ASSESSMENT OF MICROBIAL STATUS OF COOKED PORK SOLD IN KASIT INTERNATIONAL PIG MARKET, KADUNA STATE, NIGERIA.

Gandi B.R., Joseph S., Makama R.S. and Alphonsus C.
Department of Animal Science, Faculty of Agriculture, Kaduna State University.
Corresponding author: gandibala1@gmail.com

Abstract
This study analysed the quality and microbial load of cooked pork sold in Kasit International Pig Market, Zangon-Kataf Local Government Area Kaduna State. A total of 24 cooked pork samples were randomly collected from 8 pork vendors around the market and analysed for their microbial status. Analysis carried out on each sample includes; Total Aerobic Plate Count for mesophilic bacteria, Coliform Bacteria Count, Fungal Count and selective plating of identified colonies to confirm the organisms. The results from this study shows that the mean microbial load (Total Aerobic Plate Count) on the cooked pork ranged between 44333.3 - 53000.0 cfu/g and Total Coliform Count between 0.0000 -2366.7cfu/g. The bacteria isolated includes: *Staphylococcus spp* (27.58%) which was predominant followed by *Bacillus spp* (24.16%), *Eschericha coli* (20.69 %), *Klebsiella spp* (10.34 %), *Salmonella spp* (10.34%) and *Streptococci spp* (6.89%). Fungi isolated includes: *Aspergillus flavus* (62.50 %), *Fusarium spp* (12.50 %), *Aspergillus niger* (12.50%) and *Penicillum* (12.50 %). From the results of this study, it can be concluded that cooked pork samples obtained from the market were all contaminated with microorganisms. However, the microbial load was found to be within satisfactory limit.

Key words: Microbial Status, Pork, Kasit Pig market.

Introduction
Pork is meat obtained from Pig. It is a major and excellent source of protein and fats, and also an important source of vitamins for most people in many parts of the world (Yannick *et al*, 2013). Pork contains quantities of essential amino acids in forms of protein, it contains B group vitamins especially niacin and riboflavin, iron, phosphorus ash and calcium.
FAO (1990) recommended that the average of 55 g animal protein is required per day for healthy living in developing countries. In developing world, food borne infection has accounted for many deaths in children, and the reoccurring cases of diarrhoea disease linked to poor food handling have long-term effects on children's growth as well as on their physical and cognitive development (Adak *et al.*, 2005).
Food borne diseases are diseases resulting from ingestion of bacteria, toxins or cells produced by microorganisms present in food. Pork is the most perishable of all important foods since it contains sufficient nutrient needed to support the growth of microorganisms (Magnus, 1995). In most cases, during slaughter, dressing and cutting, microorganisms come chiefly from the exterior of the animal and its intestinal tract but more comes from knives, cloths, air, and equipment in general (Adak *et al.*, 2005). Retail cut could also result in greater microbial load because of the large amount of exposed surface area, more readily available water, nutrient and greater oxygen penetration available (Forest *et. al*., 1996).
Food borne microbial hazards may be responsible for many cases of illness as possible each year and are thus an important food safety challenge (Yannick *et al*, 2013). It has been reported that Gram negative bacteria account for approximately 69% of the cases of bacterial food borne disease (Clarence *et al.*, 2009). There is need for more information as to the level of microbial contamination in ready to eat pork retailed in Kasit International Pig Market of Kaduna State.

The objective of this study was to assess the microbial load and also to identify the types of fungi and bacteria associated with cooked pork sold in Kasit International Pig Market of Kaduna State.

Materials and Method

Description of the research area:

The study area is the International Pig market of Kasit popularly known as Tunga. Kasit Pig market is one of the biggest in Nigeria and located in Zangon-Kataf Local Government Area of Kaduna State.

Sample collection:

Twenty four (24) samples of ready to eat pork were randomly purchased from 8 different vendors in the market. The samples were aseptically collected in clean polyethylene bags and transferred immediately to the laboratory for analysis.

Sample preparation:

Ten grams (10g) obtained from each sample were homogenized vigorously for 5 minutes in sterile 0.1% peptone water using a sterile food blender. Serial dilutions of homogenates were made (to 10^{-3}), 0.5 ml of each set was pipetted onto the surfaces of two plates; Mac Conkey for Coliforms and Nutrient agar for Total viable count and immediately spread out with a sterile glass spreader i.e. using a standard pour plate technique, according to the procedure of ISO, (2001). The Total viable count was calculated from the average colony count/plate after incubation.

