

Full Length Research Paper

Quality of beef, chevon and mutton at Hawassa, Southern Ethiopia

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The study was conducted to study meat quality of beef, chevon and mutton consumed at Hawassa city in Southern Ethiopia. Purposive sampling technique was used to collect information from butcheries. From each sub cities, 15 butcheries were selected randomly for the purpose thus, a total of 45 sample butchers were used. From longissimus dorsi muscle, sample of beef, chevon and mutton were taken and analyzed for the study. The average pH value of beef, chevon and mutton was 5.6, 5.8 and 5.5, respectively. The average water holding capacity (WHC) was 23, 29 and 32%, respectively, for beef, chevon and mutton. The average cook loss of beef, chevon and mutton was 33.8, 32.5 and 29.9%, respectively. Protein content of raw, boiled and roasted beef was 16.1, 23 and 31.2% DM, respectively, while the average fat of raw, boiled and roasted beef were 5.4, 7.2 and 10% DM, respectively. Ash content of 1.2, 1.8 and 2.7% DM was found for raw, roasted and cooked beef, respectively and the average moisture of raw, boiled and roasted beef was reported as 72.7, 63.2 and 51.8%, respectively. The average value of raw, boiled and roasted protein and fat chevon was 20, 29.8, 34; 5.3, 8 and 11.4%, respectively. On the other hand, ash content was 0.9, 2 and 3. 6% DM; moisture 74.2, 60.6 and 48.2%; were found for raw, roasted and cooked chevon, respectively. For raw, roasted and cooked mutton, protein content of 19, 28.2 and 32% DM; fat 6.4, 8.1 and 11.6% DM; ash 1.1, 2.7 and 3.7% DM and moisture 72.7, 59.4 and 44.8%, respectively, were found. The results indicate that the moisture, ash, protein, fat, cooking loss and water holding capacity of the beef, chevon and mutton were almost in comparable with the results reported by various researchers in Africa.

Key words: Quality of meat, beef, cheven, mutton, Hawassa city, Ethiopia.

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,

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tenderness, juiciness, flavor, palatability, color, and neatness (Beriaín et al., 2001). However, the best method of determining of meat quality are assessing 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 circumstances, decreases during post-mortem due to formation of lactic acid from glycogen. The low pH-value is favorable for keeping quality and flavor (FAO, 2004). Determining of meat water-holding capacity is important because it can affect on both the yield and the quality of meat, and 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 are water, fat, protein and minerals (FAO, 2004; Adam 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, 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). Cooking loss is an indicator of meat quality; the lower the cooking loss, the better the juiciness of the meat (Ameha, 2006). Therefore, 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, the study was conducted to evaluate pH value, cook loss, water holding capacity, and chemical composition of meat beef, chevon and mutton consumed in the Hawassa city of Ethiopia. The study was concerned of three meat types: beef, chevon and mutton because these meat types are dominantly available and consumed by the people in the study area.

Therefore, evaluation of meat quality on the basis of pH value, water holding capacity, chemical composition (water, fat, protein and minerals), cooking loss of meat (Gustavson et al., 2011) is important. These days, consumers demand to know the nutrient quality of the food they consume because they are more conscious of their health and are increasingly focusing on their feeding habits (Sainsbury, 2009). It is also important to improve livestock production sector through designing appropriate livestock development strategies and policies. Meat quality has a direct relationship to the whole management (feeding, watering, caring, handling, transporting, marketing, slaughtering) of livestock production. However, there is no documented information on pH, water holding capacity, chemical composition of meat in the study area so far. Therefore, the study was focused

on determining the above mentioned quality parameters. The study included both raw and cooked 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 the Southern regional state of Ethiopia. It is located 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). Hawassa city had a total population of 183,027 residents, of whom 94,366 were men and 88,661 women (CSA, 2007). The city has an area of 157.21 square kilometers which of course has increased since 2007. 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.

Sample collection

Purposive and random sampling methods were used for the study. The study city has eight administrative sub-cities of which five sub-cities which had more butchers were purposively selected. From the selected sub-cities, 15 butcherries were selected randomly for each beef, chevon and mutton. Thus, a total of 45 butchers were selected. From these selected butchers, meat sample of beef, chevon and mutton were purchased from the *Longissormus dorsii* muscle.

Laboratory analysis

The following parameters were determined: fat, protein, ash and moisture content, pH level, water holding capacity as well as loss on cooking. The study was carried out at the Animal Nutrition Laboratory of Agriculture College, Hawassa University.

Sampling and analytical procedures

The meat samples 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 until required for analysis. The pH of the muscle was estimated within 48 h of its collection using a digital pH-meter (Basic 20, Crison Instrument, Spain). 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. On average the meat was roasted for about 12 min, or boiled for about 25 min on a stove where the temperature was maintained at 180°C.

The contents of moisture, protein, fat and ash were determined according to the AOAC (1990) and the pH of the samples was measured using pH-meter, Basic 20, Crison Instrument, Spain.

Determination of water holding capacity of meat

Water-holding capacity of meat was measured using the method

Table 1. Quality parameters of beef, chevon and mutton meats in Hawassa city (mean \pm SD).

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

SD=Standard deviation; WHC=water holding capacity; N=15 for each beef, chevon and mutton.

suggested by Kauffman et al. (1986) and Trout (1998). A 0.5 g 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, giving a total compression weight of 4.8428 kg for 5 min. The water from the meat was then absorbed on 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 planimeter. 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 was 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 g of each of 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 min 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.

