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An evaluation of the microbiological quality of commercial beef *Suya* sold in Benin city, South-south of Nigeria

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Abstract

The safety of suya, a ready-to-eat barbecue meat, for consumption has been of growing concern as a result of the handling practices associated with its processing. Of major concern is the microbiological quality of the product. This study evaluated the microbial content of suya meat processed and consumed in Benin City, Edo State, Nigeria. A total of nine (9) suya meat samples were purchased from popular suya spots within each of the three Local Government Areas of Benin City, namely: Ikpoba Okha, Egor and Oredo. Samples were subjected to microbiological analysis by first evaluating for the Total Heterotrophic Bacterial Count (THBC), Mean Bacterial Count (MBC), Total Heterotrophic Fungal Count (THFC) and Mean Fungal Count (MFC), followed by characterization and identification of the organisms present and then the sensitivity of the bacteria to some antibiotics. Results showed that highest THBC (cfu/g) and THFC (cfu/g) were recorded in suya obtained from Aduwawa of Ikpoba Okha Local Government Area as 6.14 x 10^4 and 2.24 x 10^4, respectively; with lowest values recorded in samples from Ring road of Oredo LGA as 1.83 ×10^4 and 0.66 x 10^4, respectively. MBC values (cfu/g) ranged from 3.29 x 10^4 to 4.37 x 10^4 while MFC values were in the range of 1.19 x 10^4 to 1.58 x 10^4. Bacterial species detected in suya samples were Proteus sp, Micrococcus sp, Serrattia sp, Bacillus sp, Escherichia coli, Klebsella sp, and Pseudomonas sp while fungi isolates detected were Aspergillus niger, Fusarium sp, Saccharomyces sp, Penicillium sp, Aspergillus sp and Penicillium sp. The bacteria and fungi isolates with the highest distribution were Bacillus sp, and Penicillum sp, while Escherichia coli and Aspergillus sp, were least distributed in the study. The bacteria with the highest susceptibility was Escherichia coli while Pseudomonas auruginosa was the least susceptible to the antibiotic discs.

Key words: *Suya, Beef, Microbiological, Safety, Commercial, Benin City.*

Introduction

Street foods are of increasing importance in Nigeria, particularly in urban areas, where they are sources of diverse, inexpensive ready-to-eat foods (Egbebi and Seidu, 2011). *Suya* is one of the most street-vended meat products in Nigeria and Sub-Saharan Africa ((Egbebi and Seidu, 2011)). Today, *suya* vendors have become prominent with their grill stands becoming very busy from about midday until late at night in town and cities.

Suya is a spicy barbecued, smoked or roasted meat product usually made from beef, rams, goats etc.; which is a popular food item in various parts of Nigeria (Eke *et al*., 2013). It is traditionally prepared by the Hausa people of Northern Nigeria, Cameroon, Niger and some parts of Sudan; where it is called *agashe* and is prepared from boneless meat of animals (Abdullahi *et al*., 2014; Ogbonna *et al*., 2012). The preparation process involves defatting and slicing the meat on a slab or tabletop, after which the thinly sliced meat is marinated in various spices which include peanut cake, salt, ginger and other flavourings, and then roasted over wood using a fire from charcoal for about

20 min (Egbebi and Seidu, 2011; Ifeadike *et al.*, 2012).

There are three types of *suya*; *tsire, balangu* and *kilishi* (Egbebi and Seidu, 2011). The *tsire* is popularly called *suya*. Recently, however, the *balangu* seems to have taken over the name *suya*, having become the most common and most popular amongst them. These ready-to-eat products (*Kilishi, Balangu* and *tsire)* are very popular street foods. *Suya* consumption has extended to all parts of the country (Inyang *et al.,* 2005). This delicacy is a poplar, traditionally processed, ready-to-eat Nigerian meat product, which may be served hot or sold along streets, in club houses, at picnics, parties, restaurants and within institutions (Igene and Mohammed, 2008).

The preparation of *suya* is carried out under largely unhygienic conditions and the risk of contamination is very high (Chin *et al*., 2015). As a result of this unhygienic production process and sales of the product in small stalls along major and local streets (Biswas *et al.,* 2008; Uzeh *et al*., 2014), concerns have been raised about the hygienic status and safety of roadside *suya* (Obadina *et al*., 2013). Again, the sporadic cases of gastroenteritis and symptoms of food infection after consumption of *suya* indicates, that the product indeed constitutes a food safety risk (Inyang, *et al,* 2005; Odusote and Akinyanju, 2003; Njaya, 2014).

