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BACTERIA CAUSING SPOILAGE OF BEEF IN MEAT SHOPS IN JOS MAIN MARKET, NIGERIA

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ABSTRACT

An investigation was conducted to establish the types of bacteria associated with beef spoilage in the Jos Main Market, Nigeria. Beef samples taken directly from the Table top and from the deep freezer were examined . During the survey, eight bacterial species were isolated from the beef samples. The isolates were *Bacillus sp, Escherichia coil, Klebslella sp, Proteus sp, Pseudomonas aeruginosa, Staphyloccus, aureus, Salmonella sp and Sttreptococcus faecalis.* Among the isolates, *Escherichia coli* and *Pseudomonas aeruginosa* had the higest frequencies of occurrence. The public health risk of the result obtained are discussed.

Introduction and Literature Review

Meats are frequently involved in food-borne illnesses because they provide ideal media for the growth sploilage of disease-causing micro-organisms. The role of meat products in the transmission of pathogenic micro-organisms to human beings has been greatly elucidated in recent years leading to improved methods of controlling their growth on these important foods (Peason and Dutson, 1986).

Meat is a highly perishable food item. The high perishabillity of meat is aided by the high temperature, high humidity and the great abundance of biodeteriogens which prevail in Nigeria all the year round. The other factors that could facilitates the early decay of meat include the meat's moisture contents, PH -value, the oxidation reduction (O-R) potential and the nutrient content (Buchanan, 1986 and Genigeogis, 1986).

Today, meat quality means more than just an attractive appearance. Quality includes characteristics such as tenderness, flavour, freshness and wholesomeness. These are affected by the quantity and quality of the

microbial growth causing chemical changes resulting in the meat being unacceptable to the consumer due to slime, souring or putrid odours. The identity of bacteria present on fresh meat is necessary to anticipate the extent of spoilage under subsequent storage of the meat in open chillers and fridges (Csiro, 1977).

Microorganisms on meat are important for three reasons :- some may be pathogenic, others may cause spoilage of the meat and some are used as indicator organisms.

Meat contamination and spoilage have been extensively studied in the industrialized countries and the process is now fairly understood in considerable details. The existing reports on microbial colonization of on meat and meat products include that of Sukiewicz et al (1975). They isolated *Escherichia coli, Salmonell* sp and *Staphylococcus aureus* from raw patties produced at establishment under federal inspection in the U.S.A. They found that contamination resulted from the grinding and mixing operations.
Emswiller et al, (1976) investigated the bacteriological quality and shelf-life of ground beef. They found that *Clostridium Perfringens, E, coil,* and *S. aureus* were among the prominent meat deteriogens. In Nigeria, Alonge (1982) implicated species of *Achromobacter, Acinetobacter, Aeromonas, Alcaligens, Flavobacterium, Lactobacillus, Micrococcus* and *Staphylococcus* as the major causes of beef spoilage in meat shops in Ibadan. He discovered that species of *Flavobacterium, Lactobacillus, Micrococcus and Pseudomonas* were the main spoilage organisms. Ejeikwu and Ogbonna (1990) isolated *Clostridium Perfringens , Straphylococcus aureus, Streptococcus faecalis, S. faecium, Enterobacter aerogens, Lactobacillus* sp from suya produce at various suya spots in Jos, Nigeria.

As a result of scanty information on the microbiology of meat in Nigeria, this project was designed to

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verify the microbial contaminants of beef stored in meat shops in the Jos Main Market, Nigeria.

MATERIALS AND METHODS

1. Sample Collection

Ten (10) beef samples were collected from five different meat shops selected at random in the Jos Main Market, Nigeria. Two samples were collected from each meat shop. The original source of the beef for sale in this market is the Jos Main Abattoir. The samples were collected aseptically with the aid of sterile forceps into sterile Petri dishes. Each sample

Table 1 Microbial Isolates From Meat Shops

	SHOPS SAMPLED				
Microbial Isolates	A	B	C	D	E
Streptococcus faecalis	-	-	+	-	=
Pseudomonas aeruginosa	+	+	+	+	+
Escherichia coli	+	+	+	+	+
Bacillus sp	+	+	-	-	-
Klebsiella sp	-	+	+	+	+
Proteus sp	-	-	-	+	+
Salmonella sp	-	-	-	+	-
Staphylococcus	-	+	+	-	+

