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Research Article

Proximate content and organoleptic levels of tempeh cowpeas from Southwest Maluku

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ABSTRACT

Cowpea (*Vigna unguiculata* L. Walp) is a type of bean that is well known and developed in Indonesia. One area in Indonesia that has the potential for these nuts is Southwest Maluku. Utilization in local communities is still limited. Therefore, the development of food products such as tempeh is considered. In making tempeh, the dosage of yeast determines the success of fermentation. To be suitable for consumption, nutritional and organoleptic composition testing is required. Thus, this research aims to analyze the proximate and organileptic levels of tempeh made from cowpeas from Southwest Maluku. The study used a Completely Randomized Design treatment with a yeast dose of 0.1 g; 0.2g; 0.4 g repeated 3 times. The data obtained were analyzed using the Anova test (one way) and continued with the DMRT test on SPSS software version 26.0. The research results showed that yeast dosage had a significant effect on ash, fat and fiber content and had high organoleptic value. Treatment two (P2) has a high nutritional composition and the best organoleptic value compared to other treatments. Thus, tempeh made from cowpeas from Southwest Maluku with a yeast dose of 0.2 g can be recommended for development as a food product for the people of Southwest Maluku.

Keywords: cowpea, organoleptic levels, proximate content, Soutwest Maluku

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INTRODUCTION

Indonesia is a country with high biodiversity, one of which is the cowpea (Vigna unguiculata L. Walp). This bean is classified as a minor local bean that has long been cultivated in Indonesia (Fachruddin 2000). This plant has several advantages, namely that it is tolerant of drought, has relatively few pests and diseases, is easy to cultivate and can produce pods even on rocky and low-nutrient soil (Rukmana & Yuniarsih 2000). In Maluku, cowpeas can be found in southern areas such as Southwest Maluku Regency (Gustaf 2016) where they are known as red beans. The type of cowpea in this area consists of 10 varieties based on differences in seed color (Polnaya 2008). This plant is cultivated by the community or grows wild and is used as a complementary carbohydrate and high protein food (Karuwal et al. 2021). The people of Southwest Maluku themselves are still limited in their use of dry beans mixed with rice and corn. In fact, cowpeas can be processed into other food products such as tempeh.

Tempeh is a traditional fermented food that is liked by people in Indonesia (Halifah 2011) and is made from soybeans. Currently, soybean prices are getting higher and production is decreasing, so they need to be imported (BPS, 2015). As an alternative to soybeans, Southwest Maluku cowpeas have the potential to be used as tempeh because they contain protein that is almost equivalent to soybeans (Haliza et al. 2010). Apart from nuts, additional ingredients are also needed in making tempeh such as fermented yeast *Rhizopus* sp. The effectiveness of using yeast is determined by the dose of yeast with the food to be fermented (Julianti et al. 2014). Using the right dosage of yeast can influence the success of fermentation so that quality tempeh is obtained. Good quality tempeh must have high nutritional content and an attractive appearance such as color, taste, aroma and texture.

Luh et al. (2024) found that the addition of 4% yeast gave the best results with a crude protein value of 8.49% in corncob tempeh. Yulia et al. (2019) stated that giving 3% tempeh yeast to make melinjo seed tempeh has a protein content of 5.86% higher than giving 1% and 2% tempeh yeast. Halifah (2011) stated that a yeast dose of 0.2 g can be used in making tempeh from 100 g of cowpeas without skin membrane. So far, research on using the right dosage of yeast to produce tempeh with high nutritional content and an attractive appearance has never been carried out, especially tempeh made from cowpeas. In fact, this information is very important as an effort to diversify local food so as to reduce people's dependence on one food commodity. By knowing the correct dosage of yeast, we can increase the knowledge and skills of the people of Southwest Maluku for developing this local ingredient.

METHODS

This research study uses experimental methods. In this experimental research, proximate content analysis and organoleptic tests of cowpea-based tempeh were carried out with varying yeast doses. The collecting sample was conducted in Wonreli Village, Kisar Island, Southwest Maluku Regency, with tempe making, organoleptic testing was carried out at the Biology Education Laboratory, Pattimura University. Meanwhile, proximate analysis was carried out at the Basic Chemistry Laboratory, Pattimura University. The research object used tempeh made from cowpeas from Southwest Maluku with a sample size of 450 g for proximate content and organoleptic tests, with a total of 9 experimental units.

The research variables consist of the independent variable (X) in the form of yeast doses of 0.1 g, 0.2 g, and 0.4 g, and the dependent variable (Y) in the form of proximate content (water, ash, fat, protein, carbohydrates, and fiber) and organoleptic (color, aroma, taste and texture). The research design used a Completely Randomized Design (CRD) with a non-factorial pattern of yeast doses of 0.1 g, 0.2 g and 0.4 g, carried out 3 times so that there were 9 experimental units.