Some previous studies have shown that traditionally prepared *suya* has been associated with high microbial population which results in short shelf life as a result of the method of handling during and after production (Adesokan *et al*., 2008; Egbebi and Seidu, 2011). In addition, most sales points hardly exhaust their products and leftovers are often carried to the next day or beyond. Quantitative studies (Madueke and Jonah, 2014; Eke *et al*., 2013; Apata *et al*., 2013; Egbebi and Seidu, 2011) have shown contamination of the *suya* products occur at several points in the production process and in the storage methods. Contamination has also been identified at the point of procuring, transportation, handling during processing and introduction of ingredients, as well as at the packaging and storage stages (Egbebi and Seidu, 2014; Ifeadike *et al*., 2014; Madueke *et al*., 2014, and Eke *et al*., 2013).

Other potential sources of contamination include the mixtures of traditional spices (Ogbonna *et al*., 2012), processing water, meat processing slabs, utensils and the raw meat used (Edema *et al*., 2008). Organisms such as *Bacillus cereus, Staphylococcus aureus, Salmonella* species and Aflatoxigenic molds with aerobic mesophilic counts in the order of 10^5 cfu/g have been detected (Abdullahi *et al.,* 2014).

Although the production, sales and consumption of *suya* is very high in Benin City of Nigeria, information on the microbiological status of this very popular and delicious delicatessens processed and marketed in this location is scarce, thereby posing a threat to the safety of the product. This study, was therefore, undertaken to determine the microbiological status, isolate, characterize and identify the various microorganisms present in beef *suya* sold in Benin City.

Materials and Methods

Site of Study

The experiment was conducted in the Food Science and Human Nutrition Unit, Department of Animal Science, Faculty of Agriculture, University of Benin, Benin City.

Sample Collection

Samples of *suya* used in this study were purchased from *suya* vendors at nine different locations (in three replicates) in Benin City, Edo State. A total of nine samples were collected from randomly selected popular *suya* spots, three samples at locations within each of the three Local Government Areas of Benin

City, Edo State. The three Local Government Areas were: Ikpoba Okha, Egor and Oredo Local Government Areas of Benin City. The spots where the *suya* samples were collected were:

LUW= Lucky way, EYA = Eyaen, ADU= Aduwawa, RRO = Ring road, ADE = Adesuwa, AGP = Agip, USE = Uselu, ADO = Adolor , BDA = Bendel Development and Property Authority

The samples were wrapped in sterile aluminum foil to prevent contamination, and were placed in labeled clean polythene bags. They were transported immediately to the laboratory for microbial analysis.

Preparation of Culture Media

Preparation of Oxoid Nutrient Agar (28 g) and Potato Dextrose Agar (39 g) were done separately by weighing the specified quantities into sterile conical flasks and homogenizing with1000 mL distilled water. Conical flasks were then covered adequately with foil paper and cotton wool, followed by autoclaving at 121 ^{o}C for 15 min and then cooling to 45 ^{o}C. Using the method of Ojokoh (2006), they were dispensed in sterile petri dishes and allowed to solidify. Peptone water (15 g) was weighed and dissolved in 1000 mL of distilled in a sterile beaker, mixed to dissolve completely before 225 ml was measured into a sterile conical flask from where 9 ml each was pipette into sterile test tubes, covered with cotton wool and autoclaved at 121^{o}C for 15 minutes.

Microbiological Analysis

Total Heterotrophic Bacterial Count (THBC), Mean Bacterial Count (MBC), Total Heterotrophic Fungal Count (THFC) and Mean Fungal Count (MFC) were determined using the method reported by Ojokoh (2006). Glass wares used for the assays were sterilized by autoclaving at 121 ^{o}C for 15 min and allowed to cool to 45 ^{o}C. Suya (10 g) was weighed and cut into pieces using sterile pair of scissors and added to 90 mL of sterile saline-peptone water solution. Mixture was transferred into a sterile 250 mL screw-capped bottle, shaken vigorously for 5 min, left undisturbed for 30 mins to enable the clear liquid to be pipetted and serially diluted up to 10^{-4} concentrations. This was followed by inoculation and incubation, estimating bacterial and fungal counts sub-culture, gram staining, spore staining, and identification of isolates were carried out (Ojokoh (2006);.Holt *et al*., (2000).

