Original Research Article

Optimization Chicken Meatball Using Red Lentil Flour (*Lens culinaris* L.) as Filler

ABSTRACT

Aims: The aim of the study was to using red lentil flour to chicken meatballs to determine the physicochemical quality based on fat content, ash content, crude fiber content, pH, and organoleptic quality, as well as scanning electron microscopy (SEM). Sample: chicken meatballs using red lentil flour.
Study design: The method used laboratory experiment, using CRD (Completely Randomized Design). Data were analyzed using analysis of variance (ANOVA) and Microsoft Excel. If different, proceed with 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, Faculty of Agricultural Product Technology, University of Brawijaya Malang, and the Integrated Research and Testing Laboratory, Gadjah Mada University. February 2023.
Methodology: 4 treatments consisting of without the addition of red lentil flour and the addition of red lentil flour 3%, 6%, and 9%. 5 replications.
Results: Chicken meatballs added with red lentil flour produce chicken meatballs with fiber content and have a meatball color that is not pale. The best treatment for chicken meatballs has fat content 9.18%, ash content 2.38%, crude fiber content 0.84%, pH 6.44, organoleptic (color 3.68) (taste 2.98) (texture 3.43), and SEM image structures of chicken meatballs have different shapes.
Conclusion: The best chicken meatballs are found in the addition of 3% red lentil flour (*Lens culinaris* L.) to produce chicken meatballs that are healthy, contain fiber, and have attractive colors.

Keywords: chicken meatballs, red lentil flour, restructured meat, physicochemical, organoleptic quality, SEM.

1. INTRODUCTION

Restructured meat is a processing method that is generally used for meat. Restructured meat is a low meat processing process such as the condition of the meat being moist and pale in color and then processing it with spices and flour which aim to produce new products. Restructured meat method aims to improve product quality such as the texture of food products. One of the ingredients that can be added to restructured meat products is red lentil flour which contains fiber [36].

Meatballs added with 25% wheat flour produced the best chicken meatballs with texture and overall acceptability rated the best and were liked by many panelists [33]. The best treatment for chicken meatballs was added with 3% gelatin with a yield value of 109.06% and the addition of 3% agar had a water-holding capacity of 29.33 g/g [12]. Beef meatballs coated

with 3% pumpkin seed flour (*Cucurbita pepo* L.) produce the best quality beef meatballs with low-fat content [20].

Meatballs are food with the basic ingredients of mashed meat added with flour then molded into rounds and then cooked until cooked [21]. Meatballs are currently being developed with the basic ingredients of chicken meat, the resulting chicken meatballs have a good taste and are liked by consumers [23]. In general, chicken meatballs have drawbacks, including pale color, less dense and dense, less fiber [14].

Filler is a filler material added to food to improve product quality such as food texture. One of the fillers that can be added to chicken meatballs is red lentil flour. Red lentil flour besides functioning as a filler also functions as a binder in food products [30]. Red lentil flour is a legume plant [28]. Red lentil flour comes from red lentil seeds and is then processed into flour which is added to food to produce healthy food [13].

Red lentil flour has health benefits such as reducing diabetes, obesity, and cancer [30]. Red lentil flour contains 10-20% dietary fiber, 0.7% fat, 35% - 53% starch, and 71.5% carbohydrates [17], 5 – 28 mg/100 g carotenoids which give a red to orange color [32], 27% protein [8], 89% calcium [25]. So the addition of red lentil flour to chicken meatballs can improve the quality of chicken meatballs.

2. MATERIAL AND METHODS

2.1 Material

Ingredients: broiler chicken breast, red lentil flour, tapioca flour, salt, sugar, pepper, chicken egg white, fried garlic, fried shallots, and ice cubes. The chemicals used were hexane solvent, acid detergent solution, filter paper, hot water, distilled water, 2.5% glutaraldehyde, 0.2M phosphate buffer solution, and ethanol.

