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EVALUATION OF PHYSICAL CHARACTERISTICS OF CHEVON AS AFFECTED BY POST-MORTEM CARCASS DRESSING AND FREEZING PRESERVATION

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Abstract
This study was conducted to investigate the effects of post-mortem dressing methods and freezing preservation on the physical characteristics of chevon. Twenty-seven Red-Sokoto male goats between 10 and 12 months of age weighing 18–20 kg were purchased, stabilized and slaughtered. The carcasses were randomly allotted to three post-mortem dressing procedures (scalding, skinning and singeing) and meat from thigh cuts was frozen for 0, 7, 14 and 21 days. Meat samples were excised each day after thawing for physical analysis and data collected were subjected to analysis of variance (ANOVA) in a completely randomized design experiment with 3x4 factorial arrangement. The significant means were separated with the Duncan multiple range test at $p < 0.05$. The results showed that the post-mortem dressing methods and freezing affected Red-Sokoto chevon significantly with the singeing method exerting the highest detrimental effects on physical attributes of meat with the exception of color, yield and pH, while the skinning method exerted the least detrimental effects. Also, cold, cooking and drip losses as well as thermal shortening, cold shortening and pH values increased between the 14th and 21st day, while color, yield, water holding capacity, texture and shear force values decreased across the three treatments during freezing periods. The effects were more significant in singed and scalded meat than in skinned chevon. It was recommended, therefore, that skinning method be encouraged if meat from Red-sokoto male goats is to be frozen and the period of freezing be limited to 14 days for wholesome meat.

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Introduction

There is a high demand for animal protein in developing countries. However, the existing conditions and facilities for slaughtering and handling meat in most of these countries without proper and efficient utilization of facilities result in meat deterioration and heavy post-slaughter losses, and therefore, pose a threat to assuaging do not allow producing sufficient amounts of animal protein in these countries [1]. Moreover, civilization and urbanization have made it difficult for most consumers to allot time to purchase meat on a daily basis, hence they purchase meat in bulk and preserve it in a home refrigerator or freezer in order to meet their daily and immediate future needs [2]. Freezing preservation is a post-slaughter handling of meat that emphasizes and facilitates meat reserve stocking, regulates periodical fluctuations in meat supply and reduces storage losses as well as limits physical, bio-chemical and microbiological changes that reduce meat shelf-life and quality [3]. It also lowers the inner temperature of meat, meat products and food items below the cryogenic point thereby increasing meat and meat product quality [4]. Reports showed that freezing preservation of meat caused some physical alterations in meat due to thawing and refreezing of meat, which resulted in the destruction of the tissue structure and meat spoilage [5]. Post-mortem dressing of carcasses has also been reported to be one of the sources of meat quality variability [6]. However, Monin et al. [7] reported that dressing of animal carcasses using the singeing method imparted better meat eating qualities. It was anticipated, therefore, that the combined effects of post-mortem dressing (namely, scalding, skinning and singeing) and preservation with freezing on meat quality attributes can be enormous. Thus, this study was carried out to evaluate the effects of post-mortem dressing methods and freezing preservation on physical characteristics of Red-Sokoto chevon.

Materials and methods

Experimental Animals

Twenty seven matured Red-Sokoto male goats between 10 and 12 months of age weighing 18–20 kg were used for this study carried out at the Department of Animal Science, University of Ibadan. The animals were quarantined and stabilized for two weeks on cowpea chaff and a standard diet. They were fasted for 16 hours after two weeks,

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but had access to clean water ad libitum. Goats were slaughtered and their carcasses were weighed and allotted randomly (n = 9) to one of the post-mortem dressing methods, namely, scalding, skinning and singeing.

Dressing of carcasses

Scalding: Carcasses were dressed by modifying the scalding method described by Monin et al. [7]. Hot water (75 °C) was poured on each carcass instead of dipping to soften the hairs before scrapping with a metal scrapper. **Skinning:** Skins on the carcasses were removed completely using a sharp knife following the procedures of Omojola and Adesehinwa [6]. A ring was made round one of the hind legs just above the hock. The knife was inserted into the skin of the leg and opened down to the root of the tail, the same operation was done to the second leg and another incision was made from the pelvic region to the neck. The skin was pulled gradually until it was removed. **Singeing:** Carcasses in this group were placed on fire (about 250 °C) made with hard wood, teakwood (*Tectona grandis*) until all the hairs were carefully burnt off with minimal damage to the skin according to the procedures of Okubanjo [8].

