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## Study of Sensory Characteristics and Nutrient Content of Catfish and Tempeh-Based Drumstick as an Alternative Food for Children with Autism

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**Abstract:** Children with autism are known allergic to some foods. People with autism should perform Gluten and Casein Free diet (GFCF), which means avoiding sources of foods containing casein and gluten. One fast food that has the potential to become an alternative food for GFCF diet is drumstick made of catfish and tempeh with tapioca as the food binder and coconut crumbs to replace the wheat flour and bread crumbs. The drumstick in this study was made of high-protein foods (i.e., catfish and tempeh) which aimed to add variety and additional dietary supplement that could be consumed by children with autism. This was an experimental study which aimed to identify the sensory characteristics (color, texture, smell and taste) and nutrient content (protein, carbohydrate, fat and crude fiber) of the drumsticks. This experiment used Completely Randomized Design (CRD) with three treatments using different proportion of catfish and tempeh (90:10, 80:20 and 70:30%). Organoleptic test was performed using hedonic method. The results showed that the proportion of catfish and tempeh had significant effect on sensory characteristics ( $p < 0.05$ ). The highest protein, carbohydrates and crude fiber contents of the drumsticks were found in the third treatment while the highest fat content was shown in the first treatment. This drumstick could be used as an alternative side dish and complementary food to meet the nutritional adequacy in children with autism, as well as healthy snack for children and people in general.

**Key words:** Children with autism, drumstick, catfish, tempeh

### INTRODUCTION

Syndrome of autism is a complex developmental disorder associated with communication, social interaction and imagination activity (Rahmayanti, 2008). This syndrome can be detected when the child is at least 18 months, in which the child begins to develop actively in walking or talking. The number of people with autism in the world was estimated to reach 30 to 60 cases per 10,000 births in 2000 and increased to 110 cases per 10,000 births in 2007 (Kogan *et al.*, 2009). Meanwhile, the exact number of people with autism in Indonesia hasn't been known with certainty because there has been no in-depth research (Nurlaila and Nur, 2009).

One of the disorders found in children with autism that needs attention from the parents is impaired immune system underlying food allergies in children. This is one of the problems that should be considered by the parents of people with autism. People with autism should be on gluten free casein free (GFCF) diet, meaning that they have to avoid foods containing gluten and casein. Gluten is a protein derived from wheat and related grains while casein is derived from cow's milk (Seroussi, 2004).

The presence of fast foods or processed food is growing rapidly these days. One fast food that can potentially be

GFCF food for an autistic child's diet is drumstick made of chicken, beef or fish. However, people with autism are not allowed to consume preserved beef, fish or chicken (Regina, 2012). This is due to Monosodium Glutamate (MSG) contained in the processed or preserved fish, beef and chicken that is not allowed for children with autism. In addition, the drumsticks sold in the market are made with broilers as the basic ingredient and wheat flour and bread crumbs as the additional ingredients which are not recommended to be consumed by children with autism because it can cause allergies. Therefore, the basic ingredients for this drumstick production were replaced with fresh catfish and tempeh. Besides that, wheat flour and bread crumbs were replaced with tapioca flour and coconut crumbs as coating materials for the drumsticks. Based on those descriptions, the researchers were interested in studying the sensory characteristics and nutrient content of catfish and tempeh-based drumsticks with different proportion as an alternative food for children with autism.

### MATERIALS AND METHODS

This was an experimental study using a completely randomized design (CRD) with 3 times treatment and 3 times replication. The proportion of catfish and tempeh

in the first (T1), second (T2) and third (T3) treatments were 90:10, 80:20 and 70:30%, respectively.

Drumstick was made using fresh catfish and tempeh as basic ingredients along with other additional ingredients such as tapioca flour, garlic, salt, corn sugar, coconut crumbs and water. The tools used consisted of stove, knife, analytical balance, spatula, chopper, cutting board, pans, basins and trays. Meanwhile, the tools for chemical analysis were oven, desiccator, porcelain evaporating dish, Soxhlet extractor, analytical balance, Erlenmeyer flask, muffle, laboratory bottle and filter paper.

