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ORGANOLEPTIC TEST OF CHICKEN MEATBALLS WITH WHITE TOFU SUBSTITUTION AT DIFFERENT CONCENTRATIONS

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Abstract

Meatballs are a processed meat product that is well-known and loved by the public. Meatballs are one of the food products regulated by the Indonesian National Standard (SNI). One parameter for determining whether a meatball product is good or not is its elasticity. People tend to prefer meatballs with a chewy texture and not hard. Factors that influence meatball texture are the composition of the meatball, the manufacturing process, and the heating time. The purpose of this study was to determine whether the addition of white tofu can affect the quality of chicken meatballs and to determine the best percentage of white tofu in making meatballs so that it can substitute the use of chicken. This study used different percentages of white tofu, namely 25%, 50%, 75%, and 100%. Organoleptic tests were carried out on taste, color, texture, and aroma. Data were analyzed using one-way ANOVA followed by the Duncan test. The best treatment with the highest average results in making chicken meatballs with white tofu substitution for organoleptic quality based on taste, color, texture, and aroma was in the control treatment P1 with the addition of 0% white tofu with an average score of 3.9 which was in the very like category, followed by P2 with the addition of 25% white tofu with an average score of 3.4667 which was in the like category.
Keywords: meatballs, chicken, white tofu, and organoleptic

INTRODUCTION

Meatballs are a very popular dish in Indonesia. They are generally made from basic ingredients such as meat, fish, or other seafood, mixed with flour and various spices, then formed into balls with a chewy texture. This dish is widely consumed by people from all walks of life, from children to adults (Purnama & Azizah, 2020). According to Indonesian National Standard (SNI) 01-3818-2014, meatballs are defined as a processed meat-based product with a minimum meat content of 50% (Badan, 2014). These products are generally round in shape and made by mixing them with starch or cereals. They may also contain other food ingredients and food additives whose use has been officially approved (Natari & Mutaqin, 2021). Likewise according to Untoro, meatballs are round-shaped food products made from a mixture of livestock meat with starch or cereals, either with or without the addition of other food ingredients and food additives whose use is permitted (Masyita & Asyura, 2025). According to the definition from (Badan, 2014) meatballs are processed products made from livestock meat mixed with starch and spices, either with or without the addition of other food

ingredients and permitted food additives, then formed into balls or other shapes and cooked until done (Masyita & Asyura, 2025).

Meatballs generally use beef as the main ingredient, but as time goes by, chicken is increasingly being used as an alternative due to its affordability, low fat content, and high protein content. Every 100 grams of chicken contains approximately 75% water, 22.8% protein, 0.9% fat, and 1.2% ash (Heinz & Hautzinger, 2007; Soeparno, 2015). Despite having these advantages, chicken meat is also relatively perishable, which has the potential to reduce the quality and freshness of the product (Masyita & Asyura, 2025). In addition, the use of chicken meat exclusively in meatball making can increase production costs. Generally, high-quality meatballs have a relatively high selling price because the main ingredient, namely meat, is used in large quantities (Rahmawati, 2016). Consumer interest and desire for meatballs drives producers to produce attractive products that meet their needs. Consumer interest in meatballs is influenced by product appearance, product variety, price, and marketing (Setiawan & Steven, 2021). Various methods have been employed in meatball processing to achieve high quality, thereby attracting consumers. Meatball quality is influenced by the composition of the ingredients. To produce quality meatballs, the right ingredients must be used without posing health risks. Healthy meatballs are made from fresh, halal chicken without preservatives. The use of high-protein ingredients in analog meatballs can produce a food product that can balance the nutritional value of beef-based products.

Thus, alternative additives are needed that are more cost-effective while maintaining the nutritional content and sensory quality of the product. Tofu is one ingredient that has potential as a substitute, due to its high vegetable protein content, soft texture, and relatively low price. Tofu is a source of plant-based protein that has long been a part of people's diets. Although its protein content is not as high as animal protein, tofu still plays a vital role in improving the nutritional quality of families (MD et al., 2019). Tofu and various soy products are rich sources of plant-based protein. Compared to animal protein sources like milk, eggs, and meat, the tofu industry plays a crucial role in providing nutritious food at relatively affordable prices to the public (Tanjung et al., 2023a). Hardjo (1964) in (Tanjung et al., 2023b) explains that soybeans (Glycine max Merr) are an important agricultural commodity as a food source because they contain approximately 40% high-quality protein. Their essential amino acid content is complete and balanced, making soybean protein quality comparable to animal protein. Substituting some chicken with tofu is expected to produce meatballs that are more affordable, nutritious, and still acceptable to consumers. Furthermore, this effort could be an innovative step in diversifying plant-based food products and encouraging the growth of micro-enterprises in the food processing sector.

