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Identify the Presence and Source of Heavy Metal in Broiler Chicken Meat (Rajshahi Region, Bangladesh)

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Abstract | **Original Research Article**

The present study was conducted to determine the level of the presence of heavy metal especially lead (Pb), chromium (Cr) and cadmium (Cd) in various body parts of broiler chicken (Liver, Bone, Core, Meat & Skin) from the Rajshahi City local markets. All results show negative effect where the highest quantity of Pd, Cr and Cd in feed is below the detection limit (BD), 0.0432, 0.0053 ppm respectively. However, the highest quantity of Pd, Cr and Cd in body parts of Chicken is 0.1313 in bone, 0.0977 and 0.0069 in skin which are safe for consumption considering the allowable WHO / FAO limit of Pb, Cr, Cd are 1.0ppm, 1.0ppm, 0.3ppm respectively. Moreover, mercury (Hg) is a vaporized, molten metal that is vaporized at the cooking temperature. As a result we can be confident that the checked product was safe for consumption as an animal protein.

Keywords: Heavy Metals, Protein, Atomic absorption Spectroscopy, Vapourization, WHO, FAO.

INTRODUCTION

High price and high cholesterol of Beef & Mutton flesh, Chicken is becoming the key source of protein not only in Rajshahi but all of Bangladesh as well. Most of the people live below the poverty line, so they can't afford to buy high price protein source, but some research shown that toxicity in broiler chicken is particularly heavy metal. The heavy metal toxicity has been proven to be one of the major threats to human health [1]. The presence of heavy metal has shown toxic effects even at very low concentrations; its presence in foodstuffs can cause serious health problems such as central nervous disorders, anemia, damage to the kidneys and bones, cancer, glucosuria, osteomalacia etc [2, 3]. Pb affects different systems in humans and causes neurological symptoms ranging from fatigue, headache and lethargy to peripheral neuropathy, severe seizures, encephalopathy and even coma [4, 5]. Furthermore, low concentrations of Pb can be found in tissues of clinically normal birds and animals [7]. Broiler chickens are vulnerable to inxication with Pb. As low as 1.0 ppm Pb in the diet can cause significant growth suppression in chickens and consistent decline of D-aminolevulinic acid dehydratase in the blood which is a Pb-sensitive erythrocyte enzyme [8]. Chicken-consumed Pb is accumulated in bones, soft tissues and eggs [8]. Pb bone levels are the highest by far, followed by liver and kidney. In the skeletal muscle the lowest Pb concentration is found [9]. Anthropogenic Cd is a priority pollutant to the atmosphere and an established risk to health [10]. The main consequence of long term exposure to Cd is permanent renal tubular dysfunction; the final and serious outcome is chronic renal failure even can cause damage to bones [5]. Ecotoxicological work has shown that marine birds that have their own breeding grounds in the northern hemisphere's arctic and subarctic regions have high levels of Cd that concentrate mainly in the highest concentration of kidneys and then in the liver at relatively lower concentrations [11]. Due to their key role in detoxification processes, ecotoxicological research on Pb and Cd accumulation has focused on the liver and kidneys in a poultry [11]. Nevertheless, with respect to the value of public health for these trace elements, determining their concentrations is important in the concept of other edible chicken giblets. Notably, Pb and Cd, in particular, are seldom investigated in chicken giblets. The main goal of our research is to establish the presence of heavy metal in Food, to determine the reason for excess heavy metal if it is present and to make people aware of what they are consuming.

MATERIALS AND METHODS

MATERIALS

All the reagents and chemicals used in the present work were purchased from Thomas Baker (Mumbai, India) and E. Merck (Germany) supplied by local vendors. All of the reagents are of analytical grade (i.e. purity higher than 99.9%) and used without further purification. All glasswares, plastic wares used, were thoroughly washed with liquid soap, rinsed with distilled water, soaked in 10% nitric acid for 24hours, once again cleaned thoroughly with DDW and dried in such a manner to ensure that any contamination does not occur. All collected samples were stored in clean polyethylene bags, and used for analysis.

