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Research Article

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Microbial quality assessment of roasted and fried meat sold in Gumel town

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Abstract

Roasted and fried meats are the two commonest and preferred meat varieties consumed in northern Nigeria. The consumption of these meat varieties is, nevertheless, without ascertaining its fitness in terms of contamination by pathogens. In line with this occurrence and preference, it is a good approach to assess the quality of roasted and fried meat in one of the prehistoric towns of northern Nigeria, which is Gumel. A total of 10 samples of both fried and roasted meat were randomly collected, prepared and microbiological analyses for mesophilic bacteria, fungi and coliform group conducted in the laboratory. The mean bacterial load was observed between 3.0 x 10^4 and 6.5 x 10^4 CFU/g for roasted beef meat and 4.7 x 10^4 and 5.3 x 10^4 CFU/g for fried beef meat. It was 4.5 x 10^4 and 6.0 x 10^4 CFU/g in roasted chicken meat and 4.0 x 10^4 and 4.7 x 10^4 CFU/g in fried chicken meat. For the fungal load, it was observed to be between the range of 1.0 x 10^4 and 3.0 x 10^3 CFU/g for roasted beef meat and 1.0 x 10^4 and 7.0 x 10^3 CFU/g for fried beef meat. For the chicken meat, it ranges from 1.0 x 10^4 to 4.0 x 10^3 CFU/g for the roasted type and 1.0 x 10^4 and 7.0 x 10^3 CFU/g for the fried meat. Investigation of the coliform group showed no growth in both samples. On biochemical tests, bacterial species confirmed to be present were *Staphylococcus aureus*, *Bacillus spp*, and *Streptococcus spp*. while *Penicillium spp, Mucor hiemalis, Aspergillus species* and *Rhizopus spp*. are the fungal species observed in the meats. This research was, therefore, conducted to assess the quality of roasted and fried meat sold in Gumel town to relate it to some common diseases affecting the community.

Keywords: Roasted meat, fried meats, microbial quality assessment.

Introduction

Meat is mainly composed of water and protein and is usually eaten together with other foods. It has been reported that meat is rich in protein (15-20%), minerals, vitamins, and all the essential amino acids. Meat is animal flesh that is eaten as food [1]. Humans are omnivorous and have hunted and killed animals for meat since prehistoric times [2,3]. The advent of civilization allowed for the domestication of animals such as chickens, sheep, fish, seafood, pigs, and cattle and eventually their use in meat production on an industrial scale. It is edible raw but is normally eaten after it has been cooked and seasoned or processed in a variety of ways. Meat consumption varies worldwide, depending on cultural and religious differences, as well as the socio-economic status of the people. Nigerians depend mainly on domestic animals and aquatic organisms and to some extent on game animals and birds. This is true of the urban as well as rural communities [4]. Unprocessed meat will spoil within hours or days.

Spoilage is caused by the practically unavoidable infection and subsequent decomposition of meat by bacteria and fungi, which are born by the animal itself, people handling the meat and their implements [5]. Because of this, meat nowadays serves as a source of various foodborne diseases due to improper processing, handling and storage. This usually results in the reduction of valuable proteins and leads to various foodborne infections. However, considering the random addiction of eating meat anyhow in mostly states of Northern Nigeria without ascertaining its fitness in terms of contamination by either bacteria or fungi, which is mostly attributed to the lack of good knowledge on the possible spoilage, it is pertinent to set up a mechanism that will be geared towards investigating the possible contamination sources and assess the quality of roasted and fried meat sold in Gumel town, one of the prehistoric towns of northern Nigeria.

Materials and Methods

This research was conducted at Gumel town, one of the Local Governments of Jigawa State, Nigeria. It is located at latitude 12.63°N and longitude 9.30°E and 36 meters elevation above the sea level with an estimated population of about 42,742. A total of 10 samples comprising three fried and roasted beef meat each, and two fried and roasted chicken meat were randomly collected from the study area. The samples were placed into cleaned polythene bags and transported immediately to the laboratory for preparation and subsequent analysis. All the media used in this study were prepared and handled according to the manufacturer's instructions. For the enumeration of aerobic mesophilic bacteria and fungi, the social dilution method, as described by the American Public Health Association [6], was employed.

