



The Physicochemical Quality of Chicken Meatball Using Red Lentil Flour (*Lens culinaris* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The aim is to determine the physicochemical quality of chicken meatballs added with red lentil flour (*Lens culinaris* L.) based on moisture content (%), protein content (%), WHC (%), cooking loss (%), and color (L*a*b*). Sample: chicken meatballs using red lentil flour.

Study Design: The research with an experimental method, using a Completely Randomized Design (CRD). Data were tabulated using Microsoft Excel and taken standard deviation (SD), then using Analysis of Variance (ANOVA) from Completely Randomized Design (CRD). Use the DMRT (Duncan's Multiple Range Test) if the result differ.

Place and Duration of Study: Laboratory of Animal Product Technology, Faculty of Animal Science, University of Brawijaya Malang and Laboratory of Food Quality and Safety Testing, Faculty of Agricultural Product Technology, University of Brawijaya Malang. December 2022.

Methodology: 4 treatments consisting of without the addition of red lentil flour, the addition of red lentil flour 3%, 6%, and 9%, and five replications.

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Results: Chicken meatballs with red lentil flour produce chicken meatballs that contain fiber and have attractive colors. Chicken meatballs with 9% red lentil flour had the best content of moisture content 52.11%, protein content 15.76%, WHC 94.94%, cooking loss 2.09%, and color (L^* 81.10) (a^* 6.94) (b^* 29.33).

Conclusion: Chicken meatballs added with 9% red lentil flour (*Lens culinaris* L.) produce the best quality. Chicken meatballs have attractive colors and contain nutrients such as protein so that the resulting chicken meatballs can become a new product accepted by the public.

Keywords: Chicken meatballs; red lentil flour; restructured meat; physicochemical quality.

1. INTRODUCTION

Chicken meat is a livestock product that is a source of animal protein, is preferred by consumers, and is easily damaged, so handling is needed, such as processing meat to preserve meat and increase economic value [1]. One of the processing methods is restructured meat [2]. Restructured meat is the process of processing small meat and reforming it to produce a large product with the addition of other ingredients, such as flour. One of the popular meat restructuring products is meatball [3].

Chicken meatballs are made from chicken meat, ground spices, added tapioca flour, and ice cubes, then mashed and shaped into rounds, then cooked in boiling water until cooked. Chicken meatball is a frozen food product usually stored in a cold storage area to maintain quality [4]. Chicken meatballs generally have weaknesses such as grayish-white color, lack of fiber content, rancid easily, and less dense texture [1].

Fillers in food processing are useful for improving quality, such as food texture. One of the fillers used in processing to improve the characteristics of chicken meatballs is red lentil flour. Red lentil flour (*Lens culinaris* L.) comes from red lentil seeds, including legumes. Red lentil flour has a characteristic red color with fine starch grains 3.5 mm in diameter [5]. Red lentil flour contains 21% - 31% protein, 5% - 20% fiber, 1% fat, 89 mg/100 g calcium, and 8.55 mg/100 g iron (Fe) [6]. Red lentil flour is widely used in foods such as beef burgers and beef steak products [7].

This study used pea fiber (*Pisum sativum* L.) chicken meatballs of 3%, 6%, and 9% produce the best chicken meatballs [8]. Chicken meatballs are added with 2% moringa powder and 2% spinach powder. The best chicken meatball with a taste value of 7.44. Chicken meatballs added with 2% moringa powder had a texture value of 7.67, and added 2% spinach

powder had a texture value of 7.44 [9]. Chicken meatballs added with 4% basil leaf powder (*Ocimum basilicum*) produced the best chicken meatballs with a cooking loss of 5.35% and an organoleptic aroma of 4.00, and a taste of 4.06 [10].

2. MATERIALS AND METHODS

2.1 Materials

The research material was chicken meatballs added with red lentil flour (*Lens culinaris* L.). The ingredients for making chicken meatballs include chicken meat (breast), red lentil flour, pepper, ice cubes, tapioca flour, salt, chicken egg white, fried garlic, fried shallots, and sugar. The chemicals used were aquades, calcium oxalate, PP indicator, 0.1 N NaOH, 40% formaldehyde, and distilled water.

The tools consist of a mug, knife, wooden mat, spoon, chicken meat grinding machine, digital scales, thermometer, pan, stove, LPG gas, spatula, stopwatch, moisture content (porcelain cup, oven, desiccator, and balance), protein content (porcelain cup and Erlenmeyer), water holding capacity (WHC) (ballast), cooking loss (scales), and color $L^*a^*b^*$ (color reader).

2.2 Methods

The method was a laboratory experiment using a Completely Randomized Design (CRD), four treatments, namely without the addition of red lentil flour, red lentil flour (3%, 6%, and 9%), and five replications.

