ASSESSMENT OF POST-MORTEM PROCESSING METHODS ON QUALITY AND SHELF LIFE OF MUTTON

ABSTRACT

To assess the influence of post-mortem processing methods on quality and shelf life of sheep meat, a total of twelve sheep (six each from Balami and Ouda) were weighed, slaughtered and allotted to three processing methods which are scalding, singeing and skinning in a completely randomized experimental design in a 2 × 3 factorial arrangement (2 breeds and 3 post-mortem processing methods). The carcass characteristics, primal cuts, physico-chemical properties, sensory and microbial counts were assessed. The results showed that Ouda breed gave the highest ($p<0.05$) dressing % (36.43%), preferred ($p<0.05$) primal cuts in rounds (15.13%), Marbling score, lipid profile (Total cholesterol, LDL), and Lipid peroxidation, Balami sheep was however rated higher ($p<0.05$) in juiciness, tenderness and overall acceptability. The Scalded sheep had the highest dressing % (35.45%), with preferred marbling score (5.80), organoleptic properties and microbial counts. The scalded samples were also the lowest ($p<0.05$) for crude Fiber, CF, tolal cholesterol (276.40 mg/dL) and LDL (183.89 mg/dL). Minimal exudate loses (cooking loss and drip loss) were recorded in singeing samples. The microbial and fungi loads increased with the storage days. Conclusively, Ouda breed and Scalding method of post-mortem dressing gave the preferred values for optimum nutrients and shelf-life of sheep meat.

Key words: Scalding, Singeing, Skinning, Post-mortem, Quality, Shelf-life.

INTRODUCTION

Various approaches have been used to improve the quality of meat in response to consumers' demand of meat of high-eating quality. These include the, nutritional and feeding strategy (Andersen *et al.*, 2005), breeding aspect and animal welfare during transportation (Rani et al., 2017) and at slaughter (Muchenje *et al.*, 2008). "However, many post-slaughter practices contribute significantly to the quality of meat, which in turn affect profits, functional properties, eating qualities and the acceptance of the meat by consumers" (Adzitey and Huda, 2012). "These practices include the way in which the carcass is handled after slaughter, chilling, and other factors. Although some of these factors are being addressed, knowledge of those that influence meat quality at the distribution stage is scarce. One of the important steps in the post-slaughter handlings that affect meat quality is dressing" (Zhang et al., 2017; Hollis et al., 1968).

Omojola *et al.*, (2006) reported that processing method widely used for dressing animals carcass post-mortem are singeing, scalding and skinning. "Singeing of slaughtered animal is a major process by which fur on the skin of the animal are removed making the hides of the carcass ready for consumption" (Okubanjo, 1997; Omojola and Adesehinwa, 2006). Scalding is the process of treating carcass with hot water or steam for efficient removal of the bristles by dehairer (Fasae *et al.*, 2010). Skinning is the removal of the carcass skin when a ring is made on the hind legs just above the hock with a sharp knife, followed by it being inserted into the leg skin and opening into the root tails and another from the pelvic of to the neck followed by the pulling of skin. (Omojola *et al.*, 2012).

"Processing helps in producing varieties and convenient meat products to meet various lifestyle requirements, while preservation aided by processing extends the shelf-life of meat and meat products" (Vasilev *et al.*, 2017). The process of preservation commences after the whole period of dressing i.e Scalding, skinning, singeing, decapitation, evisceration etc. have been completed. (Omojola and Adeshinwa, 2006). The aims of preservation methods are to inhibit the microbial spoilage and to minimize the oxidation and enzymatic spoilage.

"Meat quality has been identified as the most critical factor in a highly competitive meat industry in which its profit lies" (Robles *et al.*, 2009). "Most researchers define it based on conformational and functional qualities" (Warriss, 2000; Muchenje et al., 2008). "Important technological meat quality attributes include colour, marbling, pH, tenderness, juiciness, and flavor" (Muchenje et al., 2009). "Should these be affected, profitability would also be influenced negatively" (Grunert et al., 2004).