Data analyses

The data was analyzed statistically using SPSS V 17 [2007] for Windows, using linear regression analysis.

RESULTS

The quality parameters of meat in Hawassa city, Ethiopia are presented in Table 1. As shown in Table 1, average pH values of beef, chevon and mutton were 5.6, 5.8 and 5.5, respectively, while water holding capacity was 23, 29 and 32%, respectively. In this study, average cook loss was 33.8 for beef, 32.5 for chevon and 29.9% for mutton.

For beef meat, protein content of raw was lower (16.1% DM) than that of boiled (23.0% DM) and roasted (31.2% DM); in similar manner, the average fat of raw (5.4% DM) was lower than boiled (7.2% DM) and roasted (10.0% DM). However, in ash content, both raw (1.2% DM) and roasted (1.8% DM) had lower content than cooked (2.7 % DM). On the other hand, due to the effect of cooking, the average moisture of beef from raw (72.7%) through boiled (63.2%) to roasted (51.8%) was reduced.

As shown in Table 1, for chevon meat, the protein content (% DM) was 20.0 (raw), 29.8 (cooked) and 34 (roasted); fat content (% DM) 5.3 (raw), 8.0 (cooked) and 11.4 (roasted); ash content (% DM) 0.9 (raw), 2.0 (cooked) and 3.6 (roasted) and moisture content (%) 74.2, 60.6 and 48.2 for raw, roasted and cooked, respectively. For raw, roasted and cooked mutton meat, protein content (% DM) of 19.0, 28.2 and 32.0; fat content (% DM) 6.4, 8.1 and 11.6; ash (% DM) 1.1, 2.7 and 3.7 and moisture content (%) 72.7, 59.4 and 44.

DISCUSSION

The pH of beef and chevon was lower than the values

observed by Fakolade and Omojola (2008) and Maiti and Ahlawat (2011). 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 lairage, 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 (Amha, 2006; Daniel, 2008; Elias et al., 2007; Gary et al., 2004; Yacob, 2002). Another factor which can attribute to low pH is the long period between slaughtering time and the time the meat is actually sold. Absence of chilling facilities within the butcheries and hence that the cold chain is not maintained also leads to changes in pH values. 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 organoleptic quality of the meat to a greater or lesser extent (Abbey, 2004; Amha, 2006; Yacob, 2002).

Water-holding capacity of the meat refers to its ability to retain inherent water and its value is influenced by both the pH of the tissue and by the amount of space in the muscle cell, particularly the myofibril that exists for water to reside. 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) from lamb reared on a ration containing of leucaena hay (*leucaena leucocephala*) as forage was 43.61-48.26%. This might be attributed by the live animal performance condition at the time of harvest; the muscle in the live animal can have a strong influence on the amount of moisture that is lost from the resulting meat products (Andrzej, 2010). As revealed in this study, the low water-holding capacity of the meat muscle may be due to the effect of low pH-value of the meat muscle (being more acidic) and such types should not be used for processing as the product developed from it is usually dry and tasteless. On the contrary, the present study was almost in agreement to Maiti and Ahlawat (2011) found from heart muscle of goat 29.19%.

Meat loss during cooking measures the decrease in edible meat mass for human consumption (Gustavson et al., 2011). 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 were also 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 Amha (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 (Amha, 2007). In general, the lower the cooking loss, the better the juiciness of the meat. This is another valuable quality trait observed in some Ethiopian indigenous sheep and goats useful in market promotion efforts.

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, 2009).

For crude protein, the average value 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 were similar to the values reported by Schonfeldt (1989) and Williams (2007). The values were also similar to the results observed by Ghita et al. (2009) and Maiti and Ahlawat (2011).

The values pertaining to the average fat% of beef as observed are similar to those of Fakolade and Omojola (2008) from dried beef (in Nigeria); Williams (2007) from red beef. However, the results of mutton and chevon fat (%) are lower than Maiti and Ahlawat (2011) who found 21.63% of chevon fat values of cooked while Ghita et al. (2009) found 35.07% from Carabash lamb. On the other hand, the results of average mutton and chevon fat value are higher than that of the findings of Schonfeldt (1989) of lamb (4.7%), angora (4.7%) and boar goat chevon (4.4%) from the M semi membranous muscle. The discrepancy might be due to the age and breed of the animals in the various studies. However, the relatively higher mean carcass fat in some Ethiopian goat breeds would be useful in reducing chilling losses and improving quality (Amha, 2007).

For ash content, the present result in beef meat is similar to the results published by Fernanda et al. (2003) and Nikmaram et al. (2011). Also, the results for ash % of chevon and mutton were similar to those obtained by Schonfeldt (1989) for lamb (1.06%), angora (1.07%) and boar goat chevon (1.08%) from M LongissimusThoracis and lumborum.

For moisture content, the results in beef were almost in similar range to those reported by Nikmaram et al. (2011) who found that 73.45% for raw, 34.8% microwave, 42.55% roasting and 38.19% braising beef and Williams

(2007) reported as 35.09 and 73.17% from dried and lean red beef, respectively. The results for chevon and mutton as assessed in this study finds consonance with the observations of Adam et al. (2010) from Nilotic male kid (fresh meat) on feed lot trial sorghum and molasses-based diets and Maiti and Ahlawat (2011).

Finally, the results also indicate 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, (2009).

Conclusion

These study indicate the overview about the quality parameters of beef, chevon and mutton meats at Hawassa city in Ethiopia.

Conflict of interests

The authors did not declare any conflict of interest.

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