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# Assessment of Heavy Metals in Some Organs of Local Chickens Sold At Central Market of Wudil Metropolis

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**ABSTRACT**

*A study was conducted to determine heavy metals (Cd, Zn, Cu, Cr and Pb) in some organs (Bones, Claws, Feather, Gizzard, Intestine, Kidney, Liver, Muscle and Skin) of local chickens. Sampling was carried out in two local chickens sold at central market of Wudil over a period of three month (December, 2014 – March, 2015). Heavy metals were determined by standard method of atomic absorption spectrometry (AAS). The concentration of the above heavy metals in the studied samples were found to be insignificant, they are generally low and within tolerance limit set by WHO, CODEX and other international bodies.*

**KEYWORDS:** *local chickens, organs, heavy metals, Spectrometry and AAS.*

## Introduction

Global environmental pollution through heavy metals lead to an increased interest in metals contamination of food stuffs, and amongst them birds tissues and organs which symbolize an important part of humans diet, which is important source of nutrients containing all the proteins, lipids, vitamins and minerals [14]. Food safety is a major public concern worldwide in recent decades, due to the growing demand for food safety which stimulated research regarding the risks associated with consumption of foods contaminated with pesticides, heavy metals or toxins [8].

The use of living organism to monitor heavy metals pollution provides more promising result than chemical and physical analysis. Birds can be exposed to heavy metals both externally by physical contact and internally by consumption of contaminated food [10]. Heavy metal concentration can be assessed in birds by using various organs(liver, kidney tissue muscle, bone, fat, eggs, feathers, and excrements) [6],[18]. Some of the heavy metals that are known as potentially toxic include Aluminum, arsenic, Cadmium, and lead and other essential metals such as Zinc, Nickel and Chromium, play a definitive roles in the intrinsic mechanism regulating vital biological processes. Toxic elements can be harmful even at low concentrations when ingested over a long period of time [11],[16]. Therefore, exposure to metals through consumption of local chicken meat or organs may pose a health risk especially for higher consumption population.

According to [19] high levels of inorganic arsenic in food or water can be fatal. A high level is 60 parts of arsenic per million parts of water or food (60 ppm). Arsenic damages many tissues including nerves (Peripheral Poly neuropathy, Axonal degeneration), stomach, intestines and skin. However, long term exposure to low concentration of cadmium in air, water or food lead to a buildup of cadmium in the kidneys. Further, cadmium is cancer-causing and potentially mutation-causing with severe sub lethal and lethal effect at low environmental

concentrations [15]. [3]Claimed that excess zinc can cause some feeding disorders and impairs the immune system. Several researches including [1], [17] have reported that lead exposure causes neurotoxicity which is characterized by histological Ultra structural and Neuro chemical changes in the central nervous system as well as behavioral shortfall.

Consequently, this study was carried out to determine and assess the concentrations and distribution of heavy metals in different organ of local chicken, and to estimate a health risk to local consummators from ingestion of metal contaminated chickens.

The purpose of this research is to provide information on trace elements concentration in Bones, Claws, Feather, Gizzard, Intestine, Kidney, Liver, Muscle and Skin of local chickens, which were bought from Wudil central market in Kano State, Nigeria.

## Materials and Method

### Sample Preparation

Two (2) samples of the local chickens were collected from Wudil central market of Kano state, Nigeria. The samples were slaughtered with stainless steel knife at department of Biological Sciences, Kano University of Science and Technology, Wudil. Feathers were removed then dissected and washed with demineralized water. They were cut into pieces with stainless steel knife and kept in a container and then stored in the refrigerator at about $5^0$C until further analysis in the laboratory [4]. The stored chicken samples in the refrigerator(muscle, gizzard, intestine, liver, feathers, bone, kidney, skin and claws organs) were collected and allowed to thaw (ice to loosen). The organs were collected in polyethylene bags and digested using the method described by [4]:

### Sample Digestion

2g of each of the organs were collected and 10ml of 36% Nitric Acid were added into a beaker for pre-digestion until the liquor is clear. After which 10 ml of 36% Nitric acid, 1ml of HCl and 2ml of hydrogen peroxide was added and the temperature maintained at $135^0$C for 1 hour until liquor become colorless. The digest was then slowly evaporated near to dryness (Avoiding prolonged heating), cooled and then dissolved in 1M $HNO_3$. The digest was then filtered through filter paper (Whatman No. 1) and diluted to 25ml with 1M $HNO_3$.

The digest of the local chickens organs were aspirated into AAS for Pb, Cd, Zn, Cr and Cu determination. The values obtained were presented in the tables below:

## Results and Discussion

The concentrations of heavy metals in the organs of local chicken are presented in Tables 3.1 and 3.2.

