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Yellow Corn Biscuits for Early Childhood: High Energy and Beta-carotene

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Abstract

Snacks which are most widely consumed by early childhood are biscuits. The conventional raw ingredients of biscuits are varied with yellow corn starch, which contains beta-carotene. The composition of yellow corn biscuit consists of 50% yellow corn starch, 40% wheat flour, and 10% cornstarch, and butter. The use of butter was varied in 25%, 30%, and 35%. An analysis was conducted on its energy content, protein, fat, and beta-carotene, as well as acceptance. The results of the study showed nutrient content was not entirely different from the use of margarine 25% and 35%, the energy was 441-468 kcal, protein was 6.4 to 7.3%, fat was 18.3 to 21.7%, and beta-carotene 2,721 -4,134 µg. The energy density of corn biscuits was 3.5 - 3.9 g / 1000 kJ. Yellow corn biscuits were considered as high-energy biscuits (> 400 kcal). The organoleptic test of the biscuits in early childhood conducted on all indicators (color, aroma corn, fragrant aroma, and crispness, sweet and savory taste) showed that the biscuits were categorized as likable. The use of different percentage of margarine is not significant concerning the acceptability of biscuits, except for the aspect of the fragrance and sweetness between the use of margarine 30% to 35%. Industrial-scale production is necessary for the dissemination of the consumption of yellow corn biscuits with margarine 35%, in particular for the early childhood

INTRODUCTION

The condition of children under five in Indonesia is currently in an epidemiological situation. A total of 19.6% are malnourished, 12.1% are underweight prevalence, while the condition of high nutrition is also quite high, 11.9% (Menteri Kesehatan RI, 2013). According to the WHO, a public health problem is considered serious when the prevalence of underweight is between 10.0 to 14.0 percent and is seen as critical when the prevalence was ≥15,0 percent (WHO, 2010). Therefore, Indonesia's 12,1% underweight prevalence shows that the health problem of children under five in Indonesia is categorized as serious. Consequently, this issue is urgent to overcome. Early childhood belong to the group of children under five, who are in the golden period of growth. They require high-quality food. To meet their nutritional needs, children under five require the main meal (3 times daily) and snack foods (2 -3 times a day).

The type of snack which is mostly consumed after milk is a biscuit (Fathonah et al., 2014). Biscuit is a food product produced by baking the dough from wheat starch with or without the use of other food ingredients and permitted food additives (Departemen Perindustrian, 1992). Varying raw ingredients of biscuits is necessary to vary the flavor and aroma are different, one of them with yellow corn flour. Excess yellow corn flour, among others, have a low glycemic index of 48 (Drummond & Brefere, 2004), containing carotenes a high of 641 µg , and contains high fiber 2.2 g (Persatuan Ahli Gizi Indonesia, 2009). Corn has a wealth of active functional food ingredients, such as

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fiber (dietary fiber), the composition of carbohydrates, anti-oxidants and minerals that are not owned Fe sorghum and wheat (Suarni & Hasyim, 2011).

As observed in many previous studies, reducing the fat content or replacing fat with other ingredients has a considerable impact on the texture attributes of biscuits (Zoulias et al. 2002; Rodríguez-García et al. 2012). Chevallier et al., (2000) concluded that biscuit structure is a composite matrix of protein aggregates, lipids, and sugars, embedding starch granules. Fat plays an important role by imparting shortness, richness, and tenderness, thereby improving the eating quality of the product. Type of fat used in the preparation of biscuits determines the quality of the end product (Jissy & Leelavathi, 2007). This study examined the effect of the use of lipid (butter) in nutrient content and acceptance of the biscuits on Early childhood In the production of biscuits, butter serves has shortening function which makes biscuits become crispier and crumb (Lean. 2013; Gallagher et.al, 2005). The use of margarine is still lower than the 40% standard recipe (Gallagher et al., 2005).

