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Physical Quality of Culled Duck Meatball Substituted with Edamame Flour Filler

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ABSTRACT

The added value of duck meat can be increased by processing meatball products. Edamame flour can be used as a filler in meatball processing. This study aimed to determine the effect of edamame flour filler substitution on the physical quality of culled duck meatballs. The research material consisted of culled duck meat, tapioca flour, edamame flour, albumen, garlic, onion, salt, pepper, monosodium glutamate, sodium tripolyphosphate, and ice. The edamame flour filler substitution treatments were P0 (0%), P1 (5%), P2 (10%), P4 (15%), and P5 (20%) from total filler. Each treatment consisted of five replications. The parameters which tested were pH value, water holding capacity, cooking loss, and chewiness. The data on physical quality results were analyzed by analysis of variance using completely randomized design and if there was significantly ($p<0.01$), then that tests further by the Duncan's New Multiple Range Test. The results showed that the substitution of edamame flour filler to the level of 20% had a highly significant effect ($p<0.01$) on pH value, water holding capacity, cooking loss, and chewiness of culled duck meatballs. The edamame flour filler substitution at the level of 20% can increase the pH value, water holding capacity, and cooking loss, but decrease chewiness of culled duck meatballs.

Keywords Meatball, Culled duck meat, Filler, Physical quality, Edamame flour

INTRODUCTION

The population of ducks in Indonesia in 2019 reached 61,221,313 birds (Ditjen PKH, 2019). Culled ducks are ducks that are no longer productive in producing eggs. The meat of culled ducks is generally less attractive to the community because it has an off-odor (Anggraini et al., 2017), rough texture, and tough so the meat quality is low (Chang & Dagaas, 2004). The volatile components derived from the oxidation of unsaturated fats are the cause of duck meat to have a fishy smell (Hustiany, 2001; Hustiany et al., 2001; Purba et al., 2010). The protein and fat content of duck meat is higher and the calories are lower when compared to other poultry meat (Utami et al., 2011). Duck meat is darker in color compared to chicken (Ali et al., 2007). The chemical composition of duck meat is 73.29-80.69% water, 19.99-24.34% protein, 1.05-1.18% ash (Qiao et al., 2017), 1.55-2.30% intramuscular fat (He et al., 2018), and 29.36-31.12% fat (Rukmiasih et al., 2009).

Meat processing is an effort to improve the weaknesses of culled duck meat, among others, by making meatballs. The processing of duck meat into meatballs can reduce the fishy smell of duck meat (Mega et al., 2009; Anggraini et al., 2017). Culled duck meat that is processed into meatballs is more preferable when compared to other processed products (Putra et al., 2011; Kusmayadi & Sundari, 2019). Meatball is one of the processed meat products made by mashing the meat and then mixing it with flour and spices, then forming balls and boiling until cooked with hot water (Chakim et al., 2013).

The increasing number of Indonesian population and busy community activities have resulted in the consumption pattern of ready to cook and ready to eat meats experiencing rapid development (Prayitno et al., 2009), one of which is meatball. Meatballs have high acceptability and nutritional value (Prayitno et al., 2016; Prayitno et al., 2019; Prayitno & Rahman, 2020; Prayitno et al., 2021). The chemical composition of meatballs consists of a minimum of 9% protein, a maximum of 2% fat, a maximum water content of 70% and a maximum of 3% ash (SNI, 2014). Meatballs can be produced using duck meat (Ariansah, 2008; Setyaningsih, 2008; Murti et al., 2013; Lestarini et al., 2015; Anggraini et al., 2017).

As a comminution product, meatballs are announced to be added with fillers in the form of tapioca flour. Tapioca flour in the manufacture of culled duck meatballs can be substituted with edamame flour as filler. Substitution of fillers in processed meat products is an innovation to optimize local resources (Syam et al., 2019). Edamame has been used as filler in sausage making. Edamame is a Japanese variety of green soybean with large pods (Suryaningsih, 2013) and contains bioactive components (Aliyah & Setiawati, 2018; Widiyawati & Susindra, 2018). Edamame production in Indonesia is mostly developed in the Jember area. The chemical composition of edamame flour consists of 3.22% water, 40.02% protein, 18.43% fat, 34.65% carbohydrates, and 3.78% ash. Edamame flour based on its chemical composition can be used as a filler and binder with a high protein and carbohydrate content. The physical quality of meatballs is one of the important parameters in determining the quality of meatballs. This study aims to determine the effect of substitution of edamame flour filler on the physical quality of the culled duck meat balls. The results of this study are expected to provide information about the use of edamame flour as filler in the processing of culled duck meatballs.

MATERIAL AND METHOD

Experimental methods

The experiment was arranged by using the completely randomized design method with one factor (different levels of edamame flour filler substitution). Edamame flour filler substitution treatments were P0 (0%), P1 (5), P2 (10%), P3 (15%), and P4 (20%) of the total filler.

