



Microbial Evaluation and Proximate Composition of Pastries Sold Within the University of Uyo Campuses

U. U. Ndubuisi-Nnaji¹ and U. A. Ofon^{1*}

¹Department of Microbiology, University of Uyo, Akwa Ibom State, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author UUNN designed the study, wrote the protocol and managed literature searches. Author UAO wrote the first draft of the manuscript, performed experimental analyses and managed data obtained in the study. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JALSI/2016/28314

Editor(s):

(1) Yunjun Yan, Institute of Bioenergy and Ecology, College of Life Science and Technology, Huazhong University of Science and Technology, P. R. China.

Reviewers:

(1) Amina Abubakari, Kumasi Polytechnic, Kumasi, Ghana.
(2) M. Fakruddin, Institute of Food Science and Technology (IFST), Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka, Bangladesh.

Complete Peer review History: <http://www.sciencedomain.org/review-history/15898>

Original Research Article

Received 14th July 2016
Accepted 16th August 2016
Published 23rd August 2016

ABSTRACT

Microbiological evaluation and proximate composition of pastries sold within the University of Uyo Campuses were determined using standard microbiological and analytical techniques. A total of 28 pastries comprising buns, chin chin, cake and doughnut were bought from different locations within the three campuses (Main campus, Town campus and Annex campus). Microbiological analysis included total aerobic plate count, coliform count and fungal count. Moisture, crude protein, fat, crude fiber, ash and carbohydrate contents were determined by methods of Association of Official Analytical Chemist. Mean total aerobic plate count ranged from 1.5×10^3 to 4.7×10^5 cfu/g, fungal count ranged from 2.5×10^3 to 4.7×10^4 cfu/g while coliforms were not detected. Among the isolated organisms were potential foodborne pathogens and/or spoilage organisms: *Staphylococcus aureus*, *Bacillus* sp., *Shigella* sp., *Salmonella* sp., *Aspergillus niger*, *Rhizopus* sp. and *Fusarium* sp. There were high microbial population from Town and Annex campuses with buns having the highest level of microbial contamination. The percentage moisture, protein, fat, ash, fiber and carbohydrate content ranged from 6.13-16.10, 1.08-8.00, 0.40-16.00, 0.90-1.52, 0.50-2.15 and 60.00-85.98% respectively. These potential foodborne pathogens are of public health significance and require further monitoring.

*Corresponding author: E-mail: utibeofon@uniuyo.edu.ng;

Keywords: Pastry; proximate composition; total aerobic count; fungal count; foodborne pathogens.

1. INTRODUCTION

In most part of the world, people depend on ready-to-eat (RTE) food also known as "Fast food" for a significant portion of their nutritional requirement. Pastry, a common type of fast food has become inevitable in our diets. In Nigeria, like other developing countries, the item is consumed by people of all age groups [1]. It is hawked and sold in every street, market place, social gathering, churches and university campuses across the country [2].

Pastries, locally called snacks, is seen in the western culture as a type of food that is not meant to be eaten as a main meal of the day like breakfast, lunch and dinner but rather to assuage a person's hunger between meals providing a brief supply of energy for the body [2]. It has been described by [3] as popular articles of diet because they are appetizing in appearance, convenient in form, nutritious in content giving pleasing fullness to the stomach when consumed.

The increase in consumption of pastries has been associated with changes in social patterns characterized by increased mobility and less family centered activities [4]. Furthermore, convenience and modern lifestyles, industrialization, economic down turn, quest for more wealth, materialism and the unavailability of time to prepare proper meal are also responsible for the increased patronage of pastries [5]. Worthy of mention is the fact that the increased consumption and sales of pastries have provided employment and contracts to the food vendors [6,7]. Since pastries are consumed on the go, it is obviously a favourite for both students and staff of most universities. The University of Uyo for instance, operates many campuses within Akwa Ibom State and with a student and staff population of approximately 18,724 and 1,406 respectively it is expected that a high patronage and consumption of these snacks would be recorded, especially during business hours.

