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Research article

MEAT QUALITY ASSESSMENT AT HAWASSA CITY IN SOUTHERN ETHIOPIA

Tsegay Lijalem, Mohammed Beyan and Sandip Banerjee

Department of Animal and range sciences, Agriculture College, Wollaita Soddo University
P.O. Box, 138 Wollaita, Ethiopia
E-mail: lijalem.tsegay@gmail.com

Abstract

The study was conducted to study meat quality of ruminants' meat consumed (cattle, sheep and goat) at Hawassa city in southern Ethiopia. Purposive sampling technique was used, sub cities having large butcheries numbers were selected purposively. From these selected sub cities, fifteen butcheries were selected randomly for each beef, chevon and mutton thus, a total of forty five butchers were selected. From these selected butchers, meat sample of beef, chevon and mutton were purchased from the longissormus dorsii muscle.

The average pH value of beef, chevon and mutton was 5.6, 5.8 and 5.5 respectively while the average WHC% and cook loss % was 23, 29, 32,33.8,32.5 and 29.9 respectively. The protein% of raw, boiled and roasted beef, chevon and mutton was assessed to be 16.1, 23, 31.2, 20, 29.8, 34, 19, 28.2 and 32 respectively while the average fat% of raw, boiled and roasted beef, chevon and mutton were about 5.4, 7.2, 10, 5.3, 8, 11.4, 6.4, 8.1 and 11.6 respectively. Similarly, the average value of ash% from raw, boiled and roasted beef, chevon and mutton were 1.2, 1.8 2.7, 0.9, 2, 3. 6, 1.1, 2.7 and 3.7 respectively and the average moisture % of raw, boiled and roasted beef, chevon and mutton were reported as 72.7, 63.2, 51.8, 74.2, 60.6, 48.2, 72.7, 59.4 and 44.8 respectively. The results indicated that the moisture, ash, protein, fat, cooking loss and water holding capacity of the beef, chevon and mutton were comparable with the results reported by various researchers.

Keywords: Beef, cheven, meat, mutton

INTRODUCTION

Meat is one of the most nutritious foods that humans can consume, particularly in terms of supplying high-quality protein (essential amino acids), minerals (especially iron) and essential vitamins. Meat is defined as all animal tissues suitable as food for human consumption. This includes all processed or manufactured products prepared from animal tissues (Amaha 2006; Soniran and Okunbanjo 2002).

Consumers often tend to evaluate meat quality on the basis of organoleptic evaluation parameters such as, tenderness, juiciness, flavorness, palatable, color, neatness (Beriain *et al*. 2001). However, the best method of determining of meat quality are, assessing of pH, water holding capacity, chemical composition of meat (Fakolade and Omojola 2008; Abd El-aal and Suliman 2007; Gustavson *et al*. 2011).

Meat pH level value, in normal circumstance, is decreased during post-mortem due to formation of lactic acid from glycogen. Decreasing in pH-value, which is favorable for keeping quality and for flavor (FAO 2004). Determining of meat water-holding capacity is important because it can affect on both the yield and the quality of meat it is often described as drip loss. This parameter can also indicate the whole performance condition of the live animal at the time of harvest, or the entire system of live animal production and handling history (Andrzej 2010).

Many scientific studies also indicate that the most valuable components of meat from the nutritional and processing point of view, for quality attributes, are water, fat, protein and minerals (FAO 2004; Ahmed *et al*. 2010). However, values of chemical composition from raw and cooked meat are not the same; the values from raw meat enable to predict the management situation of animal till slaughtering (Sainsbury *et al*. 2009). On the other hand, values from cooking of meat are used to achieve a palatable and safe product (Tornberg 2005). Cooking may also affect nutritive value and consumer preference of flavour and tenderness of meat (Pietrasik *et al* 1995); it is the fact that, cooking loss indicator of meat quality, the lower the cooking loss, the better the juiciness of the meat (Ameha 2006). So the type of cooking may have effects on nutritive values, organoleptic attributes and acceptability of meat from ruminants (Wood *et al*. 2003; Olfaz *et al*.2005).

Therefore, evaluating of meat quality on the basis of pH value, water holding capacity, chemical composition (water, fat, protein and minerals), cooking lost of meat (Gustavson *et al*. 2011) is importance. Because now a days, people are on need of knowledge of nutrient quality as consumers are becoming more conscious their health and are increasingly focusing on their feeding habit (Sainsbury *et al*. 2009). It is also importance for improving of livestock production sector through designing appropriate livestock development strategies and policies accordingly. Since meat quality has a direct relation to the whole management (feeding, watering, caring, handling, transporting, marketing, slaughtering) type of livestock production. However, there was no clear cut documented information on pH value, water holding capacity, chemical composition of meat in the study area so far. So the study was focused on above mentioned quality parameters. The study was included both raw and cooked meat for chemical composition analysis of meat. The quality of the raw meat and that of the cooked meat affects its attributes. Accordingly, the study was focused to study with objectives on pH value, water holding capacity, chemical composition of meat from meat ruminant (cattle, goat and sheep).

