*European Journal of Nutrition & Food Safety*

***9(4): 365-371, 2019; Article no.EJNFS.2019.055***
***ISSN: 2347-5641***

# A Comparative Assessment of the Microbial Load of Beef and Chicken Meat Collected at Different Hours of the Day in Ekpoma Town Market

**P. I. Okoh[1*], M. I. Okoruwa[1] and S. E. Okosun[1]**

*[1]Department of Animal Science, Faculty of Agriculture, Ambrose Alli University, Ekpoma, Edo State, Nigeria.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. Author PIO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MIO managed the analyses of the study. Author SEO managed the literature searches. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/EJNFS/2019/v9i430083
Editor(s):
(1) Dr. Kristina Mastanjevic, Assistant Professor, Department of Process Engineering, Faculty of Food Technology, Josip Juraj Strossmayer University of Osijek, Croatia.
Reviewers:
(1) S. Selvajeyanthi, Tiruppur Kumaran College for Women, India.
(2) Adeyeye, Samuel Ayofemi Olalekan, Ton Duc Thang University, Vietnam.
Complete Peer review History: http://www.sdiarticle3.com/review-history/50314

***Original Research Article***

***Received 13 May 2019***
***Accepted 23 July 2019***
***Published 31 July 2019***

## ABSTRACT

A study on comparative assessment of the microbial load of beef and chicken meat collected at different hours of the day in Ekpoma town market was carried out. Samples were purchased at 8am, 1pm and 5pm and taken to the laboratory for microbial load counts. The design of the experiment was a completely randomized design (CRD). Result from the study revealed that microbial load of beef for Diluent 1 (Dil.-1) was less at 8am, having 30.0 log10 CFU/g as compared with 43.5 and 47.0 observed at 1pm and 5pm respectively. Diluent 2 (Dil.-2) showed similar results of less counts at 8am (22.0 log10 CFU/g) compared with 31.5 and 45.0 recorded at 1pm and 5pm respectively, as well as Diluent 3 (Dil.-3), which recorded similar results of less microbial load at the early hours of the day. The result from the microbial load count of chicken was not affected by the time (hours) of collection, as values were not significantly (P>0.05) different. Diluent 1 (Dil.-1) had the least count of 22.0 log10 CFU/g at 8am compared with a high count of 32.5 at 1pm and a less count of 24.5 at 5pm. Similarly, Diluent 2 (Dil.-2) recorded a microbial count of 20.5 log10 CFU/g at 8am compared with 24.5 and 22.5 recorded at 1pm and 5pm respectively. While Diluent

**Corresponding author: Email: paulokoh75@ gmail.com;*

3 (Dil.-3) had 14.5 log 10 CFU/g at 8am compared with 18.5 and 17.5 recorded at 1pm and 5pm respectively. Microbial load of chicken meat was lowest in the morning (8am), high in the afternoon (1pm) and lower in the evening (5pm). Here, the rate of exposure of chickens in the refrigerator to the atmosphere affected its microbial load. The result did not follow the trend of higher microbial load as time of the day progressed, observed in beef. Results on a comparative assessment of the microbial load of beef and chicken meat further revealed that microbial load in beef was higher than chicken, as beef was completely exposed on a table platform in the market, while chicken was stored in the refrigerator when sold in the market. It also revealed that microbial load concentration of beef and chicken decreased as dilution rate of concentration increased, as observed in Dil.1 – 3. Hence, home consumers should buy beef meat in the early hours of the day, and chicken meat in the morning and evening from the market, in order to check the risk of microbial contamination.

*Keywords: Beef; chicken; microbial counts; different hours; Ekpoma market.*

## 1. INTRODUCTION

Recently, food safety has been a matter of great concern and of public health importance in particular, when the environment in which the food (meat inclusive) is handled is heavily contaminated [1]. Most of the fresh foods especially that of animal origin like beef and chicken are highly vulnerable to microbial invasion and food poisoning, since meat serves as a good medium for the growth of microbes [2,3] and the best growth media for spoilage microorganisms. Meat infected with microorganism is the cause of many food-borne diseases, the sources of which may be the animals themselves or from outside the surrounding where the animals are kept as well as the way they are processed after slaughtering [4].

In most developing countries especially Nigeria, meat is widely consumed as source of protein. It is either eaten cooked or processed into other forms to avoid associated spoilage [5]. However, because of its unique biological and chemical structure, meat undergoes progressive deterioration from the time of slaughter until consumption. Consumption of meat contaminated with pathogenic bacteria therefore, precedes many food-borne illnesses [6], with human health consequences ranging from illness to death [7,8].

