Impact of Incorporating White Oyster Mushrooms (*Pleurotus ostreatus*) in Chicken Meatball Formulation on Moisture Content and Sensory Properties

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Abstract

Avenue for reducing meat consumption in chicken meatballs. This research aimed to assess the impact of incorporating oyster mushrooms on both the moisture content and sensory properties of meatballs. The study involved four treatment groups, each with varying proportions of chicken meat and oyster mushrooms: P1 (100% chicken meat: 0% oyster mushrooms), P2 (90% chicken meat: 10% oyster mushrooms), P3 (80% chicken meat: 20% oyster mushrooms), and P4 (70% chicken meat: 30% oyster mushrooms). Notably, the research findings demonstrated that the addition of oyster mushrooms significantly influenced moisture content and organoleptic characteristics. The resulting moisture content met quality standards for combined meatballs. Furthermore, sensory testing revealed that meatball formulation P1 (100% chicken meat: 0% oyster mushrooms) yielded the highest sensory value compared to formulations with 10%, 20%, and 30% oyster mushroom additions.

Keywords: chicken meatballs, oyster mushrooms, moisture content, organoleptic.

Introduction

Meatballs, a moist food product, exhibit a round or other shape resulting from the amalgamation of livestock meat—whether chicken or beef with starch or cereals, sometimes accompanied by food additives (BTP) (SNI 3818-2023). Originating in Indonesia, meatballs enjoy popularity among Indonesian people. However, excessive consumption of meat-based meatballs can adversely affect health. The World Health Organization (WHO) reports that individuals who excessively consume meat face a 30% higher risk of developing cancer. Consequently, individuals with degenerative diseases may find it challenging to include meatballs in their diet. To address this, diversified food options such as meatballs should be developed as alternatives for those unable to consume substantial amounts of meat or for those adopting a health-conscious lifestyle by reducing meat intake (Ali et al., 2022). Notably, white oyster mushrooms have emerged as a promising vegetable raw material with potential as a meat substitute (Aviana & Heryani, 2016).

White oyster mushrooms (*Pleurotus ostreatus*) are native tropical fungi widely distributed throughout Indonesia. These mushrooms boast a nutritional profile that includes 1.9 g of protein, 5.5 g of carbohydrates, 3.6 g of fibre, 0.1 g of fat, and 0.6 g of ash. Notably, a study by Chang & Miles (1997) and Aviana & Heryani (2016) indicates that white oyster mushrooms have a higher protein content compared to other known edible mushroom varieties. Additionally, these mushrooms naturally contain glutamic acid, which imparts a savoury flavour to food. Consequently, many researchers have explored using oyster mushrooms to create a flavorful mushroom broth, serving as a healthier alternative to MSG (Monosodium glutamate) (Kuntari & Fitriani, 2021). Moreover, their relatively high fibre content makes them an excellent choice for dieters. Furthermore, white oyster mushrooms are economically priced compared to chicken or beef, making them accessible to a wide range of consumers.

The objective of this research is to investigate the formulation for creating chicken meatballs by incorporating white oyster mushrooms. The primary focus is to analyze the impact on water content and sensory properties. The anticipated outcome is the development of chicken meatball products that adhere to quality standards and are well-received by consumers. This research aims to contribute positively to the advancement of panga products.

Materials and Methods

Material

The ingredients employed in crafting mushroom meatballs encompass chicken fillet, oyster mushrooms, tapioca flour, garlic, ice water, ground pepper, salt, and egg whites. In contrast, the material utilized for sensory analysis comprises mineral water.

Mushroom Meatballs Production

The process of crafting mushroom meatballs commences with the preparation of chicken fillet and white oyster mushrooms, both of which have undergone blanching according to the comparative proportions outlined in Table 1.

Table 1. Comparative proportions of chicken meat and oyster mushrooms in making meatballs

No	Material	P1	P2	P3	P4
1.	Chicken meat	100g	90g	80 g	70 g
2.	Oyster mushroom	0 g	10 g	20 g	30 g
Amount		100g	100g	100g	100g

Subsequently, the chicken meat and white oyster mushrooms undergo grinding and mixing, following the ratio formula outlined in Table 1. Throughout the mixing process, spices and other essential ingredients are incorporated, including tapioca flour (30 g), salt (2 g), garlic (5 g), pepper (0.3 g), ice water (15 g), and egg white (1 g). Once the mixture achieves a fine consistency, it is shaped into rounds and boiled until it floats. The resulting oyster mushroom chicken meatballs undergo both organoleptic testing (likability assessment) and chemical analysis (moisture content determination).

