BIOCHEMICAL ANALYSIS AND SAFETY OF CHICKEN MEAT CONSUMED IN ILARO, OGUN STATE

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Abstract

Chicken meat importation has been banned since 2005 in Nigerian. Surprisingly, it is still been smuggled into the country through the borders; leading to neighbouring towns like Idiroko and Oja Odan road which leads into Ilaro, Ogun state and sold to retailers and consumers in the open markets. This study was carried out to assess and compare the nutritional composition and safety profile of the imported, randomized and indigenous chicken meats consumed within Ilaro metropolis. A total of 21 chicken meat samples were used for the analyses. Group 1, 2 and 3 comprise of seven samples each of imported, randomized and local chicken meat samples respectively. The samples were digested after which nutritional composition was assessed by determination of proximate composition, safety profile was determined by quantification of levels of heavy metals (cadmium lead; magnesium and potassium were also assayed for as index for mineral content) and High Density-Lipoprotein (HDL-C) of the chicken meats. Data analysis was done using SPSS version 21. The level of significance was set at $p < 0.05$. The HDL-C, were significantly higher ($p < 0.05$) in group 2; similarly the elemental analysis for this group showed the lowest concentration of lead and magnesium. Cadmium and potassium has same effect across board. Furthermore the proximate composition revealed significant increase ($p < 0.05$) in levels of food nutrients in group 1 to that of group 3 and 2 samples. This study concludes that the chronic consumption of chicken meat can pose health hazards and also the imported ones may not give the nutritional benefit expected as reported on the product labels. Therefore proper caution should be taken on the choice of consumption.

Keywords: chicken meat, proximate composition, elemental analysis.

INTRODUCTION

Poultry is one of the most developed animal industries in Nigeria. Historically, the growth of poultry industry began as a result of its high level of energy and protein, rapid turnover rate and short incubation period (i.e. 21 days) which are advantages of poultry over other livestock animals (Adedeji et *al.*, 2014). Chicken meat can be identified as one of the most essential sources of affordable protein, where the white meat (poultry meat) is very cheap as unlike the red meat (cow meat) Wahyono and Utami (2018).Human beings consume protein-rich foods to supply and meat products are integral parts of the daily diet for their nutritional requirements,

mainly of animal origin, many people due to tradition, variety, reasonable prices, such origin lying in meat .The contaminants of food-stuff in the world include animal, others are not readily metabolized or excreted and microorganisms and their metabolites, mycotoxins, heavy so, their residues will persist in the animal tissues and metals, nitrates, nitrites, hormones, pesticide residues, Chicken flesh used for food is a relevant dietary source of proteins, essential amino acids, chemical elements (e.g. iron, zinc) and vitamins (e.g. B12, D). The safety of the consumption of this kind of meat is questionable by its negative association with non-nutritional issues like the presence of various toxic contaminants Dalia and Bassma (2015). Applying food safety standards on a product is very important because it relates closely to human's health. Good food products have a high nutritional quality, as well as being free from physical, chemical and biological contaminations Hozan and Hemin (2013). Hence animal protein is referred to as complete protein. Worldwide, consumption surveys indicate that chicken is the second largest consumed meat Toluwalase et al., (2017). Technologically industrial activities and increased road way traffic have caused a significant increases of toxic heavy metals in the environment and has affected all the global air, water and food. The presence of toxic elements in the food chain is as a result of the environmental pollution and their concentration need to be controlled constantly Elatrash and Atoweir (2014).

Chicken is the most widely eaten poultry in the world. It has both white and dark types of meat and has much less fat than other poultry. The chicken (*Gallus gallus domesticus*) is a type of domesticated fowl, a subspecies of the red jungle fowl. It is one of the most common and widespread domestic animals, with a total population of more than 19 billion as of 2011(SAPA, 2015). There are more chickens in the world than any other bird or domesticated fowl. Humans keep chickens primarily as a source of food (consuming both their meat and eggs) and, less commonly, as pets. Young, tender chickens could be cooked by using any cooking method. Older birds are best suited to be braised or stewed. Chicken has the unique appeal of being extremely versatile and due to its neutral flavour lends itself to a variety of garnishing, marinating and can be stuffed, basted and paired with just about anything. If there is one thing that is universal, is the worlds' love for chicken. In sub-Saharan Africa, the largest producer of chicken meat is South Africa with a consumption of 37.47 kg per capita per year in 2014 (SAPA, 2015). The dominance of chicken meat in the African meat market is due to similar factors to those driving chicken demand globally and the price of chicken meat is generally lower than that of other meats (DAFF, 2013).The link between diet and health is important, given the prevalence of diet related disease. Consumers need to be able to discriminate between foods based on the nutritional contribution of each to a healthy diet. They also need to be able to discriminate between foods in a broader context, considering issues such as food safety, how the food is produced and the environmental consequences of its production. Chicken can contribute to a healthy eating pattern. It is an important source of protein. The predominant cut consumed, breast meat, is low in fat, with its fat profile favouring polyunsaturated, rather than saturated, fatty acids (Charlton et al., 2012).Chicken meat delivers essential vitamins and minerals such potassium, magnesium etc, and is the most affordable meat source. Potassium and magnesium

