EVALUATION OF SENSORY CHARACTERISTICS OF DIFFERENT PROCESSED MEAT PRODUCTS FROM INTENSIVELY REARED BUCK AND RAM IN JOS PLATEAU STATE

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ABSTRACT
The aim of the study was to evaluate the sensory characteristics of different processed meat products from intensively reared buck and ram. The experiment was carried out at Federal College of Animal Health and Production Technology Vom, Plateau State. Two (2) intensively reared Red Sokoto bucks and Yankasa rams aged 12 months and weighing 15 – 20 kg were used for this experiment. The bucks and rams were randomly selected and were fed mainly Rhode grass (Chloris gayana) as basal diet. Prior to the slaughtering processes, the animals were fasted for 24 hours with free access to water. The carcasses were cut into primal cuts (shoulder, rack, loin, breast shark and flank) according to standard method. Four kilograms (4 kg) each of lean meat were collected from the loin region of each of the animals for further processing. The meat was collected and processed from each animal into different meat products (Tsire, Balangu and Tukunya) and subjected to sensory evaluation for their Colour, Flavour, Tenderness, Texture, Juiciness and acceptance. Ten (10) panelists were trained for the assessment procedure two days prior to the evaluation. The results obtained from the panelist reports showed that there was no significant difference in the colours and overall acceptability of the meat products from buck and ram ($p>0.05$). Tukunya differed significantly ($P<0.05$) in flavour and tenderness when compared with Balangu and Tsire from buck while all the meat products (Tsire, Balangu and Tukunya) from buck differed significantly ($P<0.05$) when compared based on their juiciness and texture. The meat products from ram showed no significant difference ($p>0.05$) in their colour but based on the flavour and juiceness, Tukunya differed significantly when compared with Tsire and Balangu ($P<0.05$). The tenderness, texture and overall acceptability of Tsire, Balangu and Tukunya from ram meat differed significantly ($P<0.05$) when compared. In conclusion, there was no difference in the colour of the meat products based on species while other sensory characteristics varied according to the meat products. Finally, the overall acceptability of the meat products from goats were the same while that of the ram varied based on the products.
Keywords: Bucks, Rams, Meat, Sensory attributes, Plateau State

INTRODUCTION

In Nigeria, the rising domestic demand for meat is driven by increased health consciousness, nutritional awareness, and disposable income among consumers. This heightened demand underscores the importance of meat quality, particularly its sensory and organoleptic properties, which significantly influence palatability and acceptability. Kalla *et al*. (2015) identified that concerns over these sensory attributes are primary objections to the consumption of locally processed meat products. To enhance consumption and patronage, it is recommended to conduct comparative assessments of different meat products before market delivery. Ojewola and Onwuka (2011) noted that consumers are increasingly willing to pay a premium for improved and better-quality products from the local meat industry.

The primary livestock species contributing to red meat production in Nigeria include sheep, goats, cattle, and camels. Sheep are particularly significant, providing almost 30% of the meat consumed and around 16% of the milk produced in Sub-Saharan Africa. In Nigeria, sheep contribute about 50% of the total domestically produced meat. The four main indigenous sheep breeds are Balami, Uda, Yankasa, and West African Dwarf. Balami and

Uda are prevalent in semi-arid regions, West African Dwarf sheep in the south, and Yankasa throughout the country. These breeds exhibit considerable differences in size, coat color, and other characteristics. Among them, Yankasa is the most widely reared due to its adaptability across various regions, hardiness, favorable body weight and size, efficient feed conversion ratio, and quick return on investment Salihu *et al.* (2020).

Goats hold a dominant position among domesticated small ruminants in Nigeria. The country ranks fifth globally in small ruminant production, with populations of 73.8 million goats and 53.7 million sheep. Sheep and goats together represent about 53.7% of total grazing domestic animals in Nigeria (FAOSTAT, 2015). The three recognized goat breeds are the West African Dwarf (WAD), Sahel (SH), and Red Sokoto (Maradi) goats. The Red Sokoto breed is particularly significant and widely distributed in Northern Nigeria, being the most common village goat in the northern two-thirds of the country. At birth, these goats weigh about 1.5–2.0 kg and reach approximately 12.0 kg at weaning (3 months) under good management. Adult does and bucks weigh between 20–35 kg and 25–40 kg, respectively. Both sexes are horned, and the breed has an average milk yield of 3.8 kg per week. Additionally, Red Sokoto goats are renowned for their suitability for fine leather production (Makun *et al.,* 2019.