"The shelf-life and quality of fresh meat are strongly influenced by initial meat quality, package parameters, and storage conditions" (Zhao *et al.*, 1994). "Meat is a good medium for bacterial growth, as shown by the numerous reports dealing with the influence of micro-organisms on the storage life of meat products. The main property that explains rapid microbial growth on meats is its composition: 75% water and many metabolites such as amino-acids, peptides, nucleotides, and sugars" (Lawrie, 1985). "Microbiological organisms and biochemical reactions are the cause of spoilage of perishable food, particularly where fresh red meat is concerned. Spoilage begins right after slaughter and is hard to prevent because the responsible organisms are already present in the food. In live animals, the internal organs are virtually sterile. However, other parts of the animal, such as skis, hooves, and intestines, contain enormous numbers of bacteria" (FAO, 2010). "Depending on the slaughter hygiene, these bacteria find their way onto the carcass or contaminate the meat during slaughterhouse operations. Skinning, scalding, evisceration, dressing and carcass transport are common contamination points. Most bacteria are transferred to the carcass via butchers' hands, tools, contact with equipment and through water, air, etc. The bacterial contamination of meat is not stopped after slaughtering. It is on-going during the operations that follow the slaughter process, such as meat cutting and meat processing" (FAO, 2010)..

To study is therefore aimed at assessing the quality and shelf life of mutton subjected to different processing methods.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was carried out at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria, while the analysis will be carried out at the Animal Nutrition Laboratory of Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

EXPERIMENTAL ANIMAL

The animals used in this experiment were a total of twelve sheep. Six Ouda sheep and Six Balami sheep were purchased from a reputable ruminant animal market in Ibadan, Oyo State. The animals were purchased from Ibadan and it was transported down to the Livestock unit of Teaching and Research Farm, Animal Nutrition and Biotechnology Department, Ladoke Akintola University of Technology, Ogbomoso where the animals were fed for two weeks to ensure animal stability and optimum condition before slaughtering. The experimental animal was scarified and processed using three different methods (Scalding, Skinning and Singeing)

Slaughtering procedure and meat preparation

Mutton used for this study were the muscles harvested from the carcasses of fattened lamb slaughtered by the halal method at the slaughter-house of the Department of Animal Nutrition and Biotechnology, Ladoke Akintola University of Technology, Ogbomoso. Bleeding (without stunning) of the animals was done by severing both the carotid arteries and jugular veins followed by copious exsanguination. The slaughtered animals were conventionally skinned/singed/scalded and eviscerated (Figure 1).

The following processing treatments were carried out;

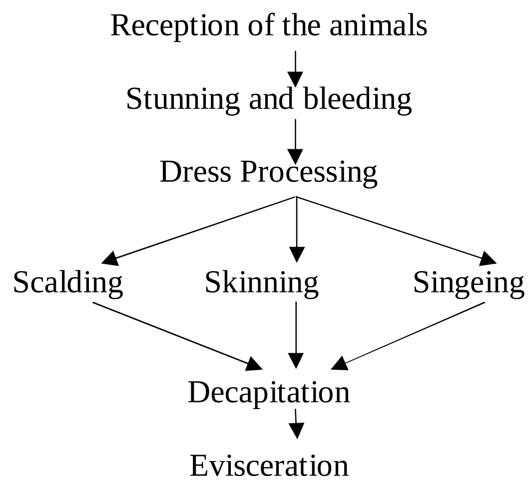
Scalding: Carcasses were scalded by pouring hot water on the carcass for the hair to loosen and scraped off with a hand metal scrapper designed for the purpose or blade until the carcass is clean as described by Omojola and Adesehinwa, (2006); Fasae *et al.* (2010) and Apata (2014)

Skinning: “The pelts of the carcasses in this group were removed with a sharp scalpel, knife and scissors. A ring was made round one of the hind legs and the knife was inserted under the skin of the leg to open it up, the same was done on the second leg. Another incision was made right from the pelvic up to the neck. The pelt was gradually pulled until it was removed as the procedure described” by Omojola and Adesehinwa, (2006); Apata (2014).

Singeing: Hairs of carcasses in this group were flamed off over burning fire made with firewood until all the hairs had been carefully burnt off with minimal damage to the skin as described by Okubanjo, (1997); Omojola and Adesehinwa, (2006) and Apata (2014).

The carcasses were thoroughly washed and scrapped.