The major problem associated with pastry is the frequent incidence of contamination [2,8]. Due to their composition and methods of preparation involving extensive handling, they are usually prone to contamination from water, air, storage, distribution facilities and human activities (food handlers and vendors). Like other processed foods, pastries are subject to physical, chemical

and microbial spoilage by organisms such as *Escherichia coli*, *Salmonella* sp., *Clostridium* sp., *Staphylococcus aureus*, *Listeria* sp., *Bacillus* sp. and moulds of several genera such as *hizopus*, *Aspergillus* and *Penicillium* [4,9,10]. Contamination with fungi of the genera *Mucor*, *Eurotium*, *Aspergillus*, *Monilla*, *Fusarium* and *Rhizopus* have been linked to the short term shelf life of many pastries [11].

The implications of consuming contaminated pastry is the risk associated with ingestion of microbial cells, toxins and mycotoxins produced by microorganisms present in the food. Food borne illness is a major international health problem with attendant economic nosedive [12]. Data on issues of food borne diseases are documented worldwide [13].

These diseases can be checked or prevented if proper personal hygiene such as maintaining clean processing environment/equipment as well as wearing clean apron/apparel and hand gloves at point of sales is adopted. This research was therefore aimed at evaluating the microbiological quality and the proximate composition of pastries sold within the University of Uyo campuses, with a view to: Enumerating the microbial isolates from the pastry samples, characterizing and identifying the isolates as well as determining the proximate composition of these pastries in relation to their nutritional benefits.

2. MATERIALS AND METHODS

2.1 Source of Samples

Different pastry samples were collected from three (3) campuses of the University of Uyo namely; Main campus along Nwaniba road, Annex campus along Ikot Ekpene road and Town campus along Ikpa road all within Uyo metropolis, Akwa Ibom State.

2.2 Sample Collection

Four (4) samples each of fresh doughnut, buns, cake and chin-chin (a small Nigerian cookie-like snack made from fried wheat flour dough containing eggs, sugar and sometimes milk) were purchased from different vendors at each campus. All the samples were aseptically collected separately into sterile polyethylene bags with proper labelling. A total of forty eight (48) samples were collected from the three (3)

different campuses. Microbiological analysis was carried out in the Department of Microbiology laboratory while the proximate food analysis was carried out at Food Science and Technology laboratory both in the University of Uyo, Uyo, Akwa Ibom State, Nigeria.

2.3 Sample Analysis

For microbiological analysis, samples of each type of pastry were bulked and homogenized. Ten (10) g portion of each homogenate was weighed and transferred into 90 ml of sterile water blank. This was mixed vigorously and 10 ml of the suspension was transferred into another dilution blank and serially diluted.

One (1) ml aliquot (10^{-4} and 10^{-5}) was plated in triplicates using pour plate technique on Nutrient agar for total aerobic bacterial counts (TABC), MacConkey agar for total coliform counts (TCC), Salmonella-Shigella agar for *Salmonella* and *Shigella* counts (SSC) and Sabouraud Dextrose agar for total fungal counts (TFC). A four-way streak on Eosine methylene blue agar plate from the 10^1 dilution was also carried out for *E. coli* detection. The bacterial plates were incubated at $37\pm 2^\circ\text{C}$ for 18-24 hours while fungi plates were incubated at room temperature ($28\pm 2^\circ\text{C}$) for 72-120 hours and observed for growth.

The proximate composition was determined according to the methods described by [14]. This included determination of crude protein (total nitrogen), crude fibre, crude lipid, moisture, ash, nitrogen-free extract and carbohydrate content. The moisture content was determined by heating 2.0 g of each pastry sample to a constant weight at 105°C in an oven. For crude protein (% total nitrogen $\times 6.25$), this was performed by Kjeldahl methods using 2.0 g of each samples. The ash content was determined by incinerating 1.5 g of each sample at 550°C for 5 to 8 hours. The crude fibre was determined by digesting 2.0 g of each sample with H_2SO_4 and NaOH and subsequently incinerating at 550°C in a muffled furnace for 5 h. Crude lipid was obtained by exhaustively extracting 10 g of each sample in Soxhlet apparatus using N-hexane as the extractant. Percentage carbohydrate was estimated using the mathematical expression: $100 - (\% \text{ moisture, ash, fibre, lipid, protein})$.

2.4 Enumeration and Identification of Isolates

The isolates were enumerated and purified by subculturing. Characterization was based on

colonial morphology, cultural characteristics, staining and biochemical reactions. The bacterial isolates were identified using Bergey's Manual of Determinative Bacteriology [15] while the fungal isolates were characterized based on their colonial and cellular morphology and identified as described by [16].

