

Spectroscopic Determination of Heavy Metals in Commercially Available and Household Chicken Meat in Quetta City

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Abstract

This research study was conducted to analyze the meat of both broiler and domestic chickens for heavy metals (Cd and Zn) through Atomic Absorption Spectrometer. The samples of both chickens were taken from different regions of Quetta City. The tissues such as heart, liver, muscles, kidney, and gizzard of both broiler and home-grown chickens were examined to detect the quantity of metals in them. This study showed higher concentration of Cd in all body parts of broiler chicken than domestic. However, it was found lower than that reported by Iwegbue et al. Gonzalez-Weller et al and Marriam et al (0.49–0.16 ppm). While on other hand, kidney, gizzard and liver of home-grown chicken showed higher level of zinc than broiler except heart and muscles. However, it showed the lower level of zinc than the study performed by Mariam et al in Lahore and Khan et al in Karachi. The current study concludes that both Cd and Zn were lower than the acceptable level 0.5 ppm and 10 – 50 ppm given by WHO/FAO respectively.

Key words: Broiler Chicken; Domestic Chicken; Heavy metals; Absorption Spectroscopy

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INTRODUCTION

Science and technology have brought a great revolution in increasing poultry industry in the world. Poultry is used as food source globally in different practices to get rid of the scarcity of the human food. Mostly used poultry type is chicken which provides meat and eggs on large scale. These products are rich of protein and other necessary elements [1]. There are so many poultry farms in Pakistan for poultry production and development. In addition, the people also keep the poultry at their homes to meet their nutritional as well as economical requirements. Home grown poultry meat is considered more beneficial for human health because of feeding on pure poultry food [2]. Heavy metals may become the cause of pollution in edible substances like water and food. Food and water get contaminated with heavy metals through the wastes of industry [3]. Some other metals also exist in a minute amount known as trace elements like copper, cobalt, manganese etc. these type of elements play very important role in the maintenance of life of both animal and birds. However, these may become toxic in large amount and may become deficient at very small amount [4].

Excessive bio-accumulation of heavy metals may have unscrupulous effect on human health. It can cause disorder even in less quantity because of its toxic nature [5]. Heavy metals such as cadmium easily enter into the poultry through intoxication and their food. the accumulation of cadmium may cause renal failure, osteoporosis and mutagenic effects in human body when crosses permissible limit fixed by the WHO [6]. While on the other hand, Zn is very imperative metal because it promotes growth and development in poultry. The national research council recommended the acceptable level of Zn for poultry in their food from 40 mg/kg to 75 mg/kg. Moreover, zinc may also be the part of different enzymes in poultry body [7]. However, the paucity of zinc in the foods tuffs of poultry may cause effect on the growth, bone abnormalities, deformities in skeleton etc.

This study aimed to determine the concentration of cadmium and zinc in the meat of both broiler and domestic chicken in Quetta, Balochistan and then compare the result of this study with previous

studies and with standards values set by different authoritative organizations.

MATERIALS AND METHODS

Reagents and solutions

All the reagents and standards were of analytical grade and dilutions were made with ultra-high pure (UHP) de-ionized water (0.067 MS/cm, Purelab Option, Elga, UK). All the glass/plastic wares were acid cleaned by keeping these in acid bath (20 % HCL) for twenty-four hours followed by rinse with UHP. A 10 ml mixture of acids used for digestion was 8 ml nitric acid (HNO₃, 14.442 M) and 2 ml of per chloric acid (HClO₄, 11.6 M) 4:1 v/v. A blank solution of 0.5 M nitric acid was used throughout the analysis. Standards for various metals were prepared from atomic absorption standards (Merck KgaA, Damnstadt, Gennany) of 1000 ppm by serial dilution with 0.5 M nitric acid.

Instrumentation and Procedures

The analysis of the elements (Cadmium and Zinc) was conducted with the flame atomic absorption spectrometer (FAAS, Thermo - Electron Corporation, S4 AA System, Ser. No, GE711544, China). The FAAS was allowed for 30 minutes to be stabilized. Blank and standards were run followed by real sample analysis [8].

Collection and Preparation of the Samples

The body parts (heart, kidney, gizzard, muscle, Liver) of both commercially available broiler and domestic chickens were collected from Quetta city randomly and packed in polyethylene bags. In lab, the collected samples were cleaned with UHP de-ionized water to remove blood/pollutant particles. These were cut to small pieces using clean scalpel knife and were dried in an oven (Binder GmbH Bergstr. 14 D-78532 tuttingen) at 100 °C temperature until the constant weight was achieved. After drying, the samples were ground into a fine powder by using a ceramic pestle and mortar and stored in polyethylene bags. 1 g of dry powder of each sample was taken by using an electronic weighing balance (Item No: AR2140 Made for OHAUS Corp, USA) and shifted into a beaker and digested with mixture of acids. The samples were heated on a hotplate (Jenway,

230V, 50Hz, 500W) for about 22 minutes at 100 °C until dense white fume appeared and then allowed to cool. The solutions were filtered using Whatman filter paper 42, diluted with UHP de-ionized water up to a final volume of 50 ml and kept at room temperature for further analysis.

RESULT AND DISCUSSION

Analytical performance

The standard calibration graph for Cd was linear in between the range of 0.5 – 2.5 mg/L and the regression equation obtained for Cd is $y = 0.0716x - 0.0034$ with R^2 of 0.9994 (Figure 1). The RSD was in the range of 0.2 – 0.9 % (n = 5). The LOD and LOQ for cadmium (Cd) were obtained as 0.000 and 0.000 respectively.

