NUTRITIONAL QUALITY OF *SUYA* PREPARED FROM MUTTON USING DIFFERENT TYPES OF MUSCLES

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ABSTRACT
Mutton is expensive expecially during muslim festivals. There is a need to increase the value of mutton into value-added products. The aim of this study was to evaluate the influence of different types of muscles on the physical, chemical, sensory and microbiological properties of suya. Three different types of muscles (Semitendonisus (ST), Deltodius (DT) and Adductor (ADD)) were harvested from the carcasses of fattened Balami rams. The muscles were grouped into three treatments to evaluate for physical properties of mutton and studying the changes in the chemical compositions of suya. The microbiological properties of the products were measured.The Water Holding Capacity was highest (P<0.05) in DT (78.17±9.83%) followed by ADD (77.21±9.63%) and least in ST (68.10%). The PY was highest in the DT with a value of 73.83±3.65% and the lowest was 69.81±2.64% for ST. There were significant differences (P≤ 0.05) among the treatments in chemical analyses; indicated that suya samples from ST muscle had the highest percentage of moisture (23.01±0.51%) compared to the lowest percentages of DT (22.46±0.42%) and ADD treatments (22.43±0.37%). Suya samples from ST treatments contained lowest content of cholesterol (48.67±5.40mg/100g), while DT treatments contained the highest content of cholesterol (53.08±3.96mg/100g). However, there were significant differences when compared with suya samples from DT muscles. This study revealed signicant effects of muscles on physical and chemical indices of suya due to variation in muscle fibre.

Keywords: *Suya*, *Semitendonisus*, *Deltodius, Adductor, muscle,* Water holding capacity, product yield.

INTRODUCTION
Meat quality has always been important to the consumer, and it is especially critical issue for the meat industry. As consumer demand for high quality meat is increasing, the meat industry should consistently produce and supply quality meat that is tasty, safe and healthy for the consumer to ensure continued consumption of meat products.

Mutton production remains one of the potential of high quality protein to meet the increasing demand for meat products. Mutton is harvested from a mature sheep. Mutton has several health benefits, just has people eat beef on daily basis in other part of the world people. It is believed that there is a relationship between the properties of muscles and physico-chemical traits of meat. In light of this, the current study aimed at comparing the effects of muscle types on physico-chemical properties, sensory evaluation and and microbiological qualities of *suya* produced from *Semitendonisus* (ST), *Deltodius* (DM) and Adductor (ADD) muscles harvested from carcasses of fattened Balami rams.

MATERIALS AND METHODS
Meat preparation: Mutton used for this study were the *Semitendonisus* (ST), *Deltodius* (DM) and Adductor (ADD) muscles harvested from the carcasses of fattened Balami rams (average age of 14 to 16 months) slaughtered by Halal method at the slaughter house of the Department of Animal Science, University of Ibadan.

Physical Evaluation:

Water-Holding Capacity (WHC): WHC of meat samples from the ST, DT and ADD muscles were determined with press method as slightly modified by Suzuki *et al.* (1991).

Cooking Loss (CL %): Meat sample (150g) was placed in tightly sealed polyethylene oven bag and heated in a water bath at 75°C until an internal temperature of 71°C (as indicated by a thermocouple) was achieved. The Cook-out was drained and the cooked mass was cooled, dried with filter paper and reweighed. The CL was expressed as the percentage loss related to the initial weight (Pena *et al.*, 2009).

Shear Force (kg/cm^2): Measurement for shear force value as indication of meat tenderness was

carried out using Warner-Bratzler Shear force (WBSF) apparatus.

Preparation of ingredient for *Suya (tsire)*: Spices and other additives used for preparation of ingredient for *suya (tsire)* were purchased individually from Bodija Market, Ibadan, Nigeria. All the spices were sundried, milled and mixed thoroughly with powdered groundnut cake and seasoning as shown in Table 1.

Preparation of *Suya*: The ingredient was spread on a clean, dry tray and each stick of meat was properly dusted with the ingredient (Omojola *et al.*, 2004). An individual *suya* stick, which was about 30 cm long, was weighed and the thin sheets of meat inserted into the *suya* stick. A total of 60 sticks of *suya* were prepared from each muscle type.

Roasting of *Suya*: The labelled stick meat were arranged round a glowing, smokeless fire made from charcoal. The distance of the stick of meat from the point of heat was 24 and 25cm. The stick meat were allowed to stay on the fire for average of 20 mins with intermittent turning at average of 10 mins of the product.

Percentage of product yield of fresh *Suya (tsire)*: The product yield of *suya* was claculated using the method described by Kembi and Okunbajo (2002). It was expressed as the ratio of the final weight of the product to the initial weight of raw samples of *suya*.

Chemical Indices: Proximate composition was determined for *suya* samples according to AOAC, 1990. Lipid oxidation was conducted according to the method of Leick *et al.* (2010) after 24 hours of prodution.

Microbiological Quality: The microbiological quality and safety of *suya* were assessed on the basis of Total Aerobic Count (TAC), Total Coliform Count (TCC) and Total Fungal Count (TFC) using Nutrient agar, MacConkey agar and Potato dextrose agar, respectively. The design for fresh *suya (tsire)* in this study was completely randomized design (CRD). Data generated were subjected to statistical analysis using (SAS, 1999), while means were separated with Least Significant Difference of the same software.