content determination as the minerals used as case study of this project belong to the class of minerals known as macro minerals. For normal function, human body requires large quantities of several macro minerals, including potassium, magnesium, chloride and calcium. Potassium and magnesium are required for normal heart and neurologic function as well as many enzymatic processes. Alterations in potassium and magnesium levels can lead to significant health effects. Muscle contractions, nervous system activity and several basic cell functions rely on normal potassium levels. Many enzymes depend on magnesium for normal function and activation. All enzymatic processes involving energy production by your body rely on magnesium, according to the Merck Manuals Online Medical Library. Magnesium levels are also related to balance of other electrolyte levels including potassium and calcium (Jesse, 2017).

MATERIALS AND METHODS

SAMPLES COLLECTIONS AND GROUPING

Samples was gotten from three different locations and was grouped into 3 groups. The groups are labelled (A1- A3) respectively, with each groups having 7 samples and each samples was gotten from different cartons.

COLLECTIONS OF SAMPLES

Samples of frozen chicken Laps (A1) was gotten from retail outlets at the major market of Ilaro (Sayedero market) Ogun state, Nigeria. While the second batch (A2) was gotten from major retail outlets along Orita and express road and the third batch of samples (A3) comprise of 4 male and 3 female local breed chicken was also gotten within Ilaro community.

STUDY GROUPS

A1 consisting of seven samples was gotten from the popular market in Ilaro (sayedero) which are labelled according to the way they have been purchased. Each was put immediately inside an iced packed cooler in other to retain its normal temperature and also to avoid enzymatic changes before it was then transferred to the laboratory freezer prior to digestion.

Same steps was taken for the purchasing of the A2 samples.

A3 consisting of seven samples was bought live from retail outlets of the popular market in Ilaro (sayedero), and was then sacrificed in the laboratory, the lap excised from each chicken was labelled accordingly to each gender and was stored at freezing temperature b before digestion.

ANALYSIS

Digestion for biochemical analysis

- 2 g of the meat sample were grounded.
- Transferred into an equivalent of 4 ml of a prepared buffer solution and homogenized.
- Centrifuge at 10,000g for ten minutes.

Then the supernatant transferred into sample bottles for further analysis.

Biochemical analysis: The biochemical analysis assayed for includes

- Low density lipo-protein (LDL)
- Triglyceride test

High density lipo-protein analysis

To carry out this analysis require that spectrophotometry reading be done at 546nm.

HDL cholesterol in the specimen is catalyzed by Cholesterol esterase and Cholesterol oxidase with addition of R2 solution into the specimen. ESPAS and 4-aminoantipyrine (4-AA) are condensed by the generated hydrogen peroxide and Peroxidase to generate a quinone dye. The absorbance of the generated quinone dye is analyzed to obtain the HDL cholesterol concentration in the specimen with reference of a standard solution.

Procedure:

- The reagent blank is composed of 225µl of the reagent and read at 546nm.
- This was followed by the reading of the standard composed of 225mµl of the standard reagent added to225µl of the reagent.
- The third reading was that of 225µl of the supernatant and 225 µl of the reagent.

CALCULATION

$$\text{HDL Concentration} = \frac{A_{\text{sample}} \times \text{Standard conc.}}{A_{\text{standard}}} = \text{mg/dl}$$

Triglyceride analysis

To carry out this analysis require that reading be done 500nm; and it is of three major phase.

- The blank is composed of only 1000µl of the reagent (the reagent R1 comprises of 40 mmol/l at pH 7.6, 5.5 mmol/ of 4-chloro-phenol, 4-aminophenazone , ATP 1.0 , ≥150U/ml lipases, ≥0.4 U/ml glycerol-kinase, ≥ 0.5peroxidase.)
- This was followed by the reading of the standard composed of 10mµl of the standard reagent added to1000µl of the reagent.

