Jurnal Triton, Vol. 15 No. 2 (December, 2024) : 538-546
e ISSN : 2745-3650, p ISSN : 2085-3823
DOI: https://doi.org/10.47687/jt.v15i2.837

JURNAL TRITON
journal homepage: http://jurnal.polbangtanmanokwari.ac.id

Enhancing the Quality of Chicken Meatball with Egg Albumen as Binding Agent: Study on Chemical, Texture Profile, and Sensory Properties

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ARTIKEL INFO

Article History
Received 07/03/2024
Received in revised 25/11/2024
Accepted 02/12/2024
Available online 25/12/2024
Published 25/12/2024

Keywords
Binding agent
Chicken meatball
Egg albumen
Natural additives

ABSTRAK

Bakso merupakan produk olahan daging yang dikenal masyarakat Indonesia, dibuat dari berbagai jenis daging yang dapat diterima oleh konsumen. Penelitian bertujuan untuk mengetahui kualitas kimia, profil tekstur, dan sensoris bakso ayam dengan penambahan putih telur. Komposisi bahan pembuatan bakso terdiri atas daging ayam broiler bagian dada (60,12%), tepung tapioka (20,04%), garam (2,51%), bumbu (2,3%), es batu (15,03%) dan putih telur berdasar berat daging ayam. Penelitian menggunakan Rancangan Acak Lengkap (RAL) pola searah dengan 5 perlakuan dan 4 ulangan. Perlakuan terdiri atas 0% (P0), 5% (P1), 10% (P2), 15% (P3), dan 20% (P4) putih telur. Parameter yang diuji berupa kualitas kimia (protein dan lemak), profil tekstur (*hardness, cohesiveness, springiness, dan adhesiveness*), dan sensoris (warna, rasa, tekstur, dan kekenyalan). Data protein, lemak, dan profil tekstur dianalisis menggunakan analisis variansi (Anova), data signifikan dilanjutkan dengan uji DMRT (*Duncan's Multiple Range Test*). Data sensoris diuji menggunakan Kruskal Wallis. Hasil penelitian menunjukkan penambahan putih telur berpengaruh nyata ($p<0.05$) terhadap protein, lemak, *hardness*, dan sensoris, namun tidak berpengaruh nyata ($p>0.05$) terhadap *cohesiveness, springiness*, dan *adhesiveness.* Penambahan 20% putih telur menghasilkan kadar protein dan lemak tertinggi yaitu masing-masing 11,83±0,30 dan 1,55±0,17%, sementara itu *hardness* bakso daging ayam perlakuan kontrol lebih rendah dibanding perlakuan lain, dengan nilai tertinggi 2351,04±7,39 g. Rerata *cohesiveness, springiness*, dan *adhesiveness* masing-masing 0,66±0,02; 9,03±0,16 mm; dan 0,04±0,03 mJ. Sifat sensoris terbaik bakso dengan penambahan 20% putih telur memiliki warna putih keabu-abuan, rasa enak, tekstur kompak, dan kekenyalan yang baik. Kesimpulannya, penambahan 20% putih telur mengahasilkan bakso ayam dengan kualitas kimia dan sifat sensoris terbaik.

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ABSTRACT

Meatball is well-known meat product especially in Indonesia, made from various kind of meat that could be accepted by consumers. The study aimed to investigate chemical, texture profile, and sensory properties of broiler chicken meatball added by egg albumen as a natural additive to increase texture and sensory properties. Meatball composition consisted of chicken breast (60.12%), tapioca starch (20.04%), salt (2.51%), seasonings (2.3%), ice cube (15.03%) and egg albumen based on meat weights. The experiment study used Completely Randomized Design (CRD) with 5 treatments and 4 replications. Treatments consisted of the addition of 0% (P0), 5% (P1), 10% (P2), 15% (P3), and 20% (P4) egg albumen measured by meat proportion. Parameters assessed were chemical (protein and fat), textural profile (hardness, cohesiveness, springiness, and adhesiveness), and sensorial properties (color, taste, texture, and chewiness). Collected data of protein, fat, and texture profile were tested by analysis of variance, significant data continued by DMRT (Duncan's Multiple Range Test). Sensory properties were analyzed by Kruskal Wallis. In result, the addition of egg albumen were significantly affected ($p<0.05$) to protein, fat, hardness, and all sensory properties, but it was not significantly affected ($p>0.05$) to cohesiveness, springiness, and adhesiveness. The addition of 20% egg albumen produced the highest protein and fat content, 11,83±0,30 and 1,55±0,17%, respectively. Then, hardness of chicken meatball on control treatment was the lowest than all treatment, with the highest was 2351,04±7,39 g. Average of cohesiveness, springiness, and adhesiveness were 0,66±0,02; 9,03±0,16 mm; and 0,04±0,03 mJ, respectively. The best sensory properties of chicken meatball with 20% egg albumen were white grayish color, delicious in taste, compact texture, and good chewiness. It could be summarized that adding 20% of egg albumen made the best characteristic on chemical dan sensory properties of chicken meatball.

