

EFFECT OF SINGEING METHODS ON CARCASS QUALITIES AND SENSORY PROPERTIES OF RED SOKOTO BUCK MUSCLE

Ani Ugochukwu¹, Elisha Zhiri Jiya¹, Ocheme² Boniface Ocheme

¹Department of Animal Production, Federal University of Technology Minna

²Department of Food Science and Technology, Federal University of Technology Minna

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Abstract: An experiment was conducted using twenty four red Sokoto bucks to evaluate effect of singeing methods on the carcass quality and sensory properties of red Sokoto buck (Chevon) meat. The study was carried out at the Animal Production Teaching and Research laboratory, Federal University of Technology Minna. The buck carcasses were randomly allocated to four singeing methods of hot water, firewood, rubber tyre and kerosene singeing after slaughter. Data were collected on the sensory parameters, mineral composition, physical and chemical properties and proximate composition. Singeing methods significantly ($P<0.05$) affects the crude protein and fat contents of the meat samples with crude protein significantly ($P<0.05$) higher in rubber tyre (31.53%) singed carcasses. While the fat content were significantly ($P<0.05$) higher in hot water (5.80%) singed carcasses. The mineral contents differs significantly ($P<0.05$) among singeing methods. The pH and thermal shortening were significantly ($P<0.05$) higher in buck carcasses singed with kerosene (6.75 and 35.35 respectively). Methods of singeing had significant effect on the carcass quality and sensory properties of meat samples. It was therefore concluded that hot water be used to remove hairs in slaughtered goat carcasses, as this will reduce to practicable level cross contamination of meat during processing. The use of firewood, tyre and kerosene should be total discouraged in meat processing and the public should be educated about the health implication of consuming animal carcasses singed with these methods.

Key words: singeing methods, carcass qualities, sensory properties, buck, muscle

Introduction

Goat meat is the world's most popular meat, as about 75 % of the world populations eat goat meat (*Suzanne, 2012*). Goat meat is lower in fat than chicken,

but higher in protein than beef. It is preferred to beef, mutton and pork due to its lower calories, total fat content, saturated fat and cholesterol (Anaeto et al., 2010). These low levels of saturated fat and cholesterol, combined with its high iron and protein content, make goat meat a good choice for anyone looking for a healthy red meat. It is a leaner, healthier choice when compared to equal serving sizes of chicken, beef and pork (Suzanne, 2012). Anaeto et al. (2010) reported that goat meat is easier to digest as a result of its molecular structure, thus it presents a healthier alternative compared to other types of red meat.

The quantity and quality of meat produced are increasingly becoming important. This situation arose from the increased consciousness and demand of consumers who desired meat characterized by special dietetic and health properties (Brunso et al., 2005). Meat quality is a generic term used to describe properties and perception of meat which includes attributes such as carcass composition and configuration, eating property of meat, health issues associated with meat, as well as animal welfare and environmental impact (Maltin et al., 2003). Meat quality is very important for consumers when it comes to making purchasing decisions. Many factors (both pre and post mortem) can affect carcass quality from producer to consumer. Paramount among the post mortem activities that affect nutritional and eating qualities of meat are processing methods especially flames from singeing that generates phenolic substances, which are of considerable importance to the organoleptic properties of roasted meat products and show antimicrobial as well as antioxidative properties (Wolfgang et al., 2013), and also the biochemical changes that occur in meat during post- slaughter storage and distributions (Keith et al., 2002). Most consumers especially in Africa eat chevon meat together with the skin processed by singeing with either hot water, open fire using either tyre, fire wood and or kerosene (Omojola and Adesehinwa, 2006; Obiri-Danso et al., 2008). Singeing maintains the carcass hide for consumption and also evokes flavours in the meat which are acceptable to the consumer (FAO, 1985). The aim of this study was to evaluate the effect of singeing methods on carcass quality of red Sokoto buck muscle.

