# Evaluation of *Suya (Tsire)* – An Intermediate Moisture Meat Product in Ogun State, Nigeria

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# Abstract

A study was conducted to evaluate suya (tsire) an intermediate moisture meat product in Ogun State. Sixty suya sticks were used. Twelve suya sticks were prepared in the laboratory while 12 suya sticks were collected from each zone of the state namely: Yewa, Egba, Remo and Ijebu. They were analyzed for physical, chemical, microbiological and organoleptic characteristics. The results showed that there were significant (P < 0.05) differences in physical properties of suva samples analyzed with suva from Yewa zone having the highest (P < P(0.05) water holding capacity and suya prepared in the laboratory and those from Egba zone had the highest (P < 0.05) shear force, while the pH was least (P < 0.05) in suva prepared from laboratory. Moisture content was least (P < 0.05) in suya samples prepared in the laboratory and from Egba zone, while ash content was higher (P < 0.05)in suya from Yewa, Remo and Ijebu Zones. Aerobic bacteria and coliform counts were least (P < 0.05) in suya prepared in the laboratory and from Egba Zone, while lactic acid bacteria were higher (P < 0.05) in suya prepared in the laboratory and from Egba Zone. The results revealed that suya samples prepared in the laboratory were accepted more (P < 0.05) followed by those from Egba and Remo Zones. However, microbial loads observed on Suya (tsire) samples in this study were not as high as those reported by previous workers. Nonetheless, efforts should be made to educate meat and meat products (Suya) processors in Ogun State on the importance of hygiene and proper packaging and preservation to avoid contamination and spoilage of meat products during processing and sale.

Keywords: evaluation, Suya, microbial load, meat-product, organoleptic

# 1. Introduction

Meat plays an important role in human diet by contributing both macro and micro nutrients that are required for growth and good health maintenance. The rate of increase in per capita consumption of meat was found to be very high in developed countries when compared with developed nations. (Anjanevulu et al., 2007). Meat is high in nutrients, but very prone to spoilage and to prevent this from occurring value addition to meat is essential (Anna et al., 2005). This involves processing and preservation of meat so as to prolong its shelf-life and improve its acceptability. (Eyas Ahmed et al., 2006). Processing aids in producing varieties and convenient meat products in order to meet various lifestyle requirements, while preservation aided by processing extend the shelf-life of meat and meat products (Sharma & Kondaiah, 2005). The need for effective, cheap and simple preservative technique cannot be ignored and one of such is intermediate moisture food processing such as suya (tsire) (Omojola, 2008). It is a mass consumer fast food which is processed and sold along streets often under unhygienic conditions (Uzeh et al., 2006). Suya when being sold is usually packaged in old newspaper, also most of the stages for processing the product, the materials used, the handlers and the environment where it is processed and sold can serve as sources of contamination to the product (Uzeh et al., 2006). It has been reported (Omojola, 2008) that the meat and some of the ingredients used for processing suva can also serve as the product contaminant especially groundnut cake power. Pace (1975) and (Solberg et al., 1986) also reported that dangerous microbial contamination of delicatessen like suya occurs when the total aerobic and or enterobic (coliform) counts reach  $10^5$  cfu/g and or lactic acid bacteria

 $10^2$ cfu/g. This condition in turn can affect the aesthetics and other eating qualities of the meat product (Anjaneyulu et al., 2007). The objective of this study therefore, is to evaluate the physicochemical, microbial and organoleptic characteristics of *suya* (*tsire*) in Ogun State of Nigeria.

# 2. Materials and Methods

# 2.1 Preparation of Suya Ingredients

The spices used in preparing the ingredient were purchased from specialized spice market. They included ginger (*Zingiber officinales*), alligator pepper (*Afromomum melegueta*), black pepper (*Piper guineense*), red pepper (*Capsicum fructescens*). Other constituents of the ingredients were groundnut cake powder (*Arachis hypogea*) Salt (*Sodium chloride*) and seasoning (*Monosodium glutamate*). The spices and other ingredient constituents were milled individually and mixed together in a specific proportion as described by Igene and Ekanen (1985) since the ingredients used by the processors of *suya* in Ogun State are similar to that used by the authors as shown in (Table 1).

Ingredient Constituents	Proportion by Weight (g)	Percent Proportion in Mixture (%)				
Groundnut Cake Powder	450	63.83				
Ginger	60	8.51				
Alligator Pepper	10	1.42				
Black Pepper	10	1.42				
Red Pepper	60	8.51				
Salt	70	9.93				
Monosodium Glutamate	45	6.38				
Total	705	100.00				

#### Table 1. Composition of Suya ingredient

Source: Igene and Ekanem (1985).

