Physical quality of Simental Ongole crossbred silverside meat at various boiling times

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Abstract. This study aims to determine the physical quality of silverside beef meat at various boiling times. Samples that have been used are the back thigh or silverside meat. Treatment of boiling meat included TR (meat without boiled), R15 (boiled 15 minutes), and R30 (boiled for 30 minutes). The experimental design using Completely Randomized Design with 3 replications. Each replication was done in triple physical quality test. Determination of physical quality was performed at the Livestock Industry and Processing Laboratory at Sebelas Maret University Surakarta and the Meat Technology Laboratory at the Faculty of Animal Husbandry of Gadjah Mada University. The result of variance analysis showed that boiling affect cooking loss (P≥0.05) and but did not affect (P≤0,05) pH, water holding capacity and meat tenderness. The conclusions of the study showed that boiling for 15 minutes and 30 minutes decreased the cooking loss of Simental Ongole Crossbred silverside meat. Meat physical quality of pH, water holding capacity and the value of tenderness is not affected by boiling for 15 and 30 minutes.

1. Introduction
Meat is a high-quality food source of animal protein. Consumers prefer meat with a texture that is not tough. The physical quality of meat is influenced by many factors such as cooking methods. Some of the physical properties of fresh meat such as structure, firmness and texture are difficult to measure objectively. Physical quality is related to the visible external appearance of the flesh, which consists of pH value, water holding capacity, tenderness and cooking loss.

The process of boiling meat improves the digestibility of protein but can also lower nutritional value. The cooking of protein foods that are not well controlled can decrease the nutritional value of the protein [1]. The higher the cooking temperature and the longer the boiling time the greater the level of the lost meat fluid. The amount of fluid obtained during boiling will increase further, it describes some of the protein damage with the damage of amino acids [2].

The method of boiling meat is based on three main factors including surface temperature of meat, external temperature and heat exchange method i.e. direct contact with heat, air or steam sources [3]. Winarso [4] mentioned that boiling meat at a temperature of 80-90°C in 30 to 60 minutes increased pH, cooking loss, tenderness and decreased water holding capacity. The purpose of this research was to know the physical quality of beef with various cooking times related to the improvement of physical quality of meat.
2. Methods
This meat samples of the study were obtained from ongole crossbred (Simpo) which had been fattened for 90 days. The fattening was done in the CV Izzah Sejahtera Multifarm in Village Sambi District Boyolali. Fattening feed consisted of fermented rice straw and basal concentrate with a ratio of 30:70%. The basal concentrate was composed of 9.10% coffee skin, 14.40% palm cake, 20.86% rice bran, 9.23% pollard, 0.61% mineral, 10.80% molasses, 15.00% formaldehyde-protected soyabean groat. The feed contained crude protein 10.45%, crude fat 6.28%, crude fiber 19.87%, organic material 88.91%, nitrogen-free extract 52.34% and total digestible nutrient 69.74%

All cows are slaughtered in slaughter houses according to Islam Method. Carcass preparation was done according to Australian Meat and Livestock Corporation [5]. The meat samples used in this study were the silverside meat. Sampling on the whole carcass was done by splitting into two halves right along the spine. Cutting between the front and rear carcass is done right between the ribs 12 and 13. The muscle samples were taken from the cross section of the rear carcass. The carcass were put into the cool box containing ice cubes to keep freshness then taken to the laboratory for examination.

Treatment of boiling meat includes TR (meat without boiled), R15 (boiled meat 15 minutes), and R30 (boiled meat 30 minutes). The experiment design using Randomized Complete Design as many as 3 replications of each replication was done triple physical quality test. The average difference in treatment effect was tested further using DMRT Test.

Preparation of the meat sample was done by cutting the meat with the same thickness, part and fiber direction. Fresh meat samples were tested for physical quality. Samples were weighed (180 - 200 g) [6] and included in tightly clipped polyethylene plastic bags. The samples were boiled using an electric stove at 100°C for 15 and 30 minutes temperature controlled [4]. Temperature is measured using a thermometer, while time is measured using stopwatch [8].

Meat pH values were tested in accordance with [6] methods in [7], samples 10 g of meat using a digital pH meter. Assessment of water holding capacity of meat using Hamm method in [6] by determining the value of free water content and total water content. Determination of free water content by taking 0.3 g meat then put on filter paper and cover the meat using filter paper on it.

Determination of total water content was done by measuring the water content i.e. weighing the initial sample with 5g digital scales then putting the sample on the filter paper then putting it in the oven at 105°C for 8 hours and weighing the final weight of the sample [7]. Assessment of cooking loss in accordance with [6] methods in [7] by boiling meat samples measuring ± 100 g at a temperature of 80°C. Meat tenderness value was determined by shear-force method [7]. Meat tenderness value using warnor tool bratzler shear force device.

3. Results and Discussion
The physical quality of beef Simpo of silverside part in various boiling times can be seen in Table 1.

| Treatment | TR (meat without boiled) | TR 15 (boiled meat 15 minutes) | TR 30 (boiled meat 30 minutes) |
|-----------|--------------------------|-------------------------------|-------------------------------|
| pH        | 6.60 ± 0.12              | 6.12 ± 0.56                   | 6.22 ± 0.10                   |
| Water holding capacity (%) | 28.68 ± 8.34             | 22.06 ± 6.46                  | 16.05 ± 5.55                  |
| Cooking loss (%)     | 31.59 ± 2.41             | 16.28 ± 0.94                  | 17.96 ± 1.37                  |
| Meat tenderness (kg/cm²) | 10.81 ± 2.95             | 9.28 ± 1.83                   | 8.98 ± 1.61                   |

a,b different superscripts on the same row showed significant differences (P <0.05)

The results showed no effect of boiling duration on pH value. Boiling at a temperature of 100°C for 15 and 30 minutes has not yet led to a fast-running glycolysis process. Previous research [9] indicated that beef cooked at 95°C for 10 minutes has a pH value of 5.7. The pH value of raw meat and meat
cooked in the study showed normal pH values. The pH values in raw meat ranged from 5.5 to 7.0 [2] while the range of normal cooking pH values ranged from 5.1 to 6.1 [10].

