Microblological Quality Assessment of Meat Samples Sold in Kaura Namoda

Tijani Ahmed Olayinka, and Jumare Sani

***Abstract*—**The study is focused on the Microbiological Quality Assessment of meat samples sold in kaura Namoda (Danbu nama, Kilishi, Balangu, Tukuyan, Tsire) that are commonly eaten in the Northern part of Nigeria. A major focus has been given to the isolation and identification of fungi and some bacteria. Six samples were taken each week within a period of one year. The microbial investigation was aimed at the deter¬mination of total plate counts, the number of coliforms, Staphylococcus aureus, the presence of Salmonella spp., and the number of moulds present in these meats. The highest level of microbial contamination (total plate count, counts of coliforms and Staphylococcus aureus) was observed in fresh meat during dry season. The presence of Salmonella was not found in any sample. The highest number of microscopic filamentous fungi was found in samples of kilishi in rainy season. Toxicogenic genera (Aspergillus spp., Penicillium spp., and Fusarium spp.) have also been identified.

***Keywords*—**Meat products, microbial contamination, toxicogenic moulds

I. Introduction

MEATS are the most perishable of all important foods and this is as a result of their chemical composition. Meats contain an abundance of all nutrients required for the growth of bacteria, yeasts, and molds and an adequate quantity of these constituents exist in fresh meats in available form. Meat which refers to meat flesh, Skeletal muscles, connective tissue or fat and others than meat flesh, including brain, heart, liver, kidney, pancreas, spleen, thymus tongue and tripe that is used as food, excluding the bone and bone marrow and it contains high biological value protein and important micronutrients that are needed for good health throughout life (lkema,1990). Meat as a source of animal protein is consumed heavily in Nigeria and is also recommended by nutritionists as a major source of protein for growing children, the convalescent, the expectant mothers and the aged. In general, mycotoxin exposure is a critical problem in the hot and humid low income countries where poor methods of food handling and storage are common. ln spite of occasional high profile incidents of acute poisoning outbreak, mycotoxins have not been widely prioritized from a public health perspective (Azziz etal.,2004). lt could also form the scientific basis for promulgation of regulations important in the decision-making process to establish meaningful limits for mycotoxins in foods ,most especially meat and meat products(Milicevic etal;2010). Raw meats, as well as final meat products are exposed to a high risk of microbial contamination at the time of their production, processing, storage and distribution. Chemical composition of food, proper¬ties of the outside environment, and specific growth requirements determine the type of microorganisms and the course of physico-chemical reactions in the contaminated food. Foodstuffs, in general ¬represent an ideal medium for the persistence and multiplication of toxicogenic filamentous fungi which posses the ability to produce mycotoxins under suitable conditions. More than 64 000 moulds, yeasts, and yeast-like organisms have been found in the environment. Among them, 114 mould and 12 yeast species are of use in the food industry. 65 species of 114 reported are able to synthetize more than 150 kinds of mycotoxins, as to fresh meat and meat delicacies, 78 mould species have already been isolated, 50 of them being potentially toxicogenic. Feeds and foods are often contaminated with various moulds and when the temperature and relative humidity are optimal after contamination, there is also a risk of mycotoxins production (Styriak, 1998). There are three main forms of suya, namely tsire, kilishi and balangu, but of these, tsire is the most commonly preferred (Alonge and Hiko, 1981). Therefore, to most consumers, tsire is synonymous with suya (Igene and Abulu, 1984). 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 staked on wood sticks, spiced with peanut cake, spices, vegetable oil, salt or other flavourings. It is a delicatessen item since it does not receive any treatments designed to extend its shelf life (Harris et al., 1975). Indeed, most sales-points hardly exhaust their sales and leftovers are often carried over to the second day or beyond. To this extent, rancidity often sets in, leading to the spoilage of this product. Suya products can become contaminated microbiologically from raw materials, handlers and/or equipment. (Igene and Abulu 1984) reported the isolation of Bacillus, Streptococcus, Staphylococcus, Escherichia, Proteus, Pseudomonas and Klebsiella from raw and freshly roasted tsire subjected to different storage treatments. (Uzeh et al. 2006) also reported the confirmation of some of these organisms in the stick meat, specifically Ps. aeruginosa, B. cereus, Staph. aureus, and E. coli. Meat is a nutritious, protein-rich food which is highly perishable and has a short shelf-life unless

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preservation methods are used (Olaoye and Onilude, 2010).. In most developing countries, including Nigeria, fresh meat forms a significant proportion of meat intake (Olaoye and Onilude, 2010). It is either eaten cooked or processed into other forms to avoid associated spoilage. The main causative factor of such spoilage has been linked to unavailability of necessary storage facilities and favourable ambient temperature that usually prevail in developing countries that are in tropical regions (Olaoye et al., 2010). Research findings have suggested that there is increasing attention on the use of naturally occurring metabolites produced by selected lactic acid bacteria (LAB) to inhibit the growth of spoilage microorganisms (Onilude et al. 2002; Olaoye and Onilude, 2010; Olaoye et al., 2010; Olaoye and Dodd, 2010). These authors have demonstrated the potential of LAB cultures as biopreservatives during processing and preservation of many forms of meat products. Lactic acid bacteria growing naturally in foods produce antimicrobial hydrogen peroxide and bacteriocins (Olaoye et al. 2008).

