BROILER FEEDS ASSESSMENT FOR HEAVY METALS WITHIN KADUNA METROPOLIS USING NON DESTRUCTIVE ANALYTICAL TECHNIQUE

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Abstract: This study evaluates heavy metals in selected broiler feed using anon-destructive analytical technique. In this study four feeds commonly used in feeding Nigerian broilers were sampled from different areas of Kaduna State, Nigeria. The results shows that all the concentrations or mass fraction of essential trace metals Ca, K, Cl, Mg, and Na were present in significant amount, respectively; while the heavy metals Fe, Mn, Zn, Rb were also present in all the samples respectively, the remaining were below detection limit (BDL).The results obtained were within the WHO recommended values of 45-80 ppm, with Fe and Zn concentrations in BRC and BRD samples exceeding the WHO/FAO maximum acceptable limit of 45-80 ppm and 10-50 ppm as adopted by SON.

Keywords: Broiler feed, NAA, heavy metala, NIRR-1

Introduction

The ingestion of heavy metals into human body is mainly through different food chains. This brought about global awareness on the adverse effects of the metals in the human bio-system and environment is rapidly increasing due to the enhanced industrialization and urbanization.

The techniques Neutron activation analysis (NAA) is a non-destructive and does not required samples dissolution. This technique is applied in the determination of essential and non-essential metal in a wide range of materials (Glasscock, 2005; Bode *et al*., 2005). Recently NAA has been increasingly used in trace element analysis in various foods (Nyarko *et al*., 2008). However, very few papers have been published using non-destructive NAA for the determination of nutrients and heavy elements in samples. This method (NAA), has been successfully used on a regularly basis in several areas of nutrition and broilers feed (Kapsimalis *et al*., 2009; Zikovsky, 2006; Oladipo, 2003). NAA has become an important and useful research tool due to its advantages. These include high accuracy, small quantities of samples and no chemical treatment. It is our hope in this research to assess the trace and heavy metals in selected Nigeria broiler feeds using non-destructive technique (NAA).

Materials

The materials used in this study are: NIRR-1, Water, HPGe detector, Balance, glove, laboratory agate and mortar, cotton wool, acetone sieve, white papers, forceps spatula, Broilers feed.

Methods

Four samples coded as BRA, BRB, BRC and BRD were purchased from different locations within Kaduna state metropolis. The samples were then dried and pulverized into fine powder and subsequently homogenized using agate and mortar. The homogenized samples were prepared in 0.125 g polyethylene vials. Each vial contained roughly 0.125 g of the feeds sample due to the complex nature of the feed.

The standard protocol applied in this research at low quantities in all types of matrices was discussed by Jonah *et al*. (2005) and Oladipo (2003). The samples were irradiated using the Nigeria Research Reactor-1 (NIRR-1) at the Centre for Energy Research and Training (CERT) Ahmadu Bello University Zaria Kaduna State Nigeria.

The HPGe detector was calibrated using standard source, quality control was done by determining the certified elemental concentration in NIST1515 apple leaves. Identify the isotopes in the spectra using gamma library was carried out to determine the elemental concentrations and their uncertainties using gamma-ray spectrum analysis software (WINSPAM, 2004; Kogo *et al*., 2009; Funtua *et al*., 2012; Anas *et al*., 2017).

Results and Discussion

The result of elemental concentration of sample BRA, BRB, BRC and BRD are given in Table 1 and Fig. 1. It can be observed from Table 1 and Figure 1 that the increasing of the concentration values of the elements for Sample BRA is K > Mg >Cl> Na > Al> Fe >Sr>Mn> Zn >Rb> Cr > Se > Co with Ca and Br found to be below detection limit (BDL), Ca> K >Cl> Mg > Fe >Na > Al > Zn >Ba >Rb>Mn>Br >Sc> Co with Cr, Sr found to be below detection limit (BDL) for Sample BRB, K >Ca>Cl> Mg > Na > Al > Fe >Mn> Zn > V >Rb> Br > Co with Cr, Sr, Th and Ba found to be below detection limit (BDL) for Sample BRC, Ca> K > Mg >Cl> Na >Mn> Fe > Zn >Rb> Br > Co with Cr and Sr found to be below the detection limit (BDL) for Sample BRD.

Table 1: shows the concentrations of trace and heavy elements in the BRA, BRB, BRC, and BRDin part per million (ppm)

Element	Concentration in ppm (µg/g)			
	BRA	BRB	BRC	BRD
Mg	3506±197	1745±145	3678±169	3215±145
Al	473±26	534±22	325±12	130±8
Cl	2224±76	3865±93	4773±81	2203±57
Ca	BDL	8562±787	6501±533	11620±709
Mn	45.2±0.6	8.3±0.3	125.2±0.9	143.4±0.9
Sr	212±25	BDL	BDL	BDL
Na	1294±3	683.4±2.1	1443±3	1402±2.8
K	7859±134	7892±126	10440±167	9822±157
Cr	0.8±0.3	BDL	BDL	BDL
Fe	334±38	718±47	333±31	113±24
Co	0.061±0.012	0.07±0.02	0.09±0.01	0.082±0.020
Zn	42.4±3.6	41.2±4.4	117±5	95±5
Br	1.450±0.416	5.1±0.6	2.9±0.7	8.11±0.71
Rb	23.2±1.6	17.6±1.5	16.1±1.5	13.6±1.4

Iron (Fe) was found in all samples but above the permissible level 45-80 ppm as stipulated by (FAO/WHO, 2000) and comparing with that of (SON, 2003) which will suffice the nutritional requirement of the poultry (broiler) (Helsing, 1994).