The protein content was measured by Kjeldahl method, carbohydrate content was measured using Luff School method, fat content was measured by Soxhlet method and crude fiber content was measured using gravimetric method (Skoog, 2004). Meanwhile, the sensory characteristics were obtained through hedonic test using 4-point hedonic scale as follows: 4 = strongly like, 3 = like, 2 = somewhat dislike and 1 = dislike. Hedonic test was carried out on slightly trained panelists, i.e., 30 students of Nutrition Science Study Program in Husada Borneo Institute of Health Science. One-way ANOVA was used to analyze the effect of the proportion of catfish and tempeh on nutrient content while the advanced test (Tukey test) was performed to analyze the significant differences between treatments. Meanwhile, the effect of catfish and tempeh proportions on the acceptance was analyzed by Friedman test followed by Wilcoxon test to analyze the significant differences between treatments.

## RESULTS

**Sensory characteristics of drumsticks:** Data of drumsticks' sensory characteristics were collected through the acceptance test to identify the preference level of a product by consumers. Factors affecting the acceptance of a product were color, texture, smell and taste.

**Color:** Results of color analysis of catfish and tempeh-based drumsticks were presented in Table 1.

Table 1 showed that the most preferred drumstick by the panelists based on its color characteristics was in T1 with average value of 3.57 while the lowest average value of color characteristics was found in T3 i.e., 2.90. Statistical analysis showed that p-value = 0.000 ( $p < 0.05$ ), meaning that the proportion of catfish and tempeh had a significant effect on the color characteristics of the drumsticks.

**Texture:** Sensory analysis results of texture of catfish and tempeh-based drumsticks were presented in Table 2.

Table 2 showed that the most preferred drumstick by the panelists based on its texture characteristics was in T1 with the average value of 3.27 while the lowest average value of texture characteristics was in T3, in the amount

of 2.63. Statistical analysis showed a p-value of 0.000 ( $p < 0.05$ ), meaning that the proportion of catfish and tempeh significantly affected the texture characteristics of the drumsticks.

**Smell:** Sensory analysis results of smell of catfish and tempeh-based drumsticks were presented in Table 3.

Table 3 showed that the most preferred drumstick by the panelists based on its smell characteristics was in T1 with an average value of 3.50 while the lowest average value of smell characteristics was found in T3, i.e., 2.87. Statistical analysis showed a p-value of 0.000 ( $p < 0.05$ ), meaning that the proportion of catfish and tempeh had a significant effect on the smell characteristics of the drumsticks.

**Taste:** Sensory analysis results of taste of catfish and tempeh-based drumsticks were presented in Table 4.

Table 4 showed that the most preferred drumstick by the panelists based on its taste characteristics was in T1 with an average value of 3.40 while the lowest average value of taste characteristics was found in T3, i.e., 2.63. Statistical analysis showed a p-value of 0.003 ( $p < 0.05$ ), meaning that the proportion of catfish and tempeh significantly affected the taste characteristics of the drumsticks.

## Nutrient content

**Protein:** Analysis results of the protein content of catfish and tempeh-based drumsticks could be seen in Table 5.

Table 5 showed that the highest protein content of drumsticks was found in T3 with an average value of 24.24% while the lowest average value of protein content was found in T1, i.e., 19.07%. Statistical analysis showed a p-value of 0.002 ( $p < 0.05$ ), indicating that there was a significant difference in protein content between the three proportion treatments of catfish and tempeh-based drumsticks.

**Carbohydrates:** Analysis results of carbohydrate content of catfish and tempeh-based drumsticks could be seen in Table 6.

Table 6 showed that the highest carbohydrate content of drumsticks was found in T3 with an average value of 15.12% while the lowest average value of carbohydrate content was found in T1, i.e., 9.54%. Statistical analysis showed a p-value of 0.000 ( $p < 0.05$ ), indicating that there was a significant difference in carbohydrate content between the three proportion treatments of catfish and tempeh-based drumsticks.

**Fat:** Analysis results of fat content of catfish and tempeh-based drumsticks could be seen in Table 7.

Table 7 showed that the highest fat content of drumsticks was found in T1 with an average value of 12.39% while the lowest average value of fat content

Table 1: Average value of drumsticks' color characteristics

Treatment (catfish: tempeh)	Color	Description
T1 (90:10)	3.57 <sup>a</sup>	Like
T2 (80:20)	3.20 <sup>b</sup>	Like
T3 (70:30)	2.90 <sup>c</sup>	Somewhat dislike

p = 0.000

Figures followed by the same subscript letters indicated not significantly different (p>0.05)

