Scientific Papers, Animal Science, Series D, vol. LV
CD-ROM ISSN 2285-5769, ISSN-L 2285-5750

EFFECT OF THAWING METHODS ON PHYSICAL CHARACTERISTIC AND CHEMICAL COMPOSITION OF RIB EYE MEAT ONGOLE CROSSED

Kusmajadi SURADI[1], Azeisha Diena RAHMANI[1], Maria Sri HARTATI[1], Nani DJUARNANI[1]
[1]Faculty of Animal Husbandry, Padjadjaran University, Bandung-Indonesia

Corresponding author email: *kusmajadi@gmail.com*

Abstract

The research was aim to know effect of thawing methods on physical characteristic and chemical composition of rib eye meat Ongole Cross, and to know method best thawing based physical characteristic of and chemical composition. Research is conducted experimentally used Completely Randomized Design (CRD) with four treatments thawing, that is: refrigeration temperature (5-7^{0}C), room temperature (27-30^{0}C), running water at room temperature (22-24^{0}C), and warm water temperature (50-55^{0}C) each treatment was repeated five times. Analysis of variance conducted to determine the effect thawing methods on the phyisical and chemical composition of rib eye meat Ongole Crosses, while to know difference between the treatment used Duncan's test. The result of statistic analysis and discussion indicated that the method of thawing significant effect (P<0,05) of physical characteristic and chemical composition of rib eye meat Ongole Crosses. The method of thawing with refrigeration temperature has the best effect on chemical composition and physical characteristic of rib eye meat Ongole Cross.

Key words*: Thawing, physical, chemical, meat, Ongole*

INTRODUCTION

Ongole Cross is a type of cow that is have dual function as a workers and beef cattle. Ongole cross is the result of crossbreeding of local cows with Ongole cattle of India and has long been maintained by farmers in Indonesia Rib eye meat is a beef carcasses are taken from the back of the sixth to the twelfth rib (Crown and Damon Jr., 1960). Rib eye steaks consists of Longissimus dorsi muscle around the rib cage area and Thoracic vertebrae (Aberle *et al*., 2001). The chemical composition of rib eye meat is 17,4% protein, 59% water, 23% fat, 0,8% ash, and calories by 280 kkal/100 gram (AMIF, 1960 in Tien. R. Muchtadi, and Sugiyono, 1992). The chemical composition is a good medium for the growth of microorganisms (Eneji *et al*, 2007), to slow the process of microbiological it is required preservation. At a temperature of -18^{o}C beef can be stored up to 12 months, whereas at a temperature of -25^{o}C beef can last up to 18 months, and at a temperature of -30^{o}C maximum storage time was 24 months (FAO, 1990 in Chalid Thedjokusuma, 2002).
Freezing can inhibit the activity of microbial growth, enzymatic and chemical reactions that cause damage and decay (Gokalp *et al*, 1999). The resulting ice crystals will inhibit the growth of more than 99% of bacterial decay (Ragab, 2010). Freezing has the disadvantage that the drip at the time of refreshment (thawing) followed by the loss of nutrient meat. Thawing with wrong technique will lead to lower quality, and otherwise the proper thawing will ensure the quality of frozen meat is more stable and consistent. Thawing method commonly used according to Ragab (2010), that is: thawing refrigeration temperature (5-7^{o}C) with a length about 12-24 hours of thawing; running water thawing at room temperature (18-20^{o}C) with a length about 2-4 hours of thawing; thawing in the microwave; thawing at room temperature (26-30^{o}C); thawing in warm water temperature (45-50^{o}C) (Ragab, 2010).
Differences in temperature and time in various methods of thawing will affect the physical quality of the texture, firmness, and juiciness of meat and meat chemical composition. Thawing at refrigeration temperatures require slow heat transfer and takes a long time, but did not make a lot of drip (His, 2000), in addition to the water content and physical and chemical quality of the meat can be sustained (Xiong and Blanchard, 1993), while thawing using a high

temperature can cause meat loses more fluid (Lametsch and Ballin, 2008), which is 15-25% more than the thawing using a low temperature, so the meat becomes dry, because a lot of water loss (Escundern *et al*, 2010). Proteins, peptides, amino acids, lactic acids, purines and various salts are substances that compose a drip (Ballin, 2008), too much drip loss effecting meat becomes dry and pale due to loss of fluids and nutritional value (Lawrie, 2003), so need to do research on the effect of various thawing methods on the physical characteristic and chemical composition of PO Beef Rib Eye cuts.

