



Research Article

Isolation and Identification of Bacteria from Hawked Suya Meat Sold within Katsina Metropolis

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ABSTRACT

The consumption of suya meat is rising significantly due to the product's growing demand. Perishable foods like meat and meat products such as soya meats are susceptible to deterioration by microorganisms. The research was conducted to ascertain the microbiological quality of suya meat sold in the Katsina metropolis. 25 samples were purchased from five different suya meat vendors. The bacteria from the suya meat products were isolated and characterized using standard microbiological techniques. Results of the investigations revealed the presence of *Salmonella* species, *Bacillus* species, *Staphylococcus* species, and *Escherichia coli*. The most predominant isolate is *Escherichia coli* with the percentage of occurrence of 24.13% while *Salmonella* and *Staphylococcus* species were the least occurring with 17.4% each. The antibiotic resistance profile of isolated bacteria showed that the majority of the bacteria were resistant to Gentamycin, Streptomycin, Amoxicillin, Penicillin, and Cefoperazone. Results of the investigation revealed that the handling techniques used by vendors and the unhygienic conditions in which suya meat are sold may be the reason for such microbial contamination. Good hygienic practices should be adopted in the processing of such meat products.

Keywords: Suya Meat, Bacterial isolates, Antibiotics, Contamination, Food Vendor

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INTRODUCTION

Meat is any animal's flesh, that is consumed as food, such as the flesh of cattle, pigs, camels, goats, and sheep that have been domesticated and contain edible portions such as muscles, fat, tendons, and ligaments. It also includes fish and bird flesh, which is utilized as food and can be a component of a balanced diet. Iron, vitamin B, and high-quality protein are among the essential nutrients found in meat. Cattle and other domesticated animals are slaughtered in slaughterhouses leading to the production of hygienic and good quality meat on a small and large scale. However, due to the high nutritional content of meat

it can only be kept for short periods without preservatives before going bad. Fresh meat though can be processed into a variety of products, such as Kilishi, Dambun nama, Suya (also known as "tsire"), and Balangu. Furthermore, since meat is susceptible to oxidative and microbiological deterioration, preservative that possesses both antioxidant and antibacterial qualities, such as yaji (a spice made from a combination of various spices or herbs known to possess antioxidant and antibacterial qualities,) (Omojola, 2008). Meat is essential to the economy of the state and culture of her people. Suya is made by

slicing or trimming a boneless beef into thin sheets staked with an iron or wooden rod and heavily dusted with spices mixture produced from groundnut cake (kuli-kuli), Maggi seasoning, salt, ginger and other aromatic spices like black chili pepper, Calabash nutmeg, negro pepper, garlic powder, smoked paprika powder, cayenne pepper, salt and ground onions. (Betumiblog, 2006). After that, the meat with stakes is left to simmer beside a roaring charcoal fire. There are also different varieties of suya: for example, Balangu, a type of suya produced from a sizable cut of a deboned cow, sheep, camel or goat meat that is then washed in water, and then sliced into sheet of one meter or less for easy drying. The dried sheets of meat are then collected and spiced with yaji and fried groundnut paste and sometimes natural sweeteners such as honey, tiger nuts and date palm fruits for a more natural flavor and sweetness and left to roast on a wet oil-in-water filled brown paper on a wire mesh placed over an open hearth oven. Groundnut oil, spices, and salt are then sprinkled on the meat during the roasting operation. The meat is continuously turned until it is well roasted. Another variant of suya is the dambun nama. It is a fried and shredded meat made from deboned beef, ram, camel or any other ruminant or domestic animal. The meat is seasoned and cooked in its own juice until it is very soft and tender and the water content is dried. It is then shredded by using a mortar and pestle, the suya spice is added and it is fried in 1-2 tables spoon of oil in a large, open pan. The microbial load in meat and meat products increases as long as growth factors or conditions are favorable. The factor influencing microbial growth includes; Acidity, pH, temperature, water activity, nutrients, gaseous requirement and competition of microbes for nutrients. The most important meat spoilage bacteria is the lactic acid bacteria which is physiologically related to a group of fastidious and ubiquitous gram positive bacteria that includes species like *Lactobacillus*, *Leuconostoc*, *Pellicoccus*, *Salmonella species*, *Streptococcus*, *Clostridium species*, and *Staphylococcus aureus* (Miranda *et al.*, 2021).