Meat preparation



Carcass Weighing
↓
Chilling
↓
cation
↓
Packaging
↓
Preservation and chilling

Figure 1: Showing Carcass Processing Chart

DATA COLLECTION
CARCASS ANALYSIS

Carcasses were eviscerated, decapitated and shanked. They were washed and split into two equal halve and further into primal cuts as described by Apata (2014).

PHYSICAL PROPERTIES

pH of meat
The internal pH of the intact carcasses were examined at the loin muscle at the depth of 1 cm after 30 minutes post-mortem according to the procedure described by Omojola and Adesehinwa, (2006); Apata (2014) using a standardize pH meter.

Raw meat colour
Raw meat colour was determined with visual method described by AMSA (1995). This was determined by examining the visual colour values based on colour intensity (redness) and homogeneity using a scale ranging from 1 – 8 with the higher score representing a more attractive and homogenous red colour.

Meat marbling
The intramuscular fat (marbling) of the meat samples at the rib eye was scored subjectively based on the score described by USDA (1965) but reported by Apata (2014). Rib eye muscle were displayed on a tray in the laboratory and the marbling status of meat was determined using the scale ranging from 1 – 10, where 1 corresponded to devoid and 10 corresponded to abundant.

Drip loss
This was measured by wrapping 10 g of meat samples (*semimembranosus muscle*) in a polyethylene bags. The bags were hung in a refrigerator at 2^0C so that the exudates would not get in contact with the meat samples. The meat samples were removed after 48 hours and the surface moisture was dried with an absorbing paper and then re-weighed. The percentage (%) weight loss was recorded as the drip loss.

Cooking loss
Approximately 10 g of meat samples (*Semimembranosus muscle*) in a polyethylene bags and cooked in a water bath in the laboratory for 20 minutes. The meat samples were then removed and allowed to equilibrate to room temperature. The meat samples were re-weighed and the percentage (%) change in weight was reported as cooking loss (Malgorzata *et al.*, 2005).

CHEMICAL PROPERTIES

Proximate properties

Parameters that were taken for the chemical properties are Cholesterol analysis, Proximate composition (Dry matter, Ash, crude protein, ether extract) according to AOAC (2000).

Lipid profile

It is also known as lipid profile or lipid panel. It was carried out on meat and in the laboratory to determine and measure the amount of cholesterol and triglycerides. Parameters were measured for cholesterol, high density lipoprotein, low density lipoprotein, triacylglycerol and lipid peroxidation by methods of AOAC (2000).

SENSORY EVALUATION FOR MEAT

Ten (10) panelist comprising of both staffs and students of Ladoke Akintola University of Technology, Ogbomoso, Oyo State, would evaluate the products for appearance and color, tenderness, texture, odour, taste, flavour, juiciness etc

MEAT PRESERVATION/REFREGERATION/ FREEZING

Every two weeks (for 4weeks), samples was evaluated for; Microbial assay; The swabs from the sample were taken to a laboratory where serial dilution, inoculation of diluents into sterile nutrient agar for incubation and catalyst test and gram staining for characterization and identification was conducted.

Microbial analysis

Twenty-five grams of the mutton samples were put into 225 mL of 0.1 per cent buffered peptone water (diluent) and blended for 2 minutes. Serial dilutions were prepared by adding 1 ml of the previous dilution to 9 ml of the sterile diluents and homogenized in a stomacher for 2 minutes.

Determination of total plate counts

1 mL of each dilution was added to a sterile Petri dish and Plate Count Agar (kept at o 45 C in a water bath) added and mixed thoroughly. The preparations were then allowed to gel and were finally incubated at o 37 C for 24 hours and isolated distinct colonies were counted. Average counts obtained were multiplied by the dilution factor and expressed as colony forming unit per gram (cfu/g) (Fawole and Oso, 2001).

Isolation of bacterial pathogens

This was done by streaking on selective media for the most common meat bacterial pathogens. These include Salmonella spp., enteropathogenic E. coli and coagulase positive staphylococcus aureus.

STATISTICAL ANALYSIS

All data obtained will be subjected to analysis of variance using SAS (2002) where statistical significance will be observed. The means will be compared using the Duncan Multiple Range test of the same software.