3. RESULTS AND DISCUSSION

Although coliforms were not detected in the study, the microbiological status of the pastry samples based on mean total aerobic plate count revealed that all samples were contaminated (Fig. 1). Specifically, buns (4.7×10^4) and doughnut (2.5×10^4) had higher levels of contamination when compared with other samples. This is particularly unsatisfactory as contained in the Public health laboratory standard [17,18,19] of the Advisory committee for food and dairy (ACFD) products which stipulates 10^3 to less than 10^4 cfu/g for aerobic plate count. Similarly, buns had the highest fungal load (Fig. 2) with mean count ranging from 2.5×10^3 to 4.7×10^4 cfu/g in the three campuses under investigation. Notwithstanding, the highest level of microbial contamination was observed in annex campus. The trend observed in this study corroborates earlier works [6,7] and may in part be attributed to the high human and vehicular movement in these campuses. On the other hand, the comparatively high microbial loads in buns and doughnut may be due to the proximate composition (moisture content) of these samples as well as other ingredient used in their preparation. Studies [4,8,20] have indicated that these ingredients serve as media for the growth and proliferation of microorganisms in food. However, high temperature involved in cake preparation, may have accounted for the relatively low microbial load in this product. The organisms isolated from this study confirms the findings of previous researchers [21,22] and they included *Bacillus* sp., *Staphylococcus aureus*, *Salmonella* sp., *Shigella* sp., *Aspergillus* sp., *Fusarium* sp. and *Rhizopus* sp (Table 1). *S. aureus* was predominant in all the samples. These organisms have been implicated with serious foodborne illness/diseases and are also known to cause food spoilage. *S. aureus* which is a normal flora of the human skin produces a heat stable enterotoxin in food [23] and upon ingestion of such contaminated food presents symptoms ranging from abdominal cramps, nausea, vomiting, prostration to diarrhoea and subsequent dehydration. Despite the heat treatment employed during preparation of

pastries, the presence of pathogens is evidently a consequence of post-treatment contamination as their preparation involves extensive handling. In addition, exposure of prepared pastries to surrounding air as well as packaging materials

[24,25] are possible sources of microbial contamination. This underscores the need to implement and enforce safety guidelines for pastries in Nigeria.