Materials and methods

Experimental animals

Twenty four red Sokoto bucks, seven (7) to eight (8) months old, with body weight between 10 to 12 Kg were used for this study. The animals were purchased from Beji Livestock Market in Bosso Local Government area of Niger State, Nigeria and allowed to acclimatize to the same diet conditions for two weeks. They were dewormed, dipped and vaccinated against known parasites and diseases. The goats picked were kept off feed for 12 hours and slaughtered by severing the jugular vein at the neck region and allowed to bleed for 5 minutes after which the carcass were weighed. Their carcasses were randomly assigned to

four singeing methods namely: hot water singeing, firewood, rubber tyre and kerosene singeing. Each method was replicated thrice with two goats per replicate. Hot water was used to process the goat meat according to the method described by (Monin *et al.*, 1995). Hot water of 75 to 90⁰C was poured on each slaughtered buck carcass to soften the hairs which was then scrapped with razor blade and afterward washed with sponge and clean water. The group singed with fire wood was carried out as described by Okubanjo (1997). Each slaughtered goat carcass was roasted on firewood (230-250⁰C) derived from shea wood until the hairs are carefully burnt off with minimal damage to the skin. Fresh clean water with sponge was used to wash off the charred surface as much as possible, thus to reduce the level of contamination on the carcass. Group three were roasted using car rubber tyres. The hairs from the slaughtered goat carcasses were carefully burnt off with minimal damage to the skins. After which fresh clean water with sponge was used to wash off the charred surface in order to reduce the level of contamination on the carcass. The fourth group was carried out using kerosene. Kerosene was rubbed all over the slaughtered goat carcass and then set ablaze until the hairs were carefully burnt off, with minimal damage to the skin. Fresh clean water with sponge was used to wash off the charred surface as much as possible to reduce the level of contamination on the carcass.

Data were collected on proximate and mineral compositions of buck meat samples using the procedures of (AOAC, 2000). The pH of the meat was determined. 10g of meat samples were homogenized for two minutes with 90 mls of distilled water using a laboratory blender (plate 5mm) model 242, Nakal Japan, the meat suspension was filtered and the pH of the meat was measured using a digital pH meter model H18424 micro-computer, Havanna Instruments Romania. The water holding capacity was determined using the procedures described by Kauffman *et al.* (1992). Cooking loss, thermal shortening and cooking yield were determined using the procedures described by Kauffman *et al.* (1992).

The sensory evaluations of the meat samples were carried out as described by Iwe, (2002). The (*Musculus semimembranosus*) from leg cut was cut into bites sizes. There were boiled in water without any form of seasoning for 30 minutes and allowed to cool. The boiled meat samples were served in plates to a twenty (20) member semi-trained panelists to assess the colour, tenderness, juiciness, flavour and overall acceptability using a 9 point hedonic scale (where 1= dislike extremely and 9=like extremely).

Data Analysis

The data collected from this study was subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS Version 9.0). The variations in means were separated using Student-Newman-Keuls (SNK) test at 5% level of probability.

Results and discussion

The effect of singeing methods on the proximate composition of meat samples obtained from red Sokoto buck carcasses is shown in Table 1. The results showed that moisture content, ash, crude fibre and nitrogen free extract were not significantly ($P>0.05$) affected by the singeing method. However, crude protein and fat contents were significantly ($P<0.05$) affected by the singeing method. Hot water singed carcasses (27.70) were significantly ($P<0.05$) lower in protein than tyre (31.53) but not lower than others. The significantly ($P<0.05$) higher amount of protein observed in buck carcasses singed with tyre, kerosene and firewood over that of hot water might be due to lesser amount of fat contents observed in buck carcasses singed using these methods, thus leading to an increase in the amount of protein. This result is in agreement with the reports of *Akwetey et al. (2013)* and *Ijeoma et al. (2015)*. The authors reported high protein content in carcasses singed with tyre and firewood and lower fat content with the same carcasses.

Fat content were significantly ($P<0.05$) higher in hot water (5.80) singed carcasses than the others. This significantly ($p<0.05$) higher amount of fat content observed in carcasses singed with hot water over those singed with rubber tyre, kerosene and firewood may be due to the buck carcass processed with hot water 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 methods due to the degradation of the fatty acid by heat treatment. This finding disagreed with the findings of (*Apata, 2014*) that reported lower fat content in meat samples prepared with hot water over those singed with rubber tyre and firewood. 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 treatments can cause undesirable changes, such as loss of essential fatty acids (FA), mainly due to lipid oxidation, reducing the nutritive value of meat.

