Herren, R.V. (2013). The Science of Animal Agriculture. Meat Production.Delmar, U.S.A 1st Ed. Pp.32-34.

Karen, B. (2009). Meat Intake's Influence on Body Fatness Can not be Assessed Without Measurement of Body Fat. *The American Journal of Clinical Nutrition*. 92(5): 105-106.

Sanusi, H. and Ademoyin, J. (2014). Determination of Meat Preferences Among Households in Ogbomosho, Oyo State, Nigeria. In: B.M. Oruwari, J.P. Alawa, O.J Owen Proceeding of the 39th Conference of Nigerian Society for Animal Production Held at Babcock University Illisheri Remo, Ogun State. Nigeria 16-19th Mar. Pp. 437-440.

Virginia, G. (2015). Influence of Marbling and Final Internal Temperature on Meat Quality Characteristics. *Food Technology*. 19:84-97.

Yuguda, M., Musa, Z. and Ibrahim, A. (2013). Socio-Economic Characteristics of Cattle Traders and Marketing Activities in Zaria, Kaduna State. Nigeria. Agricultural Transformation in a Deregulated Economy: Prospects and Challengers in: Muktar, I., Muhammad, S.G. and Garba, Y. Proceedings of the 48th Annual Conference of the Agricultural Society of Nigeria Held at the Faculty of Agriculture, Ahmad Bello Zaria. 5th-9th Nov, 2013. Pp. 228-230.

# MICROBIAL QUALITY OF RAWAND *TSIRE* MEAT OFFERED FOR SALE AT HADEJIA LOCAL GOVERNMENT AREA, JIGAWA STATE

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**Abstract**
Microbial quality of raw meat and *tsire* sold at retail outlets from Yayari, Yankoli and Matsaro of Hadejia metropolis, Jigawa State were evaluated. Three samples from each outlet were collected fortnightly from 3rd to 17th April, 2018 into sterile plastic bags, stored at 4 $^{O}$C in ice chest filled with ice and transported immediate to the laboratory for Total Viable Count (TVC), Total Coliform Count (TCC), Total Staphylococcus Count(TCS) and Total Fungal Count(TFC) analyses using Nutrient Agar, Mac Conkey Agar, Mannitol Salt Agar and Potato Dextrose Agar, respectively and incubated at 37 $^{0}$C for 24 hours except for the detection of fungi, which was incubated at 25 $^{0}$C for 5 days. *Tsire* samples collected from Matsaro have the highest TVC (6.0 x $10^4$) while those collected from Yankoli have the highest TCS (4.0x$10^2$).The presence of bacteria on raw meat and *tsire* sold at the study area is an indication of low standard of animal and meat handling practices from pre-slaughter to post–slaughter, sales of meat, abattoir facilities and equipment.
**Key words: Microbial, *Tsire*, Sale, Quality and Raw Meat**

## Introduction
*Tsire* is a roasted or smoked beef or other boneless animal meat. It is rich in protein, mineral (zinc, selenium and phosphorus) and is also a good source of niacin, vitamin B6 (pyridoxine) and iron (Koffi-Nevry *et al*., 2011). It is one of the most street-vended meat products in Nigeria and sub-Saharan Africa (Abdullahi *et al*., 2006). The preparation processes of *tsire* involved de-fatting and slicing the meat on a slab or table, after which it is staked into sticks, spiced and roasted for about twenty (20) minutes, thereafter, the products is spiced again and briefly reheated for about two (2) minutes. It's then displayed for marketing on table tops or trays where it can be street-vended (Edema *et al.*, 2008). *Tsire* preparation process in Nigeria lacks standard or hygienic quality control: therefore there is increase in food safety risks (Odusole and Akinyanju, 2003; Inyang *et al*., 2005 and Adzitey *et al*., 2010). Notwithstanding the major role meat plays in our meals, it can also serve as a rich medium of growth for harmful microorganisms. Meat infected with microorganisms is the cause of many food-borne diseases (WHO, 1997). The sources of these pathogenic microorganisms may be the animals themselves or from outside the surroundings where these animals were kept as well as the way they were processed after slaughter (Adeyemo, 2002). Meat infected with microorganisms is normally poor in quality (Mukhopadhyay, 2009). Microbes such as *Staphylococcus* spp., *Aspergillus* spp., *Salmonella* spp., *Enterococcus* spp., *Streptococcus* spp. and *Escherichia coli* have all been found on contaminated meat (James *et al*., 2005).The study is aimed to examine the microbial quality of *tsire* offered for sale at Hadejia Local Government Area of Jigawa State.