# 2.2 Processing of Suya

Twelve sticks of *suya* were prepared in the Meat Science Laboratory, Department of Animal Production, Olabisi Onabanjo University, Ayetoro Campus to serve as the control (O) using beef muscle from the leg cut as described by (Omojola, 2008). Meat samples were sliced into thin sheets and were inserted onto the weighed *suya* sticks. The ingredient was spread on a flat tray and each stick of meat was pressed on the ingredient to be properly soaked into the meat. The sticks of meat were labeled, about 5-10 ml of groundnut oil was sprinkled on each meat stick before roasting.

# 2.3 Roasting of Suya

Labeled sticked meats were arranged round a glowing smokeless fire made from charcoal. The sticked meats were allowed to stay on the fire for 20 min with the distance of 22-23 cm from the centre of fire and intermittent turning of the product. Additional groundnut oil was sprinkled on the meat while roasting continued (Omojola, 2008). All necessary hygienic precausions were observed in the laboratory.

# 2.4 Collection of Suya from Four Zones of Ogun State

Fourty eight *Suya* (*tsire*) samples were purchased from three towns that are popular in processing *suya* in each of the four geo-political zones of Ogun State. *Suya* samples from each zone represented a treatment, thus five treatments of *Suya* samples (12 samples from each zone and 12 samples prepared in the laboratory equals 60 sticks of *Suya*). The *suya* samples were evaluated as follows.

0 (control) = Suya samples processed in the laboratory

- 1 = Suya samples collected from Yewa Zone
- 2 = Suya samples collected from Egba Zone
- 3 = Suya samples collected from Remo Zone
- 4 = Suya samples collected from Ijebu Zone

## 2.5 Determination of Chemical Composition of Suya

This was carried out as described by (AOAC, 2000). Moisture content was determined by drying the *suya* sample (2 g) from each stick in an oven at (100-105°C) until constant weight was achieved. Crude protein of *suya* samples was obtained using Kjeldahl methods which included digestion, distillation and titration of the distillates. The values of crude protein were derived by converting nitrogen (N%) content of the distillates with a constant (6.25) thus, crude protein was obtained as (6.25xN%). Crude fat of *suya* was determined with soxhlet extraction method using petroleum ether. *Suya* samples were dried in an oven for 4 hours and fat was extracted. Ash content of *suya* was determined by igniting the *suya* samples in a Muffle furnace at (550-600°C) for 24 hours until ashes were formed.

#### 2.6 Determination of Lipid Oxidation of Suya

Lipid oxidation of *Suya* samples was determined using the modified peroxide value (mPV) method described by (AOAC, 2000). 50 g of *Suya* samples from each treatment were ground in a blender (plate 5 mm) model 242 NAKAI, JAPAN for 20-30sec. and extracted with 30 ml of ice cold (3:2 V/V) acetic acid: chloroform. 0.5 ml of saturated k1 was added and mixed thoroughly by adding 30 ml of distilled water. The mixture was allowed to stand for 5-10min at room temperature. The mixture was titrated with 0.01 M Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> gradually with vigorous shaking. 0.5ml starch indicator (1% starch + 0.3 chloroform) was added. The sample mixture was vigorously swirled and was allowed to stand for an additional 10 min. The end point of the titration was established when the colour of the upper aqueous layer disappeared. The modified peroxide value (mPV) of *Suya* samples was calculated using the following formula:

$$mPV = \frac{(S)(N)(1000)}{W}$$

Where mPV = Modified Peroxide Value

$$S = M1 \text{ of } Na_2S_2O_3$$

 $N = Normally of Na_2S_2O_3$ 

W = Weight of Suya samples (g of fat)

#### 2.7 Measurement of Shear Force of Suya

*Suya* sample, 3.30cm in diameter were sheared at three locations with Warner-Bratzler V-notch blade shearing instrument following the procedures described by Honikel (1998).