RESULTS AND DISCUSSION

Processing characteristics of *Suya*: The results of the effects of muscle on the physical properties of mutton are expressed in Table 2. The water holding capacity varied between 68.10±10.12 and 78.17±9.83%, 68.10±10.12 in ST muscle; while 77.21±9.63 in ADD and 78.17±9.83% in DT muscles. The results of the analysis indicated the differences in water holding capacity between the three muscles were significant ($P<0.05$). The trend for a lower WHC in ST muscle might suggest that the meat is juicier than DT and ADD muscles. The improved WHC for DT and ADD muscles could be due to proteolytic degradation which has subsequently caused swelling of the myofibrils and allowed the meat to retain water (Huff-Lonnergan, 2005). It was observed that the cooking loss in ST was higher (30.67±2.78%) compared to DT (26.70±3.85%) and (26.70±3.00%). The highest cooking loss might be due to changes in sarcomere length which resulted in longitudunal shrinkage and more crosslinks that compelled more water out of the cooked muscles. There were differences ($P<0.05$) in SF values across the three different muscles investigated in this study. The highest SF values ($P< 0.05$) were obtained for DT (4.79±0.31) and ST (4.39±0.21) while the lowest SF value ($P< 0.05$) were observed for ADD (3.97± 0.30). These differences could be attributed to the differences in intramuscular fat content and muscle fibres due to their high binding ability and water holding capacity.

Chemical composition of *suya* from different muscle types: The proximate composition of *suya* from different types of muscles is as shown in Table 3. The effects of muscles on the chemical composition of *suya* in this study was not significantly different for crude protein, ether extract, TBARS and nitrogen free extract. The *suya* produced using ST muscle had the highest moisture content (23.03±0.51%), followed by those *suya* produced using DT (22.46±0.42%) and *suya* produced from ADD (22.43±0.37%). The presence of (TBARS) in a sample of meat products indicates that lipid peroxidation has taken place and the level of TBARS showed the amount of peroxidation that has already occurred (Lukaszewicz *et al.*, 2004). TBARS values fall within the minimum threshold value (1-2 mg malonaldehyde/kg) recommended by the Central Agency for Standardization and Quality Control (1987). The highest ($P<0.05$) value of cholesterol was established in *suya* produced from DT (53.08±3.96mg/100g) and it is higher than the

values obtained for *suya* from ST (51.33±4.60mg/100g) and ADD (48.67±5.40mg/100g) muscles. The three types of muscle showed definite differences in the cholesterol content. The results from this studies indicated a predicted relationship between muscle types and cholesterol. It might be hypothesizesd that the differences between DT and the other two muscles cause a significant influence on cell structure, which could result in higher cholesterols.

Microbial loads of *suya* produced from diffent types of muscles: The microbiological evaluation of the three *suya* samples is as shown in Table 6. No significant difference ($P<0.05$) was found in TAC and TCC. The reason for this might be due to the addition of some preservatives which have an important role in reducing the growth of anaerobic bacteria and coliforms (Al-Obaidi, 2005).

CONCLUSION

As indicated by physical properties, chemical composition as well as microbiological qualities, it is concluded that *Deltodius* and *Adductor* muscles from fattened Balami ram are an excellent sources of meat alternative to *Semitendonisus* muscle in *suya* production.

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Table 1: Percentage composition of Suya ingredient

Name of spices and Additives	Scientific names	Percentage
Groundnut cake powder	*Arachis hypogea*	52.00
Ginger	*Zingiber offinale*	5.00
Garlic	*Allium sativum*	5.00
Red Dried pepper	*Capsicum annuum*	10.00
White dried pepper	*Piper nigrum*	5.00
Curry	*Murraya koenigii*	5.00
Salt	*Sodium chloride*	8.50
Seasoning	(*Monosodium glutamate*)	7.50
Groundnut oil		2.00
Total		100.00

Source: Omojola *et al.* (2004)
* 5-10 mls of groundnut oil was added to each stick of meat during roasting.

Table 2: Physical properties of mutton used in *suya* production

Parameters	ST	DT	ADD
Water Holding Capacity	68.10±10.12^{b}	78.17±9.83^{a}	77.21±9.63^{a}
Cooking Loss	30.67±2.78^{a}	26.70±3.85^{b}	26.70±3.00^{b}
Shear Force	4.39±0.21^{b}	4.79±0.31^{a}	3.97±0.30^{b}
Product Yield	69.81±2.64^{b}	73.83±3.65^{a}	72.95±3.02^{a}
pH	5.85±0.05^{a}	5.71±0.06^{b}	5.68±0.05^{c}

^{a,b} :Means with different superscripts in the same row differ signifcantly (P<0.05).

Table 3: Chemical composition of *suya* produced from three different types of muscles

Parameters	ST	DT	ADD
Moisture Content	23.03±0.51^{a}	22.46±0.42^{b}	22.43±0.37^{b}
Crude Protein	49.50±0.95	49.44±1.06	50.14±0.47
Ether Extract	18.04±0.46	18.05±0.67	17.99±0.49
Ash	7.98±0.41^{b}	8.53±0.47^{a}	7.98±0.51^{b}
Nitrogen Free Extract	0.82±0.16	0.86±0.14	0.86±0.14
Cholesterol	48.67±5.40^{b}	53.08±3.96^{a}	51.33±4.60^{ab}
TBARS	0.21±0.02	0.22±0.04	0.21±0.02

^{a,b,} :Means with different superscripts in the same row differ signifcantly (P<0.05).

Table 4: Microbiological properties of *suya* produced from three different types of muscles

Parameters	ST	DT	ADD
TAC	4.95±2.13	3.99±3.02	5.84±2.08
TCC	3.21±2.15	4.13±2.04	3.89±1.94
TFC	5.43±2.91^{a}	3.20±1.81^{b}	5.00±2.48^{b}

^{a,b,} :Means with different superscripts in the same row differ significantly (P<0.05).