MICROBIOLOGICAL EVALUATION OF ROASTED CHICKEN SOLD IN KEFFI METROPOLIS

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Abstract: Microbial evaluation of roasted chicken sold in Keffi metropolis was investigated. Samples of the roasted chickens were collected in triplicates from seven different sales locations for an assessment of their microbiological qualities. Spread plate technique was employed for the isolation of the microorganisms following serial dilution of the samples. The hands of the vendors preparing and selling the roasted chickens were also swabbed for isolation of microorganisms. The microbial load on the roasted chicken examined ranged from 1.3 x 10^5 to 3.7 x 10^5 cfu/g, whereas the microbial load on the sellers' hands were in the range of 3.4 x 10^5 to 7.4 x 10^5 cfu/ml. *Escherichia coli, Staphylococcus* spp, *Klebsiella* spp, *Salmonella* spp, *Shigella* spp and *Aspergillus fumigatus* were the microbial species isolated from both the roasted chickens and the sellers' hands, respectively. The counts of *A. fumigatus* were lowest while those of Staphylococcus spp were highest in both the roasted chicken and the sellers' hands respectively. However, with respect to occurrence in the different locations studied, Staphylococcus spp had the highest percentage occurrence of 85%, followed by *A. fumigatus* which had 71%, while E. coli and Salmonella spp had the least (43%) respectively. The results generally revealed that sellers' hands had higher microbial counts than the roasted chickens. The findings of this investigation are of immense public health significance especially to the consumers of roasted chickens in the Keffi metropolis. The presence of pathogens and E. coli, an indicator of feacal contamination, can render food unsafe for human consumption. Thus, the roasted chickens sold in Keffi potent a health risk to its consumers.

Keywords: Microbial load, roasted chickens, sellers' hands, Keffi

INTRODUCTION

Chicken meat, simply called 'chicken' is a type of poultry meat consumed by humans, due to its relatively low cost, chicken is one of the most widely consumed meat in the world. Nearly all parts of the bird can be used for food, and the meat can be prepared for consumption in much different ways in different communities which is popularly prepared either as roasted chicken or fried chicken or chicken pepper soup (Smith, 2007).

Roasted chicken is a popular meat product in West Africa which is prepared with fresh chicken that is garnished with hot spices and then roasted over fire.

Roasted chicken is a delicacy in most parts of Nigeria. Chickens raised specifically for meat are called broilers which are typically purchased at a very young age and then nurtured to maturity, and subsequently butchered after 8 – 12 weeks (Jango-Cohen, 2005).

Roasted chickens as sources of food are frequently involved in food illnesses

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because they provide an ideal medium for the growth of disease-causing microorganisms. Mckane and Kandel (1996) assert that the high rate of roasted chicken consumption could be responsible for the periodic outbreak of diarrhea and other gastroenteritis amongst the roasted chicken consumers.

Roasted chickens can be contaminated by microorganisms from many different sources, especially from the ingredients used and also from exposure to dust-laden air. Hinton *et al.* (2004) reported that during processing there may be a ten fold increase in the microbial counts of the skin of chicken carcasses. Some of these increases are due to contaminated scald water (hot water or steams used in the removal of feathers and hairs from the carcasses of chickens) and direct contamination from human handlers. The equipment used in processing the chicken also play a role in contaminating the carcasses (Hinton *et al*,. 2004). At every stage of the processing operation there is an ample opportunity for microbial contamination (Bibek, 2001).The quality of a roasted chicken is greatly influenced by the quality of the ingredients used (Hinton *et al.*, 2004). Although ingredients do constitute a small part of the total roasted chicken, they however add substantial numbers of microorganisms.

Chicken processing equipment such as knives, cutting boards and bins are major sources of contamination of the roasted chickens (Alcamo, 1994). The equipment used may be cleaned and sanitized, but usually not sterilized, and the potential for microbial build-up on the equipment is enhanced if food residues are visible on equipment (Rodes *et al.*, 2001).

Contamination could result from humans handling foods after using the lavatory without properly washing their hands, touching the raw and roasted meat and also during preparation of vegetables and spices, especially when hands are not properly washed. The handler's cloths or aprons are also a source of contamination especially when handlers use them to wipe their hands between tasks (Patel *et al.*, 2002).

Microorganisms may also come from the water used in washing hands by the chicken sellers during processing and after roasting and these may include spoilage, Coliforms and pathogenic species (Bibek, 2001). This investigation was aimed at determining the species of microorganisms associated with roasted chickens sold in Keffi metropolis.