MATERIALS AND METHODS

Description of the Study Area

The study was carried out from December 2012 to June 2013 in Hawassa city, which is the capital city of southern regional state of Ethiopia it locate 270 km south of Addis Ababa via Debre Zeit between 7.05° N to 7°3′N latitude and 38°28′ E to 38.467° E longitude (CSA 2007). Data of CSA (2007) indicated that, Hawassa city had a total population of 183,027 residents, of whom 94,366 were men and 88,661 women, it is expected that since then the population has escalated significantly. The city has an area of 157.21 square kilometers which of course has increased since then. In the year 2007, the Hawassa city had 45,823 households, with an average of 4.22 persons per households, which also increased over time.

Sampling Techniques

In the present study, purposive sampling technique was used, sub cities having large butcheries numbers were selected purposively. From these selected sub cities, fifteen butcheries were selected randomly for each beef, chevon and mutton. Thus, a total of forty five butchers were selected. From these selected butchers, meat sample of beef, chevon and mutton were purchased from the *longissormus dorsii* muscle.

Laboratory Analysis

The parameters used to assess the proximate composition (fat, protein, ash and moisture content) and other quality parameters of meat (pH level, water holding capacity as well as cook loss amounts of meat) were studied. The study was carried out at the Animal Nutrition laboratory of Agriculture College, Hawassa University.

The samples meats were collected in aseptic containers labeled and transported in an ice box from the selected butchers. The sample muscle considered for the study was the *longissormus dorsii*. After bringing the sample to the laboratory it was stored in a refrigerator at 4°C till further analysis. However; the pH of the muscle was estimated within 48 hours of its collection using a digital pH- meter (Basic 20). The muscle sample was divided into two parts; one for estimation of raw muscle quality while second was for cooking. There were two types of cooking, roasting and boiling. Averagely, the meat was roasted for about 12 minute and for cooking it was boiled for about 25 minute on a stove where the temperature was maintained at 180 ^{o}C at 48 hours post mortem.

Determination of Meat pH

In order to estimate the pH of meat, 0.5 grams of the sample was ground in a juicer and diluted with 5 milliliter (ml) distilled water but before that the pH meter was calibrated at range of 4-7 pH value there after the diluted meat sample was measured using pH meter. In each measurement, the pH meter was recalibrated and the beakers and juicer were washed, with distilled water.

Determination of Water Holding Capacity of Meat

The water holding capacity of meat was determined using the method suggested by Kauffman *et al* (1986), Trout (1998). A 0.5 gram of meat sample was weighed and placed between two filter papers this in turn was placed between two glass sheets. Over it, a weight of 4.015 kg weight was placed while the glass sheet weighed 0.8278 kg sheet, giving a total compression weight of 4.8428 kg load for 5 minutes. The water from the meat was then absorbed in the filter paper and the filter paper was dried then after the area of the filter paper marked with and meat was later determined using a compensatory plani meter. Taking differences from the resulting areas of the sample from a marked borderline on the filter paper (moisture) and meat and a ratio area marked borderline expressed as water holding capacity of the meat (WHC).

WHC % = (Area marked borderline-area meat)*100 / Area marked borderline

Determination of Cooking Loss of Meat

Cooking loss of meat was determined by using procedure described by Bouton et al (1971).Three replicates of 0.5 gram of each the meat sample were freshly cut and represented by individual slices. The meat samples were then placed in three test tubes they were then placed in a boiling water bath for 5 minutes and was removed then cooled. Cook loss of meat was obtained by taking difference of initial and final weight.

Cook loss%= Initial weight of the sample (before cooking) - final weight of the sample (after cooking)*100/ initial weight of the sample

Determination of total moisture, Protein (CP), fat and ash were performed according to the methods described by the AOAC (1990).

Determination of Meat Protein

The meat protein was determined according to the method suggested by AOAC (1990) by Kjeldhal method. A 0.5 grams of the meat sample was weighed on a sensitive balance and the sample was transferred to a digestion tube and 5 ml of concentrated, H_2SO_4 (AR grade) was added to it. All samples were assessed in triplicate and two blank samples (without the meat sample) were also taken. The digestion tube was then placed in a boiling hot water bath for 40 minutes and then after catalyst (7:1 $CuSO_4$: K_2 SO_4) and 10 ml of concentrated, H_2SO_4) was added then transferred to the digestion block. The sample was digested at 300°C for 3 hours or till the sample turned colorless. The sample was then removed from the digestion block and allowed to cool overnight. The aliquot was diluted with single distilled water to make up the volume to 250 ml. The sample was then made alkaline by adding 10 ml of

35% NaOH. The sample was then distilled and the distillate collected in a flask containing 4% Boric acid (H_3BO_3) and bromocresol green was taken as an indicator. The distillate was collected for 5 minutes considering that all the ammonia was collected in the boric acid solution. The distillate was then titrated with 0.1 N H_2SO_4 all times two blank samples were run along with the meat sample. The nitrogen assessed in the sample was then multiplied with 6.38 to determine the protein percentage.

