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The role of porang flour and oyster mushroom in providing quality vegetarian meatball

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Abstract. The demand for good quality vegetarian food is increasing nowadays. The aim of this paper is to discuss the role of porang flour in the characteristics of oyster mushrooms meatball to support the availability of good quality vegetarian foods. A trial was conducted to optimize the right concentration of porang flour that produced good quality oyster mushroom meatballs. Several quality parameters were assessed, including the protein content, fat content, texture, aroma, and taste. The results of this study revealed that oyster mushrooms produced nutritious meatballs and low-fat content. The data also indicated that the use of porang flour as a natural food additive for meatball processing is in the excellent texture of the oyster mushroom meatballs and had no adverse effect on the taste and aroma of the meatball products.

Keywords: Meatball; oyster mushroom; porang; quality

1. Introduction

Meatballs are traditionally made from a mixture of beef, starch, and sometimes with or without permitted food additives [1]. Beef or other types of animal meat are used as the main ingredients for meatballs. Some people, especially vegetarians, may not be able to consume these traditional meatballs. Therefore, it is necessary to develop alternative materials for meat in meatball processing. One potential nutritious material is oyster mushrooms [2]. Oyster mushroom (*Pleurotus ostreatus*) is a healthy food material with high protein content, rich in vitamins and minerals including iron, calcium, vitamin B1, vitamin B2 and vitamin C, low carbohydrates, fat, and calories [3].

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Good quality meatballs are characterized by the texture, color, and taste. Several factors affect the quality of the meatballs, including the raw materials or ingredients used and the method of processing [4]. One of the parameters used to determine the meatball quality is the chewiness. In general, meatball producers use sodium tripolyphosphate (STPP) to produce good meatball's chewiness. According to Soeparno [5], phosphate may have a vital function in increasing the water-binding power of meat proteins, reducing meat wrinkling, and inhibiting rancidity. However, the use of STPP has become a concern as it is suspected to be not safe for human health when used excessively. Therefore, it is necessary to develop an alternative safe material such as porang flour to be used in meatballs processing.

Porang flour is made from porang tubers (*Amormophillus oncophillus*), which contains a very high glucomannan concentration, which is about 64.77% [6]. The high level of glucomannan causes porang flour to be widely used as a filler, thickener, and additive for food products or health-based material. The study results on the effect of porang flour concentration on the quality of oyster mushroom meatballs will be presented and discussed in this article.

2. Materials and Methods

The method used in this research was an experimental method, which was carried out in the laboratory. The research design used was a completely randomized design (CRD) with six porang flour treatments as a thickening agent, including 1%, 2%, 3%, 4%, 5% porang flour, and the control (without the use of porang flour). For this control, a commercial thickening agent (STPP 0.3%) was used. Each treatment was repeated three times. According to the treatments, meatballs were made using oyster mushrooms as the main ingredients, spices, and thickening agents.

The parameters observed in this study included the moisture content assessed using the thermographic method [7], the ash content analyzed using the oven method [8], the protein content using the Kjeldahl method [8], the fat content using the Soxhlet method [9]. The organoleptic characteristics of meatballs, including the aroma, taste, and texture, were assessed using the hedonic method [10].

The data obtained from the observation were analyzed using variance analysis (Analysis of variance) at a 5% significant level using the Costat software. When there was a significant difference, a further test was carried out with the Honest Real Difference Test (HSD) at the same significant level.

3. Results and Discussion

This research revealed that the use of porang flour as an alternative food additive significantly improved the quality of meatballs (Tables 1 and 2). Details of the results from this study are presented and discussed in the following sub-sections.

3.1. Results

Table 1. The average of the moisture content, ash content, protein content, and fat content of oyster mushrooms meatballs

Treatments	Average value*			
	Water content (%)	Ash content (%)	Protein content (%)	Fat content (%)
Control (STPP 0.3%)	69.67a	2.09c	3.31b	0.056

Porang flour 1%	69.65a	2.16c	4.05b	0.062
Porang flour 2%	69.44ab	2.21bc	4.10b	0.064
Porang flour 3%	68.82ab	2.34abc	4.33ab	0.065
Porang flour 4%	68.73ab	2.46ab	5.04ab	0.07
Porang flour 5%	68.10b	2.59a	6.08a	0.09

*Value is the mean of three replications. Means followed by the same letter within the same column are not significantly different ($p<0.05$).

Table 2. The average score of aroma, taste, and texture of oyster mushrooms meatballs

Treatments	Average value*		
	Aroma	Taste	Texture
Control (STPP 0.3%)	4.01	3.93	3.42d
Porang flour 1%	4.05	3.92	3.68d
Porang flour 2%	4.05	3.92	4.28c
Porang flour 3%	4.10	3.82	5.13a
Porang flour 4%	4.17	3.75	4.76ab
Porang flour 5%	4.22	3.72	4.63bc

*Value is the mean of three replications. Means followed by the same letter within the same column are not significantly different ($p<0.05$).