MATERIALS AND METHODS

STUDY AREA

The study was carried out in Keffi, a fast growing cosmopolitan town, Nasarawa State, North Central Nigeria. The town is about 68 km away from Abuja (the Federal Capital Territory) and 128km from Lafia (the state capital of Nasarawa State). Keffi is located on latitude 8°5′ North and longitude 7° 5′ East, and situated on an altitude of 850m above sea level (Akwa *et al.*, 2007).

SAMPLE COLLECTION

Samples were aseptically collected in triplicates from each of the seven different locations within the Keffi town. The samples were collected in a sterile aluminum foil and immediately transported to the laboratory in an pack cooler within 15 minutes for analysis. The hands of human handlers before and after roasting the chickens as well as the knives, containers, and the water used for washing carcasses were swabbed in triplicates using swab sticks prior to usage and these were immediately transported to the laboratory where to be analyzed microbiologically.

ISOLATION AND IDENTIFICATION OF BACTERIA ISOLATED FROM SAMPLES

Standard aerobic plate count using spread plate methods as recommended by (Sanders, 2012) were used for the determination of aerobic microbial count. A five-fold serial dilution of each sample was made and plated out on Aerobic Plate Agar using spread plate technique. The plates were incubated at 35°C for 24 h. The

average microbial loads from the roasted chicken samples were expressed in Colony Forming Unit per gram (cfu/g) while samples from the chicken sellers hands obtained from the different locations were expressed as Colony Forming Units per milliliter (CFU/ml) of the diluents (Distilled water) used.

The media used for isolation and cultural characterization of the isolates were Nutrient Agar, Salmonella-Shigella Agar, Mannitol Salt Agar, MacConkey Agar and Potato Dextrose Agar. Plates were incubated at 35°C°C for 24hrs for the isolation of bacteria. However the Potato Dextrose Agar was incubated at 30°C for 4days (96 hours) for the isolation of fungi (Nester *et al.*, 2007). The isolates were further characterized morphologically and biochemically using standard methods (Holt, 1994; Cheesbrough, 2006).

STATISTICAL ANALYSIS

Proportions using percentages, computation of averages and standard deviations of microbial counts as well as correlation analysis were carried out using statistical package for social sciences (SPSS) software [version 20.0] (SPSS, 2012).

RESULTS

Table 1 shows the Total Aerobic Microbial Counts (cfu/g) from Roasted chickens and hands of sellers at the different locations of Keffi metropolis. The microbial counts from roasted chickens ranged from 2.2×10^5 to 3.7×10^5 cfu/g, while the counts from the sellers hands' ranged from 3.4×10^5 to 7.4×10^5. Table 2 shows the bacterial and fungal species isolated from the roasted chickens and hands of sellers with their respective microbial counts. The bacterial species isolated were *Salmonella, E. coli, Shigella, Klebsiella* and *Staphylococcus,* while the only fungal species isolated was *Aspergillus fumigatus.* Table 3 shows the frequencies of occurrence (percentage) of microbial isolates from roasted chickens' *vis-à-vis* locations. They were *Salmonella* spp (23%), *E. coli* (42.9%), *Shigella* spp. (57.1%), *Klebsiella* spp (57.1%), *Staphylococcus* spp. (85.7%) and *Aspergillus fumigatus* (71.4%).

Table 1: Total aerobic microbial counts (cfu/g) from roasted chickens and sellers' hands from the different locations

Location	Microbial Counts	
	Roasted Chickens (cfu/g)	Sellers Hands (cfu/ml)
GRA	$3.7 \times 10^5 \pm 0.21$	$5.2 \times 10^5 \pm 2.60$
NKH	$2.4 \times 10^5 \pm 1.01$	$3.4 \times 10^5 \pm 1.20$
AKD	$3.2 \times 10^5 \pm 0.32$	$5.3 \times 10^5 \pm 2.00$
AKW	$1.3 \times 10^5 \pm 0.10$	$3.4 \times 10^5 \pm 0.11$
EP	$2.2 \times 10^5 \pm 0.22$	$4.3 \times 10^5 \pm 0.22$
YA	$2.6 \times 10^5 \pm 0.21$	$6.6 \times 10^5 \pm 3.33$
RA	$2.8 \times 10^5 \pm 0.21$	$7.4 \times 10^5 \pm 7.37$

