Original Research Article

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

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 from Completely Randomized Design (CRD) were calculated using ANOVA (Analysis of Variance) and Microsoft Excel. The results showed different results, followed by the DMRT (Duncan's Multiple Range Test).
Place and Duration of Study: Laboratory of Animal Product Technology, Faculty of Animal Husbandry, University of Brawijaya Malang, Laboratory of Food Quality and Safety Testing, and the 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 5 replications.
Results: Chicken meatballs with the addition of red lentil flour produce chicken meatballs that contain fiber and have attractive colors. Chicken meatballs with 3% red lentil flour had the best content of moisture content 53.16%, protein content 15.76%, WHC 92.10%, cooking loss 2.09%, and color (L* 75.73) (a* 6.94) (b* 29.33).
Conclusion: Chicken meatballs added with 3% red lentil flour *(Lens culinaris* L.*)* produce the best quality chicken meatballs and are accepted by consumers.

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 with the aim of preserving meat and increasing economic value [16]. One of the processing methods is restructured meat [36]. Restructured meat is the process of processing small meat and then 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 [1].

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 that is usually stored in a cold storage area to maintain its quality [24]. Chicken meatballs generally have weaknesses such as grayish-white color, lack of fiber content, rancid easily, and less dense texture [16].

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 [22]. 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) [34]. Red lentil flour is widely used in foods such as beef burgers and beef steak products [31].

This study used pea fiber (*Pisum sativum* L.) in chicken meatballs of 3%, 6%, and 9% to produce the best chicken meatballs [15]. 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 [28]. 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 [29].

2. MATERIAL AND METHODS

2.1 Material

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 distilled water, 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 (gravimetic/oven), protein content (titration), water holding capacity (WHC) (centrifugation/balance), cooking loss (water bath), and L*a*b* color (color reader) brand OEM type CHNSPEC CSS-10.

2.2 Method

The method was in the form of a laboratory experiment using a Completely Randomized Design (CRD), 4 treatments, namely without the addition of red lentil flour, the addition of red lentil flour (3%, 6%, and 9%), and 5 replications.

2.3 Data Analysis

Data from Completely Randomized Design (CRD) were calculated using ANOVA (Analysis of Variance) and Microsoft Excel. The results showed different results, followed by the DMRT (Duncan's Multiple Range Test).

2.4 Procedure for Making Chicken Meatballs

The procedure for making chicken meatballs using red lentil flour *(Lens culinaris* L*.)* are modified [38] namely chicken meat is cleaned and then cut and then mashed using a meat grinder until smooth. The chicken meat mixture was divided into four treatments and added with red lentil flour according to the composition of each treatment. The dough is then added with pepper, fried garlic, chicken egg white, fried shallots, tapioca flour, salt, sugar, and ice cubes according to the composition. The dough from each treatment was mixed until smooth. The meatball dough for each treatment was formed into balls (11 g) and cooked in 80 ˚C water (30 minutes). Cooked chicken meatballs were drained and then cooled in the freezer before being analyzed. The following formulation of chicken meatballs using red lentil flour is shown in Table 1.

Table 1. The composition of the research 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)	6	6	6	6
5	Shallot (g)	6	6	6	6
6	Chicken egg white (g)	6	6	6	6
7	Tapioca flour (g)	40	40	40	40
8	Salt (g)	7	7	7	7
9	Sugar (g)	7	7	7	7
10	Ice tube (g)	40	40	40	40
	Amount (g)	313	319	325	331

Notes
Treatment: without the addition of red lentil flour (P_0), the addition of red lentil flour 3% (P_1), 6% (P_2), and 9% (P_3).
% of ingredients for making meatballs from the weight of chicken meat per 100g.

2.5 Moisture Content Test Procedure

The procedure for testing the moisture content of chicken meatballs using the (gravimetric/oven) method: 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.

$$\text{Moisture content (\%)} = \frac{\text{wet sample weight - dry sample weight}}{\text{weight sample weight}} \times 100\%$$

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 that has been mashed with a porcelain cup is dissolved in 20 ml of distilled water. 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 distilled water, 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.

$$\text{Nitrogen content} = \frac{\text{(a ml of distilled water – B ml of distilled water)}}{\text{sample weight (g) x 10 x normality of NaOH x 14.008 x 100 \%}}$$

$$\text{Protein content (\%)} = \text{\% N x correction factor (6.25)}$$

2.7 Water Holding Capacity (WHC) Test Procedure

The WHC test procedure or water holding capacity of chicken meatballs by centrifugation method: 10 g sample is put in a 50 ml tube. 49 ml of distilled water was added to the sample and then weighed. The sample mixture was put in a water bath at 30 °C (30 minutes). Samples were centrifuged for 30 minutes and incubated for another 10 minutes. The supernatant was discarded and the sample was weighed.

$$\text{WHC (\%)} = \frac{\text{sample weight after removing the supernatant}}{\text{sample weight with added water}} \times 100\%$$

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 the color (L*a*b*) of chicken meatballs 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 below.