% N= 1.401(Volume of sample –Black volume) 0.1 N /Weight of sample*DM

% protein=% Nitrogen*6.38

Determination of Meat Fat

The meat fat was estimated using soxhlet extraction method as suggested by AOAC (1990). Three samples of 0.5 grams each of dried meat sample was weighed on sensitive balance. The sample was then placed on a filter paper and properly tied with a string and then transferred to a fat free thimble. Petroleum benzene with a boiling point between 60-80^o C was used for distillation. The samples were refluxed in the soxhlet for 50 times to ensure complete removal of fat. The sample was then taken out of the soxhlet and extra benzene was allowed to drip off and evaporate, then it was transferred to a dissector. The sample was reweighed after overnight cooling and the difference between the original and final weight was calculated and converted into percentage value.

Fat %= initial weight of the sample (before extracted) - final weight sample (after extracted)*100/ initial weight of the sample

Determination of Meat Ash

The ash of the meat percentage was assessed using the dry ashing technique. Three samples of 0.5 grams each of fresh meat was taken in silica crucibles. The sample was then transferred to a muffle furnace. The furnace was then heated to 600^o C the temperature was maintained for 6 hours and then after the sample was allowed to cool overnight. The cooled crucible was then transferred to a dissector and the sample was weighed. Each sample was weighed thrice and the average weight was taken and finally it was calculated as
% ash= Weight of the ash*100/ weight of the sample taken

Determination of Meat Moisture

Sample (in triplicate) of fresh meat were weighed on a sensitive balance. The samples were then placed on a flat bottom aluminum dish, which was then placed overnight in hot oven at 105^{o}C. The sample was then placed in dissector and allowed to cool. The dried and cooled sample was then weighed on the same balance the weight was taken three times and then averaged. Moisture content was obtained through difference of initial and final weight of the sample.

Moisture % = initial weight of the sample (before dried) - final weight of sample ((after dried)*100/ initial weight sample.

Data Analysis

The data were analyzed statistically using SPSS v-17 for Windows by using general linear model.

RESULTS AND DISCUSSION

pH Level and Water Holding Capacity of Ruminant Meat

pH-value level

The results pertaining to the pH of the meat sold at the slaughter houses are presented in Table 1. The results indicated that the pH of beef and chevon was lower than the values observed by Fakolade and Omojola (2008) and Maiti and Ahlawat (2011), respectively. However, the values as obtained for mutton was similar to those reported by Abd El-aal and Suliman (2007) who found that the average pH- value of lamb fed on ration containing different levels of leucena leaves to be similar to those observed in this study. The low values of pH as observed in the study may be attributed to high lactic acid content in the muscle which can be a fall out of several factors, like poor pre-slaughter handling and which sometimes leads to spread of infection during transportation and in overcrowded lairages, as well as to loss of weight , long distance travelled by the animal just prior to slaughter and also inadequate rest between the travelling and slaughtering period , absence of stunning facilities in the slaughter houses (Yacob 2002; Gary *et al* 2004; Ameha 2006; Elias *et al* 2007; Daniel 2008).

Another factor which can attribute to low pH is the long period between slaughtering time and the time the meat is actually sold for, absence of chilling facilities within the butcheries and that the cold chain is not maintained also leads to changes in pH. The washing of the carcass may also be carried out with contaminated water and sanitation within the slaughtering facility itself may not be favorable, all the above mentioned parameters to some extent or the other lead to the development of low pH in the muscle fibers which of course affects the organolephtic quality of the meat to a greater or lesser extent (Yacob 2002; Abbey 2004; Ameha 2006).

Water holding capacity

The average values pertaining to the water holding capacity of beef, chevon and mutton as assessed in the present study are presented in Table1. The current result of all types of meat (beef, chevon and mutton) showed that the values were lower than that reported by Abd El-aal and Suliman (2007) while higher than those reported by Adam *et al*. (2010). The value for chevon as assessed in this study was comparable to the observation of Maiti and Ahlawat (2011).

