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PROXIMATE COMPOSITION AND LEVELS OF TRACE METALS IN CHICKEN MEAT CONSUMED IN UYO METROPOLIS, AKWA IBOM STATE

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Abstract.
This study was conducted to determine the proximate composition as well as the concentrations of Pb,Ni,Mn, As, Zn, and Cd in the muscles,liver and gizzards of chicken consumed in Uyo,Akwa Ibom State, Nigeria. Proximate analysis was done on the different parts of chicken using standard methods and the concentrations of Pb,Ni, Mn, As, Zn, and Cd were determined using atomic absorption spectrophotometry. The mean levels of trace metals were ranged between 0.210±0.014-0.268±0.014mg/kg for Pb; 0.342±0.017-0.437±0.033mg/kg for Ni; 0.483±0.221-0.518±0.025mg/kg for Mn; 0.030±0.025-0.048±0.002mg/kg for As; 2.567±0.025-2.981±0.06mg/kg for Zn; and 0.024±0.04-0.17±0.025mg/kg for Cd.The mean moisture contents of various parts were 67.03±0.03, 66.0±0.002 and 67.23±0.004% formuscle,liver and gizzard respectively. The protein content ranged from 26.22±0.005 -28.35±0.03%; 1.32±0.05-1.23±0.121% for ash; and 0.91±0.01-1.11±0.111% for fat. The results indicated that chicken meat in this study were rich sources of nutrients. The concentrations of trace metals in this study were below tolerance limits except Pb, which was slightly higher than the WHO/FAO permissible limit. Therefore, it can be concluded that chicken meat in Uyo, Akwa Ibom State has a high nutritional value and it is safe for human consumption.

Keywords:*Trace metals, gizzard, liver, muscle, chicken*

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1. INTRODUCTION

Chicken meat is a major source of proteins to the population and is widely consumed in Nigeria. It is low in calories and especially enriched with essential amino acids. In total protein availability, animal protein is of more importance than vegetable protein. Therefore, poultry meat is considered best source of animal protein, having high biological value due to availability of all essential amino acids required to promote human growth and health (Panda, 1995). Chicken meat contains low amount of cholesterol than other foods of animal origin, thus making it an ideal food for infants, young children, adolescents, adults, old people, and convalescents and also for those who are attempting to control their weight (Mountney, 1985). Despite their nutritional benefits, the quality of these meats may be affected as a result of contamination through various anthropogenic activities. Bird population is particularly susceptible to the effects of human activities on the environment. Several biological and physiological processes such as eating habits, growth rate, breeding molting may influence concentration and distribution of heavy metals in birds. (Kim *et.al,* 2000). The risk of heavy metal contamination in meat is of great concern for both food safety and human health because of the toxic nature of these metals at relatively minute concentrations (Santhi *et al,*2008).Trace metal pollutants can contaminate the meat and its products during processing (through the raw material, spices, water and packaging), by inhalation of air and penetration through the skin's surface (Raikwar *et al*. 2008; Santhi *et al.,* 2008). In other cases, contaminated animal feed and rearing of livestock in proximity to polluted environment were reportedly responsible for trace metal contamination in meat (Miranda *et al.,* 2005 and Sabir *et al.,* 2003). Continuous monitoring of the levels of this contaminant is very important because of its health implications. Some of these metals have been reported to be extremely dangerous to human health. Lead is a metabolic poison and a neurotoxin that binds to essential enzymes and several other cellular components and inactivates them (Cunningham &Saigo, 1997). Toxic effects of lead are seen on hemopoietic, nervous, gastrointestinal and renal systems (Baykov *et al.,* 1996). Toxic effects of cadmium are kidney dysfunction, hypertension, hepatic injury and lung damage (John and Jeanne 1994). Cadmium chloride at teratogenic dose induced significant alterations in the detoxification enzymes in the liver and the kidney (Reddy and Yellamma.1996). Zinc is an essential element in food, when it is inadequate in diet, it may lead to loss of appetite, immunosuppression, growth retardation and low libido. However, high amount can cause nausea, vomiting and stomach cramp. (ATSDR.2004). Consequently the aim of this study is to determine the levels of Pb, Cd, Cr, As, Zn and Ni in the different parts of chicken selected for this study, and compare with maximum tolerable values of regulatory agencies, and to determine the nutritional value of these meats consumed in Uyo metropolis, Akwa Ibom State, Nigeria.

