



## Effects of Tempeh Flour Snack Bar on Organoleptic Tests and Nutritional Content as a Snack for Athletes

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### ABSTRACT

**Introduction:** Athletes need snacks, one of which is a snack bar. Tempe flour snack bar and watermelon rind can help restore muscle damage after sports activities. This study aims to determine the effect of tempeh flour snack bars with the addition of watermelon rind on organoleptic tests and nutritional content referring to SNI 0-4216-1996 quality standards and determine the best formula. **Methods:** This type of research is an experimental study using a Completely Randomized Single Factor Design. There are three formulas with different kinds of watermelon rind: SBT 1 of 6 g, SBT 2 of 4 g, and SBT 3 of 8 g. Analysis of nutritional content using the calculation method, Wilcoxon, titimetry. Data analysis used Kruskal Wallis, One Way ANOVA, and Duncan's test using SPSS software. **Results:** The results showed no significant difference in the organoleptic test of the three formulas. There is a substantial difference in nutritional content. The best formula is SBT 1, which has 385.49 kcal/g energy and 14.94 g protein. Tempe flour snack bar products are said to contain high energy because they exceed the quality standards of SNI 0-4216-1996. **Conclusion:** Based on the athlete's AKG approach, the SBT 1 snack bar product contributes 11% of energy.

**Keywords:** Snack Bar, Tempeh Flour, Nutritional Contents

### INTRODUCTION

Athlete performance is an indicator that determines success in a competition. An athlete is required to have good stamina to prevent fatigue during competition. However, athletes experience a decrease in stamina during matches, which impacts fatigue in a short time (Dieny et al., 2020). This impact occurs as a result of imbalances in nutritional intake. Nutritional imbalance still occurs even though nutritional management guidelines have been given to athletes (Irianto, 2017). Research by Pontang et al. (2020) states that the nutritional intake of soccer players is still categorized as very low because it only meets around 2350–2600 kcal of the total recommended needs. A similar statement said that PPLOP soccer and sepak takraw athletes had an energy intake level of 67.53%, which was included in the less category, and protein intake of 1.88%, which was also included in the less category (Santoso, 2016). Central Java PPLOP athletes have 5% energy, 5% protein, and 19% fat intake. The intake of all these nutrients is included in the deficient category (Mukarromah et al., 2017).

The significant deficit rate of nutritional intake in athletes cannot be separated from nutritional arrangements with various considerations, such as the type, schedule of administration, and the amount of intake according to the needs calculation (Ministry of Health, 2014). Several things need

to be considered related to the fulfillment of nutritional intake. Some of these things include adequate energy intake, high carbohydrate intake (about 60-70%), adequate intake of vitamins, minerals, and protein, low fat intake, and high fluid consumption. Therefore, foods that can be used as alternatives to athletes' snack bars, namely snack bars, can be considered. Snack bars are energy-dense and high in protein.

The development of snack bars uses tempeh flour as the main ingredient added to watermelon skin. Tempeh flour has a protein content of 48 grams per 100 grams of weight (Dianingtyas et al., 2018). High protein nutrients can help in the recovery of muscle damage and repair of athletes' body tissues. Watermelon skin is also known to affect VO<sub>2</sub>max repair because it contains one type of non-essential amino acid, citrulline. This study aims to determine the nutritional content of tempeh flour snack bars with watermelon peel and organoleptic tests as an alternative food interlude for athletes.

## **METHODS**

### **1. Location and Time of Research**

The research was conducted at the Department of Public Health Sciences Campus and Saraswanti Indo Genetech (SIG) Laboratory Semarang in June-November 2022.

### **2. Tools and Materials**

The ingredients used in making snack bars are tempeh flour, according to quality requirements according to SNI 1992. These quality requirements include having a typical aroma, color, and taste. Other ingredients used are Egyptian dates and watermelon peel, which are made into powder. Gas ovens, mixers, food scales, flour sievers, and molds are used.

### **3. Type and Design of Research**

This type of research is an experimental study with a Single, Factor Complete, Randomized Design research design. The study used three formulas with two repetitions. The organoleptic test involved 25 moderately trained panelists who were selected after conducting an interview selection. The nutritional content test was carried out at the GIS Laboratory, Semarang.