MATERIAL AND METHOD

Research is conducted experimentally used Complete Randomized Design (CRD) with four treatment methods of thawing, that is : refrigeration temperature (5-7^{0}C), room temperature (27-30^{0}C), running water at room temperature (22-24^{0}C), and warm water temperature (50-55^{0}C), each treatment was repeated five times in order to obtain 20 combinations of treatments. To find the difference between the treatments used Duncan multiple range test.

Research Procedure: Preparation of meat samples, Aging, Freezing, Thawing and measure of variables (physical characteristic and chemical composition)

1. Preparation of meat samples

Rib eye meat of the 20 head of cattle carcasses Ongole Cross between the ages of 4 to 4.5 years.

2. Aging

Samples are packed in plastic stored in a chiller (5-6 °C) for 2 days in the withering process.

3. Freezing

Performed on the freezer (slow freezing method, temperature of -20 °C for 4 days).

4. Thawing

Meat melting process of solid phase into the liquid phase again. Post rigor of fresh meat Ongole Cross cattle were used as controls.

Variables measured:

1. Shrinkage of meat (Modified Xiong and Blanchard, 1993)

$$S\ (\%) = \frac{\text{Length of fresh meat (cm)} - \text{length of thawed meat (cm)}}{\text{Length of fresh meat (cm)}} \times 100\ \%$$

2. Cooking Lost

$$CL\ (\%) = \frac{\text{Weight before cooking} - \text{Weight after cooking}}{\text{Weight before cooking}} \times 100\ \%$$

3. Water Holding Capacity (Honikel and Hamm, 1994)

$$Mg\ H_20 = \frac{\text{Wet area (cm}^2\text{)}}{0,0948} - 8,0$$

$$\text{Water Holding Capacity} = \%\ \text{Water Content} - \frac{(\text{mg } H_2O)}{300\ \text{mg}} \times 100\%$$

4. Tenderness (penetrometer)

$$\text{Tenderness (mm/gram/10 seconds)} = \frac{\text{Average Measure}}{\text{10 Seconds}} \times 100\ \%$$

5. Kjeldahl Method Protein Content (AOAC, 1984)

6. Gravimetric Method Water Content (AOAC, 1984)

RESULTS AND DISCUSSIONS

The results in Table 1 indicate that the highest water content and protein meat on thawing refrigeration temperature treatment significantly different (P <0.05) from the thawing using higher temperature.

Table 1. Effect of Treatment on Chemical Composition of Beef Rib Eye Cuts

Item	Treatment			
	TRf	TAm	TAw	Tww
Water Content (%)	71,75 a	70,76 ab	70,38 b	57,32 c
Protein Content (%)	22,20 a	20,89 b	20,28 b	16,49 c

Description: TRf = Refrigeration Temperature, TAm= Room Temperature,
TAw = Running Water Temperature ,Tww = warm water Temperature.
Values followed by different letters towards the line significantly different (P <0.05)

This is due to the high thawing temperatures cause protein denaturation, which will be followed by the opening of the muscle fibers that inflict water released from the protein of meat. As stated Wismer-Pedersen (1971) that at the time the meat protein has denaturation would have released a number of free water in between the protein molecules. The results of this study strengthen the research Escundern *et al*., (2010), that the amount of liquid coming out of the meat more on thawing temperatures above 40 °C compared with lower temperatures.

The highest water content of beef rib eye with the refrigeration temperature thawing treatment, not significantly different from thawing at room temperature, because refrigeration and thawing at room temperature was slow so it can retain a liquid meat, this is in accordance with the opinion Varnam and Sutherland (1995) that the slow thawing produce a minimal drip. Similarly, thawing at room temperature due slow heat transfer will not generate a lot of meat fluid. According to the statement of Lawrie (2003) and Phillips (1995) that the heat transfer at refrigeration temperature and room temperature is slow so that the meat does not cause excessive fluid loss.