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 (%)	52.11±1.10^{a}	53.16±0.91^{ac}	55.72±1.12^{b}	56.35±0.93^{d}	**
Protein content (%)	14.12±0.18^{a}	14.85±0.14^{b}	15.33±0.19^{c}	15.76±0.19^{d}	**
WHC (%)	94.94±0.74^{b}	92.10±1.63^{ad}	90.76±0.48^{ac}	89.77±0.93^{a}	**
Cooking loss (%)	2.64±1.17	2.09±0.99	2.27±1.22	2.38±0.87	

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^{ad}	73.62±1.08^{ac}	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*	27.65±2.20	28.07±1.55	26.45±3.22	29.33±2.46	

Notes:
*** : very significant effect, p<0.01*
** : significant effect, p<0.05*

3.1 Moisture Content

Table 2 states, 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% [2], 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 with a value of 3%. The best moisture content for chicken meatballs is caused by cooking (boiling) so that the water evaporates and the moisture content decreases [19].

The moisture content determines the durability of food [14]. High moisture content, food is easily damaged by microbes, because it uses water to grow and develop [9]. The lower the moisture content, the less food is damaged and the food lasts longer because there are no microbes in the food [14]. Analysis of the moisture content of chicken meatballs using red lentil flour using the gravimetric method [5], using an oven [14].

Beef meatballs added with quinoa flour *(Chenopodium quinoa* Willd.) without the addition of quinoa flour had the best moisture content, namely 44.06% [4]. Perilla seeds 20% added to pork meatballs produced the best meatballs with a moisture content value of 62.38% [32]. Pumpkin seed flour *(Cucurbita pepo* L.*)* 9% in beef meatballs to produce good quality meatballs with a moisture content of 44.32% [26].

3.2 Protein Content

The protein content of chicken meatballs using red lentil flour was analyzed using the titration method [21]. Table 2 explains, chicken meatballs added with red lentil flour a very significant effect (p<0.01) on protein content. 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 [10]. The protein content value of chicken meatballs using red lentil flour does not meet the maximum meatball protein content requirement of 8% [2].

The protein content of chicken meatballs using red lentil flour has increased [18]. Research by [32] 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 protein content by 20.28% [26]. The best beef meatballs added with 7.5% quinoa *(Chenopodium quinoa* Willd.) flour produced beef meatballs with a high protein content (38.49%) [4].

3.3 Water Holding Capacity (WHC)

WHC analysis of chicken meatballs added with red lentil flour was carried out by the centrifugation method [41]. 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 [12]. High water holding capacity produces the best product because it can retain the moisture content of the product [20]. The results showed the best WHC value for chicken meatballs with the addition of 3% red lentil flour.

The best low-fat hamburger with 4.8% quince seeds resulted in a WHC value of 59.62% [40]. Red bean flour 5% and taro flour 3% added to the chicken patty had the highest WHC value of 42.83% [23]. The best beef patty using 5% pumpkin seeds had a WHC value of 79.80% [35].

3.4 Cooking Loss

Analysis of cooking loss for chicken meatballs added with red lentil flour using a water bath [8], by comparing the initial weight with the final weight [30]. Table 3 states that the cooking loss of chicken meatballs using red lentil flour has no very significant effect ($p>0.01$). The best cooking loss value for chicken meatballs (low cooking loss) with the addition of 3% red lentil flour. The low cooking loss is caused by the loss of nutrients and product weight which is lost a little during cooking and finally consumers like it [37].

The best beef burger using 7% lentil flour observed on the 6th day obtained a value of 8.06% [6]. Quinoa starch and quinoa seeds added to chicken meatballs resulted in the best cooking loss of 13.86% [27]. 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% [7].

3.5 Color (L*a*b*)

Color L*a*b* analysis of chicken meatballs added with red lentil flour using a color reader [39], namely L* (brightness), a* (reddish), and b* (yellowish) [33]. 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* [25]. 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 plus 3% red lentil flour, reddish and yellowish the best chicken meatballs plus 9% red lentil flour [11]. The color L*a*b* value of food affects product quality and consumer acceptance [3].

Beef meatballs added with 3% pumpkin seed flour produced the best color, with L* (55.41), a* (12.88), and b* (17.35) [26]. Beef meatballs added with 2.5% quinoa seed flour produced good beef meatball colors, L* (43.06), a* (14.00), and b* (10.20) [4]. 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 [17].

4. CONCLUSION

Chicken meatballs added with 3% red lentil flour *(Lens culinaris* L.*)* produce the best quality chicken meatballs and are accepted by the public.

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