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RISK ASSESSMENT OF CHROMIUM LEVELS IN BROILER FEEDS AND MEATS FROM SELECTED FARMS OF BANGLADESH

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ABSTRACT

The present study was conducted to evaluate the status of chromium concentration in broiler feeds with the risk assessment of chromium in broiler meat. Seven broiler farms were selected to collect the feed and meat samples of broiler. Atomic absorption spectrophotometer (AAS) was used to determine the chromium concentration in broiler feed and meat samples. The highest concentration of chromium in broiler meat samples was 1.31±0.20 µg/g and in feed samples was 1.71±0.24µg/g. In this study, the mean (± SE) concentration of chromium in feed samples from Gazipur Sadar, Gazipur; Sreepur, Gazipur and Tangail Sadar, Tangail were 1.71(± 0.24) µg/g,1.64(±0.61) µg/g and 1.64(±0.61) µg/g respectively. The mean (± SE) concentration of chromium in meat samples from Gazipur Sadar, Gazipur; Sreepur, Gazipur and Tangail Sadar, Tangail were 1.139 (±0.26) µg/g, 1.31 (±0.20) µg/g and 0.61 (±0.23) µg/g respectively. The concentrations of chromium in broiler edible tissues were much higher than permissible levels determined by FAO and WHO. Precocious steps must be taken to avoid use of such health hazardous concentrations of heavy metals in poultry feeds. Considering these findings, there is a critical need to set legal limits and surveillance system for detection of heavy metals in poultry industry of Bangladesh.

Key words: Chromium, broiler feeds, broiler meats.

INTRODUCTION

Food safety is a major public health concern worldwide. During the last decades, the increasing demand of food safety has stimulated research regarding the risk associated with consumption of heavy metals (D'Mello, 2003). Heavy metals, in general are not biodegradable, having long biological half-lives and having the potential for accumulation in the different body organs leading to unwanted side effects (Jarup, 2003; Banerjee *et al.*, 2011). The risk associated with the exposure to heavy metals present in food product had aroused wide spread concern in human health (Meli *et al.*, 2015).Occasionally, mineral supplements are added to broiler feeds to fulfill the required limit. Most of the time, studies conducted on broiler feeds in India, Bangladesh, Pakistan and various other places around the world, have shown the presence of high concentration of heavy metals in broiler feeds, due to purely anthropogenic reasons (Mahmood *et al.*, 2004; Islam *et al*., 2007; Sunda, 2010). Khan *et al.* (2005) assessed the risk of polluted and excessive amount of various ingredients used in animal feed. As far as the feed ingredients and the compound feed for poultry are an essential part of the consumer's food chain, they need to be determined as potential sources of chromium contamination. Many studies are conducted to detect the chromium from poultry feed and results showed the mixing of high concentration of heavy metals (Alkhalaf *et al*., 2005). When these metals are added in feed more than the required level, these can accumulate in body tissues of broiler and in human being on its consumption (McBride *et al.*, 2001). Chromium and its compounds are also well known toxins especially chromium (VI) which due to its oxidizing potentials easily permeates biological membranes and causes renal damage, disease of the central nervous system, cancer etc. in human (Bae *et al*., 2001). In case of poultry industry deposition of chromium in broiler meats were result of their excessive use in poultry feed. Considering the potential risks of chromium in broiler edible tissues in Bangladesh, the present study was designed to detect chromium in broiler feed and their accumulation in body tissues.

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MATERIALS AND METHODS

Sample collection

A study was conducted at the Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh during the period of January 2016 to May 2016 from selected 5 broiler farms and 2 live bird markets of Gazipur Sadar and Sreepur upazilla of Gazipur district and 2 broiler farms from Tangail Sadar of Tangail district in Bangladesh. A total of 37 samples were collected from 7 broiler farms and 2 live bird markets including 30 meat samples and 7 feed samples to evaluate the intensity of chromium levels in feeds and meats of broiler. Then it was immediately brought to the Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh through cool chain maintaining.

Sample preparation

This process of digestion is required for spectroscopic analysis. The principle is releasing of metals from solid matrix to the acid solution during the extraction process (Koki, 2015). The concentration of total heavy metals in broiler feed and meat samples were determined at the Department of Agricultural Chemistry of Bangladesh Agricultural University, Mymensingh. According to Rashid *et al.* (2016) nitric and perchloric acid digestion in 2:1 ratio was used for digestion of samples. For nitric and perchloric acid digestion it is required to prepare di-acid mixture by adding 100ml nitric acid and 50 ml perchloric acid to produce 150ml preparation. Approximately 1gm of sample was placed in a 250 ml of digestion tube before the addition of 10 ml di-acid mixture. The mixture then placed on a hot plate to maintain 120^0c temperature until the mixture become colorless. After completing the digestion, the sample kept cool at room temperature. Then the digest was filtered through a filter paper (Whatman no.42) and the filtrate volume was made up to 50 ml with distilled water. The sample was then diluted to 100 ml using deionised distilled water and preserved it plastic water container.