INTRODUCTION

Meat processing is obtained to produce nutritious and acceptable products to consumers. Meatballs are processed meat with seasonings, starch as a binding agent, and food additives with appropriate composition. Meatballs could be made of chopped beef, pork, or chicken combined with others ingredients containing water, additives such phosphate, salt, spices and starch or flour (Aukkanit *et al*., 2015). The main ingredient of meatball is meat (not less than 50%), combined with flour or starch, and such additives to enhance quality. Meatball is such a nutritional source of energy and protein, but lack of dietary fiber. It should contain chemical properties such protein (min. 9.0%), fat (2.0%), moisture (max. 70%), ash (3.0%), meaty flavor, umami taste, normal appearance and chewy texture (Widati *et al*., 2021). Chicken meat could be used as main ingredient for meatball and is more affordable because lower price than beef, lamb, or mutton. Chicken meat contains protein 17.18%; fat 1.14%; water 71.36% and pH 5.99 (Hidayah *et al*., 2019).

The characteristics of meatball contains protein more than 11% and fat less than 10%, normal sensory properties, meaty flavor (Badan Standardisasi Nasional, 2014). The physical properties of meatball such as chewiness and texture are the most important for consumer's acceptance (Rosyidi, 2020). Chicken has not been common used as meatball ingredient because of some disadvantages, likes pale and less chewy rather than meat from lamb or beef (Hafid *et al*., 2020). It makes chicken meatballs has lower physical properties which needs to be improved. Texture of chicken meatball is 3.00

(Para *et al*., 2022), beef meatball is 3.11 (Widati *et al*., 2021) and lamb meatball is 3.23 (Armansyah *et al*., 2017) on sensory testing. An innovation could be assessed to enhance texture properties, such as the use of both natural and synthetic chewing agents. For instance, egg albumen or sodium tripolyphosphat/ STPP ($Na_5P_3O_{10}$). Recent study, the use of egg albumen could increase protein content and chewiness of lamb meatball (Tiven & Simanjorang, 2020).

The use of natural additive meets consideration because it is generally safer to be consumed. Meanwhile, synthetic additives potentially leave residues when it is consumed excessive and in long term (Ossom *et al*., 2016). The use of natural additive have been experimented such as food protein, seaweed flour, and gelatin (Ossom *et al*., 2016; Widati *et al*., 2021; Hafid *et al*., 2020). Egg albumen commonly applied in the meat production as binding agent, improving the taste and texture (Ruri *et al*., 2014). Previous study conducted by Tiven & Simanjorang (2020) that adding 0.2% egg albumen could increase protein content of lamb meatball. It may affect to other quality properties to such meat product as binding agent. Egg albumen has the best biological value compared with other food, so that it promotes health benefits, besides being cheap and easy to be founded. It contains 10.5 g protein/100 g albumen (Syamsiatun & Siswati, 2015). Egg albumen from layer hens could be added into chicken meatballs as binding agent, so it would increase quality properties, especially protein because of highly protein content of egg albumen, also texture properties. The use of egg albumen on chicken meatball needs to be investigated to determine chemical, texture profile, and sensory properties of chicken meatball.

METHODS

Composition of chicken meatball are listed in Table 1.

Table 1. Composition of Chicken Meatball (Tiven & Simanjorang, 2020)

Composition	(%)	Amount
Chicken breast	60.12	3,607.2 g
Tapioca starch	20.04	1,202.4 g
Salt	2.51	150.6 g
Seasoings	2.3	138 g
Ice cube	15.03	901.8 g
Total	100	6000 g

Note: Egg albumen was added based on meat weight, for each treatments were described below

Chicken meatball was produced using meat grinder, stove, pan, bowl, knife, scale, thermometer. Measurement of parameters were using a set of semi-micro Kjeldahl test for protein, a set of Soxhlet for fat, TA. XT plus C Texture Analyzer for texture profile, and questionnaire to panelists for sensory analysis.