METHODS

Chicken feed was collected from a local shop and dried for 6 hr into the oven, then grinded into a powder and mixed homogeneously for analysis. To assess heavy metal of chicken meat the chicken were also collected from the market of Rajshahi, shaheb bazar and binodpur bazar. Then all the parts of chicken and feed were hashed, dried at 95 ^{0}C and mineralized by wet digestion method (HNO_3– H_2O_2- H_2SO_4). Approximately 0.5 g of each dried sample was digested in 8 mL 65% HNO_3 for 3ml H_2O_2 excluding bone sample. The bone sample was then digested in a microwave heating digester with 8 mL 65% HNO_3 and 2ml H_2SO_4. The resultant solutions were analyzed with an atomic absorption spectrophotometer. Total process is presented in the Fig-1.

For each sample two replication determinations have been made.

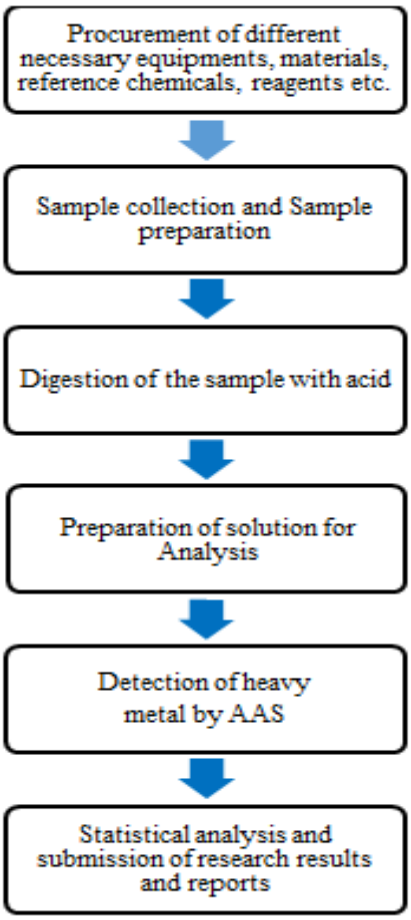

Fig-1: Flowsheet for sample preparation and sample analysis process

RESULT AND DISCUSSION

The present study reports on the heavy metal content of Pb, Cr, and Cd as determined by the collected Chicken in selected body parts (Liver, Bone, Heart, Meat & Skin) and feed from market sites in the Bangladesh Rajshahi City Corporation district. The measured concentrations of Pb, Cr, and Cd in the chicken and feed were compared with the recommended limit set by the FAO / WHO in 2000 to determine the contamination levels of the food. The mean concentrations and variety of heavy metals found in chicken and feed collected from local markets in Bangladesh's Rajshahi City Corporate Area are given below:

Table-1: Mean concentration of heavy metal in eight different type of feed

Serial No	Sample Name	Selected heavy metal in ppm		
		Pb	Cd	Cr
01	Feed-1	BD	0.0038	0.0173
02	Feed-2	BD	0.0044	0.0243
03	Feed-3	BD	0.0044	0.029
04	Feed-4	BD	0.005	0.0243
05	Feed-5	BD	0.0044	0.0432
06	Feed-6	BD	0.0053	0.022
07	Feed-7	BD	0.0041	0.0243
08	Feed-8	BD	0.0039	0.0173

Table-2: Mean concentration of heavy metal in selected five chicken meat

Serial No	Sample name	Selected Heavy metal in ppm		
		Pb	Cr	Cd
01	Chicken -1	0.0113	0.055	0.0035
02	Chicken -2	BD	0.0507	0.0019
03	Chicken -3	BD	0.022	0.0032
04	Chicken -4	BD	0.0173	0.0038
05	Chicken -5	0.0112	0.055	0.0032
06	WHO/FAO MPL	1.00	1.00	0.30

Table-3: Mean concentration of heavy metal in selected five chicken bone

Serial No	Sample name	Selected Heavy metal in ppm		
		Pb	Cr	Cd
01	Chicken -1	0.1313	0.0432	0.0041
02	Chicken -2	0.1313	0.0196	0.0025
03	Chicken -3	0.1313	0.0314	0.0053
04	Chicken -4	0.0976	0.0102	0.0063
05	Chicken -5	0.1213	0.035	0.0024
06	WHO/FAO MPL	1.00	1.00	0.30

Table-4: Mean concentration of heavy metal in selected five chicken liver

Serial No	Sample name	Selected Heavy metal in ppm		
		Pb	Cr	Cd
01	Chicken -1	BD	0.022	0.005
02	Chicken -2	BD	0.0243	0.0044
03	Chicken -3	BD	0.0173	0.0053
04	Chicken -4	BD	0.022	0.0041
05	Chicken -5	BD	0.0233	0.005
06	WHO/FAO MPL	1.00	1.00	0.30