RESULTS AND DISCUSSION

RESULTS

Carcass Characteristics and Primal Cuts

Table 1 showed that the breed effect favoured Ouda the highest ($P<0.05$) values for Eviscerated weight (46.95%), dressing percentage (36.43%), Leg round (15.13%), Loin(3.86%), and Rack(4.60%) ahead of the Balami breed. The result showed that there was no significant different across the parameters in the external offals. The result table also showed that the processing methods significantly ($P<0.05$) affects the carcass characteristics of the sheep with the skinning having the highest ($P<0.05$) value (43.43kg) for live weight and bled weight (98.16%) but lowest in eviscerated weight (37.32%) and dressing (32.25%). Scalding however had the highest for dressing weight (35.45%) and also for eviscerated weight (48.05%). Mutton processed through singeing and skinning had the highest value of leg round (14.61) and shoulder (7.14) respectively.

Chemical Properties

Table 2 showed the breed effect and post-slaughter processing methods on the chemical composition of mutton. It was observed the breed effect had no influence ($p>0.05$) on the proximate composition of mutton but all the parameters of lipid profile and peroxidation were significantly ($p<0.05$) influenced except the High Density Lipoprotein (HDL). Balami breed of sheep had higher ($p<0.05$) Total cholesterol (208.19mg/dL), LDL (131.42 mg/dL) and lipid peroxidation (MDA) (9.87mm/L) values as compared to Ouda breed which had higher Triacylglycerol value of 100.00.

The effect of processing methods on chemical composition of different breeds of sheep revealed Crude protein and fat contents were significantly ($p<0.05$) affected by dressing methods with the highest ($p<0.05$) in skinning methods. Values recorded for ash content in the meat samples were not significantly different among singeing and skinning dressing methods, though, a higher value was recorded for singed carcass which had 5.66 followed by skinned carcass which had the lowest value of 3.79%. Also, nitrogen content of the meat samples was significantly affected by dressing methods applied with scalding imposing highest value of 4.30%

As regards to lipid profile and peroxidation, the skinned carcass had highest ($p<0.05$) Total cholesterol (305.60mg/dL), and LDL (215.70 mg/dL) but lowest ($p<0.05$) in MDA (8.05) and HDL (64.53). High density lipoprotein (HDL) and triacylglycerol (TAD) were reported highest ($p<0.05$) in singed meat with values of 74.54 mg/dL and 133.40 mg/dL respectively but singed and skinned maintain same level of significant in their TAG and MDA was reportedly highest ($p<0.05$) with scalded but with no difference ($p>0.05$) with singeing method.

Physical Properties

Table 3 indicates the breed effect and post-slaughter processing methods on the physical properties of mutton. The breed of sheep proved no significant difference ($p>0.05$) on the cooking loss, pH, and the color of meat but significant ($p<0.05$) difference was observed in its effect on the Drip loss and marbling of the muscle where Ouda breed had the highest ($p<0.05$)

value of 3.05% and 3.00 respectively when compared with the drip loss percentage (1.96%) and marbling (1.93) of Balami breed.

Significant difference ($p<0.05$) was also observed in the post-slaughter processing method on all the examined physical properties of meat except that of pH. Skinning method expressed the highest significant ($p<0.05$) values on the cooking loss (35.83%), drip loss (2.70%), Marbling (5.20), and color (7.00). However, same level of significant ($p>0.05$) was observed between scalding and skinning on the drip loss and marbling while Singeing method had the least significant level ($p<0.05$) in the cooking loss (30.26%), drip loss (1.99%) and marbling (2.22)

Organoleptic Properties

The result in table 4 showed that there were no significant differences in the effect of breed on the organoleptic properties except for juiciness and tenderness. Balami breed however was rated significantly ($p<0.05$) highest in terms of Juiciness (6.03) and tenderness (5.27) while overall acceptability of both Ouda and Balami breeds was rated the same ($p>0.05$).

The different processing methods of mutton proved to have significant difference ($p<0.05$) in all the sensory properties. Scalding method of processing the mutton had the highest significant ($p<0.05$) values for overall acceptability (7.65), flavor (7.25) and juiciness (6.65) while skinning appeared best ($p<0.05$) in color (6.10) and tenderness (5.20). However, singeing was rated with lowest significant values in overall acceptability (5.70) and color (4.20) while it maintained same level of significant with skinning in flavor and juiciness.