Evisceration and Fabrication of Carcasses

Carcasses were decapitated, shanked and eviscerated by removing the gastrointestinal tract and other interval organs. The carcasses were washed and split into two mirror halves using a hand meat saw and fabricated into primal cuts: leg, loin, rack, shoulder, breast, shank and flank (BSF) and neck following the procedures of Field et al. [9]. The carcasses primal cuts were chilled immediately after evisceration in a refrigerator at 4 ^{0}C for 24 hours before freezing .

Freezing Preservation of Meat

Leg cuts from scalded, skinned and singed carcasses were frozen at –18 °C in a freezer for 0, 7, 14 and 21 days [2]. The leg cuts were thawed and meat samples were excised from them for the determination of physical variables of meat and were refrozen on the same day.

Measurement of physical variables

The physical properties of frozen chevon measured included the followings:

Frozen meat visual color

The visual color of frozen meat was determined using the subjective visual method as described by [10]. Meat samples from leg cuts of each treatment were placed on a tray in the laboratory and a 10-member panel was used to evaluate the meat color based on the color intensity (redness) and homogeneity using a scale ranging from 1 to 8 with higher scores representing more attractive and homogenous red color after 0, 7, 14 and 21 days of freezing.

Cooking loss and thermal shortening

The cooking loss was determined following the method of Malgorzata et al. [11]. A meat piece with a weight of about 10 g and a length of 6 cm from the leg cut was wrapped in a polythene bag and boiled in a pressure cooking pot at 80 °C for 20 minutes after thawing on 0,7, 14 and 21 days. The meat samples were boiled on an adjustable PIFCO Japan Electric hot plate model No (ECP 202) until reaching a temperature of 72 °C in the geometric center of the meat samples. The meat samples were removed and cooled to room temperature (27 °C) for 10 minutes and were reweighed. The difference in weight was expressed as loss. Thus:

$$\text{Cooking loss} = \frac{Wt_1 - Wt_2}{Wt_1} \times 100 \quad (1)$$

where:

Wt_1 = initial weight of meat (g)

Wt_2 = final weight of meat (g)

Thermal shortening

The thermal shortening of meat was determined with the same meat samples used to measure the cooking loss according to Apata [12]. The length of meat samples was remeasured after cooking and cooling. The difference in length of meat samples was expressed as thermal shortening percentage:

$$\text{Thermal shortening} = \frac{L_{h1} - L_{h2}}{L_{h1}} \times 100 \quad (2)$$

where:

L_{h1} = initial length of meat (cm)

L_{h2} = final length of meat (cm)

Cold loss

The cold loss of meat samples from frozen leg cuts was determined after thawing meat on 0, 7, 14 and 21 days. A piece of deboned meat with a weight of 10 g and a length of 6 cm was excised from the leg cuts, wrapped in a polythene bag and refrozen for 48 hours following the procedures of Lawrie and Ledward [13]. The meat samples were removed and reweighed. The difference in weight was expressed as percentage of cold loss, thus:

$$\text{Cold loss} = \frac{Wt_{c1} - Wt_{c2}}{Wt_{c1}} \times 100 \quad (3)$$

where:

Wt_{c1} = initial cold weight of meat (g)

Wt_{c2} = final cold weight of meat (g)

Cold shortening

The cold shortening was determined using the same meat samples used to measure the cold loss according to Lawrie and Ledward [13]. The length of the meat samples was remeasured after refreezing for 48 hours and the reduction in the initial length was expressed as the cold shortening percentage, thus:

$$\text{Cold shortening} = \frac{L_{c1} - L_{c2}}{L_{c2}} \times 100 \quad (4)$$

where:

L_{c1} = initial length of meat samples (cm)

L_{c2} = final length of meat samples (cm)

Cooking yield

The cooking yield was determined after thawing meat on 0, 7, 14 and 21 days. A piece of deboned meat (25 g) was removed from leg cuts, wrapped in a polythene bag and boiled for 20 minutes. Then, meat was removed, cooled to room temperature (27 °C) and reweighed. The weight of the boiled meat was used to calculate the cooking yield according to Apata [12].

$$\text{Cooking yield} = \frac{Wt_{m1}}{Wt_{m2}} \times 100 \quad (5)$$

where:

Wt_{m1} = initial weight of meat samples (g)
Wt_{m2} = final weight of meat samples (g)

Drip loss

The drip loss was determined following the procedures of Insausti [14]. Slices of meat samples (10 g) from leg cuts were suspended in polythene bags sealed under atmospheric pressure. The meat samples were then hanged in a refrigerator at 4 °C for 48 hours so that juice could drain. After that, the meat samples were reweighed. The drip loss was calculated as follows:

$$\text{Drip loss} = \frac{(W_p + j) - W_p}{(W_p + m) - W_p} \times 100 \quad (6)$$

where:

$W_p + j$ = weight of pack + juice
W_p = weight of pack
$W_p + m$ = weight of pack + meat

Water Holding Capacity (WHC)

The water holding capacity was determined as expressible juice following the procedures of Malikajuna and Mittal [15]. An approximately 1 g of a meat sample from the leg cut was placed between two pre-weighed 9 cm Whatman No 1 filter papers (Model C, Caver Inc. Wabash USA). The meat sample and the filter papers were pressed between two 10.2 × 10.2 cm^2 plexiglass plates at about 32.7 kg/cm^3 absolute pressure for 1 minute with a vice. The wetted filter papers were removed and reweighed. The WHC was calculated as follows:

$$\text{WHC} = \frac{W_{wp} - W_{dp}}{W_{dp}} \times 100 \quad (7)$$

where:

W_{wp} = weight of wetted papers (g)
W_{dp} = weight of dry papers (g)

Meat Texture

This variable was determined following the procedures of [16] using the subjective visual method. A 10-member panel was used to score the texture of the meat samples from the leg cut. The scores were based on a scale ranging from 1 to 8, on which 1 = extremely coarse and 8 = extremely fine texture.

Shear force value

The Warner Bratzler shear values of meat samples were determined following the procedures of Malgorzata et al. [11]. Meat samples (10 g) from the leg cut were wrapped in polythene bags and boiled for 20 minutes in a pressure pot on a PIFCO Japan Electric hot plate (Model No ECP 202) to an internal temperature of 73 °C. The meat samples were then cooled to room temperature (27.8 °C) and were reweighed, wrapped in polythene bags and chilled at 4 °C for 18 hours. The meat samples were removed and were held to equilibrate to room temperature. Then, 1.25 cm diameter cores parallel to muscle fiber orientation were made and were sheared at three locations with a Warner Bratzler V-Notch blade shearing instrument. The average shear values were recorded for each treatment.

Meat pH

The pH values of meat samples were determined following the method described by Marchiori and de Felicio [17]. A meat sample (10 g) from the leg cut was homogenized with 90 ml of distilled water for 5 minutes using a laboratory blender (plate 5mm, Model 242, Nakai Japan). The pH values of meat samples were measured with a pH meter (model H-18424 micro-computer, Hanna instruments, Romania).

Experimental design n and statistical analysis

The completely randomized design was used for this study. There were three treatments (scalding, skinning, singering) and four different periods of freezing preservation (0, 7, 14 and 21 days). All data collected from this study were subjected to analysis of variance (ANOVA) using [18] and the significant means were separated with the Duncan multiple range test of the same statistical system.

Results and discussion

The results for the chevon visual color as affected by carcass dressing and freezing preservation are presented in Table 1. The scores for the chevon color were higher ($p < 0.05$) in meat samples from the carcasses dressed with the singeing method and were lower ($p < 0.05$) in those from the carcasses dressed with the skinning method. The scores for the color of frozen chevon decreased as the period of freezing preservation increased from 0 to 21days ($p < 0.05$).

Color or appearance of meat or any food substance is an attribute most valued by consumers, and it is used in categorizing meat quality [6]. Meat samples from the singed and scalded carcasses had higher scores for color compared to meat samples from the skinned carcasses probably because of heat treatment of the carcasses. The heat might have stabilized the content of oxygen, which could not be attacked by oxygen consuming enzymes [19]. The scores for color of meat decreased steadily as the time of freezing increased probably because of non-steady flow of oxygen in the freezer due to the epileptic nature of electricity supply, therefore the meat samples could not be oxygenated as reported by Apata [12]. The meat color values were high on 0 and 7th day of freezing probably due to blooming

that took place in the freezer as a result of availability of oxygen both in the open air where meat was processed and in a freezer when electricity was at maximum [13]. Other researchers [20,21,22] also reported that when meat was frozen color changes progressed over a long period, which supports the results obtained from this study.