Determination of chromium in broiler feed and meat by spectroscopic analysis

The determination of chromium in extracted samples was done by using an atomic absorption spectrophotometer (AAS) (Shimadzo, AA7000, Japan). Monoelement hollow cathode lamp was employed for the determination of each heavy metal of interest. At first the AAS was calibrated followed by the manufacturer's recommendation. A standard curve was prepared by plotting the absorbance reading on Y-axis versus the concentration of each standard solution of metal on X-axis. Then, the concentration of heavy metal was calculated in the samples of interest by plotting the AAS reading on the standard curve.

Statistical analysis

Data for chromium (Cr) content of broiler feeds and meats from different locations were analyzed statistically using the SPSS (version 20.1) software. A one-way analysis of variance (ANOVA) of each variable was worked out.

RESULTS AND DISCUSSION

The chromium (Cr) concentration in collected broiler meat and feed samples are presented in Table 1. The mean (± SE) concentration of chromium in meat samples from Gazipur Sadar, Gazipur; Sreepur, Gazipur and Tangail Sadar, Tangail were 1.139 (±0.26) µg/g, 1.31 (±0.20) µg/g and 0.61 (±0.23) µg/g respectively. In this study, a total of 30 meat samples were collected from 7 broiler farms and highest concentrations of chromium (1.31±0.20µg/g) were detected in Sreepur, Gazipur. The mean (± SE) concentration of chromium in feed samples from Gazipur Sadar, Gazipur; Sreepur, Gazipur and Tangail Sadar, Tangail were 1.71(± 0.24) µg/g, 1.64(±0.61) µg/g and 1.64(±0.61) µg/g respectively. A total of 7 feed samples were collected from 7 broiler farms and highest concentrations of chromium (1.71±0.24µg/g) were detected in Sreepur, Gazipur. Analysis of variance shows that different placement had non- significant effect on broiler feed and meat chromium levels (Table 1). The current study was conducted to investigate the presence of chromium level in broiler feeds and meats from selected farms of Bangladesh. For the detection of the chromium concentration sample preparation, digestion and spectroscopic analysis were performed. Chromium concentration was found to be much lower than the permissible limit set by NRC, 2005 (500 ppm or µg/g). There is no permissible limit for chromium in feeding stuff given by the EU, 2003. The concentrations of chromium in broiler edible tissues were much higher than

permissible levels determined by FAO and WHO (Choi, 2011). The current study recorded only chromium in feed and edible tissues of broiler. It is necessary to conduct a study for the screening of heavy metals that are intentionally or unintentionally introduced in broiler production.

Table 1. Concentration of Chromium (Cr) in collected broiler meat and feed samples

Type of Sample	Sample No.	Placement	Chromium concentration (µg/g)	Mean Concentration (± SE)(µg/g)
Meat	1	Gazipur Sadar, Gazipur	BDL	1.139 (± 0.26)
	2		1.19	
	3		2.41	
	4		0.97	
	5		1.68	
	6		1.83	
	7		2.29	
	8		1.01	
	9		0.86	
	10		BDL	
	11		BDL	
	12		2.57	
	13		BDL	
	14	Sreepur, Gazipur	1.18	1.31(± 0.20)
	15		1.59	
	16		2.21	
	17		BDL	
	18		1.87	
	19		1.16	
	20		1.44	
	21		1.26	
	22		1.13	
	23	Tangail Sadar, Tangail	BDL	0.61(± 0.23)
	24		BDL	
	25		1.51	
	26		0.98	
	27		1.18	
	28		BDL	
	29		1.22	
	30		BDL	
Feed	1	Gazipur Sadar, Gazipur	1.37	1.71(± 0.24)
	2		1.59	
	3		2.18	
	4	Sreepur, Gazipur	2.26	1.64(± 0.61)
	5		1.03	
	6	Tangail Sadar, Tangail	1.28	1.175(± 0.11)
	7		1.07	

*BDL= Below Detectable Limit in ppm level **(**µg/g)

CONCLUSIONS

The result of this study therefore indicates that broilers raised with commercial feed have significant concentrations of chromium over the permissible FAO/WHO levels. High concentration of chromium in broiler feeds resulted in their bioaccumulation in muscle tissues of broiler. That is not only harmful for broilers itself but can also be harmful for consumers on excessive consumption.

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