Historically, there has been a focus on beef quality, leading to a neglect in understanding the carcass characteristics and meat quality traits of indigenous sheep and goat breeds. However, with butchers' expectations and consumer demand for superior quality meat with optimal nutritional value, the importance of mutton quality has become more prominent. Chilling freshly harvested meat carcasses is essential for food safety and quality. Before mechanical refrigeration, meat had to be consumed immediately after slaughter or preserved through methods like salting, curing, and smoking. The advent of mechanical refrigeration and refrigerated transport has made the production, processing, and distribution of carcasses and cuts more practical. It has been known for about half a century that exposing meat to cold temperatures early postmortem can cause cold shortening or cold toughening.

Ikeme (2014) stated that meat, being nutritious with high moisture content and nearly neutral pH, serves as an excellent culture medium for most bacteria fyanand fungi, classifying it among perishable foods prone to contamination by spoilage organisms. Bala (2016) indicated that meat preservation is more challenging than other foods, as it may result in oxidative rancidity, discoloration, moldiness, off-flavors, and sliminess. However, meat processing enables the conversion of low-priced meat cuts into high-priced products and facilitates packaging, handling, distribution, and marketing.

MATERIALS AND METHODS

Experimental Site

The study was carried out in Jos South LGA of Plateau State Nigeria. It is one of the seventeen LGAs in Plateau State. It lies between Latitude 8 – 43^0 North and Longitude 8 – 46^0 South with an altitude of 1293.2m above sea level. It is the second most populated LGA after Jos North LGA. The LGA has the population of 650,835 (National Population Commission, 2006) with an average land of 1.037km. The dialect spoken in Jos South is Berom and their sources of income are mining and farming.

Management of Experimental Animals

Two (2) intensively reared Red Sokoto bucks Yankasa rams aged 12 months and weighing 15 – 20kg were used for this experiment. The bucks and rams were randomly allotted into dietary supplements of chevron and mutton production ration respectively in a completely randomized design (CRD). Ingredients used in the formulation of the concentrate are: maize offal, rice offal, cowpea shell, groundnut haulm, cotton seed cake, bone meal, premix and table salt. The Bucks and rams were fed Rhode grass (*Chloris gayana*) as basal diet.

The experimental animals were housed in individual pens. Prior to the experiment the Bucks and rams were dewormed using Albendazole suspension and dipped in acaricide (Amitix) solution one week before the commencement of the feeding trial to control endo and ecto-parasites. Fresh drinking water was available at all day times in other to give the animals the right to hygienic water and freedom from thirst. Fecal remains were removed daily, drinkers and feeders were clean daily and environment kept clean to avoid disease outbreak. They were fed the supplementary concentrate diet at 1.5% body weight and basal diet of urea-molasses treated maize cob *ad libitum*. The concentrate ration was adjusted at regular intervals of 2 weeks along with changes in live weight. The trial lasted for a period of 60 days.

Slaughter and Selection of Meat Parts

Prior to the slaughtering processes, the animals were fasted for 24 hours with free access to water. The animals were slaughtered according to the Halal standard procedure by severing the Jugular vein and carotid arteries. The hairs were removed by skinning as described by (Salihu *et al.,* 2020). The internal organs (kidney, liver, heart and spleen) were carefully excised and separated to avoid contamination. The carcasses were cut into primal cuts

(shoulder, rack, loin, breast shark and flank) according to the method described by (Salihu *et al.,* 2020). 4kg each of lean meat were collected from the loin region of each of the animals for further procesing.

Meat Processing

Tsire

The preparation of the Tsire were done as described by Igene and Mohammed (2013) and Uzeh *et al.* (2006). The ingredients comprised of groundnut cake powder, Pepper powder, ginger powder, Onion powder, groundnut oil, seasoning cube (Maggi™), Masala™ (curry, thyme and nutmeg) and table salt. The fire was first set by burning the fire wood into red hot charcoal before staking the meat for roasting. The roasting was done on a local *tukuba*; a heap of soil built for the same purpose. The fresh meat staked on skewer was fixed into the soil around the glowing charcoal fire to roast.

