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QUALITATIVE AND ORGANOLEPTIC PROPERTIES OF *suya* PRODUCED FROM SELECTED MUSCLES OF NIGERIAN LOCAL DUCKS RAISED IN DIFFERENT LOCATIONS OF EKITI STATE

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ABSTRACT

Production of easy, highly nutritive, cheap and affordable ready-to-eat meat products as delicacy should consistently be made available to ameliorate shortage of animal protein in the diets. The study investigated the effect of different locations on qualities and sensory properties of suya produced from breast and drum stick muscles of Nigerian indigenous breed of ducks. A 24 indigenous breed duck of 24 months old of an average live weight of ±3.5kg for the drakes (male) and ±2.5kg for females were randomly selected from household keepers within three different locations in Ekiti State. The birds were acclimatized for two weeks and quarantined. Six ducks were randomly selected from treatment group, weighed prior slaughtering, carcasses dissected into standard cuts. The breast muscles were filleted and weighed. The breast and drum stick muscles were chilled at 4°C in a polythene bags overnight. Suya ingredients were prepared and muscles processed into suya. Suya were roasted on a smokeless fire to internal temperature of 70^0C and cooled before weight was taken. Suya was evaluated for cook loss, cook yield; organoleptic properties, moisture content, shear force, Thiobarbituric Acid Reacting Substance (Tbars) and pH. The study revealed that meat qualities (thaw loss, cook loss, cook yield and pH values) significantly differs ($p<0.05$); shear force of suya of female muscles differ significantly ($p<0.05$) between locations and Tbars values did not differ ($p>0.05$) in suya samples of breast and drum stick muscles derived from male and female ducks from different locations. The overall best organoleptic properties was rated in breast suya meat of male from location A (Ekiti Central) while the drum stick suya was best rated in female duck of location B (Ekiti North).

KEY WORDS: suya, muscles, indigenous ducks, sex, different locations.

1.0 INTRODUCTION

Animal products of value added varieties such as spiced, cooked and uncooked have been in use from the time immemorial. Some of the meat products consumed are products from animal such as cattle (beef/veal), sheep (mutton), swine (pork), goats (chevon), poultry (chicken) and games. Conversion of meat into healthy, easy, affordable and ready-to-cook and ready-to-eat products contributes to meeting the need for adequate consumption of daily animal protein requirement in the diet.

Value-added meat products such as comminuted, non-comminuted meat, dry, smoke and fermented products are always available as delicacies, generate income per household and could boost the nation's gross domestic product (GDP) through exportation of animal products. Several poultry species have been processed into fast muscle food products that are being sold along the road side, restaurants, open markets and

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other available outlets in Nigeria. *Suya*, a special meat delicacy is known to be popular among the Northerners in Nigeria [1]. The population of Nigerian is increasing on geometric progression on daily basis while the source of meeting the demand for animal protein is growing on arithmetic progression. To ameliorate this major challenge, there is need to utilize less exploited poultry specie such as Nigerian indigenous ducks which is gradually going into an extinction. Therefore, the study aimed at investigating the yield and consumer's preference of *suya* an intermediate moisture meat from the indigenous duck raised under extensive system at three different locations in Ekiti State, South-West region, Nigeria.

2.0 MATERIALS AND METHODS

2.1 Animal management and experimental design

A total number of twenty four of twenty-four months old Nigerian indigenous ducks comprise twelve drakes and twelve female were procured. Eight ducks each were randomly selected from households per locations. Animals were housed individually in a pen at the poultry unit of the Teaching and Research farm, Ekiti state University, Ado-Ekiti. The birds were acclimatized for one week, dewormed and fed with maize grain and water provided.