Organoleptic testing is a method of assessing how humans perceive and respond to food products through the five senses, such as sight, smell, taste, touch, and hearing. The goal is to evaluate the sensory quality of a product, including appearance, aroma, flavor, and

texture, and to ensure that it meets consumer preferences and expectations. Based on research conducted by (Handarsari et al., 2010) In his study, entitled "Analysis of Nutrient Content, Metal Contamination Test, and Organoleptic Tests in Meatballs with Tofu Dregs Substituent," he found that meatballs with 30% tofu dregs substituted obtained the highest organoleptic score, namely 3.29. This value is almost equivalent to the score of meatballs without the addition of tofu dregs, namely 3.32. Likewise, research conducted by Fillaili on the effect of tofu dregs flour substitution on tilapia fish meatballs and obtained the results of tilapia fish meatballs substituted with tofu dregs flour that were preferred by panelists, namely in the treatment with the addition of 10% tofu dregs flour, where the results of tilapia fish meatballs substituted with tofu dregs flour were white, had the aroma of tilapia fish, had a savory taste and a little tofu dregs flour, and had a chewy and slightly dense texture(Fillaili et al., 2020). However, the addition of tofu to meatball dough has the potential to impact consumer acceptance. Therefore, research is needed to evaluate the extent to which substituting tofu for chicken can impact sensory characteristics such as color, aroma, texture, and flavor.

RESEARCH METHODS

This experimental study aimed to determine the organoleptic properties of chicken meatballs substituted for tofu. The research design used was a completely randomized design with five treatments:

P1: 300 grams of chicken meat, 0 grams of white tofu (100%: 0%)
P2: 225 grams of chicken meat, 75 grams of white tofu (75%: 25%)
P3: 150 grams of chicken meat, 150 grams of white tofu (50%: 50%)
P4: 75 grams of chicken meat, 225 grams of white tofu (25%: 75%)
P5: Chicken meat weighing 0 grams, white tofu 300 grams (0%: 100%)

Tools and materials

The list of tools used in this study are blender/chopper, digital scales, stove and pan, measuring spoon, basin, knife, organoleptic test sheet form (hedonic scale). The materials used are chicken fillet, white tofu (squeezed, crushed), ice cubes, water, tapioca flour, egg white, seasonings: garlic, fried shallots, salt, pepper powder.

Research Procedures

A. Making chicken meatballs with tofu substitute

The procedure for making chicken meatballs substituted for tofu is as follows: Divide the ingredients into five treatments, namely for treatments P1, P2, P3, P4 and P5. For treatments P2, P3 and P4, mix the tofu and chicken, then cut them into small pieces. Then the chicken and tofu are cut into small pieces, then ground with a blender then added ice cubes, table salt and

other spices then ground again until smooth, then add tapioca flour until a homogeneous meatball dough is obtained. The homogeneous meatball dough is then formed into meatball balls using hands and a spoon, the formed meatball balls are then boiled in boiling water until cooked. The cooked meatballs are removed then drained and cooled at room temperature, (specifically for treatment P5 only using tofu and P1 only using chicken as control) (Natari & Mutaqin, 2021).

B. Organoleptic Test

Organoleptic testing was conducted using the hedonic method, namely the preference test for treatments P1, P2, P3, P4 and P5. The purpose of this test was to evaluate the effect of the chicken meatball formulation substituted with tofu on panelists' preferences, as well as to determine their level of preference. The hedonic assessment involved 15 panelists in the somewhat trained category because they were considered familiar with the standard taste of meatballs and were already accustomed to being respondents for organoleptic tests, namely lecturers and undergraduate students of Nutrition Science at Universitas Nahdlatul Ulama Sumatera Utara who had taken the Food Technology course.