- The third reading was that of 10mμl of the supernatant and 1.00ml of the reagent.

Calculation

$$\text{Triglyceride concentration} = \frac{A_{sample}}{A_{standard}} \times \text{Standard conc.} = \text{mg/dl}$$

Proximate composition analysis

Moisture content

The moisture content was determined using the AOAC, (1990).

- 2g of the sample was weighed into a dried, cooled and pre weighed aluminum moisture can.
- The can was subsequently dried to a constant weight at $105 \pm 2^{o}C$.
- After drying, drying the can were weighed the cans were cooled in a dessicator and the weight after cooling was obtained.

Calculation

$$\frac{(\text{Weight of can-weight of empty can})}{\text{Weight of sample}} \times 100$$

Ash Content

- 2g of the samples were weighed into well incinerated crucibles.
- Then it was moved into muffle furnace and then ashed at $600^{o}C$ for 3 hours.
- Afterwards , the muffle furnace was allowed to cool .The crucibles and the ash contents were brought out of the furnace
- Re-weighing of the crucible after the ashing was done and the readings was recorded.

Calculation

$$\frac{(\text{Weight of crucible + Ash - weight of empty crcible})}{\text{Weight of sample}} \times 100$$

Crude Fat

- The extractor cans were oven dried,cooled and weighed.
- 80mls of petroleum ether was measured into the extractor cans (6 of them)
- 2g of the meat samples were placed in the thimble and then clogged with grease free cotton wool.
- The thimble was then placed in the extraction chamber and extraction commenced at $135^{o}C$

CALCULATION.

$$\frac{(\text{Weight of can + Fat – Weight of empty can}) \times 100}{\text{Weight of sample}}$$

Crude Fibre content

- 2g of the meat sample was weighed and placed in the conical flask.
- 100ml of 0.1 concentrated H_2SO_4 was measured and poured into the conical flask containing the weighed meat sample.
- This was boiled for 30 minutes, after which the acid was filtered and rinsed away.
- The same was done using NAOH.
- The obtained residue was made to be contained in already weighed crucibles and then heated in the muffle furnace for three hours.
- After which this was then weighed and recorded.

Calculation

$$\frac{(\text{Weight of crucible after oven drying - weight of crucible after ashing}) \times 100}{\text{Weight of sample}}$$

Mineral analysis

This was done using Atomic Absorption spectrophotometer (AAS). The AAS machine operate base on the principle of the beer lambert law. The concentration of the analyse in the sample is directly proportional to the rate at which the rate of absorbtion by the machine.

Procedure

This analysis requires that the raw meat sample be digested and this was done as follows.

- 5 grams of the chicken meat samples was weighed using the weigh balance.
- The weighed samples was be placed inside the digestion tube and 2.5mls of nitric acid (HNO_3) will be added to it.
- The sample in the digestion tubes was subjected to digestion as take place at 220 ^{o}c until a clear solution is formed.
- The solution was then be left for 10-15mins in the fume cupboard to allow the chocking smell to go off and to cool.
- After which the supernatant was obtained by filtration.

- After the digested sample has been obtained it is then used for mineral assay. Using the AAS .This machine requires for accuracy the preparation of the standard of element to assay for so it could use it to set a limit for the absorbance and also to indicate an overage of the standard in any particular sample Instead of reading it normally in part per million(ppm). The prepared standard in the case of the minerals and heavy metals assayed for are listed below.

Minerals

Magnesium (mg) standard prepared was 1ppm
Iron (Fe) standard prepared was 3ppm

Heavy metals

Cadmium

Lead

STATISTICAL ANALYSIS

The data obtained are represented as mean ± standard error of mean (S.E.M). Statistically noteworthy dissimilarities in mean values were tested by one way analysis of variance (ANOVA). The data are analysed using Spss v 20.0The dissimilarities were deliberated significant when $p<0.005$.

RESULTS

TABLE 1: Lipid profile of all the Groups; the Exotic Frozen Chicken Meat (A1), Randomized frozen chicken meat samples (A2) and Local Chicken Meat (A3).

Samples	Triglyceride	HDL Cholesterol
A1	71.64 ± 43.95^{a}	134.34 ± 41.46^{b}
A2	155.90 ± 27.88^{b}	128.14 ± 17.27^{ab}
A3	167.90 ± 58.39^{b}	114.06 ± 9.71^{a}

Values are means of triplicate determination ± standard deviation. Mean values with different superscripts within the same column are significantly different at 5% level.