Table 2: Average value of drumsticks' texture characteristics

Treatment (catfish: tempeh)	Texture	Description
T1 (90:10)	3.27 <sup>a</sup>	Like
T2 (80:20)	3.10 <sup>ab</sup>	Like
T3 (70:30)	2.63 <sup>c</sup>	Somewhat dislike

p = 0.000

Figures followed by the same subscript letters indicated not significantly different (p>0.05)

Table 3: Average value of drumsticks' smell characteristics

Treatment (catfish: tempeh)	Smell	Description
T1 (90: 10)	3.50 <sup>a</sup>	Like
T2 (80: 20)	3.27 <sup>ab</sup>	Like
T3 (70: 30)	2.87 <sup>c</sup>	Somewhat dislike

p = 0.000

Figures followed by the same subscript letters indicated not significantly different (p>0.05)

Table 4: Average value of taste characteristics of catfish and tempeh-based drumsticks

Treatment (catfish: tempeh)	Taste	Description
T1 (90: 10)	3.40 <sup>a</sup>	Like
T2 (80: 20)	3.20 <sup>ab</sup>	Like
T3 (70: 30)	2.63 <sup>c</sup>	Somewhat dislike

p = 0.003

Figures followed by the same subscript letters indicated not significantly different (p>0.05)

Table 5: Protein content of the drumsticks

Treatment (catfish: tempeh)	Protein content (%)
T1 (90: 10)	19.07 <sup>ac</sup>
T2 (80: 20)	21.02 <sup>a</sup>
T3 (70: 30)	24.24 <sup>b</sup>

p = 0.002

Figures followed by the same subscript letters indicated no significant effect (p>0.05)

Table 6: Carbohydrate content of the drumsticks

Treatment (catfish: tempeh)	Carbohydrate content (%)
T1 (90: 10)	9.54 <sup>a</sup>
T2 (80: 20)	13.12 <sup>b</sup>
T3 (70: 30)	15.12 <sup>c</sup>

p = 0.000

Figures followed by the same subscript letters indicated no significant effect (p>0.05)

Table 7: Fat content of the drumsticks

Treatment (catfish : tempeh)	Fat content (%)
T1 (90: 10)	12.39 <sup>a</sup>
T2 (80: 20)	10.36 <sup>ac</sup>
T3 (70: 30)	8.32 <sup>bc</sup>

p = 0.003

Figures followed by the same subscript letters indicated no significant effect (p>0.05)

Table 8: Fiber content of the drumsticks

Treatment (catfish: tempeh)	Fiber content (%)
T1 (90: 10)	8.69 <sup>a</sup>
T2 (80: 20)	11.44 <sup>b</sup>
T3 (70: 30)	12.97 <sup>bc</sup>

p = 0.001

Figures followed by the same subscript letters indicated no significant effect (p>0.05)

was found in T3, i.e., 8.32%. ANOVA statistical analysis showed a p-value of 0.003 (p<0.05), meaning that there was a significant difference in fat content between three proportion treatments of catfish and tempeh-based drumsticks.

**Crude fiber:** Analysis results of crude fiber content of catfish and tempeh-based drumsticks could be seen in Table 8.

Table 8 showed that the highest fiber content was found in the drumstick in T3 with an average value of 12.97% while the lowest average value of fiber was found in T1, i.e., 8.69%. ANOVA statistical analysis showed a p-value of 0.001 (p<0.05), meaning that there was a significant difference in fiber content between three proportion treatments of catfish and tempeh-based drumsticks.

## DISCUSSION

### Sensory characteristics of drumsticks

**Color:** Quality determination of foodstuffs in general depends on several factors, such as flavor, color, texture and other nutritional values (Winarno, 2004). However, color is a factor to be considered first before other factors visually and sometimes very decisive. This is because an ingredient which is considered as nutritious, tasty and has decent texture will not be consumed if it has an unpleasant color. Besides that, color can also be used as freshness or ripeness indicator of a food product.

Based on statistical analysis, the p-value was 0.000 (p<0.05) which indicated that the proportion of catfish and tempeh had a significant effect on drumsticks' color characteristics. In general, the results of organoleptic test showed that the panelists preferred the drumstick's color in the first treatment (T1) with 90% catfish and 10% tempeh proportions and the second treatment (T2) with 80% catfish and 20% tempeh proportions. Meanwhile, the third treatment (T3) with 70% catfish and 30% tempeh proportions was less preferred by the panelists. This was due to the addition of tempeh and catfish in which the color would become darker if more tempeh were added and the color would be brighter if more catfish were added.

