



An Assessment of the Bacteriological Quality of Tsire-Suya (Grilled Beef) sold in Awka, Nigeria

Onuorah Samuel^{1*}, Obika Ifeanyi², Odibo Frederick¹, Orji Michael¹

1. Department of Applied Microbiology and Brewing Nnamdi Azikiwe University
2. Department of Zoology, Nnamdi Azikiwe University

*Corresponding author: Onuorah Samuel

Abstract: Tsire-Suya is a spicy, popular, ready-to-eat, boneless, beef product that is stacked on slender wooden sticks and cooked by roasting using a glowing fire from charcoal. It has high nutritive value, hence bacteria could easily grow on it, leading to its spoilage with the resultant economic losses and adverse health effects. The aim of this work was therefore to assess the bacteriological quality of tsire-suya sold in Awka, Nigeria with a view to determining its suitability for human consumption. **Materials and Method:** The total viable counts, total coliform counts and faecal coliform counts were determined using standard methods. The bacterial species were characterized and identified on the basis of their colonial and biochemical characteristics. **Results:** The total viable counts were between 0.9×10^4 and 1.5×10^4 cfu/g, total coliform counts between 0.5×10^4 and 1.0×10^4 cfu/g and while the faecal coliform counts ranged between 0.1×10^4 and 0.5×10^4 cfu/g. The bacterial species isolated were *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa* and *Streptococcus pyogenes*. *Escherichia coli* was most frequently isolated (34.3%) while *Streptococcus pyogenes* had the least percentage distribution (8.6%). **Discussion:** The coliforms exceeded the maximum permissible limit indicating that the suya meat examined poses a serious food safety risk. These bacteria have been known to cause diseases of humans leading to fatal consequences if left untreated. **Conclusion:** Hygienic processing under healthy environments, proper handling and preservation will reduce the occurrence of the bacteria in the meat product thereby safeguarding the health of the consuming public.

Keyword: Assessment, Bacteriological, Quality, Tsire-Suya, Awka, Nigeria.

INTRODUCTION

Meat from fresh slaughtered, healthy animals is supposed to have no or very low microbial populations, however, they could be contaminated to an unsafe level at the point of consumption. The need for effective, cheap and simple preservative technique cannot be ignored and one of such is the intermediate moisture food processing such as Suya¹.

Suya is a boneless lean meat stacked on sticks, coated with sauces, oiled and then roasted over wood using a fire from charcoal. It originated from the Hausa people of Northern Nigeria where cattle rearing is an important pre-occupation and a major source of livelihood for the people^{2,3}. There are three main forms of suya namely tsire, kilishi and balangu but of these, tsire is the most commonly preferred⁴, therefore to most consumers, tsire is synonymous with suya⁵.

Tsire is a roasted boneless meat of animals⁶ that is roasted over a glowing fire. The meat pieces are stacked on wooden sticks and spiced with peanut cake, spices, vegetable oil, salt, red pepper, ground ginger, ground garlic, chunked fresh tomatoes and minced fresh onions depending on the quality of the suya meat to be prepared. The smoke from the fire has a preservative effect on the suya meat⁷.

Suya has become very popular as a street delicacy of several countries, particularly those in West Africa. It is processed and sold along streets often under unhygienic conditions. The prepared suya when sold are usually packaged in newspapers and sometimes in cellophane or nylon bags. Most of the stages of tsire preparation, materials used in its preparation and packaging, the handlers and the surrounding environment can serve as source of contamination of the product⁸. Also traditionally prepared suya has been known to have a short shelf life due to the mode of handling during and after production⁷. Indeed, most sales points hardly exhaust their sales and leftovers are often carried over to the next day or beyond. Rancidity may set in as a result of this leading to the spoilage of the meat product.