Keys: GRA - Government Reserved Area; NKH - New Keffi Hotel; AKD - Angwan Kadae, AKW - Angwan Kwara; EP - Emir Palace; YA - Yara; RA - Round About

Table 2: Microbial Counts (cfu/g) of Isolates from Roasted Chickens and Sellers Hands at Different Locations

Isolates	Microbial counts	
	Roasted chickens (cfu/g)	Sellers hands (cfu/ml)
Salmonella spp.	$6.30 \times 10^5 \pm 14.23$	$7.45 \times 10^5 \pm 12.45$
E. coli.	$4.80 \times 10^5 \pm 7.20$	$4.23 \times 10^5 \pm 3.12$
Shigella spp.	$7.53 \times 10^5 \pm 8.70$	$7.22 \times 10^5 \pm 5.12$
Klebsiella spp.	$6.15 \times 10^5 \pm 1.53$	$7.23 \times 10^5 \pm 4.11$
Staphylococcus spp.	$7.90 \times 10^5 \pm 1.53$	$8.34 \times 10^5 \pm 2.12$
Aspergillus fumigatus	$3.24 \times 10^3 \pm 1.53$	$7.90 \times 10^3 \pm 1.12$

Keys: GRA - Government Reserved Area; NKH - New Keffi Hotel; AKD - Angwa Kadae AKW - Angwa Kwara; EP - Emir Palace; YA - Yara; RA - Round About

Table 3: Percentage Frequencies of Microbial Isolates from Roasted Chickens at Various Locations

	Locations							
Isolatess	GRA	NKH	AKD	AKW	EP	YA	RA	Occurrence (%)
Salmonella spp.	-	-	+	-	+	-	-	43
E. coli.	+	-	-	+	+	-	-	43
Shigella spp.	+	+	-	+	-	+	-	57
Klebsiella spp.	-	+	+	-	-	+	+	57
Staphylococcus spp.	+	+	+	+	-	+	+	85
Aspergillus fumigatus	+	-	-	+	+	+	+	71

Keys: GRA - Government Reserved Area; NKH - New Keffi Hotel; AKD - Angwa Kadae AKW - Angwa Kwara; EP - Emir Palace; YA - Yara; RA - Round About

DISCUSSION

The result of this study shows that the hands of the chicken sellers and the roasted chickens had varying levels of microbial contaminants, even though the sellers' hands had higher counts. This suggests that contamination of the roasted chickens is to a large extent due to cross contamination from the sellers' hands either during processing or after roasting. This therefore calls for improvement in the personal hygiene of sellers' of the roasted chickens. There is a positive correlation ($P<0.05$) in the microbial contamination of the sellers hands and the roasted chickens being sold in Keffi metropolis. The presence of *Salmonella*, *E. coli*, *Shigella*, *Klebsiella* and *Staphylococcus* species on roasted chickens sold at Keffi metropolis portents a health danger to the public because several strains of these bacteria are known to be pathogenic to humans (Arora and Arora, 2012). Out of the five species of bacteria isolated, *Staphylococcus* species had the highest total aerobic counts on both the sellers' hands and the roasted chickens, followed by *Salmonella* species. The high counts of *Staphylococcus* is not a surprise because several species of this organism are normal dwellers of the human skin and the nasal region (Williams, 1996). The presence of *Salmonella* on chickens has been reported

by Alice (1994). Some species and several strains such as those of *S. typhi* and *S. paratyphi* are known to cause enteric fever (Herikstad *et al.*, 2002). *Aspergillus fumigatus* is a thermotolerant fungus that withstands relatively high temperatures, and its conidia, like many other fungi, are always present in the air. There were generally low counts of *A. fumigatus* in both the roasted chickens and the hands of sellers. However, these counts were much lower counts on the roasted chickens than on the sellers' hands, and this is partly due to the fact that the hands are actively being moved about for work and partly because the hands are often in contact with water that sheds off the conidia which are deposited on carcasses during washing. Generally, the contamination of roasted chickens must have been as a result of poor hygiene and sanitation by the chicken sellers and even from the environment where these roasted chickens are being sold, because the preparation and the processing of the roasted chickens were being carried out exposed to the air environment. In this situation, microbial contamination from the air becomes an important factor of consideration.