Microbial assay

The result presented in table 5 showed that the breeds have no significant ($P>0.05$) effect on the mutton microbial count. However, Ouda breed had the lowest value of total bacteria count, TBC (4.83 cfu/g x 10^6) and total coliform count, TCC (5.20 cfu/g x 10^6). The results also showed that the processing methods have significant ($P<0.05$) effect on the microbial count. Skinning method expressed the highest significantly ($p<0.05$) value of the mean TBC (5.36 cfu/g x 10^6), mean TCC (5.90 cfu/g x 10^6) and Total Yeast and Mold count, TYB (9.53 cfu/g x 10^6). Mutton processed by scalding and singeing exhibited the same level of significance in the TCC while singeing had the lowest level of significance in terms of Total Bacteria Count (2.32 cfu/g x 10^6)
The storage period effect was also reported to possess significant ($P<0.05$) differences on the microbial count of mutton. TBC (4.40 cfu/g x 10^6), TCC (5.01 cfu/g x 10^6) and Total Yeast and Mold Count (6.53 cfu/g x 10^6) proved to have the least significant ($p<0.05$) value at 0days storage time when compared with mutton stored till 4weeks having highest level of significant (6.32 cfu/g x 10^6, 7.25 cfu/g x 10^6 and 9.64 cfu/g x 10^6 respectively)

DISCUSSION

Carcass

Carcass can be described as one that has a minimum amount of bone, a maximum amount of muscle and an optimum amount of fat (Akinleye *et al.,* 2019). This result was in line with that of Akinleye *et al.,* (2019) who reported in his research work that carcass traits of sheep were affected by breed of the sheep. The primal cut of the sheep was also influenced by the different processing methods, though the effect was quite much on the Balami breed; however the Ouda breed was also affected. This result is in agreement with the reports of Akwetey *et al*., (2013) and Ijeoma *et al*., (2015). The authors reported that singeing as a processing method affects the general carcass characteristics of sheep. It is therefore safe to believe that skinning as a processing technique has lesser or low negative effect on carcass. The primal cuts were also affected by the processing methods, with the animals processed via singeing methods having the best value for Back feet, leg round and loin.

The research work also pointed out the effect of processing methods on the carcass characteristics of the sheep with the skinning having the highest Bled weight value compared to the Scalding and Singeing; this may mean that the processing methods affect the carcass characteristics of the sheep. However, this does not totally agrees with the result of Mahgoub *et al*., (2005), who reported in his work that Slaughter weight is the main factor influencing carcass composition and characteristics. This work also showed that the ouda breed of sheep that was processed using the scalding processing technique had the overall best carcass characteristic, however the result is against the result gotten by Akinleye *et al.*, (2019), who also reported that Balami breed of sheep had the best potential for performance and carcass characteristics

Chemical Properties

There is no significant ($p<0.05$) difference in the proximate composition of the two breeds of sheep that was subjected to the same processing methods. The low value of moisture content for singed carcass was expected since flame would have evaporated some moisture in the carcass during processing. The higher value recorded by the skinned carcass could be as a result of the skin removal method applied, as no heat was applied in processing the carcass. Singing processing method recorded the highest value of Ash content, this finding was in line with (Ikene, 1990) who reported that flaming of meat increases its ash content. Skinned meat had highest level of crude protein, due to the fact that high heat and thorough washing which would have denatured the protein, hence, crude protein content was intact. Also, the collagen and myofibrilla contents which are protein content was not distorted (Omojola *et al*., 2012)

Crude fat content was significantly ($p<0.05$) highest in skinned carcass with value13.88 due to the fact that skinned meat did not undergo intensive heat treatment, therefore the subcutaneous fat content were not altered by the intensity of the heat treatment, while the variations in temperature of the thermal treatments applied may be responsible for fat losses observed in the other processing methods due to the degradation of the fatty acid by heat treatment. This finding disagreed with the findings of (Apata and Toluwase, 2015) that reported lower fat content in meat samples prepared with hot water. “Meat composition, especially its fat content combined with specific heat treatment methods is among the factors that mostly affect the final quality of meat products” (Alflaia *et al*., 2010). Thermal treatment can cause undesirable changes such as loses of essential fatty acids (FA), mainly due to lipid oxidation, reducing the nutritive value of meat