Tools: vessel, wooden mat, spoon, chicken meat grinding machine, digital scales, knife, thermometer, pan, LPG gas, stove, spatula, stopwatch, fat content using the Soxhlet method, ash content using the gravimetric method (oven), crude fiber content with oven/gravimetry, pH meter, organoleptic with hedonic scale, and scanning electron microscope (SEM) with scanning electron microscope spectrophotometer.

2.2 Method

Experiments in the laboratory are the method used in research. The design used is a Completely Randomized Design (CRD). The treatments used were 4, namely without the addition of red lentil flour as a control and the addition of 3%, 6%, and 9% red lentil flour, and using 5 replications.

2.3 Data Analysis

Data from the research using a Completely Randomized Design (CRD) and calculated using Microsoft Excel were then analyzed using Analysis of Variance (ANOVA). If different, the next data is calculated by Duncan's Multiple Range Test or DMRT.

2.4 Procedure for Making Chicken Meatballs

The steps for making chicken meatballs with the addition of red lentil flour (*Lens culinaris* L.) are modified from [35], namely 800 g chicken meat (divided into 4 groups) cleaned, cut into small sizes then mashed using a meat grinder until smooth. The chicken meat was divided into 4 groups, weighing 200 g each. The first group was without added red lentil flour, groups 2, 3, and 4 were added with red lentil flour, respectively 3% (6 g), 6% (12 g), and 9% (18 g). The formula for each group was added with 1 g of pepper, 6 g of fried garlic, 6 g of fried shallots, 6 g of chicken egg white, 40 g of tapioca flour, 7 g of salt, 7 g of sugar, and 40 g of ice cubes. The formula of each group is mixed until blended. The four groups of meatball formulations were formed into balls (11g) and cooked in 80˚C water (30 minutes). Cooked chicken meatballs are drained and put into a container and labeled according to the treatment group. Chicken meatballs put in the freezer before being analyzed.

2.4 Fat Content Test Procedure

The procedure for testing chicken meatball fat uses the Soxhlet method: a 5g sample is weighed and placed in a thimble. Place the thimble in a soxhlet extractor and add the hexane solvent. Extracted for 6 hours. Take out the sample and put the sample in the oven at 105°C (1 hour). The final step is the sample is weighed.

$$\text{Fat content (\%)} = \frac{\text{initial weight} - \text{final weight}}{\text{final weight}} \times 100\ \%$$

2.5 Ash Content Test Procedure

The procedure for testing chicken meatball ash uses the gravimetric method: a 10g sample is put in a cup and weighed. The cup is put in the oven (525°C) until the sample is white. Cooled in a desiccator and weighed. Calculated ash content with the formula.

$$\text{Ash content (\%)} = \frac{\text{ash weight}}{\text{weight before baking}} \times 100\%$$

2.6 Crude Fiber Test Procedure

The procedure for testing chicken meatballs for crude fiber uses the gravimetric method: a 1g sample that has been mashed is weighed and put into a 600ml beaker. 100ml of the acidic detergent solution was extracted using an electric heater (1 hour) after boiling. The extract was filtered using filter paper with the help of a vacuum pump. The residue is rinsed with 300ml of hot water (±3x). The residue was dried in an oven at 105ºC (8 hours). The residue is cooled in a desiccator for 30 minutes and weighed.

$$\text{Crude fiber content (\%)} = \frac{\text{residual weight-paper weight}}{\text{final weight}} \times 100\%$$

2.7 pH Test Procedure

The procedure for testing the pH of chicken meatballs uses the AOAC method (pH meter): 10g of chicken meatballs plus 50 ml of distilled water. Chicken meatballs and distilled water were ground to a fine paste using a laboratory blender. Samples of fine chicken meatballs were then analyzed for pH. Analysis was measured using a digital pH meter.

