

# Organoleptic Characteristics of Tempeh from Durian Seed (*Durio zibethinus* Murr) as Alternative Raw Material

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**Abstract:** Durian seeds have a high starch content, making it possible to be used as a raw material for making tempeh as an alternative to soybeans. This research aims to make tempeh using durian seeds as raw material and determine the taste of durian seed tempeh using organoleptic tests. The method used to make tempeh from durian seeds is by fermentation, the durian seed samples are washed, cleaned, then boiled and the hard skin removed, then sliced and steamed until soft. The final stage of the two-day fermentation process continues with packaging. To determine suitability for consumption, an organoleptic/taste test (color, taste, texture and aroma) is carried out. The panelists who determined the taste consisted of several people from the Chemistry Study Program, FKIP UNTAD. The results of the study showed that durian seed tempeh was less white compared to soybean tempeh. The panelists' organoleptic tests for color liking levels stated that they liked 50% and disliked 50%, for taste 60% liked, 10% and disliked 30%, and texture panelists stated that they liked 60% and disliked 40% and 70% liked the aroma and 30% disliked it. The conclusion obtained in this research is that durian seeds can be used as an alternative for making tempeh and can reduce durian seed waste.

**Keywords:** Durian seeds; Tempeh making; Taste.

## Introduction

Durian (*Durio zibethinus* Murr) is a very popular fruit in Indonesia. This fruit, known as The King of fruits, belongs to the family Bombacaceae, and is widely found in Parigi and Moutong Regencies, Central Sulawesi Province. Local durians in the area have the characteristic of large seeds (pongge), but are in great demand by consumers, because of their delicious, soft and fragrant taste. Durian fruit that is usually consumed is only the coated part of the fruit or the flesh. The percentage of meat weight is low, only (20-35%). Durian skin and seeds have not been used optimally. During this pandemic, many people are looking for work to make ends meet. Some people consume the seeds by burning, steaming or boiling. In fact, if further processed durian seeds can be useful as raw materials for various processed foods, so that it will provide added value (Djaeni & Prasetyaningrum, 2010). The most durian-

producing areas in Central Sulawesi are on the west coast and east coast (Parigi Mutong Regency). So far, the seeds have not been widely used. In times of crisis like now, an innovation is needed to create new food products that have high nutritional value and are suitable for consumption with ingredients such as durian.

Durian fruit, which is one type of fruit that has long been developed and planted in the Central Sulawesi region, is very popular with the public because it has a delicious taste and distinctive aroma. However, there are parts of the fruit that have not been utilized, including the seeds. Therefore, it is necessary to strive for the use of these seeds as food book materials.

Durian seeds have a high starch content, so they are an alternative carbohydrate food source. So far, durian seeds have not been widely used, generally eaten as a snack after being boiled. Durian seeds can be processed into flour which has the potential as an alternative

## How to Cite:

**Example:** Susilawati, S., Doyan, A., Mulyadi, L., & Hakim, S. (2019). Growth of tin oxide thin film by aluminum and fluorine doping using spin coating Sol-Gel techniques. *Jurnal Penelitian Pendidikan IPA*, 1(1), 1-4. <https://doi.org/10.29303/jppipa.v1i1.264>

carbohydrate source for people with diabetes mellitus (Ningsih et al., 2020). In addition, durian seeds are also used as edible films because of their high carbohydrate content (Rahmawati et al., 2021). Ripe durian seeds contain 46.2% carbohydrates, 2.5% protein, 0.2% fat, and 51.1% water. This carbohydrate content is higher than cassava which has a carbohydrate content of 34.7%, or sweet potato carbohydrates by 27.9% (Djaeni & Prasetyaningrum, 2010; Nuryanti et al., 2024). The high carbohydrate and protein content in durian seeds allows it to be used as a raw material for making tempeh and is very possible as an alternative to soybeans.

Tempeh is a traditional food, which is rich in nutrition and healthy, because of its protein, fiber, vitamins, minerals, probiotics and antioxidant content. The manufacturing process is carried out using simple household equipment, does not require special skills and requires relatively little capital. Tempe is a food produced through fermentation techniques by the fungus *Rhizopus* sp or also called tempeh fungus. The fermentation process by the fungus *Rhizopus* sp also provides additional nutritional value and increases the availability of several important nutrients (Kariluoto et al., 2004; Wikandari et al., 2021).