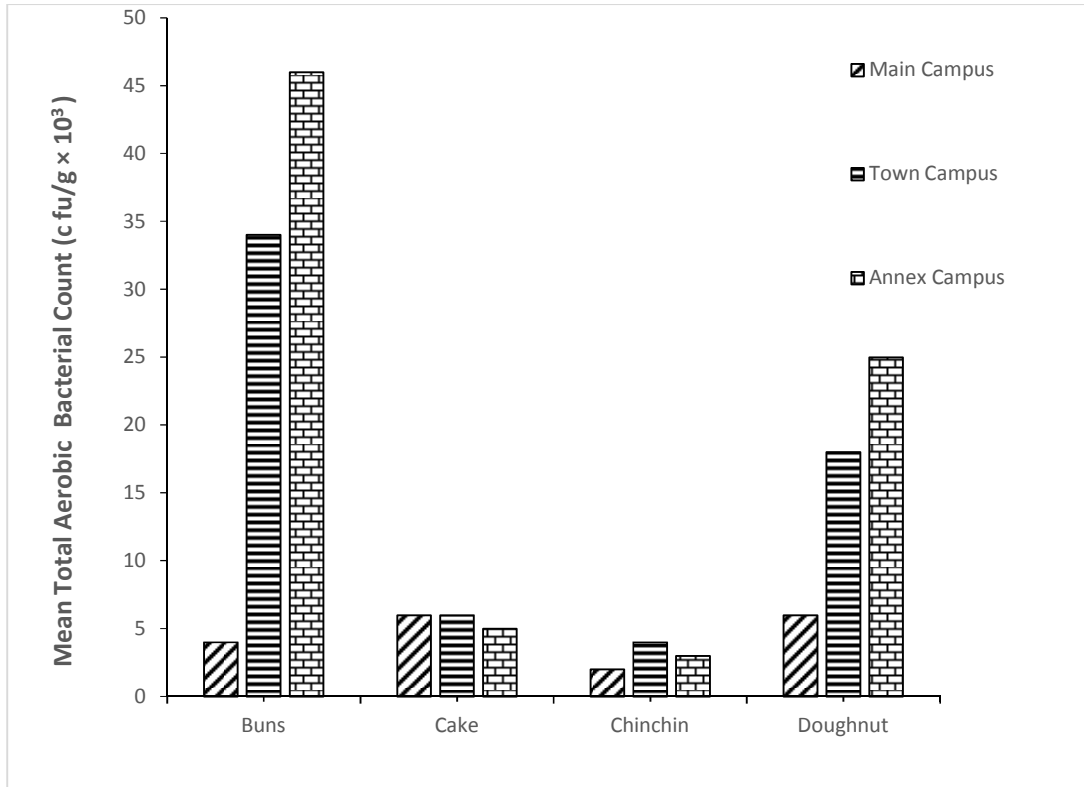


Fig. 1. Mean total aerobic bacterial count (cfu/g) of pastry samples

Table 1. Distribution of bacterial isolates in pastries

Bacterial isolates	Source of samples											
	Main campus				Town campus				Annex campus			
	Cake	Chin chin	Buns	Doughnut	Cake	Chin chin	Buns	Doughnut	Cake	Chin chin	Buns	Doughnut
<i>S. aureus</i>	+	+	+	+	+	+	+	+	+	+	+	+
<i>Bacillus</i> sp.	-	-	+	+	+	+	-	+	-	+	-	+
<i>Salmonella</i> sp.	+	-	+	+	-	+	+	+	-	+	-	+
<i>Shigella</i> sp.	-	-	+	-	-	-	+	+	-	+	-	-
<i>Aspergillus niger</i>	-	-	+	-	-	+	-	+	-	-	+	+
<i>Rhizopus</i> sp.	-	-	+	+	-	-	+	+	+	-	+	+
<i>Fusarium</i> sp.	-	-	+	+	-	-	+	+	-	-	+	+