Microbial load guide in animal food product, according to Wilson et al., (1991) is shown in table 1.

Table 1: Standard Microbial Load Specification on Animal Food Product.

Grades	Total Viable Count/g at 30°C	Description
1	<½million	Satisfactory
2	½millionto<10million	Passable
3	10million and more	Unsatisfactory

Source: Wilson *et al*., (1991).

Statistical Analysis:

Data obtained were subjected to Analysis of Variance (ANOVA), and significant means were separated using the Least Significant Difference test. Statistix 9.0 statistical package was used for all statistical analysis

Results and Discussion:

The Total Plate Count and Coliform Count for Bacteria are shown in Table 2 below. The Total Aerobic Plate count ranges from 44333.3 to 53000.0 Cfu/g with cooked pork from retail point one (T1) having the highest value while T8 has the lowest. T 2 and 6 were statistically similar, while T 4, 5 and 7 were also statistically similar. Total Plate count for mesophilic aerobic bacteria of all cooked pork samples were within satisfactory limit with reference to standard microbial load specification (Wilson *et al.,* 1991). The presence of these aerobic bacteria can be linked to their ability to survive in the presence of oxygen. All samples were displayed in an open air environment hence the possible source of contamination. This report agrees with the findings of Yannick *et al.*, (2013) on ready to eat Suya. The results obtained in this experiment are equally comparable to report by Venia *et al*., (2006) for dehydrated pork stored for 2 days post production. However, Ekanem (2000), reported lower values on street vended meat product. The higher values could be because the meat samples were exposed for longer periods in Ekanem's (2000) study as compared to this study. Generally, possible sources of these Micro-organisms in the pork could be inherent micro-flora in normal tissues of animals, air, environment, or contamination due to unhygienic slaughtering, handling and processing conditions as suggested by Zattola, (1982). Although the Bacteria count recorded are within the acceptable limit, there is need to further reduce the number. The number could be further reduced by raising the number of Lactic Acid Bacteria (LAB) which are not as destructive as the non-acid-tolerant species of Micro-organism (Apata and Akinfemi, 2010).

The Coliform unit ranged from 1533.3 to 2366.7 Cfu/g with the highest value from retail point one (T1) while lowest count was observed in T3. Samples from T 1, 4 and 5 were statistically the same, so as T 2

and 8. Coliform count from all pork samples were equally within satisfactory limits (Wilson *et al.,* 1991). Coliform bacteria are non-spore forming rods that occur in large number in human and animal faeces. They are usually present on raw product such as meat, milk, egg and on surfaces of plants. They are heat sensitive and die rapidly during blanching and pasteurizing. Large number of Coliform after a heat process indicates and unacceptable degree of post heating contamination, it could also indicate time – temperature insufficiency in food which permits Coliform growth. Thus, high Coliform levels mean recontamination or temperature mishandling. The number of Coliform count form this study disagrees with the findings of Yannick *et al.,* (2013) who recorded higher values. The Coliform bacteria observed could be due to improper heating since Coliform bacteria are very sensitive to heat. The absence of Coliform bacteria in T 3 could be due to sufficient heating and frying by the vendor.

Table 2**:** Total Aerobic Plate Count and Coliform Count for Bacteria on cooked pork from different retail point in Kasit Market.

Treatment	Aerobic bacteria count Cfu/g	Coliform count Cfu/g
T 1	53000.0^{a}	2366.7^{a}
T 2	45000.0^{bc}	2000.0^{ab}
T 3	51330.3^{ab}	0.0000^{c}
T 4	49333.3^{abc}	2333.3^{a}
T 5	50660.7^{abc}	2066.7^{a}
T 6	45330.3^{bc}	2233.3^{a}
T 7	46333.3^{abc}	1533.3^{b}
T 8	44333.3^{c}	2000.0^{ab}

All values are means from triplicate determinations. Means in the same column with different superscripts are significantly different at $p<0.05$ T=Vendor/Retailer point

The result for Total Fungal Count on ready to eat pork sold in Kasit International Pig Market is shown in Table 3. The mean fungal count ranges from 916.67 to 2100 Cfu/g with values from retail point one (T1) having the highest count while T 8 had the lowest count. Samples from T 2 and T 7 were statistically the same, T 4 and T 8 were also statistically the same. Results from the statistical analysis obtained shows that T 5 and T 6 are similar.