3.2. Discussion

3.2.1 Water content. Water content is one component of foodstuffs that must be considered in food processing because it affects food products' shelf life. Besides affecting the shelf life, the moisture content in the products can also affect the appearance, texture, and taste of foods. Based on data in Table 1, the water content of the oyster mushroom meatballs was significantly affected after being treated with porang flour. This is probably associated with the water absorption capacity of porang flour, which may be higher than the STTP. A higher percentage of porang flour added to the meatballs mixture resulted in lower water content of the oyster mushroom meatballs. The high-water absorption capacity of porang flour is a result of glucomannan content in porang flour that can bind water well.

Johnson [11] states that konjac flour can form a heat-resistant gel and remains stable at 100 ° C or higher to lead to a decrease in products' water content. According to Chan and Albert [12], a reduction in water content indicates a break in the hydrogen bonds between water and the glucomannan polymer, which can cause the bonds between molecules to break.

The range of the oyster mushroom meatball's water content obtained in this study was 68.10-69.67%. According to the Indonesian national standard for meatballs, this water content fulfills the quality standard of meatballs, SNI No.01-3818-1995, which describes that the maximum water content requirement for meatballs is 70%.

3.2.2 Ash content. Ash content is a component that represents the mineral content in food. Table 1 shows the ash content of the oyster mushroom meatball increases with the increasing concentration of porang flour added to the meatball mixture. The ash content increase is due to essential mineral components in the porang flour used in the meatball production in this study. As stated by Alonso-

Sande *et al.* [13], porang flour has several important mineral components, including Calcium (Ca), Iron (Fe), Magnesium (Mg), Phosphorus (P), Potassium (K), Sodium (Na), and Zinc (Zn). Therefore, the meatball with 5% porang flour treatment had the highest ash content, which was 2.59%. The level of the ash content of the oyster mushroom meatballs (2.09-2.59%) also fulfills the quality requirement for meatballs according to the SNI No. 01-3818-1995, which describes that 3.0% is the maximum ash content allowed for meatballs.

3.2.3 *Protein Content.* The protein content is one of the critical nutritional components in determining the quality of meatballs. Based on Table 1, the protein content of oyster mushroom meatballs obtained in this study was in the range of 3.31–6.08%. The increase in protein content of meatballs as the concentration of porang flour added to the meatball mixture increased may be related to porang flour's ability to bind nutrients in food [14]. This increase may also result from the protein component in the porang flour itself that was added to the meatball mixture. Anggraeni *et al.* [15] also reported that an increase in sausages' protein content was due to the use of porang flour in the materials used for making the product. The protein content in the oyster mushroom meatball in the study (3.31–6.08%) did not fulfill the quality requirements for meatballs based on the SNI No.01-3818-1995 that requires the minimum protein content of 9.0% for meatball.

3.2.4 Fat level. Based on Table 1, the fat content of oyster mushroom meatballs obtained was low (0.056-0.09%). This may occur due to the low-fat content of oyster mushrooms and the porang flour used in this study. The low-fat content characteristics of oyster mushroom meatballs are very suitable foods, especially for the vegetarian old age group. If compared with the quality requirements for meatball according to the SNI No. 01-3818-1995, the fat content of the oyster mushroom meatballs meets SNI, which requires the maximum fat content of the meatball is 2.0%.

3.2.5 *Aroma and Taste.* Table 2 shows that the level of panelist preference to the aroma of oyster mushroom meatballs was about the same among the panelists (4.01 - 4.22, which means neutral). This may be because the glucomannan and other porang flour components do not have a unique aroma and taste [16]. Thus it did not change the aroma and the taste of the oyster meatballs significantly. This resulted in relatively the same panelist preference for the meatball taste. The prominent aroma of oyster mushroom meatballs obtained in this study is a distinctive aroma of the mushroom itself. This is in line with Crisan and Sands [17], who state that a particular aroma and taste of white oyster mushrooms may be associated with high glutamic acid content (about 890 milligrams of amino acids per 100 grams of dry weight). The STPP used as the control treatment also does not have a specific aroma, so it did not change the oyster mushroom meatballs' aroma.

3.2.6 *Texture.* The texture is an important characteristic that determines the quality of meatballs. Generally, meatballs with a chewy texture characteristic are preferred by consumers. Table 2 shows that the panelists' most preferred meatballs are the meatballs made with 3% porang flour, as they produced a good meatball chewiness level. This may be associated with the ability of porang flour to bind water, which leads to the dough's elastic properties, resulting in good meatball texture characteristics. The binding capacity of porang flour is closely related to glucomannan, a hydrocolloid

that functions as a binding agent and forms a good texture of the products. This characteristic has made porang flour widely used as a filler, thickener, and additives for food products [18], [19].

4. Conclusion

Based on the results obtained in this research, it can be concluded that the use of porang flour at the range of concentrations used in the treatments had a significant effect on the water content, protein content, ash content, and fat content. Adding 3% of porang flour was the best treatment in making oyster mushroom meatballs, as it produces oyster mushroom meatballs with a water content of 68.82%; ash content 2.34%; protein content 4.33%; fat content 0.07%. These characteristics fulfill the quality standard according to SNI 01-3818 of 1995. The use of porang flour as a food additive in meatball production is very potential. It did not reduce the panelist's preferences to the aroma and taste of the oyster mushroom meatballs.

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