### **4. Research Procedure**

#### **Tempeh Flour Snack Bar**

Making tempeh flour snack bars includes preparation, implementation, and completion. The process of making tempeh flour is based on the method of Indrastati and Anjani (2016) with modifications. Tempeh cut to a thickness of 0.5 cm. Drying for 6 hours at 60°C using an oven to produce tempeh flour with a reasonable degree of whiteness. Then, additional ingredients, including eggs, sugar, milk powder, watermelon peel powder, dates, maizena, and margarine, are added. The dough is baked for approximately 30 minutes at a temperature of 60°C. The results of the snack

bar-making experiments will be carried out by packaging in a clean and tightly closed place and stored at room temperature.

**Organoleptic Test**

Panelists are placed in one room. Panelists faced three formulas with two repetitions (SBT 11, SBT 21, SBT 31, SBT 12, SBT 22, and SBT 32). Panelists are directed to understand the rules that have been provided. Then, panelists rated each formula with different codes. The assessment indicator is 1 = very dislike; 2 = dislike; 3 = somewhat like; 4 = likes; and 5 = very likes.

**Nutritional Content**

Tempeh flour snack bars were tested at the GIS Laboratory, Semarang. The nutritional content tested includes water content (AOAC 2005), ash content (AOAC 2005), protein (Kjehdhal), fat content (AOAC 2005), carbohydrate content (*by difference*), and energy content.

**Data Analysis**

Data was analyzed using IBM SPSS software. Univariate analysis is used to describe the characteristics of each variable, while bivariate analysis is used to determine the correlation between variables. Organoleptic tests were analyzed using the Kruskal-Wallis test. In contrast, nutritional content was analyzed using the One-way Anova statistical test with Duncan's Multiple Range Test (DMRT) with a confidence level of 95% or ( $\alpha=0.05$ ).

**RESULTS AND DISCUSSION**

**1. Organoleptic Test Tempeh Flour Snack Bar**

The following is the average table of hedonic tests of the tempeh flour snack bar, which includes control formulas, SBT 1, SBT 2, and SBT 3, with sensory parameters including color, aroma, texture, and taste.

**Table 1. Average Hedonic Test of Tempeh Flour Snack Bar**

Parameter	Mean Value of Hedonic Tests from Samples			
	Control	SBT1	SBT2	SBT3
Color	3.16±0.800 <sup>a</sup>	3.56±0.821 <sup>a</sup>	3.36±0.810 <sup>a</sup>	3.16±0.800 <sup>a</sup>
Aroma	3.16±0.987 <sup>a</sup>	3.56±1.003 <sup>a</sup>	3.16±1.028 <sup>a</sup>	3.32±0.900 <sup>a</sup>
Texture	3.36±0.860 <sup>a</sup>	3.36±0.860 <sup>a</sup>	3.36±0.810 <sup>a</sup>	3.16±1.106 <sup>a</sup>
Flavor	2.64±0.995 <sup>a</sup>	3.08±0.862 <sup>a</sup>	2.92±0.862 <sup>a</sup>	2.80±1.118 <sup>a</sup>

Information: 1 = very dislike; 2 = dislike; 3 = somewhat like; 4 = like; 5 = very like

<sup>a,b</sup> = similar letter notation means there is no noticeable difference in the Mann-Whitney test grade with a value of 5%

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Based on the table above, it can be seen that there are no significant differences between the color, aroma, texture, and taste parameters in each formula because it produces  $P > 0.05$ . The organoleptic test results on color showed that the SBT 1 formula had the highest favorability level, with an average of 3.56, and the lowest value in the SBT 3 formula, with an average of 3.16. The color difference in each formula is due to the caramelization process, which affects the brownness level of the product. Sucrose contained in dates causes the Maillard reaction, so a reducing sugar reaction with protein occurs due to the difference in oven temperature (Rohmawati et al., 2013).

The organoleptic tests on aroma showed that the SBT 1 formula had the highest favorability level, with an average of 3.56, and the lowest value in the SBT 2 formula, with an average of 3.16. The difference in aroma produced in each formula is influenced by heat exposure during baking and caramelization. This statement is supported by research on sensory evaluation of tempeh flour-based products that produce more robust aromas due to high heat exposure that releases volatile substances from dates, cocoa powder, and caramelization reactions (Andriani et al., 2019).