**TABLE 3.1** Concentration of heavy metals in the organs of 1st chicken sample

| Sample | Cd (mg/kg) | Cr (mg/kg) | Cu (mg/kg) | Pb (mg/kg) | Zn (mg/kg) |
|---|---|---|---|---|---|
| Bone | 0.1834 | 0.2247 | 3.9406 | 0.0865 | 0.0546 |
| Claws | 0.2752 | 0.2247 | 1.3559 | 0.0433 | 0.0819 |
| Feather | 0.2752 | 0.2247 | 2.5423 | 0.0433 | 0.1366 |
| Gizzard | 0.1834 | 0.2247 | 2.8813 | 0.1299 | 0.0819 |
| Intestine | 0.2752 | 0.4494 | 1.6949 | 0.0433 | 0.0546 |
| Kidney | 0.3669 | 0.3370 | 1.1864 | 0.0433 | 0.1366 |
| Liver | 0.4587 | 0.3370 | 1.7796 | 0.0865 | 0.0564 |
| Muscle | 0.3669 | 0.4494 | 2.5423 | 0.0865 | 0.0273 |
| Skin | 0.2752 | 0.3370 | 1.0508 | 0.0865 | 0.1366 |
| Permissible Limits (ppm) | 0.2 | 1 | - | 6 | - |

*National and international standards (permissible limits): Codex Alimentarius commission (CODEX), China (GB), US, Food and Drug Administration (FDA), European commission (EU) and Australia and New Zealand (FSANZ)

For The Organs Of The First Chicken Sample, the concentration of lead (Pb) ranges from 0.0433-0.1299mg/kg, where Gizzard had the highest concentration of 0.1299 while Claws, Feather, intestine and Kidney had the lowest and the same concentration of 0.0433mg/kg. Concentration of copper (Cu) ranges from 1.0508-3.9406mg/kg,

where Bone had the highest concentration of 3.9406 while Skin had the lowest concentration of 1.0508mg/kg. Concentration of Cadmium (Cd) ranges from 0.1834-0.45876mg/kg, where Liver had the highest concentration of 0.4587 while Bone and Gizzard had the lowest and the same concentration of 0.1834mg/kg. Concentration of Chromium (Cr) in the organs of the first chicken sample ranges from 0.2247-0.44946mg/kg, where Intestine and Muscle had the highest and the same concentration of 0.4494 while Bone, Claws, Feather and gizzard with the lowest and the same concentration of 0.2247mg/kg. Concentration of Zinc (Zn) in the organs of the first chicken sample ranges from 0.0273-0.1366mg/kg, where Feather, kidney and skin had the highest and the same concentration of 0.1366 while Muscle had the lowest concentration of 1.0508mg/kg,

**TABLE 3.2** Concentration of heavy metals in the organs of 2nd chicken sample

| Sample | Cd (mg/kg) | Cr (mg/kg) | Cu (mg/kg) | Pb (mg/kg) | Zn (mg/kg) |
|---|---|---|---|---|---|
| Bone | 0.4587 | 0.1123 | ND* | 0.0433 | 0.0273 |
| Claws | 0.3669 | 0.1123 | ND | 0.0865 | 0.0546 |
| Feather | 0.6422 | 0.1123 | 0.1695 | 0.0433 | 0.0273 |
| Gizzard | 0.4587 | 0.1123 | 0.0847 | 0.0865 | 0.0546 |
| Intestine | 0.3669 | 0.1123 | 0.0847 | 0.0433 | 0.0273 |
| Kidney | 0.3669 | 0.1123 | ND | 0.0433 | 0.0273 |
| Liver | 0. 3669 | 0.1123 | 0.0847 | 0.0433 | 0.0273 |
| Muscle | 0.2752 | 0.1123 | ND | 0.0865 | 0.0546 |
| Skin | 0.2752 | 0.1123 | ND | 0.0433 | 0.0273 |
| Permissible Limits (ppm) | 0.2 | 1 | - | 6 | - |

*National and international standards (permissible limits): Codex Alimentarius commission (CODEX), China (GB), US, Food and Drug Administration (FDA), European commission (EU) and Australia and New Zealand (FSANZ)

*NOTE: Fields Designated as ND, indicates the absorbance of the sample were not detected by AAS Machine.

While for the organs of the second chicken sample, the concentration of Pb ranges from 0.0433-0.0865mg/kg in which gizzard, claws and Muscle had the highest and same concentration of 0.0865 while Bone, Feather, intestine, kidney, liver and skin had the lowest and same concentration of 0.0433mg/kg. Concentration of Cu ranges from 0.0847-0.1695mg/kg in which Feather had the highest concentration of 0.1695 while Gizzard, intestine, and liver had the lowest and same concentration of 0.0847mg/kg. Concentration of Cd ranges from 0.2752-0.6422mg/kg in which Feather had the highest concentration of 0.6422 while Muscle and Skin had the lowest and same concentration of 0.2752mg/kg. Cr in all the Organs had the same concentration of 0.1123mg/kg.

Finally, the concentration of Zn in the organs of 2nd chicken sample ranges from 0.0273-0.0546mg/kg in which Claws, Gizzard and Muscle had the highest

and same concentration of 0.0546 while Bone, Feather, intestine, kidney Liver, and skin had the lowest and same concentration of 0.0273mg/kg.