Hedonic testing is a method of evaluating product acceptability that involves panelists completing a questionnaire assessing their level of liking or disliking various treatments. This assessment is conducted sensory (organoleptic) and the results are presented on a numeric scale. Scale used in Table 1:

Hedonic Scale	Numerical Scale
Really like	4
Like	3
Somewhat Like (normal)	2
Do not like	1

RESULTS AND DISCUSSION

The results of the organoleptic test of chicken meatballs with white tofu substitution are as follows:

Table 2. Average Value of Panelists' Preference Level for the Organoleptic Quality of Chicken Meatballs with White Tofu Substitution

Treatment	Flavor	Color	Texture	Aroma	Amount	Average
P1 (100 : 0)	3.8667	3.9333	4,0000	3,8000	15,6000	3,9000
P2 (75 : 25)	3.6000	3.3333	3.6000	3.3333	13,8666	3,4667
P3 (50 : 50)	2.7333	2.8667	3.6000	2.7333	11,9333	2.9833
P4 (25 : 75)	2.6667	2.8667	3.3333	2.7333	11,6000	2,9000
P5 (0 : 100)	2.5333	2,8000	2.9333	2.6667	10,9333	2,7333

In the organoleptic test study of chicken meatballs with white tofu substitution, the highest average value of panelists' preference for taste, color, texture, and aroma was obtained in the control treatment P1 with the addition of 0% white tofu with an average score of 3.9 which is in the very like category, followed by P2 with the addition of 25% white tofu, namely with an average score of 3.4667 which is in the like category.

1. Flavor

Taste is an impression produced on a food ingredient that enters the mouth and is felt by the taste buds, namely the tongue. Organoleptic tests of taste are highly dependent on the preferences of the white tofu meatball panelists. Taste is very important in determining consumer acceptance of meatballs, including savoryness, saltiness, the presence of a spiced taste but not excessive and the absence of foreign, disturbing tastes. Factors that influence taste include temperature, chemical compounds and interactions that occur with other components. Based on the results of the analysis of variance ANOVA, it shows that the white tofu substitution treatment has a significant effect (p 0.00 < 0.05), f count (78,491) >f table (3.48), on the taste of the meatballs produced. More clearly the average organoleptic taste of chicken meatballs with white tofu substitution as a result of each treatment can be seen in Table 3.

Table 3. Average Organoleptic Taste of Chicken Meatballs Substituted with White Tofu

Treatment (g)	Taste Score	Criteria
P1 (100 : 0)	3.8667 [b]	Really like
P2 (75 : 25)	3.6000 [b]	Really like
P3 (50 : 50)	2.7333 [a]	Like
P4 (25 : 75)	2.6667 [a]	Like
P5 (0 : 100)	2.5333 [a]	Like

The table above shows a trend in the organoleptic test scores conducted by the panelists on taste, indicating a decrease in each treatment. The highest average score for chicken meatballs substituted with white tofu with a taste indicator was in treatment P2 (75% chicken: 25% white tofu). The panelists considered the P2 formula meatballs to be preferred in terms of taste because they were considered more savory, salty, and had a meaty taste. This can be explained because the determining factor for the taste of chicken meatballs with white tofu substitution is due to the ratio of the use of chicken to white tofu. In addition, the use of additional spices used during the cooking process, such as salt and garlic powder, can also add flavor to the resulting meatballs. According to (Soeparno, 2015), adding spices to processed meat can produce different flavors.

The taste score of the resulting meatballs decreased with increasing amounts of white tofu used. The resulting delicious taste can also be attributed to the breakdown of protein

into amino acids. The use of starch as a filler can also affect the resulting flavor because the amylose in tapioca flour can form inclusions with flavor compounds like salt and spices.

Based on the results of the taste test parameters, the panelists' assessment of the organoleptic test on the taste of white tofu meatballs in treatment P2 with the addition of 25% white tofu was more preferred than the white tofu meatballs in treatment P3, P5 and P4 with the addition of 50%, 100% and 75% of white tofu. It can be seen from the parameters that if the addition of white tofu is excessive, it will give a slightly bland taste to the tofu meatballs such as samples P4 and P5. According to (Ceria et al., 2025) the addition of tofu dregs flour in different amounts does not have a significant effect, but the addition of too much tofu dregs flour is also less preferred because the more tofu dregs flour, the more the resulting taste of tofu dregs feels, thus reducing the distinctive savory taste of chicken.

2. Color

Color plays a crucial role in stimulating a food product and is also the primary sensory tool directly visible to the panelists. Color is the overall impression the eye makes and can be influenced by viewing conditions. If a food deviates from the generally accepted color, it is less likely to be chosen by consumers, even if the food is still in good condition. However, color is not always synonymous with a particular taste (Astawan, 2008; Sari & Jairani, 2019)The results of the panelists' preference test for the color seen in chicken meatballs with white tofu substitution can be seen in Table 4.

