

## EFFECT OF SLAUGHTERING PROCESSES ON MEAT QUALITY OF CATTLE IN AKURE SOUTH AND NORTH LOCAL GOVERNMENT AREAS OF ONDO STATE, NIGERIA

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### ABSTRACT

*The study investigated how the impact of various slaughtering methods affects the quality of beef in Akure South and North Local Government Areas of Ondo State, Nigeria, utilizing questionnaire-based data collection, the study employed a multi-stage sampling method involving 40 cattle butchers. Results show that 97.5% of the butchers were male, with skinning and singeing being the most common methods of carcass dressing. Statistical analysis revealed no significant differences in cooking loss with the highest values ( $42.19 \pm 0.77\%$ ) observed in singeing, while skinning had the lowest value ( $40.52 \pm 1.19\%$ ). Meat samples from the singeing had the highest thaw loss value ( $3.10 \pm 0.62\%$ ) compared to skinning ( $1.45 \pm 0.54\%$ ). The sensory evaluation shows no significant ( $p > 0.05$ ) difference. Skinning had the highest values ( $6.13 \pm 0.21$ ,  $6.20 \pm 0.17$ ) for juiciness and tenderness, while singeing had the lowest values ( $6.12 \pm 0.10$ ,  $5.92 \pm 0.28$ ). Singeing had the highest values for flavour and overall acceptability ( $6.05 \pm 0.23$ ,  $6.43 \pm 0.17$ ) compared to skinning ( $5.98 \pm 0.20$ ,  $6.40 \pm 0.26$ ). There was no significant difference ( $p > 0.05$ ) observed in the microbial status. Singeing meat recorded the highest bacterial count at  $14.00 \text{ CFU/ml} \times 10^7$ , while skinning had the lowest count ( $4.50 \text{ CFU/ml} \times 10^7$ ). Skin samples also presented the highest number of microbial isolates, including coliforms such as *E. coli*, observed in both singeing and skinning methods. Meticulous handling ensures food safety and satisfaction; skinning reduces bacterial contamination and produces tender meat compared to singeing.*

**Keywords:** Meat quality, Singeing, Skinning, Scalding, Microbial status, Cattle

### INTRODUCTION

The meat industry is pivotal in catering to global dietary meat requirements. With the rising demand for high-quality meat products, there is a growing emphasis on understanding the various factors that influence meat quality (Ponnampalam *et al.*, 2018). Among these factors, slaughtering processes stand out as

critical determinants impacting the sensory, nutritional, and functional properties of meat derived from cattle (Poveda-Arteaga *et al.*, 2023). Cattle play a significant role in Nigeria's meat supply and livestock industry, with beef accounting for approximately 45% of the total meat consumed in the country (Kubkomawa *et al.*, 2018). Most of the cattle production, over 90%, is managed by traditional producers,

primarily located in the Northern regions (Kubkomawa *et al.*, 2018). The quality of the final animal products heavily depends on their handling and processing methods, as well as environmental conditions (Sofos, 2013). Many animals brought for slaughter endure long distances treks or in crowded trucks, often arriving at the slaughterhouse in a weakened or exhausted state. Consequently, this can lead to tougher or lower-quality meat, sometimes resulting in dark and dry meat (Gallo *et al.*, 2022).

Slaughtering processes encompass a range of activities from stunning to bleeding, skinning, evisceration, and carcass chilling, each step potentially influencing the final meat quality (Nastasijevic *et al.*, 2023). The efficiency and humaneness of these processes not only affect the welfare of the animals but also significantly impact the ultimate palatability, tenderness, juiciness, and shelf-life of the meat produced (Ponnampalam and Holman, 2014). Inadequate pre-slaughter handling can have negative consequences on meat quality, leading to reduced consumer acceptance and lower profits for meat processors. Improper handling may result in carcass and meat quality issues such as pale soft exudative meat, dark firm dry meat, skin blemishes, blood splashes, bruising, spoilage, broken bones, and even death (Adzitey and Huda, 2012). Furthermore, advancements in slaughtering technologies, have been introduced to enhance both efficiency and animal welfare during the slaughter process (Sabow *et al.*, 2017). In many developing countries, challenges such as limited education, lack of access to clean water, and unreliable electricity supply contribute to traditional meat processing methods being carried out in unhygienic conditions (Rani *et al.*, 2017). This study delves into the effect of slaughtering methods and processing on the meat quality of cattle in Akure South and North Local Government Areas of Ondo State, Nigeria.

## MATERIALS AND METHODS

**Study Area:** The study was conducted from November 2023 – April 2024 in Akure South and North Local Government Areas within Ondo State, Nigeria, a region known for its agricultural

activities and diverse ethnic makeup. With a population of 5.4 million according to 2022 population projection by National Population Commission of Nigeria, the state spans 15,049 square kilometres and experiences a tropical rainforest climate, characterized by distinct wet and dry seasons (City Population, 2024).