The study applied Completely Randomized Design (CRD) containing 5 treatments and repeated 4 times. Treatments consisted of the addition 0% (P0), 5% (P1),

10% (P2), 15% (P3), and 20% (P4) ($^{w}/_{w}$) of egg albumen from chicken breast. Each treatment and replication used 500 grams of meatball.

Meatball making. Chicken breast without fat was measured and chopped for the first time with adding ice cube. The chopped chicken breast then chopped again with adding egg albumen, tapioca starch, and seasonings. The mixture was then grinded until mixed well, then it was formed in uniform shape and weight. The formed meatball was boiled in hot water (60-80°C) for 15 minutes until floating.

Variables measurement. Variables tested were protein content, fat content, sensory properties, and texture profile. Analysis of protein carried by Semi Micro Kjeldahl and fat by Soxhlet (Association Official Analitycal Chemistry, 2005; Iswoyo *et al*., 2023). Measurement of protein conducted by prepared 0.51 g of sample and put into Kjeldahl glass, adding 2 g of catalyst and 25 mL of H_2SO_4 96%. Kjeldahl glass then destructed for 2 hours until obtained clear-greenish solution. It was diluted up to 100 mL, then pipetted 5 mL to distillation process. The last process was titration using HCl 0.01 N. Determination of protein using formula: $\frac{ml\ HCl\ x\ N\ HCl\ x\ 0.014\ x\ 6.25\ x\ 20}{sample\ weight}\ x\ 100\%$

Fat content was analyzed using Soxhlet method by preparing 1 g sample (*w1*) and wrapped into filter paper (*w2*), then put it into Soxhlet tube. Extraction took about 6 hours. The extracted fat was separated from the hexane solvent in the oven (105°C), then it was measured (*w3*). Determination of fat content using: $\frac{w3-w2}{w1}\ x\ 100\%$

Texture profile was measured using TA. XT pluc C Texture Analyzer (Stable Micro System, United Kingdom), consisted of hardness, cohesiveness, springiness, and adhesiveness. Procedure of texture analysis followed (Yeung & Huang, 2017) as follows. Samples were cut by two sides to get 20 mm depth strip. The conditions of texture analyzer were: pre speed 2.0 mm/s; test speed 2.0 mm/s; post-test speed 2.0 mm/s; distance 10.0 mm; time 5.0 s; trigger type auto; and trigger force 10 g. Sensory properties carried by 20 quite trained panelists to asses color, taste, texture, and chewy. Hedonic scale from 1-5, following Armansyah *et al*. (2017) described as follows. Color: blackish grey (1), grayish (2), quite grayish (3), white grayish (4), and whitish (5). Taste: very not delicious (1), not delicious (2), quiet delicious (3), delicious (4), and very delicious (5). Texture: very rough (1), rough (2), quiet rough (3), compact (4), and very compact (5). Chewy: very not chewy (1), not chewy (2), quiet chewy (3), chewy (4), and very chewy (5). Measuring procedure following Adawiah *et al*. (2022) by preparing samples and drinking water on tray. Sample measured was ready-to-eat meatball for each treatment to be tested by panelists by filling out sensory questionnaire.

Data analysis. Collected data were tested by normality test using Shapiro-Wilk. Normal data of protein, fat, and texture profile then tested by analysis of variance, significant data continued by DMRT (Duncan's Multiple Range Test). Sensory properties data analyzed by Kruskal Wallis.

RESULTS AND DISCUSSION

Nowadays, the development of meat industries increase rapidly along with adapt and develop innovations of new formulation designed to longer shelf-life, quality, and safety of products. Dhara *et al*. (2022) declared that there are some innovations to increase quality, shelf life, and safety of food such the use of natural ingredient as antioxidants, vitamins, minerals or fiber form plants or other compounds which containing potential bioactive. Egg albumen could be applied as a natural binding agent on the meatball dough (Ruri *et al.*, 2014), in order to improve the texture of meatball and better sensory properties. Protein content, fat content, and texture profile of meatball are presented on the Table 2. The addition of egg albumen was significantly affected ($p<0.05$) to protein, fat, and hardness, but not significantly affected ($p>0.05$) to others texture profile such cohesiveness, springiness, and adhesiveness.