Balangu

Balangu is prepared from boneless meat of a sizeable cut, which were placed on a wet brown paper on a wire mesh over fire to roast. The pieces of meat were sliced into thin sheets not less than 1 cm in thickness. Groundnut oil and spices were added during roasting. The meat was turned continuously until it was well roasted as reported by (Kalla *et al.,* 2015)

Tukunya

This is similar to Balangu except that the sizeable cuts are enwrapped in a wet brown paper after adding groundnut oil and spices. It was then placed on a wire mesh over fire to roast (Zahraddeen *et al.,* 2006).

Sensory Evaluation

The meat was collected and processed from each animal into different meat products and subjected to sensory evaluation for their Colour, Flavour, Tenderness, Texture, Juiciness and acceptance. Ten (10) panelists were trained for the assessment procedure two days prior to the evaluation; these were done using the method described by (Salihu *et al.,* 2020).

Statistical Analysis

The data collected were subjected to Analysis of Variance (ANOVA), using the general linear model procedure of Statistical Analysis is System (SAS) 2005. The significant differences among the treatment means were separated using the Duncan's Multiple Range Test (DMRT) in the SAS package.

RESULTS

Table 1: Showing Sensory parameters of different meat products from intensively reared Red Sokoto buck

Parameters	Colour	Flavour	Tenderness	Juiciness	Texture	Overall acceptability
Red Sokoto Buck						
Tsire	5.87	3.67^{a}	4.27^{b}	3.80^{c}	5.20^{a}	7.07
Balangu	4.93	3.67^{a}	4.53^{b}	5.13^{bc}	4.85^{b}	6.87
Tukunya	4.60	4.80^{ab}	5.33^{ab}	5.87^{ab}	4.30^{c}	6.00
SEM	0.28^{NS}	0.27^{*}	0.27^{*}	0.32^{*}	0.44	0.24^{NS}

^{abc} Mean value in the same column with the same letters did not differ significantly ($p>0.05$), SEM – Standard error of mean

Table 2: Showing sensory parameters of different meat products from intensively reared Yankasa ram.

Parameters	Colour	Flavour	Tenderness	Juiciness	Texture	Overall acceptability
Yankasa Ram						
Tsire	5.17	4.13^{b}	5.90^{a}	4.83^{b}	5.27^{b}	6.70^{b}
Balangu	5.83	4.30^{b}	3.67^{c}	4.90^{b}	4.30^{c}	5.87^{c}
Tukunya	6.54	5.34^{a}	5.34^{b}	5.22^{a}	6.00^{a}	7.35^{a}
SEM	0.23^{NS}	0.28	0.32	0.33	0.36	0.26

[abc] Mean value in the same column with the same letters did not differ significantly ($p>0.05$), SEM – Standard error of mean, NS = Not Significant

DISCUSSION

The influence of breed that is reported significant ($p<0.05$) on the organoleptic properties in Table 1 is in accordance with (Salihu *et al.,* 2020) who reported significant ($p<0.05$) of breed effect on all sensory properties and also with was reported in his review that breed has effect, however low on the sensory properties of meat. Meat colour hold the most impacting criterion in the purchase decision, through its intensity or instability or alteration, and it remains the major visual parameter used by consumers. The colour of fresh meat is however shaped by its myoglobin content and its pH. (Salihu *et al.,* 2020) reported that Balami strain was rated significantly highest ($p<0.05$) for all organoleptic properties, whereas in this study, the Yankasa Ram was rated highest for Colour, flavor, tenderness, and texture ($p<0.05$) moderately significant. Tsire, Balangu and Tukunya processed products had no significant ($p>0.05$) effect on the colour but had significant difference ($p<0.05$) on all other processed products.

Tenderness is the most important eating quality characteristic, and it determines consumer acceptability. Okoh (2019) reported highest value ($p>0.05$) for West African Dwarf meat tenderness processed under scalding method, this study proved similarly to Okoh (2019) but contradicted the Omojola and Adesehinwa, (2006) who reported the processing method to have significant on the tenderness of rabbit meat. The meat tenderness, juiciness, flavour, and overall acceptability are positively related to Intramuscular fat content, even though these relationships can vary between countries. However, the lowest ($p<0.05$) significant value obtained in Red Sokoto Buck (*Tsire*) in terms of juiciness (3.80) is expected due the dehydration that has occurred during burning treatment. *Tsire* and *Balangu* form the Red Sokoto Buck chevron had higher overall acceptability compared to the same processed products of Yankasa ram chevron, however, the overall acceptability of *Tukunya* processed product rated more in Yankasa ram than Red Sokoto Buck Chevon.