#### 2.8 Measurement of Water Holding Capacity (WHC) of Suya

This was determined with press method according to Suzuki et al. (1991). An approximately 1g of *Suya* sample was placed between two 9 cm whatman No 1 filter papers (model C, Caver Inc, Wabash, U. S. A). The sandwish was pressed between two 10.2 x 10.2 plexiglasses for 1 minutes using a vice. Pressed *suya* samples were oven dried at 105°C for 24 hours and their moisture contents determined. Amount of water released from *Suya* samples was measured indirectly by measuring the area of filter paper wetted relative to the area of pressed *suya* samples. Water holding capacity of *Suya* samples was calculated thus:

WHC = 
$$\frac{100 - (Aw - As) \times 9.47}{Ws \times Mc} \times 100$$

Where Aw = Area of water released from *Suya* Samples (cm<sup>2</sup>)

As = Area of *Suya* Sample  $(cm^2)$ 

Ws = Weight of Suya Samples (g)

Mc = Moisture Content of Suya Samples (%)

9.47 = Constant Factor

This was carried out following the procedures of (APHA, 1992), (ICMSF 1986) and (AOAC, 2000). *Suya* samples from each treatment (10 g) were blended with 90ml of 0.1% (W/V) peptone water for 60sec. with a blender of (plate 5 mm) model 242 NAKAI, JAPAN. Additional dilutions were made in 0.1% peptone water (W/V). Thereafter, 1ml of undiluted homogenate of *suya* samples was spread on duplicate petriplates. Bacteria numbers were determined from plates bearing colonies. Counts were obtained as follows: AEROBIC plate counts on plate

count Agar (DIFCO, USA) incubated at 32°C for 48hours; ENTEROBACTERIACEAE (Coliform) on Violet Red Bile Glucose Agar (DIFCO, USA) overlaid with the same medium and incubated at 37°C for 24hours, while LACTIC ACID BACTERIA (LAB) were on Lactobacilli; MRS Broth (DIFCO, USA), Bacto Agar (DIFCO, USA) and glacial acetic acid (Pancrease) incubated at 32°C for 48 hours. Colony forming units were counted and were expressed in log<sub>10</sub>cfu/g of samples.

## 2.10 Sensory Evaluation of Suya

This was conducted according to the procedures of (AMSA, 1995). A 10-member semi-trained taste panel was used. The panelists were supplied unsalted biscuits and water for use in between the treatments *suya* samples. *Suya* samples evaluated were coded and presented sequentially to the panelists on a clean saucer and were evaluated independently of each other. The panelists rated the *suya* samples on a 9-point hedonic scale on which 1=dislike extremely and 9=like extremely for colour, aroma, flavour, tenderness, juiciness, texture and overall-acceptability, where higher values indicated higher preference for *suya* from each treatment.

## 2.11 Experimental Design and Statistical Analysis

Completely randomized design (CRD) was used for this study. Data obtained from this study were analysed with (SAS, 2002), while the means were separated using Duncan multiple Range test of the same software.

## 3. Results and Discussion

The results of chemical composition of *Suya* ingredients prepared in the laboratory and those collected from *Suya* processors in each zone are presented in (Table 2).

The results showed that there was no significant (P > 0.05) difference in the chemical composition of all the ingredients. This result confirmed the fact that almost all the *Suya* processors in Ogun State like their counterparts in the Northern part of Nigeria use similar ingredient (Igene & Ekanem, 1985). Table 3 shows the results of mean physicochemical composition of *Suya*. There were significant (P < 0.05) differences in all the variables except in fat, crude protein and lipid oxidation of *Suya* samples. Water Holding Capacity (WHC) (35.93%) was highest (P < 0.05) in *Suya* sample from Yewa Zone and least (P < 0.05), in *suya* samples prepared in the laboratory (24.52%). Shear force values were higher (P < 0.05) in *suya* prepared in the laboratory (6.87 kg/cm<sup>3</sup>) and those collected from Egba Zone (6.85 kg/cm<sup>3</sup>) and least (P < 0.05) in *suya* samples from Yewa zone (4.21 kg/cm<sup>3</sup>). The pH of *Suya* samples prepared in the laboratory (5.93) was significantly lower (P < 0.05) than in *Suya* samples from the four zones. Moisture contents of *Suya* samples from Yewa, Remo and Ijebu Zones were higher (P < 0.05) than moisture content of *Suya* samples prepared in the laboratory and Egba Zone.

The results of the mean microbial load of *Suya* samples are presented in (Table 4). The results showed that there were significant (P < 0.05) differences in the microbial loads of *Suya* samples. Aerobic bacteria and coliform were higher (P < 0.05) in *Suya* from Yewa, Remo and Ijebu Zones and lower (P < 0.05) in *Suya* prepared in the laboratory and from Egba Zone while Lactic Acid Bacteria (LAB) were higher (P < 0.05) in *Suya* prepared in laboratory (1.25log<sub>10</sub>/cfu/g) and Egba zone (1.03log<sub>10</sub>cfu/g) and lower (P < 0.05) in *Suya* from Yewa, Remo and Ijebu zones.