**Data Collection:** The study gathered data using a close-ended questionnaire and interview guides. The collected data encompassed various demographic and socioeconomic variables, including age, gender, marital status, household size, educational attainment, and years of education. Additionally, the data covered aspects such as handling methods and slaughtering practices, among other relevant factors. The questionnaire was face-validated, pretested and tested for reliability before administration (Roopa and Rani, 2012).

**Sampling Procedure:** A multi-stage sampling technique was employed to select respondents (cattle butchers) for the study. Data collection was conducted in two local government areas, namely Akure-South and Akure-North, within Ondo State. The first stage was a purposive selection of two popular and functional slaughter slabs from each local government. The second stage was a random selection of 10 butchers per slaughter slab earlier selected from each local government bringing a total of accessed and interviewed butchers to 40.

**Meat Quality Parameters:** The quality of meat obtained from two slaughtering methods was assessed by examining organoleptic properties, cooking loss, and thawing loss in triplicate. Samples were collected from carcasses processed through skinning, scalding, and singeing at various slaughtering slabs in the morning. Cooking loss was determined by weighing samples before and after cooking for 25 minutes, while thawing loss was calculated by comparing weights before and after refrigeration (Li *et al.*, 2012). According to Agustina *et al.* (2021), organoleptic tests were conducted in the Meat Laboratory at the Federal University of Technology Akure (FUTA) by a panel of ten student panellists, evaluating aspects such as

juiciness, tenderness, flavour, and overall acceptance of the meat samples, using a specifically coded questionnaire for scoring.

**Microbiological Analysis:** Microbiological assay of four meat samples was conducted in triplicate in the Microbiology Laboratory at the Federal University of Technology Akure (FUTA). Samples obtained from the thighs of animals slaughtered at selected slaughtering slabs were collected, wrapped in foil paper, and transported inside a cooler with ice blocks to maintain freshness. The samples were then analysed for microbial counts, with bacterial isolation and characterisation performed using a series of culturing techniques and biochemical tests. Nutrient and MacConkey agar were used for culturing, and various biochemical tests, including glucose, oxidase, catalase, sugar fermentation, citrate, starch hydrolysis, urea agar, and dimethyl red tests, were carried out to identify and characterise bacterial organisms. The resulting data were reported as colony-forming units per millilitre (CFU/mL). The bacterial isolates were further cultured, streaked onto nutrient and MacConkey agar plates, and characterised based on morphological and cultural traits, Gram staining, and a series of biochemical reactions as described by Cheesebrough *et al.* (2006) and Muhammad *et al.* (2016).

**Data Analysis:** Socioeconomic characteristics of the respondents were analyzed using percentages, frequencies and central tendencies statistics. Data collected from meat quality and microbiological assays were all subjected to one-way Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD). Significant means were separated using the Duncan Multiple Range Test (DMRT) at  $p < 0.05$ . Statistical Package for the Social Sciences (SPSS) version 16 (SPSS, 2007) was used for all analyses.

## RESULTS

The socioeconomic characteristics of cattle butchers are reported; including age groups, educational levels, gender, religion, type of labour, and methods of animal acquisition in Table 1.

**Table 1: Socio-economic characteristics of cattle butchers in Akure South and North Local Government Areas of Ondo State, Nigeria**

Variables	Frequency	Percentage (%)
<b>Sex</b>		
Male	39	97.5
Female	1	2.5
<b>Age</b>		
26 – 30	1	2.5
31 – 35	15	37.5
36 – 40	16	40.0
41 – 45	4	10.0
46 – 50	3	7.5
51 – 55	1	2.5
<b>Level of Education</b>		
Secondary	3	7.5
Attempted Secondary	35	87.5
Attempted Tertiary	2	5.0
<b>Religion</b>		
Christianity	5	12.5
Islamic	34	85.0
Others	1	2.5
<b>Method of Cattle Acquisition</b>		
Purchased	38	95.0
Credit	2	5.0
<b>Method of Slab Acquisition</b>		
Inherited	6	15.0
Rented	34	85.0
<b>Type of Labour</b>		
Apprentice	39	97.5
Others	1	2.5
Total	40	100.0

Among the sampled butchers, 97.5% were males, and 2.5% were females. Regarding age distribution, the majority (40.0%) fell within the 36 – 40 years age group, followed by 31 – 35 years (37.5%), while other age brackets had varying percentages. In terms of education, 88% attempted secondary education, 7% completed secondary education, and 5% attempted tertiary education. Religious affiliation revealed 85% were Muslims, 12.5% were Christians, and 2.5% were of other religions. Most butchers (95%) acquired animals through purchase, and 5% procured on credit. Majority of the butchers (85%) acquired slaughter sites through rent, while 15.0% inherited the site. Additionally, 97.5% of butchers employed apprentices for daily tasks, often compensating them with meat, while 2.5% utilized labourers from other sources methods.

