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Research Article

BACTERIA AND FUNGI CONTAMINATING ROASTED MEAT TYPES IN PLATEAU STATE NIGERIA

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ABSTRACT

Meat is a very nutritious food use for human consumption. It is an excellent source of high product which is necessary for body building and repairs of wore out tissues. Improvement in the microbial quality of roasted meat product is very important and adequate steps must be taking to prevent contamination and spoilage of microorganism. The microorganisms isolated from roasted meat in this study indicated that the standard of preparation and preservation is poor are need to be improved with the facilities use in the preparation of roasted meat. Aseptic techniques should be employed in order to reduce microbial load of meat and its product for safe consumption by consumers and thus prevent economic lost and food borne infections and intoxication. National Agency of Food and Drugs Administration and Control should particularly regulate or setup a local body nationwide to monitor the production or processing, packaging of meat and meat products in order to reduce health hazard and guarantee good health of the nation there is the need for establishment of national legislation that would restrict sells of roasted meat in strategic locations to reduce the level of contamination of such meat product.

Keywords: Bacteria, Fungi Contaminating, Roasted Meat, Nigeria.

INTRODUCTION

Meat is defined as animal flesh which is suitable for use as food. Meat is a major source of protein and important source of vitamins for most people in many parts of the world, thus, they are essential for the growth, repair and maintenance of body cells which are necessary for everyday activities (Hassan *et al*., 2014). Meat is one of the nutritious food sources for human utilization. It is an incredible wellspring of top notch protein. It contains a lot of minerals and fundamental nutrients just as fats and carbs for energy. The genuine arrangement of meat relies upon the variety, age, sex, sustenance and warmth condition of creature (Balogun *et al*., 2010). Meat can be change to various palatable structure, for example, crushing, cleaving and expansion of preparing, modification of shading or warmth treatment which results to item, for example, suya, bacon, ham, corned hamburger and various assortments of frankfurter which may in the long run change the properties of meat (Adesokan *et al*.,2010).

Broiling is a moderate strategy for cooking meat that Is appropriate to bigger cuts where the warmth needs an ideal opportunity to reach through to the center (Oulton and Randal, 2002). It is a cooking technique that utilizations dry warmth where hot air envelopes the food, cooking it equitably on all sides from an open fire, stove or other warmth source. Broiling utilizes direct diffused warmth and is appropriate for more slow cooking of meat in a bigger entire piece (Blaisdell, 2002).

Food handling is quite possibly the main issues in showcasing and any sort of food, especially meat and its item (Okonko *et al*., 2010). Safe food stockpiling temperatures are once in a while applied to road nourishments which except if accurately put away, bundled and circulated may ruin rapidly (Falegan and Oluwaniyi, 2015). The most genuine security issues bringing about quick purchasers medical condition is related with bacterial microorganisms (Sousa, 2008). The main bacterial meat deterioration is brought about by Lactic corrosive microorganisms these incorporate numerous species, for example, Lactobacillus,

Leuconostoc, Pediococcusand Streptococcus which are physiologically identified with a gathering of particular and pervasive gram positive creatures (Hassan et al., 2014). The most well-known bacterial specialists are Campylobacter, Salmonella, Escherichia coli, Shigella, staphylococcus and Clostridia (Agbondaze *et al*., 2005). Road food sources utilization is regularly connected with diarrheal infections which happen because of inappropriate utilization of added substances, the presence of pathogenic microscopic organisms, natural pollutants and dismissal of good assembling and cleanliness rehearses (Tambeka *et al*., 2008). Meat defilement during butchering might be related with abattoir offices and workers (Falegan *et al*., 2017). Openness of nourishments on open yards can undoubtedly be sullied by dust, smoke, creepy crawlies, hands of purchasers and downpours. Wrong holding temperatures and helpless individual cleanliness of food overseers are a portion of the primary driver of defilement of road distributed food sources (Falola *et al*., 2011). The microbial burden in meat increments as long as the development condition are positive , be that as it may, appropriate safeguarding of meat can be accomplish by the mix of at least two strategy which incorporate drying, salting and high temperature (Nester *et al*.,2001).