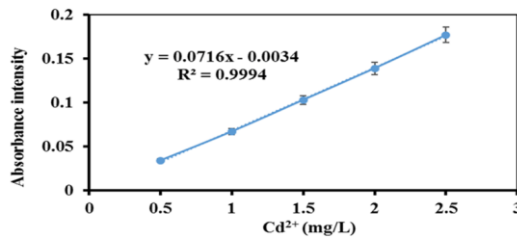


Figure 1: Calibration curve for cadmium

The standard calibration graph for Zn was linear in between the range of 1 – 15 mg/L and the regression equation obtained for Cd is $y = 0.04144x - 0.0021$ with R^2 of 0.9997 (Figure 2). The RSD was in the range of 0.3 – 0.8 % (n = 4). The LOD and LOQ for cadmium (Zn) were obtained as 0.000 and 0.000 respectively.

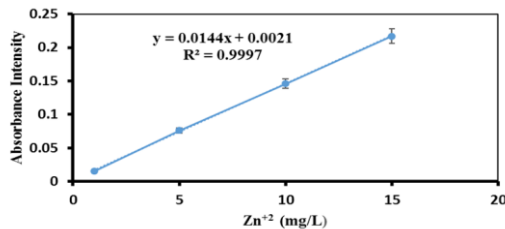


Figure 2: Calibration curve for zinc

Real analysis

Poultry plays very important role in the field of food for human beings. Heavy metals may enter into poultry via their contaminated feed. The present study estimated the concentration of Cd and Zn in both domestic and broiler chickens at Quetta City, Balochistan Province.

The results of concentrations of Cd and Zn in both house-hold and broiler chickens are shown in table 1. The comparison of Cd and Zn among the used tissues of both broiler and home-grown chickens are shown in figure 3 and 4 respectively.

Table 1: Concentration of Cadmium and Zinc in various body parts of domestic and broiler chickens (ppm)

Type of Chickens	Metals	Heart	Kidney	Muscles	Gizzard	Liver
Domestic	Cd	0.0288	0.0376	0.0471	0.04	0.0572
	Zn	1.5305	1.3515	2.4634	2.5434	1.3404
Broiler	Cd	0.0731	0.0619	0.088	0.0909	0.0783
	Zn	2.700	1.1073	1.3256	2.0500	2.440

Cadmium

The high concentration of cadmium may affect human body in different ways such as kidney dysfunction, skeletal damage, prostate cancer, mutations, fetal death etc. heavy metals may contaminate the chicken meat through natural source, food etc. The findings of Cd in present study were found lower than that reported by Iwegbue and his coworkers (1.27–0.11ppm) [9], Gonzalez-Weller et al (0.52 – 5.22 µg/kg) [10] and Marriam et al (0.49–0.16 ppm) [11]. However, the amount of Cd in domestic and broiler chickens were found below than the acceptable level (0.5 ppm) given by WHO/FAO. On the other hand, the findings of present study in domestic chicken were comparable to the acceptable level (0.05 ppm) fixed by European commission while in broiler chicken it exceeded this level.

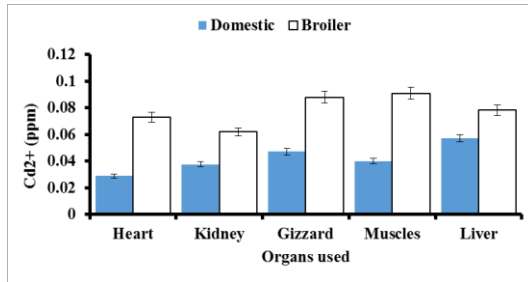


Figure 3: the concentration of Cd²⁺ in different parts of domestic and broiler chickens

Zinc

Zinc is very important for the health of human beings. However, it may be poisonous when found in large amount [12]. Zinc is supplied to the poultry through their food for increasing weight gain and preventing diseases in them [13]. The present study shows the higher quantity of zinc in the heart and liver of broiler than domestic while on other hand it showed higher concentration of zinc in gizzard, muscles and liver of domestic chicken than broiler. Comparatively, it showed the lower level of zinc than the study performed by Mariam and others in Lahore [11] and Khan and his friends in Karachi [14]. However, the concentration of zinc in present study was also found lower than standard values 10 – 50 ppm given by FAO/WHO. This may be due to the deficiency of zinc in the food of poultry.

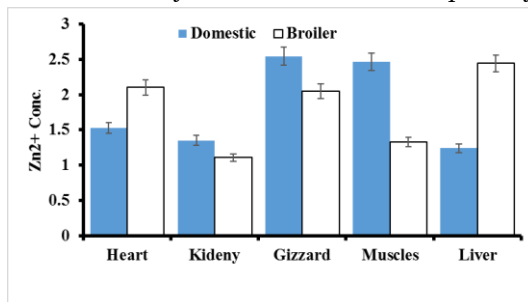


Figure 4: the concentration of Zn²⁺ in different parts of domestic and broiler chickens

CONCLUSION

This study showed that the poultry meat used in Quetta city and surrounding areas is contaminated with heavy metals. The polluted environment and contaminated poultry food are main sources of heavy metals. This study showed higher concentration of Cd in broiler chicken than domestic. Conversely, kidney, gizzard and liver of domestic chicken showed higher concentration of Zinc than broiler while heart and muscles were found lesser than broiler. However, both cadmium and zinc were found below than permissible limits fixed by WHO/FAO Therefore, it is concluded that poultry food must contain zinc as it is necessary for human health.

ACKNOWLEDGEMENT

We are highly thankful to Department of Chemistry, University of Baluchistan, Quetta Pakistan and also acknowledged and express their gratitude to high support from the University that provided essential laboratory facilities.

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