ORIGINAL RESEARCH PAPER

EFFEECT OF COOKING METHODS ON THE MICROBIAL LOAD OF BEEF COLLECTED AT DIFFERENT HOURS IN EKPOMA TOWN MARKET.

P.I. OKOH[1], A.S. ADELANI[2] and T.A. SALAU[2]

1. Department of Animal Science, Faculty of Agriculture, Ambrose Alli University Ekpoma, Edo State, Nigeria.
2. Microbiology Laboratory, Animal Science Department, University of Ibadan, Ibadan Nigeria.

Corresponding Email: paulokoh75@ gmail.com

Abstract

A study on the effect of cooking methods on the microbial load of beef collected at different hours of the day in Ekpoma town market was conducted. Meat samples were purchased at 8am, 1pm and 5pm from the market and taken to the laboratory for microbial load analysis. Another portion of the meat was subjected to three cooking methods (boiling, broiling and roasting) and microbial load analysed in a completely randomized design (CRD. Results from the study showed that mean microbial load of beef collected at 8am were significantly ($P< 0.05$) less compared with those collected at 1pm and 5pm, an indication that microbial load increase as meat stays for longer hours of the day in the market. While boiling cooking method significantly ($P< 0.05$) reduced the microbial loads of beef compared with broiling and roasting, an indication that cooking meat with water reduced microorganisms more. Thus, beef meat should be purchased in the early hours of the day (7am-9am) from the market and boiling cooking method should be implored by home consumers when cooking meat.

Introduction

Meat is the flesh of an animal that is eaten as food. The advent of civilization allowed the domestication of animals such as chicken, sheep and goats, cattle, pigs and rabbits, and eventually their use in meat production on an industrial scale (Womack, 2010). The meat industry is concerned with turning animal carcass into many different end-products. These end-products are derived from all parts of the animal (muscle, bone, fat, cartilage, skin, fluids and glands) and are produced through a range of physical, chemical and biological processes (Ozean and Bozkurt, 2015). In achieving this, food safety is a matter of great concern and of public health importance particularly when the environment in which such food is handled is heavily contaminated (Soyiri *et al*., 2008).

Most of the fresh food especially that of animal origin like beef is highly vulnerable to microbial invasion and food poisoning, since meat is an ideal medium for the growth of a number of microorganisms due to its nutritive value (Soyiri *et al*., 2008). However, the consumption of meat contaminated with pathogenic bacteria is the cause of many food-borne illnesses (Nouich and Hamdi, 2009), with human health consequences ranging from illness to death (Iroha *et al.,* 2011; Hassan *et al.,* 2010). In most developing countries especially Nigeria, a number of foods (meat inclusive) have been reported to have high incidence of bacteria (Okonko *et al*., 2008a; Clarence *et al*., 2009). This is because the meat available at retail outlets comes through a long chain of slaughtering and transportation, where each step may pose a risk of microbial contamination. The sanitary conditions of abattoirs and its surrounding environment are major factors contributing to bacterial contamination of meat (Gill *et al.,* 2000). Consequently, it is very important to implement hygiene and safety procedures not only during slaughter but also when handling and processing meat.

Meat has to be cooked before consumption, and cooking of meat results in quality changes such as flavour and taste enhancement, inhibition of microorganisms, shelf life increase and improved digestibility (Broncano *et al*., 2009). Cooking methods influence the color, texture, flavor, nutritional composition and microbial load of final meat products. Each cooking method has its own advantages and disadvantages depending on the product processed (Cholean *et al*., 2011). Several studies have been conducted to assess the effect of cooking methods on quality and storage stability of meat and meat products (Chettri *et al*., 2011; Adedeji *et al*., 2009 and Peiretti *et al*., 2012). Also, the effect of time and temperature on meat microbial load has generated interest from most authors to carry out the study; results of which may be useful in solving problems of meat spoilage during transportation, storage and up to its disposal to the consumers. To this end, Bradeaba and Sivalcumaar (2013) reported significant difference between beef and mutton products as well as beef and pork products. They stated that Coliform counts, *Pseudomonas* and *Bacillus sp.* were noted, and significant differences were observed between samples for Total viable counts (TVC), Coliform and Psychophilic sampled from 6.00am to 6.00pm, where higher values of microbial loads were observed as time progressed.