MATERIAL AND METHODS

Study Area

This study was carried out in Barkin-ladi Local Government in Plateau State, Nigeria. Barkin-ladi is a Local Government area in Plateau State, Nigeria. Its headquarters are in the town of Barkin-ladi at 9'32'00 "N 8'54'00"E. It has an area of 1,032km2 and a population of 175,267 at the 2006 census. The languages spoken in Barkin-ladi are Berom, Foron and Gashish,(Plateaus State Government, 2018).

Sample Collection

Different samples of roasted meat (balangu, suya, chicken and dog meat) were obtained randomly vendors at popular sports in Barkin-ladi metropolis into a sterile polythene bag. Overall, 20 samples were collected, 5 from suya (Roasted beef), 5 from balangu (Roasted lamb), 5 from chicken and 5 from dog meat. Samples were transported to the Microbiology Laboratory, Plateau State University, Bokkos for microbial analysis.

Media Types and Preparation

The media used were MacConkey agar (Antec) differential and selective for *Escherichia coli*, Nutrient agar (Fluka Biochemika) for general bacteria isolation and Potato Dextrose agar (Titan Biotech. Ltd) by Acumedia Manufacturers for fungi isolation. All media were prepared following the manufacturer's instructions and sterilized by autoclaving at 121^0C for 15minutes. Media were aseptically poured into petri dishes, allowed to solidify and incubated at 37^0C for 24 hours for sterility.

Procedure for Sample Processing

A gram from each sample was mashed in a sterile mortar and pestle. The mashed samples were aseptically introduced into 9ml of sterile peptone water and properly shaken and sieved. 1ml each of the sample from peptone water were aseptically transferred into 9ml of sterile distilled water using syringe and needle and a 5 fold serial dilution was carried out.

Procedure for Culturing Samples

Culture plates were labeled according to the samples collected. The samples were inoculated aseptically with a wire loop on the prepared agar plates of MacConkey and Nutrient agars for bacteria and Potato Dextrose agar for fungi using the streak technique. Plates were incubated at 37^0C for 24hours for bacteria and 3-5 days at 27^0C for fungi. Plates were read for growth of organism.

Macroscopy

Macroscopic examination was carried out after incubation to examine the different colonies and their morphology, i.e their shape, colour, size etc.

Determination of Microbial Density

After inoculation and incubation samples at appropriate temperatures and time, colonies were counted using the colony counter to get the colony forming unit (cfu)i.e.

cfu ml/g= number of colony x dilution factor x inoculation size

Identification of Bacteria and Fungi Isolates

Isolates were characterized and identified based on their cultural characteristics and biochemical reactions as follows.

Gram Staining

This is carried out to differentiate gram positive from gram negative organisms.

Lactose Phenol Cotton Blue Stain

This is carried out to identify fungi. A sterile blade was used to cut a portion of growth and was placed on a clean grease free slide and teased, a drop of Lactose Phenol Cotton Blue solution was added. Slides were covered with cover slip.

RESULT AND DISCUSSION

From twenty (20) different roasted meat samples, six different bacterial species and five fungal species were isolated and identified as contaminant. This include *Staphylococcus aureus, Proteus vulgaris, Escherichia coli, Salmonella spp, Streptococcus faecalis, Shigelle spp, Candida spp, Saccharomyces spp, Mucor spp, Aspergillus spp, and Rhizopus spp* as shown in table 4.1 and 4.2. Among the bacteria, table 4.5 shows the occurrence of *Staphyloccus aureus has the highest percentage of 33.33% follow by Escherichia coli 25%, Streptococcus faecalis 20.83%, Salmonella spp 12.5%, Shigella spp and Proteus valgaris 4.17% respectively.* The count of fungi, *Candida spp* and *Saccharomyces spp* have the highest occurrence of 33.33% follow by *Aspergillusspp* 20%,

Mucor and Rhizopus spp 6.67% respectively as shown in table 4.6.