The boiling time did not affect WHC (P <0.08). Boiling up to 30 minutes has not caused the breakdown of protein structures and the same protein's ability to bind water. Boiling at temperatures over 60°C causes protein denaturation that will lower the value of juice in the meat so that the meat is more tender. The results of this study were consistent with previous study, in which the duration of boiling meat 60 and 90 minutes tended to decrease the water holding capacity shown by 19.76 and 19.07%, respectively [11]. Higher crude protein content decreased the capacity of meat to absorb water [12]. According to Lawrie [2] pH is affected by the final pH of the meat, when the pH value is higher or lower than the isoelectric point of meat (5.0 - 5.1). The results showed that pH values on the meat were above the isoelectric point. The increased pH value will lead to an increase in WHC value.

The length of boiling time affect to cooking loss (P <0.05). Soeparno [7] states that cooking loss is affected by the temperature and duration of boiling. The higher the cooking temperature the greater the fluid content lost from the meat. The results of this study was in accordance with Ridwan [13] who showed that the value of cooking loss decreased by 44.04; 40.21 and 37.23% resulting in improved physical quality of the meat. Soeparno [7] mentioned that the cooking loss varies between 1.5 -54.5%. The value of cooking loss in the study ranged from 17 to 30% which shows the value of normal cooking loss.

The boiling duration up to 30 minutes did not affect the meat tenderness although the tenderness tends to decrease (P <0.11). The boiling time up to 30 minutes causes the denaturation of myofibril proteins, resulted the tender meat which according to consumer's preference. The results were in accordance with [14] that the value of tenderness of boiled beef at external temperature 100 °C with internal temperature meat 75 and 60 °C resulted the same tenderness value. Suryati and Arief [15] stated that the very soft meat has the power of warner bratzler <4.15 kg cm⁻², tender meat 4.15 -<5.86 kg cm⁻², slightly tender meat 5.86 -<7.56 kg cm⁻², a bit tough meat of 7.56 -<9.27 kg cm⁻², tough meat 9.27 -<10.97 kg cm⁻² and very tough meat ≥10.97 kg cm⁻².

4. Conclusion

The cooking loss in Simpo Crossbred silverside meat decreased with increasing boiling duration. The meat that were boiled for 15 and 30 minutes did not have different cooking loss. Furthermore, physical qualities in terms of pH, water holding capacity and tenderness in fresh meat and boiled meat 15 and 30 minutes were not different.

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References

[1] Wyrwisz J, Półtorak A, Polawska E, Pierzchala M, Jozwik A, Zalewska M, Zaremba R and Wierzbicka A 2012 The impact of heat treatment methods on the physical properties and cooking yield of selected muscles from Limousine crossbred cattle Anim. Sci. Papers Reports 30 339-351

[2] Lawrie R A 2003 Meat Science Fifth Edition Aminudin Parakkasi Translation (Jakarta: University of Indonesia)

[3] Janz J A M, Aalhus J L, Dugan M E R and Price M A 2006 Mapping method for the description of warner-bratzler shear force gradients in beef longissimus thoracic et lumborum and semitendinosus Meat Sci. 72 79-90

[4] Winarso D 2003 Changes in physical characteristics due to differences in age, muscle type, time and temperature of boiling in chicken meat J. Indon. Trop. Anim Agric. 28 119-132

[5] Australian Meat and Livestock Corporation (AMLC) 1991 Study the Australian Feeder Steer Trade to Indonesia Lot Feeding Industry (Australia: Asian Marketing Division)
[6] Bouton P E and Harris P V 1972 The effect of cooking temperature and time on some mechanical properties of meat J.Food Sci. 37 140-144
[7] Soeparno 2005 Meat Science and Technology. 5th Print (Yogyakarta: Gadjah Mada University Press)
[8] Subagyo W C 2014 Characteristics of Bali beef protein and Wagyu after boiling. Thesis. Graduate program. (Denpasar: Udayana University)
[9] Honikel K O 2004 Water-holding capacity of meat (Kulmbach, Germany: Prosiding Federal Center for Meat Research) pp 389 - 400
[10] Buckle K A, Edwards R A, Fleet G H 1987 Food Science (Jakarta: University of Indonesia Press)
[11] Lukman H 2004 The Influence of Different Temperature and Cooking Time Against Chemical Composition and Physical Quality of afkirf duck meat Thesis (Yogyakarta: Gadjah Mada University)
[12] Bailey C R, G C Duff, S R Sanders, J L Treichel, L H Baumgard, J A Marchello, D W Schafer and C P McMurphy 2008 Effect of increasing crude protein concentrations on performance and carcass characteristics of developing and finishing steers and heifers Anim. Feed Sci. Tech. 142 111-120
[13] Ridwan T 2011 Characteristics of Physical Beef Dara Brahman Cross by Giving Different Concentrate Types Essay (Bogor: Bogor Agricultural Institute)
[14] Kołczak T, Krzysztoforski K and Palka K 2008 Effect of post-mortem aging, method of heating and reheating on collagen solubility, shear force and texture parameters of bovine muscles Polish J. Food Nut. Sci. 58 27 - 32
[15] Suryati, I and Arief I I 2005 Testing power of Warner Bratzler, cooking and organoleptik shrinkage as a predictor of the level of tenderness of beef preferred by consumers Research report (Bogor: Faculty of Animal Husbandry, Bogor Agricultural University)