The purpose of this study are to figure out the effect of differences in the use of margarine on energy content, protein, fat and beta-carotene in yellow corn starch biscuits, and to determine the effect of the difference in the use of margarine on the acceptance of biscuits on early childhood

MATERIALS AND METHODS

The Ingredients of the Biscuits

The composition of ingredients of the biscuits in this study is 50% yellow corn flour, 40% wheat flour and maize flour 10%. The difference in the use of margarine is as follows 25%, 30%, and 35% from the amount of flour. Other supporting ingredients are refined sugar, egg yolks, and baking powder. The composition of yellow corn biscuits ingredients is presented in Table 1.

The Process of Making the Biscuits

The process of making yellow corn flour was conducted in the following steps: the grains of yellow corn were loosened then washed, soaked for one day and then washed back and taken the husk; washed back to the net and drying it in the sun for ± 2 days until completely dry; yellow corn milled until smooth, done up to 3 times until the texture of the flour milling process really smooth, filtered through 80 mesh size; the biscuit-making process through the following steps; margarine was mixed with powdered sugar with hand- mixer for about 3 minutes until it was well blended; add the egg yolk and mix with a hand - mixer for 2 minutes until it was well–blended; mix the yellow corn flour, wheat flour, maize flour, powdered milk and baking powder with hand–mixer for 1 minute until it was blended; roll the dough with until it was 3 millimeters thick and then cut it with a biscuit cutter; arrange the cut dough on a baking dish and put into an oven for 15 minutes at a temperature of 170° C; then cool it for 7 minutes; and pack with hermetic packaging.

Table 1. The ingredient of Yellow Corn Biscuits

Ingredients	Margarine Usage		
	25 %	**30 %**	**35 %**
Corn flour (g)	250	250	250
Wheat Flour (g)	200	200	200
Maize Flour (g)	50	50	50
Margarine (g)	**125**	**150**	**175**
Sugar Powder (g)	200	200	200
Milk Powder (g)	25	25	25
Egg yolk (g)	170	170	170
Baking powder (g)	0.5	0.5	0.5

Analysis

The energy, protein, lipid and beta-carotene were determined by the method Described by the Association of Official Analytical Chemists (AOAC) 1990. Organoleptic evaluation, consumer sensory panels were selected from early childhood to evaluate the biscuits According to Reviews their likeness, using 5-points hedonic scale, in which 5 indicates like very much, and 1 indicates dislike (Setyaningsih et al.., 2010).

ANOVA analysis was conducted using SPSS software version 23 to determine the effects of the use of margarine on nutrient content and acceptability of biscuits.

RESULTS AND DISCUSSION

Yellow corn biscuits corn must have criteria for a good biscuit. The main criteria are crunchy texture. The color of the biscuit depends on starch as the primary ingredient, which is a golden yellow, but rather dull.

Snack is categorized as high-energy when the energy content is 20% or more than the Daily Value. Daily values are a set of nutrient intake

Table 2. Nutritional Content of Yellow Corn Biscuits

Nutrient	Margarine Usage			SNI 01-2973 -1992
	25 %	30 %	35 %	
Energy (kcal)	441 ± 0.71[a]	456 ± 0.71[b]	468± 2.12[c]	Min 400
Protein (g)	7.3 ± 0.00[a]	6.5 ± 0.07[b]	6.4 ± 0.07[b]	Min 9.0
Lipid (g)	18.2 ± 0.14[a]	20.3± 0.07[b]	21.7 ± 0.14[c]	Min 9.5
Betacarotene (μg)	2.721 ± 19.80[a]	3.278 ± 9.90[b]	4.134 ± 9.90[c]	Tad
Energy density (g/1000 kJ)	4.00 ± 0.00[a]	3.45 ± 0.07[b]	3.30 ± 0.00[b]	Tad

(a) (b) (c)

Figure 1. Yellow corn biscuits with the variation on the use of margarine (a) 25 %, (b) 30 %, dan c) 35 %.

value that is used as a reference for expressing nutrient content on nutrition labels. The daily value for certain nutrients at both the 2,000-calorie and 2500-calorie levels (Drummond & Brefere, 2004). When referring to 2,000 kcal, biscuits can be considered as high – energy if it contains 400 kcal. According to the table-2 is known energy content of yellow corn biscuits between 441-468 kcal. Therefore, it can be categorized as high-energy. High energy biscuits are also produced by using green peanuts with energy content of 402 -453 kcal (Fathonah & Muvida, 2015) and purple sweet patato with energy content of 490 - 515 kcal (Fathonah & Sari, 2015). The high energy content suits the need for children under five requiring highly nutritious foods, including energy.