**TABLE 3.3** The WHO (2005) permissible limits for the analyzed metals

| Heavy metals | Concentrations (ppm) |
|---|---|
| Cadmium | 1 |
| Lead | 1-5 |
| Zinc | 20-50 |
| Copper | 40-50 |
| Chromium | - |

The trends for the concentration of the metals in two local chicken samples were:

Sample 1

Pb: Gizzard (0.1299) > Bone (0.0865) = Muscle (0.0865) = liver (0.0865) = Skin (0.0865) > intestine (0.0433) = kidney (0.0433) = feather(0.0433)= claws(0.0433) mg/kg. Cu: Bone (3.9406) > Gizzard (2.8813) > Feather (2.5423) > Muscle (2.4576) > liver (1.7796) > Intestine (1.6949) > Claws (1.3559) > Kidney (1.1864) > Skin (1.0508)mg/kg. Zn: Kidney (0.1366) = Skin (0.1366) = Feather (0.1366) > Claws (0.0819) = Gizzard (0.0819) > Bone (0.0546) = Intestine (0.0546) = Liver (0.0546) > Muscle (0.0273) mg/kg. Cr: Muscle (0.4494) = Intestine (0.4494) > Liver (0.3370) = Skin (0.3370) = kidney (0.3370) > Bone (0.2247) = Gizzard (0.2247) = Feather (0.2247) = Claws (0.2247)mg/kg. Cd: Liver (0.4587) > Muscle (0.3669) = Kidney (0.3669) > Feather (0.2752) = Claws (0.2752) = Skin (0.2752) = Intestine (0.2752) > Bone (0.1834) = Gizzard (0.1834)mg/kg

Sample 2

Pb: Gizzard (0.0865) = Muscle (0.0865) = Claws (0.0865) > Intestine (0.0433) = Liver (0.0433) = Feather (0.0433) = Bone(0.0433) = Kidney (0.0433) = Skin (0.0433) mg/kg. Cu: Feather (0.1695) > Intestine (0.0847) = liver (0.0847) = Gizzard (0.0874)mg/kg. Zn: Gizzard (0.0456) = Muscle (0.0456) = Claws (0.0456) > Intestine (0.0273) = Liver (0.0273) = Feather (0.0273) = Bone (0.0273) = Kidney (0.0273) = Skin (0.0273)mg/kg. Cr: Bone (0.1123) = Intestine (0.1123) = Liver (0.1123) = Skin (0.1123) = kidney (0.1123) = Bone (0.1123) = Gizzard (0.1123) = Feather (0.1123) = Claws (0.1123)mg/kg. Cd: Feather (0.6422) > Gizzard (0.4587) = Bone (0.4587) > Intestine (0.3669) = Liver (0.3669) = Claws (0.3669) = Kidney (0.3669) > Skin (0.2752) = Muscle (0.2752) mg/kg. Cu metal has the highest concentration in the organs of the first chicken sample, whereas Cd in the organs of the other chicken sample has the highest concentration. It is also reported that Cd can affect Ca, P and bone metabolism in both industrial and people exposed to Cd in general environment [12]. [9],[13] detected cadmium levels in the livers and kidneys of cattle in Poland and they found the cadmium concentration to be higher than the permissible limit set by WHO, CODEX and other international bodies. Similarly, [5] found higher levels of cadmium and zinc in the livers and kidneys of the hens and chickens, which exceeded the official tolerance levels. From the results of the present study, the concentration of cadmium in all the samples organs studied were found to be lower than the 0.2 ppm (μg/g) permissible limit set by CODEX and other bodies, this was similar to the results obtained by [7].

If local chicken organs had the highest concentration of Pb refers to a serious contamination with Pb in chickens. The sources of pollution may be located near the breeding area, like industrial and chemical factories which will result in the contamination of feed, water, as well as the air inhaled by the animals Similar results obtained by [7] who determined lead concentration in liver of caprine, and [9] who reported higher concentration of lead than the permissible limit in the liver and kidney of animals. The present results revealed that the concentrations of lead in the organs of chicken taken from Wudil Central Market were lower than the permissible limit.

Generally these heavy metals were found to be lower than the permissible limits sets by world health organization (WHO), the food Agriculture organization (FAO), European Commission (EU), China (GB), Codex Alimentarius commission (CODEX), US, Food and Drug Administration

(FDA) and Australia and Newzealand (FSANZ) as shown in Table 3.4 which reflect deliberate additions of some of these metals (especially Cu and Zn) to meet the animal nutrient requirement in their feeds.

**Conclusion**

From the results of this study, the concentrations of all metals in the chickens were found to be insignificant. The comparison among the brand of chickens sample organs, there did show significant differences in the levels of heavy metals. Hence, the concentrations of (Cd, Cr, Cu, Pb and Zn) were within the tolerance limits set by WHO, FAO, CODEX and other international bodies.

This study also confirmed that analyzing metal content of liver, bone, feather, muscle, gizzard, skin, claws, intestine and kidney of a local chicken provides a reliable non-invasive method of monitoring ecological consequences of the contamination of the environment and its effect to health, and consequently, organs of local chicken are bio indicators of metals pollution. Hence there is need for deliberate addition of Cu and Zn metals in the animal feed for support and normal growth of these Animals.

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