Table 4. Average Organoleptic Color of Chicken Meatballs Substituted with White Tofu

Treatment (g)	Color Score	Criteria
P1 (100 : 0)	3.9333 ^{c}	Really like
P2 (75 : 25)	3.3333 ^{b}	Like
P3 (50 : 50)	2.8667 ^{a}	Like
P4 (25 : 75)	2.8667 ^{a}	Like
P5 (0 : 100)	2.8000 ^{a}	Like

Table 4 shows that the highest average color of meatballs from white tofu was found in the white tofu substitution treatment with 25% (score 3.3333) and the lowest was in the addition of 100% white tofu (score 2.8000). Based on the results of the ANOVA analysis of variance, it showed that the white tofu substitution treatment had a significant effect (p 0.00 < 0.05), f count (35,766) >f table (3.48), on the color of the meatballs produced.

From these data, it can be said that the average consumer preference level is in the range of white to yellowish white. This color is possibly influenced by the color of white tofu which when reacted with heat causes the color to change to yellow. This occurs due to the browning reaction in the Maillard reaction which is the result of the reaction of amino groups in amino acids, peptides, or proteins with glycosidic hydroxyl groups in sugars, and ends with the formation of brown nitrogen polymers or melanoidins(Winarno, 2004) (Winarno, 2004).

The results of the Duncan Test showed that the addition of white tofu with different percentages had a significantly different effect (P <0.01) on the color of chicken meatballs.

Based on the results of the Duncan Test on color, it shows that treatment P1 is significantly different from treatments P2, P3, P4, and P5. Treatment P2 is significantly different from treatments P3, P4, and P5. Meanwhile, treatments P3, P4, and P5 with the amount of white tofu added at 50%, 75%, and 100% are not significantly different.

3. Texture

Texture will affect the final shape produced by the material. The texture or viscosity of the material can change the taste and smell that arise because it can affect the speed of stimulation of olfactory receptor cells and salivary glands. Quoted from (Nurhuda & Rochima, 2016) that the texture of good fish meatballs must be compact, elastic, not tough or bouncy, without spines or bones, not soft, not watery and not brittle. Texture assessment is done by pressing the surface of the meatballs based on the level of compactness, elasticity and density of the meatballs, in addition, the texture of the meatballs is sometimes more important than the aroma, taste and color because it affects the image of the food. The results of the panelists' preference test for the texture seen in chicken meatballs with white tofu substitution can be seen in Table 5.

Table 5. Average Organoleptic Texture of Chicken Meatballs Substituted with White Tofu

Treatment (g)	Texture Score	Criteria
P1 (100 : 0)	4,0000 ^{c}c	Really like
P2 (75 : 25)	3.6000 ^{b}	Really like
P3 (50 : 50)	3.6000 ^{b}	Really like
P4 (25 : 75)	3.3333 ^{b}	Like
P5 (0 : 100)	2.9333 ^{a}	Like

Based on the results of the ANOVA analysis of variance, it shows that the white tofu substitution treatment has a significant effect (p 0.00 < 0.05), f count (34,384) >f table (3.48), regarding the texture of tofu meatballs, this is in accordance with the research of (Rahmawati et al., 2013), that texture is the most important characteristic of meatballs and consumers prefer a chewy texture that tends not to be hard. The results of the hedonic test for the level of panelists' preference for the texture of meatballs are in the range of normal to slightly liked. The meatballs that the panelists like most are meatballs with a slightly chewy texture. Treatment P2 has a chewy and not hard texture so it tends to be liked by panelists, while treatment P5 has a dense chewy texture so it tends not to be liked by panelists.

Table 5 shows the highest average values found in the 25% and 50% treatments, followed by the 75% treatment. This indicates that the texture of the resulting meatballs can be influenced by the addition of fillers. The addition of white tofu can provide a fiber role in the texture of the meatballs. This can be caused by white tofu itself which has a characteristic coarse fiber. However, if the addition of white tofu is done excessively can produce meatballs

that are too fibrous and do not hold together so that they are not perfectly shaped and very fragile. This is in accordance with (Purbaningrum, 2019) that the addition of tofu dregs flour in the manufacture of food products produces a dough that is less elastic, especially if the amount of tofu dregs flour used is greater. The fiber content in tofu dregs flour is in the form of cellulose and hemicellulose which have a strong structure, making the texture of the meatballs harder.