A, B, C, D, and E represent the five (5) different shops from which fresh meat samples were taken
+ = Organisms was present
- = Organisms was absent

Table 2: Microbial Isolates from Different Meat Shops Showing their Frequencies of Occurrence

	SHOPS SAMPLED						
Microbial Isolates	A	B	C	D	E	TOTAL	MEAN
Streptococcus faecalis	0	0	1	0	0	1	0.2
Staphylococcus aureus	0	0	2	1	1	4	0.8
Pseudomonas aeruginosa	4	2	3	3	3	15	2
Escherichia coli	2	4	1	3	4	14	2.8
Bacillus sp	3	3	0	0	0	6	1.2
Klebsiella sp	0	1	2	2	2	7	1.4
Proteus sp	0	0	0	1	1	2	0.4
Salmonella sp	0	0	0	1	0	1	0.2
Total	9	10	9	11	11	50	10
Mean	1.125	1.25	1.125	1.375	1.375		

ANOVA TABLE

SOURCE OF VARIATION	SUM OF SQUARES	DEGREE OF FREEDOM	MEAN OF SQUARE	F-RATIO CALCULATION	F-RATIO TABULATION
TREATMENT	38.3	7(t-1)	5.47	4.97	2.36
BLOCKS	3.5	4(b-1)	0.875	0.79	2.71
ERROR	29.7	28(t-1)(b-1)	1.1		
TOTAL	71.5	39(tb-1)			

A, B, C, D and E represent the five (5) different shops from which fresh meat samples were taken.

TABLE 3. Occurrence of Microorganism At Different Temperatures

Microorganism	Temperatures (°c)		
	25	37	45
Streptococcus faecalis	+	+	+
Staphylococcus aureus	+	+	+
Pseudomonas aeruginosa	+	+	-
Escherichia coli	+	+	+
Bacillus sp	+	+	+
Klebsiella sp	+	+	-
Proteus sp	+	+	-
Salmonella sp	+	+	-

KEY

\+ = Organism was Present

\- = Organism was Absent

was made up of bundles of fresh beef from the table top and from the deep freezer. The samples were immediately taken to the laboratory for analysis.

2. Microbial Isolation Experiments

Two different methods were employed for the isolation of microorganisms from the beef samples. In the first method, I gram of the beef sample was aseptically cut into five pieces and the pieces were plated out on molten Nutrient Agar (N. A) and then incubated for 24 hrs. The second method involved placing five (5) pieces of 1gm beef samples into 100ml of sterile distilled water for six (6) hrs. This was to allow for easy isolation of contaminants in the inner tissues of the meat. Serial dilutions of this were plated out by pipetting 1ml of each dilution into each of marked Petri dishes. About 15ml of molten Nutrient agar (at 45°C) was poured into each dish and contents were mixed by gentle swirling . The particular method was also used by Jay and Margitic (1979). For each isolation experiment, the Petri

dishes were divided into three (3) batches. One batch of plates were incubated at 25°, the second batch at 37°C and the third batch at 45°C for 24hrs. These isolation methods, along with homogenisation method were employed by Ejeikwu and Ogbonna (1988).

IDENTIFICATION OF MICROBIAL ISOLATES

The bacteria isolates were identified with the aid of Gram's reaction and various biochemical tests. The biochemical tests performed were coagulate test, Hemolysis, catalase test, nitrate reduction, oxidase test, indole test, starch hydrolysis, V-P test, methyl red test, Novabiocin resistance test, phosphate activity, Bile-esculin test, motility test and carbohydrate fermentation tests. The cultural and morphological characteristics used for picking out isolates for pure culture preparations were colony morphology, pigmentation and abundance of growth. The results were interpreted with reference to Bergy's Manual of Determinative Bacteriology.

RESULTS

During the survey, eight bacterial species were isolated from beef samples. These were *Bacillus,* sp, *Escherichia coli, Klebsiella* sp, *Proteus* sp *Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella* sp and *Streptococcus faecalis* . The details of the microbial isolates from the beef samples from different meat shops at the marketing centers are presented in Tables 1 and 2. Table 2 also shows the frequency of occurrence of each microbial isolate from each meat shop. Table 3 shows the occurrence of microorganism at different temperatures. Table 4 presents a comparison of

TABLE 4: A Comparism of Isolation Methods On The Recovery Of Microbial Contaminants.