Biochemical Testing

Biochemical tests carried out for identification and confirmation of the colonies isolated were Indole Test, Motility Test, Oxidase Test, Catalase Test, Methyl Red Test and Voges Proskeur Test, Sugar Fermentation Test and Citrate Utilization Test, using the method by Cheesbrough (2006).

Antibiotic Disc Used

Gram-positive and Gram negative antibiotics sensitivity disc was bought from the pharmaceutical shopping store. The Gram positive disc was used on the culture of *Staphylococcus aureus* and other gram positive isolates; while Gram negative disc was used on *Salmonella sp* and other gram negative isolates.

Data Analysis

The data obtained from the assays were subjected to analysis of variance (ANOVA) using Gen Stat (Version 12.1) at 5% level of probability. The Duncan multiple range test (DMRT) were used to separate the means where they exist.

Results and Discussion

Total Microbial Counts

The Total Heterotrophic Bacterial Count (THBC) and Fungal Count (THFC) of the *suya* collected from the different locations are as presented in Table 1. The results showed that the highest THBC (6.14×10^4 cfu/g) was obtained in samples from Aduwawa area,

whereas the least count (1.83×10^4 cfu/g) was obtained from Ring road area. THBC values were generally lower than those reported by Adesoji *et al*. (2019), in which values were in the range of 1.6 ×105 to 7.7×105 cfu/g). The highest THFC was 2.24×10^4 cfu/g recorded in Aduwawa area, while the least fungi count was recorded in samples from Ring road area with (0.66×10^4 cfu/g) as shown in Table 1.

Table 1: Total Heterotrophic Bacterial and Fungal Counts (cfu/g) in *Suya* Samples Tested

LGA	Location	Total Heterotrophic Bacterial Count (× 10^4 cfu/g)	Total Heterotrophic Fungal Count (× 10^4 cfu/g)
Ikpoba-Okha	**LUW**	3.74	1.33
	EYA	3.15	1.16
	ADU	6.14	2.24
Oredo	**RRO**	1.83	0.66
	ADE	4.65	1.66
	AGP	3.40	1.25
Egor	**USE**	5.64	1.99
	ADO	2.74	1.00
	BDA	4.73	1.74

LUW= Lucky way, EYA = Eyaen, ADU = Aduwawa, RRO = Ringroad, ADE = Adesuwa, AGP = Agip, USE = Uselu, ADO = Adolor, BDA = BDPA

Mean Bacterial and Fungal Counts

The mean bacterial (MHBC) and fungal (MFBC) counts present in *suya* collected from the different locations in Ikpoba Okha, Oredo and Egor Local Government Areas of Benin city are as shown in Table 2. From the results, values of MHBC ranged from 3.29 to 4.37 × 10^4 cfu/g, while MFBC values ranged from 1.19 to 1.58×10^4 cfu/g, as presented in Table 2. This implies that some of the meats were unsafe for consumption since $<10^3$ is accepted as safe and $\geq 10^5$ Cfu/g is recognized as unacceptable or potentially hazardous (Gilbert, 2000).

Table 2: Mean Bacteria and Fungi Counts (cfu/g) in *Suya* Samples Tested

LGA	Total Heterotrophic Bacterial Count **(× 10^4 cfu/g)**	Total Heterotrophic Bacterial Count **(× 10^4 cfu/g)**
Ikpoba Okha LGA	4.35^a	1.58^a
Oredo LGA	3.29^a	1.58^a
Egor LGA	4.37^a	1.19^a
SEM	0.95	0.33

SEM = Standard Error of Means; LGA= Local government area
a = Mean values not significantly different ($p > 0.05$)

Bacteria Isolates and their Characteristic Features

The cultural and morphological characteristics as well as the biochemical and fermentation analysis of the bacteria isolate are presented in Table 3. Alphabets A to G as shown in the Table represents unknown organisms that were detected from culture

colonies in the *suya* samples before identification of the unknown organisms was achieved using standard test procedures. Results obtained from biochemical and fermentation tests as well as the morphological and cultural characteristics revealed the identity of the unknown organisms as: *Proteus sp* (isolate A), *Micrococcus sp* (isolate B), *Serretia sp* (isolate C), *Bacillus sp* (isolate D), *Escherichia coli* (isolate E), *Klebsiella sp* (isolate F), and *Pseudomonas sp*; isolate G (Table 3).

