The total plate count, *Staphylococcus aureus*, and pH value of raw chicken meat sold at the traditional markets in Maros regency

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Abstract. Chicken meat sold in traditional markets generally has not implemented proper sanitation procedures. Chicken meat is easily damaged and has the potential to cause illness due to contamination by pathogenic bacteria. *Staphylococcus aureus* is a major bacterium that causes food poisoning. This study aimed to determine the total bacteria, *Staphylococcus aureus*, and pH chicken meat from the traditional market in Maros. This research was conducted by the survey method and observing market conditions. A total of 24 samples of chicken meat obtained from four Maros traditional markets were examined using the pour plate method to enumerate the total bacteria and *Staphylococcus aureus*. The results were then analyzed descriptively. The pH value data were analyzed using analysis of variance, then further testing using the least significant difference. The results showed that the total bacteria in the four Maros traditional markets was 25% according to SNI, ranging from $4.8 \times 10^5$–$6.8 \times 10^6$ CFU/g. Based on the Indonesian National Standard (SNI) 7388-2009 [1] all chicken meat samples did not meet the standard of the *Staphylococcus aureus* bacteria. The pH values of all chicken meat samples were in the normal range according to SNI 6.2–6.7, respectively.

1. Introduction

Chicken meat contributes greatly to people's needs for animal protein. Some of the advantages of chicken meat are high nutrition, palatable, soft texture, delicious taste, and is relatively cheap. People mostly buy chicken meat in the traditional markets. The chicken meat sold in the traditional markets generally has not implemented proper sanitation procedures. The chicken meat is usually placed on the table uncovered and is not chilled. Poor sanitation is thought to cause contamination of pathogens and high total bacteria number in chicken meat [2].

*Staphylococcus aureus* is one of the contaminant bacteria in chicken meat. Baron (1996) stated that $10^6$ CFU/gram of this Gram-positive bacteria caused skin infections [3]. *S. aureus* can also cause food poisoning which is characterized by nausea, vomiting, hypothermia, stomach cramps, diarrhea, sweating, dizziness, weakness, and lethargy starting from 1–6 hours (generally 4 hours) after consuming contaminated food [4]. Ibrahim (2017) revealed that the total *S. aureus* in chicken meat sold in Makassar traditional markets ranged from $2 \times 10^2$–$1.50 \times 10^4$ CFU/g [5]. The research showed that 65.8% of chicken meat samples exceeded the SNI 7388:2009 [1] requirement and concluded as unsafe for consumption. Maros regency is a buffer area and is directly adjacent to the city of Makassar. This research was carried out to determine the occurrence of *S. aureus* contamination and the total number of bacteria in chicken meat sold in traditional markets in Maros regency.
2. Methods

2.1. Chicken meat samples
The sample used in this study was chicken thigh meat from four traditional markets in Maros regency. From each market, samples were taken from six sellers, hence a total of 24 samples were collected. The samples were put in sterile plastic bags, labeled and transported using an icebox to the laboratory for testing. The determination of total bacteria, *S. aureus* and pH value was carried out at the Veterinary Public Health Laboratory, Disease Investigation Center, Maros.

2.2. Total plate count (TPC) and *Staphylococcus aureus* evaluation
The total plate count (TPC) was evaluated by the pour plate method with dilution on plate count agar (PCA). The total *S. aureus* was also evaluated by the dilution method. Samples from 10^{-1}, 10^{-2} and 10^{-3} dilutions were pipetted 0.3 mL from each dilution test tube and put into a petri dish containing Baird Parker Agar (BPA) + egg yolk, in Duplo. Samples were leveled with a hockey stick and incubated for 48 hours at 35℃. The positive control dish was made by growing *S. aureus* culture on BPA media, while the negative control was made by pouring BPA media on a petri dish. *S. aureus* was identified as gray to dark black colony with round shape. The colony was smooth, shiny, convex and surrounded by an opaque zone. The total plate count and *S. aureus* were calculated using the formula as follow Fardiaz [6]:

\[
\text{Bacteria number} = \text{colony number} \times \frac{1}{\text{dilution factor}}
\]

2.3. pH value determination
Five grams of chicken thigh meat sample was mashed and mixed with 25 mL of distilled water with a ratio of 1:5 then shaken until homogeneous. The pH measurements on chicken meat were carried out using a pH meter. Measurements were carried out 3 times in each experimental unit then the results were averaged [7].

3. Results and discussion
The SNI 7388:2009 required that the maximum threshold for microbial contamination in food is 1×10^6 CFU/g. Table 1 showed that the results of the analysis of microbial contamination on chicken meat sold in markets A, B, and D did not meet the SNI 7338:2009 [1] requirements. Only samples from market C were in accordance with SNI requirements.

