



THE EFFECT OF FOOD ADDITIVES ON PALM MUSHROOMS (VOLVARIELLA VOLVACEA) MEATBALLS AND MOCAF FLOUR (MODIFIED CASSAVA FLOUR)

PENGARUH ADITIF MAKANAN TERHADAP BAKSO JAMUR KELAPA SAWIT (VOLVARIELLA VOLVACEA) DAN TEPUNG MOCAF (TEPUNG SINGKONG YANG DIMODIFIKASI)

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DOI: <https://doi.org/10.62567/micjo.v3i2.2427>

Abstract

This study aims to characterize the effect of food additives on the quality of meatballs made from palm mushrooms (*Volvariella volvacea*) and mocaf flour. Meatballs were made with a formulation of 70% palm mushrooms and 30% mocaf, and the addition of carrageenan, CMC, and STPP at concentrations of 0.25%, 0.5%, and 1% with 9 treatments. The parameters analyzed included yield, water content, protein, fiber, organoleptic and production cost. The results showed that the yield ranged from 82.15–96.39% and was significantly different between treatments. Water content was 65.01–70.60%, while the highest protein and fiber content was obtained with the addition of 0.25% carrageenan, respectively 10.53% and 7.97%, respectively. The type and concentration of food additives significantly affected the yield, water content, protein, fiber and texture but did not significantly affect the color and taste of palm mushroom and mocaf flour meatballs.

Keywords : Thickener, Texture, Vegetarian.

Abstrak

Penelitian ini bertujuan mengkarakterisasi pengaruh bahan tambahan makanan terhadap mutu bakso berbahan jamur sawit (*Volvariella volvacea*) dan tepung mocaf. Bakso dibuat dengan formulasi jamur sawit 70% dan mocaf 30%, serta penambahan karagenan, CMC, dan STPP pada konsentrasi 0,25%, 0,5%, dan 1% dengan 9 perlakuan. Parameter yang dianalisis meliputi rendemen, kadar air, protein, serat, organoleptik serta harga pokok produksi. Hasil menunjukkan rendemen berkisar 82,15–96,39% dan berbeda nyata antar perlakuan. Kadar air 65,01–70,60%, sedangkan kadar protein dan serat tertinggi diperoleh pada penambahan karagenan 0,25% masing-masing 10,53% dan 7,97% perlakuan jenis dan konsentrasi bahan tambahan makanan berpengaruh nyata terhadap rendemen, kadar air, protein, serat dan tekstur tetapi tidak berpengaruh nyata terhadap warna dan rasa bakso jamur sawit dan tepung mocaf.

Kata Kunci : Pengental, Tekstur, Vegetarian.



1. INTRODUCTION

Meatballs are a popular processed meat product among Indonesians from all walks of life. They are typically made from ground beef mixed with binding and texturizing agents, then shaped into balls and boiled until cooked through. Their popularity stems from their savory flavor and chewy texture. However, the relatively high price of beef poses a challenge in meatball production, necessitating innovations that can reduce production costs without sacrificing product quality. One such approach is the use of oil palm mushrooms, which are a potential vegetarian alternative and are commonly found on oil palm plantations. The oil palm mushroom (*Volvariella volvacea*) is a type of edible mushroom that grows on solid palm oil waste, such as empty fruit bunches (FFBs), a byproduct of palm oil processing plants, which are abundant in Bengkulu province. This mushroom has a meaty texture, a relatively high protein content of 34.24%, and a strong umami flavor, making it highly potential as a substitute or ingredient in processed food products like meatballs. According to (Rosianti et al., 2024), palm mushrooms have great potential as an alternative food ingredient with a protein content of 16.58% and a high fiber content of 2.73%. They can also be processed into economically viable value-added products (meatballs).

The results showed that increasing the proportion of palm mushrooms in the meatball formulation provided nutritional advantages in the form of increased protein and fiber content. Meatballs with a composition of 70% palm mushrooms and 30% mocaf produced the highest protein content at 16.58% and the highest fiber content at 2.73%, with a softer and less chewy texture. This is because the use of mocaf flour as a binding agent in palm mushroom meatballs is less effective, despite having better functional properties than regular cassava flour, being gluten-free, having good water-binding and gel-forming properties. Therefore, food additives such as carrageenan, CMC, and STPP are needed to improve the texture of palm mushroom meatballs and mocaf flour. This study aims to examine how these additional ingredients can improve the quality of palm mushroom meatballs with mocaf flour.

2. RESEARCH METHOD

This research method uses a Completely Randomized Design (CRD) consisting of 9 samples with different treatments, namely using palm mushrooms and mocaf flour with the addition of food additives. The data obtained were analyzed using the analysis of variance (ANNOVA) method, if differences are found between samples, it will be continued with a real difference test using Duncan's Multiple Range Test (DMRT) analysis at a significance level of 5%.