"Cholesterol level is higher in skinned meat and lowest in scalded meat. There is a need to reduce the cholesterol of meat producing animals, as consumers in many countries are demanding less cholesterol in their meat, mainly for reasons of the perceived benefits to health" (Allen, 1990). Ouda breed of sheep had preferred lipid profile content (Total cholesterol), however this might related or influenced by the nutritional status the particular breed was exposed to during the rearing phase prior to purchase and slaughter. Skinned meat had the highest Crude fat, Cholesterol, Triacylglycerol and Low density lipoprotein. The result obtained on chemical composition of meat samples from three processing methods were in agreement with those reported by (Omojola and Adesehinwa, 2006).

Microbial

The mean total bacteria count and coliform count obtained in this study were below the Nigeria Agency for Drug Administration and Control (NAFDAC) recommendation. The standard recommended by NAFDAC for public health is between 5.0 x 10^6 and 1.0 x 10^6 cfu/g. The meat obtained in this study was fit and safe for consumption except the one stored for 4weeks and processed by skinning. Coliforms are indicator organisms signifying contamination of the product by faecal matter (Taiwo *et al.*, 2017).

The variation obtained during 4weeks of storage for bacteria count, coliform count, mold and yeast count might be attributed to the freezing effect that allow thrive of mesophiles and psychotrophs in which higher bacteria, coliform count and mold and yeast count were obtained before freezing. This agrees with the report of Taiwo *et al.* (2017) that the kind and number of microorganisms found on frozen fish depend on freezing temperature during storage and severity of freezing process with respect to lethality to microorganisms. Most food spoilage microorganism grow rapidly to temperatures above 10^{o}C while some food poisoning organisms grow slowly between 4.4^{o}C and -9.4^{o}C provided the food is not solidly frozen (Sivasanker, 2005). "These organisms will not produce food poisoning or disease but even below -3.9^{o}C cause the deterioration of the food quality. Below - 9.4^{oc} there is no significant growth of microorganisms in the food and there is a gradual reduction in their numbers due to slow death. But complete death of all the microorganisms does not occur merely due to low temperatures and when the food is thawed there can be a rapid multiplication of microorganisms" (Sivasanker, 2005). The bacteria identified are a matter of public health importance that the presence of bacteria capable of causing food poisoning and/or infection be eliminated in animal product through improved handling processes.

Table 1: The Breed Effect and Post-Slaughter Processing Methods on the on Carcass and Primal Cuts and External offal Of Mutton.

Parameters	Live weight (%)	Bled Weight (%)	Eviscerated Weight (%)	Dressing (%)	Back Feet	Front Feet	Leg Round	Shoulder	Loin	Rack
					Breed					
Balami	40.82	93.39	41.56^{b}	34.37^{b}	1.45	0.73	11.10^{b}	5.92	2.62^{b}	2.34^{b}
Ouda	33.5	92.15	46.95^{a}	36.43^{a}	1.33	1.33	15.13^{a}	5.70	3.86^{a}	4.60^{a}
SEM	3.21	2.13	2.01	1.23	2.45	0.27	0.23	0.23	0.23	0.24
				Processing Methods						
Scalding	34.58^{c}	92.32^{b}	48.05^{a}	35.45^{a}	1.45	1.02	12.13^{b}	4.05^{c}	3.18	3.76^{a}
Singeing	38.46^{b}	93.34^{b}	42.58^{b}	32.25^{b}	1.48	0.97	14.61^{a}	6.95^{b}	3.23	3.20^{b}
Skinning	43.43^{a}	98.16^{a}	37.32^{c}	31.25^{c}	1.15	0.92	10.06^{c}	7.14^{a}	2.76	2.30^{c}
SEM	3.21	1.23	2.03	1.42	2.04	0.23	0.52	0.34	0.26	0.42

Table 2: The Breed Effect and Post-Slaughter Processing Methods on the Chemical Composition Of Mutton.

