Research Article

Nutritional value in traditional snack food for elementary school children made from a mixture of maize and tempeh flours

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Abstract

Blended food is a base food that is formulated from several ingredients to increase quantity and quality of the nutritional content. The aim of the research was to develop a blended food from local ingredients (maize and tempeh) to be used in a supplementary feeding program for children in order to increase their nutritional status. The objectives were to find the acceptable maximal proportion of tempeh flour that could substitute maize flour and to determine the nutritional content of the product and the acceptability. The study used conventional procedures in making blended flour from maize and tempeh into snack food (cookies). Snack food (cookies) was made from this blended flour by adding fat, eggs and milk. The study results are presented by descriptive quantitative method.

Research showed that the best nutritional content was in the formula of maize-tempeh flour (70:30). Carbohydrates were around 62 gram, protein 20 and fat 8 gram per 100 gram formula. Total calories were around 400 kcal/100 gram blended flour. Crude fibre content was less than 2%. The nutritional content increases to more than 500 kcal/100 gram cookies as a result of additional fat. From the cookies produced, carbohydrate content was 45.78 gram, fats 30.15 gram and protein 14.61 gram. From the organoleptic test it was found that average panelists (children) quite liked the product by giving a score between 3 – 3.5 for colour, flavour and texture. However, for taste, most of the panelists did not like the formula by giving score 2.1-2.1 on 1 to 5 scale.

Keywords: Blended food, supplementary feeding, child nutrition, snack food, Indonesia.

Introduction

One of the strategic efforts in order to improve nutrition of children is through the provision of supplementary food. Children aged 6 - 12 months are given MP-ASI (complementary food for breastfed infant) in the form of food ingredient mixture with the optimum formulation to obtain

certain nutrients. For school-age children promotions are undertaken through PMT-AS (additional feeding school children). The supplementary food for both programs is made from local ingredients which are fortified with vitamins and minerals. The program is particularly designed to address nutritional problems in districts of Indonesia with a high prevalence of moderate and severe malnutrition, especially in rural areas. The programs have some limitations, particularly the continuity, physical and nutritional quality of food which relies on the availability on local raw materials as well as the sustainability of the program.

Corn is one potential local food product that is used as a source of carbohydrate. In addition to its abundant availability, and so far only used as fodder, it also has valuable nutrient content comparable to traditional food sources of carbohydrates such as wheat and rice. Lack of protein and micro components can be mitigated by the substitution of other local food such as tempeh.

Tempeh is a fermented product, which has a high nutritional quality with the availability of both macro and micro nutrient components and it is easy for the body to utilize these nutrients (bioavailability). Research has shown that food with tempeh formulation may cure chronic diarrhea in patients with poor nutrition and malnutrition. Besides those affects, food with tempeh formulation may increase weight loss due to high protein content than other grains, as well raising the hemoglobin concentration due to Fe content availability and other bioactive components which are available in tempeh [1].

Therefore, substitution will be examined on corn meal soybean meal as a food ingredient mixture (BMC) for children under five. It is expected that this research will obtain the optimal mixture of BMC formulas and various forms of BMC products such as cakes and cookies. This product was recommended to be used as complementary breastfeeding and supplementary food for infants and school children and can be produced commercially.

Materials and Methods

Materials
Yellow corn (*Zea mays* L. ssp) and tempeh (*soyfood*) were used for production of instant corn flour (maize) and tempeh flour. The ingredients were bought from the same shop in the local market to minimize the variation of consistency, microbial contamination.

Methods
Product Formulation
Production of instant corn flour (maize).
Raw materials were chosen from parboiled and partially de-hulled yellow corn. Yellow corn were then washed and soaked for 24 hours. After soaking, the corn was drained and ground with an electric grinding machine which was available from the laboratory to make corn flour (maize). The corn flour (maize) was then sifted using an 80-mesh sieve then boiled to form slurry; characterized by the consistency of the dough. Following this, the dough (porridge) was cooled down until 20^0C then packaged in a plastic bag, put into freezer -20°C temperature. After being frozen for 24 hours, the corn flour (maize) package was thawed with running cold water and then dried at 60-70°C temperature in an oven for 3 hours. The corn flour (maize) was then sieved using 80 mesh sieves.

Production of instant tempeh flour.
Fresh tempe bought from local market was cut and blanched with 100°C water for 10 minutes, removed, drained, settled at room temperature for 10 minutes, then wrapped in plastic. Tempe were packed frozen in a freezer at -20°C temperature for approximately 48 hours, then thawed for 30 minutes with running cold water, then dried in a oven at a temperature of 60-70°C for 8 hours.

Dried tempeh was then ground with an electric grinder from the lab and then sieved using 80 mesh sieves.

Research matrix
The treatments were done by mixing instant corn flour (maize) and tempeh flour with 3 matrixes. The matrixes were the combination mixture of yellow corn flour (maize): tempeh flour was: 90:10; 80:20; and 70:30. Only the most preferable of those combination mixtures was selected to make the cookies.

Biochemical parameters
In this study, nutrients have been determined on dry weight basis. Estimations for following biochemical parameters have been carried out:

Proximate composition
Moisture content was estimated by the standard method of AOAC [2]. Fat, total nitrogen and crude protein (N · 6.25) contents [3], ash and crude fibre contents of corn and tempeh mixture were estimated following the method of *Sudarmadji, et. al. (1996).* Total carbohydrates and energy contents were calculated by the formula given in Winarno [4].