Fermentation is the most important step in the process of making tempeh. In the fermentation process occurs the formation of bubbles of CO<sub>2</sub> and energy as a result of catabolism of sugar in the soybean anaerobically into simpler compounds. Biochemically, fermentation can be defined as the formation of energy, through the catabolism of organic compounds by utilizing microbes, while in the industrial field, fermentation is the process of utilizing microbes to produce a product.

The current fermented product that is very familiar in the community is tempeh. This fermented product is popular not only by people in the village but also by various upper classes and even abroad. In addition to its high nutritional content, low prices and easy to find in supermarkets to small shops. Tempe is an important food ingredient for the people of Indonesia and abroad, because it is easily processed into various kinds of ready-to-eat foods. So far, only tempe on the market is made from soybeans (Rahmi, 2019).

Recently, soybeans are relatively expensive, so that it affects the price of tempeh, which is the community's favorite food. One of the ingredients for substitution of soybeans that is very possible is durian seeds, because the carbohydrate content is quite high. In addition, the protein content is 2.5% and low fat content of about 0.2%. The high carbohydrate content and sufficient protein make it possible to use durian seeds as raw material for making tempeh as a substitute for soybeans.

Based on this fact, researchers are interested in studying durian seeds as a raw material for making

tempeh and analyzing the organoleptic aspects and taste of the resulting tempeh.

## Method

### *Tools and Materials*

The tools used are simple tools such as stoves, scales, collisions, boiled and steamed boilers, basins, porcelain mortars, sieves, banana leaves, plastic, needles. The materials used are durian fruit seeds obtained from the waste of durian sellers at the durian market in Palu City, other materials for comparison are soybeans purchased from the Impres market, and traditional yeast (made by the researcher himself).

### *Work Procedures*

#### *Making Yeast Tempe*

Tempeh that has been made (white in color) is taken from the surface (which has a lot of mold) by using a thin layer. Then dried in the sun for 2-3 days until completely dry. Then ground, then sifted until it becomes powder and ready to use.

#### *Making Tempe from Durian Seeds*

Durian seeds are washed with clean water, then drained, then dried in the sun for 4 days to dry. Dried durian seeds were weighed as much as 1 kg, then boiled until cooked, then removed the skin, then washed until the mucus disappeared. After that it was sliced into small pieces as big as soybeans. The next step is steamed again, the steering wheel is cooled, by blowing it in front of a fan until it cools down. Furthermore, the fermentation process is carried out using 1 g of yeast. Then wrapped in banana leaves and then cured (fermented) for 2 days.

#### *Making Durian Seeds Tempeh*

The process of making tempeh follows the procedure of Mulyowidarso (Mulyowidarso et al., 1990) which was modified by the author in the fermentation process (using yeast made by the researcher) and the packaging process using plastic. The comparison of soybeans and yeast is made the same as making tempeh from durian seeds.

### *Organoleptic Tests*

Organoleptic tests carried out were taste, color, taste, texture and aroma tests. As many as 20 students of Chemistry Education and the general public as fannels. The research flow diagram can be seen in Figure 1.

