Physicochemical Quality and Organoleptic Properties of Commercial Beef Meatballs in Malang City, East Java, Indonesia

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Abstract. The objective of this research was to determine the physical, chemical and organoleptic properties of commercial beef meatballs obtained from five different districts; Klojen, Sukun, Blimbing, Lowokwaru and Kedungkandang, in Malang city. Randomized complete design was used with seven random samples obtained from each district. The pH, water-holding capacity (WHC), elasticity, protein, moisture and fat content of the samples were analyzed. Organoleptic quality variables including color, aroma, flavor, and texture, had been observed. The results showed that there were no significant differences on all variables among five districts. The pH, WHC and elasticity ranged from 6.17 to 6.32, 66.77% to 72.23%, and 20.14 N/m² to 20.55 N/m², respectively. The moisture, fat and protein content ranged from 73.81% to 74.76%, 4.19% to 5.71%, and 12.38% to 14.28%, respectively. The acceptance on color, aroma, flavor and texture ranged from 3.17 to 3.97, 3.02 to 4.68, 3.68 to 4.28, and 3.27 to 4.41, respectively. These suggest that the physicochemical quality and organoleptic properties of commercial beef meatballs in five different districts in Malang city were comparable.

1. Introduction
Indonesia is a culturally diverse country with variety of traditional food available across the archipelago. Bakso or Indonesian-style meatball is one of the most familiar food. It can be found across the country, particularly in Malang City, where bakso is one of the city’s icon. Indonesian style meatball is a boiled type of meatball that is made from ground beef, seasonings, starch as binder and other additives with greyish pale appearance and chewy texture [1].

The quality of meatball is commonly influenced by the quality of beef and proximate composition of the ingredients, the use of phosphate salt and the processing technique [1]. Compact appearance and chewy texture are the first criteria that should be met as these criteria representing the acceptable meatball for Indonesian costumers. Besides that, the overall quality should meet the national standard set by Badan Standardisasi Nasional [2].

Malang City consists of five districts; Klojen, Sukun, Blimbing, Lowokwaru and Kedungkandang. Therefore, the objective of this study was to evaluate the physicochemical quality and organoleptic properties of beef meatballs available in five districts of Malang City. The results could help to bring out the basic information regarding the quality of beef meatballs in Malang City whether it is different across the districts and meet the national standard.
2. Materials and methods

2.1. Sampling and experimental design
Beef meatballs were collected from randomly selected seven outlet stores in each district in Malang City; Klojen, Sukun, Blimbing, Lowokwaru and Kedungkandang according to sampling method by Suntoyo [3]. Randomized block design was used for this study and is shown in Table 1. The beef meatball outlet store selection was based on following criteria; (1) strategic and accessible location, (2) not outlet carts, (3) applying sanitary procedures, and (4) familiar outlet brand in each district.

| Outlet (O) | Klojen (D1) | Sukun (D2) | Blimbing (D3) | Lowokwaru (D4) | Kedungkandang (D5) |
|------------|-------------|-------------|----------------|-----------------|---------------------|
| O1         | O1D1        | O1D2        | O1D3           | O1D4            | O1D5                |
| O2         | O2D1        | O2D2        | O2D3           | O2D4            | O2D5                |
| O3         | O3D1        | O3D2        | O3D3           | O3D4            | O3D5                |
| O4         | O4D1        | O4D2        | O4D3           | O4D4            | O4D5                |
| O5         | O5D1        | O5D2        | O5D3           | O5D4            | O5D5                |
| O6         | O6D1        | O6D2        | O6D3           | O6D4            | O6D5                |
| O7         | O7D1        | O7D2        | O7D3           | O7D4            | O7D5                |

2.2. Physicochemical quality analysis
The pH of the homogenized samples was determined according to the method described by Apriyanto [4]. Water-holding capacity (%) was determined using Hamm method [5]. The elasticity (N/m²) of the samples was determined according to a method described by Carballo [6]. The proximate composition (moisture, crude fat and crude protein, %) was measured according to AOAC method [7].

2.3. Sensory evaluation
The color, aroma, taste and texture of beef meatballs were evaluated by 30 untrained panelists (college students) using 5-hedonic scales; 1 (very bad), 2 (bad), 3 (neutral), 4 (good), 5 (very good), according to a method described by Sudrajat [8].

2.4. Statistical analysis
Analysis of variance (ANOVA) was performed to determine any significant differences among districts.