2.3 Data Analysis

Data were tabulated using Microsoft Excel and taken standard deviation (SD), then using Analysis of Variance (ANOVA) from Completely Randomized Design (CRD). Use the DMRT (Duncan's Multiple Range Test) if the results differ.

2.4 Procedure for Making Chicken Meatballs

The procedure for making chicken meatballs using red lentil flour (*Lens culinaris* L.) is modified [11]; chicken meat is cleaned, cut, and then mashed using a meat grinder until smooth. Added red lentil flour according to the composition. Then added with pepper, fried garlic, chicken egg white, fried shallots, tapioca flour, salt, sugar, and ice cubes according to the composition. All materials were mixed until smooth. The meatball dough was formed into balls (11 g) and cooked in 80±2°C water (10 minutes). Then after the meatballs are cooked (float) they are transferred to water at 100±2°C for 20 minutes. Cooked chicken meatballs were drained and then cooled before being analyzed. The following formulation of chicken meatballs using red lentil flour is shown in Table 1.

2.5 Moisture Content Test Procedure

The procedure for testing the moisture content of chicken meatballs using the (gravimetric/oven) method: The sample weight is weighed. Dry an empty cup by placing it in the oven (105°C, 15 minutes). The cup is cooled first in a desiccator and then weighed. A 10 g sample was placed in a cup and then dried using an oven (105 °C, 12 hours). The dry sample in the cup is placed in a desiccator and, cooled, then weighed. Samples were dried to constant weight.

$$\text{Moisture content (\%)} = \frac{\text{sample weight} - ((\text{cup weight} + \text{sample weight after drying}) - \text{cup weight})}{\text{weight sample weight}} \times 100\%$$

2.6 Protein Content Test Procedure

The procedure for testing the protein content of chicken meatballs is the titration method: 2 g of the sample mashed with a porcelain cup is dissolved in 20 ml of aquades. The sample mixture was mixed and stirred (15 minutes) until mixed. The filtrate was filtered, and 10 ml was taken and then put into an Erlenmeyer, added 20 ml of aquades, 0.4 ml of calcium oxalate (K-oxalate: water = 1:3), and 1 ml of PP indicator and allowed to stand for 2 minutes. NaOH 0.1 N was added to titrate the sample (sample pink). The titrated sample was added with 40% formaldehyde (2 ml). 0.1 N NaOH has added again for the second sample titration until the color is pink. The volume of NaOH was recorded, and the protein content was calculated.

$$\text{Nitrogen content} = \frac{(\text{a ml of distilled water} - \text{B ml of distilled water}) \times \text{sample weight (g)} \times 10 \times \text{normality of NaOH} \times 14.008 \times 100 \%}{\% \text{ N} \times \text{correction factor (6.25)}}$$

2.7 Water Holding Capacity (WHC) Test Procedure

The water holding capacity (WHC) test procedure for chicken meatballs by weight method: 300 mg of sample is placed on filter paper. Samples were smeared on filter paper for 5 minutes. Then do the pressing using a ballast until the water comes out. Calculate the water holding capacity.

Table 1. The composition of the formula for making chicken meatballs using modified red lentil flour (*Lens culinaris* L.)

No.	Material	P ₀	P ₁	P ₂	P ₃
1	Chicken meat (g)	200	200	200	200
2	Red lentil flour (g)	0	6	12	18
3	Pepper (g)	1	1	1	1
4	Garlic (g)	4	4	4	4
5	Shallot (g)	4	4	4	4
6	Chicken egg white (g)	4	4	4	4
7	Tapioca flour (g)	35	35	35	35
8	Salt (g)	6	6	6	6
9	Sugar (g)	6	6	6	6
10	Ice tube (g)	40	40	40	40
	Amount (g)	300	306	312	318

Notes: Treatment: without the addition of red lentil flour (P₀), the addition of red lentil flour 3% (P₁), 6% (P₂), and 9% (P₃)

WHC (%) = total moisture content of sample – water released during pressing

Notes: the total moisture content of the sample was obtained from the decreased sample weight after heating to 105 °C (12 hours)

2.8 Cooking Loss Test Procedure

The cooking loss test procedure for chicken meatballs uses the water bath method: the meatball dough as the initial weight is weighed on the scales. Meatball dough is boiled at 80 °C (30 minutes). The final weight of the meatballs is obtained by weighing the meatballs after boiling.

$$\text{Cooking loss (\%)} = \frac{\text{initial weight (raw)} - \text{final weight (cooked)}}{\text{initial weight (raw)}} \times 100\%$$

2.9 Color (L*a*b*) Test Procedure

The procedure for testing chicken meatballs' color (L*a*b*) is the CIELab method (color reader): the color reader is turned on by pressing the power button. Color is measured using the color scale color reader L* (white), a* (red), and b* (yellow). The sample is placed on the lens contained in the tool. The chromameter was first white as standard. The results of color measurements are expressed as L*, a*, and b*.

