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Effect of Different Types of Preservative Methods on Microbial Load of Beef from Public Market

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Abstract

This study was conducted to evaluate various preservative methods on the microbial load of beef purchased from the market in Ilorin. Five pieces of meat were purchased from Ipata market at five (5) different time (8 am, 12 pm, 2 pm, 4 pm and 6 pm) labelled samples A, B, C, D and E respectively, from the same butcher and from a particular cow slaughtered that same day. Microbial and fungal load of the meat was carried out immediately after slaughter to be compared to that of a microbial and fungal load of the meat after preservation with four different methods (freezing, solar, roasted and frying) at the end of the three months. It was found that freezing has the lowest quantity of microbial and fungal load ($P<0.05$) making it the best, followed by solar, roast and frying which is the least ($P>0.05$). It was discovered that the longer the meat stays in the market the more the microbial and fungal load. Also, the amount of fungal load is more than the amount of bacterial load under the same condition and handling. The equipment used during slaughtering and touching by the prospective buyer contributes greatly to the source and amount of microorganism found on the meat.

Keywords: Preservative methods, microbial load, analysis, markets

INTRODUCTION

The processes used in meat preservation are principally concerned with inhibiting microbial spoilage, although other methods of preservation are sought to minimise other deteriorative changes such as colour and oxidative changes. A number of inter-related factors influence the shelf life and keeping quality of meat, specifically holding temperature, atmospheric oxygen (O2), endogenous enzymes, moisture (dehydration), light and, most importantly, micro-organisms. All of these factors, either alone or in combination, can result in detrimental changes in the colour (Faustmann & Cassens, 1990), odour, texture and flavour of the meat. Although the deterioration of meat can occur in the absence of micro-organisms (e.g., proteolysis, lipolysis and oxidation), microbial growth is by far the most important factor in relation to the keeping quality of fresh meat (Lambert, Smith and Dodds, 1991).

Traditionally, methods of meat preservation may be grouped into three broad categories based on control by temperature, by moisture and, more directly, by inhibitory processes (bactericidal and bacteriostatic, such as ionising radiation, packaging, etc.), although a particular method of preservation may involve several antimicrobial principles. Each control step may be regarded as a 'hurdle' against microbial proliferation, and combinations of processes (so-called hurdle technology (HT) can be devised to achieve particular objectives in terms of both microbial and organoleptic quality (Lawrie and Ledward, 2006).

The most investigated new preservation technologies for fresh meat are non-thermal inactivation technologies such as high hydrostatic pressure (HHP), new packaging systems such as modified atmosphere packaging (MAP) and active packaging (AP), natural antimicrobial compounds and bio-preservation. All these alternative technologies attempt to be mild, energy-saving, and environmentally friendly and guarantee natural appearance while eliminating pathogens and spoilage micro-organisms. The study aimed to monitor the meat quality from the time of slaughter to a final time of sales for that day, access the nutrient lost from time of slaughter till the end of the day and determine the best preservative method.

Materials and methods

Site of the experiment

The experiment was carried out at the Agricultural garden of the Department of Agriculture, Kwara state polytechnic, Ilorin, Kwara State

Sample collection

Meat sample was purchased from Ipata market, Ilorin at five (5) different time 8 am, 10 am, 2 pm, 4 pm and 6 pm and were labelled A, B, C, D and E and later taken to the laboratory for analysis.

Sample preparation

All the pieces of meat purchased from the market were used for the experiment and all equipment used in this experiment was sterilized before the commencement of the experiment. 30g of the meat was cut and taken to the laboratory for both fungi and bacteria analysis each time it was purchased and the other part was then prepared for storage by cutting into four (4) part again one part each was fried for 30minutes till it is consumable, another part roasted for one (1) hour until it also becomes consumable,

the third and the fourth part was solar dried and freeze throughout the three months period of the experiment, while the fried and roasted meat was kept in the laboratory also throughout the period of the experiment, at the end of the experiment, all the samples were harvested and taken to the laboratory for analysis.

Laboratory analysis

There are two types of analysis in the laboratory; these are fungi and bacteria as explained below.

Fungal

Total viable count (TVC):

The media was autoclaved and 20 ml of sterilized Nutrient Agar medium measured into the plate. 100L of the product was pipette into the Petri dish and swilled to mix aseptically. They were incubated at 35^0C for 24 hrs. The colony-forming units were counted and recorded as CFU.

Total Fungal count:

The media were autoclaved and 20 ml of sterilized Potato Dextrose agar was measured into the sterile culture plates. 100L of the serially diluted sample (x10-6) were pipetted into the Petri dishes and swilled to mix aseptically. They were incubated at 35^0C for 3 – 5 days.

The colony-forming units were counted and recorded as CFU.

Total Coliform count (TCC)

The media was autoclaved and 20 ml of sterilized MacConkey Agar medium the plate. 100µL of the product was pipette into the petri dish and swilled to mix aseptically. They were incubated at35^0C for 24 hrs. The colony-forming units were counted and recorded as CFU.