Fungi isolated include *Aspergillus niger*, *Aspergillus flavus, Fusarium sp.* and *Penicillium sp.* Some of the isolated Micro-organisms are directly or indirectly involved in spoilage, although some may have been present as opportunistic contaminants which may not play any role in the spoilage of the meat samples. Taniwaki *et al.,* (2001) reported that fungi are capable of growing at a very low moisture content or low water activity of less than 0.83 $_{aw}$ and can adapt to dry and partially dry food. *Aspergillus spp.* among the fungal isolates has been associated with disease conditions (Talaro, 2009). Results from this study are in agreement with findings of Talaro (2009), revealing that *A. flavus* and *A. niger* are some of the fungal isolates of pork.

Table 3**:** Fungal count for cooked pork from different retail point in Kasit Market

Code	Fungal count Cfu/g
T 1	2100.0^{a}
T 2	1866.7^{ab}
T 3	1233.3^{cd}
T 4	1083.3^{d}
T 5	1766.7^{abc}

T 6	1466.7bcd
T 7	1933.3^{ab}
T 8	916.67^{d}

All values are means from triplicate determinations. Means in the same column with different superscripts are significantly different at $p<0.05$ T=Vendor/Retail point

The graphical representation on the frequencies of fungi isolate are shown in figure 1.The result shows that *A. flavus* was the highest constituting 62.50% while *A. Niger*, *Fusarium spp.* and *Penicellium* spp. had 12.50%, 12.50%, and 12.50 % level of occurrence respectively. The high percentage of *Aspergillus flavus* (62.50%) indicates likely contamination from the environment as reported by Gandi *et al.*, (2015). Results from this study are also in agreement with findings of Talaro, (2009) who reported that *A. flavus* and *A. niger* are some of the fungal isolates of pork.

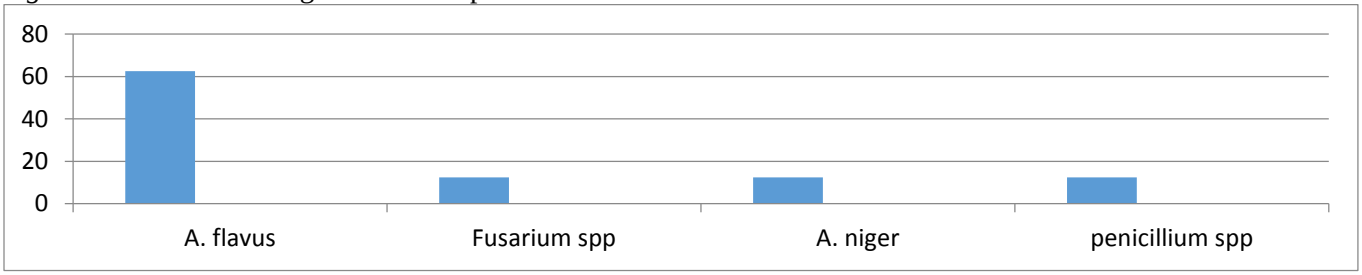

Figure 1**: G**raphical representation of fungal distribution in percentage from pork sold in Katsit Market.

The distribution of microbial isolates are shown in Figure 2. The result shows that the samples were found to be contaminated with varying degree of bacteria. *Staphylococcus spp* form 27.58 % while *Bacillus spp.* had 24.13 %, *Escherichia coli* accounted for 20.69 %, *Klebsiella* and *salmonella* spp. had 10.34% and 9.21 %, respectively. *Streptococci spp.* had the lowest frequency (8.57 %). The presence of these organisms could possibly be due to poor hygiene during processing or faecal contamination. These isolate were equally identified in reports by Gandi *et al.*, (2015) and Clearance *et al.*, (2009) on processed meat. These organisms when present in high amount can cause serious health challenge to individual. Therefore effort should be made to reduce their number.