**Texture:** Texture of foodstuffs is one of the physical properties of the food itself. It relates to the taste while chewing the food. Organoleptic test of drumstick's texture tended to decrease with the increasing number

of tempeh added. The results of the test showed that the panelists preferred the drumsticks in T1 with 90% catfish and 10% tempeh proportions and T2 with 80% catfish and 20% tempeh proportions. Meanwhile, drumstick in T3 with 70% catfish and 30% tempeh proportions was less preferred by the panelists.

Decrease in organoleptic test on the most addition of tempeh was due to drumstick's texture that became harder. This was caused by the less water content of tempeh compared to the water content of catfish. There were 61.2 g water in 100 g tempeh (Cahyadi, 2007) while there were 71.8 g water contained in 100 g catfish (Rosa *et al.*, 2007). Panelists preferred a quite soft texture. It was proven by the results of organoleptic test indicating that the proportion of catfish and tempeh had a significant effect ( $p = 0.000$ ) on the drumsticks' texture characteristics.

**Smell:** The smell of food mostly determines the food delicacy; therefore, it is one of the factors in quality determination (Winarno, 2004). The smell of food emerges from the formation of volatile compounds. Each food has different smell. Besides, different way of cooking will also emerge different smell (Moehyi, 2002). The smell test is very important in the industry because it can quickly deliver the results of the production assessment, whether it is liked or disliked (Soekarto, 2000).

Based on statistical analysis, the  $p$ -value was 0.000 ( $p < 0.05$ ), indicating that the proportion of catfish and tempeh had a significant effect on the drumsticks' smell characteristics. Test of the smell characteristics of catfish and tempeh-based drumsticks showed a decline result in the drumsticks with the highest number of tempeh addition. Organoleptic test of the drumstick's smell showed that the panelists preferred the drumsticks in T1 with 90% catfish and 10% tempeh proportions and T2 with 80% catfish and 20% tempeh proportion. Meanwhile, T3 with 70% catfish and 30% tempeh proportions was less preferred by the panelists. Results of organoleptic test of drumstick's smell showed a significant difference in each treatment where the typical smell of catfish reduced due to the increasing number of tempeh added in each treatment. Tempeh has a distinctive smell, that is, unpleasant odor which is caused by the action of lipoyxygenase contained in soybean that serves to hydrolyze the soy fat resulting in unpleasant odor-causing compounds (Megia *et al.*, 2010).

**Taste:** Taste is a parameter of individual hedonic test of a product. Although other parameters are considered good but if the taste is not favored then the product will not be consumed. Test of the taste characteristics of catfish and tempeh-based drumsticks tended to show a decline result in the drumsticks with the highest number

of tempeh addition. Organoleptic test of the drumstick's taste showed that the panelists preferred the drumsticks in T1 with 90% catfish and 10% tempeh proportions and T2 with 80% catfish and 20% tempeh proportion. Meanwhile, T3 with 70% catfish and 30% tempeh proportions was less preferred by the panelists. Based on statistical analysis, the  $p$ -value was 0.000 ( $p < 0.05$ ), meaning that the proportion of catfish and tempeh had a significant effect on the drumsticks' taste characteristics.

The drumstick of the first treatment (T1) was much preferred by the panelists. This was due to the catfish, an animal source food, which gave more savory taste than tempeh. In general, the drumsticks sold on the market were made from fish or chicken; thus, the panelists had the perception that the drumsticks should taste like fish or chicken while in this study, tempeh was added as the basic ingredient in the making.

#### **Nutrient content of the drumsticks**

**Protein:** Drumstick is similar to nuggets made from chicken as the basic ingredient and then it is added with the spices, food additives, binders and coating. Food binder commonly used is wheat flour which contains carbohydrates (Priwinda, 2009) while eggs and bread crumbs are used as the coating materials. Basic ingredient for making a bread is wheat flour which is added with instant yeast, fat, salt and sugar. Wheat flour contains a special protein called gluten. People with autism should avoid foods containing gluten and casein because they will interfere the digestion and cause hyperactive behaviors (Danuatmaja, 2004). In this study, the wheat flour in the production of catfish and tempeh-based drumsticks was replaced with tapioca flour and the bread crumbs for coating were substituted with dried coconut crumbs so that the gluten-free drumsticks were produced.