Microbial evaluation

Total Bacteria Count (TBC)

The media was autoclaved and 20ml of sterilized Nutrient Agar medium measured into the plate. 100µL of the product was pipette into the Petri dish and swilled to mix aseptically. They were incubated 35^0C for 24 hrs. The colony-forming units were counted and recorded as CFU.

Total Fungal Count

The media were autoclaved and 20 ml of sterilized Potato Dextrose agar was measured into the sterile culture plates. 100µL of the serially diluted sample ($x10^{-6}$) was pipette into the Petri dishes and swilled to mix aseptically. They were incubated at 35^0C for 3 – 5 days.

The colony-forming units were counted and recorded as CFU.

Total Coliform Count (TCC)

The media was autoclaved and 20 ml of sterilized MacConkey Agar medium measured into the plate. 100µL of the product was pipette into the Petri dish and swilled to mix aseptically. They were incubated at 35^0C for 24 hrs. The colony-forming units were counted and recorded as CFU.

Laboratory result

The fresh meat collected was taken to the laboratory for analysis immediately they were purchased at the five (5) different time (8 am, 11 am, 2 pm 4 pm and 6 pm) and

after the preservation methods meat samples from each method were also taken to the laboratory again and the results of the microbial load from the preserved meat and that of the fresh meat are then compared and conclusions and recommendations were drawn.

RESULT AND DISCUSSION

Results

Tables 1 and 2 showed the microbial load (bacterial) of meat samples purchased from Ipata market at five different times in a day.

Significant differences occurred in the freeing method within the different period of purchase, sample E (6 pm) was significantly different ($P<0.05$), followed by sample D purchased (4 pm), sample A (8 am), sample B (12pm) and sample C (2 pm) respectively which was the least ($P>0.05$). Significant different occurred in the solar-dried method of preservation, sample C was significant ($P<0.05$) followed by samples D, E, A and sample B been the least ($P>0.05$). The roasted method had sample D significantly different, followed by sample A, C, B and E being the least ($P>0.05$). There was no significant difference in the frying method irrespective of the time of purchase in all the samples.

The laboratory analysis revealed that the fresh meat sample that was taken into the laboratory contained some amount of bacteria load of about 1.1×10^6 while after the preservation methods, the freezing methods had 1.7×10^4 solar has 1.85×10^4, roasted had 2.1×10^5 while fried had 2.5×10^4 . The sample that was purchased four (4) hours later had 1.38×10^7 and after three months of preservation, freezing, solar, roasted and fried had 1.6×10^4, 1.7×10^4 , 1.6×10^5 and 2.3×10^4 respectively. The 2 pm meat purchased which was just 2 hours later had 4.9×10^6 and three months later the microbial load from the samples were 1.1×10^4 1.45×10^6,1.6×10^5 and 1×10^6 freezing, solar and frying. The 4 pm meat sample gave 6.27×10^6 and after the preservations, the microbial load were 9×10^4 for freezing meat, 9.2×10^4 for solar meat, 8.6×10^5 for roasted meat and 1.55×10^5 fried meat. The last meat sample which is about 6 pm gave 9.02×10^7 of microbial load and after the preservation methods the freezing methods gave 7.2×10^4, Solar gave 5×10^5, Roasted gave 8.5×10^4 and Fried gave 9.3×10^4.

Table 3. Showed the value of fungi load for fresh meat and after the preservation methods that was purchased five (5) different times in a day.

The freezing, roasted and frying methods in fungi had no significant difference ($P>0.05$) in all irrespective of the time of purchase of the meat but the solar method followed a different order with the meat sample A, purchased 8 am was significantly different followed by sample B, E and D being the least

The 8 am meat purchased had a fungi load of 1.5×10^5 slightly higher than that of bacteria, load purchased same time and under the same conditions and after preservations the Freezing method had 4.1×10^4, the solar had 8.2×10^4, the roasted 9×10^4 and the fried had 1.05×10^5, the second sample had a 1.8×10^5 fungi load for fresh meat and after the preservative methods the freezing, solar, roasted and fried methods had 4.7×10^4 ,5.1×10^4 ,4.9×10^4 and 5.5×10^4 respectively. The third meat sample which was purchased around 2 pm had 4.3×10^5 fungi load and after preservation, the fungi load are as follows 2.3×10^4 , 3×10^4, 3.1×10^4 and 4.5×10^4 for freezing, solar, roasted and fried methods, similarly the

meat purchased at 4 pm had 2.7 x 10^5 load of fungi while after preservations the fungi load are 1.8 x 10^4 for freezing, 1.92 x 10^4 for solar, 2.1 x 10^4 for roasted and 2.4 x 10^4 for fried meat the last meat sample that was purchased about 6 pm had 3.6 x 10^5 of fungi and after preservation Freezing method had 2.7 x 10^4, Solar had 2.9 x 10^4,Roasted had 3.1 x 10^4 and Fried had 4.8 x 10^4 .