2. MATERIALS AND METHODS.

A total of sixty meat samples comprising of muscle, gizzard and liver acquired from Twenty (20) live chickens obtained from different poultry farms in Uyo, Akwa Ibom state were used for the study. The samples were dried in an oven at 105^{o}C for 48hrs to a constant weight and pulverized with a porcelain mortar and pestle and kept in acid leached nylon bags in a dessicator prior to digestion. The digestion of the samples was done using a mixture of HNO_3, $HClO_4$ and hydrogen peroxide (H_2O_2). The samples (2.00g) placed in a digestion tube were predigested in 10 ml concentrated HNO_3 at 135^{o}C until the liquor was clear. Next, 10ml of HNO_3, 1 ml $HClO_4$ and 2 ml H_2O_2 were added and temperature was maintained at 135^{o}C for 1 h until the liquor became colorless. The digest was slowly evaporated to near dryness (avoiding prolonged baking), cooled and dissolved in 1M HNO_3. The digests were subsequently filtered through Whatman filter No 1 and diluted to 25 ml with 1MHNO_3 (Iwegbue *et al.,* 2008). Heavy metals concentrations were obtained spectophotometrically using Perkin-Elmer Analyst 300 Atomic Absorption spectroscopy (AAS). All analysis was carried out in triplicates, and the results were given as (mg/kg wet weight).

Proximate Composition. Proximate compositions of the various chicken parts weredetermined using AOAC methods (1995). All analysis was done in triplicate. Moisture content was measured by weighing differences before and after oven drying at 100-105^{0}C for 16h. Lipid determination was carried out using the modified Bligh and Dyer procedure (1959), the ash content was determined by igniting the sample at 550^{0}C for 5-6 hours until the sample was completely free from carbon particles in a carbolite muffle furnace while the total nitrogen was determined by Kjedahl method as described by AOAC (1995) and a factor of 6.25 was used for converting the total nitrogen to crude protein of the different chicken parts under study.

Statistical Analysis. One way analysis of variance (ANOVA) was carried out on the data obtained in other to determine any significant difference in the studied metals in the various meat parts.

RESULTS AND DISCUSSION

Results of analysis of variance (ANOVA) ($p = 0.05$) did not show appreciable variation in the concentrations of the various metals in the different parts of chicken meat under study.

TABLE 1. Mean concentrations of trace metals (mg/kg) in chicken meat.

Mean concentration of metals(mg/kg)	Muscle	Liver	Gizzard
Pb	0.210±0.014	0.268±0.02	0.263±0.03
Ni	0.35±0.221	0.437±0.033	0.342±0.017
Mn	0.483±0.221	0.518±0.025	0.437±0.017
As	0.030±0.025	0.048±0.002	0.033±0.041
Zn	2.567±0.025	2.981±0.06	2.664±0.024
Cd	0.024±0.021	0.17±0.025	0.038±0.03

Table 2.Results of proximate composition of chicken parts.

PROXIMATE COMPOSITION (%)	MUSCLE	LIVER	GIZZARD
Moisture	67.03±0.03	66±0.002	67.23±0.004
Protein	27.01±0.04	28.35±0.003	26.22±0.005
Ash	1.23±0.121	1.32±0.055	1.30±0.002
Fat	1.11±0.111	0.96±0.044	0.91±0.01