Running water is a rapid conductor of heat transfer, thus leading to flesh out a lot more fluid, is shown by the high water content compared with the thawing meat refrigeration temperature (P <0.05). This is supported by Philips (1995) which states that the running water dissipates heat faster than heat transfer in water is not running.

Lowest levels of meat protein in the treatment of thawing warm water temperature 50^{o}C significantly different (P <0.05) compared with other treatments thawing. This is due to the treatment of warm water temperature 50^{o}C thawing cause damage to the muscle fibers due to denaturation of proteins, so the meat will increase the loss of nutrients dissolved in water and disappeared along with the drip. This is in accordance with the opinion of Ragab (2010), that the use of high temperature thawing results in damage to the muscle fibers and sarcolema resulting in a number of muscle protein denaturation. Supported by the opinions of Varnam and Sutherland (1995) which states that protein denaturation occurs at a temperature of 45^{o}C will lead to protein loss with drip.

The lower temperature used for thawing, it will minimize the resulting drip so that the nutrient content of meat can be maintained, from this study demonstrated that the protein of meat can be kept at refrigeration temperature thawing which is supported by the opinions of Xiong and Blanchard (1993) that the thawing using refrigeration temperatures 5 ± 1^{o}C will not cause too much fluid loss of meat because of the heat transfer was slow and takes a long time so that the meat quality of both physical and chemical properties can be maintained.

The results showed that the water content of meat by the use of thawing methods at

refrigeration temperature (5^{o}C) can better maintain the water content of beef rib eye cuts, according to the research Ballin and Lametsch (2008) that the thawing method at refrigeration temperature can maintain the water content of meat, so that thawed meat still has a water content that is not different from fresh meat.

Effect of thawing methods on the physical characteristic of meat (Table 2), indicating that the pH of meat from various treatments were not significantly different, namely in the range of 5,66 to 5,88 means that the meat has reached the ultimate pH, thus obtained are not significantly different pH. Soeparno (2005), states that the final meat pH in the range of 5,1 to 6,1. This is due prior to frozen storage, the flesh withered at refrigeration temperature for 48 hours. Overhaul of glycogen into lactic acid persists at low temperature storage through anaerobic glycolysis, so that the pH of the meat reach to 5,5-5,6 (Lawrie, 2003).

Table 2. Effect of Treatment on Physical Characteristics PO Beef Rib Eye Cuts

Items	Treatment			
	P1	P2	P3	P4
Daya Ikat Air (%)	71.24 a	70.25 ab	69.58 b	56.71 c
Susut Masak (%)	16.00 a	32.00 bc	26.00 ab	44.00 c
Pengerutan (%)	2.13 a	2.27 a	2.27 a	3.07 b
Keempukan (mm/g/10 dtk)	106.06 a	95.58 b	90.12 bc	64.36 c

Description: TRF = Refrigeration Temperature, TAM = Room Temperature, Taw = Running Water Temperature, Tww = Warm Water Temperature.
Values followed by different letters towards the line significantly different (P <0.05)

Meat with the treatment of refrigeration temperature thawing method has a water holding capacity value were not significantly different by thawing at room temperature, however both significantly (P <0.05) higher than other treatments. The difference in results may be explained by the slow of heat transfer and a long time, this provide an opportunity for meat to reabsorb the water to minimize the amount of fluid that comes out from the meat. As noted Hendrickson (1978) that thawing at a not too high temperature will cause the re-absorption of water, so the loss of fluid from the meat is reduced. Otherwise to the method of thawing with warm water temperatures, due to thawing at high temperatures lead to changes in structure tissue of the meat that it will reduce the ability of tissue cells in maintaining the extracellular fluid. Ophart (2003), states that the heating will make the meat protein denatured and cause the water binding capacity decreased. In the opinion Aberle, et al (2001) that the decrease in water holding capacity began to be seen on heating above 40^{o}C that cause alteration in water holding capacity of meat significantly.