Table 1. Bacterial load of meat samples.

Parameter	Freeze	Solar	Roasted	Fried
A	1.7 X10^{4c}	1.85 X 10^{4d}	2.1 X 10^{5b}	2.5 X 10^4
B	1.6 X 10^{4d}	1.7 X 10^{4e}	1.6 X 10^{5d}	2.3 X 10^4
C	1.1 X 10^{4e}	1.45 X 10^{6a}	1.6 X 10^{5c}	3.7 X 10^5
D	5.7 X 10^{4b}	6.44 X 10^{5b}	8.6 X 10^{6a}	1.55 X 10^5
E	7.2 X 10^{4a}	5.0 X 10^{5c}	8.5 X 10^{4e}	9.3 X 10^4
SEM	778	149	295	635

a, b, c and d within the same row with different superscripts are significantly different at (P <0.05).

Table 2. Bacterial load of meat samples.

SAMPLES	BEFORE PRESERVATION (RAW MEAT)	AFTER PRESERVATION
Sample A (8:00am)	1.1 x 10^6	Freeze = 1.7 x 10^4 Solar = 1.85 x 10^4 Roasted = 2.1 x10^5 Fried = 2.5 x 10^4
Sample B (12:00pm)		Freeze= 1.6 x 10^4 Solar = 1.7 x 10^4 Roasted = 1.6 x 10^5

	1.38 X 10^7	Fried = 2.3 x 10^4
Sample C (2:00pm)	4.9 x 10^6	Freeze = 1.1 x 10^4 Solar = 1.45 x10^6 Roasted = 1.6 x 10^5 Fried = 1 x 10^6
Sample D(4:00pm)	6.27 X10^6	Freeze = 9 x 10^4 Solar = 9.2 x 10^4 Roasted = 8.6 x10^5 Fried = 1.55 x 10^5
Sample E(6:00pm)	9.02 X 10^7	Freeze = 7.2 x 10^4 Solar = 5 x 10^5 Roasted = 8.5 x 10^4 Fried = 9.3 x 10^4

Table 3. Fungi load of meat samples

Parameter	Freeze	Solar	Roasted	Fried
A	1.61 X 10^4	8.2 X 10^{4a}	5.7 X 10^4	1.05 X 10^5
B	4.7 X 10^4	5.1 X 10^{4b}	4.9 X 10^4	2. 05 X 10^5
C	2.3 X 10^4	2.6 X 10^{4c}	2.1 X 10^4	4.05 X 10^4
D	1.8 X 10^4	1.92 X 10^{4d}	3.1 X 10^4	2.4 X 10^4
E	2.7 X 10^4	2.9 X 10^{4c}	3.78 X 10^4	4.7 X 10^4
SEM	247	628	534	304

a, b, c and d within the same row with different superscripts are significantly different at (P <0.05).

Table 4. Fungi load of meat samples

SAMPLES	BEFORE PRESERVATION (RAW MEAT)	AFTER PRESERVATION
Sample A (8:00am)	1.5×10^5	Freeze = 4.1×10^4 Solar = 8.2×10^4 Roasted = 9×10^4 Fried= 1.05×10^5
Sample B (12:00pm)	1.8×10^4	Freeze= 4.7×10^4 Solar = 5.1×10^4 Roasted = 4.9×10^4 Fried = 5.5×10^4
Sample C (2:00pm)	4.3×10^5	Freeze = 2.3×10^4 Solar = 3×10^4 Roasted = 3.1×10^4 Fried = 4.5×10^4
Sample D (4:00pm)	2.7×10^5	Freeze = 1.8×10^4 Solar = 1.92×10^4 Roasted = 2.1×10^4 Fried = 2.4×10^4
Sample E(6:00pm)	3.6×10^5	Freeze = 2.7×10^4 Solar = 2.9×10^4 Roasted =3.1×10^4 Fried = 4.8×10^4

Discussion

The fresh meat that was newly slaughtered that had a certain quantity of microbial the load may be as a result of equipment used in the abattoir and secondly the environment where the slaughtering took place, therefore handling must have caused the meat to have a certain amount of microorganisms and after preservations, it was generally observed that the freezing method had the lowest amount of microorganisms which makes the best, followed by solar, roasting,

and frying method. This may be due to the freezing method actually makes the microbes inactive the temperature is very low for their survival, the solar-dried the meat sample completely for the period of three months and the moisture content is very low that the microbes find very difficult to exist or survive in that medium, the roasted after sometimes acquired some moisture from the environment and then has a quantity of moisture that can make the microbes to survive but the frying method even invite the microbes because of the presence of oil on the meat that was used to fry it as a result of Aspergillosis.

CONCLUSIONS AND RECOMMENDATIONS

The amount of fungi is more than the amount of bacteria found on the meat under the same environmental condition and handling

Recommendation

i. General hygiene of the meat during sales and after-sales is very important so that the consumer will not buy microbial infested meat.

ii. Proper preservation of unsold meat is very important

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