Table 1. Visual color scores of chevon as influenced by carcass dressing methods and frozen storage

	Treatments		
Time/Day	Scalding	Skinning	Singeing
0	7.00 ± 0.01^{a}	7.00 ± 0.01^{a}	7.00 ± 0.01^{a}
7	7.00 ± 0.01^{a}	6 .00 ± 0.02^{a}	7.00 ± 0.01^{a}
14	5.00 ± 0.03^{b}	4.00 ± 0.05^{c}	6.00 ± 0.02^{a}
21	5.00 ± 0.03^{b}	4.00 ± 0.05^{c}	6.00 ± 0.02^{a}

abc: Means in the same row with different superscripts are statistically significant ($p < 0.05$)

Table 2 shows the results of determination of the chevon cooking loss as influenced by carcass dressing and freezing preservation. Meat samples from the carcasses dressed with the singeing method had higher ($p < 0.05$) percentage of cooking loss followed by meat samples from the carcasses dressed with scalding, while meat from the carcasses dressed with the skinning method had the lowest ($p < 0.05$) cooking loss percentage. The percentage of cooking loss of chevon increased ($p < 0.05$) as the period of freezing increased and was highest ($p < 0.05$) on the 21st day of preservation.

The highest cooking loss observed in meat from the singed carcasses (Table 2) could be connected with the action of heat resulting in weakening and puncturing the myofibrils as well as the connective tissue of meat, which facilitated the loss of juices from heated carcasses and subsequently meat [16]. In this study, the cooking loss followed the intensity of heat applied. The heat intensity was higher in singeing than in scalding and no heat was applied to the skinned carcasses, hence it was expected that the cooking loss in meat from the skinned carcasses would be minimal [6]. The loss of juices in meat from the singed carcasses could have been aggravated by thawing that accompanies freezing. Kondratowicz and Mamsevicius [3] reported that freezing and thawing destroy the structure of meat, and since the meat samples were removed from partially heated carcasses by singeing and scalding, these procedures might have added to the damage unlike meat samples from the skinned carcasses [16].

Table 2. Percentage of cooking loss in meat as influenced by carcass dressing methods and frozen storage

	Treatments		
Time/Day	Scalding	Skinning	Singeing
0	13.12 ± 0.04^{b}	10.22 ± 0.06^{c}	14.20 ± 0.03^{a}
7	13.17 ± 0.04^{b}	11.25 ± 0.05^{c}	15.42 ± 0.02^{a}
14	13.29 ± 0.04^{b}	11.60 ± 0.05^{c}	15.50 ± 0.02^{a}
21	13.31 ± 0.04^{b}	11.68 ± 0.05^{c}	16.64 ± 0.01^{a}

abc: Means in the same row with different superscripts are statistically significant ($p < 0.05$)

The results of cooking yield percentage of chevon as influenced by carcass dressing and freezing preservation are shown in Table 3. Meat from the skinned carcasses had the highest ($p < 0.05$) cooking yield compared with other two treatments, while meat from the skinned carcasses had the lowest ($p < 0.05$) cooking yield. The results showed further that cooking yield of frozen chevon decreased as the period of freezing preservation increased and was lowest ($p < 0.05$) on the 21st day.

Meat yield is an important aspect of carcass processing as it indicates the economic value of meat for the processors [12]. In this study, the yield was highest in meat from the skinned carcasses (Table 3). The high yield observed in meat from scalded carcasses could be due to the skin cover and lower juice loss from meat during processing. Although there was skin cover in meat from singed carcasses, but there could be loss of juices during singeing, which could have decreased the yield in meat samples from the singed carcasses. The yield was very low in singed meat due to heat applied to the carcasses which also reflected in the preserved meat (Table 3). Other researchers also reported that singed meat has a higher tendency to loose juices than scalded and skinned meat because of the heat applied [6,8,19]. The yield decreased as the time of freezing preservation increased due to higher draining as a result of softness and tenderness of the meat which would have warranted more drains from the meat.