2.2 Sample collection

Three drakes and three female ducks were randomly selected from each location. The average live weight of birds was taken prior slaughtering, stunned humanely, sticked, bled adequately, defeathered by scalding, eviscerated and dismembered into standard commercial chicken cuts. The breast and drum stick muscles muscle types were selected from the cut-parts. The selected muscles were weighed separately, wrapped with polythene bags and labeled accordingly. Muscles were chilled at 4°C overnight. The spice used for the ingredients were procured from main market, Ado, Ekiti State.

2.2 Preparation of *suya*

A mixture of ingredients for *suya* marinade comprise salt, black pepper, red pepper, garlic powder, ginger powder, alligator pepper and curry powder. Table 1 shows composition percentage of the mixture. Each of the meat muscles was gently placed in the constituted mixture (marinade) leaving no part untouched and marination was allowed for about 1hr 30mins. The spiced meats were spread on the wire mesh placed on heat source; a smokeless fire made from charcoal and sprinkled with groundnut oil for easy penetration of marinades. The duck meat *suya* was roasted to internal temperature of 70°C. Cooked *suya* samples were spread out on clean absorbable paper, allowed to cool to room temperature and analyzed.

2.3 Determination of physical properties of *suya*

2.3.1 pH determination

The pH of *suya* samples was determined using a pH meter after calibration with pH 4, 10 and 7 buffers. All analyses were taken in triplicate.

2.3.2 Thaw loss (%)

The thaw loss was evaluated by deducting the weight of sample after chilling from weight of sample before chilling divided by weight of sample before chilling multiply by one hundred.

$$\text{Thaw loss (\%)} = \frac{\text{weight of sample before chilling - weight of sample after chilling}}{\text{Weight of sample before chilling}} \times 100$$

2.3.3 Moisture content

The moisture content of the sample was determined according to the procedure of [2].

Table 1 Composition of *suya* ingredients

Ingredient constituents	Proportion by weight (g)	Percentage proportion in mixture (%)
Garlic powder	101	20.2
Ginger powder	101	20.2
Alligator pepper	20	4
Black pepper	20	4
Red pepper	70	14
Curry powder	50	10
Salt	85	17
Monosodium glutamate	53	10.6

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Total	500	100

2.3.4 Cook loss
The percentage cook loss was evaluated by subtracting the weight of cooked sample from weight of raw sample, divided by the weight of raw sample and the result multiplied by 100.
2.3.5 Cook yield
The percentage cook yield was calculated by dividing the weight of cooked samples by the initial weight and the result multiplied by 100.
2.3.6 TBARS determination
Thiobarbituric Acid Reacting Substance (TBARS) was determined by the assessment of lipid oxidation [3]. TBARS rates were calculated from a standard curve and expressed as mg malonaldehyde (MDA) per kg of meat.
2.3.7 Shear force (Kg/cm^2)
The shear force value was determined by the method of [4]. Cooked *suya* samples were chopped to the size of 1.0 x 2.0 x 0.5 cm .Texture Analyzer equipped with a Warner-Bratzler shear apparatus was used for the analysis of shear force. The shear force was measured perpendicular to the axis of muscle fibers and values were taken on the cores.
2.3.8 Sensory Evaluation
A ten member taste panelist evaluated the *suya* prepared from the muscle types of sexed indigenous ducks. Samples were coded and evaluated independently using a 9-point hedonic scale to assess the following parameters: aroma, flavour, juiciness, tenderness, texture and overall acceptability. Scores were assigned with 9 being "like extremely'' and 1 "dislike'' extremely'' [5].