Test of protein content showed that the protein content of catfish and tempeh-based drumsticks was increasing along with the increasing percentage of the addition of tempeh. This was due to the protein content in 100 g tempeh (41.5%) which was higher than the protein content in 100 g of catfish (18.2%). It was proven in the third treatment (T3) in which 30% tempeh proportion yielded an average protein content which reached 24.24%. Based on the statistical analysis, it could be concluded that the proportion of catfish and tempeh had a significant effect on protein content of the drumsticks ( $p < 0.05$ ).

Indonesian National Standard (SNI) for drumstick was still unavailable; therefore, this study used SNI for chicken nuggets because the basic ingredients of the drumsticks were generally similar with nuggets. Minimum limit of protein content was 12%, referring to SNI in 2002 on the quality requirements for chicken nuggets (National Standardization Agency, 2002).

Based on that standard, the average protein content of the drumsticks in this study could be considered to have reached the standardized requirements, i.e., more than 12%.

**Carbohydrates:** In general, the carbohydrate content of catfish and tempeh-based drumsticks increased. This was due to the carbohydrate content in 100 g tempeh, in the amount of 29.6% (Cahyadi, 2007) while there was no carbohydrate content in catfish. The third treatment (T3), with the highest tempeh proportion (30%), had the highest average carbohydrate content, reaching 15.12%. High amount of carbohydrates gave energy contribution which were ready to use in the form of simple sugar. Statistical analysis showed that the proportion of catfish and tempeh had a significant effect on the carbohydrate content of the drumsticks.

Referring to SNI in 2002 on the quality requirements for chicken nuggets, the maximum limit of carbohydrate content was 25% (14). Based on that standard, the average value of carbohydrate content of the drumsticks in this study could be said to have reached the standardized requirements because it did not exceed 25%.

**Fat:** The highest proportion of catfish was proven to have an effect on the reduction in fat content of catfish and tempeh-based drumsticks. The addition of catfish could increase the water content and weight on each treatment so that the percentage of fat content would decrease. There were 78.1% water in 100 g catfish (Rosa *et al.*, 2007) while 100 g tempeh contained 61.2% water (Cahyadi, 2007). Of the three treatments, the highest fat content was found in T1, in the amount of 12.39%, while the fat contents in T2 and T3 were 10.36 and 8.32%, respectively. Statistical analysis showed that the proportion of catfish and tempeh had a significant effect on the fat content of the drumsticks ( $p < 0.05$ ).

In this study, the decreased fat content might be due to the fat breakdown during frying or heating process. The longer and the higher the temperature used during processing, the fat damage, as a result of hydrolysis, would be even greater. The more catfish were added, the higher the water content of the drumsticks; thus, the greater the likelihood of hydrolysis.

Dietary fat plays an important role in the digestion, absorption and transport of fat-soluble vitamin and phytochemical compounds, such as carotenoids and lycopene. Adequate fat intake can help children to meet their energy requirements so that the protein is not broken down into energy (Lucas *et al.*, 2008).

Referring to SNI in 2002 on the quality requirements for chicken nuggets, the maximum limit of fat content was 20% (14). Based on that standard, the average value of fat content of the drumsticks in this study could be considered to have reached the standardized requirements because it did not exceed 20%.

**Crude fiber:** In general, the crude fiber content of catfish and tempeh-based drumsticks increased. This was due to the crude fiber content in 100 g tempeh which reached 3.4% (Cahyadi, 2007). Meanwhile, catfish had no fiber content. T3, with the highest proportion of tempeh (30%), had the highest average value of fiber which reached 12.97%. Based on the statistical analysis, it could be concluded that the proportion of catfish and tempeh had a significant effect on the fiber content of the drumsticks ( $p < 0.05$ ).

Contribution of catfish and tempeh-based drumsticks to fiber requirements for children was 25.94 per 100 g serving or 2 pieces of drumsticks. The recommended fiber intake for children was 15 g/day, according to their needs. In children with autism, the fiber in digestion served to give the bulky nature in feces; thus, helping to reduce the diarrhea symptoms which often occurred (Marsono *et al.*, 2005).

Drumsticks which were made of catfish and tempeh can be used as an alternative side dish and complementary food to help autistic children meet their nutritional adequacy and as a healthy snack for children and people in general. Further study is needed regarding the acceptance and the effect of consumption of catfish and tempeh-based drumsticks on the behavior and development of children with autism.

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