

ANALYSIS OF THE COMPARISON OF SAGA SEED TEMPEH WITH SOYBEAN TEMPEH ON THE PROXIMATE QUALITY VALUE OF THE PRODUCT

Saddam Husein Hasibuan, Alfi Asben* and Deivy Andhika Permata

Department of Agricultural Industrial Technology, Faculty of Agricultural Technology, University of Andalas, West Sumatra, Indonesia,

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CORRESPONDING AUTHOR

*Email: alfi_asben@yahoo.com

ABSTRACT

Tempeh is one of the favorite foods of Indonesian people. But as the population increases, the need for tempeh has also increased while the raw material in tempeh processing, namely soybeans, is not sufficient for tempeh producers. apart from soybeans, tempeh can be made from other raw materials such as saga seeds. this is because saga has a higher protein content than soybeans. To optimize the utilization of saga, it is necessary to compare soybean tempeh to saga tempeh produced. This study aims to assess the difference between soybean tempeh and saga tempeh. The research design was to compare soybean tempeh with saga tempeh using the Independent T-test. The results obtained were then analyzed using the SPSS program. The results showed that the comparison of saga and soybean tempeh had a significant effect ($p < 0.05$) on protein, moisture content, crude fiber, flavonoids, and texture. However, there was no significant effect ($p > 0.05$) on ash content and fat content.

1. INTRODUCTION

1.1. Research background

Tempeh is a traditional Indonesian food fermented by the mold *Rhizopus* sp. Its relatively low price, good functional properties, and high protein content make tempeh increasingly favored by various levels of society. Tempeh is generally made from soybean raw materials. Soybean tempeh has nutritional content in the form of protein 20.8g, carbohydrates 13.5g, fat 8.8g, vitamin B1 0.19 mg, calcium 155 mg, and fiber [1]. However, the utilization of soybeans as raw materials is hampered by the low production of soybeans in Indonesia, so it is necessary to import to increase the availability of soybeans in the market. Therefore, there is a need for substitute raw materials to solve the problem. The fulfillment of raw materials with lower prices and the same nutrition, especially protein content. One alternative raw material in

the tempeh processing process is saga tree seeds (*Adenanthera pavonine* L).

Saga seeds (*Adenanthera pavonine* L) are a source of nutrients such as carbohydrates and protein [2]. Saga seeds have the potential to be used as a better source of protein than soybeans [3]. [3]. And has a shape similar to soybeans [2]. [2], informs that saga has a protein content of 48.2% found in dry seeds. Saga seeds also contain flavonoids and steroids that are beneficial as antioxidants for the human body. [4]. [5] conducted research on making tempeh saga and jackfruit with the results of protein 22.75%, water content 61.35%, ash 1.12% and fat 5.30%. Based on the above statement, it is necessary to compare soybean tempeh with saga tempeh to see the potential of saga seeds as raw material in tempeh processing. In this study, saga tempeh was compared with soybean tempeh using the independent T test.



1.2. Literature Review

1.2.1. Tempeh

Tempeh is a typical Indonesian food made by fermentation. According to SNI 3144: 2015, tempeh is a white solid made from peeled soybean seeds that have been cooked and fermented with *Rhizopus* sp. *Rhizopus oryzae* and *Rhizopus oligosporus* are fungi commonly used in tempeh processing [6].

Tempeh has a distinctive white color due to the growth of fungal mycelia that bind together between soybean seeds to form a dense texture. According to [7] the mycelia produced by tempeh during fermentation binds the grains, thus giving the fermented food a solid texture. The degradation that occurs in the components of soy during fermentation causes the appearance of the distinctive flavor of tempeh. [6].

[8] stated that tempeh from fermented soybeans has a higher protein content than those that do not go through the fermentation process. Tempeh is rich in bioactive substances and important nutrients that support digestive, circulatory, and respiratory health [1].

1.2.2. Independent sample T-test

Independent sample t-test is a statistical method used to compare the means of two unrelated or independent samples. This test is used when you have two sets of data taken from different populations and there are no subjects in common between the two samples. Independent sample t-test is also referred to as unpaired t-test [9]. The independent sample t-test or unpaired t-test is a statistical method used to compare two groups of samples that are not statistically related. This t-test is used to determine whether there is a significant difference between two groups in terms of the mean value of a variable. Independent sample t-test is used to test the significance of the difference between the means of the two groups. This test is used to test the effect of the independent variable on the dependent variable. This independent T-test has assumptions/conditions that must be met, namely: (1)The data is normally distributed.; (2) Both data groups are independent (free) [9].

