



YUMSUK JOURNAL OF PURE AND APPLIED SCIENCES

MICROBIOLOGICAL QUALITY ASSESSMENT OF MEAT PRODUCTS (*TSIRE*) SOLD IN WUDIL TOWN

*¹Fatima Muhd Yazid, ²Sadisu Farouk Umar, ³Khadija Muhammad Lawan and ⁴Hauwa Ibrahim Danjaji
^{1, 3, 4}Department of Science Laboratory Technology, Aliko Dangote University of Science and Technology,

Wudil P.M.B 3244, Kano

²Department of Microbiology, Aliko Dangote University of Science and Technology Wudil P.M.B 3244, Kano

*Correspondence Author's email- fatimamyazid@gmail.com

ABSTRACT

Tsire is a roasted boneless meat of beef, goat or mutton that is cooked around a glowing charcoal fire in which the meat pieces are stalked on wood stick, spiced with peanut cake, spices, vegetable oil, salt or other flavorings. The aim of this research was to ascertain the microbiological quality of meat and meat product (*tsire*) consumed in Wudil town. The analysis consisted of total microbial count, coliform count and detection of Enterobacteriaceae, *Pseudomonas* spp. and *Staphylococcus aureus*. A total 10 samples of *tsire* were collected from three different selling points. The mean bacterial count for *tsire* ranged from 3.5log₁₀cfu/g to 3.7log₁₀cfu/g while the mean fungal count ranged from <3 to 1.5log₁₀MPN/g. Comparison of the mean bacterial count shows no significant differences at 0.05 level. The bacteria isolated and identified were *Staphylococcus aureus* (32%), *Pseudomonas* species (36%), and the members of the Enterobacteriaceae family (32%) while the fungi identified were *Aspergillus niger* (38%), *Candida* species (50%) and *Sacchromyces* species (12%). The mean bacterial count observed in all the selling points were within the limit set by ICMSF (2.5 X 10⁵ to 1.8 X 10⁸cfu/g). Based on the study, the meat (*tsire*) supplied by the three selling point was fit for human consumption. It is recommended that the processors/handlers/sellers of *tsire* and other meat products should observe strict hygienic measures so that they may not serve as source of microorganism to the meat products.

Keywords: Microbiological Quality, *Tsire*, Wudil Town

INTRODUCTION

Meat is defined as the edible part of the skeletal muscle of an animal that was healthy at the time of slaughter (CFDAR 1990). It is composed of four major components: water, protein, Lipid, carbohydrate and many other minor components such as vitamin, enzyme, pigments and flavor compounds (Lambert *et al.* 1991). The relative proportions of all these constituents give meat its particular structure, texture, flavor and color. However, because of its unique biological and chemical nature meat undergoes progressive deterioration from time of slaughter to the time of consumption (Lambert *et al.* 1991).

Beef have been the major source of meat in Nigeria as a

result of extensive and semi-intensive cattle production system in Nigeria by Fulani and Hausa people of the Northern Nigeria (Umoh 2004). This leads to the production of ready-to-eat meat products such as *kilishi*, *tsire* and *balangu*. However, *tsire* is the most popular as its consumption has extended to the other part of the country (Inyang *et al.* 2005). *Tsire* is a roasted boneless meat of beef, goat or mutton that is cooked around a glowing charcoal fire in which the meat pieces are stalked on wood stick, spiced with peanut cake, spices, vegetable oil, salt and other flavorings.

Tsire is served or sold along the streets, in club houses, at picnics, parties, restaurants and within institutions

(Igene and Mohammad 2008). It is a mass consumer fast food. Its preparation and sale along streets are usually not done under strict hygienic conditions because they are still done locally with crude tools and does not receive any treatment designed to extend its shelf life thus serving as a source of foodborne infection if contaminated. The study, therefore, will determine the microbial load as well as identify the microorganism on the meat product (*tsire*) so that recommendation could be made on its safety accordingly.

MATERIALS AND METHODS

Sample Collection

A total of 10 samples were collected (Abdullahi *et al.* 2004) from three different selling points in Wudil town using FOA (1979). The samples were aseptically collected in a clean polyethene bag (Okonko *et al.* 2013).