2.4 Statistical analysis
All data were collected in triplicate and statistically analyzed [6].

3.0 RESULTS
Table 2 shows the meat quality and cook yield of *suya* made from breast muscles of drakes (male) and female Nigerian indigenous ducks reared in different locations. The thaw loss of the raw breast muscle was highest (4.81%) in location C while the lowest value of 3.43% was observed from location B drakes. The thaw loss of the female raw breast muscle ranged from 6.67% (location C) and 8.76% in location B. Moisture content of *suya* samples of 21% in female of location A and 32% in drakes of location A and female of location B were determined respectively. pH value was statistically similar ($p>0.05$) between suya sample made from breast muscle of drakes from different locations, while suya samples significantly differs ($p<0.05$) between samples in female ducks. The percent cook loss and cook yield values were significantly different ($p<0.05$) between *suya* samples prepared from breast muscles of ducks raised from different locations. The results of meat quality and cook yield of *suya* made from drum stick muscles of Nigerian indigenous ducks reared in different locations is shown in Table 3. The thaw loss of raw drum stick muscles ranged from 2.53 % (location B) to 4.68% (location A) in drakes while it ranged from 3.80% (location C) to 5.28% (location B). Moisture content of suya made from drum stick muscle of drakes ranged from 23% (location A) to 31% (location B). However, the moisture contents of suya from drum stick muscles of female ducks had the highest value of 34% recorded in location B while the least value of 24% was obtained in location A. pH differs statistically ($p<0.05$) between suya samples of drakes and female ducks as obtained from different locations. The percent cook losses were significantly higher ($p<0.05$) in suya from drum stick of indigenous duck of location A than locations B and C. The highest suya cook yield of drumstick muscle was found in drakes of location B (93%) and the lowest value of 77% recorded in female muscles of location A. The study revealed significant difference ($p<0.05$) between *suya* of breast and drum stick muscles made from female ducks with no significant ($p>0.05$) difference in male ducks. The Tbars value of *suya* of two muscles of either sex was not influenced ($p>0.05$).

The organoleptic properties of suya of breast and drumstick muscles of duck meat were shown on Tables 4 and 5 respectively. The result showed that organoleptic properties rated by the panelists were significantly different ($p<0.05$) between traits such as aroma, flavor, tenderness, juiciness, texture and overall acceptability in the two muscle types derived from drakes and female indigenous ducks from different locations.

4.0 DISCUSSION
The study showed that low thaw losses were recorded in the raw breast and drumstick muscles of indigenous ducks of either sex. It was observed that the percent thaw loss values were below 10% among samples obtained from ducks of different locations. This qualifies duck meat of either sex to possess good quality of high water retention capacity. This implies that little moisture was lost during chilling and thawing of raw muscles. The moisture contents was lower than 35% as observed in *suya* of both muscle types in drakes and female ducks. This implies that the *suya* contains moisture that could enhance its eating characteristics

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such as juiciness, texture and tenderness [7]. The moisture contents obtained for *suya* made from either muscle were much higher than the observations of [8,9]. The moisture contents were lower in *suya* prepared from muscle types of drakes than female across the locations. The pH values obtained in the study were within the range previous reported works for cooked duck meat [10] but lower than those reported by [8] for chicken *suya*. pH may influence the meat attributes such as water holding capacity, aroma, flavor, appearance and texture[11,12]. The percent cook loss of *suya* was extremely lower in drake muscles of locations B and C than the values obtained from female muscles. The cook losses obtained from the study were closer to those reported for cooked chicken [13]. Cook loss indicates that edible meat mass has been lost during processing. Cooking loss may have resulted from the denaturation of the collagen and myofibrillar protein matrix during thermal processing which makes the myofibrillar proteins lose their water holding capacity [13]. The study revealed that *suya* made from either breast or drum stick muscles had low cook out loss especially in the male ducks and this would have influenced the higher cook yield observed in the study. Low cook loss and high cook yield may have been influenced by the procedure of cooking and structural composition of the muscle types. Study showed that shear force values were higher in drakes than female from the same locations. This is an indication that muscle types influences toughness and texture of meat. The shear force value obtained from male duck muscles were higher than those reported [14] but lower than the values obtained by [13]. The shear force obtained in the study for female muscles were similar to the report of [14] for cooked duck meat. Tbars values of *suya* produced from the two muscles of male and female indigenous ducks were very low and this may be due to the fact that the choice of muscle types used may not have possessed high level of intramuscular fat that could facilitate high rate of lipid oxidation during storage. Also, the nature of management system under which the birds were raised may not allow accumulation of fat in their adipose tissues and some of the ingredients used for the processing of *suya* might have possessed some antioxidants properties that account for low tbars values. Several factors such as juiciness and tenderness[15]could have been responsible for the rating of organoleptic properties of *suya* made from different muscles types of indigenous duck meats reared under extensive system.