Table 1 shows the lipid profile of the three samples. Mean values with different superscripts within the same column are significantly different at 5% level. The superscript ^{a,b,c} indicates that the values bearing it are significantly difference by $p>0.05$ respectively from one another in their groups. It increases in the superscript ascending order.

Triglyceride content are lowest in the imported chicken meat samples that is the group A1 with a significant difference ($p>0.05$) than the other two groups, that is the randomized samples group and the local chicken meat sample group. For the HDL cholesterol analysis; cholesterol content were observed to be lowest in the local chicken meat sample group A3 with a significant difference ($p>0.05$); followed by the randomized chicken meat samples group A2 and the local chicken meat sample.

TABLE 2: Nutritional Composition of all the Groups; the Exotic Frozen Chicken Meat (A1), Randomized frozen chicken meat samples (A2) and Local Chicken Meat (A3).

Samples	Moisture	Crude fibre	Ash	Protein	Carbohydrates	Fat
A1	24.02 ± 1.93^{a}	0.88 ± 0.21^{b}	1.93 ± 0.32^{b}	21.71 ± 1.09^{b}	46.68 ± 1.95^{a}	4.76 ± 1.54^{b}
A2	25.17 ± 0.70^{b}	0.65 ± 0.20^{a}	1.54 ± 0.44^{a}	20.72 ± 1.79^{a}	48.15 ± 2.46^{ab}	3.78 ± 0.78^{a}
A3	25.58 ± 0.76^{b}	0.55 ± 0.24^{a}	1.52 ± 0.35^{a}	20.00 ± 1.73^{a}	49.24 ± 2.73^{b}	3.16 ± 0.17^{a}

The superscript ^{a,b,c} indicates that the values bearing it are significantly difference by $p>0.05$ respectively from one another in their groups. It increases in the superscript ascending order.

As represented in table 4 above the imported sample (group 1) has the lowest moisture content, although with significant difference from the rest of the groups. A lower crude fibre content was obtained in the groups A2 and A3 than A1, The ash contents was also higher in group A1 than that of the group A2 and A3, but the exotic sample has the highest content of protein with significant difference among all the groups; carbohydrate is lowest in the group A1 (the exotic) followed by the group A2 and then the group A3; The local samples that is the group 3 shows high content of carbohydrate. This can be attributed to the type of feed they consume as this is composed of about 65 % carbohydrate and for the local breed samples though they also consume carbohydrate foods especially corn; but this may not be regular. The group A2 and A3 have seemingly low fat content with significant difference from group A1.

TABLE 3: Result for toxicological analysis for All the Groups; the Exotic Frozen Chicken Meat Samples, Randomized and Local Chicken Meat Samples

Samples	Lead	Cadmium	Magnesium	Potassium
A1	0.01 ± 0.00^{ab}	0.66 ± 0.38^{a}	1.72 ± 0.48^{b}	19.48 ± 7.03^{a}
A2	0.00 ± 0.00^{a}	0.73 ± 0.28^{a}	1.74 ± 0.47^{b}	19.96 ± 3.05^{a}
A3	0.02 ± 0.04^{b}	0.64 ± 0.23^{a}	1.34 ± 0.27^{a}	16.77 ± 8.66^{a}

Values are means of triplicate determination ± standard deviation in ppm. Mean values with different superscripts within the same column are significantly different at 5% level..

As represented in table 4 above the lead content of the lowest lead concentration was obtained in the randomized frozen chicken sample group A2 followed by the imported samples group A1 and then then the group A1 which are the local samples with significant difference ($p>0.05$). The local samples group A3 were observed to have the lowest magnesium concentration with significant difference ($p>0.05$) than the other two groups. This may be due to a mal-nutrient diet as most of local chicken have to fend for themselves in their free range rearing method. Potassium and cadmium are the same across board with no significant difference.
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DISCUSSION

The results of proximate analysis reveals significantly increased values of protein, fat, crude fibre and ash content of the imported chicken compared to the local chicken which had significantly lesser levels. However, significant high levels were observed in the moisture and carbohydrate values for all the measured groups. Crude fibre helps to reduce serum cholesterol

level, risk of coronary heart disease, colon and breast cancer and hypertension. Fibres in food also help in maintaining blood sugar level thus lower the risk of cardio vascular disease.