The low percentage of meat cooking lost at refrigeration temperature thawing method (P1) indicate that still many water bound within and between muscle fibers. This is due to the low thawing temperature affected on slightly meat protein which may denatured cause lower drip losses. Supported by the opinion Chandirasekaran and Thulasi (2010), meat stored at temperatures below 35 ˚C, makes fluid exudation on the inside meat work slowly.

The results showed that the lowest cooking lost at refrigeration temperature thawing method. Meat with the lowest cooking lost having a better quality rather than meat with higher cooking lost. This is supported by the opinion Hermanianto Joko (2008) that the use of thawing temperature which not reach 40 °C not caused muscles denaturation so the structure of the meat muscle fibers has not been damaged and was not caused a lot of shrinkage in the meat. Unlike the case at high thawing temperature caused denaturation of

proteins, thus decreasing the ability to bind water. In line with the opinion of Ranken (2000), that the heating process with a higher temperature of 50-60 ˚C can lead to loss of water up to 80%.

High meat shrinkage on warm water thawing treatment 50^{o}C compared to other treatments (P <0.05) due to protein denaturation of myofibrils by the heat that would cause the number of muscle fibers in the meat will shrink. This opinion is supported Xiong and Blanchard (1993) which states that meat protein denaturation by heat resulted in shortening the length of the muscle fibers because the muscle fibers was shrink. This is supported by the opinion of Buckle et al., (1987) that during the thawing process of muscle fibers tend to shrink at a pace that is affected by the temperature level, at high temperatures there is rapid reduction of ATP reserves and muscle fibers can shrink quite a lot. Unlike the case with thawing at lower temperatures (refrigeration, room temperature, and running water at room temperature) with one another are not significantly different. This happens because at temperatures between 5-30^{o}C myofibrils protein denaturation has not occurred so that the use of thawing method using the temperature reaches 30^{o}C insignificant. According to the research Chandirasekaran and Thulasi (2010) that the use of the thawing method at temperature 5^{o}C or until the temperature reaches 30^{o}C will not cause a lot of meat shrinkage due to thermal effects which are used by the thawing temperature will not much affect the length of the muscle fibers.

The highest value of meat tenderness thawing method with refrigeration temperatures significantly different (P <0.05) compared with other treatment methods of thawing, because the ability of meat to retain water better. Kramlich (1973) claimed that the tenderness is influenced by moisture content, fat and protein. In addition, Aberle, *et al*., (2001) stated that tenderness is affected by the water holding capacity. Increased water holding capacity due to the extraction of protein-protein interacting and resulting in the space between the filaments becomes larger, so the water can be retained and increased water holding capacity. In contrast the use of thawing method with warm water temperatures, resulting in more drip out and the lower water content, due to the low ability of meat to bind water so the meat becomes tougher and low juicy.

CONCLUSIONS

1. Thawing method significantly (P <0.05) affected the physical characteristic and chemical composition of rib eye meat Onggole Crossed.
2. The best chemical composition and physical characteristic of rib eye meat Onggole Crossed on the treartment thawing method at refrigeration temperature (5 ^{o}C).

REFERENCES

[1] Aberle, E.D., Forrest, J.C., Gerrand, D.E., Mills, E.W., 2001. *Principles of Meat Science.* Fourth Edition. Amerika. Kendal/Hunt Publishing Company

[2] AOAC. 1984. *Official Methods of Analysis*. Association of Official Analytical Chemist,Washington D.C.

[3] Ballin, N.Z., R. Lametsch. 2008. *Analytical methods for authentication of fresh vs thawed meat*. A review. Meat Science.

[4] Buckle, K. A., R. A. Edward, G. H. Flet dan M. Wootton. 1987. *Ilmu Pangan*. Penerjemah. H. Purnomo dan Adiyono. Jakarta: Universitas Indonesia Press.