3. RESULTS AND DISCUSSION

The physicochemical qualities of chicken meatballs using red lentil flour are shown in the Table 2.

3.1 Moisture Content

Table 2 states that chicken meatballs added with red lentil flour showed a very significant effect ($p < 0.01$) on the moisture content of the meatballs. The moisture content requirement for meatballs is a maximum of 70% [12], and the moisture content of chicken meatballs as a result of the research meets the requirements. Moisture content is the moisture content in food [13]. Good chicken meatball moisture content (low value). The best moisture content is chicken meatballs with red lentil flour valued at 9%. The best moisture content for chicken meatballs is caused by cooking (boiling), so the water evaporates, and the moisture content decreases [14].

The moisture content determines the durability of food [15]. With high moisture content, microbes easily damage food because it uses water to grow and develop [16]. The lower the moisture content, the less food is damaged, and the food lasts longer because there are no microbes [15]. Analysis of the moisture content of chicken meatballs using red lentil flour using the gravimetric method [17] using an oven [16].

Table 2. The average value of chicken meatballs using red lentil flour (*Lens culinaris* L.) on moisture content, protein content, WHC, and cooking loss

Variable	Treatment				Level
	P ₀	P ₁	P ₂	P ₃	
Moisture content (%)	56.35±0.93 ^b	53.72±1.12 ^b	53.16±0.91 ^{ab}	52.11±1.10 ^a	**
Protein content (%)	14.12±0.18 ^a	14.85±0.14 ^b	15.33±0.19 ^c	15.76±0.19 ^d	**
WHC (%)	89.77±0.93 ^a	90.76±0.48 ^a	92.10±1.63 ^a	94.94±0.74 ^a	**
Cooking loss (%)	2.64±1.17	2.38±0.89	2.27±1.22	2.09±0.99	

Notes: **: $p < 0.01$, very significant effect

Table 3. The average value of chicken meatballs using red lentil flour (*Lens culinaris* L.) on L*a*b* color

Variable	Treatment				Level
	P ₀	P ₁	P ₂	P ₃	
Color L*	81.10±2.67 ^b	75.73±3.11 ^a	73.62±1.08 ^a	72.72±2.06 ^a	**
Color a*	4.01±1.30 ^a	5.74±1.50 ^{ab}	6.82±0.90 ^b	6.94±1.04 ^b	*
Color b*	26.45±3.22	27.65±2.20	28.07±1.55	29.33±2.46	

Notes: **: very significant effect, $p < 0.01$

*: significant effect, $p < 0.05$

Beef meatballs added with quinoa flour (*Chenopodium quinoa* Willd.) without adding quinoa flour had the best moisture content, namely 44.06% [18]. Perilla seeds of 20% added to pork meatballs produced the best meatballs with a moisture content value of 62.38% [19]. Pumpkin seed flour (*Cucurbita pepo* L.) 9% in beef meatballs to produce good quality meatballs with a moisture content of 44.32% [20].

The study's results showed that adding 4% basil leaf powder (*Ocimum basilicum*) produced the best treatment of chicken meatballs with a moisture content of 64.5% [10]. Examined 1.5% carrageenan, added to chicken meatballs to produce a good water content of 71.64%. Another study explained that the best beef meatball [21] water content value of 47.67% was obtained by adding 15% dry bread flour cooked at 250 °C [14].

3.2 Protein Content

The protein content of chicken meatballs using red lentil flour was analyzed using titration [22]. Table 2 explains that chicken meatballs added with red lentil flour significantly effect protein content ($p < 0.01$). The highest and best protein content of chicken meatballs was added with 9% red lentil flour. The high protein content is due to the amount of red lentil flour added because red lentil flour contains 25.1% protein [23]. The protein content value of chicken meatballs using red lentil flour does not meet the maximum meatball protein content requirement of 8% [12].

The protein content of chicken meatballs using red lentil flour has increased [24]. Research [19] pork meatballs added with 20% perilla seeds increased the protein content of the meatballs with a protein content of 13.84%. Pumpkin seed flour (*Cucurbita pepo* L.) 12% used for beef meatballs increases the protein content by 20.28% [20]. The best beef meatballs added with 7.5% quinoa (*Chenopodium quinoa* Willd.) flour produced beef meatballs with a high protein content (38.49%) [5].

The best treatment for chicken meatballs plus 1.5% carrageenan can increase the protein content by 16.94% [21]. Adding 5 mg of argel leaf extract (*Solenostemma argel*) to chicken meatballs produces good chicken meatballs with a protein content value of 62.31% [25,26]. The highest protein content 16.29%, was obtained from beef meatballs added with 50% adzuki bean flour (*Vigna angularis*).