Table 1. Proximate composition of meat samples from red Sokoto buck singed using different methods

Parameters %	HW	FW	TYR	KERO	SEM	LS
Moisture	24.50	23.29	24.68	23.96	0.674	NS
Crude protein	27.70 ^b	29.33 ^{ab}	31.53 ^a	30.21 ^{ab}	0.504	*
Crude fibre	0.67	0.26	0.56	0.27	0.126	NS
Fat	5.80 ^a	2.67 ^b	2.87 ^b	2.30 ^b	0.538	*
Ash	3.53	2.16	2.43	1.80	0.321	NS
NFE	37.81	42.30	37.94	41.46	0.966	NS

a, b Means in the same row not followed by the same superscript are significantly different ($P<0.05$). HW = Hot water, FW = Firewood, TYR = Rubber tyre, KERO = Kerosene, NFE = Nitrogen Free Extract, LS= Level of significant, *= Significantly different at ($P<0.05$), NS = Non significantly different.

The result on the effect of singeing methods on the mineral contents of meat samples from red Sokoto buck (Table 2) revealed that singeing methods had significant ($P<0.05$) effects on some of the mineral composition tested. Meat samples singed with tyre (12.89) were significantly ($P<0.05$) higher in calcium and the least values were recorded in hot water (12.31) singed carcasses, while those carcasses singed with firewood and kerosene were statistically similar. Magnesium and potassium were shown to be significantly ($P<0.05$) higher in carcasses singed with tyre (19.86 and 296.13 respectively) than other meat samples. These significant ($P<0.05$) differences obtained in calcium, magnesium and potassium among carcass singed with tyre, firewood as well as kerosene over those singed with hot water may be attributed to the more moisture losses observed with those carcasses leading to the concentration of these mineral contents. This result is in agreement with the report of *Lawrie and Ledward (2006)* who reported increase in mineral concentration in meat as a result of moisture loss through cooking. The results also showed that sodium (68.76) and phosphorus (176.48) were significantly ($P<0.05$) higher in carcasses singed with hot water and the least values were obtained with those carcasses singed with firewood (61.63 and 153.61 respectively). However the observed increase in sodium and phosphorus among carcasses prepared with hot water over other methods might be due to direct loss of mineral as a result of higher temperature observed with those methods. This is also in agreement with *Gerber et al. (2009)* the authors reported loss of minerals in meat due to heat treatment. The lesser the moisture content, the more the mineral concentration, but as the intensity of the heat and temperature increases the higher the mineral losses due to leaching.

Table 2. Mineral content of meat samples from red Sokoto buck singed using different methods

Parameters (mg/100g)	HW	FW	TYR	KERO	SEM	LS
Calcium	12.31 ^c	12.79 ^{ab}	12.89 ^a	12.55 ^{bc}	0.078	*
Magnesium	19.10 ^c	19.56 ^b	19.86 ^a	19.33 ^{bc}	0.091b	*
Potassium	292.59 ^b	292.92 ^b	296.13 ^a	291.55 ^b	0.583	*
Sodium	68.76 ^a	61.63 ^d	67.10 ^b	64.65 ^c	0.822	*
Phosphorus	176.48 ^a	153.61 ^d	155.44 ^c	162.05 ^b	2.71	*

a, b Means in the same row not followed by the same superscript are significantly different ($P<0.05$). HW = Hot water, FW = Firewood, TYR = Rubber tyre, KERO = Kerosene, SEM = Standard error means, LS = Level of significant, * = Significantly different at ($P<0.05$), NS = Non significantly different