Table 3: The Bacteria Isolates and their Characteristic Features

Cultural Characteristics	A	B	C	D	E	F	G
Shape	Round	Round	Round	Round	Round	Round	Round
Colour	Creamy	Creamy	Red	Milky	Milky	Milky	Pale green
Size	Large	Large	Small	Large	Large	Small	Large
Elevation	Raised	Flate	Flat	Raised	Flat	Flat	Flat
Transparency	Opaque	Opaue	Opaque	Transparent	Opaque	Opaue	Opaque
MORPHOLOGY							
Gram stain	Negative	Positive	Negative	Positive	Negative	Negative	Negative
Cell type	Rod	Rod	Rod	Rod	Rod	Rod	Rod
Cell arrangement	Single	Pair	Single	Pair	Pair	Single	Single
BIOCHEMICAL TEST							
Citrate utilization	-	+	+	+	+	+	+
Spore forming	-	-	-	+	-	-	-
Catalase production	+	+	+	+	+	-	-
Indole	-	-	-	+	+	+	+
Motility	+	+	+	+	+	+	-
Methyl red	+	-	-	-	+	+	-
Vogues prauskeur	-	+	+	+	-	-	+
Oxidase test	+	+	+	-	-	+	+
Fermentation test							
Lactose	+	-	+	+	+	+	-
Glucose	+	+	+	+	+	+	-
Galactose	-	+	-	+	+	-	+
Maltose	+	+	+	+	-	+	+
Probable identity	*Proteus Sp*	*Micrococcus sp*	*Serretia sp*	*Bacillus sp*	*Escherichia coli*	*Klebsiella sp*	*Pseudomonas sp*

Key: + …….. Positive to test; - …… Negative to test

Fungi Isolates and their Characteristic Features

The cultural and microscopic characteristics features of the fungi isolates are presented in Table 4. Six unknown organisms (F1 – F6) were detected from culture colonies in the *suya*. However, observation of the cultural characteristics of the unknown organisms and microscopic examination revealed their identity as: *Aspergillus niger* (isolate F1), *Fusarium sp* (isolate F2), *Saccharomyces sp* (isolate F3), *Penicillium sp* (isolate F4), *Aspergillus sp* (isolate F5), and *Penicillium sp* (isolate F6). The cultural characteristics of *Penicillium sp* from isolate F4 were significantly different ($p < 0.05$) from that of *Penicillium sp* from isolate F6, which had blue flat colony with reverse side dirty white whereas *Penicillium sp* from isolate F4 had green flat colony with reverse side dirty white.

Table 4: Fungi Isolates and their Characteristic Features

Isolate	Cultural	Microscopic examination	Fungal isolates
F1	Black fluffy colonies with reverse side yellow	Simple separate and branched conidia in chains.	*Aspergillus niger*
F2	White and cottony hyphae with reverse side pinkish	Non separate hyphae with sporangiosphore and rhizoid	*Fusarium* sp
F3	Milky whitish colonies, and white on reverse	Spherical to ova shape fungi Stained positive on gram reaction	*Saccharomyces sp*
F4	Green flat colony with reverse side dirty white	Brush-like conidia, separate branching conidiphore was smooth/rough walled.	*Penicillium* sp
F5	Black fluffy colonies with reverse side white	Simple separate and branched conidia in chains.	*Aspergillus sp*
F6	Blue flat colony with reverse side dirty white	Brush-like conidia, separate branching conidiphore was smooth/rough walled.	*Penicillium sp*

Distribution of the Bacteria Isolates

The distribution of the isolated bacteria is as shown in Table 5. Seven different bacteria genera were isolated. The bacteria isolated were: *Proteus sp, Micrococcus sp, Serretia sp, Bacillus sp, Escherichia coli, Klebsiella sp* and *Pseudomonas sp. Bacillus sp* was the most widely distributed bacteria isolate as it was present in all the study locations. This was followed by *Serretia sp* and *Proteus sp* which were distributed in eight locations. However, *Serretia sp* was absent in Eyaen area, while *Proteus sp* was absent in Agip area. *Micrococcus sp* and *Pseudomonas sp* were distributed in seven locations; *Micrococcus sp* was absent in Aduwawa and Uselu areas, while *Pseudomonas sp* was absent in Agip and BDPA area. *Klebsiella sp* was distributed in six locations with the exception of Aduwawa, Agip and Adolor areas of the City. *Escherichia coli* had the least distribution as it was present in only four locations with the exception of Lucky way, Ring road, Adesuwa, Adolor and BDPA areas (Table 5).