Ash content in sample A2 and A3 samples has the lowest ash content compared to A1 samples. This agrees to (Nielson 1988). Ash in food determines largely the extent to which the dietary minerals would be available in a particular food sample. It also determines the rate at which food substances would make available the amount of energy locked in it. This implies that exotic chicken could furnish man with more energy and some viable minerals than the other chicken meat samples. Protein content in A1 samples has more protein content than A2 and A3 samples. The exotic chicken meat is higher than the randomized and local chicken which agrees to the findings of Ogunmola, *et al.,* (2013). Protein is a powerful compound that builds and repair tissues; it also helps to maintain the body structures. Protein speed up the chemical reaction in the body, serves as chemical messenger, fight infections and transport oxygen from the lungs to the body tissue. Fat content in sample A2 and A3 samples has the lowest fat content than A1samples. Here, A1 samples has the highest fat content than the other two samples because the localized chicken meat used for this analysis are 4 males and 3 females which implies that the male chicken meat have low fat than the female chicken meat used which affect the result.

The concentration of heavy metals in frozen chicken meat products has been determined by several authors and in different countries. Despite enough production of local chicken, public interest is still directed towards consumption of imported chicken. The local chicken meat is proved to be tastier than imported chickens Noorhan *et al* (2017). Pollution of poultry with heavy metals is an inevitable worldwide phenomenon particularly in industrial countries. Residues of the pollutants are detected in several parts of avian including feathers. Heavy metals are considered to be persistent types of pollutant which cannot be destroyed by heat treatment.

Lead and cadmium are toxic metals occurring in the environment naturally and from anthropogenic activities and can lead to chemical contamination of products entering in the human food chain. Lead concentration (a) is the lowest in the exotic samples followed by the randomize samples and lastly the indigenous sample. Cadmium has the same concentration across the three groups. The results of this study indicated that frozen chicken meat samples contain high cadmium levels which exceed the maximum limit (0.5 ppm) in the Codex Alimentarius international food standards. This high level of Cadmium concentration could be attributed to the heavy environmental pollution with cadmium which has high tendency for bioaccumulation in chicken meat. Lead in meat is a toxic metal of primary concern, present at low concentrations in most foods. Contaminations of food during processing or food production in contaminated areas are the main reasons for enhanced Pb intake via foodstuffs Noorhan et al (2017). Lead is known to induce reduced cognitive development and intellectual performance in children and increase blood pressure and cardiovascular disease in adults. The source of lead contamination of food livestock come from the air, water, food materials, cooking utensils and food packaging. Lead concentrations appear to be below

permissible limit in both the exotic, indigenous and randomized chicken [0.01-0.12ppm] which indicates their safety for public consumption Noorhan et al (2017). The maximum limit of lead Pb is (0.5ppm) Ismail *et al.,* (2013). Lead may enter the atmosphere through various sources, it can either be during mining, smelting, refining, manufacturing processes and also by the use of lead containing products. The source of Pb contamination of livestock come from the air, water they drink and feed they eat. All the frozen chicken meat samples analysed contain little and in some of the samples lead was not detected at all. Food stuffs are the main source of Cd exposure Dalia and Bassma (2015). Since toxic Cd residues were found to be high in the frozen chicken meat sample, consistent monitoring should be employed as its bioaccumulation could lead to serious human health problems among consumers. In addition, excessive consumption of meat originated from chicken raised in Cd contaminated environment should be discouraged. The results obtained were compared with maximum tolerable Cd level which was 0.50ppm according to Codex Alimentorum (Ismail *et al.,* 2013). Cadmium exists in low concentrations in all soils. It is spread by air and water (sewage sludge) far over sea and land, but especially in the vicinity of heavy industrial plants and hence absorbed by many animals, chicken and sea organisms. The highest level of cadmium detected in the chicken meat could be as a result of contact with both soil, drinking water or feed as compared to the other animals. Cadmium may elicit diabetes-induced effects on kidneys Marian and Jonathan (2014). Kidney damage may further progress to renal disease (ESRD) and death if exposure is high and prolonged. Recent investigations show that cadmium may also play a role in the development of cancers. The levels of cadmium detected in most of the meat samples however, pose toxicological risk to consumers (Marian *et al.,* 2014). The anemia observed during cadmium toxicities can be alleviated to a certain extent by addition of iron to diets, also addition of dietary ascorbic acid and selenium had the greatest protective effects on damage from cadmium consumption (Ismail *et al.,* 2013).