1.3. Research Objectives

This research aims to (1). This study aims to assess the difference between saga tempeh and soybean tempeh using the Independent T-test method following the SNI tempeh standard.

2. MATERIALS AND METHODS

2.1. Research Location

This research took place in the Laboratory of Biochemistry of Agricultural Products and Food Nutrition, Laboratory of Agricultural Products Technology and Engineering, Laboratory of Microbiology and Biotechnology of Agricultural Products and Instrumentation Laboratory of the Faculty of Agricultural Products Technology, Andalas University.

2.2. Materials and Tools

The materials used in this study were saga tree seeds obtained in Panam, Tampan District, Pekanbaru. Soybeans from Kuranji District, Padang. Raprima brand Tempe yeast, NH₄OH, distilled

water, NaOH 40%, AlCl₃, and others. Equipment used in this study, namely glassware, stove, pan, basin, stirrer, knife, stainless steel pot, aluminum cup, oven, coffee roasting machine, desiccator, ultrasonic bath, centrifuge, spectrophotometry, filter paper, blender, spatula, scale, tongs, hand sealer.

2.3. Research Design

Conduct a comparative test of saga tempeh with soybean tempeh. Then the quality of the product using an independent T-test with a confidence level of 95%. From the results of the T-test, it can be stated that there is a significant or insignificant difference. The value is declared significant if ($p < 0.05$), and insignificant if the value ($p > 0.05$).

2.4. Research Procedure

Saga seed raw materials obtained are sorted. The seeds that have been sorted are then washed thoroughly so that no more dirt sticks to the saga seeds. Saga seeds were soaked with 2.5% NaHCO₃ solution (boiling at 70°C for 10 minutes and soaking in NaHCO₃ solution for 24 hours), and without treatment with soybean raw materials. Saga and soybeans were then stripped of the epidermis and shell, after which they were soaked in water for 12 hours. During the soaking process, the pH was measured to range from 4.5 to 5.5. The soaked saga and soybeans were then boiled at 70 °C for 10 minutes until soft. Saga and soybeans are air-dried so that the water in the raw materials is reduced and easy in the process of giving yeast. Inoculation is done by sprinkling yeast on the surface of saga and soybeans as much as 1% of 100 g of the material used. The wrapper used for tempeh fermentation was plastic. The fermentation process was carried out with a fermentation time of 36 hours. The packaged tempeh was placed at room temperature ranging from 25-37°C [10].

2.5. Analysis Method

The analysis observed in this study such as moisture content using the oven method, ash content using the sooting method, protein content using the Kjeldahl micro method, fat content using the soxhlet method, crude fiber content using gravimetry [11], flavonoid content using the Wilstetter test [12], and texture with the Brook Field Texture Analyzer [13].

3. RESULTS AND DISCUSSION

3.1. Saga Tempeh and Soybean Tempeh

Saga tempeh from this study has the appearance of soybean tempeh, which has a white color all over the surface of the tempeh which is the mycelia of *Rhizopus* sp. The fermentation process of saga tempeh lasts according to the fermentation process of soybean tempeh, which is 36 hours. The results of tempeh from this study are presented in Figure 1.

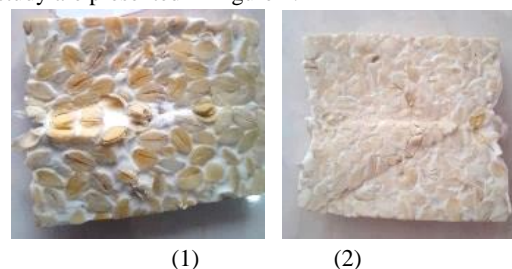


Figure 1. (1) saga tempeh, (2) soybean tempeh

Furthermore, saga tempeh and soybean tempeh were compared in terms of protein, water content, ash content, fat, crude fiber, total flavonoids, and texture of tempeh. After that, it was compared using the independent T-test. The results obtained were significantly different if ($p < 0.05$) and not significantly different if ($p > 0.05$). The results of the comparative test are presented in Table 1.