Table 5: Distribution of the Bacteria Isolates

Location	*Proteus sp*	*Micrococcus sp*	*Serretia sp*	*Bacillus sp*	*Escherichia coli*	*Klebsiella sp*	*Pseudomonas sp*
A	+	+	+	+	-	+	+
B	+	+	-	+	+	+	+
C	+	-	+	+	+	-	+
D	+	+	+	+	-	+	+
E	+	+	+	+	-	+	+
F	-	+	+	+	+	-	-
G	+	-	+	+	+	+	+
H	+	+	+	+	-	-	+
I	+	+	+	+	-	+	-

Key: LUW= Lucky way EYA = Eyaen ADU = Aduwawa RRO = Ringroad ADE = Adesuwa AGP = Agip USE = Uselu ADO = Adolor BDA = BDPA

Distribution of Fungi Isolates

The distribution of the isolated fungi is shown in Table 6. Six different fungi genera were isolated. The fungi isolated were: *Aspergillus niger, Fusarium sp, Saccharomyces sp, Penicillium sp* (F4), *Aspergillus sp* and *Penicillium sp* (F6). The most widely distributed fungi isolate was *Penicillium sp* (isolate F4), which was present in seven locations with the exception of Aduwawa and Agip areas. *Aspergillus niger, Fusarium sp, Saccharomyces sp and Penicillium sp* (isolate F6) were all distributed in six locations; with *Aspergillus niger* being absent in Lucky way, Ring road and BDPA areas. *Fusarium sp* was absent in Eyaen, Agip and Uselu areas. *Saccharomyces sp* was absent in Aduwawa, Adesuwa and Adolor areas; while *Penicillium sp* (isolate F6) was absent in Lucky way, Aduwawa, and Uselu areas. The least distributed fungi isolate was *Aspergillus sp* which was distributed in only five locations with the exception of Eyaen, Uselu, Adolor and BDPA areas respectively (Table 6).

Table 6: Distribution of Fungal Isolates

Location	*Aspergillus niger*	*Fusarium sp*	*Saccharomyces sp*	*Penicillium sp*	*Aspergillus sp*	*Penicillium sp*
A	-	+	+	+	+	-
B	+	-	+	+	-	+
C	+	+	-	-	+	-
D	-	+	+	+	+	+
E	+	+	-	+	+	+
F	+	-	+	-	+	+
G	+	-	+	+	-	-
H	+	+	-	+	-	+
I	-	+	+	+	-	+

Key: +ve ……. Present; -ve……..Absent

LUW= Lucky way EYA = Eyaen ADU = Aduwawa RRO = Ringroad ADE = Adesuwa AGP = Agip USE = Uselu ADO = Adolor BDA = BDPA

Anti-Biogram Pattern of the Bacteria Isolates

The result of the antibiotic sensitivity test for the different bacteria isolates is shown in Table 7. The bacteria with the highest susceptibility to the antibiotic disc was *Escherichia coli. E. coli* was highly sensitive to Augmentin (34%) and Septrin (32%) but was moderately sensitive to the other antibiotic disc present. The bacteria isolate with the least susceptibility was *Pseudomonas auruginosa*, which was least sensitive to Gentamycin (18), Pefloxacin (15), Tarivid (18), Streptomycin (13), Cloranphenicol (14), Sparfloxacin (16), Ciprofloxacin (15), and Amoxacillin (18). *Peusdomonas auruginosa* was however, moderately sensitive to Augmentin (21), and Septrin (20). *Proteus vulgaris* was least susceptible to Streptomycin (15), Cloranphenicol (18), and Ciprofloxacin (19), and was moderately susceptible to other antibiotics disc present. *Micrococcus sp* was moderately susceptible to Augmentin (22), and Septrin (21), and was least susceptible to other antibiotic disc present.