3.3 Water Holding Capacity (WHC)

The ballast method carried out WHC analysis of chicken meatballs added with red lentil flour [27]. Red lentil flour added to chicken meatballs in Table 3 showed a very significant effect ($p < 0.01$). Increasing red lentil flour can reduce the WHC value [28]. High water holding capacity produces the best product because it can retain the moisture content of the product [29]. The results showed the best WHC value for chicken meatballs with the addition of 9% red lentil flour.

The best low-fat hamburger with 4.8% quince seeds yielded in a WHC value of 59.62% [30]. Red bean flour 5% and taro flour 3% added to the chicken patty had the highest WHC value of 42.83% [31]. The best beef patty using 5% pumpkin seeds had a WHC value of 79.80% [32].

Rasak et al. [33] observed beef meatballs without adding Moringa leaf flour (*Moringa oleifera* L.). The best meatball WHC value produced was 33.12%. Research on beef meatballs has a high WHC value of 9.85 g/g due to the addition of 16% date seed flour [34]. In another study, a WHC value of 64.11% resulted from adding seaweed flour with a percentage of 7.5% in beef meatballs [11].

3.4 Cooking Loss

Analysis of cooking loss for chicken meatballs added with red lentil flour using a water bath [35] by comparing the initial weight with the final weight [36]. Table 3 states that the cooking loss of chicken meatballs using red lentil flour has no significant effect ($p > 0.01$). The best cooking loss value for chicken meatballs (low cooking loss) with the addition of 9% red lentil flour. Low cooking loss is caused by the loss of nutrients and product weight, which is lost a little during cooking, and consumers like it [37].

The best beef burger using 7% lentil flour observed on the sixth day obtained a value of 8.06% [38]. Quinoa starch and quinoa seeds added to chicken meatballs resulted in the best cooking loss of 13.86% [39]. A study on beef steak added lentil flour with a 4% transglutaminase binder to produce the best beef steak with a cooking loss value of 29.72% [40]. Moringa leaf flour (*Moringa oleifera* L.) with a percentage of 1.5% added to beef meatballs produces beef meatballs with the lowest cooking loss value of 2.32% [33]. The best beef meatball cooking loss value is 31.92 % in beef

meatballs plus 12% pumpkin seed flour (*Cucurbita pepo* L.) [20].

3.5 Color (L*a*b*)

Color L*a*b* analysis of chicken meatballs added with red lentil flour using a color reader [30], namely L* (brightness), a* (reddish), and b* (yellowish) [41]. Table 3, the addition of red lentil flour to chicken meatballs has a very significant effect ($p < 0.01$) on (L*), a significant effect ($p < 0.05$) on (a*), and no very significant effect ($p > 0.01$) on (b*). The best color value is influenced by the highest L*a*b* [42]. The color value of the chicken meatballs is affected by the added red lentil flour, so it affects the color of the chicken meatballs. The best brightness of chicken meatballs without red lentil flour, are reddish and yellowish the best chicken meatballs, plus 9% red lentil flour [43]. Food color L*a*b* value affects product quality and consumer acceptance [34].

Beef meatballs added with 3% pumpkin seed flour produced the best color, with L* (55.41), a* (12.88), and b* (17.35) [20]. Beef meatballs added with 2.5% quinoa seed flour produced good beef meatball colors, L* (43.06), a* (14.00), and b* (10.20) [18]. Kirklareli meatballs using 4% cowpea flour to produce meatballs with the best color, L* (39.00), a* (8.79), and b* (16.43) and were accepted consumers [44,45].

Research on moringa leaf flour (*Moringa oleifera* L.) as much as 1% used in beef meatballs produced the best brightness color value of 51.67 and the highest yellowness value of 18.43. In addition, beef meatballs produced the best redness value of 11.51 without adding moringa flour [33].

Sujarwanta et al. [26] beef meatballs without adding adzuki bean flour produced the highest scores for all color components. The brightness value produced by the meatballs was 57.80, the reddish color of the meatballs was 2.45, and the yellowish value was 11.45. In another study, the highest brightness value of 48.33 was found in beef meatballs after adding 4% date seed flour. In comparison reddish and yellowish colors obtained the highest values of 6.93 and 11.94, respectively, with 16% date seed flour added [34].

4. CONCLUSION

Chicken meatballs added with 9% red lentil flour (*Lens culinaris* L.) produce the best quality

chicken meatballs and are accepted by the public. The resulting chicken meatballs have attractive colors and contain nutrients such as protein so that the resulting chicken meatballs can become a new product accepted by the public.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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