Pathogenic microorganisms have been implicated in Suya^{3,6,9}. Microorganisms depend on nutrients from meat or meat product for survival. Meat contains proteins, fats, vitamins and phosphorus which support the growth of microorganisms. *Pseudomonas aeruginosa* synthesizes its vitamins and so cause spoilage even in a medium without vitamins. *Staphylococcus aureus* requires about 6.5% of sodium chloride for growth and is usually found in salty meat products. *Bacillus* species, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Proteus* species and *Serratia* species were reported to be isolated from Suya meat samples¹⁰.

Suya preparation process in Awka lacks standard hygienic quality control. Many travelers have complained of diarrhea, dysentery, enteric fever, sore throat and abdominal discomfort after consuming suya. The fact that there are sporadic cases of gastroenteritis and symptoms of food infection after the consumption of grilled meat (suya) indicate that the product constitutes a food safety risk¹¹.

The bacteriological quality assessment of suya is therefore necessary in order to determine its safety, thus in this study, the bacterial species in the tsire-suya sold in Awka, Nigeria were isolated, characterized and identified. It is hoped that the result of the study will add to the existing literature on suya and educate the consuming public on the dangers inherent in the consumption of bacterially-contaminated suya meat.

MATERIAL AND METHODS

Samples Collection

Thirty tsire-suya samples were purchased randomly from suya vendors at popular suya spots in Awka. The spots were located at Eke-Awka, Temporary site, Aroma, Okpuno and Ifite Awka. The samples were wrapped in sterile aluminum foil to prevent contamination and transported to the laboratory where they were analyzed within twenty-four hours for the presence of bacteria.

Pre-treatment of samples

Each of the samples was enriched in sterile nutrient broth and incubated at room temperature for twenty-four hours. A tenfold serial dilution of each of the enriched samples was thereafter carried out.

Enumeration of the Total Viable Bacteria

One milliliter aliquot of each of the serially-diluted samples (10^4) was plated on sterile nutrient agar (NA) using the spread plate technique. Incubation was carried out in an inverted position at room temperature for twenty-four hours. Discrete bacterial colonies that developed were counted and purified by repeated sub-culturing on sterile NA plates and later stored on sterile NA slants for characterization and identification.

Enumeration of Total Coliform Bacteria

The spread plate technique was used. One milliliter aliquot of each of the diluted samples (10^4) was plated out on sterile MacConkey agar (MA). Incubation was at room temperature for forty-eight hours in an inverted position. Discrete colonies of coliform bacteria that developed were counted, sub-cultured on sterile MA plates and later stored on sterile MA slants for characterization and identification.

Enumeration of the Faecal Coliform Bacteria

The spread plate method was used, with Eosin methylene blue (EMB) agar as the growth medium. One milliliter of each of the serially-diluted sample (10^4) was plated out on the sterile medium. Incubation was in an inverted position at room temperature for forty-eight hours. Discrete colonies that developed were counted and purified by repeated sub-culturing. They were later stored on sterile EMB agar slants for further tests.

Characterization and Identification of the Isolates

The isolates were characterized and identified on the basis of their colonial characteristics and biochemical reactions. Gram staining, motility, catalase, coagulase, oxidase, citrate utilization, voges proskauer, indole, methyl red, spore and sugar fermentation tests were carried out using standard methods¹².

RESULTS

The total viable counts, total coliform counts and faecal coliform counts of the tsire-suya samples examined ranged between 0.9×10^4 cfu/g and 1.5×10^4 cfu/g, 0.5×10^4 cfu/g and 1.0×10^4 cfu/g, and 0.1×10^4 cfu/g and 0.5×10^4 cfu/g respectively.

The bacteria isolated from the suya samples studied were *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa* and *Streptococcus pyogenes*. *Escherichia coli* was isolated from the sample collected from all the study locations. *Staphylococcus aureus* was isolated from the samples from Eke-Awka, Aroma and Ifite-Awka locations, *Bacillus cereus* from the samples from Eke-Awka and Aroma locations, *Klebsiella aerogenes* from the samples from Temporary site and Okpuno locations, *Pseudomonas aeruginosa* from the samples from Temporary site and Ifite-Awka locations while *Streptococcus pyogenes* was isolated from the samples from Aroma and Ifite-Awka locations.