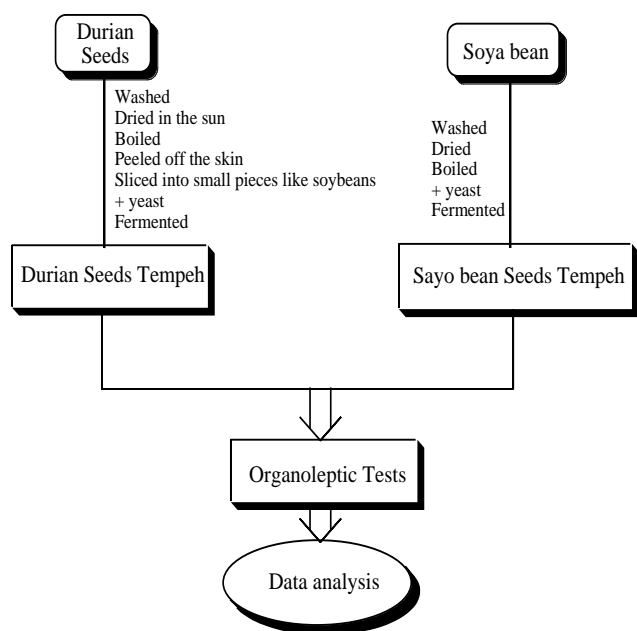


Figure 1. The research flow diagram

## Result and Discussion

### Making Yeast

The tempeh yeast produced from this study is shown in Figure 2. Yeast is made with white soy tempe as raw material.

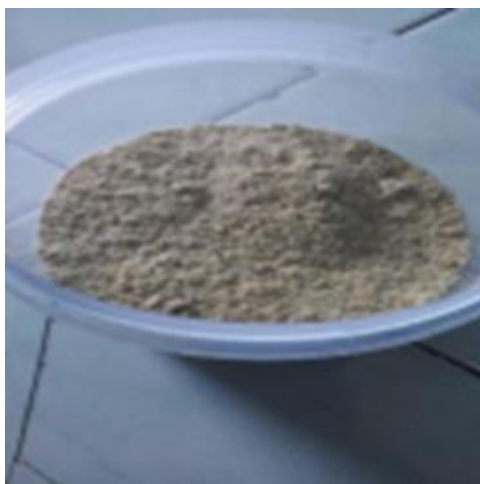


Figure 2. Yeast made from soybean tempeh

Yeast has long been suspected of being involved in tempe fermentation (Surono, 2016). Yeast is obtained from white tempeh mushrooms from the surface of soybean tempeh. Tempe is made as yeast from fermentation using the fungus *Rhizopus oligosporus*, so it is assumed that the yeast or fungus obtained from this research is the fungus *Rhizopus oligosporus*. Some yeasts were also found in marketed tempeh and during soaking soybeans for the manufacture of tempeh, but

fungi/yeasts found in soaking soybeans were not found in tempe products, this was due to damage after heating, namely during boiling/steaming. If yeast is able to grow and interact with other microflora during fermentation, it is possible that yeast has a role in improving the nutritional quality and flavor of tempeh (Kustyawati, 2009).

### Making Soybean Tempeh

Tempe from soybean seeds produced as shown in Figure 3, making tempe following the procedure of Mulyowidarso (Mulyowidarso et al., 1990) which was modified using yeast made by the researcher himself.



Figure 3. Soybean tempeh made with research yeast

Tempe from soybean seeds was made as a comparison from durian seed tempe, the treatment was made the same and in the same time. In terms of color, soybean tempeh and durian seed tempeh are different. White warrants were evenly distributed for soybean tempeh, while durian seeds were less evenly distributed (2 day fermentation). Organoleptic tests that need to be done include, color, taste, texture and aroma (Ari & Priambudi, 2020). Table 1 shows the results of the soybean tempeh taste test and durian seed tempeh.

One of the most potential sources of isoflavones in fermented foods is soybean tempeh. Isoflavones in soybean tempeh are free isoflavones or aglycones of gynestein and daidzein (Figure 4). It is a free aglycone because it has undergone hydrolysis during fermentation (Kustyawati, 2009).

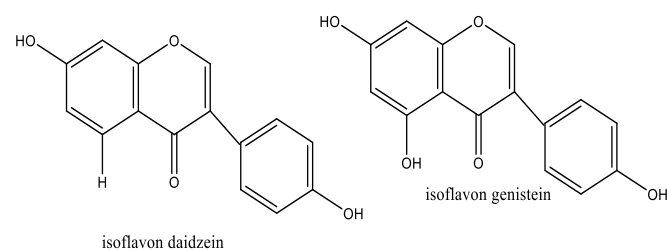


Figure 4. Isoflavone daidzein and genistein (Harborne, 2006)



**Table 1.** Soy Tempeh and Durian Seed Tempeh Taste Test

Organoleptic Tests	Durian Seed Tempeh				Soy tempeh			
	Really Like (%)	Like (%)	Not Like (%)	Very Dislike (%)	Really Like (%)	Like (%)	Not Like (%)	Very Dislike (%)
Color	-	50	50	-	80	20	-	-
Taste	60	10	30	-	90	10	-	-
Texture	-	60	40	-	68	32	-	-
Aroma	-	70	30	-	-	90	10	-

Results of the assessment of panelists to taste the percentage which really likes to be in the highest rank, this indicates that the yeast made by the researchers is good enough to make tempeh from soybeans as raw materials. The yeast produced can be said to be a very high producer of extracellular lipolytic and proteolytic enzymes (Strauss et al., 2001; Esteves et al, 2014; Vakhlu, 2006).