A great diversity of microbes inhabits fresh meat generally but different types may become dominant depending on the pH, composition, texture, storage temperature and transportation means of the meat [9]. Basically, two types of microbial contaminants can be expected in beef and chicken meat, that is; spoilage bacteria, which are those microorganisms that spoil the product and render it unfit for human consumption, and pathogenic bacteria, which are the microorganisms that produce diseases. Major spoilage organisms include *Pseudomonas* spp., others are members of the enterobacteriaceae, while yeast and molds growth are essentially slow compared with bacteria, and are therefore not major components of spoilage in meat [10]. Pathogenic microbes harboured in meat include *Salmonella* spp, *Campylobacter, Bacillus, Clostridium, Staphilococus* etc. Also, zoonotic infection has been reported to be associated with contaminated meat [11].

In order to keep the microbial load of raw meat, especially beef and chicken in check, the food safety requirements should be followed strictly in accordance with the Hazard Analysis Critical Control Point (HACCP). However, in Nigeria a number of foods (meat inclusive) have been reported to have high incidence of bacteria [12] and [13]. This is because the meat available at retail outlets comes through a long chain of slaughtering and transportation process, where each step may pose a risk of microbial contamination. The sanitary conditions of abattoirs and their surrounding environments are major factors contributing to bacteria contamination of meat [14]. Contamination can also be compounded during storage and handling of the meat (beef and chicken) at butchers' shops in the market.

Understanding the prevalence and distribution of food-borne pathogens in beef and chicken meat retained within any given community, and determining management strategies associated with lower prevalence, is key to decreasing the risk of high bacteria load at harvest [15]. To this end, this study was setup to conduct a comparative assessment of the microbial load of beef and chicken meat collected at different hours of the day in Ekpoma town market.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

This study was conducted in Ekpoma town. Ekpoma lies on Longitude 6.07º E and Latitude 6.75º N. It has a prevailing tropical climate with annual rainfall of about 1500 – 2000 mm. The vegetation in this region represents an interface between the tropical rainforest and derived savannah [16].

### 2.2 Sample Collection

One (1) Kg of beef and chicken meat samples were purchased from the open market and meat shop respectively at 8am. They were then cut into ten parts of 10 g each, which served as replicates, put in a clean polythene bag and labeled accordingly, and then taken to Animal Science Laboratory for Microbiological load determination. The same process was applied to the meat samples collected at 1pm and 5pm respectively.

### 2.3 Culture Media Preparation

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

### 2.4 Microbial Population Determination

The microbial load counts of beef and chicken meat samples were determined by using the pure – plate culture described by [17].

### 2.5 Serial Dilution Techniques

Serial dilution was done for each portion of the samples. Nine mls of sterile water was introduced into sets of test tube and one ml of the sample was put in a serial dilution method replicated three times. One ml of the diluents was taken randomly into the pure-plate and the nutrient agar (NA) added. It was shaken to cover the plate, sealed and labeled. The samples were then incubated for 20 – 24 hours in order to coagulate, after which the colony was formed and counts made on each plate sample, using a marker.

### 2.6 Experimental Design

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

### 2.7 Statistical Analysis

All data were subjected to analysis of variance (ANOVA) using the SL Statistical programme for windows [18] at 5% level of significance.

## 3. RESULTS AND DISCUSSION

Results on the microbial load of beef and chicken meat collected at different hours of the day in Ekpoma town market are presented in Tables 1 and 2.

The result showed that microbial load of beef for Diluent 1 ($Dil.^{-1}$) was less at 8am, with 30.0 $log_{10}$ CFU/g as compared with 43.5 and 47.0 observed at 1pm and 5pm respectively. This implies that microbial load was less in meat at the early hours of the day, and tends to increase as the time of the day progressed. Similar observations of higher microbial load as time progressed were reported by Bradeaba and Sivakumaar [19]. Results from Diluent 2 ($Dil.^{-2}$) showed similar results of less counts at 8am (22.0 $log_{10}$ CFU/g) compared with 31.5 and 45.0 recorded at 1pm and 5pm respectively. Also, Diluent 3 ($Dil.^{-3}$) recorded similar results of less microbial load at 8 am (15.5 $log_{10}$ CFU/g) compared with 20.0 and 42.5 recorded for 1pm and 5pm respectively. These results were in line with the findings of [20] on effect of cooking methods on the microbial load of beef collected at different hours in Ekpoma Town market. The results from this study further revealed that microbial load decreased as dilution rate of concentration increases, as observed in Diluent(s) 1-3 ($Dil^{-1to-3}$). Similar observation was also reported in previous work by Okoh et al. [20].