The most likely sources of contamination are through slaughtering of the animal, during evisceration of meat, quality of water used during meat washing operation, handling by butchers, ubiquitous microorganisms found in the environment, hygienic conditions of spices used to flavor the suya meat and equipment like knives, skewers, and other utensils used during the process (Igyor and Uma, 2005). In the light of the increasing consumption of suya meat and

the propensity for pathogenic germs to harbour and grow and the perishable nature of meat and the reported linkage to food poisoning as documented occurrences of sporadic gastroenteritis, or inflammation of the bowels and stomach, following suya meat ingestion (Lianou *et al.*, 2017), suggests a risk to food safety especially if the food is prepared in a rather unsanitary manner where there are high chances of contamination and the ready to eat nature of the product. Katsina State is reckoned as a leading state in suya meat production particularly in Northern Nigeria. Furthermore, most people living in most third world countries rely on meat from animal sources as their main source of quality protein.

MATERIALS AND METHODS

Study Area

The study was carried out within Katsina metropolis of Katsina State.

Sample Collection

Twenty Five (25) samples were aseptically collected from five different suya vendors in a sterile aluminum foil to avoid any contamination. The samples were then labeled and transported aseptically to the microbiology laboratory of the Federal University Dutsin-Ma for further microbial analysis.

Media Preparation

Nutrient and MacConkey agars media were prepared according to the manufacturer's instructions and sterilized by autoclaving for 15 minutes. Pour plates technique was then employed for the inoculation of media (Ogodo, 2022)

Sample Processing

Ten gram (10 g) of suya meat from each sample were removed from the skewers and mashed (homogenized) in a sterile laboratory type mortar and pestle. One gram (1 g) of the mashed suya meat was then weighed and aseptically transferred into a corresponding sterile test tube containing 9ml of distilled water and centrifuged. After the centrifugation, the sample was sieved to decant the supernatant. A five-fold (10^{-5}) serial dilution was performed to obtain discreet colonies using the pour plate technique. 1ml aliquot of the dilution was transferred to a clean, sterile petri dishes containing cooled nutrient agar and allowed to set firmly after 5 minutes. The inoculated plates were incubated at 37°C for 24hours. After which the bacterial colony

were counted (Clarke *et al.*, 2010). All counts were expressed in CFU/ml. Sub culturing was also carried out in order to obtain pure colonies of the isolates.

Microscopy

The bacteria isolates were then characterized by initial morphological examination of the colonies in the plate, gram stain reaction, and confirmatory biochemical tests in accordance with standard methods.

Gram Stain

Gram staining was carried out according to methods described by (Cheesbrough, 2010).

Biochemical Tests

Catalase test

A drop of hydrogen peroxide was placed a microscopic slide. An applicator stick was used to touch the colony and its tip was smeared onto the hydrogen peroxide drop. Production of gas bubbles is indicative of positive result.

Coagulase test

Clean grease-free slide was marked into two halves by a marker. Two drops of distilled water were added on the two halves of the glass slide. Colonies to be tested was picked from the agar plate and gently emulsified in the drops of the distilled water on the slide. A drop of an undiluted blood plasma was added to the bacteria suspension and mixed with a wire loop. Another drop of distilled water was added in the other half of the slide as a control. The slide was rocked back and forth and observed for coagulation reaction.

Citrate utilization test

A slant was streaked back and forth with a light inoculum picked from the center of a well-isolated colony, and was incubated aerobically at 37°C for 24 hours and the color change from green to blue was observed along the slant.

Oxidase test

Using a dropper, a drop of oxidase reagent was added to the bacteria isolate on a filter paper. The appearance of blue or purple spots is indicative of a positive result.