Cooking Loss of Meat

Meat loss during cooking measures the decrease in edible meat mass for human consumption (Gustavson *et a*l. 2011). The average values pertaining to cook loss of beef, chevon and mutton as assessed in the present study are presented in Table1. The values pertaining to the average values of cook loss of beef was higher than those reported by Jama *et al*. (2008) for Nguni, Bonsmara and Angus cattle breeds. The values as assessed too are higher than those reported by Nikmaram et al (2011) while the cook loss values for chevon as assessed in this study was lower than the values reported by Ameha (2006) and Maiti and Ahlawat (2011). But it was higher than that of cook loss value reported by Adam *et al*. (2010). Similarly, the cook loss value for mutton as observed in this study was lower than the values reported by Abd El-aal and Suliman (2007). The differences as observed in this study may be attributed to the sex, breed, age besides both ant mortem and postmortem of animals and the carcass (Ameha 2007).

Proximate Composition of Meat

Determining proximate composition of both cooked and raw meat is necessary for assessing nutritive value of meat. The nutrient value of cooked meat is more useful than raw as the cooked meat show actually consumed meat (Ono *et al*. 1984). However, the raw value was used to evaluate the effect of husbandry practices, production and marketing on the nutrient composition of the muscles (Sainsbury *et al.*2009).

The average values pertaining to proximate composition of beef, chevon and mutton are presented in Table1. The results pertaining to the average value for protein in beef was comparable to those observed by Fernanda *et al*. (2003), Williams (2007), Fakolade and Omojola (2008) and Nikmaram *et al.* (2011). Similarly, the average value for protein in chevon and mutton as observed in this study are similar to the values reported by Schonfeldt (1989) and Williams (2007). The values are also similar to the results observed by Ghita *et al*. (2009) and Maiti and Ahlawat (2011).

Table 1: Quality parameters of meat in Hawassa city (Mean±s.e)

	Meat type

Parameters	Category	Beef Mean±s.e	Chevon Mean±s.e	Mutton Mean±s.e
pH level	Raw	5.6±0.1	5.8±0.14	5.5±0.09
WHC (%)	Raw	23±1.92	29±1.58	32±0.40
Cook loss (%)	Raw	33.8±3	32.5±2.2	29.9±1.3
Moisture (%)	Raw	72.7±0.5	74.2±0.8	72.7±0.9
	Boil	63.2±1.3	60.6±1.1	59.4±2.3
	Roast	51.8±1.1	48.2±2	44.8±2.8
Protein (% DM)	Raw	16.1±2.1	20±1.4	19±1.9
	Boil	23±2.2	29.8±1.8	28.2±2.6
	Roast	31.2±2.3	34±1.5	32±2.6
Fat (% DM)	Raw	5.4±0.8	5.3±0.6	6.4±1.5
	Boil	7.2±0.6	8±0.4	8.1±1.6
	Roast	10±0.7	11.4±1	11.6±1
Ash (% DM)	Raw	1.2±0.26	0.9±0.06	1.1±0.06
	Boil	1.8±0.4	2. ±0.18	2.7±0.35
	Roast	2.7±0.68	3.6±0.3	3.7±0.45

s.e=Standarderror, WHC=water holding capacity,N=15 for each beef, chevon and mutton

The values pertaining to the average fat percentage of beef as observed are similar to the values reported by Fernanda *et al*. (2003), Williams (2007), Fakolade and Omojola (2008) and Nikmaram *et al* (2011). The results of mutton and chevon fat too are similar to the findings of Schonfeldt (1989), Williams (2007) and Maiti and Ahlawat (2011) for both raw and cooked chevon while the value are similar to what was reported by Ghita *et a*l.(2009) for lamb.

A present result of ash % in beef is similar with the results published by Fernanda et al (2003), Fakolade and Omojola (2008) and Nikmaram et al. (2011). The results pertaining to the ash % of chevon and mutton are similar to those resulted by Schonfeldt (1989), Adam *et al.* (2010) and Maiti and Ahlawat (2011).

The result of the study pertaining to moisture % in beef is similar with that reported by Fernanda et al (2003), Williams (2007), Fakolade and Omojola (2008) and Nikmaram et al (2011). While the results for chevon and mutton as assessed in this study finds consonance with the observations of Schonfeldt (1989), Williams (2007), Adam et al (2010) and Maiti and Ahlawat (2011).

The results also indicated that the raw meat samples (beef, chevon and mutton) had higher moisture (%) when compared to the cooked meat (beef, chevon and mutton) while protein, fat and ash nutrient components (%) showed an increase after cooking. This may be because that there is coagulation of meat protein thereby hardening of the muscle fibers which leads to expulsion of water from the muscles which resulted in lower moisture content of the cooked meat. The result is in accordance with the observations of Jamora and Rhee (1998), Aaslyng *et al*. (2003) and Sainsbury *et al*. (2009).

CONCLUSION

- The results indicated that the moisture, ash, protein, fat, cooking loss and water holding capacity of the beef, chevon and mutton were comparable with the results reported by various researchers.

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