2.8 Organoleptic Test Procedure

The procedure for organoleptic testing of chicken meatballs uses the hedonic method: meatball samples are placed on a plate that is coded. The hedonic test used 15 semi-trained

panelists. Panelists provide an assessment of texture, color, and taste. All parameters were assessed in a score range of 1-5 (1 = dislike very much, 2 = dislike, 3 = fairly like, 4 = like, 5 = really like.

2.9 Scanning Electron Microscope (SEM) Test Procedure

The scanning electron microscope (SEM) test procedure for chicken meatballs: meatball samples were sliced 1-2mm in size. Samples were added with 2.5% glutaraldehyde in 0.2M phosphate buffer solution (pH 7) and preserved for 2 hours, then washed and soaked in distilled water for 1 hour. Samples were cleaned with ethanol in distilled water (50%, 60%, 70%, 80%, 90%, and 100% by weight of sample) for 1 hour. The dried sample is placed on the holder and observed at 3000x magnification.

3. RESULTS AND DISCUSSION

The physicochemical and organoleptic qualities of chicken meatballs using red lentil flour are shown below.

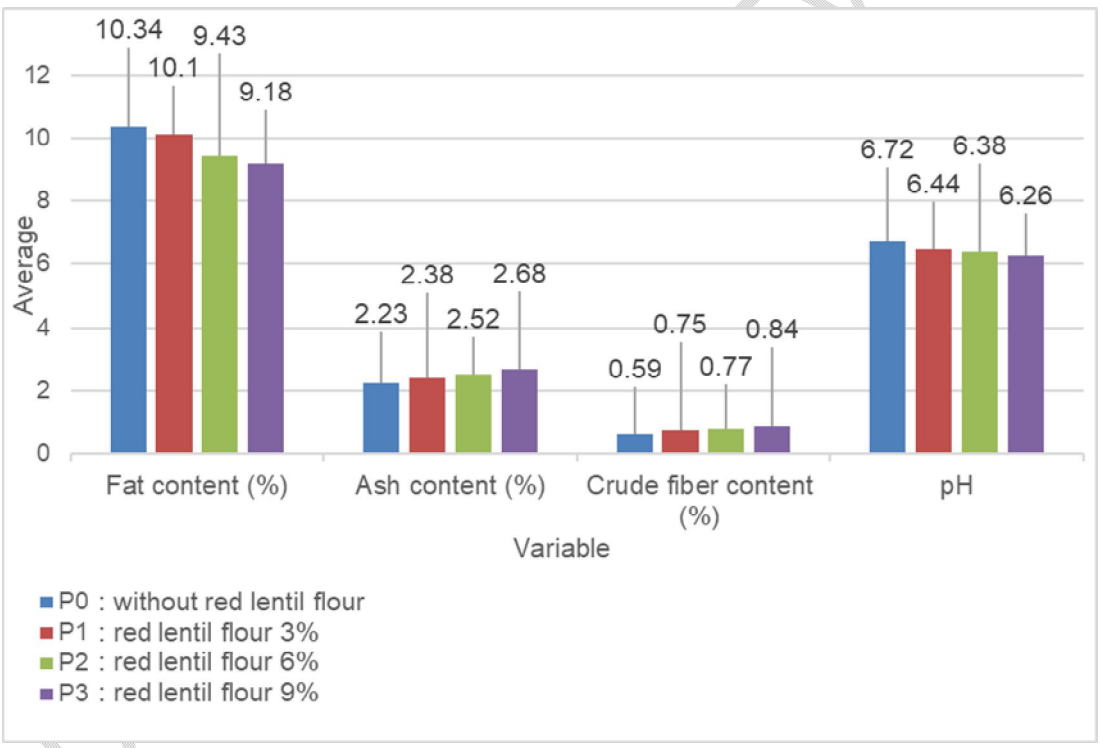


Fig. 1. Physicochemical quality of chicken meatballs using red lentil flour

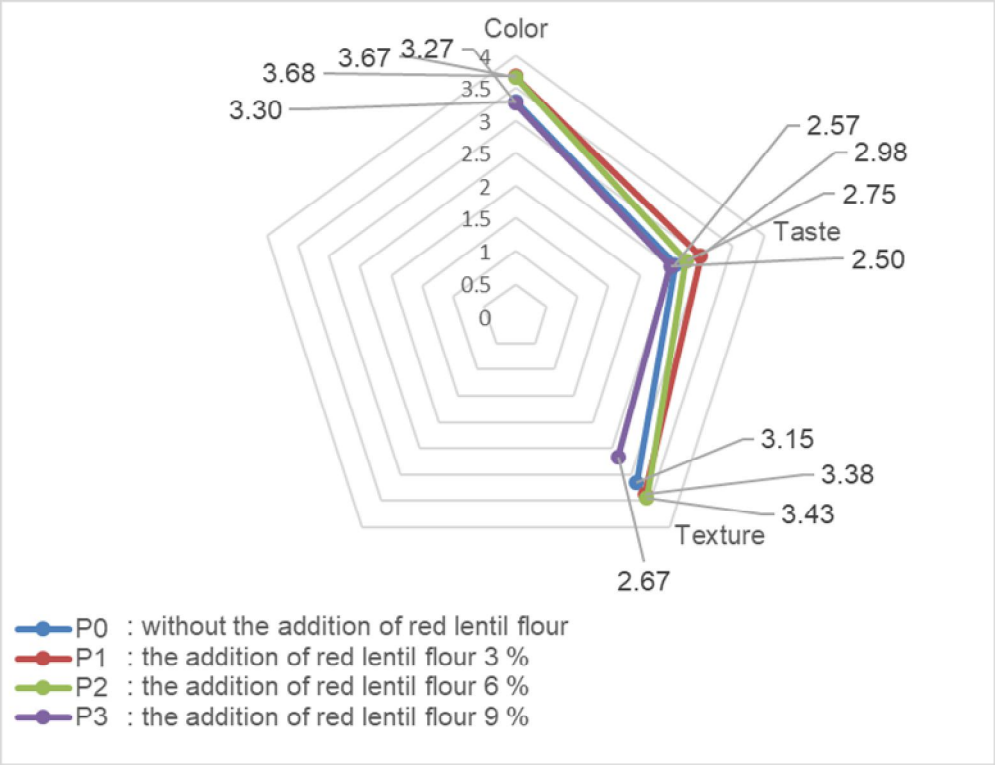


Fig. 2. Organoleptic quality of chicken meatballs using red lentil flour

3.1 Fat Content

figure 2 states that chicken meatballs added with red lentil flour did not have a significant effect ($p>0.01$) on the fat content of chicken meatballs. The fat content of chicken meatballs using 6% and 9% red lentil flour meets the requirements for a maximum meatball fat content of 10%, but the fat content of chicken meatballs without adding red lentil flour and adding 3% red lentil flour does not meet the requirements [4]. Meatball fat content requirements. The lowest (best) fat content chicken meatball in this study was chicken meatballs added with red lentil flour 9%. The low-fat content of chicken meatballs is due to the addition of red lentil flour, red lentil flour contains 0.7% fat [8]. The fat content of chicken meatballs decreased because the fat content dissolved during cooking [3].

Fat content affects food texture [26]. Fat affects the appearance and softness of food [10]. Processed foods from meat contain low-fat levels to produce healthy food [16]. Quinoa flour (*Chenopodium quinoa* Willd.) 7.5% added to chicken meatballs produces the best chicken meatballs with fat content (80%) [6]. The best beef meatballs added with 100% adzuki bean flour (2.11%) produce low-fat beef meatballs [3]. Date palm flour 16% used in beef meatballs has good quality meatballs with a fat content of 3.51% [5].

