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HEALTH RISK ASSESSMSNT OF TANNINS AND SOME TRACE METALS IN POULTRY FEEDS SOLD IN CALABAR, CROSS RIVER STATE, NIGERIA

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Abstract: The aim of this research was to determine tannins and trace metals level namely; cadmium, cobalt, iron, nickel, lead and tannins in poultry feed sold in Calabar and assess the health risk associated with the consumption of poultry products in the area. To achieve this, two major Brands of poultry feed sold in the area were purchased from the market and taken to the University of Calabar Chemistry Laboratory, labelled, digested and analysed for trace metals using Atomic Absorption Spectrometer and tannins using UV- Spectrometer. The results showed that the poultry feed used in Calabar contains some level of trace metals and tannins with mean values in mg/kg ranging between the two brands thus: Cd (0.25 - 0.39), Co (0.21- 0.37), Fe (6.20 -7.60), Ni (0.25 – 0.32), Pb (0.22 – 0.35) and Tannins (0.35 – 0.64 mg/L). The mean values of the metals in all the feed samples were below the WHO permissible limit of 1mg/kg, except for Fe. There was no significant difference between the amount of trace metals in the two Brands of poultry feed at $P<0.05$. From the Target Hazard Quotients values of highly less than 1, there is no health risk associated with the consumption of poultry products at the moment.

Keywords: Health risk, Trace metals, Poultry feed, Calabar.

Introduction

Food is any substance consumed to provide nutritional support for the body. It is usually of plant or animal origin. Some food is obtained directly from plants; but even animals that are used as food sources are raised by feeding them with food derived from plants (e.g. Cereal grains, Corn (maize), wheat, rice, etc.). Most of the grain that is produced worldwide is fed to livestock. Poultry is a category of domesticated birds kept by humans for the purpose of collecting their eggs, or killing for their meat and/or feathers). Poultry is the second most widely eaten meat in the world accounting for about 30% of meat production

worldwide, after beef at 38% (Mahesar *et al*., 2010). Poultry is basically a source of economic, palatable and healthy food protein. Poultry feed is food for farm poultry, including chickens, ducks, geese and other domestic birds. Besides, meat from domesticated birds have become the most preferred source of animal protein recently because it is believed to be healthier for adults and the aged than red meats like beef, mutton, pork, etc. However, the presence of some tannins and some trace metals like Cadmium (Cd), Lead (Pb), Cobalt (Co), Nickel (Ni) and Iron (Fe) in poultry feed have some advantages as well as disadvantage in the growth of the birds. Co, Fe and Ni are needed in the body in trace amounts for the normal physiological and metabolic processes but can become toxic in high doses while Cd and Pb are considered toxic even in small amounts as they have no specific use in animal body. Moreover, they can accumulate in animal bodies for a long time and later transferred to humans who use them as food and a source of protein.

Tannins are a group of phytochemicals that contains polyphenolic compounds of high molecular weight found occurring naturally in plants. Tannins have also been implicated in the development of some forms of cancer (Wamwari *et al*., 1995). As one of the anti-nutritional factors common in most cereal grains and legume seeds, tannins bind proteins, thus impairing protein digestion (Olomu, 1995). Douglas *et al*. (1991) reported depressed growth rate and reduced feed efficiency in poultry fed diets containing tannins. This was attributed to the fact; tannins reduce the utilization of energy and protein as well as amino acids Trevino *et al*., 1992).

These elements found in body in small amounts such as cadmium (Cd), Lead (Pb), cobalt (Co), Nickel (Ni) and iron (Fe) are elements important for maintaining the life processes in plants and/or animals including humans. Low uptake/intake causes deficiency and high cause's toxicity (Johnson, 2005).

Poultry feeds are known as a complete feed, since it is prepared in such a way to contain all the vitamins, minerals, energy, protein and other nutrients essential for proper health of the birds, egg production and growth (Bukar and Saeed, 2014). Feed ingredients and additives in poultry diets contain different sources: Corn and soybean meal sources of energy, fish meals and meat meals good sources of protein and amino acids. Bale *et al*. (2015) reported also that the feed consists of grains such as corn, wheat or barley, oil seeds, cake meal (originating mainly from oil producing seeds such as soybeans) sunflower seeds, peanuts, cotton seed and protein products of animal origin such as fish meal, meat and bone meal.