The expanded list of serving size for the food guide pyramid states that four small cookies (Drummond & Brefere, 2004). The cookies had a weight of 5 g, and one serving size means 20 g. One serving size contains the energy as much as 20 / 100 x 441 kcal = 88 kcal.

Similarly, other nutrients have met ISO standards, except for protein content which has not fulfilled ISO standards. The protein content of these biscuits was lower when compared with the nutrient content of 80% peeled corn biscuits with the addition of 10% sugar whose protein content is 12.92%, crude fiber content is 3.2%, and the content of beta-carotene is 1,739 ppm (Arisanto, 2014).

Based on ANOVA test, the use of margarine provided significant differences in energy content, protein, fat and beta-carotene, except for protein content. The use of 25% margarine and 30% margarine did not have a significant effect on the protein content because the margarine contains 720 kcal / 100 g, fat 81.6 g / 100 g and retinol 606 ug / 100 g. Meanwhile, the protein content which is 0.6 g / 100 g is categorized as quite small (Persatuan Ahli Gizi Indonesia, 2009)

The total fat of this yellow corn biscuit was 18.2 - 21.7% which is still within reasonable limits when compared biscuits in the market. The results of the study of 12 kinds of biscuits in Pakistan showed that a fat content varied from 13.7 to 27.6% (Kandhro, 2008). The results of analysis of 46 samples biscuit sold in Indian market showed that the total fat content ranged from 9.5 to 25.0 g / 100 g of biscuits (Kala. 2014). The total fat contents of the six types of biscuit samples produced by four different Turkish manufacture ranged between 8.5% and 26.0% (Daglioglu et al., 2000). High-fat content is very good when consumed by children under five who still requires a high fat content to support their growth and immunity. It is important to note that biscuits containing high-fat content have more limited storage span. Filipčev et al., (2014) confirms that higher fat content has an effect in maintaining the flavor during storage.

The content of beta-carotene is quite high on corn biscuits which are between 2721-4134 μg. 1 μg retinol = 6 μg beta-carotene (Almatsier, 2003). When converted to retinol, the beta – carotene content is equal to 453.5 - 689 μg retinol. The needs for vitamin A for children under five is 400 μg retinol (Menteri Kesehatan RI, 2013). The consumption of 100 g of this yellow corn biscuits was able to meet the needs of vitamin A per day. It shows that yellow corn biscuits can be considered as a functional food as a source of vitamin A. Beta-carotene is one of the carotenoids which possesses antioxidant functions. Beta-carotene helps to protect the nutrients which are easily oxidized, such as PUFAs from oxidation and can

Table 3. The Results of Organoleptic Test of Yellow Corn Biscuits

Sensory Aspects	Margarine Usage		
	25%	30%	35%
Color	3.68 ± 1.29[a]	3.66± 0.99[a]	3.78± 1.12 [a]
Corn Flavour	3.78 ± 1.15[a]	3.60 ± 1.12[a]	3.69 ± 1.19[a]
Fragrant Flavour	3.68 ± 1.06[a]	3.81 ± 0,94[a]	4.13 ± 0.93[b]
Crispness	3.66 ± 1.20[a]	3.73 ± 1.00[a]	3.99 ± 1.02[a]
Sweetness	3.50 ± 1.31[a]	3.86 ± 1.00[a]	3.95 ± 1.16[b]
Tastiness	3.75 ± 1.19[a]	3.88 ± 1.02[a]	4.05 ± 0.87[a]
Overall	3.67 ± 0.78[a]	3.77 ± 0.49[a]	3.91 ± 0.53[b]
Criteria	Like	Like	Like

resist the harmful effects of free radicals in the body (Lean, 2013).

The very high content of beta-carotene is required to support vitamin A deficiency which still occurs in children under five in Indonesia. Research in 2013 showed that the figure of corneal opacities prevalence nationally was 5.5% with the highest prevalence found in Bali (11.0%), followed by DI Yogyakarta (10.2%) and South Sulawesi (9.4%). The prevalence of corneal opacities in children under five years of 0.8% (Menteri Kesehatan RI, 2013).