**Table 1.** The average TPC of chicken thighs meat sold in traditional markets in Maros.

| Market | TPC (CFU/g) | SNI(*) (CFU/g) |
|--------|------------|----------------|
| A      | 1.5×10^6   |                |
| B      | 1.2×10^6   | 1.0×10^6       |
| C      | 4.8×10^5   |                |
| D      | 6.8×10^6   |                |

*SNI 7388:2009 maximum threshold for microbial contamination in food [1].

Hygiene can affect the quality of chicken meat due to microbiological contamination, thus affecting the total bacteria count. Humans are one of the factors in the occurrence of contamination, when sellers or buyers hold chicken meat repeatedly and do not wash their hands, it will cause contamination to food. Therefore it is very important to wash hands before and after handling chickens because hands, fingers, and nails may become sources of microbes.

Other factors that could cause bacterial contamination of chicken meat were types of equipment used by sellers, which include knives, tables, cutting boards, boxes (cooling equipment). At the four
traditional markets, we revealed that the sellers only used one knife repeatedly. They did not wash the knife after being used and likewise the cutting boards. We suggested the sellers use more than one knife and cutting board and also wash those things periodically. Gustiani (2009) suggested preparing 2 knives for the meat seller and used alternately and to use running water to avoid microbial contamination [8].

The high level of bacterial contamination is also due to open meat outlets, unpackaged meat, and not equipped with cooling boxes for more than 4 hours. The cooling boxes functioned to inhibit bacterial growth. Murtidjo (2003) stated that to provide seven days of durability, it is best to store raw chicken meat in cold temperatures, of not more than 4°C [9]. Rachmawan (2001) also supported that meat sales should be equipped with a hygienic meat storage area, closed from free air, controlled temperature and humidity level to prevent and reduce the potential for microorganism contamination [10]. The distribution process must also concern the packaging standard and distribution times.

**Table 2.** The average value of total *S. aureus* of chicken thighs meat sold in traditional markets in Maros.

| Market | *S. aureus* (CFU/g) | SNI* (CFU/g) |
|--------|---------------------|--------------|
| A      | 1.1×10^3            |              |
| B      | 1.9×10^2            | 1.0×10^2     |
| C      | 1.2×10^3            |              |
| D      | 1.9×10^2            |              |

*SNI 7388:2009 maximum threshold for microbial contamination in food [1].

Table 2 showed that all 24 samples of chicken thigh meat contained 1.9×10^2 – 1.2×10^3 CFU/g *Staphylococcus aureus*. The amount exceeded the SNI 7388:2009 standard [1]. The chicken meat was categorized as safe for consumption if the number of *S. aureus* bacteria was less than 1×10^2 CFU/g. As a comparison, research conducted by Ibrahim (2017) revealed that 18 out of 24 samples of chicken meat sold in traditional markets in Makassar contained 2×10^2 – 1.5×10^4 CFU/g *S. aureus* [5]. The result showed that 65.8% of samples did not safe for consumption.

The variance of the total value of *S. aureus* in each sample was due to differences in the handling of chicken meat. Handling of chicken meat in traditional markets was still not proper in terms of equipment sanitation, workers’ hygiene, and chicken meat packaging. Generally, the personal hygiene of chicken meat sellers in the four markets was poor. The seller did not wear an apron, head cap, mask, and gloves. According to Hestininingsih et al (2019), sellers who use personal protective equipment (PPE) such as aprons, head cap, masks and gloves could avoid direct contact with chicken meat [11].

**Table 3.** The average value of pH of chicken thighs meat sold in traditional markets in Maros.

| Market | Average | SNI(*) |
|--------|---------|--------|
| A      | 6.6^a   |        |
| B      | 6.6^c   |        |
| C      | 6.7^d   | 6–7    |
| D      | 6.2^a   |        |

*SNI 7388:2009 maximum threshold for microbial contamination in food [1].

Table 3 showed the average pH value of the chicken thigh meat samples. The results of the analysis of variance showed that the pH value of chicken thigh meat in each market had a significant effect (P<0.05). The least significant difference test showed that the pH value of samples in market C was
significantly higher than market A, B, and D. The pH value of samples in market B was significantly higher than market A and the pH value of samples in market A was significantly higher than market D. The difference in pH value of chicken thigh meat in each market was due to differences in the length of storage for the meat. The longer it was stored, the pH will decrease, which indicated that the quality of the meat was decreasing [12]. The SNI 7388:2009 suggested the good fresh meat was obtained no more than four hours after slaughtering and stored at a temperature of below 4°C [1]. A long room temperature storage will reduce the meat quality due to bacterial growth.

4. Conclusion
The total bacteria count in chicken thigh meat samples sold in Maros traditional market ranged from $4.8\times10^5$–$6.8\times10^6$ CFU/g. All samples contained *Staphylococcus aureus* bacteria with a number exceeding the SNI 7388:2009 standard. The pH value of all samples was in the normal range, 6.2–6.7. The sellers should concern the sanitation and hygiene in handling meat. It is very important to store the chicken meat in the cooling box or a chiller to maintain the quality of the chicken.

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