The study found no significant difference ($p > 0.05$) in the color and overall acceptability of meat products from buck and ram. This aligns with previous research, which suggests that species has minimal influence on the color of cooked meat products (Lawrie & Ledward, 2006). Meat color is primarily affected by factors such as myoglobin content, diet, and processing conditions rather than the species itself (Mancini and Hunt, 2005). This also aligns with the findings of Doma *et al*. (2024), who evaluated various meat products—Tsire, Balangu, Danbu Nama, and Kilishi—processed from beef. Their sensory evaluation revealed that Tsire had the highest scores in parameters such as color, juiciness, palatability, tenderness, and overall acceptability. While their study focused on beef, the lack of significant differences in color among different meat products suggests that processing methods may play a more crucial role than the species of origin in determining color attributes.

The significant difference ($p < 0.05$) observed in Tukunya's flavor and tenderness of buck meat suggests that the processing or composition of Tukunya may alter these sensory properties. Studies indicate that goat meat often has a stronger flavor due to its higher proportion of volatile compounds such as branched-chain fatty acids (Kadim *et al*., 2014). This may explain the flavor variations observed in Tukunya. Additionally, tenderness is influenced by connective tissue composition, which varies between species and cuts (Koohmaraie, 1996). This may also be influenced by specific processing techniques and the inherent characteristics of the meat. Bashir *et al*. (2024) assessed the sensory attributes of *Dambu* —a traditional shredded meat product—prepared from various poultry species. Their findings indicated that guinea fowl *Dambu* was superior in tenderness and palatability, while local chicken *Dambu* had the highest acceptability score. Although this study focused on poultry, it underscores the impact of species and processing methods on flavor and tenderness.

The significant differences in juiciness and texture among buck-derived meat products (**p < 0.05**) could be attributed to variations in processing methods and the specific cuts of meat used. A study by Omojola *et al*. (2019) investigated the effect of dietary garlic powder supplementation on the quality of Kilishi—a dried meat product made from West African Dwarf rams. The results suggested that garlic powder supplementation enhanced certain sensory attributes, including juiciness and texture, thereby improving the overall quality of Kilishi. These findings are also consistent with studies indicating that goat meat generally has lower intramuscular fat than sheep meat, affecting juiciness (Webb *et al.,* 2005). Texture variations could result from different cooking methods and the muscle fiber characteristics of the specific meat products.

In ram meat products, while color differences were not significant, Tukunya differed significantly in flavor and juiciness compared to Tsire and Balangu (**p < 0.05**). This variation may result from the unique processing techniques and ingredient formulations used in Tukunya. Doma *et al*. (2024) highlighted that different meat products, even when derived from the same species, can exhibit significant differences in sensory attributes due to variations in processing methods and spice applications. Furthermore, the tenderness, texture, and overall acceptability of the ram meat products differed significantly, suggesting that processing methods influence the sensory perception of different products from the same species. According to Hoffman *et al*. (2003), sheep meat is generally more tender than goat meat due to higher fat content and shorter muscle fibers, which may explain the variation in tenderness and texture.

CONCLUSION

The findings indicated that species had no impact on color, while other sensory characteristics varied based on the product type. Goat-derived meat products had uniform overall acceptability, whereas ram-derived products varied significantly. This suggests that product-specific attributes (e.g., processing methods, seasoning, and fat content) play a crucial role in consumer perception, supporting prior research in sensory evaluation of meat (Purslow *et al*., 2016). Based on the research findings, the following recommendations can help enhance the sensory attributes and overall acceptability of meat products from buck (goat) and ram (sheep) meat: improve tenderness and texture through processing techniques, enhance flavor through optimized seasoning and smoking, improve juiciness through fat optimization, standardize meat processing for consistent quality and consumer sensory preference studies**.** Implementing these recommendations can help improve the sensory attributes of meat products from bucks and rams, thereby increasing consumer acceptability. By focusing on tenderization methods, spice optimization, fat enhancement, and standardized processing techniques, meat processors can ensure high-quality meat products that meet consumer expectations

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