Table 7: Anti-biogram Pattern of the Bacteria Isolates

Isolate	Augmentin	Gentamycin	Pefloxacin	Tarivid	Streptomycin	Septrin	Chloramphenicol	Sparfloxacin	Ciproflo xacin	Amoxacillin
Proteu vulgaris	26	22	20	22	15	25	18	21	19	22
Micrococus sp	22	19	16	19	14	21	15	18	16	19
Serretia macersan	21	19	16	19	13	20	14	18	15	19
Bacillus licheniformis	25	21	18	21	15	23	16	20	18	21
Escherichia coli	34	29	26	29	20	32	23	27	25	29
Klebsiella sp	29	25	22	25	18	28	20	23	21	25
Pseudomonas sp	21	18	15	18	13	20	14	16	15	18

Bacteria and Fungi species Isolated and their Relevant Counts

Bacteria and fungi species were isolated from all the *suya* samples collected from the study locations. The bacteria species isolated were: *Proteus sp, Micrococcus sp, Serretia sp, Bacillus sp, Escherichia coli, Klebsiella sp, and Pseudomonas sp*. The presence of these bacteria in the meat products is hazardous to public health particularly some species of *Escherichia coli* and *Bacillus sp* (Oko *et al.*, 2015). These organisms are known to produce potent enterotoxins and the ingestion of food containing these toxins can cause a sudden onset of illness within three to four hours, with nausea, vomiting and diarrhea as the major symptoms (Samuel *et al*., 2015). Total heterotrophic bacteria count ranged between 1.83×10^4 cfu/g and 6.14×10^4 cfu/g *suya*. Study by Inyang *et al.* (2006) however reported a plate count of 3.7×10^5 to 2.4×10^6 cfu/g, a coliform count of 1.9×10^2 to 1.0×10^3 cfu/g and an *Escherichia coli* count of 4×10^2 cfu/g for the *suya* samples that was studied. Uzeh *et al*. (2006), has also reported a total bacterial count of 7×10^2 to 171×10^2 cfu/g and coliform counts of 1×10^2 to 2×10^2 cfu/g for the samples they studied. The variation in the bacterial counts may be attributed to the samples, the packaging materials used, contamination by flies, method of handling, transportation and the air flora of the environment (Samuel *et al.*, 2015). *Suya* from Aduwawa area (sample C) had the highest bacteria count (6.14×10^4 cfu/g) whereas *suya* from Ring road area (sample D) had the least bacteria count (1.83×10^4 cfu/g). The fungi species isolated were: *Aspergillus niger, Fusarium sp, Saccharomyces sp, Penicillium sp* (F4), *Aspergillus sp*, and *Penicillium sp* (F6). *Suya* from Aduwawa area (sample C) however, had the highest fungi count (2.24×10^4 cfu/g) while s*uya* from ring road area had the least fungi counts (0.66×10^4 cfu/g). The highest mean bacteria counts of 4.37×10^4 cfu/g in *suya* in this study, is within the 10^4 cfu/g. This is taken as a tolerable limit of coliform in food in developed countries (Manyi *et al*., 2014). This probably explains why people could consume the *suya* without necessarily getting down with infection (Manyi *et al*., 2014; Chukwuma and Mojekwu, 2002).

Implications of the Bacterial and Fungal Species Isolated

Isolation of *Escherichia coli* and *Bacillus sp*. in the *suya* samples revealed that there is relatively lack of personal hygiene amongst sellers of *suya*, since humans are the largest source of food contaminants (Falegan *et al*., 2017; Mouka, 2017). Again, the level of these organisms in food has been described as an index of food hygiene (Adesokan *et al.*, 2008; Muoka, 2017). Presence of coliform in food is used as a yardstick for measuring the hygiene standard (Manyi *et al.*, 2014; Joshua *et al.*, 2016). *Escherichia coli* and *Klebsiella sp*. all coliforms were detected from some of the study locations, while the presence of *Bacillus sp.* which was highly distributed in all the

study locations rendered the *suya* unsatisfactory for consumption. Six species of fungi were identified: *Aspergillus niger, Fusarium sp, Saccharomyces sp, Penicillium sp, Aspergillus sp*, and *Penicillium sp*. It is important to note that some species of *Aspergillus* are known to produce powerful mycotoxins which are harmful to man, thus, their occurrence in *suya* is undesirable (Egbebi *et al*., 2011). Therefore, their presence may have come from contaminated spices used and wrapping with contaminated wrap before serving (Shamsudeen and Oyeyi, 2008; Hassan and Dimasi, 2014).

Conclusion and Recommendations

The results from this study indicates that the level of distribution and relative counts of bacteria and fungi species isolated from the *suya* samples studied are not significant enough to call for public health concerns. The organisms isolated may cause diseases of man and animals. This has further proven that meat contains all the nutrients for microbial growth and metabolism, making it very susceptible to microbial contamination. In view of the microbial quality of meat and meat products, proper hygiene must be observed to ensure safety of commercial *suya* consumption.

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