3. Results and discussion

3.1. Physicochemical quality of beef meatballs obtained from five districts in Malang City
Table 2 shows that there were no significant differences on any physicochemical traits determined in this study for beef meatballs obtained from different districts in Malang City. The pH of meatball samples ranged from 6.17 to 6.32 with an average of 6.26. These ranged values met the standard of Indonesian style-beef meatball and were influenced mainly by the ingredients such as the pH of meat and the use of sodium tripolyphosphate [9]. In case of water-holding capacity, the value ranged from 66.77% to 79.15% with an average of 73.31%. The water-holding capacity of the samples was also within the acceptable range of Indonesian style-beef meatball as the pH value of the samples is within the range when meat proteins possess their ability to retain water [10]. The elasticity of the samples ranged from 20.23 N/m² to 20.55 N/m² with an average of 20.38 N/m². The values indicate that the beef meatballs in Malang City had an acceptable chewy texture. These suggest that the physical quality of beef meatballs obtained from different districts in Malang City was comparable and within the acceptable range.
Table 2. Physical quality of beef meatballs obtained from different districts in Malang City

| District  | pH       | Water-holding capacity (%) | Elasticity (N/m²) |
|-----------|----------|----------------------------|-------------------|
| Klojen    | 6.31±3.01| 66.77±1.05                 | 20.55±3.41        |
| Sukun     | 6.29±2.02| 78.18±3.05                 | 20.44±2.23        |
| Blimbing  | 6.32±3.12| 79.15±2.40                 | 20.33±3.49        |
| Lowokwaru | 6.21±2.13| 70.20±1.12                 | 20.23±2.02        |
| Kedungkandang | 6.17±3.02| 72.23±2.10                 | 20.24±2.10        |

Means: 6.26 73.31 20.38

The moisture, crude fat and crude protein content of beef meatballs obtained from different districts in Malang City were also comparable (Table 3). The crude fat and protein content were within the acceptable range. The measured moisture content, however, could not meet the national standard set by Badan Standardisasi Nasional, which should not be more than 70% [2]. This could be caused by the reduction of fat sources in recipe such as using very lean cut of meat or the loss of fat during boiling [11]. Wibowo [12] also found that the moisture content of beef meatballs in Malang City was above the limit as the fat content ranged from 1.09% to 8.19%. Therefore, the current findings are in line with the previous one. Further, the use of tapioca as binder ingredient could reduce the fat content of the meatballs even though this ingredient gives the chewy texture to the meatballs [13].

The amount of tapioca used in the recipe influences the fat content of final product (boiled meatball). The fat content can be reduced by adding more tapioca to the meat batter. Tiven et al. [13] reported that the fat content of tapioca is 0.3 g per 100 g. As carbohydrate was predominant in tapioca flour, the fat content of meatballs added with tapioca flour reduced.

Table 3. Proximate composition of beef meatballs obtained from different districts in Malang City

| District   | Moisture (%) | Crude fat (%) | Crude Protein (%) |
|------------|--------------|---------------|-------------------|
| Klojen     | 74.71±3.79   | 5.71±2.83     | 12.38±2.86        |
| Sukun      | 73.82±3.44   | 4.58±2.07     | 13.85±2.79        |
| Blimbing   | 74.13±4.28   | 5.61±2.11     | 13.40±3.74        |
| Lowokwaru  | 74.76±3.08   | 4.73±2.71     | 14.20±3.60        |
| Kedungkandang | 74.18±2.89 | 4.19±3.01     | 14.28±3.23        |

Means: 74.32 4.96 13.62

3.2. Organoleptic properties of beef meatballs obtained from five districts in Malang City

There were no significant differences on the acceptance of color, aroma, taste and texture of beef meatballs obtained from different districts in Malang City (Table 4). The values ranged from 3 (neutral) to 4 (good), which indicates that the overall quality of beef meatballs in Malang City was comparable and acceptable. According to the national standard, the color of the meatballs should be normal, the aroma should represent the meaty note with umami taste and chewy texture [2].

Table 4. Organoleptic properties of beef meatballs obtained from different districts in Malang City

| District   | Color   | Aroma   | Taste   | Texture  |
|------------|---------|---------|---------|----------|
| Klojen     | 3.17±1.17| 4.13±2.42| 4.27±2.86| 3.21±2.78|
| Sukun      | 3.81±1.34| 3.87±2.71| 4.28±1.92| 3.98±2.72|
| Blimbing   | 3.18±2.01| 3.02±3.17| 4.17±1.26| 4.41±1.35|
| Lowokwaru  | 3.87±1.57| 4.68±3.11| 3.68±2.48| 3.27±2.24|
| Kedungkandang | 3.97±2.01| 4.67±2.23| 3.98±2.80| 4.28±2.53|
4. Conclusion
Although the moisture content of the meatballs obtained from five districts in Malang city did not meet the national standard, the physicochemical and organoleptic properties of the meatballs were comparable and acceptable.

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