The research procedure included making cowpea tempeh and analyzing proximate levels. For proximate content analysis, water, ash, fat, protein, carbohydrate and fiber content were measured using the AOAC 2012 method. The research results were then analyzed using the One Way Anova and Duncan Multiple Range test (DMRT) statistical tests in the SPSS version 26.0 program.

RESULTS AND DISCUSSION

A. Proximate content of tempeh made from cowpeas from Southwest Maluku

Proximate content of tempeh made from cowpeas from Southwest Maluku consist of water, ash, lemak, protein, carbohydrate and fiber content. Based on the results of the ANOVA test, yeast doses show that significance effect on water content, ash content, fat content, protein content, carbohydrate content and fiber content. Respectively can be seen in Figure 1 and Figure 2.

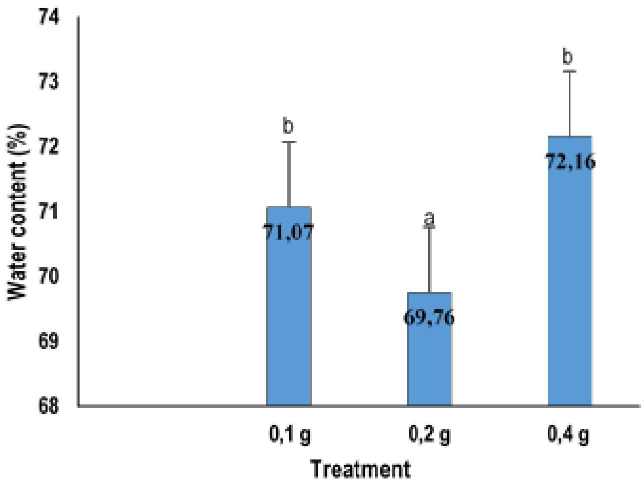

Figure 1. Water content of tempeh made from cowpeas from Southwest Maluku

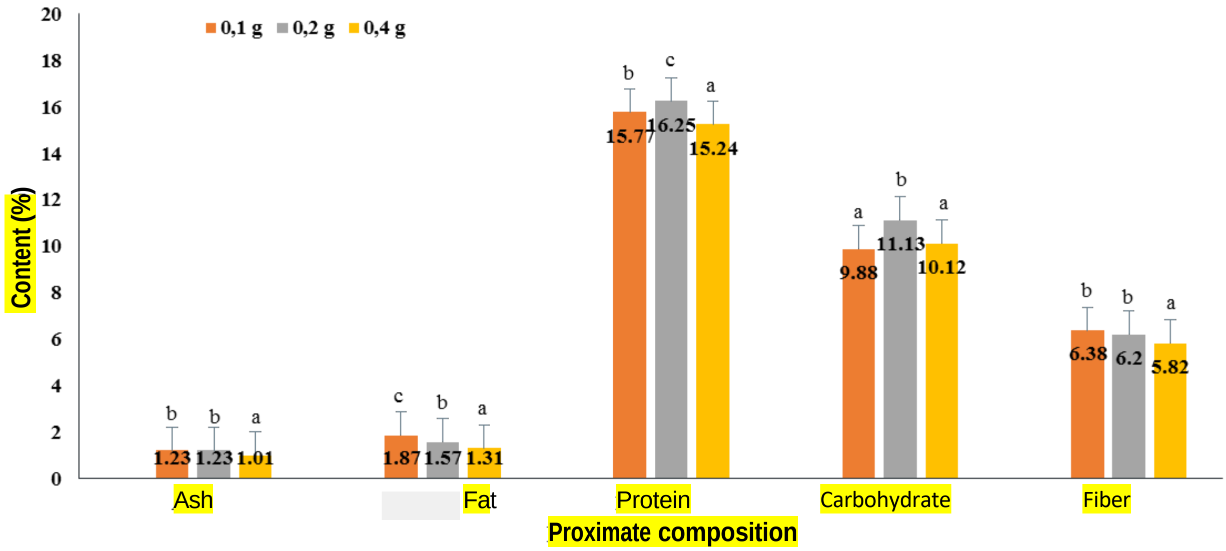

Figure 2. Ash, lemak, protein, carbohydrate, fiber content of tempeh made from cowpeas from Southwest Maluku

The results show that the highest water content was seen at yeast dose of 0.4 g, highest ash, protein and carbohydrate content at a treatment dose of 0.2 g. While, the highest lemak and fiber content founded in yeast dose 0.1 g.