Sensory evaluation
For the assessment of acceptability, all samples were selected except the control raw sample. A 5-point hedonic scale test was performed to measure the degree of likeness or dislike for different corn and tempeh flour samples, which were rated on a scale ranging from 'like extremely' to 'dislike extremely' [5]. Composite scoring test was carried out to determine acceptability of various quality attributes, such as colour, taste, texture, flavour and acceptability of cookies made from corn samples separately.

Quantitative descriptive analysis (QDA)
A panel of 50 school students of 5th grade was trained in the process of sensory analysis. A questionnaire was developed. Reliability of these students in the use of questionnaire was evaluated by presenting several food items twice. The process took 4 weeks.

Results and Discussion

Nutritional content
The selection of the tempeh flour and corn flour (maize) combination was conducted to see suitable nutrition needed in order to formulate cookies to increase nutritional intake of elementary students. Table 1 shows the variety of nutritional content of each mixture. Based on the highest percentage of carbohydrate, fats, protein and crude fibre, the mixture of maize and tempeh flour (70:30) combination was selected to formulate into cookies.

Table 1. Nutrient value found in tempeh and corn (maize) instant flour.

Mixture of tempeh and corn (maize) instant flour	Carbohydrate %	Fat %	Protein%	Crude fibre %
100 : 0	84.32	0.74	7.19	0.57
90 : 10	79.16	2.765	10.425	0.965
80 : 20	74.846	5.155	12.915	1.595
70 : 30	66.836	7.64	19.21	1.73

Sensory evaluation
Evaluation of instant flour combination (maize and tempeh flour)
A panel of ten judges was selected from triangle test who were well acquainted with organoleptic qualities of flour. Samples were prepared in a-100 gram package after making into instant flour. The flour combination was scored in the range of liked slightly to like moderately in the hedonic scale test, using a "hedonic-scale" consisting of a 5 point scale: 1-dislikes extremely, 3-neither likes nor dislikes, and 5-likes extremely. From organoleptic test it is found that average panelists quite liked the product by giving score between 3 – 3.5 for colour, flavour and texture.

Sensory evaluation of cookies made from selected flour combination
From the selected instant flour combination, cookies were produced in a way to reduce the aroma and flavour from soybean (tempeh). However, for taste, most of the panelists did not like the formula by giving score 2.1-2.1 in 1 to 5 scale.

Total nutrient value and total energy evaluation on the cookies produced
Total energy resulting from 100 gram cookies produced can be seen in Table 2 below:

Table 2. Nutrient value and total energy in a-100 gram cookie.

Mixture of Maize and Tempeh Instant Flour (70:30)	Content (%)
Carbohydrate	45.76
Fats	30.15
Protein	14.61
Crude fiber	2.23
Total Calories	528.54

Discussion
Nutritional content
The nutrition content in the product showed increasing protein value due to tempeh addition. In addition, enzymatic process produced by microorganisms influenced quality and nutritional value, digestion process and shorter cooking time [6]. The research showed moisture may be increased as a result of absorption of water during fermentation, but after a certain period, a drop in water content may be due to utilization of water in metabolic activities. Increase in ash content may be as a result of the addition of salt. Ash, protein content, fat and crude fibre increased. Crude protein may be increased because of proteolytic activity of bacteria during fermentation that degrades protein into simple proteins, peptides and amino acids which are readily utilizable by bacteria [7]..

Crude fibre content of food ingredients on the product formula especially for children is very important. Crude fibre content in food should not be too high because it affects the digestive process of children's food. According to the USDA standard for fibre, it should not exceed 2.0% solids [8]. Fibre analysis showed that the maximum crude fibre content in the resulting formula was still below 2%. It also showed that the increase in soybean meal substitution caused an increase in the proportion of coarse fibres in the formula produced. From these results, we may conclude that the crude fibre in tempeh flour plays a role in increasing the fibre content in the formula for BMC instant flour, but the highest proportion in the substitution of crude fibre can still be accepted as it is less than 2%.

Total nutrient value
Energy content (calories) in a formula of ingredients is very important for the additional food to improve nutritional status. Foodstuffs with high energy density are very beneficial to meet the caloric needs of children every day. It is also important to note that with high energy density the

child does not need to eat huge portions to meet daily recommended calorific needs. BMC corn meal: soybean (70:30) with the energy density of about 410 grams kcal/100 is considered quite high considering using 2 - 3 servings of this BMC (800-1200kcal) child's daily calorie needs can be met. Besides, from the proximate analysis results described previously, the composition of macro nutrients (proteins, fats and carbohydrates) on the BMC corn; tempeh 70:30 formula is most appropriate to the standard MP breastfeeding and supplementary food [8, 9, 10].

Conclusion

The mixture of tempeh flour and maize flour of (70:30) is considered as a functional food and there has been an increased interest in fulfilling energy content and nutrient value status of the children. The research result has obtained the optimal mixture of BMC formulas and various forms of BMC products of cookies. This product was recommended to be used as supplementary food for infants and school children and can be produced commercially. When tempeh flour and maize flour were incorporated into the cookies, there resulted a higher protein content and total calories, firmer crumb and darker crumb and crust colour. Soya contains natural antioxidants and the 10% substitution level could have had an effect by lowering peroxide value development, but negatively affecting sensory quality of the cookie.

This is a new and important topic that needs further investigation. The combination of these two kinds of flour has limited exposure in the literature. The health aspects that they offer are unique. There appears to be a possible synergistic relationship between these two flour combinations.

Acknowledgments

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