*Making Tempe from Durian Seeds*

Durian seed tempeh is made after fermenting for one day as shown in Figure 5 (fermented for a day), Figure 6, after being fermented for two days, while Figure 7 durian seed tempeh after frying.



**Figure 5.** After being fermented for one day

Fermentation within a period of one day (24 hours) obtained results that were not perfect, because the growth of fungi was less or not evenly distributed. In addition, it is characterized by the resulting tempe that is not yet compact (not yet solid or chewy), and still tastes sour which indicates that the fermentation has not been completed (Mulyowidarso et al., 1990).



**Figure 6.** After being fermented for two days

Fermentation in a period of two days (2x24 hours) obtained perfect results, because the growth of the fungus was evenly distributed. In addition, it is characterized by the resulting tempeh which is solid or chewy, and does not taste sour, which indicates that the fermentation is complete (Mulyowidarso et al., 1990). The sour taste in tempeh is usually also caused when washing is not clean. Besides causing a taste with a low pH, it also accelerates spoilage.



**Figure 7.** After frying

*Color Tempe Seeds Durian*

Based on Table 1 color test, panelists were like to the color as much as 50%, this is because at the time of making the tempeh, the durian seeds used are already brownish in color, resulting in the resulting tempe not giving an attractive color. Besides that, the possibility of cleaning time is not paying attention to the epidermis that is still attached to the surface of the seeds, this can also be the cause of the bad color of the tempe produced. The color quality of durian seed tempeh is also largely determined by the quality of the seeds called tempeh. Therefore, the durian seeds to be made into tempeh must be of high quality.

The resulting tempe has almost the same characteristics as soybean tempe. Physical differences can only be seen from the color and size of the mold mycelium. The color produced from durian seed tempeh is white, uneven and slightly brownish accompanied by fungus/mold which only grows a small part and

unevenly, this is due to the lack of good mixing during fermentation. According to the panelists' perception, after frying, it is slightly dark brown in color and absorbs oil very well, unlike the usual tempeh (soybean tempeh). This condition is areaction browning non-enzymaticthat occurs between reducing sugars and amino acids that produces a brownish color in foodstuffs when subjected to the heating process(Buzzini & Martini, 2002; Syukri et al., 2022). The duration of fermentation and the addition of yeast will determine the quality of the resulting tempe (El Romadhon & Utomo, 2019).

*The Taste of Tempe Seed Durian*

Taste according to panelists who stated that they didn't like it was only 30%, while those who really liked it were 60% and those who liked it were 10%. The distinctive taste of tempeh is due to the degradation of the components in tempeh during the fermentation process. The distinctive taste of delicious tempeh is not sour. The sour taste that arises is due to washing that is not clean, thus affecting the resulting taste. The test results of making durian seed tempeh packaged using banana leaves were favored by the panelists. Panelists liked the taste of durian seed tempeh and the taste that was obtained was soft like tubers and when it broke in the mouth with a distinctive taste.

**Table 2.** Taste Test of Durian Seed Tempe

Tempeh type	Materials	Material price/Rp	Total production cost/Rp	Description
Soybean tempeh	Soybean 2 kg	44.000,-	72.500;	Production costs are very cheap because the raw material for making tempeh from durian seeds is not purchased, only the cost of cleaning 2 kg of durian seeds costs Rp. 5,000, -
	Kerosene 1.25 L	13.500,'		
	Cost of labor	15.000,		
	Tempeh yeast	2.000;		
Durian seed tempeh	Durian seeds 2 kg	Not purchased (waste)	31.500;	
	kerosene 1.25 L	13.500;		
	Cost of labor	20.000;		
	Tempe yeast	2.000;		

The frying process that uses oil causes the tempeh to taste more savory (Wihandini et al., 2012; Ahnan et al, 2021; Matsuo, 2006). Apart from being a heat-conducting medium, cooking oil also serves to add flavor and calories to food. In addition, there is a distinctive aroma of tempeh packed with banana leaves which is thought to contribute to the delicious and distinctive taste of fried durian seed tempeh.