Plates containing between 30 and 300 colonies were selected and counted for bacteria, and the number obtained was multiplied by the dilution factor. This gave the number of bacterial colony-forming units per gram of meat samples (CFU/g of the meat sample). For fungi, the plate that contained less than 50 colonies were selected and counted after 3-5-day incubation period. The count was reported as fungi/mold colony forming a gram of meat sample (CFU/g). Sets of control for each sample containing agar and diluents were also incubated to ascertain the sterility of the media. The following formula was used to calculate the number of bacteria/fungi colony forming units per gram of the meat.

$N = {}^{n}/_{vd}$; Where: N= the number of bacterial/fungal colonies per gram of sample; n= number of colonies counted; v= volume of sample used; d= dilution factor.

For the enumeration of mesophilic coliform bacteria, the three tube method described by [6] was employed. The color, size, shape and microscopy (for Gram staining), surface elevation and margin of different colonies developed on the plates were observed. A representative colony of the various morphological types was picked and transferred to a freshly prepared, sterilized and solidified nutrient agar incubated at 35°C for 24hours to obtain a pure culture of the organisms [6]. The isolated organisms were then subjected to grams staining techniques, and microscopy then followed.

The fungal isolates were identified as described in the illustrated genera of imperfect fungi [7] and microbiological methods [8]. Catalase tests coagulate test, methyl red-Voges Proskauer, citrate test, urease test, motility test and indole test were all carried out according to the method described by Cheesbrough [9].

Results and Discussion

The results of bacterial colony counts (colony-forming units per gram, CFU/g) as presented in **Table 1** for the beef meat were observed to be within the range of 3.0 x 10^4 to 6.5 x 10^4 and 4.7 x 10^4 to 5.3 x 10^4 CFU/g for roasted and fried beef meat, respectively.

Table 1. Total bacterial count of roasted and fried meats in beef and chickens.

S/N	Sample	Bacterial colony count per gram of sample (CFU/g)	Log No.
1	BR-1	$3.5X10^4$	4.5
2	BR-2	$6.5X10^4$	4.8
3	BR-3	$3.0X10^4$	4.5
4	BF-1	$4.7X10^4$	4.7
5	BF-2	$3.8X10^4$	4.6
6	BF-3	$5.3X10^4$	4.7
7	CR-1	$4.5X10^4$	4.7
8	CR-2	$6.0X10^4$	4.8
9	CF-1	$4.7X10^4$	4.7
10	CF-2	$4.0X10^4$	4.6

KEY: BR=Roasted beef meat, BF=Fried beef meat, CR= Roasted Chicken meat CF=Fried chicken meat

In comparison, it was observed to be within the range of 4.5 x 10^4 to 6.0 x 10^4 and 4.0 x 10^4 to 4.7 x 10^4 CFU/g for roasted and fried chicken meat, respectively. These values obtained for the mean bacterial and fungal loads were within the acceptable range of 1 x 10^3 to 1 x 10^7 CFU/g as provided by Ledward [10] and 1.0 x10^3 for the acceptable limits for the ready to eat foods and is an indication that the meat was processed thoroughly because Heetun *et al.* [11] reported that meat and meat products are highly perishable commodities and if not properly stored, processed, packed and distributed microbial growth will be highly accelerated. The level of microorganisms present in meat products as reported by Jay *et al.* [12] can be reduced

only when they are further processed. Another report Davies and Board [13] has revealed that if spoilage microorganisms such as *Brochothrix thermosphacta* and *Pseudomonas spp*. are present and grow to a high number, the meat will spoil and will be unfit for human consumption. The total fungal count (**Table 2**) was observed to range between 1.0 x 10^4 to 3.0 10^3 and 1.0 x 10^4 to 7.0 x 10^3 CFU/g for roasted and fried beef meat, respectively. It was, however, observed that in chicken meat, it ranged between 1.0x 10^4 to 4.0 x 10^3 and 1.0 x 10^4 to 7.0 x 10^3 CFU/g for roasted and fried meat variety.

Table 2. Fungal count of roasted and fried meat (beef and chickens).

S/N	Sample	Fungal colony count per gram of sample (CFU/g)	Log No.
1	BR-1	$1.0X10^4$	4.0
2	BR-2	$3.0X10^3$	3.5
3	BR-3	$1.0X10^4$	4.0
4	BF-1	$1.0X10^4$	3.8
5	BF-2	$4.0X10^3$	3.6
6	BF-3	$7.0X10^3$	3.8
7	CR-1	$4.0\ X10^3$	3.6
8	CR-2	$1.0X10^4$	4.0
9	CF-1	$1.0X10^4$	4.0
10	CF-2	$7.0\ x10^3$	3.8

KEY: BR=Roasted beef meat; BF=Fried beef meat; CR= Roasted Chicken meat; CF=Fried chicken meat.