The results of organoleptic tests on texture showed that SBT 1 and SBT 2 formulas had the same favorability level with an average of 3.36, and the lowest value in the SBT 3 formula with an average of 3.16. The cause of snack bar texture still feels soft due to using a manual oven, so the temperature becomes unstable and results in an uneven snack bar roasting process. In addition, the resulting texture difference is also influenced by the time of the oven process and caramelization.

The organoleptic tests on taste showed that the SBT 1 formula had the highest favorability level, with an average of 3.08, and the lowest in the SBT 3 formula, with an average of 2.80. Tempeh flour snack bar has a bitter aftertaste. The bitter taste is caused by the Maillard reaction, which hydrolyzes amino acids both during the manufacture of tempeh flour and when opened products are made from tempeh flour. Amino acids in proteins that can cause a bitter taste include lysine, arginine, proline, phenylalanine, and valine. Among others, the most bitter amino acid is lysine (Kurniawati, 2012). This is in line with research, which states that the Maillard reaction causes the bitter aftertaste of tempeh flour biscuit products and dates, so it tends to be disliked by panelists. The bitter taste in biscuits can be suppressed by adding a concentration of dates and raisins to tempeh-based products (Sari et al., 2019).

## **2. Nutritional Content of Tempeh Flour Snack Bar**

The following is a table of nutritional content analysis in *tempeh flour* snack bars using the One Way ANOVA test, which includes water content, ash content, protein, fat, carbohydrates, and energy.

**Table 2. Nutritional Content of Tempeh Flour Snack Bar**

Treatment Group	Proximate Analysis Results					
	Water Content (bb%)	Ash Content (bb%)	Protein (bb%)	Fat (bb%)	Carbohydrate (bb%)	Energy (Kcal/100g)
Control	24.70±0.346 <sup>d</sup>	2.22±0.042 <sup>c</sup>	18.59±0.233 <sup>c</sup>	17.73±0.198 <sup>c</sup>	36.75±0.453 <sup>b</sup>	380.91±2.659 <sup>c</sup>
SBT1	19.05±0.035 <sup>a</sup>	2.45±0.021 <sup>a</sup>	14.94±0.403 <sup>a</sup>	14.29±0.283 <sup>a</sup>	49.29±0.742 <sup>a</sup>	385.49±1.188 <sup>a</sup>
SBT2	19.72±0.127 <sup>b</sup>	2.33±0.021 <sup>b</sup>	15.01±0.283 <sup>a</sup>	14.63±0.092 <sup>a</sup>	48.32±0.269 <sup>a</sup>	384.95±0.884 <sup>a</sup>
SBT3	23.22±0.099 <sup>c</sup>	2.47±0.028 <sup>a</sup>	13.34±0.368 <sup>b</sup>	13.04±0.099 <sup>b</sup>	47.93±0.396 <sup>a</sup>	362.44±0.778 <sup>b</sup>
<b>SNI Standard</b>	Max. 4%	2,65%	25 – 50%	1,4 – 14%	46,67%	120 kkal

Information: <sup>a,b</sup> = similar letter notation means there is no noticeable difference in Duncan's test level with a value of 5%.

Based on the results of the One-way ANOVA test in the table above, it was found that there was a significant difference between the nutritional content of tempeh flour snack bars in each formula. This shows the effect of watermelon skin in powder form on the nutritional content of snack bars made from tempeh flour. SBT Formula 1 has a smaller moisture content than other formulas because it is given an oven time of 30 minutes with a temperature of 60°C. This statement is in line with research on the chemical composition of snack bars that the high and low water content of snack bars is influenced by raw materials, shape, thickness, time, and baking temperature (Taula'bi et al., 2021).

The ash content contained in a food product indicates its mineral content. SBT 3 has the highest ash content, with an average of 2.47%. The decrease in ash content can be caused by using water in the processing process, so it affects mineral levels because it can dissolve in water. This statement aligns with research on making snack bars as a high-calorie source, which explains that the decrease in ash content can result from using water during the processing process and reduce the availability of minerals. This is because minerals are soluble in water. The decrease in ash content can also be caused by using raw materials (Dwi et al., 2021).

The results of the One Way ANOVA test showed that there was a significant difference ( $P < 0.05$ ) in each formula. Based on further DMRT tests, the highest protein content was found in the SBT 2 formula, where the average reached 15.01%. Compared with the standard protein content according to SNI, which is 25-50% in 100 gr of ingredients, all treatments have not met the standard. The decrease in protein levels in snack bars is caused by ingredients and the time and temperature used during baking. This statement is supported by research stating that raw materials influence a product's high protein content and additives such as milk and eggs (Taula'bi et al., 2021). The addition of egg yolk and milk can increase protein levels. However, researchers only added eggs to get the texture of the snack bar.