Understanding the prevalence and distribution of microorganisms in fresh meat retailed within any given market and determining management strategies associated with lower prevalence is key to decreasing the risk of high microbial loads at harvest (Foley and Lynne, 2008). To this end, this study sorts to investigate the effect of cooking methods on the microbial load of beef collected at different hours of the day in Ekpoma town market.

Materials and Methods

Sample collection

Meat samples were purchased from the open market in Ekpoma town. Ekpoma is located in Edo Central senatorial district of Edo State. It is the headquarter of Esan West Local Government Council. It has a prevailing tropical climate with annual rainfall of about 1500 – 2000mm. The vegetation in this region represents an interface between the tropical rainforest and derived savannah (Fredrick *et al*., 2007).

One Kg of meat sample was collected from the open market in the early hour (8am) of the day. It was cut into two portions. The first portion was cut into ten (10) parts as replicates for microbiological loads determination. Same process was applied for meat samples collected at 1pm and 5pm. While the second portion of meat samples were subjected to three (3) cooking methods (boiling, broiling and roasting) to determine their effects on microbial load. The experiment was carried out in the microbiology laboratory of Animal Science Department, University of Ibadan.

Culture media preparation

The culture media was Nutrient Agar (NA), which was prepared according to the manufacturer's specification. A total of 7g of the media was weighed into a clean conical flask and dissolved in 100ml distilled water. It was autoclaved at 121^0C for 15 minutes.

Microbial population determination

The microbial load counts of beef meat samples were determined by using the pure – plate culture described by Olutola *et al*., (1991).

Cooking methods

Boiling – Meat sample was washed and boiled in an aluminum pot containing 100ml of water, using a gas burner for 5 mins at a boiling temperature of 100^0C. This was allowed to cool before 20g was weighed and taken for laboratory analysis.

Broiling – Meat sample was washed and put in an aluminum pot without the addition of water, and placed on a regulating gas burner to boil for 5 mins at a temperature of 100^0C. The meat was then cooled and 20g weighed for analysis.

Roasting – Meat sample was roasted on an iron gauge placed on a cool pot containing hot burning charcoal at a temperature of 100^0C (full redness of charcoal) for 5 mins. The meat was also allowed to cool and 20g taken for laboratory analysis.

Serial dilution techniques

Serial dilution was done for each portion of the samples. Nine (9) mls of sterile water was introduced into sets of test tube and 1ml of the sample was put in a serial dilution method replicated three (3) times. One (1) ml of the diluents was taken randomly into the pure-plate and the nutrient agar (NA) added. It was shaken to cover the plate, well sealed and labeled. The

samples were taken to the incubator for 20 – 24 hours in order to coagulate, after which the colony was formed and counts made on each plate sample, using a marker.

Experimental Design

The design for the experiment was a completely randomized design (CRD), one way analysis of variance.

Statistical Analysis

All data were subjected to analysis of variance (ANOVA) using the SL Statistical programme for windows SAS (2004) at 5% level of significance.

Results and Discussions

Results on the effect of cooking methods on the microbial load of beef collected at different hours of the day in Ekpoma town market are shown on the Tables and discussed below.

Table 1: Mean microbial load of beef collected at different hours of the day in Ekpoma town market

Microbial counts (CFU/g)	8am	1pm	5pm	SEM
Dil^{-1}	30.0^{a}	43.5^{b}	47.0^{b}	1.68
Dil^{-2}	22.0^{a}	31.5^{b}	45.0^{c}	2.61
Dil.$^{-3}$	15.5^{a}	20.0^{a}	42.5^{b}	2.89

abc: Means with similar superscripts along rows are not significantly (P<0.05) different.
SEM: Standard errors of means; Dil$^{-1\ -2\ -3}$: Diluents 1, 2, and 3.