Meat surface is usually heavily contaminated with a wide range of microorganisms. Due to its beneficial chemical composition (the content of water, proteins, peptides, amino acids, nucleo-tides, sugars, minerals and vitamins), the meat is a suitable medium for the development of all microorganisms (Steinhauser et al., 1995). Besides various G-negative (Escherichia spp., Enterobacter spp., Yersinia spp., and Pseudomonas spp.) and G-positive bacteria (Bacillus spp., Micrococcus spp. and Lactobacillus spp.), psychrotrophic moulds (Aspergillus spp., Cladosporium spp., Geotrichum spp., Mucor spp. and Rhizopus spp.) are frequently isolated from the meat surface (Polster et al., 1985). It is evident, that both variability and adaptability of moulds make practically impossible to set some general and stable conditions for their development in food, as well as for the production of mycotoxins. The prepared meat when being sold is usually packaged in newspapers and sometimes in cellophane or nylon bags. Most of the stages of meat preparation, materials used in its preparation and packaging, the handlers and the surrounding environment can serve as source of contaminants to the meat product. The situation of the meat-processing plants, the slaughter of animals, insufficient cleaning and disinfection of working areas, instruments and other equipment are the most important sources of food contamination by toxicogenic moulds. Therefore, the objective of this study was to determine the various contaminating microbes on meat, consumed the in Northen part of Nigeria and also to create awareness on the presence, concentrations and distributions of mycotoxins in meat.

TABLE I
SHOWS THE GENERAL CHARACTERISTICS OF MOULD DEVELOPMENT AND THE PRODUCTION OF MYCOTOXINS IN RAW MEAT AND READY-TO-EAT MEAT . (OSTRY, 2001)

Factor	**Growth of moulds**	**Production of mycotoxin**
Temperature	from – 12 to 55 ºC	from +4 to +44 ºC
pH- value	from 1.7 to 10	from 2,5; optimum between 5 and 7
Available water, aW	min. of 0.62	min.of 0.8 – 0.85
Redox potential	aerobic conditions	aerobic conditions
Addition of salt, NaCl	up to 20 % NaCl	up to 14 % NaCl
Influence of spice	Inhibition	Inhibition

II. METHODS

Samples purchased from different locations in Kaura-Namoda in the Northern part of Nigeria were selected for this study. The locations (Sabon-gari area, Motor-park, Market, Academic area, Gulubi area) are known for wide patronage by inhabitants in these localities. Six samples were taken each week within a period of one year. Samples collected were placed in labeled sterile polythene bags and transferred immediately to the laboratory for microbial analysis. Ten grams of sample was diluted with 90ml of physiological saline and homogenization was achieved using mortal pestle. Two hundred microlitres (200 uL) of ten-fold serially diluted homogenized sample was inoculated onto nutrient agar, Blood agar, Chocolate agar, potato dextrose agar (PDA). Bacterial identification was carried out using Gram's staining technique. Fungal enumeration was by plate count (Domsch, 1981).

III. RESULTS AND DISCUSSION

The microbial quality of any food item is a measure of the degree of safety and the practices. The result in table (2) and (3) shows that the highest level of microbial contamination was observed in dry season, as the total plate counts is between 10^4/g to108g, the presence of Staphylococcus aureus was found throughout the season, but more abundant in dry season, table (2).The presence of S. aureus in food products is usually not a major cause for alarm since not all Staphylococcus aureus strains produce enterotoxins. Among the S. aureus strains isolated from food samples ,the percentage of enterotoxigenic strains is estimated to be around 25% to 39% (Bergdoll,1989;Rosec etal;1997;Tsen etal;1998;Holeckova etal;2002).As for Salmonella sp it was not determine in any samples inspected. Moreso, the presence of Coliforms was higher in all the seasons but significantly high in dry season Table (2) which exceeded the maximum values set by the Slovax codex Alimentarious . Coliforms are found in the intestine of human and vertebrates, some strains of E.coli can cause gastroenteritis and urinary tract infection (Pelczar etal; 1993) .It was observed that microbes are widely distributed in fresh meat; this can be attributed to its beneficial chemical composition, the meat serve as a medium for microbial growth. The presence of molds was determine in all the seasons but are more peculiar in rainy season,