Table 3. Cooking yield of chevon as affected by carcass dressing methods and frozen storage

	Treatments		
Time/Day	Scalding	Skinning	Singeing
0	86.88 ± 0.01^{b}	89.78 ± 0.01^{a}	85.80 ± 0.03^{c}
7	86.83 ± 0.01^{b}	88.75 ± 0.02^{a}	84.58 ± 0.04^{c}
14	86.71 ± 0.01^{b}	88.40 ± 0.02^{a}	84.50 ± 0.04^{c}
21	86.69 ± 0.001^{b}	88.32 ± 0.02^{a}	83.36 ± 0.05^{c}

abc: Means in the same row with different superscripts are statistically significant ($p < 0.05$)

The results of cold loss values of chevon as affected by carcass dressing and freezing preservation are presented in Table 4. The results indicated that meat from the skinned carcasses had the highest ($p < 0.05$) cold loss percentage, while meat samples from the scalded carcasses had the lowest ($p < 0.05$) cold loss values. The percentage of the cold loss of meat samples increased across the treatments as the time of freezing preservation increased and was highest ($p < 0.05$) on the 21st day of freezing.

The cold loss was highest in meat samples from the singed carcasses and least in meats from scalded carcasses (Table 4). Heating of singed carcasses during processing (dressing) could have weakened the muscle structure of meat and led to higher draining from meat unlike skinned meat, which did not pass through heat at all.

Table 4. Cold loss of chevon as influenced by carcass dressing methods and frozen storage

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	10.09 ± 0.12^{c}	11.20 ± 0.10^{b}	12.88 ± 0.09^{a}
7	11.14 ± 0.10^{c}	12.25 ± 0.09^{b}	14 .08 ± 0.08^{a}
14	11.31 ± 0.10^{c}	12.59 ± 0.09^{b}	14.23 ± 0.08^{a}
21	11.90 ± 0.09^{c}	13.68 ± 0.08^{b}	15.33 ± 0.07^{a}

abc: Means in the same row with different superscripts are statistically significant (p < 0.05)

Table 5 presents the results of drip loss percentage in chevon as influenced by carcass dressing and freezing preservation. There were significant (p < 0.05) differences in the drip loss values of chevon due to carcass dressing and freezing preservation. Meat samples from the singed carcasses had the highest (p < 0.05) drip loss values, while meat from the skinned carcasses had the lowest (p < 0.05) drip loss percentage. The values of drip losses in chevon increased from 0 day to 21day due to freezing with the highest (p < 0 .05) drip loss observed on the 21st day.

Table 5. Drip loss of chevon as affected by carcass dressing methods and frozen storage

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	9.25 ± 0.02^{b}	8.20 ± 0.03^{c}	10.28 ± 0.01^{a}
7	10.28 ± 0.03^{b}	9.24 ± 0.04^{c}	11.32 ± 0.02^{a}
14	11.30 ± 0.04^{b}	10.27 ± 0.05^{c}	12.49 ± 0.03^{a}
21	12.42 ± 0.05^{b}	11.33 ± 0.06^{c}	13.53 ± 0.04^{a}

abc: Means in the same row with different superscripts are statistically significant (p < 0.05)

The same pattern as found for the drip loss was observed in the values of thermal shortening of chevon as affected by carcass dressing and freezing (Table 6). Thermal shortening values were higher (p < 0.05) in meat samples from the carcasses dressed with singeing and lower in those from the carcasses that were skinned. Meat from the scalded carcasses had thermal loss values close to the values obtained for meat from the singed carcasses. The highest (p < 0.05) values for thermal shortening of chevon were recorded on the 21st day of freezing preservation.

The results on thermal shortening of chevon stored for 21days had similar pattern as obtained for the drip loss in meat (Table 6). Lawrie and Ledwards [13] reported that any muscle that underwent thermal processing (heating) would have a tendency to shorten more when kept in a freezer over time. The same results were observed in this study, which confirmed the report of Dalatowski et al. [4]. Meat samples from the singed carcasses showed the highest shortening followed by meat from the scalded carcasses, while the lowest values were in skinned meat because skinned meat was not subjected to heating during processing.

Table 6. Thermal shortening of chevon as influenced by carcass dressing methods and frozen storage

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	18.78± 0.08^{b}	15.27± 0.09^{c}	20.24± 0.06^{a}
7	20.27± 0.06^{b}	17.31± 0.08^{c}	21.37± 0.05^{a}
14	21.52± 0.05^{b}	18.40± 0.07^{c}	23.67± 0.04^{a}
21	21.70 ± 0.05^{b}	18.47± 0.07^{c}	23.71± 0.04^{a}

abc: Means in the same row with different superscripts are statistically significant (p < 0.05)

Table 7 presents the results of cold shortening of chevon as affected by carcass dressing and freezing preservation. The singed carcasses gave meat with the highest (p < 0.05) cold shortening values followed by meat samples from the scalded carcasses. Meat from the skinned carcasses had the lowest (p < 0.05) cold shortening values. The results also revealed that the values of meat cold shortening increased progressively as the time of freezing increased to 21days.