Results on the mean microbial load of beef collected at different hours of the day showed that microbial counts from Dil.$^{-1}$ were significantly (P<0.05) fewer at 8am with 30.0 counts, compared with those of 1pm and 5pm which had 43.5 and 47.0 counts respectively, and did not differ (P>0.05) from both hours. This implies that time of collection affects the microbial load of beef sold in the market. This result was in line with the findings of Bradeaba and Sivakumaar (2013), where higher values of microbial load were observed as time progresses. Result from Dil.$^{-2}$ followed similar trend, with less microbial counts (22.0) recorded at 8am as against 31.5 and 45.0 recorded at 1pm and 5pm respectively, which were significantly (P<0.05) different. Also, Dil.$^{-3}$ showed similar result of less microbial load in the morning 8am (15.5), though not significantly (P>0.05) different from 1pm (20.0) but differed significant (P<0.05) from 5pm (42.5). Thus, the longer meat stays in the market or meat shop, the higher its microbial load.

Results from this study further revealed that microbial loads concentration tend to reduce as the dilution increases, hence the reduction in microbial loads counts from diluents 1 to 3, as observed in the result.

Table 2: Effect of cooking methods on microbial load of beef

Microbial counts (CFU/g)	Boiling	Broiling	Roasting	SEM
Dil. $^{-1}$	64.0^{a}	65.0^{a}	74.5^{b}	2.86
Dil. $^{-2}$	42.0^{a}	52.5^{b}	62.0^{b}	3.08
Dil. $^{-3}$	30.5^{a}	42.0^{b}	52.5^{c}	2.89

abc: Means with similar superscripts along rows are not significantly (P<0.05) different.
SEM: Standard errors of means; Dil$^{-1\ -2\ -3}$: Diluents 1, 2, and 3.

Results on effect of cooking methods on the microbial load of beef showed that cooking methods affected the microbial load of beef, with boiling significantly (P<0.05) reducing the microbial loads of beef to 64.0 as against roasting (74.5) but did not differ (P>0.05) significantly from broiling (65.0), from Dil.$^{-1}$. This implies that boiling cooking method tends to reduce microbial load in meat, while roasting increases microbial load. In line with this finding, Ikeme (1990) reported that submerging meat inside water with the application of heat at a high temperature will cook the meat, thus reducing its bacterial contamination and enhancing its shelf life. The result followed similar trend for Dil.$^{-2}$ with boiled meat sample having 42.0 microbial counts, which was significantly (P<0.05) less than those of broiled meat (52.5). While, the microbial counts of roasted meat were higher but not significantly (P>0.05) different from broiled meat. Also, results from Dil.$^{-3}$ showed that boiling significantly (P<0.05) reduced the microbial counts of beef to 30.5 as against 42.0 and 52.5 recorded for broiling and roasting respectively. The study revealed that higher microbial load was observed for the roasted beef samples on all three (3) diluents replicates taken. The high microbial loads recorded for the roasted beef could be as a result of the roasting process, which further exposes the meat to microbial contamination, compared with boiling and broiling. In line with this, Anihouvi *et al.,* (2013) reported that different processing methods had significant changes in the microbial content of meat samples as a result of the processing environment. This study further revealed that the concentration of microbes in meat sample-solution tends to reduce as dilution rate increases. This explains why microbial load counts dropped gradually from Dil.$^{-1}$ to $^{-3}$ for the three (3) cooking methods measured.

Conclusion and Recommendation

It can be concluded that time (hour) of purchase of beef meat from the market affects the microbial loads of meat, as the longer the time meat stays in the market, the higher its microbial content. Also, boiling cooking method reduces the microbial load of beef more, compared with broiling and roasting cooking methods. Furthermore, that microbial concentration in meat sample-solution reduces as dilution of concentration increases.

It is therefore recommended that beef meat should be purchased in the early hours of day from the market, and boiling cooking method should be implored by home consumers when cooking meat.

Ethical declaration and consent is not applicable

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