Table 3 shows the effect of singeing method on the physical and chemical properties of red Sokoto buck carcasses. The result showed that the singeing method had no significant ($P>0.05$) effect on thawing loss, cooking yield, cooking loss, as well as the water holding capacity of the singed buck carcasses. However, the pH and thermal shortening of the red Sokoto buck carcasses were significantly ($P<0.05$) affected by singeing methods. The carcasses singed with hot water had a

significantly ($P < 0.05$) lower pH (6.08) than the other methods. The significantly ($P < 0.05$) higher pH observed in buck carcasses singed with firewood, rubber tyre and kerosene may be as a result of the sources of heat materials, as well as the intensity of these heat on the rigor stage of the buck carcasses. *Dal Bosco et al. (2001)* and *Huang et al. (2011)* also found, that heat treatment of raw meat resulted in the increase in meat pH. *Huang et al. (2011)* explained that the changes in the pH values of meat during heat treatment were caused by changes in the balance of acid-base groups. According to *Istrati et al. (2011)* an increase in pH of meat means improved water holding capacity as well as improved taste and tenderness of the meat. The authors also reported that an increase in pH of meat also occurs due to the efficiency of the heat treatment leading to changes in the internal temperature of the meat.

Also buck carcasses singed with kerosene had a significantly ($P < 0.05$) higher thermal shortening (35.35) than the samples singed with firewood (24.13) and rubber tyre (25.04). The higher thermal shortening observed in buck carcasses singed with kerosene can be attributed to the duration of the heat source on the sarcomere length of the buck carcasses. This is in agreement with the report of *Sigurgisladottir et al. (2001)* whose report stated that most sarcomere shortening occurred within the first 20 minutes of heating. This 20 minutes critical heating time also implies that short heat exposure can yield tender products, and that heating beyond this time does not improve texture as was observed in this study. According to *Bertram et al. (2004)* strong correlation between cooking losses and shrinkage (thermal shortening) of meat can be explained by the fact, that the shrinkage appearing during heat treatment causes loss of the meat liquid, which results in mass loss. The process of meat shrinkage has several phases, at approximately 40°C – myosin starts to denature and shrinkage across the muscle fibres is observed, at $55\text{--}60^{\circ}\text{C}$ – collagen shrinkage occurs as a result of denaturation while at over 60°C which marks the beginning of the shrinkage along the muscle fibres.

The effect of singeing methods on the sensory properties of red Sokoto buck carcasses is shown in Table 4. The result shows that while singeing methods had no significant ($P > 0.05$) effect on the juiciness of the carcasses, the colour, tenderness, flavour, as well as the overall acceptability of the meat samples were significantly ($P < 0.05$) affected by the singeing methods. Kerosene singed carcasses had the best scores for colour (9.00), tenderness (7.55), flavour (6.90), and over all acceptability (7.75). The observed colour difference may be attributed to the material used in singeing of the carcasses and the non- enzymatic browning between the carbohydrate and protein molecules of the carcasses known as Maillard Reaction. The Maillard Reaction (also known as browning) is a type of non-enzymatic browning which involves the reaction of simple sugars (carbonyl groups) and amino acids (free amino group) that begins to occur when food samples are heated, thus creating flavours, colour changes and taste in food

(Brunton *et al.*, 2002). Colour is often the first sensory quality by which foods are judged, and it may also provide an indication of chemical changes suffered by them. The improved tenderness reported in this method may be due to higher pH observed with buck carcass samples singed with kerosene that correlated to the better tenderness, according to the data reported by *Takahashi (1996)*, an improvement in the tenderness of meat is proportional to the increasing pH which was also observed in this study, while the improved flavour, may be possible disposition of aromatic flavour (Maillard Reaction) by this method.

Table 3 Physical and chemical properties of meat samples from red Sokoto buck singed using different methods

Parameters	HW	FW	TYR	KERO	SEM	LS
pH	6.08 ^b	7.01 ^a	6.87 ^a	6.75 ^a	0.125	*
Thawing Loss (%)	9.70	11.43	11.37	11.43	0.651	NS
Cooking yield (%)	61.26	72.01	66.76	64.21	1.903	NS
Cooking loss (%)	38.55	27.99	33.24	35.79	1.862	NS
WHC (%)	90.82	90.02	88.77	88.22	1.350	NS
Thermal-shortening (%)	31.10 ^{ab}	24.13 ^b	25.04 ^b	35.35 ^a	1.803	*

a, b Means in the same row not followed by the same superscript are significantly different ($P < 0.05$). HW = Hot water, FW = Firewood, TYR = Rubber tyre, KERO = Kerosene, WHC = Water holding capacity, LS = Level of significant, * = Significantly different at ($P < 0.05$), NS = Non significantly different.