The effect of carcass processing (dressing) was very evident in the cold shortening results of the meat samples (Table 7). It was obvious that as the heat intensity was highest in singed carcass, cold shortening was also very high in the singed meat, whereas meat from the skinned carcasses shortened very poor because no heat was applied and no muscle weakening took place. These results confirm the reports of Lawrie and Ledwards [13] as well as Apata [12].

Table 7. Cold shortening of chevon as influenced by carcass dressing methods and frozen storage

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	11.27 ± 0.10^{b}	10.20 ± 0.12^{c}	12.45 ± 0.10^{a}
7	11.42 ± 0.10^{b}	10.27 ± 0.12^{c}	12.60 ± 0.10^{a}
14	12.60 ± 0.10^{b}	11.35 ± 0.12^{c}	13.65 ± 0.09^{a}
21	12.67 ± 0.10^{b}	11.46 ± 0.12^{c}	13.82 ± 0.09^{a}

abc: Means in the same row with different superscripts are statistically significant (p < 0.05)

The results of the water holding capacity (WHC) of chevon as influenced by carcass dressing and freezing showed significant (p < 0.05) differences in the value of WHC across the three dressing treatments with meat samples from the skinned carcasses having the highest (p < 0.05) WHC followed by meat from the scalded carcasses, while the lowest (p < 0.05) WHC values were recorded in meat samples from the singed carcasses. The water holding capacity values decreased as the number of days of freezing preservation were prolonged to 21days.

The water holding capacity (WHC) is very important in determining a degree of other eating attributes of meat because when it is relatively high it influences the tenderness, juiciness, texture and overall acceptability of meat or meat products (Table 8). This could be because skinned meat did not pass through heat like singed meat. Therefore,

the muscle structure in skinned meat was intact unlike that in singed meat and scalded meat, whose muscle architecture could have been destroyed by heat and this might have paved the way for more water in form of drains to exudate from meat. This result correlates with the studies by Omojola and Adesehinwa [6], Monin et al. [7], [8] and aApata [12] who reported that skinned meat has higher WHC than either scalded or singed meat. The WHC decreased as the time of freezing increased in this study, which agrees with the results of Apata [12].

Table 8. Water holding capacity of chevon as affected by carcass dressing methods and frozen storage

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	66.70 ± 5.39^{b}	72.18 ± 2.31^{a}	55.41 ± 6.22^{c}
7	61.57 ± 8.82^{b}	66.70 ± 5.39^{a}	55.27 ± 6.88^{c}
14	59.72 ± 9.46^{b}	63.87 ± 7.16^{a}	53.32 ± 8.28^{c}
21	57.15 ± 10.29^{b}	60.64 ± 9.94^{a}	49.61 ± 8.13^{c}

abc: Means in the same row with different superscripts are statistically significant ($p < 0.05$)

The meat texture is influenced by a level of the water holding capacity and heat treatment. In this study the texture scores for meat from the skinned carcasses were highest (Table 9), followed by meat from the scalded carcasses, while meat from the singed carcasses received the lowest scores for texture profile. The reason for these results could be the fact that meat from the skinned carcasses retained a high amount of water, which resulted in meat with very fine texture. In addition, heat did not affect skinned meat, while meat from both singed and scalded carcasses was exposed to heat. Moreover, the temperature applied to singed meat was higher than that applied to scalded meat. Therefore, although scalded meat also underwent heat treatment, it was not as severe as in the case of singed meat. As a result, the lowest scores for the texture profile were recorded for singed meat, while finer texture of meat was observed in case of scalding. These results agree with the reports of Omojola and Adesehinwa [6] and Apata [12].