Moisture Content

The determination of moisture content follows the approach outlined by Husein et al. (2022), utilizing the Thermogravimetry method with minor adjustments. Initially, a sample weighing 1-3 g is placed in a sterilized cup, and its initial weight is recorded. Subsequently, the sample undergoes heating in an oven at 105°C for approximately 3 hours. After this period, the sample is removed, allowed to cool in a desiccator for 5 minutes, and then reweighed. This process is repeated iteratively until a consistent weight is achieved.

Organoleptic Test

The organoleptic testing method employs a scoring system, following the guidelines set forth by Nurwati et al. (2022) with minor adjustments. During the assessment, the texture, aroma, color, and taste of the oyster mushroom chicken meatball product were evaluated for each treatment. The goal was to determine which oyster mushroom chicken meatball product was most favored by the panelists. This evaluation involved assigning scores to color, texture, aroma, and taste. The study included 60 (sixty) untrained panelists who were asked to rate the aroma, taste, color, and texture using the following assessment scale: 1 = ‘don’t like very much,’ 2 = ‘don’t like,’ 3 = ‘somewhat like,’ 4 = ‘like,’ and 5 = ‘like very much.

Research design

This research employed a completely randomized design (CRD) with three replications (Hasdar et al., 2021). The study included four levels of oyster mushrooms, denoted as follows: P1 (100% chicken meat : 0% oyster mushrooms), P2 (90% chicken meat : 10% oyster mushrooms), P3 (80% chicken meat : 20% oyster mushrooms), and P4 (70% chicken meat : 30% oyster mushrooms), resulting in a total of twelve experimental units. The formulation for this design was established based on preliminary research

Data analysis

In this study, data were analyzed based on the results of organoleptic assessments by panelists and chemical tests regarding the variations in oyster mushroom additions to chicken meatball products. The chosen analysis method is One-Way ANOVA. The primary objective of this statistical analysis is to determine whether a significant influence exists among the samples at the 5% significance level. If a significant effect is observed, further investigation will involve the Duncan's Multiple Range Test (DMRT).

Results and Discussion

Moisture content

The results of the conducted analysis reveal that incorporating oyster mushrooms into meatball formulations using four different concentration levels significantly impacts the moisture content of oyster mushroom chicken meatballs. These findings are presented in Table 2.

Table 2 . Moisture content test results for the aroma of oyster mushroom chicken meatballs

Treatment	Average
P1	59.63 ± 1,474 [a]
P2	67.16 ± 1,501 [b]
P3	68.13 ± 1.106 [b]
P4	72.56 ± 4,338 [c]

Note: *superscripts* with different letters in one column indicate significantly different results ($P<0.05$)

Table 2 reveals that the moisture content of chicken meatballs with the addition of 30% oyster mushrooms (P4) surpasses that of chicken meatballs with 0%, 10%, and 20% oyster mushroom additions. The variation in moisture content among chicken meatballs can be attributed to the quantity of oyster mushrooms utilized in each treatment. Moisture content significantly impacts meatball characteristics, including appearance, texture, taste, freshness, and shelf life. Elevated moisture content creates a favourable environment for bacterial, mould, and yeast growth, potentially altering food products (Winarno, 2008; Harmayani & Fajri, 2021). Notably, our study demonstrates that the inclusion of oyster mushrooms leads to increased moisture content in the meatballs. This phenomenon is attributed to the high fibre content present in oyster mushrooms. According to Suprapti & Djarwanto (1992) and Apriani *et al*. (2022), white oyster mushrooms (Pleurotus ostreatus) boast a fibre content of 11.5%. Dietary fibre exhibits remarkable water absorption capacity, resulting in higher moisture content when incorporated into food materials. Once water becomes trapped within the dietary fibre, evaporation becomes challenging (Ayunir *et al*., 2017).