## Materials and Methods
This study was carried out in Hadejia Metropolitan of Jigawa State. Meat outlets from three locations namely Yayari, Yankoli and Matsaro were randomly selected. A total of fifty four meat samples (Table 1) were collected aseptically with the help of sterilized knives. Freshly slaughtered beef and *tsire* samples from the various outlets were collected fortnightly from 3rd to 17th April, 2018 into sterile plastic bags, stored at 4 $^{O}$C in ice chest filled with ice and transported immediate to the laboratory for Total Viable Count (TVC), Total Coliform Count (TCC), Total Staphylococcus Count (TCS) and Total Fungal Count (TFC)

analyses using Nutrient Agar, Mac Conkey Agar, Mannitol Salt Agar and Potato Dextrose Agar, respectively and incubated at 37 $^0$C for 24 hours except for the detection of fungi, which was incubated at 25 $^0$C for 5 days.

*Tsire* piece from each sample was removed from the skewers and mashed in a sterile laboratory mortar and pestle. 1g of the mashed sample was weighed and then aseptically introduced into 9 ml of sterile distilled water, properly shaken and sieved before a twofold dilution was performed. The samples were inoculated aseptically using streak technique and the plates were read for growth of organisms. The counts for each plate were expressed as colony forming unit (cfu/g) of the suspension ie

$$\text{Colony forming unit/g} = \frac{\text{Number of colony counted x Reciprocal of dilution factor}}{\text{Volume of sample inoculated}}$$

**Results and Discussion**

The microbial load of raw meat was presented in Table 2. Highest TVC ($9.0x10^6$ cfu/g) and TCC ($5.0x10^6$ cfu/g) were reported from samples collected at Matsaro while highest TSC ($3.8x10^3$ cfu/g) and TFC ($4.2x10^2$ cfu/g) were reported from samples collected at Yayari.

Table 1: Total Number of Samples Collected for Assessment of Microbial Contamination

| S/N | Type of meat | Number of Samples |
|---|---|---|
| 1 | Raw | 27 |
| 2 | *Tsire* | 27 |
| | Total | 54 |

Table 2: Microbial Load of Raw Meat (cfu/g)

| Sample Location | Total viable count ($x10^6$) | Total coliform count ($x10^6$) | Total staphylococcus count ($x10^3$) | Total fungal count ($x10^2$) |
|---|---|---|---|---|
| Yayari | 7.5 | 4.5 | 3.8 | 4.2 |
| Yankoli | 3.5 | 3.0 | 2.4 | 1.3 |
| Matsaro | 9.0 | 5.0 | 1.0 | 3.5 |

The microbial load of *tsire* was presented in Table 3. No growth of TCC and TSC were reported from samples collected at Matsaro, equally no growth of TSC and TFC were reported from samples collected at Yankoli. On the other hand, samples collected from Matsaro had the highest TVC ($6.0 \times 10^4$ cfu/g) while that collected from Yankoli had the highest TSC ($4.0x10^2$ cfu/g).