Table 4.3 shows the microbial load of 1g of sample, total aerobic count of suya ranges from $1x10^4$ cfu/g to $2x10^{4,}$ Coliform counts ranges from $2x10^4$ cfu/g to 7.2 $x10^4$cfu/g, no fungal count. Total aerobic count of balangu ranges from $1x10^4$cfu/g to $5x10^4$ cfu/g, coliform ranges from $1.8x10^4$ to $4.1x10^4$cfu/g no fungal count. Total aerobic count for chicken ranges from $1.44x10^3$cfu/g to $9.3x10^3$cfu/g, coliform count ranges from $2x10^3$cfu/g to $7x10^3$cfu/g, fungal count ranges from $1x10^3$cfu/g to $5x10^3$cfu/g. Total aerobic count of dog meat ranges from $1.04x10^3$ cfu/g to $2.31x10^3$ cfu/g, coliform count ranges from $1.8x10^3$ cfu/g to $5.3x10^3$ cfu/g, fungal count ranges from $3.35x10^3$ cfu/g to $6.77x10^3$cfu/g.

In this study the microorganisms isolated where *Staphylococcusaureus*(33.33%), *E.coli (*25%), *Salmonella species (*12.5%), *Streptococcus faecalis (*20.83%), *Shigella species (*4.17%), *Proteus vulgaris (*4.17%) andsome *molds* and *yeast, Aspergillus species 20%, Mucors species (*6.67%), *Rhizopus species (6.67%), Candida species (*33.33%), *Saccharomyces species (*33.33%). This concurs with the discoveries of Egbebi and Seidu (2011) which express that, the microbiological assessment of suya sold in Ado and Akure South West, Nigeria, demonstrating defilement of meat tests with different bacterial species incorporates: Staphylococcus, E. coli, Bacillus spp, Salmonella, Klebsiella and some different microorganisms including molds and yeast. The outcome were additionally in consonance with the report of chukwura and Mojekwu (2002) which expressed that microbiological investigation of meat tests in Awka, the capital of Anambra State, in Nigeria showed defilement of meat tests with different bacterial species including Staphylococcus aureus and some enteric microscopic organisms. The life forms separated in this investigation were the living beings generally embroiled with unhygienic states of meat taking care of. This is additionally in concurrence with the report of Umoh (2004) that the presence of Escherichia coli most likely may emerge from the utilization of non-compact water during washing of crude meat.

Total bacterial count ranges from 1×10^4 cfu/g to 7.2×10^4cfu/g, total fungal count ranges from 1×10^3 cfu/g to 6.77×10^4 cfu/g. this agrees with the report of Okonko *et al.,* (2010) correspondingly, the mean total coliform count on fresh meat ranged between 2.24×10^4 and 5.0×10^4 cfu/g. According to NSWFA, (2012), total bacterial count of $\geq 10^4$ cfu/g is unacceptable, established in all screened foods. In this study, all the sample where traditionally processed product and the total count exceed the prescribedmicrobiological safety limits. The findings from this study implied that the products (Suya, Balangu, Chicken and Dog meat) are unsafe and constitute a food safety risk to the numerousconsumers. If measures are not put in place, there may be a possible outbreak of food poisoning and food borne infections due to consumption of the contaminated roasted meat products which may lead to serious economic and public health problem. The study suggest that maintaining good and proper hygiene condition during handling, processing and packaging of meat product is very necessary so as to reduce the risk of food poisoning and infections.