Duncan's test results showed that the treatment of adding 25% white tofu was not significantly different from 50% and 75%. The addition of 100% white tofu was the smallest and significantly different from the other formulations. This indicates that the coarser texture of the meatballs is caused by the protein content found in the meat and has the ability to emulsify fat, resulting in a compact and rough texture. Meanwhile, the smoother texture of the meatballs is caused by the starch content contained in the filler material which has a denser structure so it is difficult to break down. According to (Moin et al., 2025), the high fiber and protein content in lentil flour contributes to its superior water-binding ability, making it very suitable for dough-based products that require a higher level of hydration. The significant increase in water absorption with increasing the ratio of lentil flour is in line with previous studies that highlight the importance of the interaction of legume protein and starch in modifying the hydration properties of flour.

4. Aroma

Aroma is also called a stimulus that is carried out from a distance, this is because humans can recognize a product that has not been seen just by smelling its aroma from a distance. In the food industry, testing aroma is considered important because the aroma of food largely determines the deliciousness of food or the acceptability or rejection of a food ingredient. According to Wheat as quoted by Grace and re-quoted by (Sari & Jairani, 2019), aroma is a smell that is difficult to measure so that it gives rise to different opinions in assessing the quality of a product's aroma. The results of the panelists' preference test for the aroma seen in chicken meatballs with white tofu substitution can be seen in Table 6.

Table 6. Average Organoleptic Aroma of Chicken Meatballs Substituted with White Tofu

Treatment (g)	Aroma Score	Criteria
P1 (100 : 0)	3.8000 ^{c}	Really like
P2 (75 : 25)	3.3333 ^{b}	Like
P3 (50 : 50)	2.7333 ^{a}	Like
P4 (25 : 75)	2.7333 ^{a}	Like
P5 (0 : 100)	2.6667 ^{a}	Like

Based on the results of the aroma test parameters, it shows that the panelists' assessment of the organoleptic test on the aroma of white tofu meatballs in treatment P2 with the addition of 25% white tofu is more preferred than the white tofu meatballs in treatment P3, P4 and P5 with the amount of white tofu added respectively 50%, 75% and 100%. Based on the results of

the ANOVA analysis of variance, it shows that the white tofu substitution treatment has a significant effect (p 0.00 < 0.05), f count (46,241) >f table (3.48), on the aroma of the meatballs produced. This is influenced by white tofu which has a distinctive soybean aroma. Of the three characteristic odors, resulting in processed meatballs that do not have a pungent and unpleasant odor, but white tofu meatballs can have a delicious and distinctive aroma. Meanwhile, based on the Duncan test, it was found that the aroma of meatballs in treatments P1, P2, and P3 with the addition of 0%, 25%, and 50% white tofu was not significantly different from each other. Treatment P4 was significantly different from the other treatments, as was P5 with the lowest level of preference and significantly different from the other treatments. This is in accordance with research by (Ceria et al., 2025; Purbaningrum, 2019) that the addition of tofu dregs flour can disguise the fishy aroma so that the resulting aroma is more distinctive and delicious. However, adding too much is also less preferred because the unpleasant odor of tofu dregs flour becomes stronger.

CONCLUSION

The best treatment with the highest average results in making chicken meatballs with white tofu substitution on organoleptic quality based on taste, color, texture, and aroma is in the control treatment P1 with the addition of 0% white tofu with an average score of 3.9 which is in the very like category, followed by P2 with the addition of 25% white tofu with an average score of 3.4667 which is in the like category. The highest average score of white tofu substitution chicken meatballs with taste indicators is in the treatment P2 25% white tofu (score 3.6000) and the lowest in the addition of 100% white tofu (score 2.5333). The highest average score for the color of meatballs from white tofu is in the white tofu substitution treatment with 25% (score 3.3333) and the lowest in the addition of 100% white tofu (score 2.8000). The highest average score for the texture of meatballs from white tofu was found in the treatment of substitution of white tofu with 25% (score 3.6000) and the lowest in the addition of white tofu with 100% (score 2.9333). The highest average score for the aroma of meatballs from white tofu was found in the treatment of substitution of white tofu with 25% (score 3.3333) and the lowest in the addition of white tofu with 100% (score 2.6667).

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