The highest fat content is found in the SBT 2 formula with the addition of the minor watermelon peel powder, with an average of 14.63%. Compared to the SNI standard on *snack bars*,

which ranges from 1.4-14%, the SBT 2 formula meets the standard. The availability of fat content in tempeh flour snack bars is produced due to the use of eggs and margarine.

The highest carbohydrate content is found in the SBT 1 formula, with an average of 49.29%. Compared with SNI quality requirements of around 47.67%, the SBT 1 formula contains high carbohydrates. Besides coming from tempeh flour, carbohydrates are also found in dates. The high and low carbohydrate content in tempeh flour snack bars is influenced by the length of baking time and the high temperature used. This statement aligns with research stating the low availability of carbohydrates in products due to the Maillard reaction and roasting process (Taula'bi et al., 2021).

The highest energy content in SBT formula 1 with an average of 385.49 kcal. Compared to the SNI standard on snack bars, which ranges from 120 kcal, the SBT 1 formula can contain high energy. High levels of protein, fat, and carbohydrates influence the high energy content of snack bars. This results from IOM (2002), which states that energy is derived from carbohydrate, fat, and protein metabolism. The higher the content of carbohydrates, proteins, and fats in a product, the higher the energy content obtained (Rinda et al., 2018).

The best formula is determined using the exponential comparison method (MPE) on each variable by giving weight to determine alternative priority sequences. The highest weighting focuses on protein and energy levels. The best formula results can be seen in Table 3.

**Table 3. Determination of the Best Tempeh Flour Snack Bar Formula**

Parameter	Weight	Formula					
		SBT1		SBT2		SBT3	
		Rank	Score	Rank	Score	Rank	Score
<b>Water</b>	5%	1	0,05	2	0,1	3	0,15
<b>Ash</b>	10%	2	0,2	3	0,3	1	0,1
<b>Protein</b>	40%	2	0,8	1	0,4	3	1,2
<b>Fat</b>	5%	2	0,1	3	0,15	1	0,05
<b>Carbohydrate</b>	10%	3	0,3	2	0,2	1	0,1
<b>Energy</b>	30%	3	0,9	2	0,6	1	0,3
<b>Total Score</b>	100%	-	2,35	-	1,75	-	1,9
<b>Ranking</b>	-	<b>1</b>		<b>3</b>		<b>2</b>	

The best formula is chosen from the highest protein content category because tempeh flour snack bars have high protein content. In addition to protein content, another parameter that is given high weight is the total energy. The highest total protein and total energy content is SBT 1. Then for water content, the lowest score was obtained in the SBT 1 formula, while the ash content obtained the highest score in the SBT 3 formula. Based on the calculation of the score x weight, SBT 1 gets

rank 1, SBT 2 gets rank 3, and SBT 3 gets rank 2. Based on this, it can be concluded that the best formula is SBT 1 tempeh flour snack bar with the addition of watermelon peel powder of 6 grams.

## **CONCLUSION**

Based on the results of the study, it can be concluded that there is no significant difference in the organoleptic assessment of tempeh flour snack bars with parameters of color, aroma, texture, and taste. However, only the SBT 1 formula has the highest average favorability on color and aroma parameters. Based on the Snack Bar Quality Standard according to SNI 0-4216-1996, tempeh flour snack bars are high in energy and protein, so they can be consumed because they are close to meeting the energy intake of athletes by 10% of the total needs. Snack bars also provide a feeling of fullness longer. The best formula for tempeh flour snack bar products using the exponential comparison method (MPE) is SBT 1 with the addition of watermelon peel as much as 6 gr with a total energy content of 385.49 kcal / g and protein of 14.94%. Based on the approach to calculating the Daily Value (RDA) of athletes, which on average ranges from 3500 kcal and at least 10% of which is contributed by snacks, SBT 1 snack bar products contribute 11% of energy. Suggestions that can be given from researchers are further research on testing citrulline levels contained in watermelon skin as additional nutritional information because it contains antioxidants that are good for the body. In addition, further research is recommended to increase protein levels and eliminate bitter aftertaste from tempeh flour-based snack bars.

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