Table 4.1: Cultural, Microbiological Morphology and Biochemical Characteristics of Bacterial isolates from different roasted meat types

Sample	Colonial morphology	Gram rxn	Microscopic morphology	Biochemical rxn				TSI				Organism
				Ca	Co	In	Ox	Gl	La	H_2S	Su	
S1	Flat circular milky colonies	+	Cocci in clusters	+	+	_	_	+	_	_	_	S. *aureus*
S2	Pink circular colonies	_	Rod in singles	_	_	+	_	+	+	-	+	*E. coli*
S3	Flat circular milky colonies	+	Cocci in chain	_	Nil	Nil	_	+	_	_	_	*Strept.faecalis*
S4	Flat circular milky colonies	+	Cocci in clusters	+	+	_	_	+	_	_	_	*S. aureus*
S5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	*Nil*
B1	Confluent colonies with swarming	_	Rod in pairs and singles	+	_	+	_	+	_	+	+	*Prot.vulgaris*
B2	Pink circular colonies	_	Rods in singles	_	_	+	_	+	+	_	+	*E.coli*
B3	Pink circular colonies	-	Rods in singles	_	_	+	_	+	+	_	+	*E.coli*
	Small circular colonies	_	Short rod in single	+	_	_	_	+	_	+	_	*Salmonella spp*
B4	Flat circular milky colonies	+	Cocci in clusters	+	+	_	_	+	_	_	_	*S. aureus*
B5	Flat circular milky colonies	+	Cocci in clusters	+	+	_	_	+	_	_	_	*S. aureus*
C1	Pink circular colonies	_	Rods in singles	_	_	+	_	+	+	_	+	*E.coli*
	Flat circular milky colonies	+	Cocci in clusters	+	+	-	_	+	_	_	_	*S. aureus*
C2	Flat circular milky colonies	+	Cocci in short chain	_	Nil	Nil	_	+	_	_	_	*Strept.faecalis*
C3	Small circular colonies	_	Short rod in singles	Nil	Nil	+	_	_	_	_	_	*Shigella spp*
	Flat circular milky colonies	+	Cocci in clusters	+	+	_	_	+	_	_	_	*S. aureus*
C4	Flat circular colonies	+	Cocci in chain	_	Nil	Nil	_	+	_	_	_	*Strept.faecalis*
C5	Flat circular milky colonies	+	Cocci in clusters	+	+	_	_	+	_	_	_	*S. aureus*
	Pink circular colonies	_	Rod in singles	_	_	+	_	+	+	_	+	*E.coli*
D1	Small circular colonies	_	Short rods in singles	+	_	_	_	+	_	+	_	*Salmonella spp*
D2	Flat circular milky colonies	+	Cocci in short chains	_	Nil	Nil	_	+	_	_	_	*Strep.faecalis*
D3	Flat circular milky colonies	+	Cocci in clusters	+	+	_	_	+	_	_	_	*S.aureus*
D4	Flat circular milky colonies	+	Cocci in chains	_	Nil	Nil	_	+	_	_	_	*Strep.faecalis*
D5	Small circular colonies	_	Short rods in singles	+	_	_	_	+	_	+	_	*Salmonella spp*
	Pink circular colonies	_	Rods in singles	_	_	+	_	+	+	_	+	*E.coli*

Keys: Ca=Catalase,Co=Coagulase,In=Indole,Ox=Oxydase,Gl=Glucose,La=Lactose,H_2S=Hydrogen Sulphide, Su=Sucrose, S=Suya,B=Balangu,C=Chicken,D=Dog

Table 4.2 Morphological characteristics of isolated fungi from difference rusted meat types

Isolates	Morphological Characteristics of Isolates
Rhizopus spp	White cottony with small black spot. Sporangia have well developed collumela which is hemispherical in shape.
Saccharomycesspp	Cream in color and oval in shape. The Collula is smooth and very small. It has a branched cell
Aspergillusspp	Black spores on the media .It produced septate, branching mycelia.Conidiophores are upright, radiating from the entire surface turning dark towards vesicle. Conidia heads are large, globose becoming radiate and biserrate
Mucorspp	Colonies are typically white or grey and fast growing. Older colonies become grey to brown in color due to the development of spores. Sporangiophore develops singly at deference places on the mycelium.
Candida spp	Creamy in color and oval in shape, the Collula is smooth and very small.