Indole test

A colony was taken from the isolates and inserted into a sterile test tube containing 4ml of tryptophan broth and then incubated for 24hours. 0.5ml Kovac's reagent was then added to the broth culture with a gentle shaking. The presence or absence of a reddish ring was observed.

Antibiotic susceptibility test

The Kirby-Bauer disc diffusion method was adopted for the antibiotic susceptibility test. 18-24hours culture of the isolates from solid media was transferred into distilled water until turbidity matches McFarland standards. The standardized culture was inoculated on the surface of Muller Hinton agar and the plates were allowed to standing for 30 minutes; with the aid of a sterile forceps. The antibiotic disc was carefully placed equidistantly from each other. The plates were then incubated at 37°C for 24 hours in an inverted position.

RESULTS

Distribution of bacterial isolates from five different vendors within Katsina LGA.

Table 1 showed the results of all the bacterial isolates from the five different vendors in Katsina states. A total of 29 isolates were identified. Investigations revealed that *Escherichia coli* had the highest percentages occurrence (24.13%) while *Salmonella spp* and *Staphylococcus species* had the least percentage occurrence (17.4%).

Cellular Morphology, Microscopic and Biochemical Characteristics of isolates

Results of the findings for the cellular and microscopic examination carried out are shown in Table 2. Gram positive rod and cocci were the predominant isolates while the gram negative bacteria isolates were the least.

Antimicrobial Susceptibility Tests Pattern of isolates.

Table 3 showed the distribution of antimicrobials susceptibility test pattern. The Gram-positive bacteria were susceptible to Cefoperazone, Chloramphenicol and Gentamycin but resistant to Septtrin, Pefloxacin, Amoxicillin and Streptomycin whereas Table 4 showed that *E. coli* was susceptible to all the antibiotics but resistance to Cefoperazone, Penicillin, Amoxicillin and Gentamycin while

Pseudomonas species was resistance to Cefoperazone, Streptomycin and Gentamycin.

Table 1: Distribution of bacterial isolates from five different vendors within Katsina LGA

Isolates	A	B	C	D	E	Total (%)
<i>Staphylococcus spp</i>	2	1	0	2	0	5(17.24)
<i>Bacillus spp</i>	2	2	0	1	1	6(20.68)
<i>L. monocytogenes</i>	2	2	0	2	0	6(20.68)
<i>Escherihia coli</i>	0	0	6	1	0	7(24.13)
<i>Salmonella spp</i>	0	0	2	2	1	5(17.24)
						29(100)

Key: A = Mansho suya spot; B=Khadija suya spot; C=Gafai suya spot; D= Yahuzasuya spot; E= Katsina suya spot

Table 2: Cellular Morphology, Microscopic and Biochemical Characteristics of isolates

Gram reaction	Shape	Cat	Coa	IN	Cu	Oxi	Probable organism
+	Cocci	+	+	-	+	-	<i>S. aureus</i>
+	Rod	+	+	-	+	-	<i>L. monocytogenes</i>
-	Rod	+	-	+	-	-	<i>E. coli</i>
-	Rod	+	-	-	-	-	<i>Salmonella spp.</i>
+	Rod	+	+	-	+	-	<i>Bacillus cereus</i>

Keys:

Cat = Catalase; Coa = Coagulase;

Cu = Citrate Utilization; Oxi = Oxidase; IN= Indole

Table 3: Antibiotic Susceptibility pattern (mm) of the Gram-positive bacteria

Isolates/No	CEF	PEN	SXT	CH	CPX	PEF	AM	S	CN
<i>S. aureus</i>	20	2	3	25	24	10	5	6	19
<i>Bacillus spp</i>	4	20	28	20	22	12	6	23	25
<i>L. monocytogenes</i>	20	19	4	24	3	15	6	24	15

Key: 1-12= Resistance (R), 13-17= Intermediate (I), 18> Above Susceptible (S). (CLSI)

