The Effect of Tempe Substitution and Addition of Carrot Puree on The Acceptability and Nutritional Value of Sausages for Snacks for School Children

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Abstract. Snacks for school children were generally only high in carbohydrates and fats, but low in protein, therefore it was necessary to study the juveniles of high-protein school children but the price was relatively cheap. This study aims to determine the effect of tempeh substitution and the addition of carrot puree to the acceptability and nutritional value of sausages for snacks for school children. Organoleptic test results were statistically analyzed using the Friedman non-parametric test and if there were significant differences then to find out the different pairs the Wilcoxon test was used with \( \alpha = 0.05 \). Determination of the best formula was taken from the highest average value of the overall acceptance of carrot tempe sausage. Laboratory test data for nutrient content were analyzed with a single ANOVA and followed by Duncan test if the treatment affected certain parameters. Tempe substitution and addition of carrot puree significantly influence on the taste and aroma of sausages, but did not significantly influence on the color and thickness of sausages. The best sausage product based on panelist acceptance was F1 formula. Tempeh substitution and addition of carrot puree significantly influence to the content of all nutritional parameters analyzed. The best sausage product based on nutrient content was F1 formula with protein content per 100 grams of sausage of 16.62 ± 0.45 grams and could meet the standard levels of protein in commercial sausages (minimum 13.00%) and was able to meet 33.24% of the protein requirements in the RDA children aged 10-12 years.

1. Introduction
Snack was one type of food that was very well known, especially among school-age children [1]. Snacks that were generally sold by food handlers around schools were generally foods that were only high in carbohydrates, sugar or sweeteners and fats, while the protein content was low. On the other hand, school children who were at the age of growth require a relatively high protein intake. Because it needs to be investigated making snacks that were high in protein but cheap. One of the food products that was relatively favored by children is sausage, but if it is made from beef or chicken the price was too
expensive for school children. One alternative solution was to substitute meat with tempeh which was also high in protein content.

Sausage was one of the many processed meat products produced. Processed meat production in Indonesia in 2015 according to the Ministry of Agriculture was 296,000 tons [2]. The definition of sausage itself was a type of food that comes from small pieces of meat that are ground and seasoned, could be prepared immediately, and immediately cooked to eat. Sausages were commonly found in casings. Sausage was also an oil emulsion in water (oil in water or o / w). Emulsion was a liquid dispersion or suspension in another liquid, the molecules of the two liquids did not blend but contradict each other [3], and sausages were foods that are favored by both children and adults.

Tempe was a traditional Indonesian food. In the homeland, tempeh had long been known for centuries ago. This food was produced and consumed for generations, especially in the area of Central Java and its surroundings [4]. Tempe was a food made from soybean seeds or some other material that was processed through fermentation of what is commonly known as "tempeh yeast". Through this fermentation process, soybean seeds undergo a process of decomposition into simple compounds so that they were easily digested [4].

Tempe substitution in sausage making was thought to reduce fat content, because tempeh fat content is relatively lower than meat. Because it needs to be investigated the amount of fat needed to produce tempeh sausages that had good criteria.

Tempeh substitution in the process of making sausages was expected to produce sausage products that are relatively inexpensive, with protein content that was relatively equivalent to beef or chicken sausages. In addition, the sausages produced were also expected to contain functional compounds that were beneficial to the body such as isoflavones and oligopeptides.

In making sausages rarely use vegetables as raw material. One of the vegetables that could be used as raw material for sausages was carrots. According to [5] carrots had bioactive compounds such as carotenoids and fiber that were sufficient to significantly improve health. If the body needs vitamin A, beta-carotene in the liver will be converted into vitamin A [6]. Development of the use of carrots in a variety of food products had been done a lot such as steamed buns, white bread, sweet bread, crackers, ice cream, blondies, sweet martabak, lasagne, shake cake cakes, and others. Therefore in this study we will try to add carrot puree to sausage products.

2. Material and Method

2.1. Material
Ingredients for making sausages include beef, tempeh, carrots, tapioca flour, skim milk, pepper, garlic, salt, granulated sugar, cooking oil, ice cubes, plastic, and sausage casings.

2.2. Making carrot puree
Carrots thoroughly washed, peeled, and cut into pieces with a length of ± 3 cm. Then the carrot pieces were put into plastic and steamed for 20 minutes. After steaming the carrot pieces were cooled, then crushed using a blender or chopper to produce carrot puree.

2.3. Sausages processing
Sausage making was started with the preparation of the material and then the meat was ground. Milling was done by using a food processor. Meat 250 g and 0.5% STPP included. The next stage was the addition of 20% chopped ice cubes, 16% starch, 12% skim milk, 6% garlic, 1.2% white pepper, 2.8% sugar, 8% cooking oil and 4% salt. The percentage of ingredient based on 100% of meat. Substitution of tempeh (20%, 30% and 40%) and addition of carrot puree (10% and 20%) were done in this step and the dough homogenized by two-times milling process. The dough was put into stuffer then filled into casings and then boiled for 60 minutes at a temperature of 60 to 65°C.