Table 5 showed the results of mean organoleptic properties of Suya samples. The results indicated that there were significant (P < 0.05) differences in organoleptic properties of Suya samples. Suya colour and flavour were higher (P < 0.05) in Suya samples prepared in the laboratory, followed by those samples from Egba Zones and least (P < 0.05) in Suya samples from Yewa and Ijebu Zones. Suya samples from Yewa was adjudged the most (P < 0.05) tender, followed by those from laboratory and other zones while Suva samples from Yewa and Ijebu Zones were rated the most (P < 0.05) juicier, followed by those from Egba and Remo Zones and least (P < 0.05) in Suya prepared in the laboratory. Suva texture was rated higher (P < 0.05) in samples from the laboratory, Egba and Remo Zones, followed by that of Suya from Ijebu and least (P < 0.05) in suya samples from Yewa Zone. The results revealed further that Suya samples prepared in the laboratory were accepted mostly (P < 0.05). Those from Egba and Remo Zones were accepted the same (P > 0.05), while those from Yewa zone were least (P < 0.05) accepted. Water holding capacity and moisture content of Suya samples prepared in the laboratory and Egba Zone were not as high as they were in Suya samples from other zones, this could be responsible for higher shear force values of Suya samples from laboratory and Egba zone. Aduku and Olukosi (2000) reported that when moisture and water binding capacity of meat or meat product are lower Warner-Bratzler value of the meat or meat product is raised as observed in this study. Also, crude fibre was numerically high in Suya samples from Yewa, Remo and Ijebu Zones; this could be responsible for higher ash contents obtained in Suva samples from these zones. Crude protein was higher in Suya Samples prepared in the laboratory and those from Egba Zone. Crude fibre is normally not analyzed for in meat as it contains little or no fibre, whereas, it was observed to be considerably high in this meat product (*suya*) as a result of high level of fibre in some of the constituents of the ingredient used in preparing the meat products whose source was from plants. Similar result was reported by Omojola (2008). This could be due to the fact that meat used for *Suya* was able to absorb more *Suya* ingredient which could have added part of its protein content to the meat which was obtained in *Suya* samples (Omojola et al., 2004), as some of the ingredient constituents are rich in protein particularly groundnut cake which had highest proportion in the ingredient.

Microbial load was lower in *Suya* samples prepared in the laboratory and from Egba Zone probably due to lower moisture contents of *Suya* samples, but LAB was higher in *Suya* Samples from the laboratory and Egba Zones which might have aided in preserving the *Suya* samples, as aerobic bacteria could not thrive well in acidic medium, the number could have been reduced which might have raised the number of lactic acid bacteria which was not as destructive as the former species of microbes (Apata, 2010). The lower percentage moisture content and pH in *Suya* Samples prepared in the laboratory and those from Egba Zone might be responsible for lower lipid oxidation and microbial loads in *Suya* Samples from the laboratory and Egba zone. Also, higher LAB in *Suya* prepared from Laboratory might be responsible for higher and better colour, flavour, texture and overall acceptability of *Suya*, followed by those collected from Egba Zone. The results of microbial load of *Suya* samples also revealed the level of hygiene of the meat and ingredient used in preparing the *Suya* as well as that of environment and *Suya* processors (Uzeh et al., 2006). Lower acceptability score for *Suya* samples from Yewa Zone could be due to higher tenderness, juiciness, moisture, WHC, as well as reduced colour and flavour, probably due to microbial activities in *Suya* samples. It was reported (Anjaneyulu et al., 2007) that most consumer's adjudge meat and meat products based first on colour and then flavour, while (Okubanjo, 1990) reported that most citizens of developing countries like Nigeria prefer less tender meat or meat product probably for longer chewability.

	Zones						
Variable	0	1	2	3	4	SEM	
Moisture Content (%)	10.40	10.82	10.60	10.71	10.80	0.38	
Crude Protein (%)	7.00	6.55	6.87	6.62	6.57	0.15	
Ether Extract (%)	9.50	8.00	8.70	8.55	8.40	0.11	
Ash (%)	5.45	6.68	5.52	6.61	6.65	0.13	
Crude Fiber (%)	6.70	6.60	6.67	6.65	6.52	0.09	
рН	5.35	5.47	5.40	5.45	5.45	0.20	

Table 2. Chemical analysis of ingredients used for Suya from laboratory and treatment zones

\* No significant difference in the treatment means (P>0.05).