Organoleptic Test

Organoleptic testing involves humans as the object of analysis and a tool for determining the results of the data obtained. In this test, panellists are asked to express their responses about their likes or dislikes and to express their level of likes/dislikes (Rampengan *et al* ., 1985; Maspeke *et al* ., 2014)

Color

Colour is one of the first factors that panellists will pay attention to, and it gives the impression of whether a food product is attractive or unattractive. This parameter is assessed using the eye senses. The results of testing the colour characteristics of chicken meatballs with the addition of oyster mushrooms are shown in Table 3.

Table 3 . Hedonic test results on the color of oyster mushroom chicken meatballs

Treatment	Average
P1	3.33 ± 0.857 [a]
P2	3.33 ± 0.837[a]
P3	3.43 ± 0.789 [a]
P4	3.17 ± 0.806 [a]

Note: *superscripts* with the same letter in one column indicate results that are not significantly different (P > 0.05)

Based on the data in Table 3, it was found from the results of the organoleptic assessment that the panellists' highest level of preference for the colour of chicken meatballs was obtained in the P3 treatment with an average percentage of 3.43%, and the treatment with the lowest value was obtained by treatment P4 with an average percentage of 3.17%. The difference in concentration of oyster mushrooms in making meatballs affects the colour intensity of the resulting meatball product (Apriani *et al*., 2022). Other factors that influence the colour of processed meat are temperature and cooking time (Lawrie, 1995; Lamadjido *et al*., 2019).

There is a difference in the scores given by the panellists. It is suspected that treatment P3 had the highest score and more attractive colour, so the panellists preferred it. Treatments P1 and P2 had the second highest score with a concentration of 100% chicken meat and 0% oyster mushrooms; chicken meat was 90%, and oyster mushrooms were 10%, allegedly due to the addition of a greater amount of chicken meat. In this study, it looked like meatballs in general, so it influenced the panellists' assessments; P4 obtained the treatment with the lowest score with a chicken meat concentration of 70% and oyster mushrooms 30% less liked by panellists. This shows that the addition of oyster mushrooms to making chicken meatballs influences the panellists' level of colour preference.

The white colour found in mushrooms is a colour caused by natural pigments called anthoxanthins (Dien, 2010; Novita, 2014). Anthoxanthins are influenced by pH and can change colour to yellowish-white under acidic conditions. Blanching oyster mushrooms and boiling meatballs can reduce the pH level in oyster mushrooms and change the white pigment to yellowish.

Aroma

Scent is a factor observed with the sense of smell. The results of testing the aroma character of chicken meatballs with the addition of oyster mushrooms are shown in Table 4.

Table 4 . Hedonic test results on the aroma of oyster mushroom chicken meatballs

Treatment	Average
P1	3.40 ± 0.924 ^{b}
P2	3.03 ± 0.920 ^{a}
P3	3.17 ± 0.785 ^{ab}
P4	3.08 ± 1.030 ^{ab}

Note: *superscripts* with different letters in one column indicate significantly different results ($P < 0.05$)

Based on Table 4, the treatment of adding oyster mushrooms to making meatballs greatly influenced the level of panellists' liking for the aroma of meatballs. In treatment P1 with 100% chicken meat and 0% oyster mushrooms, panellists preferred meatballs with the addition of 10%, 20% and 30% oyster mushrooms; this was because the addition of oyster mushrooms used influenced the panellists' assessments.

The difference in panellists' preferences for the aroma of chicken meatball products with the addition of oyster mushrooms is due to the fact that the addition of oyster mushrooms will increase the aroma that is not suitable for meatballs, such as an unpleasant aroma. This is thought to be due to the presence of oyster mushrooms, which are food ingredients which have aroma compounds consisting of 1,3-dimethyl benzene, phenyl ethyl alcohol, followed by other compounds such as 1-octen-3-ol, 1,2-Benzenedicarboxylic acid (Siregar *et al. al*., 2020). Other additional ingredients can also influence the aroma of meatballs. According to (Kurniawan, 2011; Apriani *et al*., 2022), the spices used also influence the aroma of a food product.

Flavor

Taste is a parameter that the sense of taste will assess. After seeing the attractive appearance of the food, the taste is the second thing that influences the panellists' assessment. The taste test results of oyster mushroom chicken meatballs are shown in Table 5.