2.4. Analysis
1) Sensory evaluation: To confirm whether or not the substitution of tempeh and addition of carrot puree on sensory properties of the sausage, sensory evaluation was performed based on modified
method of [7]. The hedonic tests of the sausages were conducted using a scale of 1 to 3. Five skilled and thirty-five untrained panellists were used for hedonic tests, respectively.

2) Nutritional composition: To confirm the effect of the substitution of tempeh and addition of carrot puree on nutritional composition of the sausage, proximate analysis was performed based on standard method of [8]. The analysis includes moisture, protein, fat, and ash contents by proximate. Carbohydrate content was calculated by difference from the proximate analysis. Analysis of fiber, β-carotene and vitamin A content was based on the standard method of [8].

3. Results and Discussion

3.1. Sausage Formula

In the preliminary research phase a sausage formulation was carried out using the basic formula from the research of [9], namely by substituting beef with tempeh and the addition of carrot puree.

Table I. Formulation Of Tempe Sausage And Addition Of Carrot Puree

| Material           | Formula | F0  | F1  | F2  | F3  | F4  |
|--------------------|---------|-----|-----|-----|-----|-----|
| Beef (g)           |         | 250 | 150 | 150 | 125 | 125 |
| Tempeh (*) (g)     |         | -   | 75  | 50  | 75  | 100 |
| Carrots (*) (g)    |         | -   | 25  | 50  | 50  | 25  |
| Tapioca flour (g)  |         | 40  | 40  | 40  | 40  | 40  |
| Skim milk (g)      |         | 30  | 30  | 30  | 30  | 30  |
| Pepper (g)         |         | 3   | 3   | 3   | 3   | 3   |
| Garlic (g)         |         | 15  | 15  | 15  | 15  | 15  |
| Salt (g)           |         | 10  | 10  | 10  | 10  | 10  |
| Granulated sugar (g)|     | 7   | 7   | 7   | 7   | 7   |
| Ice cubes (g)      |         | 50  | 50  | 50  | 50  | 50  |
| cooking oil (g)    |         | 20  | 20  | 20  | 20  | 20  |
| Total (g)          |         | 486 | 486 | 486 | 486 | 486 |

Information (*): The number of substituted tempeh and carrot puree added is based on beef weight.

3.2. Sensory evaluation

Organoleptic test is a test carried out by the sensing process where the sensory apparatus gets stimulation so that a mental reaction (sensation) occurs. The reaction caused due to the stimulation that can form an attitude to towards or away from, like, or dislike an object that causes stimulation. In [10] it was said that things such as awareness, impressions, and attitudes towards stimuli could be referred to as psychological reactions or subjective reactions. Sometimes humans respond differently to the same stimuli. This difference can occur for two people could be caused by differences in sensations received because of differences in the level of sensitivity of sensing organs, or because of a lack of knowledge of certain odors or tastes, or also a lack of training in expressing what they feel in words or numbers [7].

The average level of preference for trained panelists towards organoleptic sausages is shown in Table II below.
Table I. Average Level Of Preference For Trained Panelists On Organoleptic Assessment Of Tempe Sausage And Addition Of Puree Carrot

| Formula | Rate | Color | Aroma | Taste | Elasticity | Mode |
|---------|------|-------|-------|-------|------------|------|
| F0      | 4    | 4     | 4     | 4     | 4          | 4    |
| F1      | 3    | 4     | 3     | 2.5   | 3          | 3    |
| F2      | 3    | 3     | 3     | 4     | 3          | 3    |
| F3      | 2.5  | 2     | 3     | 3     | 3          | 3    |
| F4      | 2.5  | 3     | 2     | 2     | 2          | 2    |

Table II above shows the sausage formula favored by trained panelists in terms of organoleptic formulations were F0, F1, F2 and F3 with mode values 4 and 3.

The sausage formulation was then tested on untrained panelists, namely grade 4 and grade 5 students to find out the preference of school children towards the sausages produced. Table III shows that the substitution treatment and the addition of carrot puree affected the aroma and taste of sausages, but did not affect the color and elasticity.