3.2 Ash Content

figure 2 states that red lentil flour added to chicken meatballs has a very significant effect ($p<0.01$) on the ash content. The ash content of chicken meatballs increased with the addition of red lentil flour. The best ash content was chicken meatballs with low ash content, found in chicken meatballs without the addition of red lentil flour. The low and best ash

content is preferred by consumers because it has an effect on maintaining health, namely chicken meatballs plus 3% red lentil flour [7]. The ash content value of chicken meatballs using red lentil flour meets the requirements for meatball ash content, namely a maximum of 3% [4].

Meatballs without added perilla seeds have meatballs with the best ash content of 1.34% [29]. Another study [3] beef meatballs added with 75% adzuki bean flour (*Vigna angularis*) had the best quality meatballs with an ash content of 1.71%. The best beef meatballs without added pumpkin seed flour (*Cucurbita pepo* L.) with an ash content value of 3.91% [20].

3.3 Crude Fiber Content

Based on figure 2 above, red lentil flour added to chicken meatballs had a significant effect ($p<0.05$) on crude fiber content. The crude fiber content of chicken meatballs increases with the increasing percentage of red lentil flour, red lentil flour contains 112.1 g/kg fiber [18]. The results showed that chicken meatballs added with 9% red lentil flour had the best crude fiber content. Food products with high crude fiber are beneficial to human health [29], lower cholesterol levels, maintain digestive tract health, and reduce high blood pressure [31]. Crude fiber reduces blood sugar content [1].

The best beef meatballs added with 16% date palm flour produced a crude fiber content of 7.93% [5]. Research conducted [27] found that turkey meatballs contained the best levels of crude fiber with the addition of coarse flaxseed flour, spinach seed flour, and fine flaxseed flour each of 8% with a value of 2.51%. Kirklareli meatballs (a mixture of beef and lamb) using 4% cowpea flour produces good quality meatballs containing 4.80% crude fiber [15].

3.4 pH

The pH value has an effect on meat which ultimately affects processed meat products [24]. Based on figure 2, chicken meatballs added with red lentil flour had a very significant effect ($p<0.01$) on the pH value. The pH value of chicken meatballs using red lentil flour as a result of the study was within the normal range of meatballs, namely 6 - 7. The pH value of chicken meatballs decreased due to an increase in red lentil flour [22]. The best pH content means that the product is liked by consumers because it is good for health, namely 3% red lentil flour added to chicken meatballs [10].

The best pH value of kirklareli meatballs (beef mixed with lamb) using 8% cowpea flour has a high pH value of 6.08 [15]. Pork meatballs using 20% perilla seeds have the best quality meatballs with an increased pH (6.34) [29]. Turkey meatballs using 8% each of coarse flaxseed flour, spinach seed flour, and fine flaxseed flour producing meatballs with the highest pH of 6.25 [27].