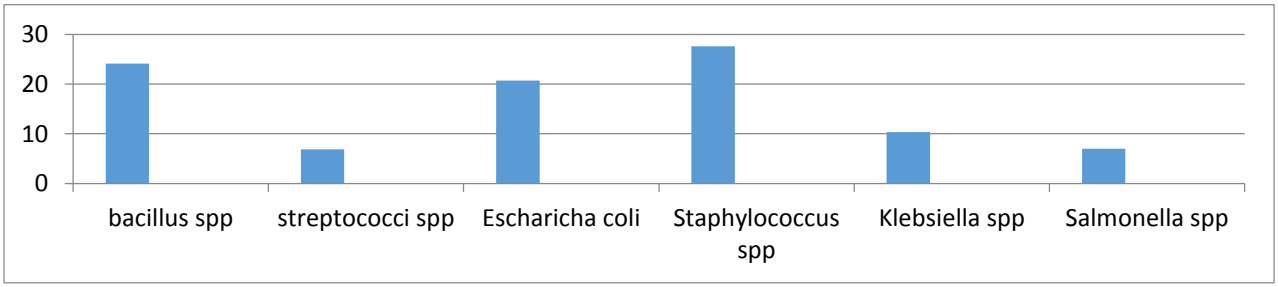

Figure 2: Graphical representation of microbial distribution from pork sold in Katsit Market.

Conclusion:
Ready to eat pork sold in Kasit International Market of Kaduna State were all contaminated with disease causing micro-organisms. However, the levels of contamination were within acceptable limits posing no real threat to consumers' health.

Recommendations
Although all samples were found to contain microorganism within the acceptable limit for consumption, cases of diarrhoea and food poisoning are still recorded. Thus, the need to maintain good hygiene during processing and also ensure adequate time – temperature ratio during cooking.

References

Adak, G.K, Meakins, S.M., Yip, H., Lopman, B.A. and O'Brien, S.J. (2005). Disease risks from foods, England and Wales, 1996-2000. Emerging Infectious Diseases, 2005 March (cited 2009 August 18). Available from http://www.cdc.gov/ncidod/EID/vol11no03/04- 0191.htm

Apata, E.S., Kuku, I.A., Apata, O.C. and Adeyemi, K.O. (2012). Evaluation of suya, an Intermediate Moisture Meat Product in Ogun State, *Nigeria. Journal of Food Research.* 2 (1): 87-91

Clarence, S.Y., Obinna, C.N. and Shalom, N.C. (2009). Assessment of bacteriological quality of ready to eat food (Meat pie) in Benin City metropolis, Nigeria. *Afr. J. Microb. Res.* 3(6):390-395

Ekanem, E.O. (2000). Application of Hazard Analysis Critical Point System to Quality Evaluation of Some Street Meat Products in Nigeria. *Asian-Austrailian Journal of Animal Science.* 13:325-327.

FAO, (1990). Manual on simple methods of meat preservation. FAO animal production and health paper 79. http://www.fao.org.

Forest, D.C., Harold, D.A., Judge, B.A. and Robert, E.A. (1996). Different Types of Meat and Meat product consumed by Nigerian. Principle of meat science. Pub. WA. Freeman and Co. pop. pp. 4 - 178.

Gandi, B.R., Olusola, O.O. and Bawa, G.S. (2015). Quality characteristics and Microbial Status of Beef smoked using different plant materials. *Nigerian Journal of Animal Science* 16 (2): 157-160

Magnus, P. (1995). Meat Composition; Food Science and Technology, 4th edition. Gohumunary Pub. London. pp. 108-215.

Yannick, N., Niba, R. and Akwah, E. (2013).Assessment of bacteriological quality of cooked pork meat sold along the commercial streets of Nkwen through Bambili Metropolis, Cameroon. *African Journal of Food Science* Vol. 7(12), pp. 441-445, December 2013.

Talaro, K.P. (2009). Foundations in Microbiology, seventh edition. The McGraw-Hill Companies Inc.

Taniwaki, M. H., Hocking, A. D., Pitt, J. I. and Fleet, G. H. (2001) Growth of fungi and mycotoxin production of cheese under modified atmospheres. *International Journal of Food Microbiology 68:125–133.*

Venia, F., Joana, B., Sandra, V., Ana, M., Fatima, S., Maria, J.M., Tim, H., Paul, G. and Paula, T. (2006). Chemical and Microbiological Characterisation of Alheria; A typical Portuguese fermented sausage with particular reference to factor relating to food safety. *Meat Science Journal. 73(4): 570-575.*

Wilson, D. and Sperber, D. (1991) On Grice‟s theory of conversation. In P. Werth (ed.) Conversation and Discourse. London: Croom Helm. 155-78. Reprinted in Kasher. 1(5):347-68.

Zattola, E.A. (1982). Introduction to meat Microbiology, American Meat Institute, Chicago, USA. 245-253