Parameters	Moisture	Crude Protein	Crude Fat	Ash	NFE	Total Cholesterols (mg/dL)	Triacylglyceride	High Density Lipoprotein (mg/dL)	Low Density Lipoprotein (mg/dL)	alondialdehyd mm/L)
						Breed				
Balami	69.10	20.26	7.56	1.72	1.26	208.19^{a}	74.30^{b}	61.91	131.42^{a}	9.87^{a}
Ouda	70.71	20.84	6.08	1.57	1.31	160.00^{b}	100.00^{a}	59.39	80.19^{b}	6.13^{b}
SEM	3.56	1.23	0.87	0.12	0.43	4.23	3.65	2.42	2.34	2.10
						Processing methods				
Scalding	28.54	55.91^{c}	7.45^{c}	3.79^{c}	4.30^{a}	276.40^{c}	107.82^{b}	70.95^{b}	183.89^{b}	11.57^{a}
Singeing	20.12	60.43^{b}	11.62^{b}	5.66^{a}	2.27^{b}	282.28^{b}	133.40^{a}	74.54^{a}	181.06^{b}	11.05^{a}
Skinning	16.98	63.51^{a}	13.88^{a}	5.00^{a}	0.55^{c}	305.60^{a}	127.00^{a}	64.53^{c}	215.70^{a}	8.05^{b}
SEM	1.43	2.03	1.52	1.02	0.23	4.54	2.87	2.32	2.34	2.04

CHO – Cholesterols, TAG – Triacylglycerol, HDL – High Density Lipoprotein, LDL – Low Density Lipoprotein, MDA – Malondialdehyde.

Table 3: The Breed Effect and Post-Slaughter Processing Methods on the Physical Properties Of Mutton.

Parameters	Cooking Loss (%)	Drip Loss (%)	pH	Marbling	Colour
		Breed			
Balami	33.26	1.96[b]	5.58	1.93[b]	6.47
Ouda	31.21	3.05[a]	5.62	3.00[a]	6.50
SEM	0.29	0.25	0.22	0.26	0.22
		Processing			
Scalding	32.12[b]	2.65[a]	5.70	5.80[a]	5.40[b]
Singeing	30.26[c]	1.99[b]	5.49	2.22[b]	7.30[a]
Skinning	35.83[a]	2.70[a]	5.61	5.20[a]	7.00[a]
SEM	2.01	0.21	0.41	0.21	1.32

Table 4: The Breed Effect and Post-Slaughter Processing Methods on the Organoleptic properties Of Mutton

Parameters	Colour	Flavour	Juiciness	Tenderness	Overall Acceptability
			Breed		
Balami	5.33	5.87	6.03[a]	5.27[a]	6.90
Ouda	5.10	6.25	5.55[b]	3.90[b]	6.30
SEM	0.29	0.25	0.22	0.26	0.22
			Processing Methods		
Scalding	5.85[b]	7.25[a]	6.65[a]	4.75[b]	7.65[a]
Singeing	4.20[c]	5.05[b]	5.10[b]	4.45[b]	5.70[c]
Skinning	6.10[a]	5.50[b]	5.70[b]	5.20[a]	6.70[b]
SEM	0.41	0.36	0.31	0.37	0.32

Table 5: The Breed Effect, Post-Slaughter Processing Methods and Storage Time On The Microbial Counts of Mutton.

Parameters	Mean Total Bacteria Count cfu/g x 10^6	Mean Total Coliform Count cfu/g x 10^4	Meat Total Yeast and Mould Count cfu/g x 10^3
		Breed	
Balami	5.53	5.23	4.23
Ouda	4.83	5.20	4.30
SEM	0.32	0.41	0.29
		Processing methods	
Scalding	3.40^b	4.50^c	6.53^c
Singeing	2.32^c	5.25^b	8.40^b
Skinning	5.36^a	5.90^a	9.53^a
SEM	0.34	0.21	0.45
		Storage	
0 day	4.40^b	5.01^b	6.53^b
4 weeks	6.32^a	7.25^a	9.64^a
SEM	0.34	0.21	0.45

5.0 CONCLUSION AND RECOMMENDATION

Ouda breed was preferred for dressing percentage primal cuts and lipid profile. Balami had better organoleptics parameter but no significance was observed for microbial counts. Scalded meat had the highest dressing percentage, with preferred marbling, CF, CHO, LDL, organoleptic properties and microbial counts. Singeing was preferred for drip and cooking losses. Four weeks of storage increased the microbial load hence natural antioxidants are hereby recommended while storing.

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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