3. RESULT AND DISCUSSION

a) Yield Analysis

Yield is an important parameter for determining the economic value and effectiveness of a product. Yield is calculated as a percentage of the final weight compared to the initial weight of the product. The higher the yield, the higher the economic value of the product (Khusnah, 2018). The initial weight is the total raw material weight before processing, and the final weight is the total raw material weight after processing. The results of the study show the yield analysis of palm mushroom meatballs and mocaf flour in the table below.

Table 1. Results of Yield Analysis of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)		
	0,25(K1)	0,5(K2)	1(K3)
Carrageenan (P1)	91,67 ^e	91,83 ^d	92,42 ^c
CMC (P2)	92,40 ^c	94,30 ^b	96,39 ^a
STPP (P3)	91,01 ^f	82,58 ^g	82,15 ^h



Note: Numbers followed by different letters indicate a significant difference at the 5% significance level.

The table above shows the results of the yield analysis, with an average value between 82.15% and 96.39%. This means that the higher the CMC concentration, the higher the yield of palm mushroom meatballs and mocaf flour. Conversely, the higher the STPP concentration, the lower the yield of palm mushroom meatballs and mocaf flour. The table above also shows that there is a significant difference in the yield of palm mushroom meatballs and mocaf flour with different concentrations of food additives.

b) Moisture Content Analysis

Moisture content analysis is a crucial component of product quality stability. The moisture content in food ingredients determines the freshness and shelf life of the food. High moisture content facilitates bacterial growth. According to Rohana (2016), moisture content is crucial in determining the shelf life of a food ingredient because it affects its physical, organoleptic, and chemical properties, as well as spoilage by microorganisms. The research results show the moisture content analysis of palm mushroom meatballs and mocaf flour in the table below.

Table 2. Results of Moisture Content Analysis of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)		
Food Additives	0,25(K1)	0,5(K2)	1(K3)
Carrageenan (P1)	67,88 ^c	67,74 ^d	68,27 ^b
CMC (P2)	67,51 ^e	68,25 ^b	70,60 ^a
STPP (P3)	67,39 ^e	67,38 ^{ef}	65,01 ^g

Note: Numbers followed by different letters indicate a significant difference at the 5% significance level.

The table above shows the results of the moisture content analysis, with an average between 65.01% and 70.60%, meaning all treatments had a moisture content that met the SNI (2014) standard, which is a maximum of 70%. The statistical calculations show that the treatments affected the moisture content of the palm mushroom meatballs. The higher the CMC concentration, the higher the moisture content of the palm mushroom meatballs and mocaf flour. Conversely, the higher the STPP concentration, the lower the moisture content of the palm mushroom meatballs and mocaf flour. The table above also shows that there was a significant difference in the moisture content of the palm mushroom meatballs and mocaf flour with food additives at different concentrations.

c) Analysis of Protein Levels

Protein is a complex organic compound with a high molecular weight. Protein is also a polymer consisting of amino acid monomers linked by peptide bonds (Ispitasari & Haryanti, 2022). The results of the study show the protein content analysis of palm mushroom meatballs and mocaf flour in the table below.

Table 3. Results of Protein Content Analysis of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)		
Food Additives	0,25(K1)	0,5(K2)	1(K3)
Karagenan (P1)	10,53 ^a	9,56 ^b	8,49 ^d
CMC (P2)	8,35 ^e	8,45 ^d	6,86 ^g
STPP (P3)	7,45 ^f	6,60 ^h	8,65 ^c

Note: Numbers followed by different letters indicate a significant difference at the 5% significance level.

The table above shows the results of the protein content analysis, with an average of 6.60% to 10.53%. According to SNI (2014), the minimum protein content is 8.0% for combination meat meatballs and 11.0% for meat meatballs. The lower the carrageenan concentration, the higher the protein content of the palm mushroom meatballs and mocaf flour. The table above also concludes that there is a significant difference in the protein content of the palm mushroom meatballs and mocaf flour with food additives at different concentrations.



d) Fiber Content Analysis

Dietary fiber, commonly known as dietary fiber (DF), is a complex carbohydrate found in the cell walls of plants that is difficult for enzymes to break down and difficult to absorb in the digestive tract. Dietary fiber plays a crucial role in maintaining human health, preventing disease, and serving as an essential component of the diet (Rahmah et al., 2017). The results of this study show the protein content analysis of palm mushroom meatballs and mocaf flour in the table below.

Table 4. Results of Fiber Content Analysis of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)		
	0,25(K1)	0,5(K2)	1(K3)
Food Additives	7,97 ^a	7,87 ^a	6,28 ^c
Carrageenan (P1)	6,80 ^{bc}	6,65 ^{cd}	4,97 ^f
CMC (P2)	6,51 ^{de}	5,13 ^f	6,99 ^b
STPP (P3)			

Note: Numbers followed by different letters indicate a significant difference at the 5% significance level.