Table II. A Mean Rank Untrained Panelists

| Formula | Color | Aroma | Taste | Elasticity | Total ranking score |
|---------|-------|-------|-------|------------|---------------------|
| F0      | 3.03a | 3.59b | 4.01b | 2.8a       | 13.43               |
| F1      | 3.06a | 3.07ab| 3.03a | 3.07a      | 12.23               |
| F2      | 3.31a | 2.87a | 2.86a | 3.16a      | 12.2                |
| F3      | 2.84a | 2.76a | 2.37a | 3.06a      | 11.03               |
| F4      | 2.76a | 2.71a | 2.73a | 2.91a      | 11.11               |

Based on the total ranking value, it appears that the formula F0 (control) obtained the highest score then followed by the F1 and F2 formulas.

The color of sausage was not affected by the substitution of tempeh and the addition of carrot puree, because the color of sausage was predominantly determined by the red color of beef that had been cured. This was in line with the results of the study of [11], which states that the color of sausages was influenced by the addition of red yeast rice, but not affected by the addition of a combination of wheat flour and sweet potato flour filler.

The sausage aroma is influenced by the treatment given, this is presumably due to the effect of the unpleasant aroma of tempeh, so the level of aroma preference tends to decrease in line with the increase in tempeh substitution. The same thing was revealed by [12], who stated that there was a tendency to decrease the aroma preference in line with the increase in the amount of tempeh used in making chicken sausages.

The taste of sausages was also influenced by the treatment given, this was presumably due to the influence of the taste of tempeh which is rather bitter, so that the level of flavor preference tends to decrease in line with the increase in tempeh substitution. Soybeans have a bitter aftertaste on the processed products, namely tempeh and Isolated Soy Protein (ISP). The bitter taste arises due to the presence of glycoside compounds in soybeans, soyaponin, and sapogenol which are the causes of bitter aftertaste [13].

The elasticity of the sausage was not affected by tempeh substitution and the addition of carrot puree. The same result was also revealed by [14] who stated that the texture response that covers the bite, hardness, suppleness and juiceness of the African catfish sausage was not influenced by the use of the type and concentration of the filling material.
3.3. Nutritional composition

ANOVA test results showed that the substitution of tempe and the addition of carrot puree significantly affected the content of energy, protein, fat, carbohydrate, water, fiber, ash, carotene, and vitamin A. The average content of each nutrient for the formulas F0, F1 and F2 could be seen in Table IV.

Table IV. Average Values Of Nutritional Content Of Sausage Products Formula F0, F1 And F2 Per 100 G

| Zat Gizi                  | F0            | F1            | F2            |
|---------------------------|---------------|---------------|---------------|
| Energy (kcal)             | (408.53±1.69)a| (420.16±4.29)b| (425.00±7.95)b|
| Protein (g)               | (14.34±0.38)a | (16.62±0.45)b | (17.53±0.61)b |
| Fat (g)                   | (31.51±0.48)b | (29.72±0.57)a | (31.67±0.54)b |
| Carbohydrate (g)          | (21.29±0.50)b | (19.47±1.04)a | (19.73±0.39)a |
| Water (g)                 | (31.05±0.14)a | (35.31±1.05)b | (30.25±0.73)a |
| Ash (g)                   | (0.36±0.04)a  | (0.46±0.05)b  | (0.41±0.03)ab |
| Fiber (g)                 | (0.88±0.15)a  | (2.17±0.16)b  | (3.65±0.52)c  |
| β carotene (mg RE)        | (11.36±0.63)a | (76.91±5.40)b | (94.92±3.94)c |
| Vitamin A (mg RE)         | (13.78±1.56)a | (111.17±5.44)b| (135.90±4.62)c|

Based on the data in Table IV, there was a trend towards an increase in energy and protein content as well as a decrease in fat and carbohydrate content in sausage formulations. This was probably because tempe had a higher protein content and lower fat compared to beef. The results showed that soy tempeh contained 37.38% protein and 17.31% fat [15], while the protein and fat content of beef was 18% and 14% [16].

The protein content of 100 grams of sausage formulation could meet 33.24% - 35.05% of the total protein in the RDA for children aged 10-12 years. The amount was far above the provision that the contribution of protein from snacks was 10-15% of the total protein.

In addition, the content of fiber, β-carotene and vitamin A sausage formulation is much higher compared to beef sausage (control), meaning that the purpose of this study was successfully achieved, namely increasing the content of protein, fiber, β-carotene and vitamin A of snacks for school children.

4. Conclusions

Tempe substitution and the addition of carrot puree significantly influence on the taste and aroma of sausages, but did not significantly influence on the color and thickness of sausages. The best sausage product based on panelist acceptance was F1 formula. Tempeh substitution and addition of carrot puree significantly influence to the content of all nutritional parameters analyzed. The best sausage product based on nutrient content was F1 formula with protein content per 100 grams of sausage of 16.62 ± 0.45 grams and could meet the standard levels of protein in commercial sausages (minimum 13.00%) and was able to meet 33.24% of the protein requirements in the RDA children aged 10-12 years.

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