However the significantly ($P < 0.05$) higher scores obtained in relation to overall acceptability with buck carcasses singed with kerosene and rubber tyre might be that the consumers are familiar with palatability of carcasses singed with kerosene, rubber tyre and firewood. This result agrees with the reports of *Omojola et al. (2012)* and *Ijeoma et al. (2015)*, the authors reported significantly ($P < 0.05$) higher scores in colour, taste, aroma and over all acceptability of meat samples singed with tyre and firewood over those prepared using hot water with razor blade. However, none of the meat samples were rejected by the panelists.

Table 4. Sensory scores of meat samples from red Sokoto buck singed using different methods

Parameter	HW	FW	TYR	KERO	SEM	LS
Colour	6.95 ^c	6.10 ^d	8.00 ^b	9.00 ^a	0.168	*
Tenderness	5.80 ^b	6.80 ^{ab}	6.50 ^b	7.55 ^a	0.178	*
Juiciness	5.85	5.80	6.45	6.65	0.184	NS
Flavour	5.5 ^c	5.65 ^{bc}	6.50 ^{ab}	6.90 ^a	0.182	*
Overall acceptability	6.40 ^b	6.70 ^b	7.40 ^a	7.75 ^a	0.150	*

a, b Means in the same row not followed by the same superscript are significantly different ($P < 0.05$). HW = Hot water, FW = Firewood., TYR = Rubber tyre., KERO = Kerosene., LS= Level of significant, * = Significantly different at ($P < 0.05$), NS= Non significantly different

Conclusion

It was concluded that hot water gave a pH of 6.08 and higher WHC numerically. Thus hot water can be used to remove the hairs in slaughtered animal carcasses, as this will reduce to a practicable level cross contamination of meat during processing. Goat's meat singed with kerosene gave the best sensory properties.

Uticaj različitih metoda termičkog tretmana trupova na kvalitet i senzorne osobine mišića jarčeva rase crveni sokoto

Ani Ugochukwu, Elisha Zhiri Jiya, Ocheme Boniface Ocheme

Rezime

Eksperiment je sproveden korišćenjem dvadeset četiri jarca rase crveni sokoto kako bi se procenio efekat metoda oprljivanja na kvalitet trupa i senzorna svojstva mesa jarčeva rase crveni sokoto (Chevon). Studija je sprovedena u Laboratoriji za nastavu i istraživanje životinja, Saveznog univerziteta za tehnologiju, u Mini. Trupovi jarčeva su nasumično raspoređeni na četiri metode oprljivanja - korišćenjem vruće vode, drva za ogrev, guma i kerozina posle klanja. Prikupljeni su podaci o senzornim parametrima, mineralnom sastavu, fizičkim i hemijskim svojstvima i približnom sastavu. Metode oprljivanja značajno ($P < 0,05$) utiču na sadržaj sirovih proteina i masti u uzorcima mesa, pri čemu je sadržaj značajnim sirovih proteina ($P < 0,05$) bio značajno viši u trupovima iz grupe sa pneumaticima (31,53%), dok je sadržaj masti bio značajno ($P < 0,05$) veći u trupovima iz grupe tretirane toplom vodom (5.80%). Sadržaj mineralnih materija se značajno razlikuje ($P < 0,05$) među ispitivanim metodama. Ph i termalno skraćivanje su značajno ($P < 0,05$) veći u trupovima tretiranim kerozinom (6,75 i 35,35 - respektivno). Metode oprljivanja imale su značajan uticaj na kvalitet trupa i senzorne osobine uzoraka mesa. Zbog toga je zaključeno da se vruća voda koristi za uklanjanje dlaka na zaklanim trupovima koza, jer će to smanjiti nivo unakrsne kontaminacije mesa tokom prerade. Upotreba ogrevnog drveta, gume i kerozina treba da bude potpuno obeshrabrena u preradi mesa, a javnost treba da se obrazuje o zdravstvenim posledicama konzumiranja životinjskih trupova tretiranih ovim metodama.

Ključne reči: metode termičkog tretmana, osobine trupova, senzorne osobine, jarac, mišić

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