Sample Preparation

For preparation of meat sample homogenate, 10g of each sample (*tsire*) collected were homogenized into 90ml of sterile distilled water using a blender (Anil and Shilpa 2010). The homogenate serve as a stock solution. From the stock solution, 1ml was transferred to the first test tube (10^{-1}) containing 9ml sterile distilled water using a syringe. From the first test tube 1ml is transferred to the second test tube (10^{-2}). The process was continued up to the fifth dilution (Fawole and Oso 2001). All the samples were inoculated according to the pour plate method, where the samples were first placed on the petri dish followed by 15ml agar (liquefied) (Fawole and Oso 2001).

Determination of Microbial Load on Meat Product (*Tsire*)

For total bacterial count, inoculated nutrient agar plates were incubated at 37°C for 24h. Following incubation all colonies on the dishes were counted and recorded per dilution factor. Plates with fewer than 30 colonies were recorded as too few to count and those with more than 300 colonies as too numerous to count (Fawole and Oso 2001).

For the fungal enumeration, the dilutions were inoculated onto a sterile potato dextrose agar. Inoculated plates were incubated at room temperature for 5 to 7 days. Following inoculation, the colonies were counted and recorded as colony forming unit per gram (cfu/g) (Cheesebrough 2000).

Enumeration and Detection Coliform

Coliform were enumerated based on the most probable number (MPN) procedure using lactose broth for presumptive test. The dilutions (10^{-1} , 10^{-2} , and 10^{-3}) were inoculated into test tubes containing 9ml of lactose broth. The test tubes were incubated at 37°C for 24-48h. Following incubation, test tubes showing gas productions were recorded (FSSAI, 2012).

Isolation of Microorganisms

Enterobacteriaceae

For Enterobacteriaceae count, 1ml of 10^{-2} dilutions were transferred to a sterile MacConkey agar plate according to the pour plate method. Inoculated plates were incubated at 37°C for 24h. Following incubation, colonies formed were counted and reported as colony forming unit per gram (Raji 2006).

Pseudomonas spp

For isolation of *Pseudomonas* species, 1ml of 10^{-2} dilutions were inoculated on Cystine lactose electrolyte deficiency agar and incubated at 37°C for 48h. After incubation, all the distinct colonies formed were sub-cultured onto a fresh petri dish and incubated at 37°C for 48h. The organisms were confirmed by oxidase test (Roberts and Greenwood 2003).

Staphylococcus aureus

S. aureus was presumptively enumerated on the basis of their appearance on Baird-Parker agar. An aliquot of each dilution was inoculated on duplicate agar plate and incubated at 37°C for 48h (Thaker *et al.* 2013).

Identification of Bacterial and Fungal Isolates

The bacterial isolates were identified based on colonial morphology and biochemical characteristics. The biochemical tests carried out were; gram staining, catalase, coagulase, oxidase, methyl red reaction and Voges-Proskaur test (Fawole and Oso 2001).

Representative fungal colonies from the inoculated agar plates were identified based on macroscopic and microscopic characteristics using atlas of fungi (Tafinta *et al.* 2013).

Statistical Analysis

Data on microbiological quality of meat were presented using descriptive statistics, with means, frequencies and percentage. Microbiological counts were represented as

log₁₀. One-way analysis of variance was used to analyze the analytical data using the SPSS software.

RESULTS

The result of microbial load analysis revealed that the mean bacterial count ranged from 3.5log₁₀cfu/g to

3.7log₁₀cfu/g. The mean fungal count range from 2.3log₁₀cfu/g to 3.2log₁₀cfu/g. The highest colony forming unit was observed in selling point B while the least colony forming unit was observed in selling point A (Table 1).

Table 1: Mean Microbial Count

Selling points	MBC (logcfu/g)	MFC (logcfu/g)	MCC (mpn/g)	MCC (logmpn/g)
Sp A	3.5	2.3	1.5	1.2
Sp B	3.7	3.2	1.2	1.1
Sp C	3.7	2.6	3.2	1.5

Key: Sp= Selling point, MBC= Mean Bacterial Count, MFC= Mean Fungal Count, MCC= Mean Coliform Count

A total of three bacterial specie and three fungi were isolated and identified based on their morphological, microscopic and biochemical characteristics (Table 2). The isolated bacteria were; *S. aureus*, *Pseudomonas*

spp, and Enterobacteriaceae while the isolated fungi were; *Aspergillus niger*, *Sacchromyces* spp and *Candida* spp.