	Zones					
Variable	0	1	2	3	4	SEM
Water Holding Capacity (%)	24.52 <sup>e</sup>	35.93 <sup>a</sup>	26.87 <sup>d</sup>	31.93°	34.24 <sup>b</sup>	1.33
Shear Force (kg/cm <sup>3</sup> )	6.87 <sup>a</sup>	4.21 <sup>c</sup>	6.85 <sup>a</sup>	5.32 <sup>b</sup>	5.43 <sup>b</sup>	0.03
pH	5.93 <sup>b</sup>	6.82 <sup>a</sup>	6.16 <sup>a</sup>	6.20 <sup>a</sup>	6.40 <sup>a</sup>	0.08
Moisture (%)	34.20 <sup>b</sup>	36.05 <sup>a</sup>	34.27 <sup>b</sup>	35.67 <sup>a</sup>	35.78 <sup>a</sup>	1.24
Crude protein (%)	39.61 <sup>a</sup>	$38.20^{b}$	39.53 <sup>a</sup>	38.52 <sup>b</sup>	38.24 <sup>b</sup>	1.27
Fat (%)	13.48	12.60	13.37	13.35	13.05	0.13
Ash (%)	6.60 <sup>b</sup>	$8.00^{a}$	6.93 <sup>b</sup>	7.45 <sup>a</sup>	7.59 <sup>a</sup>	0.19
Crude Fiber (%)	1.01	1.36	1.20	1.30	1.34	0.02
Lipid Oxidation (meq/kg/fat)	0.50 <sup>c</sup>	$0.78^{a}$	0.63 <sup>b</sup>	0.67 <sup>b</sup>	0.77 <sup>a</sup>	0.08

Table 3. Physicochemical composition of *Suya* samples

abcde: Means in the same row with different superscripts are statistically significant (P<0.05).

	Zones						
Variable	0	1	2	3	4	SEM	
Aerobic bacteria	0.90 <sup>b</sup>	1.99 <sup>a</sup>	0.97 <sup>b</sup>	1.79 <sup>a</sup>	1.86 <sup>a</sup>	0.13	
Coliform	0.41 <sup>b</sup>	1.69 <sup>a</sup>	0.46 <sup>b</sup>	1.55 <sup>a</sup>	1.61 <sup>a</sup>	0.68	
Lactic Acid Bacteria	1.25 <sup>a</sup>	0.53 <sup>c</sup>	1.03 <sup>b</sup>	0.68 <sup>c</sup>	0.67 <sup>c</sup>	0.06	

#### Table 4. Microbial load of *Suya* samples (log<sub>10</sub>cfu/g)

abc: Means in the same row with different superscripts are statistically significant different (P<0.05).

Table 5. Mean organoleptic properties of Suya samples

	Zones						
Variable	0	1	2	3	4	SEM	
Colour	7.64 <sup>a</sup>	4.02 <sup>d</sup>	6.51 <sup>b</sup>	5.31 <sup>c</sup>	4.65 <sup>d</sup>	0.42	
Flavour	7.32 <sup>a</sup>	4.24 <sup>d</sup>	6.42 <sup>b</sup>	5.27 <sup>c</sup>	4.10 <sup>d</sup>	0.12	
Tenderness	5.72 <sup>b</sup>	7.50 <sup>a</sup>	5.81 <sup>b</sup>	6.00 <sup>b</sup>	5.91 <sup>b</sup>	0.18	
Juiciness	4.91 <sup>c</sup>	7.35 <sup>a</sup>	5.08 <sup>b</sup>	5.33 <sup>b</sup>	7.23 <sup>a</sup>	0.16	
Texture	7.26 <sup>a</sup>	4.51 <sup>c</sup>	7.10 <sup>a</sup>	7.08 <sup>a</sup>	5.71 <sup>b</sup>	0.31	
Overall Acceptability	7.65 <sup>a</sup>	4.81 <sup>d</sup>	6.51 <sup>b</sup>	6.33 <sup>b</sup>	5.35 <sup>c</sup>	0.16	

abcd: Means in the same row with different superscripts are statistically significant (P<0.05).

### 4. Conclusion

The findings from this study revealed that *Suya* Samples prepared in the laboratory was better followed by those collected from Egba, Remo, Ijebu and Yewa Zones respectively. It is also evident from this study that the microbial loads of *Suya* samples were not as high as those reported by previous workers, as spoilage was minimal. However, efforts should be geared towards educating meat and meat especially *suya* processors in Ogun State on the importance of hygiene and proper packaging and preservation, since microbial contamination due to improper preservation could lead to complete spoilage of *suya* product and subsequent reduction of its eating qualities and overall acceptability.

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