*The Texture of Durian Seed Tempeh*

The results of the assessment from the panelists stated that 60% liked durian seed tempe and 40% disliked it, their comments were a bit harsh unlike soy tempeh. The quality of the texture of tempeh using durian seeds has a slightly hard texture, good tempeh, namely tempeh looks hard and not dry, tempeh made with a ratio of 1 kg of durian seeds and 1 g of yeast produces a slightly hard texture because it is influenced by the basic ingredients. However, durian seed tempeh still shows a dense texture and does not fall out. The standard characteristic of a good tempeh product in terms of texture is compact, if it is sliced it remains intact it does not fall out easily (SNI 3144–2015 Soybean Tempeh, 2015). Observing the characteristics of soybean tempeh, the texture is dense and compact so that when cutting it can be sliced perfectly, when frying soybean

tempeh the texture is the same as durian seed tempeh when it breaks in the mouth, it is crispy and tasty.

The process of making tempe according to (Nurrahman et al., 2012) the texture is strongly influenced when boiling using excessive water. In the manufacture of tempeh, it can result in inhibition of oxygen demand into soybeans, which can inhibit the growth of tempeh fungi, causing fungal mycelia that connect soybean seeds to one another unevenly and the texture of tempeh is not dense. Meanwhile, the incomplete draining of soybeans can inhibit the diffusion of oxygen into soybeans, thereby spurring the growth of contaminant bacteria that can cause spoilage and damage the aroma of tempeh.

*The Aroma of Tempeh with Durian Seeds*

Panelists/respondents stated that they liked 70% and disliked 30%, while for tempeh from kedelsi 90% liked and 10% disliked. The aroma of durian seed tempeh is favored by its aroma, because it uses yeast derived from molds/mushrooms from soybean tempeh, so there is a similarity in the aroma of soy tempeh. Besides the influence of yeast is also influenced by the length of fermentation. Fermentation time is too long will cause bad aroma or bad smell (Irna et al., 2020; Tang & Li, 2017; Christoph & Bauer-Christoph, 2007). The

fermentation process will cause chemical and physical changes that change the appearance, shape and flavor of the original food ingredients. The longer the fermentation process, the higher the fermentation temperature (Mulyowidarso et al., 1990; Sharma et al., 2020; Teoh et al, 2024). This high temperature resulted in an increase in the hydrolysis process of a compound by the fungus *Rhizopus* sp which resulted in the distinctive aroma of tempeh (Yarlina et al., 2023; Jelen et al, 2013). The distinctive aroma is produced by the presence of lipoxidase enzymes in tempeh raw materials. This enzyme hydrolyzes or decomposes soybean fat into compounds that cause a distinctive odor (Kustyawati, 2009).

## Conclusion

Based on the results of the research conducted, it can be concluded that: Durian seeds can be used as an ingredient in making tempeh, so it is very possible to use it as a substitute for making soybean tempeh. The characteristics of the tempeh produced are that the color is uneven white, has a distinctive taste (60% of panelists really like it and 10% like it), the texture is dense and the slices don't fall apart (60% of panelists really like it), and the aroma of durian seed tempeh is liked by 70% of panelists. The fermentation conditions that produce optimal organoleptic characteristics of durian seed tempeh are a fermentation time of two days with the addition of one gram of yeast. This research is initial research, it is hoped that further studies can be carried out with various variations in fermentation time and the addition of yeast as well as statistical studies.

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## Author Contributions

Siti Nuryanti, Sitti Rahmawati, Sriyulaningsi: conceptualization, analysis, methodology, discussion, conclusion, visualization, investigation, writing original draft, and proofreading; Magfirah: editing and review.

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## Conflicts of Interest

The authors declare no conflict of interest

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