Table 2: Microscopic, Macroscopic and Biochemical Characteristics of Bacteria and Fungi Isolated

Organism	Macroscopic examination	Gram staining	Microscopic examination	Ca	Co	Mo	Me	Vp	Ox
<i>S. aureus</i>	Dark colonies on Baird Parker medium	+	Cocci and occur in cluster	+	+	-	+	+	-
<i>Pseudomonas spp</i>	Green colonies on CLED agar	-	Rod shaped	+	-	+	-	-	+
Enterobacteriaceae	Pink color on macConkey agar	-	Rod shaped	+		-	+	-	-
<i>Candida spp</i>	Flat smooth large colonies	Nil	Unicellular cocci larger than bacteria	Nil	Nil	Nil	Nil	Nil	Nil
<i>Aspergillus niger</i>	Pink like black growth	Nil	Consist of conidiospores and spores	Nil	Nil	Nil	Nil	Nil	Nil
<i>Saccharomyces spp</i>	Flat, smooth, moist or dull and cream in color	Nil	Unicellular ovoid shape larger than bacteria	Nil	Nil	Nil	Nil	Nil	Nil

KEY: Ca= Catalase, Co= Coagulase, Mo= Motility, Me= Methyl red, Ox= Oxidase, Vp= Vogesproskauer, Nil= not applicable

Among the bacteria isolated, *Psuedomonas spp* had the highest frequency (36%) while *S. aureus* and Enterobacteriaceae had the least frequency (32%) each (Table 3). Among the fungi isolated, *Candida spp* had the highest frequency (50%) while *Sacchchromyces spp* had the least frequency (13%) (Table 4).

Table 3: frequency of occurrence of bacteria isolated

Organism	SpA	Sp B	Sp C	Total	Percentage %
<i>S. aureus</i>	2	2	3	7	32
<i>Pseudomonas spp</i>	3	3	2	8	36
Enterobacteriaceae	3	1	3	7	32

Key: Sp= Selling point

Table 4: Frequency of Occurrence of Fungi Isolated from *Tsire*

Organism	SpA	Sp B	Sp C	Total	percentage%
<i>Aspergillus niger</i>	0	1	2	3	38
<i>Candida spp</i>	3	1	0	4	50
<i>Saccharomyces spp</i>	0	0	1	1	12

key: Sp= Selling point

DISCUSSION

In this study, the highest mean bacterial count observed was 3.7 log₁₀cfu/g. There has been a large debate concerning the total viable bacterial count in meat and meat products at the point of consumption. ICMF (2011) put the limit between 2.5 x 10⁵ to 1.0 x 10⁸cfu/g of consumable meat products. Hence, the meat (*tsire*) supplied by the three selling points was fit for human consumption.

The bacteria isolated were identified as *S. aureus* (32%), *Pseudomonas* specie (36%) and Enterobacteriaceae (32%). Among the members of the Enterobacteriaceae, only *E. coli* was identified while the *Pseudomonas* specie was identified as *P. aeruginosa*. Microorganisms isolated from the *tsire* samples in this study have been earlier found in foods, environment and other places and their pattern is similar to previous reports (Enabulele and Uraih 2009, Sobukola *et al.* 2009, Clarence *et al.* 2009, Oyeleke 2009 & Okonko *et al.* 2008a, b, c, d, 2009a, b, 2010).

The fungi isolated were *A. niger* (38%), *Candida* (50%) and *Sacchchromyces* (13%). This is similar to the findings of Inyang *et al.* (2005) and Hassan *et al.* (2014) who worked on quality of smoked meat product and microbiological quality of ready-to-eat barbecue meat and isolated species of yeast and mold which include *Sacchchromyces*, *Candida*, *Rhodototorula*, *A. niger*, *Rhizopus* and *Mucor*. Enterobacteriaceae, *Pseudomonas* specie, *Aspergillus*, and yeast are among the microorganisms that can cause spoilage of meat. However, their presence alone is not sufficient to cause spoilage their count must reach an unacceptable level (10⁶cfu/g) before they can cause spoilage (Maria *et al.* 2015). In this study, the Enterobacteriaceae and *Pseudomonas* count were insignificant. However, control measures should be taken to prevent further multiplication of the organisms or to eliminate them from the meat product to avoid spoilage.

