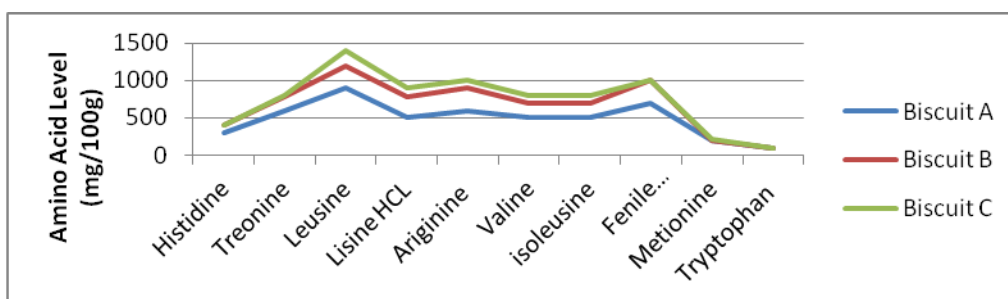


Fig 5: The Composition of Essential Amino Acid in Sweet Potato Biscuit and Tempeh Flour Substituted by Red Palm Oil.

Thus, development of biscuit using sweet potato flour and tempeh flour and substituting red palm oil is expected to continue for the further applied research, especially in overcoming the problem of lack of energy protein (LEP) and the problem of micronutrient deficiencies such as iron anemia, zinc deficiency and a problem of lack of vitamin A on different groups of vulnerable people.

CONCLUSION

Based on the results of research, so it concludes that:

1. Biscuit sweet potato and tempeh flour substituted by red palm oil have better nutrition composition; it has the content about 8,84 - 14,48% of protein, 27,70 - 30,64% of fat, 42,70 - 51,53% of carbohydrate, 0,29 - 0,35% of calcium, 4,18 - 5,59mg of iron, 4,29 - 7,60mg of zinc, 14,93 - 17,28mg of beta carotene, 331,12mcg of folic acid.
2. Biscuit sweet potato and tempeh flour substituted by red palm oil can contribute approximately 34 - 55, 8% of protein of Dietary Allowances for children aged 1-3 years old and 25, 3 - 41, 4% for children aged 4-6 years old.
3. A high protein, iron, zinc and beta carotene in biscuit probably can be used as an alternative way to tackle the problems of lack of energy protein and micronutrient deficiencies such as iron anemia, zinc deficiency and a problem of lack of vitamin A on different groups of vulnerable people.

SUGESTION

The result of this research is expected can be used for an intervening activity in the field concerning with the problems of Lack of Energy Protein (LEP), iron anemia, zinc deficiency and lack of vitamin A.

CONFLICT OF INTEREST

There is no conflict of interest.

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