Trace minerals are important in poultry feeds because they contribute in biochemical processes required for normal growth, development and eggshell formation (Yenice *et al*., 2015). Heavy metals residues may concentrate in poultry meat and eggs which take up from different sources (Nisianakis *et al*., 2009). Some trace elements such as Iron (Fe) and copper (Cu) are

necessary for good human health which are commonly found in the diet nevertheless, all metals are toxic at higher concentrations (Lane and Morel, 2000). Other heavy metals like arsenic (As), Cadmium (Cd) lead (Pb) are toxic and their accumulation over time inside chicken can cause serious illness. Toxic metals such as arsenic, cadmium, lead and mercury are harmful to animals' health which occurs naturally in the environment as a result of natural causes, as well as industrial and agricultural practices. When found in feed, they pose serious health hazards to consumers and secondary consumers due to bio magnifications Bampidis *et al*., 2013). These toxic elements are also normally present in natural environment. Due to many reasons these elements can easily entered in feed ingredients of different animals and complexes of nature these elements are not digested at all. Many studies showed that elements used in feed accumulated in body and cause harmful impacts. In case of poultry industry deposition of heavy metals in body of broiler were result of their excessive use in poultry feed (Rehman *et al*.,2012). Some trace elements emitted to the environment from industrial activities, are harmful contaminates to humans which important element of pollution and bring about considerable damage to live ecosystems and the environment through natural and artificial means, easily accumulated and create complex structures particularly in soil, and they are defined as hazardous pollutants (Altundag *et al*., 2015).

Lead (Pb) causes acute and chronic poisoning and induces a broad range of physiological, biochemical and behavioural dysfunctions in man, animals and aquatic life (Erdogan *et al.,* 2005). Cadmium (Cd) pollutants found in the air, drinking water, and food is a potential health threat to humans, animals, and plants. Previous studies indicated that exposure to Cd results in severe damage to multiple organs and tissues, including the brain (Zhang *et al*., 2016).

Iron (Fe) is significant trace element for chicks, and it is required for functions of numerous Fe- containing enzymes and protein systems. Fe prevents clinical deficiencies in chickens or ensures they reach their optimal growth, for this reason Fe have been supplemented into their diets. Iron fortification is critical for broiler chickens because of increasing demand for' Fe because of the rapid increases in red blood cell volume and body mass Sun *et al*., 2015). Nickel is an essential element for the chick. It is required for activity of vitamin B12 and biotin during metabolism of odd-chain fatty acid in animals (Nielsen, 1991). Nickel, high concentrations of which can affect human health badly, can accumulate on plants, animals, and soil (Demir *et al.*, 2005).

From the above review, trace metals levels in poultry feed have not been studied in Calabar, Cross River State and reported. Thus, the need to carry out this study to ascertain the level of trace metals and tannins in poultry feed used in Calabar and the nearby States to ensure the safety of poultry product (meat and eggs)

consumed by humans in the study area (Calabar) and possible health risk that could be associated with the consumption of poultry products became imperative so as to safeguard the health of millions of people in the area.

Materials and Methods

Materials: The materials used for the study include: Reagents namely; Concentrated Nitric acid (HNO_3), Conc. Hydrochloric acid {HCl), Potassium ferrocyanide, 0.1N hydrochloric acid and Distilled water. Apparatus used were Electrical Analytical balance, Beakers**,** Filter paper**,** volumetric flasks, measuring cylinder, test- tubes in a rack and washed bottle and plastic bottle shaker.

Instruments: UV (Ultraviolet-Visible) Spectrophotometer, and Atomic Absorption Spectrometer (AAS).

Samples and Sample collection: Two brands of poultry feeds labelled as A and B were purchased from the market. Starter feed and Grower feed samples (most popular) brands were collected from different markets in Calabar. The samples were of different qualities and different manufacturing origin. They were labelled as A and B samples respectively.

Sample Preparation (digestion) of poultry feed for AAS Analysis

2g of crushed dry poultry feed is accurately weighed into a conical flask. Then 15 mL aliquot of aqua regia (HNO_3: HCl, 1:3 v/v) and 5 mL of H_2SO_4 were added in a fume cupboard. After digestion was complete, the beaker was heated in a fume cupboard for about 30 minutes. The digested sample was removed and allowed to cool. De-ionized water was added to the digest in a volumetric flask and made up to 100 mL. The solution of the digest was stirred and filtered to obtain the supernatant liquid ready for heavy metals analysis. The digestion procedure used in this study was modified from that reported by Akpe *et al*. (2020) and it conforms to methods of the Association of Official Analytical Chemists (AOAC). Trace metals analysis using a VGP 210 BUCK Scientific Model of flame Atomic Absorption Spectrometer (AAS) at the following wavelengths: Cd (228.9 nm), Co (240.7 nm), Pb (283.3 nm), Fe (248.0 nm) and Ni (232.0 nm).