In the same vain, Ismail *et al.* [14] studied the microbial quality of some meat products obtained from local markets in Egypt, and reported many types of fungi belonging to several genera such as Aspergillus, Candida, Cladosporium, Eupenicillium, Eurotium, Geotrichum, Mucor, Penicillium, Rhototorula besides aflatoxin B1. These researchers also isolated *Clostridium perfringens* and *Staphylococcus aureus*. In this scenery, Yousuf *et al.* [15] have elaborated that the presence of coliforms such as *Escherichia coli* in food is suggestive of faecal contamination from animals. The results of the most probable number index per gram of coliform of the roasted and fried meats of beef and chickens (**Table 3**) showed no growth in all samples.

Table 3. Results of the most probable number index per gram of coliform of the roasted and fried meat (beef and chickens)

S/N	Sample	MPN per gram	Log Number
1	BR-1	No growth	-
2	BR-2	No growth	-
3	BR-3	No growth	-
4	Bf-1	No growth	-
5	Bf-2	No growth	-
6	BF-3	No growth	-
7	CR-1	No growth	-
8	CR-2	No growth	-
9	CR-1	No growth	-
10	CR-2	No growth	-

KEY: BR=Roasted beef meat; BF=Fried beef meat; CR= roasted Chicken meat; CF=Fried chicken meat.

The results of morphological characterization of the bacterial and fungal isolates (**Tables 4 and 5**) showed some colonies of bacteria appearing yellow and some whitish. Most of the fungal colonies, when stained with lactophenol stain appeared blackish, brown and greenish with characteristic section.

Table 4. Morphology of the bacterial isolates in meat samples (beef and Chicken).

S/N	Isolate	Br-1	Br-2	Br-3	Bf-1	Bf-2	Bf-3	Cr-1	Cr-2	Cf-1	Cf-2
1	A_1	+	+	+	+	+	+	+	+	+	+
2	B_1	+	+	-	-	+	-	+	+	-	-
3	C_1	+	-	+	+	+	+	-	-	+	+

Key: + = growth observed; – = growth was not observed.

Table 5. Morphology of the bacterial isolates in meat samples (beef and Chicken).

S/N	Isolate	Br-1	Br-2	Br-3	Bf-1	Bf-2	Bf-3	Cr-1	Cr-2	Cf-1	Cf-2
1	A_2	-	+	+	-	+	+	+	+	+	+
2	B_2		-	-	-	+	+	+	+	+	+
3	C_2	+	+	+	+	+	+	-	-	-	+
4	D_2	+	-	-	+	-	+	-	-	-	+

Key: + = growth observed; – = growth was not observed.

Table 6. Biochemical tests of bacterial isolates from roasted and fried meats (beef and chickens).

Isolate	Microscopy	Gram reaction	Coagulase	Carbohydrate fermentation	Indole	Methyl red	Voges proskaver	Citrate	Motility	Expected organism
A1	Cocci in Closter	-	+	-	-	+	-	-	+	*Staphylococcus aureus*
B1	Short rod	+	+	+	-	+	-	-	-	*Baccilus* spp
C1	Cocci in chain	+	-	-	-	+	-	+	-	*Streptococcus* spp

Key: + = presence; - = Absence

The fungal species isolated as presented in **Tables (6 and 7)** were *Penicillium spp, Mucor hiemalis, Aspergillus species* and *Rhizopus spp*. On biochemical tests, the bacterial species confirmed to be present are *Staphylococcus aureus*, *Baccilus* spp, and *Streptococcus spp* **Table 6.**

Table 7. Fungal isolation and identification of roasted and fried meats (beef and chickens).

S/N	*Isolate*	*Expected organism*
1	A_2	*Penicillium* spp
2	B_2	*Mucor hiemalis*
3	C_2	*Aspergillus* spp
4	D_2	*Rhizopus nigricans*

Conclusion

It can be concluded that the total bacterial and fungal counts of both roasted and fried meats prepared and sold by commercial meat sellers in Gumel town in Nigeria was found to fall within the standard range endorsed by WHO and other international organizations. Hence, contained fewer contaminants, and this can be attributed to the hygienic conditions of utensils, water and the ingredients used in processing the meat.

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