Table 2 presents the variables concerning slaughtering practices; including stunning, equipment utilization, sterilization, and carcass dressing methods.

**Table 2: Cattle slaughtering practices in Akure South and North Local Government Areas of Ondo State, Nigeria**

Variables	Frequency	Percentage (%)
<b>Stunning of animals</b>		
No	40	100
Yes	0	0
Cutlass	1	2.5
Knife and cutlass	39	97.5
Daily	12	30.0
Weekly	27	67.5
Fortnightly	1	2.5
<b>Equipment sterilisation</b>		
No	40	100.0
Yes	0	100.0
<b>Method of carcass dressing</b>		
Skinning	30	75.0
Singeing	10	25.0
Scalding	0	0
<b>Perception of carcass dressing method</b>		
Singeing meat carcass – tough	27	67.5
Singeing meat carcass – tender	2	5.0
Skinned meat carcass – tough	9	22.5
Skinned meat carcass – tender	2	5
<b>Total</b>	40	100.0

None of the butchers in Akure South and North Local Government Areas of Ondo State practice stunning during slaughter. Regarding equipment used in meat processing, 97.5% employ both knife and cutlass, while 2.5% solely rely on a cutlass. Cleaning practices for meat-cutting tables vary, with 67.5% cleaning weekly, 30.0% daily, and 2.5% fortnightly. Interestingly, none of the butchers sterilize their processing equipment. Carcass dressing methods predominantly include skinning and singeing, with 75.0% of butchers employing skinning, 25.0% using singeing, and none practising scalding. Additionally, more than half of the butchers prefer tender meat obtained from skinned carcasses (67.5%), followed by singed carcasses, while scalding and tough singed carcasses are less favoured (5.0%).

The microbial load and isolate of singed and skinned meat are shown in Table 3. There was a significant difference ( $p < 0.05$ ) between the parameters observed. The highest bacteria ( $14.00 \pm 3.06$  CFU/ml  $\times 10^{-7}$ ) value was recorded for singeing meat while skinning recorded the lowest value ( $4.50 \pm 0.96$  CFU/ml  $\times 10^{-7}$ ).

**Table 3: Microbial status of meat obtained from skinning and singeing methods**

Parameters	Singeing	Skinning
<b>Bacteria isolate</b>	<i>Pseudomonas aeruginosa</i>	<i>Pseudomonas aeruginosa</i>
	<i>Streptococcus faecalis</i>	-
	<i>Bacillus</i> spp.	<i>Bacillus</i> spp.
	<i>Micrococcus luteus</i>	<i>Micrococcus luteus</i>
	<i>Staphylococcus aureus</i>	<i>Staphylococcus aureus</i>
	<i>Salmonella</i> spp.	<i>Salmonella</i> spp.
	-	<i>Lactobacillus</i> spp.
	-	<i>Proteus vulgaris</i>
	-	<i>Serratia marcescens</i>
	-	<i>Enterobacter aerogenes</i>
<b>Coliform</b>	<i>Escherichia coli</i>	<i>Escherichia coli</i>
<b>Total bacteria count (CFU/ml <math>\times 10^{-7}</math>)</b>	$14.00 \pm 3.06$	$4.50 \pm 0.96$

Skinning has the highest number of microbial isolates and the coliform isolate includes *Escherichia coli* for both singeing and skinning and the bacteria species include *Salmonella* spp., *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus* spp., *Streptococcus faecalis*, *Micrococcus luteus*, *Lactobacillus* spp., *Serratia marcescens*, *Proteus vulgaris*, *Enterobacter aerogenes*.

Table 4 shows no significant differences were observed among all parameters evaluated. Cooking loss's highest value ( $42.19 \pm 0.77\%$ ) was observed in singeing while skinning had the lowest value ( $40.52 \pm 1.19\%$ ) among the slaughtering methods. The meat sampled from the singeing had the highest thaw loss value ( $3.10 \pm 0.62\%$ ) compared to skinning ( $1.45 \pm 0.54\%$ ). The sensory evaluation shows no significant differences ( $p > 0.05$ ) were observed in the juiciness, tenderness, flavour, and overall acceptability of meat samples between the two methods. However, numerical differences were noted in all parameters.

**Table 4: Effect of carcass dressing method on meat quality**

Treatments	Singeing	Skinning
<b>Cooking Loss</b>	42.19 ± 0.77	40.52 ± 1.19
<b>Thawing Loss</b>	3.10 ± 0.62	1.45 ± 0.54
<b>Sensory Quality</b>		
Juiciness	6.12 ± 0.10	6.13 ± 0.21
Tenderness	5.92 ± 0.28	6.20 ± 0.17
Flavour	6.05 ± 0.23	5.98 ± 0.20
<b>Overall acceptability</b>	6.43 ± 0.17	6.40 ± 0.26

Notably, tenderness and flavour showed the most noticeable numerical differences, with meat from the skinning method receiving the highest tenderness score (6.20 ± 0.17) and meat from the singeing method scoring higher in flavour (6.05 ± 0.23).