Table-5: Mean concentration of heavy metal in selected five chicken heart

Serial No	Sample name	Selected Heavy metal in ppm		
		Pb	Cr	Cd
01	Chicken -1	BD	0.0196	0.005
02	Chicken -2	BD	0.0203	0.005
03	Chicken -3	BD	0.0149	0.005
04	Chicken -4	BD	0.0163	0.0063
05	Chicken -5	BD	0.0196	0.005
06	WHO/FAO MPL	1.00	1.00	0.30

Table-6: Mean concentration of heavy metal in selected five chicken skin

Serial No	Sample name	Selected Heavy metal in ppm		
		Pb	Cr	Cd
01	Chicken -1	BD	0.0856	0.0044
02	Chicken -2	BD	0.0196	0.0047
03	Chicken -3	BD	0.0977	0.0069
04	Chicken -4	BD	0.0149	0.0056
05	Chicken -5	BD	0.0267	0.0041
06	WHO/FAO MPL	1.00	1.00	0.30

The calculated concentrations of heavy metal were based on dry weight of the sample.

The mean concentration range of Cr and Cd in the feed sample, as shown in Table-1, is 0.0173 to 0.0432ppm and 0.0038 to 0.0053ppm respectively, where the amount of lead is below the detection limit. In some poultry feeds sold in Bangladesh, some researchers have reported that mean concentrations of heavy metals to include 0.1852-0.0232 ppm for cadmium, 20.6498-0.6019 ppm for lead and 5.7875-0.0926 ppm for chromium [12, 13]. It reveals that all the feed sample tested were safe for the poultry chicken.

Table-2 contains the highest concentration of lead was identified in chicken meat known as muscle sample-1 is 0.1313ppm, far below the WHO / FAO allowable limit [14]. The two concentrations of metals still remain below the allowable level of 0.0173 to 0.055ppm and 0.0019 to 0.0038ppm respectively of Cr and Cd [14].

The range of heavy metal selected to be tested in chosen sample were between 0.0976 to 0.1313, 0.0102 to 0.0432 and 0.0024 to 0.0063 of Pb, Cr and Cd respectively shown in table -3. They were also well below the permissible limit set by WHO/FAO 2000.

From the results in Table-4, among the five selected chicken sample liver contain below detection limit Pb. Although others two element Cr and Cd can be detected but their concentration range between 0.0173 to 0.0243ppm and 0.0041 to 0.0053ppm respectively, which is also below the permissible limits.

In Table-5, we observed that the selected heavy metal range is 0.0149 to 0.0203ppm and 0.005 to 0.0063ppm of Cr and Cd respectively where the concentration of Pb is below detection limit.

The result shown in Table-6, mean concentration of heavy metal confines chicken skin ranges in between 0.0149 to 0.0977 and 0.0041 to 0.0069ppm of Cr and Cd metal. In this experiment, Pb also remain below detection limit.

To summarize all the results, it is shown that the levels of Pb in all body parts ranged between BD to 0.1313mg/kg. The range of Cd concentration (0.0019 mg/kg to 0.0069 mg/kg and 0.010 to 0.0977mg/kg) in the current study was substantially lower than the Cd contents (2.67- 4.33 mg/kg) found in chicken in Bangladesh in a study by Rahman *et al*., [15]. Cr also found in tested sample. Therefore, it can be concluded that all the result shows negative effect which means that the feed and chicken sample considered for being checked was safe and healthy.

CONCLUSION

In this study, the result reported here confirms that the possible accumulation of heavy metals (Pb, Cr and Cd) in broiler chicken tissue / organs originates from the feed. According to the results, the feed sample safe for poultry (Broiler chicken) and heavy metal accumulation (Pb, Cr, Cd) in family poultry tissue / organs (Broiler chicken) has below the acceptable limits set by the WHO / FAO 2000, so chickens can be considered safe from this area for human consumption. To provide safe food or to maintain food safety certain type of investigation after a time interval is needed. Finally, this study can help poultry feed producers and poultry farmers provide nutrient-balanced, nutritious, safe, and cost-effective broiler flesh that continues to be a major protein source for consumers.

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Conflicts: Authors declare that there is no conflict of interest.

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