Table 3: Microbial Load of *Tsire* (cfu/g)

| Sample Location | Total viable count | Total coliform count | Total staphylococcus count | Total fungal count |
|---|---|---|---|---|
| Yayari | $1.8x10^4$ | $1.0x10^2$ | $0.0x10^1$ | $0.0x10^1$ |
| Yankoli | $2.6x10^5$ | $1.7x10^3$ | $4.0x10^2$ | $2.0x10^2$ |
| Matsaro | $6.0x10^4$ | $0.0x10^1$ | $0.0x10^1$ | $1.0x10^2$ |

The various meat outlets have different hygienic levels as far as transportation, handling and processing is concerned. This might have accounted for the variations in TVC, TCC, TSC and TFC as shown in tables 2 and 3. This is in line with the work of Ruban and Fairoze (2011) and Obeng *et al.* (2013) who attributed the higher microbial levels from non-sophisticated outlets compared to sophisticated ones. This may be due to unhygienic handling of meat right from slaughtering, butchering equipment, handling, transportation and processing (Warris, 2010). Similarly Abubakar *et al*. (2011) isolated four fungal species (*Aspergillus niger, Aspergillus fumigatus*, *Rhizophus nigricans* and *Hansenula anomala)* after seven days storage of meat products at ambient temperature. Other workers such as Ologhobo *et al*. (2010) and Salihu *et al*. (2010) have also reported that meat products sold in Nigeria were contaminated with various species of bacteria and fungi.

The high level of microbes presence on meat increase the chances of the meat getting spoiled within the shortest possible time. Although microbial load on the meat samples were within the safe limits of $10^7$ cfu/g specified for meat products (ICMSF, 1978). It can therefore be said that meat sold in the study areas were not spoiled. Nevertheless the isolation of *Staphylococcus* spp. is of great concern because certain strains of this bacterium cause food-borne infections. *Staphylococcus* spp. infections can be contracted through consumption of contaminated chevon and mutton (Adzitey *et al*., 2010). It is an important cause of gastroenteritis. *Staphylococcus* spp. can be present on the skin of humans and animals and can be transmitted from person to product through unhygienic practices (Postgate, 2000). *Staphylococcus* spp. cause infections such as arthritis, black pox, boil, bronchitis, carbuncle, cystitis, endocarditis, meningitis, osteomyelitis, pneumonia and scalded skin (Stuart, 2005). To ensure good microbial quality of meat products, proper hygiene must be ascertained to guarantee safety from infection and to promote quality assurance. On the whole, the major sources of microbial contaminate of meat appear to be handling by processor and the use of contamination water and equipment. So control of meat contamination can be achieved if aseptic techniques are employed during the production of meat (Field, 2002). The variation in the microbial count may be attributed to the sample used, contamination by flies, method of handling and transportation and the air flora of the environment. Processing operations such as heating, boiling, filtration, freezing, irradiation of finished product, addition of condiment and condition of storage affect both bacterial and fungal loads (Igyor and Uma 2005). High microbial loads lead to spoilage of foods that have not been properly stored (Nester *et al.*, 2001).

**Conclusion and Recommendation**

The study concluded that *tsire* sold at Hadejia Local Government Area was safe for consumption, due to it less microbial load. It is recommended that meat sellers and handlers should as often as possible be enlightened on proper animal handling, hygienic slaughter, proper meat transportation, sanitation of utensils, equipment and proper storage of meat. This would help to reduce the rate of meat contamination.

**References**

Abubakar, M. M., Bube, M. M., Adegbola, T. A. and Oyawoye, E. O. (2011). Processing and Evaluation of *Dambu*, *Tsire* and *Balangu* from Non-Ruminant Animals. *ACT-Biotechnology Research Communications*, 1:149-155.

Abdullahi, I.O., Umoh, V.J. and Galadima, M. (2006). Hazzards Associated with *Kilishi* Preparation in Zaria, Nigeria. *Journal of Microbiology*, 18(2):328-345.

Adzitey, F., Teye, G. A., Ayim, A. G. and Addy, S. (2010). Microbial Quality of Chevon and Mutton sold in Tamale Metropolis of Northern Ghana. *Journal of Applied Sciences and Environmental Management*. 14(4):53-55.