The table above shows the results of the analysis of the fiber content of palm mushroom meatballs and mocaf flour with food additives, with an average of 4.97% to 7.97%. According to Prasetya et al. (2017), the fiber content of palm mushroom is 39.83% in fresh mushrooms, while the fiber content of mocaf flour, according to the Indonesian Food Composition Table (2017), is 6%. The highest fiber content was found with the addition of 0.25% carrageenan, with an average value of 7.97%, while the lowest fiber content was found with the addition of 1% CMC, with an average value of 4.97%. The statistical calculations show a significant difference between the treatments.

e) Organoleptic Color

Color is one of the first organoleptic attributes consumers notice when purchasing or consuming a product (Apandi et al. 2016). The results of this study show the organoleptic color analysis of palm mushroom meatballs and mocaf flour in the table below.

Table 5. Organoleptic Color Results of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)		
	0,25(K1)	0,5(K2)	1(K3)
Food Additives	4 ^a	3,85 ^a	3,8 ^a
Carrageenan (P1)	4 ^a	3,95 ^a	3,8 ^a
CMC (P2)	3,85 ^a	4,1 ^a	4,2 ^a
STPP (P3)			

Note: Numbers followed by different letter codes indicate no significant difference. Scale: 1 = dislike very much; 2 = dislike; 3 = somewhat like; 4 = like; 5 = like very much.

The results of the organoleptic color analysis of the palm mushroom meatballs and mocaf flour with food additives showed an average value of 3.8 (like) to 4.2 (like). The highest color intensity was found with the addition of 1% STPP, with an average value of 4.2 (like). The lowest color intensity was found with the addition of 1% carrageenan and CMC, with an average value of 3.8 (like). Statistical analysis showed that the addition of each food additive at different concentrations did not significantly affect the palm mushroom meatballs and mocaf flour. However, in terms of color, panelists preferred the palm mushroom meatballs and mocaf flour with the addition of 1% STPP, or 3 grams.

f) Organoleptic Taste

Taste is a crucial factor in food because acceptance or rejection of a food is determined by its taste. Food taste is a combination of tasting and smelling. Taste assessment uses the five senses of taste, namely the tongue, which serves as a taste assessor by tasting a food or drink. The results of the study show the organoleptic analysis of the taste of palm mushroom meatballs and mocaf flour in the table below.

Table 6. Organoleptic Results of Taste of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)



Food Additives	0,25(K1)	0,5(K2)	1(K3)
Carrageenan (P1)	3,95 ^a	4,05 ^a	3,75 ^a
CMC (P2)	3,9 ^a	3,75 ^a	3,7 ^a
STPP (P3)	3,9 ^a	3,75 ^a	3,9 ^a

Note: Numbers followed by different letter codes indicate no significant difference.

Scale: 1 = dislike very much; 2 = dislike; 3 = somewhat like; 4 = like; 5 = like very much.

The results of the statistical analysis of panelists' acceptance of the taste of the palm mushroom meatballs showed an average score of 3.7 (like) to 4.05 (like). Panelists' preference for the taste of the nine palm mushroom meatball treatments showed no significant difference. The highest taste score was found in the 0.5% carrageenan treatment with an average score of 4.05 (like), while the lowest taste score was found in the 1% CMC treatment with an average score of 3.7 (like).

g) Organoleptic Texture

Texture is a response or sensation of pressure that can be observed and experienced through the mouth (biting, chewing, and swallowing). Midayanto and Yuwono (2014) state that texture is a characteristic of a material resulting from a combination of several physical properties, including size, shape, quantity, and constituents of the material, that can be perceived by the senses of touch and taste, including the mouth and eyes/sight. The results of the study show the organoleptic analysis of the texture of palm mushroom meatballs and mocaf flour in the table below.

Table 7. Organoleptic Results of the Texture of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)		
Food Additives	0,25(K1)	0,5(K2)	1(K3)
Carrageenan (P1)	3,8 ^{ab}	3,9 ^{ab}	3,75 ^b
CMC (P2)	3,9 ^{ab}	3,75 ^b	3,2 ^c
STPP (P3)	3,9 ^{ab}	3,85 ^{ab}	4 ^a

Note: Numbers followed by different letter codes indicate no significant difference.

Scale: 1 = dislike very much; 2 = dislike; 3 = somewhat like; 4 = like; 5 = like very much.