The heavy and metals such as lead, cadmium; have toxic properties and a tendency to accumulate in meat products. Eight per cent of the lead in food is taken up into the human gastrointestinal tract. Lead interferes with haemoglobin synthesis and is able to inhibit several enzymes needed by the body. Cadmium accumulates in the kidneys and it has an extremely long biological half-life in humans in the order of 20-30 years (WHO). Five to ten per cent of cadmium is absorbed and bound in the liver with metallothionein and stored in the kidney ss Cd-thionein. Kidneys which contain more than 200 mg Cadmium per kg may exhibit morphological abnormalities in the tissue structure and increase excretion of proteins, amino acids, glucose and calcium. Other symptoms of cadmium poisoning are emphysema of the lungs, anaemia and insufficient bone mineralization as a result of increased calcium excretion (Soetan *et al.,* 2014). Magnesium is an active component of several enzyme systems in which thymine pyrophosphate is a cofactor. Oxidative phosphorylation is greatly reduced in the absence of magnesium. Mg is also an essential activator for the phosphate-transferring enzymes myokinase and creatine kinase. It also activates pyruvic acid carboxylase, pyruvic acid oxidase, and the condensing enzyme for the reactions in the citric acid cycle. It is also a constituent of bones, teeth, enzyme cofactor,

Magnesium is absorbed in the intestines and then transported through the blood to cells and tissues (Soetan *et al.,* 2014).

Magnesium ions in frozen chickens meat samples are considered as electrolytes which retain useful for the body. The Magnesium is considered to be one of the seven essential macro-minerals required as much as or greater than 100mg/day Noorhan et al (2017).The human body contains approximately 20-28 mg of Magnesium in which over 50% of is stored in the system and the rest is found in muscle, soft tissues and bodily fluids. Potassium is the principal cation in intracellular fluid and functions in acid-base balance, regulation of osmotic pressure, conduction of nerve impulse, muscle contraction particularly the cardiac muscle, cell membrane function and Na+/K+-ATPase. Potassium is also required during glycogenesis. It also helps in the transfer of phosphate from ATP to pyruvic acid and probably has a role in many other basic cellular enzymatic reactions Noorhan et al (2017).

There are no permissible limits of Potassium in frozen chicken meat samples which was are important intracellular cation which acts as a second messenger in various signal transduction cascades.

CONCLUSION AND RECOMMENDATION

The result of this study has been able to elucidate the comparison and possible discrepancies that exist between these various types of chicken meat (imported, randomized samples and local breed) consumed in Ilaro Ogun State as to their proximate composition and nutritional quality, lipid profile, heavy metals and mineral analysis. This study indicate that the consumption of chicken meat, especially the imported ones may not give the nutritional benefit expected as reported on the product labels. This may also be due to the long term storage of the product, mode of preservation and handling before it finally gets to the consumers and so proper cautions should be taken as regards what we choose to consume. The level of lead assessed for in the meat sample was compared with the permissible limits, which shows that the lead content in the samples has no healthy risk on the consumers. On the other hand Cadmium level in the samples were determined by comparing the results with the permissible limits. Cadmium and potassium were observed to be same across board having no significant difference. The local chicken meat samples were observed to have the lowest concentration of magnesium with significant difference ($p>0.05$). Cadmium indicates heavy risk as their values were higher than the permissible tolerable levels as cited by international committees. The kidneys are target organ for As, Cd, Hg toxicity. Long-term, even low-level, exposure to this metal leads to kidney damage characterized by tubular dysfunction. Based on the above results, it can therefore be concluded that metals bioaccumulation in the chicken meat species studied did not exceeds the permissible limits set for heavy metals by FAO and WHO except cadmium. This study indicates the consumption of chicken meat can pose health hazards after over time consumption; and so proper cautions should be taken as what we choose to consume.

I hereby recommend the consumption of local fowl, cock, duck etc. is quite safer than those of the imported birds that are not reared under normal conditions; birds that could have been injected with growth hormones to make the develop more rapidly just to create food security and profit for the producers, but at the detriment of the consumers. Thawing of frozen product should be done under running cold water or as part of cooking method as this could also help to alleviate other contaminations that could have occurred due to the mode of handling of retailers; putting consumers of the product at the receiving end.

More importantly, The law enforcement agencies and other related bodies should implement a more effective method of securities at the borders; in order to stop the smuggling of this poultry products into the country.

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