Table 2 Meat quality and cook yield of breast muscle *suya* of sexed Nigerian indigenous ducks raised in different geo-political zones

Items	sex	Location A (Ekiti Central)	Location B (Ekiti North)	Location C (Ekiti South)	SEM	p-value
Raw weight (g)	Male	133.8^{c}	181.7^{a}	147.3^{b}	4.13	0.30
	Female	113.7^{b}	110.3^{c}	126.7^{a}	1.16	0.20
% thaw loss	Male	3.48^{b}	3.43^{c}	4.81^{a}	0.15	0.50
	Female	8.80^{a}	8.76^{a}	6.67^{b}	0.14	0.10
Moisture content (%)	Male	32.0^{a}	31.0^{b}	31.0^{b}	0.04	0.00
	Female	21.0^{c}	32.0^{a}	29.0^{b}	0.11	0.00
pH	Male	6.00	6.00	6.00	0.02	1.00
	Female	6.0^{a}	5.70^{b}	5.70^{b}	0.01	0.08
Cook loss (%)	Male	17.0^{a}	7.60^{c}	9.61^{b}	0.20	0.00
	Female	32.4^{a}	18.9^{c}	19.5^{b}	0.10	0.00
Cook yield (%)	Male	84.0^{c}	92.4^{a}	90.4^{b}	0.54	0.00
	Female	68.0^{c}	81.1^{a}	82.0^{b}	0.34	0.00
Shear force (kg/cm^{2})	Male	4.40	4.41	4.40	0.02	0.00
	Female	3.36^{b}	3.40^{a}	3.30^{c}	0.10	0.00
Tbars(mg malonaldehyde /kg meat)	Male	0.10	0.10	0.10	0.10	0.00
	Female	0.10	0.10	0.10	0.01	0.00

a, b, c- means with different superscripts on same row are significantly different (P<0.05)

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Table 3 Meat quality and cook yield of drum stick muscle *suya* of sexed Nigerian indigenous ducks raised in different geo-political zones

Items	sex	Location A (Ekiti Central)	Location B (Ekiti North)	Location C (Ekiti South)	SEM	p-value
Raw weight (g)	M	199.3^{c}	329.7^{a}	261.3^{b}	4.64	0.03
	F	151.4^{c}	162.03^{b}	222.7^{a}	2.93	0.03
% thaw loss	M	4.68^{a}	2.53^{c}	3.45^{b}	0.09	0.04
	F	5.27^{a}	5.28^{a}	3.80^{b}	0.14	0.32
Moisture Content (%)	M	23.0^{c}	31.0^{a}	30.0^{b}	0.22	0.00
	F	24.0^{c}	34.0^{a}	26.0^{b}	0.12	0.00
pH	M	6.83^{a}	6.63^{c}	6.73^{b}	0.03	0.64
	F	6.67^{a}	6.63^{b}	6.60^{c}	0.02	0.91
Cook loss (%)	M	14.87^{a}	7.07^{b}	7.27^{b}	0.37	0.04
	F	25.3^{a}	18.9^{b}	12.7^{c}	0.45	0.03
Cook yield	M	85.2^{b}	93.0^{a}	84.0^{b}	0.36	0.03
	F	77.0^{c}	81.1^{b}	87.3^{a}	0.44	0.04
Shear force (kg/cm^{2})	M	4.00	4.00	4.00	0.01	1.00
	F	3.68^{a}	3.53^{b}	3.45^{c}	0.08	0.04
Tbars (mg malonaldehyde /kg meat)	M	0.10	0.10	0.10	0.01	0.00
	F	0.10	0.10	0.10	0.00	0.00

a, b, c- means with different superscripts on same row are significantly different (P<0.05)