Calculations: The Target Hazard Quotient which is the ratio of the body intake dose of a pollutant to the reference dose. According to US-EPA through Integrated Risk Information System-database IRIS (2011), if THQ is less than 1(THQ<1), it shows that there is no potential health risk associated with the pollutant. But if THQ>1, there is a health risk associated with the pollutant (heavy metal) at that moment. It is calculated thus:

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$$THQ = \frac{DIMxCm}{RfDxB}$$

Where DIM is the daily intake of meat in kg/day, Cm is the concentration of pollutant (trace or heavy metal) in the vegetable in $mgkg^{-1}$, B is the average body weight of humans in kg, while RfD is the oral reference dose of the pollutant permissible and it is fixed by United States Environmental Protection Agency (US-EPA). The RfD values for Cd, Co, Fe, Ni and Pb from IRIS are 0.03, 0.1, 0.01, 0.7 and 0.0035 $mgkg^{-1}$ respectively (IRIS, 2011). Note: B is assumed by US-EPA to be 70kg for men and 60kg for women. For this study, 65kg (the average of 70kg and 60kg) was used for all adults, while the DIV was assumed to be 100g (0.1kg/day) per day (Akpe *et al*., 2018; Akpe *et al*., 2021).

Determination of tannins: 0.5g of the sample was weighed into plastic bottle and 50cm3 of water was added and shaken for 1 hour in a shaker. It was transferred and 5 cm^3 of the extract was measured to a test tube and mixed with 3 cm^3 of 0.1N HCl and 3 drops of ferrocyanide. It was allowed to stand for 10min, then measured in the UV-Spectrometer at 605nm. Blank too was determined.

Results and Discussion

The results of analysis are presented in Table 1 and 2 for trace metals and tannins levels in poultry feed, and the Target Hazard Quotients respectively.

Table 1: Mean values of trace metals (mg/kg^{-1}) and tannins (mg/L) in poultry feed sold in Calabar.

Samples	Cd	Co	Fe	Ni	Pb	Tannins
A	0.25 ± 0.13	0.21 ± 0.04	6.20 ± 0.18	0.32 ± 0.03	0.22 ± 0.18	0.35 ± 0.03
B	0.39 ± 0.01	0.37 ± 0.12	7.60± 0.14	0.25 ± 0.04	0.35 ± 0.12	0.64 ± 0.03

Note: values reported mean ±SD Format, with N= 3.

Table 2: Target Hazard Quotients of Trace metals in Poultry feed sold in Calabar.

Sample	Cd	Co	Fe	Ni	Pb
A	0.013	0.003	0.014	0.049	0.097
B	0.020	0.006	0.017	0.038	0.154

The results in Table 1 showed that the poultry feed used in Calabar contains some level of trace metals and tannins with mean values in mg/kg ranging between the two brands thus: Cd (0.25 - 0.39), Co (0.21- 0.37), Fe (6.20 -7.60), Ni (0.25 – 0.32), Pb (0.22 – 0.35) and Tannins (0.35 – 0.64 mg/L). The mean values of the metals in all the feed samples were below the WHO permissible limit of 1mg/kg, except for Fe. Also, the low concentration of tannins, a group of phytochemicals may not have any serious negative physiological effects on the birds nor cause any harm to humans who consume poultry products (meat or eggs). This is because tannins can be digested or metabolised by the body of the birds. Brand B feed had slightly higher values of all the metals and Tannins than Brand A except Ni that was higher in Brand A than B. However, there was no significant difference between the amount of trace metals in the two Brands of poultry feed at $P<0.05$. The variation of the metals was in the order: Fe > Cd > Co > Pb > Ni. From the results of the Target Hazard Quotients (THQ) in Table 2, it shows that the metals amounts are still low as they are highly less than 1, indicating that there is no health risk associated with the consumption of poultry products at the moment (IRIS, 2011). The level of trace metals in these poultry are lower than those reported in China and some other places in the globe. For instance, Mashesar *et al*. (2010) analyzed four metals (Zn, Pb, and Cu) the amount of Zn, Cd, Pb and Cu in about 28 commercial broiler poultry feeds samples and reported values ranging between 54.3-482.2, 3.8-33.6, 23.2-32.6, and 12.3-65.8 mg/kg, respectively. In most poultry feed samples, the amount of Cd and Pb was found greater than the maximum tolerable level which could be harmful for the poultry. Also, Alkhalaf *et al*. (2010) found the amount of copper and other metals were within the permissible limits but amount of nickel and some other metals were more than the permissible limits. Wang *et al*. (2013) analyzed feed samples which were collected from farm in Fiangusu Province in China to detect heavy metals concentrations, their results showed that heavy metal content showed large variety indicating the difference in the use of feed additives among farmers.

Conclusion: The results of the study revealed that there is trace metals contamination of the poultry feeds sold in Calabar as well as the presence of tannins. However, their amount is still low and within the permissible limit of World Health Organisation (WHO). The consumption of poultry products in the study area may not cause any health risk at the moment as a result of trace metals or tannins. There is need to maintain this low level by creating awareness and close monitoring by the relevant government agencies.

Conflict of Interest: The authors declare that there is no conflict of interest with the manuscript.

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