From this result, time (hour) of collection affected the microbial load of beef sold in the market.

The result showed that microbial load of chicken was not affected by the time (hour) of collection, as values were not significantly ($P>0.05$) different. The non – significance was due to the fact that chicken meat is not exposed when sold in the market and shops, they are stored in refrigerators thus preventing contamination with microorganisms.

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

| Microbial counts ($log_{10}$ 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, 2,3*

**Table 2. Mean microbial load of chicken meat collected at different hours of the day in Ekpoma town market**

| Microbial counts ($log_{10}$ CFU/g) | 8am | 1pm | 5pm | SEM |
|---|---|---|---|---|
| $Dil^{-1}$ | 22.0 | 32.5 | 24.5 | 3.32 |
| $Dil^{-2}$ | 20.5 | 24.5 | 22.5 | 3.54 |
| $Dil.^{-3}$ | 14.5 | 18.5 | 17.5 | 3.54 |

*NS: Means Not Significant (P>0.05); SEM: Standard errors of means; $Dil^{-1\,-2\,-3}$: Diluents 1, 2, 3*

Diluent 1 ($Dil.^{-1}$) had a lower count of 22.0 $log_{10}$ CFU/g at 8am compared with a high count of 32.5 at 1pm and a low count of 24.5 at 5pm. Similarly, Diluent 2 ($Dil.^{-2}$) recorded least microbial count of 20.5 $log_{10}$ CFU/g at 8am compared with 24.5 and 22.5 recorded at 1pm and 5pm respectively. While Diluent 3 ($Dil.^{-3}$) had 14.5 $log_{10}$ CFU/g at 8am compared with 18.5 and 17.5 recorded at 1pm and 5pm respectively.

From the result, it was observed that microbial load of chicken meat was lower in the morning (8am), high in the afternoon (1pm) and low in the evening (5pm). The result did not follow similar trend of higher microbial load as time progressed, observed in beef meat. The lower microbial load observed in the early hour (8am) of the day was as a result of non-frequent exposure of the refrigerator containing chicken, due to low patronage in the morning, compared with a high microbial load observed in the afternoon (1pm), where there was frequent exposure or opening of the refrigerator as a result of high patronage. While, low values recorded in the evening (5pm) was also due to non-frequent exposure of chickens in the refrigerator, as demand for it at that time was low.

The rate of exposure of chickens in the refrigerator to the atmosphere affects its microbial load. [10], opined that good hygienic practices are extremely important to prevent microbial contamination in meat and other foods, in addition to proper handling, cooking and cooling practices. Therefore meat should be stored in the coldest part of the refrigerator or stored frozen to prevent contamination with by microorganism.

Results on a comparative assessment of the microbial load of beef and chicken meat collected at different hours of the day, revealed that microbial load in beef was higher than chicken. This was an indication that the hygienic conditions where both meats were sold affected their microbial load, as beef was completely exposed on a table platform and chicken stored in the refrigerator when sold in the market. Also, their microbial loads were lower in the morning (8am), high in the afternoon (1pm) and low in the evening (5pm). The higher microbial load observed in beef, as time (hour) of the day progressed agrees with previous reports of [19]. While the lower microbial counts observed in the chicken for morning (8am) and evening (5pm) was in agreement with the findings of [21], who observed that mean anaerobic protein counts (APC) for morning and evening samples of meat were similar (fewer), hence whether a consumer bought chicken meat in the morning or evening, chances of purchasing contaminated ones were similar and fewer. Result from this study also revealed that the microbial load concentration decreased as dilution rate of concentration increased, as observed in $Dil.^{1\,-\,3.}$ This was in line with the findings of [20] reported on the beef meat.

Graphical representations on the relationship between the microbial load of beef and chicken meat collected at different hours of the day are shown below in Figs. 1 & 2.