CEF= Cefoperazone, PEN= Penicillin SXT= Septrin CH= Chloramphenicol

CPX= Ciprofloxacin, PEF= Pefloxacin, AM= Amoxicillin, S= Streptomycin

CN= Gentamycin

Table 4: Antibiotic Susceptibility of the for Gram negative bacteria

Isolates	CEF	PEN	SXT	CH	CPX	PEF	AM	S	CN
<i>Saalmoneella spp</i>	8	17	22	26	15	22	2	4	3
<i>Escherichia coli</i>	2	6	29	23	25	17	12	19	6

Key: Resistance, R= 1-12; Intermediate, I= 13-17; Susceptible, S= 18> Above. (CLSI)

CEF= Cefoperazone PEN= Penicillin SXT= Septrin, CH= Chloramphenicol

CPX= Ciprofloxacin, PEF= Pefloxacin, AM= Amoxicillin, S= Streptomycin, CN= Gentamycin

DISCUSSION

The research assessed the bacteriological quality of suya meat that is sold in Katsina city. Five different suya places provided a total of twenty-five samples. The study's findings showed that the suya meat contained *Bacillus species*; *Salmonella spp.*, *E. coli*, *Staphylococcus aureus*, and *Listeria monocytogenes* which are microorganism associated with unsanitary

environments. Food and goods sold or stored in such environment can promote contamination and thus spread of illness. The investigation revealed that *Escherichia Coli* was the most isolated bacterium. This finding could be attributed to potential fecal contamination and the use of non-portable water for washing of the raw meats.

This result agrees with the findings of Mashood *et al.* (2000) and Adesoji *et al.*, (2015), who isolated *E. coli* in their studies carried out in Bauchi and Kaduna respectively. The outcome, however, is inconsistent with isolated bacteria found in comparable meat items from Ondo, where *E. coli* frequency was low in the research location (Olatoye, 2011) Moreover, *Staphylococcus aureus* was found in significant concentrations in Ado-Ekiti in a related study carried out by Osho (2004) as opposed to this study. This can be the result of variations in how the beef products from the various local are handled and processed. Serious complications including hemolytic uremic syndrome and gastrointestinal issues result from *E. coli* ingestion. Kidney failure can also result from this syndrome, which harms the kidney's microscopic blood vessels' lining. The microbes found in this study are typically thought to be connected to meat deterioration and contamination (Stellato *et al.*, 2016). Antibiotic resistance profile of isolated bacteria showed that the majority of the bacteria were resistant to Gentamycin, Streptomycin, Amoxicillin, Penicillin, and Cefoperazone. When a knife, cutting board, or other equipment is used repeatedly without being cleaned between usages, microbes can be transferred from one food to another.

A food that is fully cooked can become re-contaminated if it touches other raw foods or drippings from raw foods that contain pathogens. This work agrees with reports by Edema *et al.*, (2008) on microbial hazards of poorly processed suya, where they isolated *Salmonella species and Escherichia coli*. The presence of *Staphylococcus spp* in suya samples reveals that contamination can be from the hands of sellers as since it is commonly found on hands, skin, clothing, the utensils, air. This study reveals suya prepared and sold under grossly unhygienic and unsafe conditions, there by constituting a food safety risk. The findings also highlighted the necessity of teaching suya vendors about product handling personal hygiene and the potential safety risks related to food. It is necessary to implement the procedure and utilize proper controls to ensure that public health is protected.

Conclusion

The study shows that the suya meat sold in the study area can have potent harm to customers' health. Inadequate food handling practices and the suya meat's production sources may be the reason for such microbial contamination. The current

investigation revealed that the handling techniques used by vendors and the unhygienic conditions in which they were sold may be the reason for possible health risk associated with these suya meat sold on the street. This study demonstrates how urgently food safety and quality standards for ready-to-eat suya meat in Katsina State's business district need to be improved.

Recommendations

Suya meat vendors should be aware of the risks involved in using unsanitary methods while preparing suya. Nigeria's meat processing sector has to set up a quality control division. When processing meat and meat products, the Hazard Analysis and Critical Control Point (HACCP) concept ought to be implemented. When it comes to smoking factories, meat markets, and even hawkers who transport meat from one location to another, regulatory bodies like NAFDAC ought to investigate the working conditions of such meat handlers.

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