The results of the mean concentrations of trace metals detected in the different chicken parts are presented in table 1.This study showed that liver contained the highest level of Pb (0.268±0.014mg/kg), followed by gizzard (0.263±0.03mg/kg), and lastly by muscle, (0.210±0.014mg/kg). Pb is known to accumulate mostly in the liver, while the high concentration of lead in the muscle indicates long term bioaccumulation (Oforka *et al.,* 2012). This is in agreement with most reports which tend to show that liver accumulates lead more than other tissues (Miranda *et al,* 2005, Korenekova *et al*, 2002).The mean concentrations of Pb in this study were lower than the mean levels reported by Miriam *et al*,(2004), Iwuegbe *et al* (2008) and Hussain *et al* (2012).However, the results were similar to the one reported by Oforka *et al* (2012).The concentration of Pb was slightly higher than FAO/WHO (2000) standard of 0.2mg/ kg for Pb. Excessive amount of Pb in chicken meat could not be attributed to industrialization alone. High levels of metals in poultry products may originate from contamination of feeds and water sources (Iwegbue *et al.,* 2008).Nickel is usually considered as an essential metal for experimental animals. However, high levels of Ni may result in serious respiratory distress. The permissible limit of Ni in food according to WHO/FAO standard is 0.5mgkg. In this study concentration of nickel ranged between 0.342±0.017mg/kg in gizzard to 0.437±0.033mg/kg in liver, indicating that the level of nickel in the different chicken parts were within permissible limits as stipulated by WHO/FAO. The result obtained differed from the ones reported by Zahurul *et al* (2011)and Abd elsalam *et al* (2013).Daily intake of small amounts of Mn is needed for growth and good health in humans, otherwise deficiency of Mn can cause nervous system problems (Demirezen and Uruç, 2006).Themean concentrations of manganese ranged from 0.483±0.221mg/kg in muscle to 0.518±0.025mg/kg in liver. Oforka*et al*., (2012), reported lower concentrations of Mn. However, Rehman,*et al* (2012)reported a very high concentration of Mn in broiler meat.The concentrations of Mn in chicken liver in this study were slightly above the WHO reference standard of 0.5mgkg.Arsenic concentrations in animal tissues are directly related to the concentration present in the diet. The range of arsenic was between 0.030±0.025mg/kg in muscle to 0.048±0.002mg/kg in liver. The permissible limit of arsenic in the livers of chickens has been reported as 2.0 ppm (ANZFA), The levels found in this study were much lower than these values and were under the permissible limits. This may be attributed to the fact that the chicken samples were not collected from polluted areas. Highest zinc concentration (2.981±0.06mg/kg) was found in the liver while the lowest concentration (2.567±0.025mg/kg) was found in the muscle. The levels of zinc found in the present study were below that reported by Hussain *et al*(2012), and Abdul Elsalam *et al*, (2013) and were below the permissible limit of 50mg/kg by Codex standard.. The low concentration of zinc may be attributed to zinc deficient cereals available to poultry. Food is one of the principal environmental sources of cadmium (Baykov *et al,* 1996). Cd level ranged between 0.024±0.021in muscle to 0.17±0.025mg/kg in liver. Cadmium levels found in this study were comparable to the levels of Gonzalez-Weller *et al,* (2006) and Skalická*et al* (2002).However, the mean concentration of cadmium in this study was much lower than those of Doganoc (1996), who found higher levels of cadmium and zinc in the livers and kidneys of the hens and chickens, which exceeded from the official tolerance levels. The concentration of Cd in this study did not exceed 0.5 ppm, (0.5mg/kg) permissible limit (FAO/WHO, 2000)

The results of the proximate composition of the different part of chicken under study are presented in Table 2. Moisture in food determines the keeping qualities of food. It also enhance the rate at which absorption takes place within the digestive system and influences the rate at which enzyme activities takes place on the food.(Ogunmola, *et al.,* 2013).The moisture content was highest in gizzard (67.23±0.004%) and lowest (66±0.002%) in liver. The moisture content observed in this study is lower than the values reported by Iklas et al (2010)and Ali *et al*(2007), for quail meat and chicken/duck meats respectively. The percentage composition of protein was highest in the liver (28.35±0.003%) and lowest in the gizzard (26.22±0.005%).Ogunmola *et al*., (2013) observed a very high protein content of 50-68%, which is higher than that reported in this study. Nevertheless, the protein content in this work was similar to the ones reported by Wattanachant,(2008) and Iklas *et al.,*(2010).Ash in any food acts as a determining factor for the availability of dietary minerals and energy. The values recorded for the three samples are however within the range of ash present in poultry meat (0.7-1.3%). (Nielson 1998). 1.32±0.055%ash was recorded for liver, while 1.23±0.121% was the mean value of ash for muscle. Fat, when present in the right proportion play an important role in blood clotting, prevention of the body from cold and heat as well as aid the body in absorbing certain vitamins. Chicken fat is mostly found in the skin.fat content ranged between0.91±0.01percent in gizzardand 1.11±0.111% in muscle. The range in this study was lower than the range reported by Ali *et al* (2007) and Wattanachant(2008).

3.CONCLUSION

From the result of this study, the concentrations of trace metals determined in the different parts of chicken meat consumed in Uyo were below tolerance limits except for Pb, whose concentration was slightly above the 0.2mg/kg recommended by FAO/WHO (2000).Also from the proximate analysis, the chicken meat in Uyo metropolis has a very high nutritional value thus making it safe and fit for consumption. However, continuous monitoring of probable sources of trace metal contamination in poultry meat should be identified and solution proffered.

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