Microbial Isolates	Plating of Meat Pieces	Plating of Diluent of Meat Pieces
Streptococcus faecalis	1	0
Staphylococcus aureus	2	2
Pseudomonas aeruginosa	9	**6**
Escherichia coli	8	7
Bacillus sp	2	4
Klebsiella sp	4	3
Proteus sp	0	2
Salmonella sp	1	0
Total	27	24
Mean	3.375	3

Calculated t(0.05) value = 1.699

Tabulated t(0.05) value = 2.365

TABLE 5: Occurrence O f Microbial Isolates From Deepfreezer and From Table Top

	Deep Freezer	Table Top
Isolates	+	+
Bacillus sp	+	+
Escherichia coli	+	+
Klebsiella sp	+	+
Proteus sp	+	+
Pseudomonas aeruginosa	+	+
Salmonella sp	+	+
Staphylococcus aureus	+	+
Streptococcus faecalis	-	+

isolation methods on the recovery of microbial contaminations. Table 5 shows which microbial isolates occurred in the deep freezer and which occurred on the table top. The implications of these results are discussed.

DISCUSSION

Table 1 shows that the Enterobacteriaceae isolated are the major meat spoilage organisms found in the Jos Main Market, Nigeria. The microbial loads of the different meat shops show only a little variation (Table 2). This may suggest that the sanitary condition of the marketing centers are not significantly different.

Houseflies , (*Musca domestica*) , were a common sight at the meat shops, and this presents a potential source of contamination of the meats. The high concentration of people at the marketing centers may also be a source of disease causing and spoilage microorganisms.

The statistical analysis carried out on Table 2 shows no significant different between the blocks ($P > 0.05$), indicating that the microbial loads of the various meat shops are not significantly different at the 5% level. This indicates that the hygiene levels of the meat shops are not significantly different at this level of test.

All the isolates grew at 25° C and 37°C, but only *Bacillus sp Escherichia coli, Staphylococcus aureus* and *Streptococcus faecallis* were able to survive temperature up to 45°C (Table 3), indicating that these organism might be thermopiles.

The statistical analysis of Table 4 does not show any significant different ($P > 0.05$) in the recovery of the meat contaminants between the isolation methods. It should however be noted that if the meat pieces were left in the diluent for longer periods, it would have probably resulted in better recovery of inner tissue contaminants of the meat.

Table 5 shows that *Staphylococcus aureus, Streptococcus faecalis* and *Salmonella* sp were not isolated from the Deep freezer but occurred on meat from table top indicating that these organisms may dislike cold. Many organisms associated with low temperature spoilage such as *Pseudomanas* sp, produce malodorous compounds when degrading amino acid. However, such organism will preferentially utilize simple carbohydrates such as glucose, if they are present and while doing so do not produce offensive by-products (Gills, 1976), so that their presence can not be easily detected. The number of these organisms is drastically reduced as would be expected, if adequate heat is applied for a reasonable length of time during cooking.

In Jos, all the unhygienic practices that lead to the production of fresh beef are accompanied with heavy microbial contamination. These practices are the method of slaughtering, washing, poor preservative methods, the knives used for cutting the meat and the method of transportation of the meat from the abattoir. Meat is usually transported in open vans in Jos.

The presence of *Staphylococcus aureus* in the meat indicates possible human comtamination. The isolation of some enterobacteriaceae from the meat definitely indicates faecal contamination which may be as result of poor dressing technique or contamination by meat handlers. Other bacteria may have been present but not recovered by the limited procedures used in this study.

Ejeikwu and Ogbonna (1990), pointed out that the danger of food infection and food poisoning can be greatly minimized by constant food inspection by health officers and that only healthy animals should be slaughtered for human consumption. The meat should be adequately protected in polythene bags to prevent flies from depositing pathogens on the fresh meat. The meat should also be properly refrigerated if it is going to be kept for long period of time before consumption.

CONCLUSION

It is important to note that the sterile production of the meat is impossible but the slaughtering, dressing and handling procedures must aim at minimizing the number of potential spoilage organisms if the products are to have a reasonable level of wholesomeness and storage life in the hands of the consumers.

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