Adeyemo, O. K. (2002). Unhygienic Operation of a City Abattoir in South Western Nigeria: Environmental Implication. *African Journal of Environmental Assessment and Management*. 4(1):23-28.

Edema, M.O., Osho, A.T. and Diala, C.I. (2008). Evaluation of Microbial Hazard Associated with Processing of *Suya* (A Grilled Meat Product). *Sci. Res. Essays* 3(12):621-626.

Field, R.A. (2002). Enteric and food-borne illnesses. *Advanced Food Research*. 27:28-35.

ICMSF (1978). International Commission of Microbiological Standards for Foods. Micro-Organisms in Foods 2. Sampling for Microbial Analysis. Principles and Specific Applications. University of Toronto Press, Toronto.

Igyor, M.A. and Uma, E.N. (2005). Bacterial Quality of Smoked Meat Product (*Suya*). *Nigeria Food Journal*. 23: 233-242.

Inyang, C.U., Igyor, M.A. and Uma, E.N. (2005). Bacterial Quality of a Smoked Meat Product (*Suya*), *Nigerian Food Journal*, 23:239-242.

James, M. J., Martin, J. I. and Golden, A. D. (2005). Modern Food Microbiology. Springer Science plus Business Media, Inc. 7th edition. pp. 12 – 63.

Koffi-Nevry, R., Koussemon, M. and Coulibaly, S. O. (2011). Bacteriological Quality of Beef Offered for Retail Sale in Cote D'ivoire. *American Journal of Food Technology*. 6(9):835-842.

Mukhopadhyay, H. K., Pillai, R. M., Pal, U. K. and Ajay, V. J. (2009). Microbial Quality of Fresh Chevon and Beef in Retail Outlets of Pondicherry Tamilnadu. *Journal of Veterinary and Animal Sciences*. 5(1):33-36.

Nester, E.W., Aderson, D.G., Roberts, C.E., Pearsall, N.N. and Nester, M.T. (2001). Microbiology; A Human Perspective. 3rd Edition. McGraw Hill Company, U.S.A.,822-809.

Obeng, A. K., Johnson, F. S. and Appenteng, S. O. (2013). Microbial Quality of Fresh Meat from Retail Outlets in Tolon and Kumbungu Districts of the Northern Region of Ghana. *International Journal of Science and Technology*. 2(6):424-428.

Odusole, K.A. and Akinyanju, O.O. (2003). Red Suya Syndrome – Acute Intravascular IeAdminstration and Control. *Consum. Saf. Bull.* 2(2):20-24.

Ologhobo, A.D., Omojola, A. B., Ofongo, S. T., Moiforay, S. and Jibir, M. (2010). Safety of Street Vended Meat Products - Chicken and Beef *Suya*. *African Journal of Biotechnology*,9:4091-4095.

Postgate, J. R. (2000). Microbes and Man. Oxford, UK; New York: Cambridge University Press. p. 373.

Ruban, S. W. and Fairoze, N. (2011). Effect of Processing Conditions on Microbiological Quality of Market Poultry Meats in Bangalore, India. *Journal of Animal and Veterinary Advances.* 10(2):88- 191.

Salihu, M.D., Junaidu, A.U., Magaji, A.A., Aliyu, R.M.Y., Shittu, A. and Ibrahim, M.A. (2010). Bacteriological Quantity of Traditionally Prepared Fried Ground Beef (*Dambun-Nama*) in Sokoto, Nigeria. *Advance Journal of Food Science and Technology*, 2:145-147.

Stuart, H. (2005). Essential Microbiology. The University of Glamorgan, UK; John Wiley and Sons, Ltd.

Warriss, P. D. (2010). Meat Science: An Introductory Text. CAB International, Cambridge University Press, Cambridge, UK. 2nd Edition. pp.77-84.

WHO (1997). World Health Organisation Statistics Quarterly. Food Safety and Foodborne Diseases. 50(1/2).