The presence of *E. coli* was attributed to

handling process such as equipment, packaging material, preparation and storage condition of the meat product (*tsire*). *E. coli* is commonly used as surrogated indicator. Its presence in food generally indicates direct or indirect fecal contamination (Clarence *et al.* 2009). Clarence *et al.* (2009) and Oyeleke (2009) reported the presence of *S. aureus*, *E. coli* and *Pseudomonas* on meat pie and yoghurts respectively. Other reporters have reported the presence of *Pseudomonas*, *E. coli* other gram-negative bacteria on raw meat sample (Lin *et al.* 2004). The occurrence of such bacterial isolates on the meat samples is determined by the storage and handling conditions adapted. Cervený *et al.* (2009) stated that storage conditions affect the type of microbes found on meat and meat products. They reported that *Pseudomonas* and psychrotropic members of the family Enterobacteriaceae are frequently present on refrigerated meat products, while *E. coli* and *S. aureus* are normal flora in humans and animals, their presence in foods is an indication of excessive human handling (Clarence *et al.* 2009).

CONCLUSION

The work confirmed that *tsire* from Wudil town was safe and acceptable for consumption. Microbial load was within acceptable limit. However, the finding of the study suggests that meat product which is subjected to thermal processing during the production process may still contain high number of microorganisms some of which can cause spoilage.

RECOMMENDATIONS

- i. The processors/handlers/sellers of *tsire* and other meat products should observe strict hygienic measures so that they may not serve as a source of microorganisms to the meat product.
- ii. Customers should also insist on using sterile foil paper or polyethylene bags for packaging *tsire*.
- iii. Food handlers and consumers should be

educated on the need for personal hygiene to minimize contamination.

- iv. *Tsire* and other meat products should be reheated adequately before purchase to ensure destruction of vegetative cells.

REFERENCES

- Abdullahi, S. A., and Osman, M. M. (2010). Isolation and identification of lactic acid bacteria from raw cow, milk, white cheese and rob in Sudan. *Pakistan Journal of Nutrition*, 9: 12-3-1206.
- Anil, K. P., and Shilpa, J. (2010). *Practical Manual on Food and Industrial Microbiology*. First edition. NDRI publication, Pg 6-8.
- Cervený, J., Meyer, J. D., and Hall, P. A. (2009). Microbiological Spoilage of Meat and Poultry Products In: Compendium of the Microbiological Spoilage, of Foods and Beverages. *Food Microbiology and Food Safety*, W. H. Sperber and M.P Doyle (Eds) Springer Science and Business Media, NY, page 69-869.
- CFDAR, Canadian Food and Drug Act and Regulations, (1990). With amendments to May 3, 1990. Section 14, paragraph B.14.002(S), page 64 Ottawa. The queen's printer.
- Cheesbrough M. (2000). *Medical Laboratory Manual*. Tropical Health Technology, Low priced Edition. Doddington, Cambridgeshire, England, pp. 20-35.
- Clarence, S. Y., Obinna, C. N., and Shalom, N. C. (2009). Assessment of Bacteriological of Ready-to-eat Food (meat pie) in Benin city metropolis, Nigeria. *African Journal of Microbiology Res*, 3(6): 390-395.
- Enabulele, S. A., and Uraih, N. (2009). Enterohaemorrhagic *Escherichia coli* 0157:H7 Prevalence in Meat and Vegetables Sold in Benin City, Nigeria. *African Journal of Microbiology Research*, 3(5): 276-279.
- Fawole, M. O., and Oso, B. A. (2001). *Laboratory Manual of Microbiology*: Revised edition spectrum books Ltd, Ibadan, p. 127.
- FSSAI, (2012). *Manual of Methods of Analysis of Food, Microbiological Testing*. New Delhi, page 13-16.
- Hassan, I. A., Emun, H. O., and Adekunle, E. O. (2014). Microbial Quality of Ready to Eat