## DISCUSSION

### Socioeconomic Characteristics of Cattle Butchers:

According to Kaka *et al.* (2016), the butchering profession in the surveyed region is primarily occupied by young and middle-aged men due to the physical demands of the job. The limited formal education among butchers, as reported by the same authors, may hinder the adoption of modern slaughtering practices. Additionally, their study highlights a significant gender disparity, with male butchers outnumbering their female counterparts. Moreover, the prevalence of more Muslims among cattle butchers, as indicated by Adzitey *et al.* (2011), suggests a preference for producing halal meat. Furthermore, Sani (2009) noted that most cattle butchers rely on apprentices as labourers during the slaughter and processing of cattle. Most cattle butchers prefer cash transactions for cattle acquisition rather than credit, especially when procuring from distant northern states such as Yobe, Sokoto, Kano, Borno, Katsina, and Bauchi, as highlighted by Sani (2009). This emphasizes the economic advantage of cash purchases, particularly for long-distance transactions.

### Slaughtering Practices and Carcass Dressing Methods:

The investigation reveals that in the surveyed area, cattle butchers do not practice stunning animals before sticking, likely due to the predominance of Muslim individuals involved in slaughtering. This omission aligns with religious

beliefs and local traditions, as stunning contradicts their requirements. Limited knowledge about animal stunning among butchers also contributes to this practice. Lokuruka (2016) similarly observed that slaughter practices are often influenced by cultural and religious factors. Despite using both knives and cutlasses for meat processing, none of the interviewed butchers sterilised their equipment due to a lack of understanding of its benefits, which may lead to poor hygiene and potential pathogen multiplication in beef.

In terms of carcass dressing methods, skinning is preferred by 75% of butchers in the surveyed area, followed by singeing at 25%. Scalding is not utilized at all. Skin removal is favoured for its ability to produce more tender meat compared to singeing, as reported by Hui (2012) and Apata *et al.* (2021). Skinning exposes the meat directly to heat during cooking, promoting even cooking and tenderness. Additionally, it allows for the removal of connective tissue and fat deposits, resulting in a more uniform taste and texture, and enhancing flavour absorption from marinades and seasonings (LaRoche *et al.*, 2022).

### Effect of Carcass Dressing Method on Meat Quality and Microbial Status:

The comparison of different slaughtering methods in a study conducted by Adeniji *et al.* (2019) revealed that singeing resulted in higher cooking loss compared to skinning, consistent with previous findings. Singeing's exposure to high heat causes moisture evaporation and surface dehydration, leading to increased cooking loss (Manalo and Gabriel, 2020). Conversely, skinning preserves more moisture within the meat during cooking, resulting in lower overall cooking loss (Cassens, 2008). Similarly, studies by Akinwumi *et al.* (2022) and Apata *et al.* (2023) reported that skinning resulted in lower thawing loss compared to singeing due to its ability to retain moisture. Sensory evaluation studies by Omojola and Adesehinwa (2006) and Okoh (2019) showed no significant differences in juiciness, tenderness, flavour, or overall acceptability between meat samples processed through skinning or singeing, supporting the comparable quality of both methods.

The animal coats, such as cattle hide and sheep fleece, are known to host high levels of microorganisms, contributing significantly to carcass contamination (Amde and Bishoftu, 2015). Singeing resulted in higher bacterial counts compared to skinning which had lower counts, indicating its potential to reduce contamination (Akinwumi *et al.*, 2022). Increased contamination during skinning might be influenced by factors like non-refrigerated transportation, and fostering bacterial growth according to Van Dijk *et al.* (2014). The identified microbial isolates, including *Salmonella spp.*, *Staphylococcus aureus*, and others, align with previous studies (Wieczorek and Osek, 2010; Adesiji *et al.*, 2011; Niyonzima *et al.*, 2013.). Skinning's efficacy in reducing bacterial contamination is supported by lower counts compared to singeing, attributed to its removal of the outer skin layer, potentially decreasing overall bacterial load (Akinwumi *et al.*, 2022).

**Conclusion:** The study revealed that butchers in Akure South and North Local Government Areas showed no preference for specific cattle breeds, often transporting them by truck to slaughter slabs lacking shelter and proper facilities. They predominantly used cutlasses and knives for processing carcasses, favouring skinning and occasionally singeing but rarely utilizing scalding. While both skinning and singeing were deemed to produce tender meat, skinning was believed to be more effective in reducing bacterial contamination compared to singeing.

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