Edamame Flour Processing

Edamame peeled, the seeds were crushed and then dried at 60°C for 24 hours and then ground until smooth then sieved using a filter with a size of 60 mesh. Filtered edamame flour was used as filler for the processing of culled duck meatballs.

Meatball Processing

The culled duck meatball formulation in this study was made based on a modification of Prayitno et al. (2019). The formulation of meatball is 60% culled duck breast meat (30 months old), 15% tapioca flour (filler), 10% egg white, 2.5% garlic, 1% onion, 1.5% salt, 1% pepper, 1% monosodium glutamate, 1% sodium tripoly-phosphate, and 7% ice. Edamame flour filler substitution treatments were P0 (0%), P1 (5), P2 (10%), P3 (15%), and P4 (20%) of the total filler. The boneless duck meat was cut into small pieces and then ground using meat grinder, followed by the addition of salt, pepper, monosodium glutamate (MSG), sodium tripolyphosphate (STPP), garlic, onion, albumen, tapioca flour, edamame flour according to treatment, and ice then ground until all mixed. The meatball dough was formed balls boiled in boiling water for 10 minutes then cooled for 15 minutes. The cooked meatballs then tested on physical quality.

Physical Quality Analysis

The culled duck meatballs substituted with edamame flour filler tested physical quality, namely the pH value (AOAC, 2019), water holding capacity (Luckose & Pandey, 2014), cooking loss (Soeparno 2015), and chewiness (Dhana & Wikandari, 2019).

Value of pH

The pH value of meatballs was carried out using a pH meter. 10 g of meatball samples were mashed and 10 ml of distilled water was added and then put into a beaker. Before the pH is measured, the pH meter is calibrated with a pH 4 buffer and a pH 7 buffer, after which the meatball pH is measured by placing the electrode on the sample and the pH value is shown on the pH meter screen.

Wate holding capacity

The water holding capacity (WHC) of meatballs was measured by centrifugal method. The meatball samples of 2 g were put into a 50 ml tube. The aquadest of 10 ml was added to tube. Then centrifuged at 3,000 rpm for 20 minutes. After the centrifugation, the free water in the test tubes was removed and weighed. WHC was calculated as (100% x (solution added – solution removed/meatball sample mass)).

Cooking loss

Cooking losses (CL) of meatball are calculated from the ratio between the weight uncooked and the weight cooked of meatballs. The meatball dough sample weighs 20 g. The sample is put in a plastic bag that has been labeled. Meatball samples were put into a water bath for 30 minutes at 80°C. Then the meatball sample is cooled. The meatball sample is removed from the plastic and dried with a tissue. Meatball samples were weighed to determine the final weight. CL was calculated as (100% x (weight uncooked meatball – weight cooked meatball)).

Chewiness

The meatball chewiness tested by penetrometer. The meatball sample is placed under the penetrometer needle, the penetrometer needle starts from scale at zero, and the penetrometer needle is inserted into the surface of the meatball for 5 seconds. The chewiness of the meatballs can be determined by reading the numbers on the penetrometer scale. The value of the chewiness of the meatballs (mm/g/5 seconds).

Data Analysis

The data were analyzed by analysis of variance using completely randomized design and if there was significantly different (p<0.01), then tested further by the Duncan's New Multiple Range Test (Riadi, 2014).

RESULT AND DISCUSSION

The physical quality of meatballs is one of the important parameters in determining the quality of meatball products such as pH value, water holding capacity, cooking loss, and meatball chewiness which is tested objectively. The physical quality of the culled duck meatballs substituted by the edamame flour filler was presented in Table 1.

Value of pH

The results showed that culled duck meatballs substituted with edamame flour filler had a highly significant effect (p<0.01) on the pH value of the meatballs. The pH value of meatballs ranges from 5.72-5.85. The pH value of the duck meatball was in accordance with the research result of Lindawati et al. (2003) namely 5.71 and Swarno (2015) namely 5.82-5.86. The results showed that the higher the substitution level for edamame flour, the higher the pH value of the meatballs. The lowest pH value of meatballs was at the 0% substitution level for edamame flour filler, namely 5.72 and the highest pH value for the meatball at the 15% substitution level for edamame flour filler, namely 5.85. Meatballs with a high pH value are of better quality (Prayitno et al. 2016). The pH value of meatballs can be influenced by the pH value of the meat. Soeparno (2015) states that the pH value of the meat ranges from 5.3-5.8. An increased pH value can increase water binding capacity and chewiness (Prayitno et al., 2016). The pH value of the bako can also be affected by the protein content. Proteins contain amino acids that are hydrophilic, namely proteins that like water. The protein content of edamame flour is 40.02% higher than the protein of tapioca flour 3.05% (Safitri et al., 2017) so that meatballs substituted for edamame flour filler have higher protein content. Water bound by hydrophilic amino acids can increase the pH value of meatballs.