The concentration of Ca in sample BRA was found to be below detection limit even though this element has significant useful functions in the broilers and human body. Samples BRB and BRD are found to be richer in Ca which suggest that these feeds can be a source of Ca supplements to animals (Rabia *et al*., 2012). Similarly the higher quantity of Mg was recorded though its precise requirement in feed sample is not known (Scott, *et al*., 1975). Significant amounts of K and Na

was observed in all the samples, this means that all the samples are richer in potassium and sodium (Djama *et al*., 2012 and Lokhande *et al*., 2009).

Zinc (Zn) concentration was found to be highest in sample BRC followed by sample BRD, BRA and BRB, respectively. It was observed that the concentration of zinc in samples BRA and BRB were within the permissible limit of 10-50 ppm (SON, 2003; Hussain *et al*., 2012 and Surtipanti *et al*., 1990), while in samples BRC and BRD is above the permissible limit of 10-50 ppm (SON, 2003; Hussain *et al*., 2012; Surtipanti *et al*., 1990). In general, zinc level were found to be high in all the samples but were still within the permissible limit of 500 mg/kg stipulated by European Union (SON, 2003).

The concentration of Chromium (Cr) in sample BRA is above the permissible limit (0.1 ppm) (µg/g), while the concentration of Chromium in samples BRB, BRC, and BRD were BDL (Dwyer, 1994; Shahidul *et al*., 2014).

Mn which is an important element in animal body was found to be present in all the analysed samples. It was found that, all the feed samples are below the microrequirement level of 50-60 µg/g except in sample BRC and BRD (Al-Mugrabi and Spyrou, 1987; Keen *et al*., 1994; Freeland *et al*., 1987).

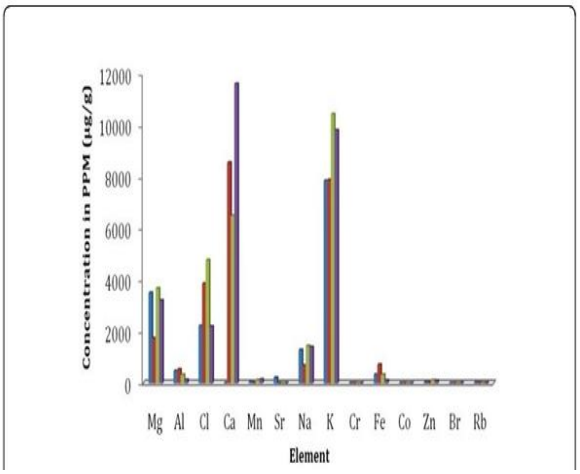

Fig. 1: The concentration of trace and essential element in BRA, BRB, BRC and BRD

The concentrations of Copper (Cu), Selenium (Se) and Cobalt (Co) in the entire sample were found to be Below Detection Limit (BDL), even though some of them have little importance in the feed and animal body.The results revealed that the selected broiler feeds accumulate these elements at different concentrations. Monitoring such broiler feed for trace and heavymetals concentration is of great importance for policymakers in protecting the public, physicians and health care professionals from the adverse effects of this metals.

Conclusion

In this work, four (4) different samples of broiler feeds were purchased from different part of Kaduna state, Nigeria andanalysed for elemental compositions using neutron activation analysis (NAA). The result shows that the macronutrient presence are Ca, K, Cl, Mg and Na, even though Ca content in sample BRA was below detection limit. The trace elements presence are Fe, Mn, Zn and Rb in all the samples respectively, the remaining were below 1% (BDL). However the distribution of elements in sample BRC and sample BRD of the feeds contain high concentration of zinc Zn compared to sample BRA and BRB, which shows that the concentration of Zn in the sample BRC and BRD were above the permissible limit. Sample BRB contained high concentration of Fe compared to BRA, BRC and BRD. This shows that sample BRB contained some level of toxicity of iron compared to other samples. The levels of the entire studied element were within the tolerance limit except Fe in sample BRB and Zn in sample BRC and BRD. There is the need to also increase the quantity of supplements been added to the feeds so as to increase its nutritional values for the poultry? We have demonstrated in this study that neutron activation analysis NAA method is ideal for determination of trace and heavy metals in broiler feed. Since the technique is a non-destructive one and requires no sample dissolution.

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