- Barbecue Meat (Suya) Sold on the Streets of Lagos State. *Int. J. Adv. Pharm., Bio. Chem.* 3(4): 973.
- ICMSF, (2011). Microorganisms in Food. Use of data for assessing process control and product acceptance. New York Springer, 400s.
- Igene, J.O., and Mohammad I. D. (2008). Consumer attitude toward suya meat product. *Am Borno* 1.
- Inyang, C. U., Igyor, M. A., and Uma, E. N. (2005). Bacterial Quality of some Meat Products (suya). *Nigerian Food Journal*. 23(1): 239-242.
- Lambert, A. D., Smith, J. P., and Dodds, K. L. (1991). Shelf life extension and microbiological safety of fresh meat-A review. *Food Microbiology*, 8: 267-297.
- Lin, M., Al-Holy, M., Mousavi-Hesary, M., Al-Qadiri, H., and Cavinato, A. G. (2004). Rapid and quantitative detection of the microbial spoilage in chicken meat by diffuse reflectance spectroscopy (600-1100nm). *Letters in Applied Microbiology*, 39: 148-155.
- Maria, F. L., Paola, S., Elena, B., and Beniamino, T. C. (2015). Meat Spoilage: A Critical Review of a Neglected Alteration due to Ropy Slime Producing Bacteria, *Italian Journal of Animal Science*. 14:3.
- Okonko, I. O., Adejoye, O. D., Ogunnusi, T. A., Fajobi, E. A., and Shittu, O. B. (2008a). Microbiological and Physicochemical Analysis of Different Water Samples Used for Domestic Purposes in Abeokuta and Ojota, Lagos State, Nigeria. *African Journal of Biotechnology*, 7(3): 617-621.
- Okonko, I. O., Donbraye, E., and Babatunde, S. O. I. (2009b). Microbiological Quality of Seafood Processors and Water Used in Two Different Sea Processing Plants in Nigeria, 8(8): 621-629.
- Okonko, I. A., Ogun, A. A., Adejoye, O. D., Ogunjobi, A. A., Nkang, A. O., and Adebayo-Tayo, B. C. (2009a). Hazard Analysis and Critical Control Points (HACCP) and Microbiology Qualities of Sea-foods as Affected by Handler's Hygiene in Ibadan and Lagos, Nigeria. *African Journal of Food Science*, 3(1):035-050.
- Okonko, I. O., Ogunjobi, A. A., Adejoye, O. D., Ogunnisi, T. A., and Olosogba, M. C. (2008c). Comparative Studies and Microbial Risk Assessment of Different Water Samples Used for Processing Frozen Sea-food in Ijoraolopa, Lagos State, Nigeria. *African Journal of Biotechnology*, 7(16): 2902-2907.
- Okonko, I. O., Ogunjobi, A. A., Fajobi, E. A., Onoja, B. A., Babalola, E. T., and Adedeji, A. O. (2008b). Comparative Studies and Microbial Risk Assessment of Different Ready-to-eat (RTE) Frozen Sea-foods Processed in Ijora-olopa, Lagos state, Nigeria. *African Journal of Biotechnology*, 7(16):2898-2901.
- Okonko, I. O., Ogunnusi, T. A., Ogunjobi, A. A., Adedeji, A. O., Adejoye, O. D., Babalola, E. T., and Ogun, A. A. (2008d), microbial studies on Frozen shrimps processed in Ibadan and Lagos, Nigeria. *Scientific Research and Essay*, 3(11):537-546.
- Okonko, I. O., Odu, N. N., and Igboh, I. E. (2013). Microbiological analysis of *kilishi* sold in Port Harcourt, Nigeria. *New York Science Journal*, 6(7):38.
- Oyeleke, S. B. (2009). Microbial assessment of some commercially prepared yoghurt retailed in Minna, Niger state. *African Journal of Microbiology Research*, 3(5):
- Raji, A. I. (2006). Bacteriological quality of dried sliced beef (*kilishi*) sold in Illorin Metropolis.
- Roberts, D., Greenwood, M. (2003). *Practical Food Microbiology*, 5th edition. Blackwell publishing Ltd, Uk. Pg. 273-274.
- Sobukola, O. P., Awonorin, O. S., Idowu, A., and M., Bamiro, O. F. (2009). Microbial profile and critical control points during processing of 'robo' snack from melon seed (*Citrullus lunatus* thumb) in Abeokuta, Nigeria. *African Journal of Biotechnology*, 8(10):2385-2388.
- Tafinta, I. Y., Shehu, K., Abdulganiyyu H., Rabe A.M., and Usman A. (2013). Isolation and identification of fungi associated with spoilage of sweet orange (*Citrus sinensis*) fruits in Sokoto State, *Nigerian Journal of Basic and Applied* 21(3):193-196.
- Thaker, H. C., Brahmhatt, M. N., and Nayak, J. B. (2013). Isolation and identification of *Staphylococcus aureus* from milk and milk products and their drug resistance patterns in Anand, Gujarat, *Vet World* 6(1):10-13.