Table 9.Texture scores of chevon as affected by carcass dressing methods and frozen storage

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	6.47 ± 0.02^{b}	7.63 ± 0.01^{a}	5.37 ± 0.06^{c}
7	6.35 ± 0.02^{b}	7.60 ± 0.01^{a}	4.35 ± 0.07^{c}
14	5.32 ± 0.03^{b}	6.52 ± 0.02^{a}	4.30 ± 0.07^{c}
21	4.30 ± 0.04^{b}	6.45 ± 0.02^{a}	3.28 ± 0.10^{c}

abc: Means in the same row with different superscripts are statistically significant ($p < 0.05$)

The results of the shear force values of chevon as affected by carcass dressing and freezing preservation are shown in Table 10. Meat samples from the singed carcasses had the highest ($p < 0.05$) shear force values followed by meats from the scalded carcasses, while the lowest ($p < 0.05$) shear force values were recorded in meat from the skinned carcasses. The meat shear force values decreased ($p < 0.05$) as the time of freezing preservation increased up to the last freezing day.

The criteria that affected the texture of meat would also apply to the shear force value of meat or meat products. The shear force represents a degree of tenderness or toughness of a meat sample and is predicated on an amount of water a meat sample can hold or bind. The shear force in singed and scalded meat was significantly higher than that in skinned meat because heat applied to the two meat samples reduced their moisture content drastically compared with skinned meat, which was not subjected to heat treatment (Table 10). The previous studies by Okubanjo [8], Omojola and Adesehinwa [6], and Apata [12] demonstrated that singed and scalded meat was tougher due to the skin cover and heat treatment when compared to skinned meat without the skin cover and heat treatment. The shear force values decreased as the time of freezing increased, which suggests that freezing contributed to the value of shear force reducing the muscle tone and rendering the muscles more tender due to ageing as reported by Apata [12].

Table 10. Shear force values of chevon as affected by carcass dressing methods and frozen storage (kg/cm3)

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	5.20 ± 0.02^{b}	4.12 ± 0.03^{c}	6.28 ± 0.01^{a}
7	5.10 ± 0.02^{b}	4.08 ± 0.03^{c}	6.20 ± 0.01^{a}
14	4.10 ± 0.03^{b}	3.05 ± 0.07^{c}	5.18 ± 0.10^{a}
21	4.07 ± 0.03^{b}	3.01 ± 0.07^{c}	5.12 ± 0.10^{a}

abc: Means in the same row with different superscripts are statistically significant ($p < 0.05$)

Table 11 presents the results of pH values of chevon as affected by carcass dressing and freezing preservation. The results indicated that there were no significant ($p < 0.05$) differences in the pH values of meat samples irrespective of the treatment between 0 and 7th day of freezing preservation, but significant ($p < 0.05$) differences were observed on the 14th and 21st days of preservation.

The pH of meat determines whether meat is PSE, DFD or normal and this in effect determines other indicators of eating quality such as color, tenderness and juiciness, as well as WHC, which in combination dictate the overall acceptability of a meat sample. A change in pH of meat from all three treatments was not significant in scalded and singed meat on 0 and 7th day of freezing, but it was significant in skinned meat within the same period of time. The pH increased from day 14 in all treatments and was highest on the 21st day of freezing. These results indicated that both singed and scalded frozen meat was still within the range of pH that allows longer shelf life of meat, whereas, pH of skinned meat was moving to the range that could encour-

age the proliferation of microorganisms, thereby shortening the shelf life of skinned meat. Apata [12] reported about similar observations.

Table 11. pH values of chevon as influenced by carcass dressing methods and frozen storage

Treatments			
Time/Day	Scalding	Skinning	Singeing
0	5.40 ± 0.02	5.40 ± 0.01	5.52 ± 0.01
7	5.44 ± 0.10	5.45 ± 0.10	5.54 ± 0.10
14	5.46 ± 0.01^{b}	6.57 ± 0.01^{a}	5.56 ± 0.10^{b}
21	5.52 ± 0.01^{b}	6.90 ± 0.00^{a}	5.58 ± 0.01^{b}

ab: Means in the same row with different superscripts are statistically significant ($p < 0.05$)

Conclusion

It can be concluded from the results of this study that carcass dressing methods (scalding, skinning and singeing) and freezing have a significant effect on physical characteristics of chevon, with singeing method exerting a higher effect than scalding and skinning. Also, freezing chevon for 21days impacted negatively on the chevon physical attributes. It is therefore, recommended that skinning method be adopted by butchers since most of the physical attributes of chevon were very low in skinned meat, and that chevчon should not be frozen beyond 14 days to avoid an increase in the physical attributes of chevon, which could make meat unacceptable.

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