Table 1. The physical quality of culled duck meatballs substituted with edamame flour filler

Variable	Treatments				
	P0	P1	P2	P3	P4
Value of pH	5.72^{a}	5.81^{ab}	5.82^{ab}	5.85^{b}	5.84^{b}
Water holding capacity (%)	20.27^{a}	22.53^{a}	23.68^{a}	23.99^{a}	35.16^{b}
Cooking loss (%)	19.19^{d}	18.52^{c}	18.41^{b}	18.26^{a}	18.18^{a}
Chewiness (mm/g/5 second)	9.44^{a}	9.54^{a}	9.56^{a}	9.54^{a}	10.46^{b}

Note: P0 (0%), P1 (5%), P2 (10%), P3 (15%), and P4 (20%) substitution edamame flour from total filler, ^{abcd} Means in the same row with different letter superscripts were a highly significantly (p<0.01)

Water Holding Capacity

The results showed that culled duck meatballs substituted with edamame flour filler had a highly significant effect ($p<0.01$) on the binding capacity of the meatball water. The binding capacity of meatball water ranges from 20.27-35.16%. The value of the water-holding capacity of duck meatballs was higher than that of Wahab et al. (2013) namely 19.77-28.47% and lower than the research of Prayitno et al. (2016) namely 48.18-57.64%. The results showed that the higher the substitution level for edamame flour, the higher the binding capacity of the meatball water. The water binding capacity can be affected by the pH value (Prayitno et al., 2010). The lowest water binding capacity of 20.27% was obtained in meatballs with a substitution level of 0% edamame flour filler. This is due to the low pH value which reduces the binding capacity of the meatball water. The highest binding capacity of meatball water, namely 35.16%, was obtained in the meatballs with a 20% substitution level for edamame flour filler. Meatballs with high water holding capacity are of better quality (Prayitno et al., 2016). Water binding capacity can also be affected by protein content. Edamame flour has a higher protein content, namely 40.02% than tapioca flour protein 3.05% (Safitri et al. 2017) so that the meatball substituted with edamame flour filler has a higher protein content.

Cooking Loss

Cooking loss is an indicator of the physical quality of the meatballs which is related to the loss of water during the meatball cooking process. The results showed that culled duck meatballs substituted with edamame flour filler had a highly significant effect ($p<0.01$) on the cooking loss of the meatballs. Meatball cooking losses ranged from 18.18-19.19%. The cooking shrinkage of duck meatballs was higher than that of Murti et al. (2013) namely in the range 4.17-7.00%. The results showed that the higher the substitution level for edamame flour, the lower the meatball cooking losses. Cooking losses can be influenced by water holding capacity (Prayitno et al. 2010) and cooking loss have a negative relationship with water holding capacity (Soeparno, 2015). Meatballs with high water holding capacity have low cooking loss. The lowest meatball cooking loss, namely 18.18%, was obtained in the meatballs with the substitution of 20% edamame flour filler. This is due to the high pH value and water binding capacity which reduces cooking loss for meatballs. The highest cooking shrinkage, namely 19.19%, was obtained in meatballs with a substitution level of 0% edamame flour filler. This is due to the low pH value and water binding capacity which increases the cooking loss of meatballs.

Chewiness

The results showed that culled duck meatballs substituted with edamame flour filler had a highly significant effect ($p<0.01$) on the chewiness of meatballs. The chewiness of the meatballs ranged from 9.44-10.46 mm/g/5 seconds. The results showed that the higher the substitution level for edamame flour, the higher the chewiness value of the meatballs. The lower the chewiness value of the meatballs obtained, the higher the chewiness level of the meatballs (Prayitno et al., 2016). This shows that the higher the substitution of edamame flour filler results in less firm meatballs. The chewiness of the meatballs can be influenced by the pH value, the water holding capacity, and the cooking loss of the meatballs. The lowest value of meatball chewiness, namely 9.44 mm/g/5 seconds, was obtained for meatballs with a substitution level of 0% edamame flour filler. This is due to the low pH value and water binding capacity which increases the chewiness of the meatballs. In addition, the use of 100% tapioca flour as a filler can produce chewier meatballs (Malini et al., 2016). The highest value of meatball elasticity, namely 10.46 mm/g/5 seconds, was obtained in meatballs with a substitution level of 20% edamame flour filler. This is due to the high pH value and water binding capacity resulting in the meatball containing more water so that the chewiness of the meatballs decreases.

CONCLUSION

The results showed that the substitution of edamame flour filler up to a level of 20% had a highly significant effect on the pH value, water holding capacity, cooking loss, and chewiness of the culled duck meatballs. Substitution of edamame flour filler to a level of 20% can increase the pH value, water holding capacity, and cooking loss, but decrease the chewiness of the meatballs.

CONFLICT OF INTEREST

The authors whose names are listed have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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