In terms of distribution, *Staphylococcus* species were the most predominant microbial contaminants on roasted chickens sold in Keffi metropolis, and this was followed by *Aspergillus fumigatus*. This should be expected because *Staphylococcus* species are typically associated with human skins including hands, while the conidia of *A. fumigatus* are prevalent in the air and can settle on the roasted chickens which were in direct exposure to the air. The presence of the microorganisms isolated, especially the bacteria, even in small quantities can render food unsafe for human consumption. It is possible that contaminations by these microorganisms could have occurred before, or during, or after roasting, as most of the persons involved in the preparation and sales of roasted chickens in Keffi metropolis do not take necessary precautions to avoid such contaminations as there were higher microbial counts on the hands of the chicken sellers than on the roasted chickens which indicates poor hygiene and poor sanitary practices by the chicken sellers.

CONCLUSION

The relatively high microbial counts on the roasted chickens sold in Keffi and on the hands of sellers, and the presence of *Salmonella* spp, *E. coli*, *Shigella* spp. and *Klebsiella* spp. on the roasted chickens sold in this locality has serious public health implications. There is therefore health risk in eating exposed roasted chickens sold in this locality. The need for improved personal and food hygiene cannot be over-emphasized to overcome the problem of contamination of roasted chickens being sold in the Keffi metropolis. However, in order to safeguard the health of the public, government and regulatory agencies such as National Agency for Food Drugs Administration and Control (NAFDAC) should intervene by setting standards that will help reduce, if not eliminate, the unwholesome practice of preparing and selling roasted chickens exposed completely to air especially by the road side.

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REFERENCES

Akwa, V.L., Binbol, N.L., Samaila., and Marcus, N.D. (2007). *Geographical Perspective of Nasarawa State*. Onaivi Printing and Publishing Company Limited Keffi Nigeria. Pp. 3 – 5.

Alcamo, I.E. (1994). *Foundation of Microbiology*, 4th ed. The Benjamin/

Cumming Publishing Company Inc. Pp. 232 – 234.

Alice, L. S. (1994). *Microbiology and Pathology*, 11th edition. CV Mosby Company. Pp. 202-203.

Arora, D.R. and Arora, B. (2012). *Textbook of Microbiology*, 3rd ed. CBS Publishers, New Delhi. Pp. 771

Bibek R (2001). *Foundational Food Microbiology*, 2nd ed. The CRC press Ltd Washington, DC. Pp. 56-90.

Cheesbrough M (2006). *District Laboratory Practice in Tropical Countries*. Cambridge University Press. Pp. 63-70.

Herikstad, H., Motarjemi, Y. and Tauxe, R.V. (2002). *Salmonella* Surveillance: a Global Survey of Public Health Serotyping. *Journal of Epidemiology, 129*: 1-8.

Hinton, A., J.A Carson and K.D. Lngram (2004). Tracking spoilage bacteria in commercial poultry processing and refrigerated storage of poultry. *International Journal of Food Microbiology, 91*: 155-165.

Holt, J.H. (1994). *Bergey's Manual of Determinative Bacteriology*. Lippincott Williams and Wilkins, Baltimore. p787

Jango-Cohen, J. (2005). *The History of Food*. Twenty First Century Book. 56p.

Mckane, L. and Kandel, J. (1996). *Microbiology Essentials and Application*, 2nd ed. McGraw-Hill, New York. Pp. 642-649.

Nester, E.W., Aderson, D.G., Robert, E. C., Nancy, N.P. and Martha J. N. (2007). *Microbiology Human Perspective* (4th edition). McGraw Hill New York. Pp354.

Patel, N.J. and Bush R.K. (2002). Role of environmental allergens in Rhinitis. *Immunology and Allergy Clinic of North America, 20*(2):322-260.

Rodes, C.E., Newson J.R. and Vanderpool R.W. (2001). Experimental methodology and preliminary transfer factor data for estimation of dermal exposure to particles. *Journal of Exposure Analysis and Environmental Epidemiology, 11*(2): 124-213.

Sanders, E.R (2012). Aseptic Laboratory Techniques: Plating methods: *Journals of Visual Experiment*, 63:e3064.

Smith, A. (2007). Food marketing, In Oxford Encyclopedia of American Food and Drink. New York, Oxford University Press. Pp. 234-341.

SPSS, 2012. Statistical Package for Social Sciences for Windows (version 20.0). http://www.spss.com.

Williams, R.E. (1996). Healthy Carriage of *Staphylococcus aureus*: its Prevalence and Importance. *Journal of Bacteriology, 13*: 3-5.