Table 2. Protein, Fat Content, and Texture Profiles of Chicken Meatball with Egg Albumen

Treatment	Protein (%)	Fat (%)	Hardness (g)	Cohessiveness (N)	Springiness (mm)	Adhesiveness (mJ)
P0	9.48±0.56^{a}	0.61±0.31^{a}	1732.26±1.00^{a}	0.67±0.02	9.13±0.21	0.03±0.03
P1	10.14±0.27^{b}	0.72±0.33^{a}	2100.96±3.11^{b}	0.64±0.02	8.98±0.21	0.03±0.02
P2	10.56±0.06^{bc}	0.66±0.23^{a}	2351.04±7.39^{b}	0.67±0.01	9.18±0.10	0.04±0.02
P3	10.91±0.18^{c}	0.84±0.40^{a}	2304.21±1.85^{b}	0.66±0.03	8.90±0.18	0.04±0.02
P4	11.83±0.30^{d}	1.55±0.17^{b}	2269.43±1.16^{b}	0.65±0.02	8.98±0.10	0.04±0.01

Different superscripts in the same column shows significant ($p<0.05$) difference

Chemical Composition

The average of protein content are 9.48-11.83 %. Badan Standardisasi Nasional (2014) regulated that protein content of meatball is more than 11%, so the addition 20% of egg albumen on meatball met SNI (National Standard of Indonesia) requirements. In other hand, adding 0-15% egg albumen are not enough to meet protein requirement based on SNI. The highest protein content is chicken meatball with 20% egg albumen, because egg albumen contains high protein content. The protein content of meatball increase along with the increase level of egg albumen, because it contains protein of 10.50 g/ 100 g (Syamsiatun & Siswati, 2015). Protein content of meatball are affected by raw materials and the proportion assessed. Tiven & Simanjorang (2020) stated that meatball produced with 70% of beef meat contains 13.01% protein. Meanwhile, meatball produced with 60% lamb meat contains 8.34% protein then increase to be 8.66% with adding 0.2% egg albumen (Tiven & Simanjorang, 2020). The cooking process could reduce protein content extracted during the process. The role of binding agent could inhibit it by binding mechanisms to some proteins, so that the decrease of protein could be minimalized well (Tiven & Simanjorang, 2020). Egg albumen as an effective natural food additive as

binding agent to produce highly protein content that meet standard.

Fat content of chicken meatball is increased ($p<0.05$) on addition 20% of egg albumen. It is lower compared to (Tiven & Simanjorang, 2020) that lamb meatball with 0.2% egg albumen was 4.10%. The lower fat content of chicken meatball is because chicken breast as raw material has low fat (1.75%) (Syafrizal *et al*., 2018), so that the meatball produced is very low fat. In contrast with the previous study conducted by Tiven & Simanjorang (2020), the addition of egg albumen was decreased the fat content of lamb meatball because highly moisture and protein content of egg albumen. The addidtion of 0, 5, 10, and 15% of egg albumen are not affected to fat of chicken meatball, because egg albumen has lower fat than egg yolk (Sari *et al.*, 2017). The fat content is lower than recent study conducted by (Nullah *et al*., 2016), meatball made with culled layer with local tuber flour-based-filler has fat content on average 2.59%.

Texture Profiles

Texture profiles tested consisted of hardness, cohesiveness, springiness, and adhesiveness. Dhara *et al*. (2022) stated that hardness is depended on the moisture percentage of meatballs. Springiness is related to elasticity of meatball, then gumminess and chewiness were related to hardness, cohesiveness, and springiness on meatballs. Egg albumen is increased the hardness of chicken meatball, because when it was cooked, structure of protein would be denatured and coagulated. Meatball without egg albumen has the lowest hardness, it is mushy. Meanwhile, the addition of 5, 10, 15, and 20% of egg albumen produces the same hardness ($p>0.05$). It aligned to Yeung & Huang (2017) that addition of egg albumen produces the hardest meatballs compared with other protein source as chewing agent. The less level of egg albumen, meatball is less chewy (Ruri *et al*., 2014). The harder meatball caused it is chewier (Yeung & Huang, 2017).