Table 4.3 Microbial Plate Count in cfu/gm for Twenty (20) Samples of Roasted Meat

Samples	Total aerobic count	Total coliform count	Total fungi count
S1	$2x10^4$	$5x10^4$	Nil
S2	Nil	$7.2x10^4$	Nil
S3	$1x10^4$	$2x10^4$	Nil
S4	Nil	$2x10^4$	Nil
S5	Nil	Nil	Nil
B1	$1x10^4$	$2.1x10^4$	Nil
B2	$5x10^4$	$3x10^4$	Nil
B3	$4.3x10^4$	$1.8x10^4$	Nil
B4	$1.21x10^4$	$4.1x10^4$	Nil
B5	$3.00x10^4$	$7x10^4$	Nil
C1	$3.11x10^3$	$7x10^3$	$1.5x10^3$
C2	$2.01x10^3$	$3x10^3$	$3x10^3$
C3	$1.44x10^3$	$2x10^3$	Nil
C4	$1.61x10^3$	$3x10^3$	$1x10^3$
C5	$9.3x10^3$	$2.33x10^3$	$5x10^3$
D1	$1.04x10^3$	$2.8x10^3$	$5.56x10^3$
D2	$2.31x10^3$	$2.3x10^3$	$6.32x10^3$
D3	$1.78x10^3$	$5.3x10^3$	$3.35x10^3$
D4	$1.61x10^3$	$1.8x10^3$	$6.30x10^3$
D5	$1.22x10^3$	$2.75x10^3$	$6.77x10^3$

Key: S= Suya, B= Balangu, C= Chicken, D= Dog

Table 4.4 Species of Bacteria and Fungi Isolated from Roasted Meat Types in Barkin-ladi

Samples	Bacteria isolate	Fungal isolate
Suya	*Staphylococcus aureus, E.coli, Streptococcus faecalis,*	*Nil*
Balangu	*Proteus vulgaris, E. coli, Salmonella species, Staphylococcus aureus*	*Nil*
Chicken	*Staphylococcus aureus, E. Coli, Streptococcus faecalis, Shigella species*	*Mucor species, Aspergillus species, Rhizopus species*
Dog	*Salmonella species, Streptococcus species, Staphylococcus aureus, E. coli*	*Candida species, Saccharomyces species*

Table 4.5 Frequency of Occurrence of Bacteria Isolate from Roasted Meat Types

Isolate	Frequency of occurrence	Percentage (%)
Staphylococcus aureus	8	33.33
Escherichia coli	6	25
Salmonella spp	3	12.5
Streptococcus faecalis	5	20.83
Shigella spp	1	4.17
Proteus vulgaris	1	4.17
Total	24	100

Frequency: number of occurrence of bacterial isolates isolated from roasted meat types (Suya, balangu, chicken and dog meat) sold in Barkin-ladi.

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Table 4.6 Frequency of Occurrence of fungal Isolates from Roasted Meat Types

Isolate	Frequency of occurrence	Percentage (%)
Candida spp	5	33.33
Saccharomyces spp	5	33.33
Mucorspp	1	6.67
Aspergillus spp	3	20
Rhizopus spp	1	6.67
Total	15	100

Frequency: number of fungal isolates isolated from roasted meat types (Suya, balangu, and chicken and dog meat) sold in Barkin-ladi.

CONCLUSION

Satisfactory measures and appropriate cleanliness ought to be utilized during creation of flavors consequently, keeping them from microbial defilement. Legitimate meat examination, screening and destruction of wiped out and undesirable creatures ought to be carefully clung to. General wellbeing schooling program is of acceptable need to illuminate the overall population about wellbeing danger in devouring sullied meat item. Convenient water and cleaned utensils and gear's ought to be utilized to lessen microbial pollution. Merchants should be taught on disinfection, individual cleanliness and its significance to food item and appropriate cleanliness measures ought to be taken during preparing, stockpiling and selling of items, if conceivable, the utilization of show glass, gloves, keeping of clean nails, utilization of foil for bundling and try not to chat on the item.

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