Water functions as a material that can disperse compounds contained in food ingredients. For some materials, water functions as a solvent. Water can dissolve various substances such as salt, water-soluble vitamins, minerals and flavor compounds. The amount of water content in food is one of the factors that influences the speed and activity of enzymes, microbial activity and chemical activity, namely the occurrence of rancidity, non-enzymatic reactions resulting in altered organoleptic properties, appearance, texture and nutritional taste. Meanwhile, free water is water that is physically bound in the matrix network of materials, membranes, capillaries, fibers and so on. If this water is completely evaporated, the water content of the material ranges between 12 - 25% depending on the type of material and temperature (Amanu, 2014). The water content contained in cowpea tempeh can be caused by hydration, especially during soaking and boiling, so that the weight of the cowpea can increase. This is because water will easily diffuse into the cell walls of cowpeas and the soaking time for cowpeas is also quite long (Suciati, 2012). In this research, the water content is seen in the SNI 2015 range. This is because the water content of tempeh is influenced by the stage of the manufacturing process. The process of soaking and boiling the cowpeas causes the water to be absorbed to double its volume (Findi 2022). The more yeast added, the water content of tempeh tends to decrease. This is because more and more braids are produced, which can cause the temperature of the fermentation process to increase. When the temperature increases, microorganisms will work faster so they will utilize existing nutrients and water to be used in the process of breaking down complex compounds into simpler ones (Padhilah et al. 2022).

The more yeast concentration added, the more the ash content increases. This is because the growth of mold increases. The minerals contained in both types of beans will be utilized by the mold as nutrients for their growth so that they can produce good compact tempeh (Sapitri, 2018). According to Findi (2022) results of analysis of the ash content of cowpea tempeh with a tempeh yeast concentration of 0.15%; 0.25% and 0.35% and types of plastic wrapping materials and banana leaves range between 0.96–1.16%. This research shows that the lowest ash content in cowpea tempeh was obtained from treatment with a yeast concentration of 0.25%, namely 1.04% and a yeast concentration of 0.35% gave the highest average ash content value of 1.12%. The type of plastic packaging material produces the highest average value of ash content, namely 1.08%, and the type of banana leaf packaging material produces the lowest average value of ash content, namely 1.05%.

This is due to the influence of yeast concentration and fermentation time. The more yeast added and the longer the fermentation time, the fat content tends to decrease. During the fermentation process, the lipase enzyme will hydrolyze triglycerol into free fatty acids which the *Rhizopus* sp mold will then use as an energy source (Padhilah et al. 2022). Astuti et al. (2000) explained that the fat content of cowpea tempeh is lower than soybeans, because during fermentation the mold will synthesize the lipase enzyme which will hydrolyze triacylglycerol into free fatty acids. Furthermore, fatty acids will become a source of energy for the mold to grow so that the fat content decreases by up to 26%.

The greater the concentration of yeast added and the longer the fermentation time, the protein content tends to decrease. In the fermentation process, mold produces protease enzymes, peptones, amino acid polypeptides, NH_3 and also nitrogen elements (Yulia 2019). Therefore, the more yeast added, the more nitrogen is used for the mold growth process so that the protein content in tempeh decreases (Muthmaina 2016). In other research, it was explained that tempeh mold produces several enzymes that are able to degrade proteins into simpler compounds including amino acids. This causes an increase in dissolved nitrogen and free amino acids, thereby increasing protein absorption in the body. Protease activity was detected after 12 hours of fermentation when there was still relatively little growth of mold hyphae.

Cowpea tempeh protein content with yeast concentration of 0.15%; 0.25%; 0.35% and types of plastic wrapping materials and banana leaves range between 25.03 – 26.01% (Findi 2022). The highest protein content of cowpea tempeh was obtained from the yeast concentration treatment of 0.35% and the type of plastic wrapping material was 26.01% and the lowest average protein content of cowpea tempeh was obtained from the yeast concentration treatment of 0.25% and the type of banana leaf wrapping material was 25%. .03%. The density of trichomes on leaves allows more mold spores to adhere, resulting in the production of more protease enzymes to break down proteins into amino acids (Setyawan 2015; Ellent et al. 2020). Tempeh wrapped in plastic has a higher soluble protein content than tempeh wrapped in banana leaves. This is because the type of plastic used is polyethylene plastic, which has good permeability to gases on a lower scale. The use of polyethylene plastic causes the protein in tempeh to decrease slightly because it is able to prevent gas from entering the storage medium (Furqon et al. 2016).