Table 5 . Hedonic test results on the taste of oyster mushroom chicken meatballs

Treatment	Average
P1	3.53 ± 0.873 ^{b}
P2	2.83 ± 0.977 ^{a}
P3	3.03 ± 0.991 ^{a}
P4	3.10 ± 1.020 ^{a}

Note: *superscripts* with different letters in one column indicate significantly different results ($P < 0.05$)

The addition of oyster mushrooms greatly influences the level of liking for the taste of meatballs. The panellists preferred the taste of meatballs without the addition of oyster mushrooms more than meatballs with the addition of oyster mushrooms. The highest level of liking for the taste of oyster mushroom chicken meatballs was obtained in treatment P1 without the addition of oyster mushrooms; then, the second highest treatment was obtained in treatment P4 with the addition of 30% oyster mushrooms. This is likely because the high concentration level of oyster mushrooms will affect the taste of the meatball product. According to (Widyastuti, 2011; Apriani *et al* ., 2022) stated that the addition of oyster mushrooms influenced

the increase in taste score because oyster mushrooms contain quite high levels of glutamic acid. The glutamic acid contained in oyster mushrooms gives vegetarians a delicious, almost meaty taste. Oyster mushrooms contain 17.7% glutamic acid (Astuti *et al*., 2017). Oyster mushrooms have a distinctive taste, which makes the taste of the meatballs in this study tastier and increases the stimulation of panellists' preferences so that the level of panellists' preferences increases (Harmayani & Fajri, 2021). The use of tapioca flour can also affect the savoury taste of meatballs because it contains 2.80 g of glutamic acid/100 g of protein(Isnaeni *et al*., 2014).

Texture

Texture is a factor that shows the characteristics of food that can be felt through the sense of touch. The results of testing the texture of oyster mushroom chicken meatballs are shown in Table 6.

Table 6 . Hedonic test results on the texture of oyster mushroom chicken meatballs

Treatment	Average
P1	3.37 ± 0.823 [b]
P2	3.00 ± 0.736 [a]
P3	3.03 ± 0.920 [a]
P4	2.83 ± 1.107 [a]

Note: *superscripts* with different letters in one column indicate significantly different results ($P < 0.05$)

In Table 5, it appears that the panellists quite liked the texture of chicken meatballs in treatment P1 (0% oyster mushrooms) and the texture of chicken meatballs in treatments P2 (10% oyster mushrooms) and P3 (20% oyster mushrooms), but did not like the texture of chicken meatballs. Oyster mushrooms in treatment P4 (30% oyster mushrooms). The assessment of the panellists' level of preference for the texture of the meatballs was influenced by the impression of tenderness, namely the ease of initial penetration of the teeth with the meat being chewed into smaller pieces and the amount of residue after chewing (Harmayani & Fajri, 2021). The results of the research showed that the addition of oyster mushrooms to chicken meatballs had a real influence on the level of preference for the texture of the meatballs.

The difference in the level of preference for the texture of the meatballs is related to the water content in the meatballs. The water content of the meatballs increased along with the addition of oyster mushrooms. According to (Acton, 1972; Lamadjido *et al*., 2019) stated that the water added to making meatballs helps make product formation easier. However, adding unlimited water will actually make it difficult to form the product and cause the product to have a wet and mushy impression. The use of untrained panellists causes relatively different levels of preference for texture. Apart from that, the treatment of mixing white oyster mushrooms in the meatball dough can cause an increase in the water content and a decrease in the dry ingredient concentration of the dough, so the higher the percentage of oyster mushrooms added, the lower the level of hardness.

Conclusion

The addition of oyster mushrooms to the chicken meatball mixture has a significant effect on the water content. Based on the results of testing the water content of the chicken meatball formulation with the addition of oyster mushrooms in treatment P1 (59.63%), it meets the Indonesian National Standard for combined meat meatballs (SNI 3818-2023) with a maximum water content of 70%. The addition of oyster mushrooms also had a significant effect ($P<0.05$) on the organoleptic parameters of meatballs. Based on the results of observations, the

best organoleptic value of jam meatballs is P1 (100%:0%) from all parameters, including colour, aroma, texture and taste. Diversification of oyster mushroom chicken meatball products provides wider product variations, thereby increasing people's choices and increasing market attractiveness.

References

Ali, NA, Wadli, & Hasdar, M. (2023). The effect of the combination of catfish meatballs and chicken meatballs with the addition of the transglutaminase enzyme: the effect of the combination of catfish meatballs and chicken meatballs with the addition of the transglutaminase enzyme. Journal of Technology and Food Processing (JTFP), 3(01), 16-24.