Key: + indicates presence; - indicates absence

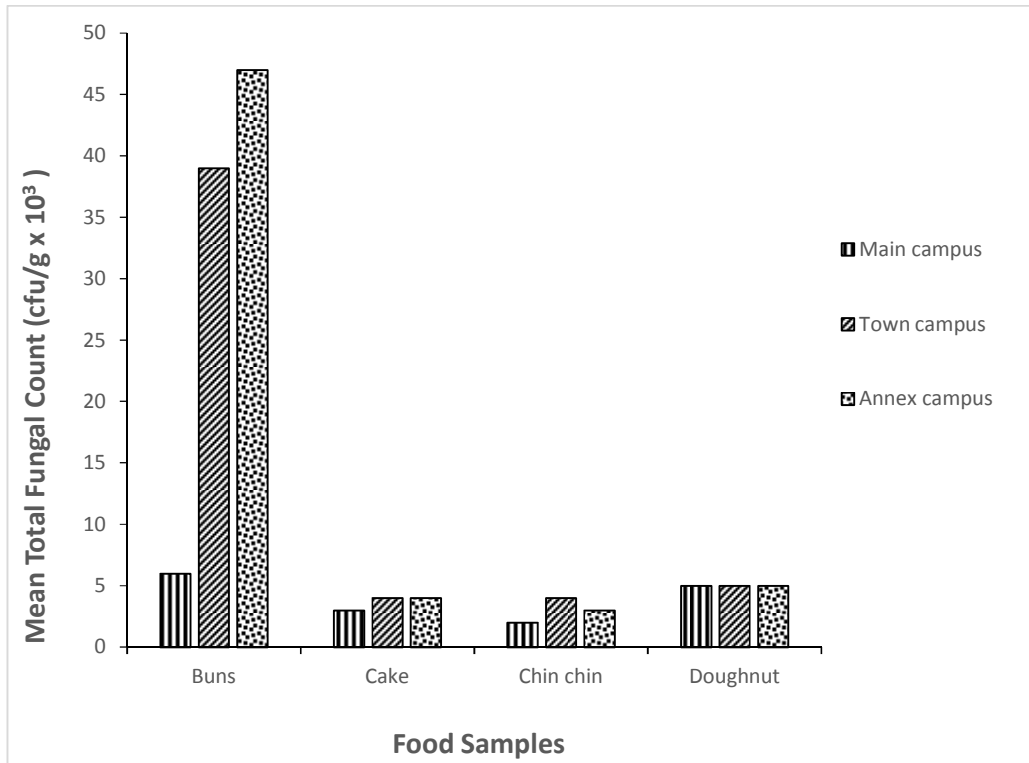


Fig. 2. Mean total fungal count (cfu/g) of pastry samples

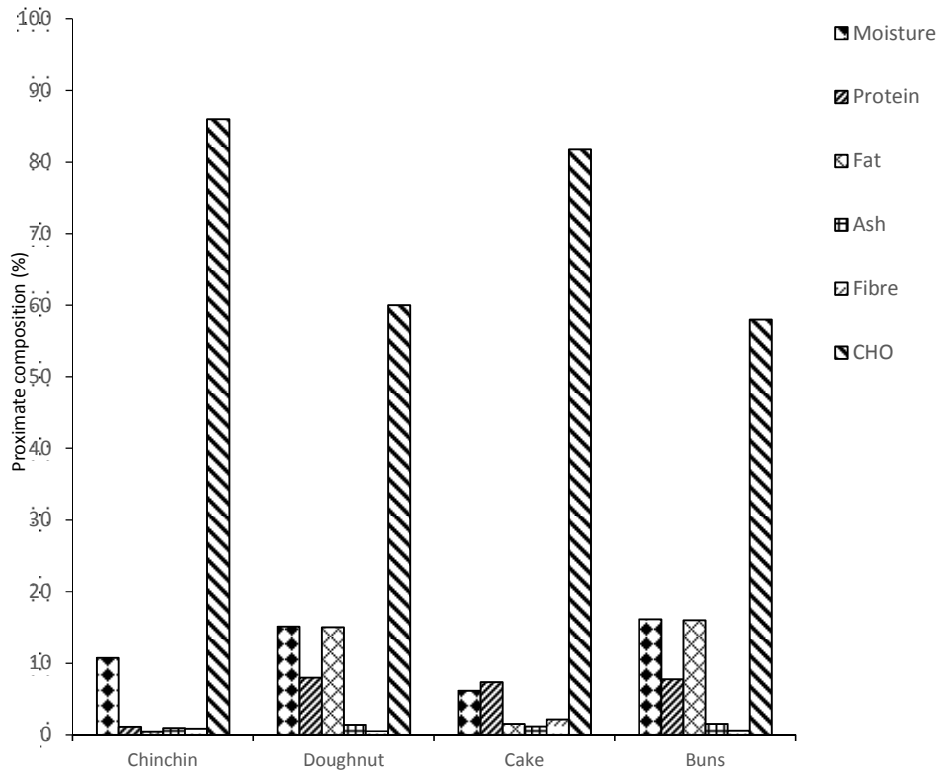


Fig. 3. Proximate composition of pastries

4. CONCLUSION

Based on the public health laboratory standard of the Advisory committee for food and dairy (ACFD) products guidelines, the microbiological status of some of the pastry samples under evaluation were within acceptable statutory limits (10^3 to less than 10^4 cfu/g for aerobic plate count). There is however the need to ensure inspection and maintenance of standard (good manufacturing practices) in order to reduce the risk and/or outbreak of foodborne infections/illnesses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Amadi JE, Onyejekwe PC, Ozokonkwo CO, Adebola O. Isolation and identification of molds associated with four selected snacks sold in Nnamdi Azikiwe University, Awka, and its environs. *Applied Science Reports*. 2014;7(1):32-35.
2. James AS. The role of breakfast in the treatment of obesity: A randomized clinical trial. *American Journal of Clinical Nutrition*. 2005;55:645-651.
3. Miller AA, Ramsden F. Contamination of meat pies by *Salmonella* in relation to baking and handling procedures. *Journal of Applied Bacteriology*. 1995;18:555-580.
4. Odu NN, Akano U. The microbiological assessment of ready-to-eat food (Shawarma) in Port Harcourt Cities, Nigeria. *Nature and Science*. 2012;10(8)1-8.
5. Nielsen AC. Consumers and ready-to-eat meals: A Global AC Nielsen Report. AC Nielsen Inc., USA; 2006. Available:<http://dk.Nielsen.com/reports/Global RTE Report December2006.pdf>
6. Mensah P, Armar-Klemensu A, Hammond S, Haruna A, Nyarko R. Bacterial contaminants in lettuce, tomatoes, beef and goat meat from metropolitan Accra, Ghana. *Medical Journal*. 2001;35:1-6.
7. Opeolu BO, Adebayo K, Okunye PA, Badru FA. Physicochemical and microbial assessment of roadside food and water samples in Lagos environs. *Journal of Applied Science Environment*. 2010;14: 29-34.
8. Oranusi S, Omagbemi F, Eni AO. Microbiological safety evaluation of snacks sold in food shops in Ota, Ogun State, Nigeria. *Research Journal of Biological Sciences*. 2011;6(7):309-313.
9. Smith JP, Daifas DP, El-Khry W, Koukoutsis J, El-Khry A. Shelf life and safety concerns of bakery products-a review. *Crit. Rev. Food Sci. Nutr*. 2004;44: 19-55.
10. Annan-Prah A, Amewowor DH, Osei-Kofi J, Amoono JE, Akorli E, Saka SY, Ndadi HA. Street foods: Handling, hygiene and client expectations in a world heritage site town. Cape Coast, Ghana. *Africa Journal of Microbiology Research*. 2011;5(13): 1629-164.
11. Coda R, Cassone A, Rizzello CG, Nionelli L, Cardinali G, Gobetti M. Antifungal activity of *Wickerhamomyces anomalus* and *Lactobacillus plantarum* during sour dough fermentation: Identification of novel compound and long term effect during storage of Wheat Bread. *Industrial and Applied Environmental Microbiology*. 2011; 77(10):3484-3492.