[5] Chalid Thedjokusuma. 2002. *Analisa kandungan protein daging sapi impor terhadap standar kriteria kesehatan dilihat dari segi penyimpanan dan pengolahannya di Hotel Westin Surabaya***.** Surabaya. Skripsi. Universitas Kristen Petra

[6] Chandirasekaran, V and G.Thulasi. 2010. *Effect of Different Thawing Methods on Phsyco-Chemical Characteristics of Frozen Buffalo Meat*. *Jornal of Food Technology*. 8 (6). 239-242.

[7] Crown, R. M. dan R. A. Damon, Jr. 1960. *The Value of the 12th Rib Cut for Measuring Beef Carcass Yields and Meat Quality. Journal of Animal Science.* Hal. 109-113; 19.

[8] Escundern, Elizabeth., M.C.Aristoy and Fidel Todra. 2010. Differentiation Between Fresh And Frozen/Thawed Pork Meat By Ionic Chromatography. *International Conference On Food Innovation, Valencia*.

[9] Eneji, C.A., C.E. Ikpeme and J.Ubua. 2007. *Effect of Refrigeration and Frozen Storage on the Shelf-life of Beef Purchased from Local Marketand abbatoir in Calabar*.

[10] Hendrickson, R. I. 1978. *Meat, Poultry and Seafood Technology Prentice.* – Hall. Inc. New Jersey.

[11] Honikel, K.O. dan R. Hamm. 1994. *Measurement of Water Holding Capacity and Juiceness. Pada Quality Attributes and Their Measurement in Meat, Poultry and Fish Products*. Adv. Meat Res. 9 Ed. By Pearson, A.M. dan T.R. Dutson. Blackie Academic & Professional Glasgow, UK.
[12] His, A. 2000. *Effect of Evaporative Cooling. Fat Content and Food Type on Phatogen Survival During Microwave Heating*. *Master Science in Food Science and Technology*, Virginia (Tesis).
[13] JokoHermanianto, 2008. *Penyimpanan Beku Daging*. http://www.foodreview.biz/login/preview (diakses Oktober 2010).
[14] Kramlich, W. E., A. M. Pearson and F. W. Tauber. 1973. *Processed Meat*. The AVI Pub. Co., Westport, Connecticut.
[15] Lawrie, R. A. 2003. *Ilmu Daging*. Diterjemahkan oleh Aminuddin Parakkasi. UI-Press. Jakarta. Metropolis - Nigeria. *Pakistan Journal of Nutrition*. 6 (6). 576-581.
[16] Ophart, C.E., 2003. *Virtual Chembook*. Elmhurst College. Page 1 of 2 [Online] tersedia: http://www.scribd.com/doc/50742988/egdp-protein (7 Mei 2011).
[17] Phillips, R. J. 1995. *The Food Processing Industry*. Food Manufacturing Coalition. Tanglewood Court Lincoln. New England.
[18] Ragab, H. 2010. *Thawing Frozen Food : Best Practices*. Meat Inspection Unit. Abu Dhabi Food Control and Food Safety Agriculture Program.
[19] Ranken, M.D. 2000. *Handbook of Meat Product Technology*. Blackwell Science Ltd., Oxford.
[20] Soeparno. 2005. *Ilmu dan Teknologi Daging*. Edisi Keempat. Gadjah Mada Universitas Press. Yogyakarta.
[21] Tien. R. Muchtadi, dan Sugiyono. 1992. *Petunjuk Laboratorium Ilmu Pengetahuan Bahan Pangan*. Jakarta: PAU IPB dan Departemen Pendidikan dan Kebudayaan.
[22] Xiong, N.Y. and S.F. Blanchard. 1993. *Functional Properties of Myofibrillar Proteins from Cold Shortening and Thaw Rigor Bovine Muscles*. *J.Food Science*. 58 : 720-723.
[23] Varnam, A. H dan J. P. Sutherland. 1995. *Meat and Meat Product*: *Technology, Chemistry and Microbiology*. Chapman and Hall. London.
[] Wismer-Pedersen J. 1971. Pada *The Science of Meat and Meat Products*. 2nd ed. Ed. J. F. Pricedan B. S. Schweigert. W. H. Freeman and Co., San Fransisco.