Egg albumen is not affected ($p<0.05$) to cohesiveness, springiness, and adhesiveness. It may be caused the egg albumen could not improve the cross-linking protein, so that the cohesiveness, springiness, and adhesiveness of chicken meatball are not increase along with the level of egg albumen. Cohesiveness is defined as a degree of which the sample could be deformed before it breaks, while springiness is the rate of which deformed product springs back after compression (Bağdatli, 2018). The following study from Erdem *et al*. (2020) that adding transglutaminase as binding agent is affected to texture properties of meatball. Yeung & Huang (2017) reported that egg albumen powder was not affected to springiness and cohesion, not as whey protein and skim powder that could increase because the ability on hydrating and gelating. The mushiness of texture, properties of meatball is due to the high of water content of egg albumen (Ruri *et al*., 2014).

Sensory Properties

Sensory properties are parameters to determine the quality of products assessed using the human senses, referred to panelists (Armansyah *et al*., 2017). Ossom *et al*. (2016) described that texture, taste, juiciness, color,

and flavor were important properties on meat product that contributed to improve the consumer acceptance. The result of sensory properties were presented on Table 3.

Table 3. Sensory Properties of Chicken Meatball with Egg Albumen

Treatment	Color	Taste	Texture	Chewiness
P0	2.85±0.37^{a}	2.85±0.37^{a}	2.75±0.44^{a}	2.45±0.60^{a}
P1	3.25±0.44^{b}	3.35±0.49^{b}	3.45±0.51^{b}	3.40±0.60^{b}
P2	3.40±0.50^{b}	3.55±0.51^{b}	4.00±0.46^{b}	4.05±0.22^{c}
P3	4.20±0.41^{c}	3.85±0.49^{b}	4.35±0.49^{c}	4.10±0.31^{c}
P4	4.25±0.44^{c}	4.35±0.49^{c}	4.85±0.37^{c}	4.70±0.41^{c}

Different superscripts in the same column shows significant ($p<0.05$) difference

The addition of egg albumen is affected to all sensory properties ($p<0.05$). Meatball without egg albumen is grayish, then the addition of 5 and 10% egg albumen are quite grayish, 15 and 20% produced grayish white. Color is an important parameter for consumer acceptance (Hafid *et al.*, 2020).

The taste of meatball increases with adding egg albumen. Panelists scored meatball without egg albumen are bad in taste, adding 5, 10, and 15% aree quiet delicious, and 20% is delicious. Egg albumen could increase tasty on meatball, so that score is higher align with the increase level of egg albumen up to 20%.

Texture increases ($p<0.05$) along with the addition of egg albumen. Meatball without egg albumen is rough texture, then 5 and 10% egg albumen are quiet rough. Addition of 15 and 20% produce compact texture. Egg albumen has powerful binding function that could increase the texture. Egg albumen is a factor affecting hardness of meatball that met consumer preference. Study from Hafid *et al.* (2020), addition of gelatin could not affected to meatball texture.

Chewiness increases ($p<0.05$) along with the addition of egg albumen. Meatball without egg albumen is the lowest chewiness, then 5% was quite chewy. Addition 10, 15, and 20% produce the best chewy meatball. In line with Yeung & Huang (2017) meatball without powder egg albumen is low chewiness. Chewiness is an important textural former which is a preference for consumer to determine meat product. Chewiness defined as the ability of meatball to return to their original form when it is chewed, chewy and not easily crumbling (Hafid *et al.*, 2020). Egg albumen are being coagulated and irreversible properties when heated, also bitch, so it is affected to chewiness. Overall, the use of egg albumen could improve the quality of chicken meatball because of its highest biological value and cheaper and easy to buy (Syamsiatun & Siswati, 2015).

CONCLUSION AND SUGGESTION

The addition of egg albumen on the chicken meat could improve protein and fat contents, hardness, and all sensory properties. Meanwhile, other texture profiles (cohesiveness, springiness, and adhesion) are not improved. Adding 20% of egg albumen increases the quality properties on chemical and sensory properties of chicken meatball.

AUTHORS CONTRIBUTION

The study study was conducted by five contributors. Ismiarti was the research conceptor together with Abdul Rokhman and Mumahad Solkhan, designing methods, conducting laboratory analysis and writing manuscript. Sugiyono and Teguh Dwi Putra as data analist and reviewing manuscript.

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