The highest carbohydrates were in treatment 0.2 g because the more yeast concentration was added, the carbohydrate content increased. This is because the greater the concentration of yeast added, the faster the fermentation process will be due to microbial activity. Under these conditions, the hyphae cell walls of the fungus *Rhizopus* sp consist mostly of polysaccharides (Padhilah et al. 2022). When the yeast concentration is increased, more *Rhizopus* sp mold will grow and mycelium will form so that the polysaccharide content in tempeh will also increase (Yulia 2019). In other research, the mycelium will be denser on substrates that have a higher carbohydrate content. This is in accordance with the statement by Miszkiewiez et al. (2003) that the number of hyphae produced depends on the availability of glucose, soluble protein, enzyme activity and the strain of R. oligosporus.

The high fiber content in cowpeas has an effect on increasing water content. This is because fiber has a very high ability to bind water (Anggi 2016). Tempe quality standards according to Indonesian National Standard No. 3144 of 2009 at a maximum fiber content of 2.5%. In this research, the fiber content was 6.25%, still more than the Indonesian National Standard. The fiber content of cowpea tempeh using banana leaf wrapping is higher than using plastic wrapping. The process of soaking cowpeas overnight also causes a decrease in fiber content, which is thought to be due to the dissolution of some soluble fiber components in the soaking water. The boiling and steaming process also causes a decrease in crude fiber content. This increase in fiber content is very beneficial because it can increase the potential of cowpea tempeh as a source of fiber like soybean tempeh (Findi, 2022).

B. Organoleptics of Tempeh Made from Cowpeas from Southwest Maluku

Based on the results of the ANOVA test, it was continued with further DMRT tests on color, aroma, taste and texture can be seen figure 3. This shows that the 0.2 g yeast dose treatment was the highest compared to other treatments. So in this study the best organoleptic results and liked by 20 trained panelists were tempeh made from cowpeas with a yeast dose of 0.2 g.

Color is one of the appearance attributes of a product which often determines the level of consumer acceptance of the product as a whole. This parameter plays an important role as a visualization that can make the product more attractive and form perceptions about its taste (Winarno & Andita, 2020). The typical color of tempeh is white, where the white color is caused by the presence of mold mycelia that grow on the surface of the soybean seeds. This is in accordance with the literature that good tempeh is tempeh that has a compact shape that is bound by mycelium so that it looks white and when sliced you can see pieces of cowpea. The higher the water content in tempeh, the less good the color will be because the tempeh will be approaching the stage of decay so that the mycelia that grow on the tempeh will become increasingly black (Priatni et al. 2013).

The process of fermenting soybeans into tempeh changes the pleasant aroma of soybeans into the distinctive aroma of tempeh. Fresh tempeh has a soft, mushroom-like aroma which comes from the aroma of the mold mycelium mixed with the delicious aroma of free amino acids and the aroma produced by the breakdown of fat. As fermentation takes longer, the soft aroma changes to a sharp one due to the release of ammonia (Jelen 2013).

Tempeh which has a high protein content will increase the aroma of tempeh due to the higher degradation of amino acids by *Rhizopus* sp (Jayanti, 2019). The most preferred aroma of tempeh has a relatively high protein content, namely 31.45%. In the food industry, aroma parameters are considered very important because they can quickly determine the level of consumer preference. The aroma assessment of a product can be detected through the sense of smell. Smell testing is considered important because it can quickly provide an assessment of the product regarding whether the product is acceptable or not. Apart from that, odor can also be used as an indicator of damage to the product (Adeningsih et al. 2015).