particularly in kilishi samples Table (2).Our results were in agreement to those reported in the literature(Andersen,1995)referring about the 90% occurrence of Pencillium spp and the 4% occurrence of both Aspergillus spp. and mucor spp in raw fermented meat product. The presence of aflatoxin producing fungi (Aspergillus flavus and A.oryzae)was reported in lunch meat, presence of moulds in the meat products usually causes a decrease in their biological value (due to the enzymatic degradation of meat components). Moulds often come into metabolic interactions with various bacterial pathogens. Thus, they can participate in an outbreak of food-borne illness. These interactions have already been well documented between moulds and Clostridium botulinum or Staphylococcus aureus (Polster et al, 1985). Mould metabolic activity results in the neutralization of organic acids, which is accompanied by an increase in pH-value. Under such conditions, the spores of Clostridium botulinum are able to germinate and to start with the production of botulinum toxin. Less acidic environment also enables the formation of enterotoxins by Staphylococcus aureus. The development of microscopic filamentous fungi in the meat products must not be negliged. Moulds must be studied and identified permanently. Food producers must follows the principles of good manufacturing practice and take preventive measures in order to reduce the growth of microscopic filamentous fungi and the production of their toxic metabolites in the final products (Čonková et al., 1993).

TABLE II
SHOWS MICROBIAL GROWTH AT DIFFERENT SEASONS

Seasons	Samples	TPC	Staphylococcus aureus	Salmonella Typhi	Coliform	Moulds
Harmarttan	1.Fresh Meat	4.3×10^{7}	2.5×10^{2}	0	2.8×10^{6}	0
	2.Danbu Nama	3.8×10^{2}	0	0	0	0
	3. Kilishi					
	4. Balango	2.1×10^{5}	0	0	0	6.3×10^{1}
	5. Tukuyan	3.5×10^{2}	1.3×10^{2}	0	0	1.2×10^{1}
	6. Tsire	1.3×10^{2}	0	0	0	0
		1.8×10^{2}	0	0	0	0
DRY	1. fresh Meat	3.2×10^{6}	1.2×10^{7}	0	2.5×10^{7}	1.5×10^{1}
	2. Danbu Nama	2.1×10^{2}	0	0	2.1×10^{2}	4.0×10^{2}
	3. Kilishi					
	4. Balango	1.5×10^{6}	0	0	0	6.1×10^{2}
	5. Tukuyan	1.7×10^{6}	0	0	0	1.2×10^{1}
	6. Tsire	2.5×10^{2}	0	0	0	1.0×10^{1}
		1.2×10^{6}	1.5×10^{2}	0	0	0
RAIN	1. fresh Meat	$3.6X10^{6}$	$1.9X10^{6}$	0	$1.9X10^{6}$	0
	2. Danbu Nama	$1.3X10^{2}$	0	0	$1.5X10^{2}$	0
	3. Kilishi	$1.8X10^{2}$	0			
	4. Balango			0	0	$1.1X10^{1}$
	5. Tukuyan	$5.4X10^{2}$	0	0	0	$1.8X10^{2}$
	6. Tsire	$3.2X10^{2}$	0	0	0	$1.5X10^{1}$
		$1.0X10^{2}$	0	0	0	0

TABLE II
SHOWS THE MICROBES ISOLATED

SEASON	Mould Species
Harmanttan	Penicillium spp Rhizopus spp, Mucor spp
Dry	Penicillium spp Rhizopus spp, Flauvs, Cladosporium
Rain	Penicillium spp, Aspergillus spp

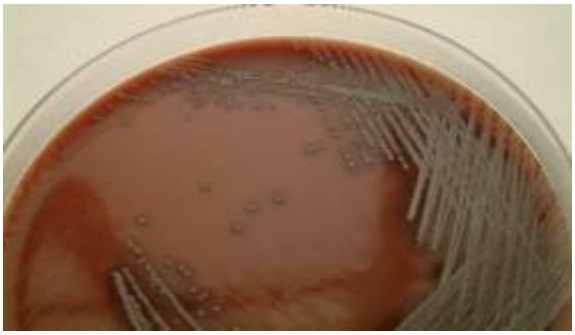

Fig. 1 *Staphylococcus aureus* on Blood agar

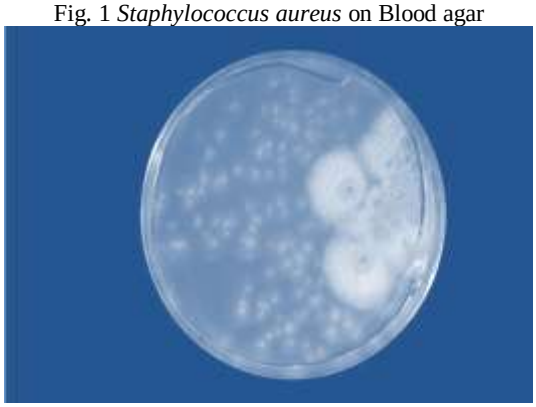

Fig. 2 Aspergillus sp on potato dextrose agar

IV. CONCLUSION

Raw food materials, as well as final products can become contaminated in any stage of their process¬ing, handling and distribution. Based upon the results of this study it can be con¬cluded, that the meat sold in kaura namoda are grossly contaminated by microbes particularly fungi species including the potentially mycotoxigenic ones. The determination of aflatoxins in acceptable concentrations should urgently be addressed with a view of ensuring the safety of the consumer..

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