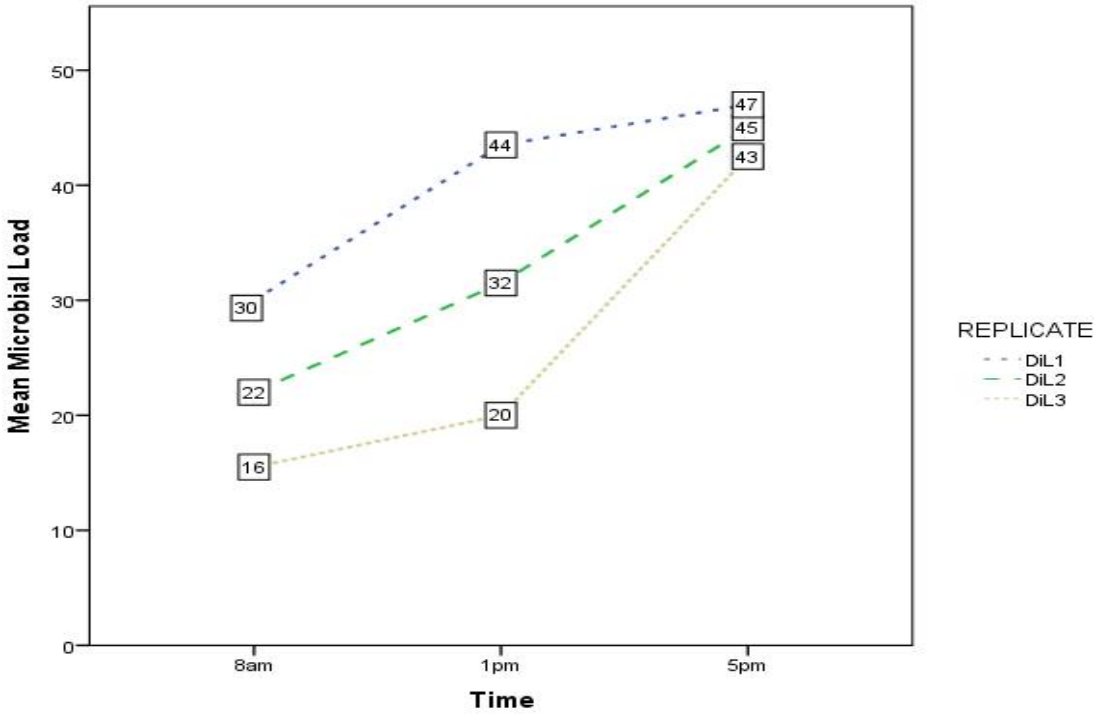


**Fig. 1. Relationship between the microbial load of beef against time (hours)**

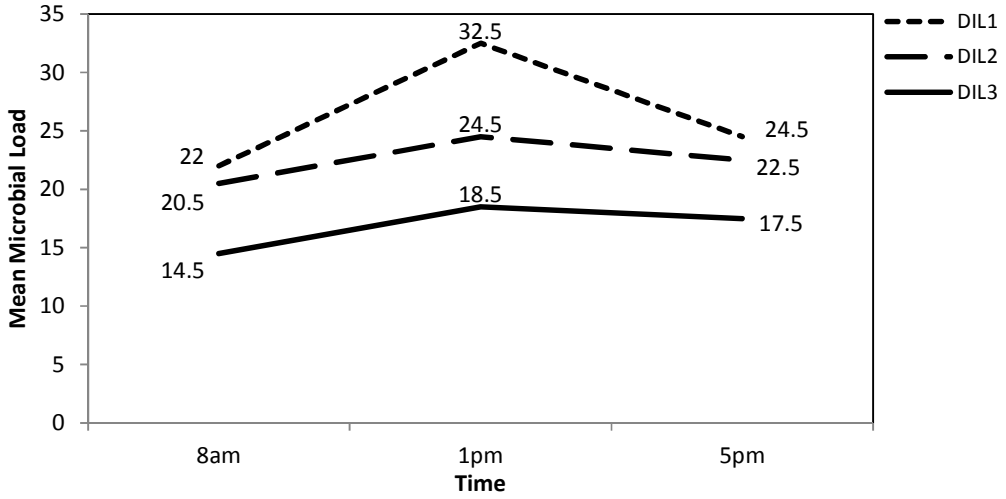


**Fig. 2. Relationship between the microbial load of chicken against time (hours)**

In Fig. 1, microbial load increased as time progressed (slanting upward from left to right).

Fig. 2 shows that microbial load only increased from 8am to 1pm and decreased at 5pm, an indication that time of purchase does not completely affect the microbial load of chicken meat.