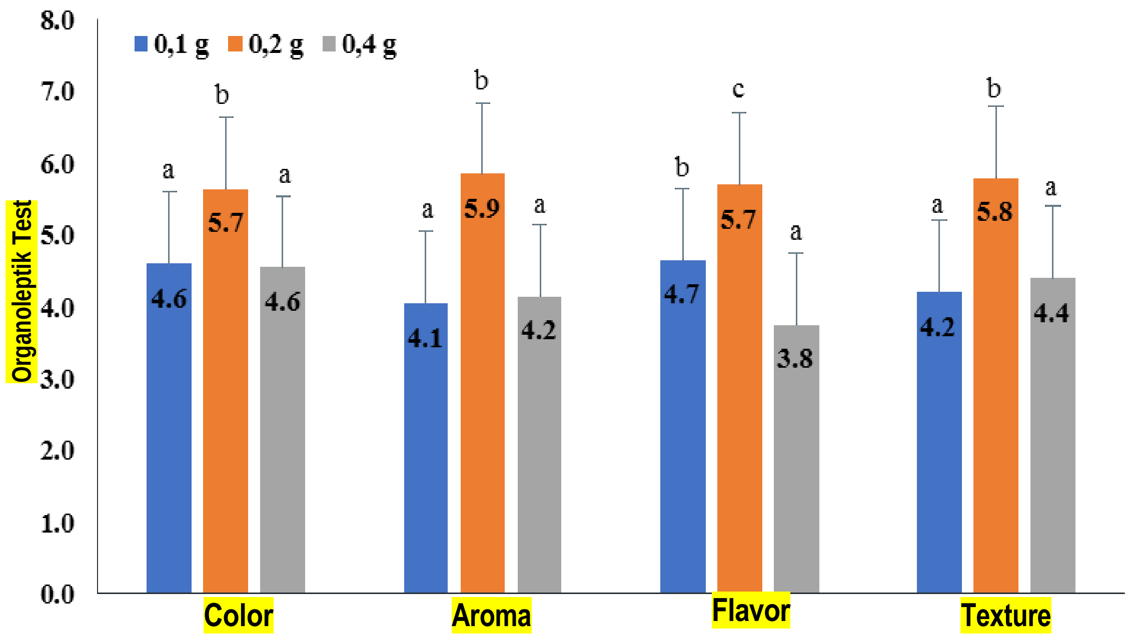

Figure 3. Organoleptic test of tempeh made from cowpeas from Southwest Maluku

Taste is a response to chemical stimulation that reaches the tongue's taste buds, especially the basic types of taste, namely sweet, sour, salty and bitter. Taste is something that is very important in accepting or rejecting a product by consumers. Taste arises as a result of chemical stimulation received by the sense of taste or tongue (Yanti et al. 2019). The distinctive taste of tempeh is due to the presence of components that are degraded in tempeh during the fermentation process (Gunawan 2015). The typical delicious taste of tempeh is not sour. The sour taste that appears is due to the washing of the soybeans being less clean, which affects the resulting taste (Priatni 2013). Tempeh generally has a savory taste because of the high protein and fat content in soybeans which are then hydrolyzed into simpler compounds. Tempeh which has a high fat content will increase the taste of tempeh because fatty acids during oxidation will produce carbonyl compounds which contribute to taste (Padhilah et al. 2022). According to Istiqomah et al. (2018) in the mushroom fermentation process uses protein, fat and carbohydrates in the ingredients to produce a distinctive tempeh taste. This makes tempeh more delicious when fried compared to other tempeh. The slightly bitter taste of black cowpea tempeh causes it to be somewhat liked by the panelists.

Texture is defined as a characteristic of the food consumption process. Evaluation of the texture of a product can be detected through the sense of touch in the mouth, lips and hands. Texture is a parameter or characteristic of a material as a result of a combination of several physical properties which include size, shape, quantity and elements of material formation that can be perceived by the senses of touch and taste, including the senses of the mouth and sight (Midayanto & Yuwono, 2014). A good tempeh texture based on SNI 3144:2015 is compact (dense), and if sliced tempeh pieces do not fall off easily (stick together) (Yheni et al. 2018). The presence of mycelium in tempeh will increase the density of the tempeh mass by combining the nuts with each other to form a compact mass and reducing air spaces inside. The most preferred tempeh in terms of texture in this study was tempeh with the lowest water content of around 60.92%. This is because the higher the water content in tempeh, the texture of the tempeh will become soft and even approach the process of rotting (Priatni et al. 2013). To produce good quality tempeh, tempeh inoculum is needed, which is a collection of mold spores that convert boiled soybeans into tempeh through a fermentation process. Tempeh yeast is a powdered inoculum used to make tempeh as a tempeh starter. For large production, tempeh yeast is made by multiplying tempeh molds such as *Rhizopus* oligosporus in certain media. Furthermore, the spores produced are preserved dry with the medium in which the tempeh mold grows (Edwin et al. 2022). The main microbe that plays a role in making tempeh is the type of mold *R. oligosporus* (Kustyawati, 2014). *R. oligosporus* grows to produce fine white mycelia, binding the beans together to produce tempeh. According to Kusuma (2005), each type of inoculum will provide different tempeh characteristics in terms of texture, color and nutritional content. The texture, aroma and nutritional content of tempeh are greatly influenced by the formation of mycelium produced by *Rhizopus* sp. (Karsono et al. 2009).

CONCLUSION

In accordance with the research studies that have been carried out, it can be concluded that the dosage of yeast has a significant effect on the characteristics of tempeh made from cowpeas from Southwest Maluku. Treatment with a yeast dose of 0.1 g showed the highest proximate levels, while a dose of 0.2 g gave organoleptic results that were preferred by the panelists, including color, aroma, taste and texture of tempeh.

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