The results of the organoleptic analysis of panelists' acceptance of the texture of the palm mushroom meatballs showed an average score of 3.2 (like) to 4 (like). Panelists' preference for the texture of the nine palm mushroom meatball treatments showed significant differences. The highest texture score was found with the addition of 1% STPP, with an average score of 4 (like), while the lowest texture score was found with the addition of 1% CMC, with an average score of 3.2 (like). This means that the addition of 1% STPP to the palm mushroom meatballs resulted in a texture that was preferred by panelists, while the texture of the addition of 1% CMC was less preferred by panelists.

h) Overall Organoleptic

According to Meilgaard et al. (2016), an overall test is conducted to describe the panelists' overall level of preference for a product, reflecting their perceptions after evaluating all sensory attributes simultaneously. The overall score is often used as a primary indicator of consumer acceptance of a product. The overall preference test for the assessment of palm mushroom meatballs and mocaf flour with the addition of food additives can be seen in the table below.

Table 8. Overall Organoleptic Results of Palm Mushroom Meatballs and Mocaf Flour

Treatment	Concentration (%)		
Food Additives	0,25(K1)	0,5(K2)	1(K3)
Carrageenan (P1)	3,9 ^a	43,85 ^a	3,75 ^a
CMC (P2)	3,8 ^a	3,75 ^a	3,8 ^a
STPP (P3)	3,85 ^a	3,8 ^a	4,2 ^a

Note: Numbers followed by different letter codes indicate no significant difference.

Scale: 1 = dislike very much; 2 = dislike; 3 = somewhat like; 4 = like; 5 = like very much.

The results of the organoleptic analysis of panelists' acceptance of all the palm mushroom meatballs showed an average score of 3.75% to 4.2%. Panelists' preference for all nine palm mushroom meatball treatments showed no significant difference. The highest overall score was found with the



addition of 1% STPP, with an average score of 4.2 (like), while the lowest overall score was found with the addition of 1% carrageenan and 0.5% CMC, with an average score of 3.75 (like).

4. CONCLUSION

Based on the results of the study on the analysis of palm mushroom meatballs and mocaf flour with the food additives carrageenan, CMC, and STPP, the following conclusions can be drawn:

1. The addition of thickening agents in the form of carrageenan, carboxymethyl cellulose, and sodium tripolyphosphate significantly increased the yield and improved the texture of palm mushroom meatballs.
2. The use of food additives did not significantly affect color and flavor, but did significantly affect texture.
3. The addition of food additives affected the chemical characteristics of the product, particularly moisture, protein, and fiber content. The chemical composition of the palm mushroom meatballs and mocaf flour produced met meatball quality standards and demonstrated good nutritional value as a plant-based food alternative.

5. REFERENCES

- Apandi I, Restuhadi F, Yusmarini. 2016. Analisis Pemetaan Kesukaan Konsumen (*Consumer's Preference Mapping*) Terhadap Atribut Sensori Produk Soygurt Mahasiswa Fakultas Dikalangan Pertanian Universitas Riau. *Jom Faperta* 3(1).
- Ispitasari, R., & Haryanti, H. (2022). Pengaruh Waktu Destilasi terhadap Ketepatan Uji Protein Kasar pada Metode Kjeldahl dalam Bahan Pakan Ternak Berprotein Tinggi. *Indonesian Journal* <https://doi.org/10.22146/ijl.v0i0.73468>.
- Khusnah, Z. (2018). Pengaruh Konsentrasi Isolat Protein Kedelai Terhadap Karakteristik Fisika, Kimia Dan Organoleptik Sosis Ikan Bandeng (*Chanos Chanos, Forsk*) (Doctoral dissertation, Universitas Brawijaya).
- Meilgaard, M., Civille, G. V., & Carr, B. T. (2016). *Teknik Evaluasi Sensorik* (edisi ke-5). Boca Raton: CRC Press.
- Prasetya, A., Budiyanto, dan Yuwana. 2017. Karakteristik Fisik dan Kimia Jamur Merang dan Jamur Tiram Putih Pada Media Limbah Tandan Kosong Kelapa Sawit (TKKS). Tidak Dipublikasikan. Tesis. Universitas Bengkulu. Bengkulu.
- Rahmah, A., rezal, F. and rasma, R. (2017) 'Perilaku Konsumsi Serat Pada Mahasiswa Angkatan 2013 Fakultas Kesehatan Masyarakat Universitas Halu Oleo Tahun 2017', *Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat Unsyiah*, 2(6), p. 198088.
- Rohana, M. L., Berhimpon, S., Palenewen, J. Ch. V., 2016. Keberadaan Mikroba pada Bakso Ikan Asap Cair, yang Dikemas dalam Retortable Pouch, Dipasteurisasi dan Disimpan pada Temperatur Ruang. *Jurnal Media Teknologi Hasil Perikanan* Vol 4, No 2, Agustus 2016.
- Rosianti, E., Arif, H. M., & Prasetya, A. (2024). Karakteristik Mutu Bakso Jamur Sawit dengan Variasi Konsentrasi Jamur Sawit (*Volvariella volvacea*) dan Tepung Mocaf (*Modified cassava flour*). *Agriovet*, 6(2), 170-186.