The energy density is high enough yellow corn biscuits between 3.5 - 3.9. The energy density is getting smaller with a higher fat usage. The high energy density is very good to be consumed by children under five " have a limited digestive capacity (More, 2014). A small portion of yellow corn biscuit consumption has been able to meet their nutritional needs of Early childhood.

The results of the organoleptic test of the yellow corn biscuits in children under five showed that the use margarine on the biscuits with 50% yellow corn had better acceptance rate, except in the aspect of maize scent (Table 3). It shows that margarine had positive effects to enhance the organoleptic qualities of the biscuits. Margarine has a plastic trait so that it can be easily mixed with biscuit dough and inflate well when mixed resulting in a crunchy texture. Fat makes food more delicious (Ferreira et al., 2015). The overall consumer acceptance was significantly higher ($p < 0.05$) in the shortening (oil-water-emulsion cellulose ether) biscuits. However, their scores were very similar to those of the cellulose (maximum difference 1.1 / 9 points).

The results of the study biscuits which are composed of 100% cassava starch were more acceptable and favorable compared to the wheat biscuits (Akingbala et al., 2011). The use of SF flour with the 50% composition resulted in high quality. Meanwhile, the 5-10% substitution of Reb Ibi Ngaoundre (RIB) were either acceptable as or better than 100% wheat biscuit (Himeda et al., 2014).

Peeled corn starch (yellowish white) and wheat starch (white) do not have an impact on the color of the biscuit which is brownish yellow / gold. The color is the result of sugar reaction which causes non-enzymatic browning. During the baking process, sugar has an effect on flavor, dimensions, color, hardness, and surface of the biscuits (Gallagher et al., 2005). More vivid biscuit surface color with yellow tone Increased probably due to a formation of products of Maillard reactions (Kulp et al., 1991; Filipčev et al., 2014).

The reaction between sugars and fats which cause the scent is evident in the use of 25% and 30% fat. It is different with the biscuit with 35% margarine. The use of 35% margarine provides more fragrant aroma which eraly childhood like.

The use of margarine does not have a significant impact on the acceptability aspects of its crispy texture and a savory taste in yellow corn biscuit. However, the mean value of the acceptability is better with the use of more margarine. It occurs because the function of margarine as a shortening fat which increases the crunchy texture of biscuits (Lean, 2013). The use of margarine produces biscuit with crispier texture because the function of margarine is to soften the texture of biscuits and it makes biscuit crumbs with high quality (Gallagher et al., 2005; O'Brien et al., 2003). Margarine serves as a shortener. The fat covers the starch and gluten from the flour with a thin layer of grease. Therefore, it breaks the structure and prevents the formation of hard mass. It causes the biscuits had soft and short crumbs. The greater the proportion of fat in the mixture, the greater the shortening effect (Ferreira et al., 2015). In accordance with the study on the use of 50% peanut butter, the overall sensory quality of experimental biscuits is improved when 50%

vanaspati (hydrogenated fat) is replaced by peanut butter in the standard biscuits recipe. The biscuits are prepared with 50% supplementation of peanut butter had a greater acceptability by sensory evaluation panel (Gajera et al., 2010). Biscuits with composite flour (cereals, legumes, millets, soy protein isolate, a dairy ingredient and fruit without refined flour) with sprouted flour had higher acceptability and were more superior to refined-flour biscuits (Murugkar, 2015). Another study using plantain and chickpea starch up to 20% provide sensory quality similar to a biscuit with 100% raw ingredients of flour (Yadav et al., 2012). Biscuits enriched with sorghum (30-50%) have the higher quality of sensory, softness and crispiness compared with controls (100% wheat starch) but lower than the biscuits substitution with rye starch (black wheat flour) (30-50%) (Filipcev et al., 2011).

CONCLUSION

Corn biscuits in the high energy category of 441-468 kcal, protein was 6.4 to 7.3%, fat was 18.3 to 21.7%. The content of betacarotene 2,721 -4,134 µg. Early child acceptance on all category indicators are likable. Corn biscuits are good for early childhood consumption in support of growth

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