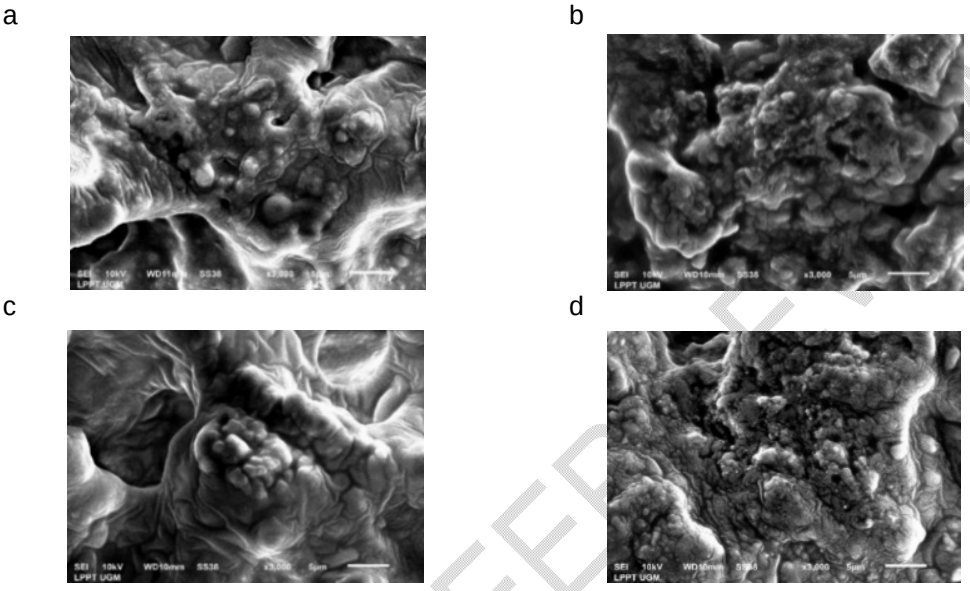
3.5 Organoleptic

The organoleptic is used to analyze the sensory quality of products [2]. The organoleptic analysis uses semi-trained panelists and provides an assessment using the hedonic scale method [19]. Red lentil flour added to chicken meatballs had a very significant effect ($p<0.01$) on color and taste but had no effect ($p>0.01$) on texture (figure 2). According to semi-trained panelists, meatballs added with high red lentil flour produced a darker color and lowered consumer ratings. Chicken meatballs using 3% red lentil flour have the highest and best organoleptic value in color and taste, and the addition of 6% red lentil flour has the best value in texture, meaning that consumers like them the most and are the best treatment [24].

Beef meatballs added with 25% adzuki bean flour (*Vigna angularis*) produced the best beef meatballs with brownish-red color, delicious taste, and compact texture [3]. Research by [17] the best chicken meatballs are 5% corn flour (15 days). Pork meatballs added with 10% seeds, which had meatballs with the color, taste, and texture that consumers liked [29].

3.6 Scanning Electron Microscope (SEM)

Scanning electron microscope image of chicken meatballs using red lentil flour is below.



Pic. 1. SEM image for chicken meatballs without adding red lentil flour (picture a), adding 3% red lentil flour (picture b), adding 6% red lentil flour (picture c), and adding 9% red lentil flour (picture d) with 3000x magnification.

Picture 1 shows that picture (a) the image of chicken meatballs has a grain-shaped meatball structure with a fine structure. Picture (b) SEM images have a small grain structure with a slightly rough texture. Picture (c) chicken meatballs have a picture structure that forms small round folds and forms many cavities. Picture (d) chicken meatballs have a flat structure with large quantities of small, rough spheres.

Chicken meatballs without added transglutaminase, have a less firm and irregular structure and a rough surface. Chicken meatballs added with 0.5% transglutaminase resulted in a tight gel structure, a more regular and homogeneous tissue structure, and a smooth surface. Chicken meatballs added with 1% transglutaminase formed a surface structure with small grains and a little rough [11]. Chicken meatballs with meat are directly processed to produce images of a gel structure that is compact and has uniform small cavities. Chicken meatballs with meat stored on ice produce an image structure with slightly large and non-uniform cavities. Meatballs stored at 4°C have a structure with a lot of tissue and large cavities with a non-uniform surface due to water vibrations which damage the structure of the chicken meatballs so that they form a less regular and less uniform gel [9]. The SEM of chicken burger without added transglutaminase has a loose, irregular, and large gel structure. Chicken burger added with 0.2% transglutaminase resulted in a compact structure and long and wide cavities. Chicken burger using 0.4% transglutaminase has a small round and irregularly hollow structure. Transglutaminase 0.6% in chicken burgers produces a larger

round structure and an irregular surface. 0.8% transglutaminase in chicken burgers produces a thin and flat structure, and the addition of 1% transglutaminase produces a compact and dense gel network structure [34].

4. CONCLUSION

The best treatment of chicken meatballs added with 3% red lentil flour (*Lens culinaris* L.) resulted in chicken meatballs that were healthy, containing fiber, and were accepted by the consumers.

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