Six bacterial species were isolated from the samples from Eke-Awka, five from the samples from temporary, eleven from the samples from Aroma, four from the samples from Okpuno while nine bacterial species were isolated from the samples from Ifite-Awka location. A total of thirty-five bacteria were isolated from the tsire-suya samples used in this study.

Escherichia coli had a percentage distribution of 34.3, *Staphylococcus aureus* 14.3, *Bacillus cereus* 17.1, *Pseudomonas aeruginosa* 14.3, *Klebsiella aerogenes* 11.4 while *Streptococcus pyogenes* had a percentage distribution of 8.6 in the suya samples studied.

Table 1. Total Viable Counts, Total Coliform counts and Faecal Coliform Counts of the Tsire-Suya Samples.

Sample Location	Total Viable Counts ($\times 10^4$ cfu/g)	Total Coliform Counts ($\times 10^4$ cfu/g)	Faecal Coliform Counts ($\times 10^4$ cfu/g)
Eke-Awka	1.3	0.6	0.2
Temporary site	0.9	0.5	0.1
Aroma	1.5	1.0	0.5
Okpuno	1.0	0.6	0.2
Ifite-Awka	1.4	0.9	0.4

Table 2. Bacterial Species Isolated from the Tsire-Suya Samples

Sample Location	Bacterial Species
Eke-Awka	<i>Escherichia coli</i> , <i>Staphylococcus aureus</i> , <i>Bacillus cereus</i>
Temporary site	<i>Escherichia coli</i> , <i>Klebsiella aerogenes</i> , <i>Pseudomonas aeruginosa</i>
Aroma	<i>Escherichia coli</i> , <i>Bacillus cereus</i> , <i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i>
Okpuno	<i>Escherichia coli</i> , <i>Klebsiella aerogenes</i>
Ifite-Awka	<i>Escherichia coli</i> , <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , <i>Streptococcus pyogenes</i>

Table 3. Frequency of Isolation of the Bacterial Isolates from the Tsire-Suya Samples

Bacterial isolates	Eke-Awka	Temporary Site	Aroma	Okpuno	Ifite-Awka	Total
<i>Escherichia coli</i>	2	1	4	2	3	12
<i>Staphylococcus aureus</i>	1	-	3	-	1	5
<i>Bacillus cereus</i>	3	-	3	-	-	6
<i>Pseudomonas aeruginosa</i>	-	2	-	-	3	5
<i>Klebsiella aerogenes</i>	-	2	-	2	-	4
<i>Streptococcus pyogenes</i>	-	-	1	-	2	3
Total	6	5	11	4	9	35

- = Not detected

Table 4. Percentage Distribution of the Bacterial Isolates in the Tsire-Suya Samples

Bacterial Isolates	Number Isolated	Percentage Distribution
<i>Escherichia coli</i>	12	34.3
<i>Staphylococcus aureus</i>	5	14.3
<i>Bacillus cereus</i>	6	17.1
<i>Pseudomonas aeruginosa</i>	5	14.3
<i>Klebsiella aerogenes</i>	4	11.4
<i>Streptococcus pyogenes</i>	3	8.6
Total	35	100.0

DISCUSSION

The bacteriological quality of tsire-suya (grilled beef) sold in Awka, Nigeria was assessed to determine its suitability for human consumption. The samples were purchased at sales points located at Eke-Awka, Temporary site, Aroma, Okpuno and Ifite-Awka.

The total viable counts ranged between 0.9×10^4 cfu/g and 1.5×10^4 cfu/g, total coliform counts between 0.5×10^4 cfu/g and 1.0×10^4 cfu/g while the faecal coliform counts were between 0.1×10^4 cfu/g and 0.5×10^4 cfu/g. 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 for the suya samples they assessed. Uzeh et al (2006) also reported a total bacterial count of 7×10^2 to 171×10^2 cfu/g and a coliform count 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 used, the packaging materials used, contamination by flies, method of handling and transportation and the air flora of the environment.