## 4. CONCLUSION AND RECOMMENDATION

The study on a comparative assessment of the microbial load of beef and chicken meat collected at different hours of the day, shows that microbial load in beef was higher than those of chicken, an indication that the hygienic conditions where both

meats are sold affect their microbial load, as beef is completely exposed on a table platform and chicken is stored in the refrigerator when sold in the market. Hence, home consumers should buy beef meat in the early hours of the day, and chicken meat in the morning or evening, as chances of purchasing contaminated ones at those times (hours) are fewer.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES


1. Soyiri IN, Agbogi HK, Dongdem JT. A pilot microbial assessment of beef in the Ashaima Market, a suburb of Accra Ghana. African Journal of Food Agriculture Nutrition and Development. 2008;8(1):91-103.
2. Bacha K, Mehari T, Ashenafi M. Microbiological study of walkalim, a traditionsl Ethiopian fermented sausage. Ethiop. J. Biol.Sci. 2007;6:129-145.
3. Zakpaa HD, Imbeah CM, Mak-Mensah EE. Microbial characterization of fermented meat product on some selected markets in the Kumasi metropolis, Ghana. Afr. J. Food Sci. 2009;3:340-346.
4. Adeyemo OK. Unhygienic operation of a city abattoir in South Western Nigeria: Environmental implication. African Journal of Environmental Assessment and Management. 2002;4(1):23–28.
5. Olaoye OA, Nilude AA. Investigation on the potential use of biological agents in the extension of fresh beef in Nigeria. World Journal of Microbiology and Biotechnology. 2010;26:1445-1454,
   Dol: 10. 1007/
6. Nouichi S, Hamdi TM. Superficial bacterial contamination of Ovine and Bovine Carcass at El-Harrach slaughter house, Algeria. European Journal of Scientific Research. 2009;38(3):474–485.
7. Iroha IR, Ugbo EC, Ilang DC, Oji AE, Ayogu TE. Bacterial contamination of raw meat sold in Abakaliki, Ebonyi State, Nigeria. Journal of Public Health Epid. 2011;3(2):49–53.
8. Hassan AN, Farooqui A, Khan A, Khan AY, Kazmi SU. Microbial contamination of raw meat and its environment in retail shops in Karachi, Pakistan. J. Infect Dev. Cties. 2010;4(6):382-388.
9. Adu-Gyamfi AW, Torghy-Tetteh, Appiah V. Microbiological quality of chicken sold in Accra and Determination of DIO-value of *E. coli.* Food Nutri. Sci. 2012;3(5):693-698.
10. Doyle ME. Microbial food spoilage - Losses and control strategies. A brief review of the literature FRI Briefings; 2007. Available:www.wiscedu/fril
11. Ali NH, Faroqui A, Khan A, Khan AY, Kazmi SU. Microbial contamination of raw meat and its environment in retail shops in Karachi Pakistan. J. Infect. Dev. Cties. 2010;14:53-55.
12. Okonko IO, Adejoye OD, Ogunnusi TA, Fajobi FA, Shittu OB. Microbiological and physicochemical analysis of different water samples used for domestic purposes in Abeokuta and Ojota, Lagos State, Nigeria. African J. Biotechnology. 2008a;7(3):617-621.
13. Clarence SY, Obinna CN, Shalom NC. Assessment of bacteriological quality of ready to eat food (meat pie) in Benin City metropolis, Nigeria. Afr. Jour. Microbial Research. 2009;3(6):390-395.
14. Gill CO, Bryant J, Bremeton DA. Microbial conditions of sheep carcasses from conventional or inverted dressing processes. J. Food prot. 2000;63(9):1291-1294.
15. Foley SL, Lynne AM. Food animal-associated Salmonella challenges. Pathogenecity and antimicrobial resistance. J. Anim. Sci. 2008;86:E173-E187.
16. Fredrick OAD, Garuba J, Addannel. Macmillan Nigeria Social Studies Atlas. Pub. Macmillan Education. 2007;8-46.
17. Olutola PO, Famrurewa O, Sountag HG. An introduction to general microbiology – A practical approach; 1991.
18. SAS. Statistical analysis system. User's Guide Version 9.0 SAS Instsitute, Inc. Cary North Carolina USA; 2004.
19. Bradeaba K, Sivakumaar PK. Assessment of microbiological quality of beef, mutton and pork and its environment in retail shops in Chidambaram, Tamil Nadu. International Journal of Plant, Animal and Environmental Sciences. 2013;3(1).

20. Okoh PI, Adelani AS, Salau TA. Effect of cooking methods on the microbial load of beef collected at different hours in Ekpoma Town Market. Asian Food Science Journal. 2019;7(1):1-5.

21. Paul B, Sylvia AB (). Microbiological quality of meat at the abattoir and butchery levels in Kampala City, Uganda. International Journal of Food Safety. 2014;16:29–35.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://www.sdiarticle3.com/review-history/50314*