Apriani, R., Astuti, S., & Suharyono, AS (2022). Substitution of White Oyster Mushroom (Pleurotus Ostreatus) in Making Beloso Fish Meatballs (Saurida Tumbil): Evaluation of Chemical and Sensory Properties of White Oyster Mushroom (Pleurotus ostreatus) Substitution Properties. *Journal of Sustainable Agroindustry* , *1* (1), 61–77.

Astuti, S., AS, S., & Fitra, N. (2017). Effect of White Oyster Mushroom (Pleurotus oestreatus) and Tapioca Formulation on the Physical, Organoleptic and Chemical Properties of Crackers. *Journal of Applied Agricultural Research* , *16* (3), 163–173.

Aviana, T., & Heryani, S. (. (2016). *The Effect of Blanching Treatment and Variations in Sugar Use on the Organoleptic Characteristics and Acceptability of Warta IHP Oyster Mushroom Jerky* (Vol. 33, Issue 2).

Ayunir, M., Ansharullah, & Hermanto. (2017). Effect of Tofu Dregs Flour Substitution on the Chemical and Organoleptic Composition of Sweet Bread. *Journal of Food Science And Technology* , *2* (3), 542–553.

Harmayani, R., & Fajri, N.A. (2021). Effect of Adding Oyster Mushrooms (Pleurotus Sp.) on the Chemical Composition and Organoleptic Values of Broiler Chicken Meatballs. *Journal of Technology & Environmental Science* , *7* (1), 78–90.

Hasdar, M., Wadli, W., & Meilani, D. (2021). Completely Randomized Design and Randomized Block Design on the pH of Sheepskin Gelatin with NaOH Solution Pretreatment. Journal of Technology and Food Processing (JTFP), 1(01), 17-23.

Husein, M., Windyasmara, L., & Hasdar, M. (2022). Soursop leaf infusion technology (Annona Muricata Lin) on the quality of free-range chicken meat. Agrisaintifika: Journal of Agricultural Sciences, 6(2), 66-74.

Indonesian National Standard. (2014). *Meatballs SNI-01-3818-2014* . 1–31.

Isnaeni, AN, Swastawati, F., & Rianingsih, L. (2014). The Influence Of Adding The Flour That Different On The Quality Of Petis Product From The Rest Liquid Of Steaming Milkfish (Chanos Chanos Forsk) Presto. *Journal of Fishery Product Processing and Biotechnology* , *3* (3), 40–46.

Kuntari, W., & Fitriani, AN (2021). Feasibility Study of Oyster Mushroom Processing Business into Mushroom Broth in White Umbrellas. *Journal of Applied Science* , *11* (2), 70–85.

Lamadjido, SR, Umrah, U., & Jamaluddin, J. (2019). Formulation and Analysis of the Nutritional Value of Boxed Meatballs from White Oyster Mushrooms (Pleurotus Ostreatus). *Galenika Journal of Pharmacy (e-Journal)* , *5* (2), 166–174.

Maspekte, PNS, Pulumoduyo, S., & Une, S. (2014). Physicochemical and Organoleptic Properties of Baby Biscuits Formulated with Pumpkin Flour (Cucurbita Moschata) and Spinach Porridge (Amaranthus Tricolor L.). *Journal of Food and Agroindustry* , *1* (1), 577–585.

Novita, Rossy Surya. (2014). The Influence of the Proportion of Gluten and White Oyster Mushrooms on the Organoleptic Quality of Vegetable Meatballs. *Food Journal* , *volume 3* , 111–119.

Nurwati, N., & Hasdar, M. (2021). Organoleptic properties of brownie cake with the addition of seaweed (Eucheuma cottonii). Journal of Food Technology and Agroindustry, 3(2), 69-75.

Sinaga, H., (2019). Acceptability of Meatballs with Variations in Oyster Mushroom *(Pleurotus ostreatus)* and Red Bean Flour Formulations for Consumers[Thesis]. Department of Nutrition. Medan Health Polytechnic.

Siregar, IMD, Pratama, F., Hamzah, B., & Wulandari. (2020). Changes in the Quality of White Oyster Mushrooms (Pleurotus ostreatus) During Storage at Various Temperatures and Co2 Concentrations. *Journal of Agricultural Products Technology & Industry* , *25* (2), 129–138.