Table 4 Organoleptic properties of breast muscle *suya* of sexed Nigerian indigenous ducks raised in different geo-political zones

Items	Sex	Location A (Ekiti Central)	Location B (Ekiti North)	Location C (Ekiti South)	SEM	p-value
Aroma	Male	6.00^{a}	5.25^{b}	2.25^{c}	0.18	0.02
	Female	5.75^{b}	6.25^{a}	6.25^{a}	0.29	1.00
Flavor	Male	7.00^{a}	6.25^{b}	5.75^{c}	0.15	0.50
	Female	6.25^{b}	5.25^{c}	6.50^{a}	0.18	0.60
Tenderness	Male	7.00^{a}	6.75^{b}	5.25^{c}	0.15	0.20
	Female	5.25^{a}	4.50^{b}	4.25^{c}	0.18	0.70
Juiciness	Male	7.50^{a}	7.00^{b}	4.00^{c}	0.17	0.02
	Female	6.50^{a}	4.25^{b}	6.50^{a}	0.11	0.02
Texture	Male	5.75^{b}	5.75^{b}	7.00^{a}	0.24	0.70
	Female	5.50^{b}	4.75^{c}	5.75^{a}	0.21	0.80
overall acceptability	Male	7.75^{a}	7.50^{b}	6.75^{c}	0.12	0.40
	Female	6.50^{c}	6.75^{b}	7.25^{a}	0.14	0.70

a, b, c- means with different superscripts on same row are significantly different (P<0.05)

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Table 5 Organoleptic properties of drum stick muscle *suya* of sexed Nigerian indigenous ducks raised in different geo-political zones

Items	Sex	Location A (Ekiti Central)	Location B (Ekiti North)	Location C (Ekiti South)	SEM	p.value
Aroma	Male	4.50^{c}	5.00^{b}	6.50^{a}	0.29	0.60
	Female	6.00^{a}	6.00 ^{a}	5.00 ^{b}	0.15	0.50
Flavor	Male	5.00^{b}	5.25^{b}	6.75^{a}	0.22	0.40
	Female	5.75^{a}	5.50^{c}	5.70^{b}	0.13	0.90
Tenderness	Male	6.00^{b}	6.00^{b}	7.00^{a}	0.15	0.50
	Female	6.75^{a}	6.00^{b}	5.25^{c}	0.18	0.50
Juiciness	Male	5.50^{b}	5.50^{b}	7.75^{a}	0.15	0.10
	Female	7.00^{a}	7.00^{a}	5.50^{b}	0.12	0.10
Texture	Male	5.25^{c}	6.25^{b}	7.50^{a}	0.13	0.10
	Female	6.00^{c}	6.50^{a}	6.25^{b}	0.10	0.80
overall acceptability	Male	6.25^{c}	6.75^{b}	7.50^{a}	0.12	0.30
	Female	7.00^{c}	8.00^{a}	7.50^{b}	0.10	0.30

a, b, c- means with different superscripts on same row are significantly different (P<0.05), SEM- standard error of mean

5.0 CONCLUSION

The study revealed that the meat qualities such as the percentage of thaw loss, cook loss and cook yield of breast and drum sticks muscles of drakes from location B had better values than those obtained from locations A and C as well as the female counterparts. The shear force revealed that suya made from breast and drumsticks muscles of female ducks were more tendered than drakes. Low Tbars values obtained in suya products from birds of different locations depict that duck meat is shelf stable and would be very safe for consumption. The suya from breast muscles of drake location A was most accepted by panelist while the overall acceptance of drum stick muscles was best rated in female of location B. It is concluded that *suya* produced from the two muscles types of either sex of Nigerian indigenous breed of ducks possessed high cook yield, shelf stable and eating qualities irrespective of their locations.

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