The bacterial species isolated from the suya samples were *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa* and *Streptococcus pyogenes*. Chukwura and Mojekwu (2002) isolated *Bacillus* sp and *Staphylococcus aureus* from the suya meat samples collected from different suya spots in Awka Urban. Uzeh et al (2006) isolated *Pseudomonas* sp, *Bacillus cereus* and *Staphylococcus aureus* from tsire-suya- a Nigerian meat product. Edema et al (2009) also isolated *Bacillus cereus* and *Staphylococcus aureus* from suya (a grilled meat product).

Abdullahi et al (2006) isolated *Bacillus* sp and *Staphylococcus* from a popular roasted meat (tsire) in Zaria, Nigeria while Enem and Onyekwodiri (2009) also isolated species of *Staphylococcus*, *Streptococcus*, *Escherichia coli* and *Bacillus* from the suya samples from Nsukka, Enugu State, Nigeria.

Manyi et al (2014) isolated *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella* sp, *Streptococcus* sp, *Bacillus* sp and *Pseudomonas* sp from Suya (roasted beef) sold in Makurdi, Benue State, Nigeria. Sokari and Anozie (1990) reported that meat preserved with a certain amount of salt permits the growth of *Staphylococcus aureus*.

Bacterial species were isolated from all the samples studied. Six isolates were detected from the samples from Eke-Awka, five from the samples from Temporary site, eleven from the samples from Aroma, four from the samples from Okpuno while nine isolates were detected in

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the samples from Ifite Awka. Thirty five bacterial isolates were detected in the samples used in this study.

The percentage distribution of the bacterial isolates in the Suya samples showed that *Escherichia coli* was most frequently isolated (34.3%) while *Streptococcus pyogenes* had the least percentage distribution (8.6%). The high incidence of *Escherichia coli* obtained in this study is a cause for concern as this thermotolerant bacterium has been implicated in serious cases of gastroenteritis.

The presence of these bacteria in the meat product is hazardous to public health particularly *Escherichia coli*, *Bacillus*, *Staphylococcus aureus* and *Streptococcus pyogenes*. 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.

The existence of these organisms in the Suya samples is attributable of the filthy environment, poor personal hygiene of the processors and retailers, the use of contaminated utensils during processing, use of contaminated materials for packaging, activities of flies as well as the addition of spices and seasonings after processing.

Staphylococcus spp and *Bacillus* spp are abundant in the nose and throat as well as the skin of humans. *Bacillus cereus* is a spore former. It can be found in the air and even in the spices and the spores are heat resistant. This may have accounted for its occurrence in the Suya samples. *Pseudomonas aeruginosa* is widely spread in nature especially in the soil, water, on plants and even in the spices used in Suya preparation and can easily contaminate Suya meat.

The findings from this study imply that the tsire-suya was bacteriologically unsafe and constitutes a food safety risk to its numerous consumers. There may be a possible outbreak of food poisoning and or food borne infections due to the consumption of contaminated suya meat if appropriate quality control measures not put in place. This may lead to serious economic and public health problems. There is therefore the need to enlighten the producers, retailers and consumers of tsire-suya meat on the importance of good environmental and personal hygiene. Aseptic techniques must be employed during the preparation of the meat product to control its contamination by bacteria.

CONCLUSION

The bacteria isolated from the grilled beef studied were *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa* and *Streptococcus pyogenes*. These organisms are known to cause diseases of man and animals. Hygienic processing under healthy environments, proper handling and preservation of the meat product will reduce the occurrence of these organisms in the product thereby reducing the economic losses and health problems associated with the consumption of bacterially-contaminated suya meat. Frequent inspection of the meat product by health authorities is also recommended.

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