12. Duff SB, Scott EZ, Mastilios MS, Todd EC, Krilov LR, Eddes AM, Acknerman SJ. Cost effectiveness of a target disinfection program in household kitchens to prevent food-borne illness in the United States, Canada and the United Kingdom. *Journal of Food Microbiology*. 2003;66(11):2103-15.
13. Hazariwala A, Sanders Q, Hudson CR, Hofacre C, Thayer SG, Mauer J. Distribution of staphylococci enterotoxin genes among *Staphylococcus aureus* isolates from poultry and humans with invasive staphylococcal disease. *Avian Diseases*. 2002;46(1):132-136.
14. AOAC. Association of official analytical chemist. Official method of analysis. 15th edition, Washington D.C. USA; 1990.
15. Holt JG, Kieg NR, Sneath PH, Stanley JT, Williams ST. Bergeys manual of determinative bacteriology, 9th edition. The Williams and Wilkins Company, Baltimore, USA; 1994.
16. Cooper BH. Taxonomy, classification and nomenclature of fungi. *Manual of clinical microbiology*. American Society for Microbiology, Washington D.C. 1995;4:10-12.
17. Public health laboratory services. Provisional microbiological guidelines for some ready- to-eat foods sampled at point

- of sales. Notes for PHLS food examiner. PHLS Microbiology Digest. 1992;9:98-99.
18. Public health laboratory service standing advisory committee on laboratory safety. Safety precautions: Notes for guidance. Public Health Laboratory Services (PHLS). London; 1993.
 19. Public health laboratory services. Microbiological guidelines for some ready-to-eat foods sampled at the point of sale: An expert opinion from the PHLS. PHLS Microbiology Digest. 1996;13:41-43.
 20. Phillips M. Analysis of microbial hazards related to time/temperature control of foods for safety. *Compre. Rev. Food Sci. Food Saf.* 2003;2:33-35.
 21. Clarence SY, Obinna CN, Shalom NC. Assessment of bacteriological quality of ready-to-eat (meat pie) in Benin city metropolis, Nigeria. *African Journal of Microbiology Research.* 2009;3(6):390-395.
 22. Oranusi S, Braide WA. Study of microbial safety of ready-to-eat foods vended on high ways, Onitsha-Owerri, South-East Nigeria. *International Research Journal of Microbiology.* 2012;3(2):66-71.
 23. Prescott LM, Harley JP, Klein DA. *Pathogenic organisms. Microbiology*, 7th edition. McGraw Hill, New York. 2008;340.
 24. Aboloma RI. Microbiological analysis of bread samples from bakery to sale points in Ado-Ekiti, Ekiti State, Nigeria. *Biol. Environ. Sci. J. Tropics.* 2008;5:77-81.
 25. Kawo AH, Abdulmumin FN. Microbiological quality of repackaged sweets sold in metropolitan Kano, Nigeria. *Bayero Journal of Pure and Applied Science.* 2009;2:154-159.

© 2016 Ndubuisi-Nnaji and Ofon; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://sciencedomain.org/review-history/15898>