Table 1. Comparative Test of Saga Tempeh and Soy Tempeh

Chemical Composition	Saga Tempeh	Soybean Tempeh	Significance
Protein (%)	23.12	19.19	0.01*
Moisture content (%)	62.02	63.31	0.018*
Ash content (%)	1.02	1.10	0.297
Fat (%)	7.99	7.22	0.152
Crude fiber (%)	2.46	3.47	0.038*
Flavonoids (mgQE/g)	34.95	24.30	0.001*
Texture (N/cm ²)	41.71	46.10	0.001*

Notes: *: states significantly different ($p < 0.05$)

After testing the independent T-test on saga tempeh and soybean tempeh, the protein content of saga tempeh and soybean tempeh showed significant differences at the 5% level. Saga tempeh showed a protein content of 23.12% higher than soybean tempeh of 19.19%. This is following research [14], the protein content of saga tempeh is 26.42% while soybean tempeh is 21.90%. In the process of boiling and soaking the protein content contained in soybeans and saga will decrease with the high heating temperature.

Based on the results of the variance analysis conducted, it can be seen in Table 1 that the water content of saga tempeh is lower than the water content of soybean tempeh. Saga tempeh contains a moisture content of 62.02% and soybean tempeh has a water content of 63.31%. These results showed significantly different results on the water content of saga tempeh and soybean tempeh. Based on the data obtained, the water content of saga tempeh and soybean tempeh follows SNI 3144-2015. Moisture content in food is often associated with an index of stability, especially in food storage. The higher the moisture content of food, the easier it is for microbes to grow [15]. Ref. [16] added that water activity determines the quality of the food produced and is related to the shelf life of the food.

The ash content of saga tempeh and soybean tempeh from Table 1 shows that the results of variance are not significantly different between the two tempeh. Saga tempeh has an ash content of 1.02% and soybean tempeh has an ash content of 1.10%. Based on SNI 3144-2015, the ash content of saga tempeh and soybean tempeh is following the standard with a maximum ash content of 1.5%. Ash content is the result of combustion in the form of mineral remains that are not burned out [17]. Ref. [18], added that the amount of ash produced shows the total minerals in a material. Minerals present in foodstuffs can be in the form of organic salts and non-organic salts.

Table 1 also shows that the fat content of saga tempeh and soybean tempeh showed no significant difference. The fat content of saga tempeh was 7.99% and the fat content of soybean tempeh was 7.22%. Fat is a nutritional substance that is needed by the body both essential and non-essential which all exist in nature and are easily soluble in organic solvents but not easily in water. This research is following the research of Haryoko and [14], stating

that the fat content of saga seeds is higher than soybean seeds, namely 22.6% and 14.1%.

Furthermore, based on Table 1, it also shows that the crude fiber content of saga tempeh is significantly different from the fiber content of soybean tempeh. The crude fiber content of saga tempeh was 2.46% while the crude fiber content of soybean tempeh was 3.47%. Crude fiber is part of food that cannot be hydrolyzed by chemicals or strong acids and strong bases. [19], said that crude fiber is very important in assessing the quality of food ingredients because it can determine the nutritional value of these foods. Dietary fiber is only found in plant foods and its levels vary according to the type of food. Fiber levels in food can change due to processing carried out on the original material.

The total flavonoid content of saga tempeh is significantly different from the flavonoid content of soybean tempeh which can be seen in Table 1. Flavonoids of saga tempeh amounted to 34.95 mgQE/g while soybean tempeh amounted to 24.30 mgQE/g. This shows that saga tempeh is comparable to soybean tempeh in terms of the content of phenol compounds, one of which is quite prominent is flavonoids. In this study, the decrease in flavonoid levels was due to flavonoids not resistant to heating with high temperatures. The longer the boiling, the lower the antioxidant activity. The maximum temperature that can be used to maintain the antioxidant activity of an ingredient is 70°C.

Analysis of variance in Table 1 shows significantly different results on the texture of saga tempeh and soybean tempeh. The texture of saga tempeh was 41.71 N/cm² and soybean tempeh was 46.01 N/cm². The hardness of food is influenced by the high and low water content in the food. The higher the water content, the softer the tempeh produced, as well as if the water content in the tempeh is lower, the tempeh looks harder. [20] states that the water content contained in food affects its texture, appearance, flavor, and shelf life.

4. CONCLUSIONS

Based on the results of research and data analysis conducted using the independent T-test method, it can be concluded that saga and soybean tempeh are significantly different ($p < 0.05$) in protein content, moisture content, crude fiber, flavonoids, and tempeh texture. However, it was not significantly different ($p > 0.05$) on the ash content and fat content of tempeh. The use of saga seeds can be promoted as a raw material for making tempeh to replace soybeans..

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