Research Article

Comparative Study of Heavy Metals in different Parts of Domestic and Broiler Chickens

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ABSTRACT

This study was designed to evaluate the heavy metals like Zn, Mn, Ag, Pb, Cu, Fe, and Ni in different body parts of broiler and domestic chickens. Broiler (Cock & Hen) and domestic chicken (Cock & Hen) were selected from Bannu to comprise different heavy metals present in different parts of their body. Samples of muscle, liver, gizzard, kidney and heart of both chickens were analyzed to determine the contents of heavy metals in these parts. Cu, Zn, Mn and Fe were found in large quantity and Ag, Pb and Cd were present in small concentration in domestic chicken. Similarly Zn, Pb, and Cu were found in higher concentration in broiler. Liver, kidney and gizzard samples of domestic chickens showed higher accumulation of Zn, Mn, Cu and Fe than broiler and Ag was the only heavy metal that showed higher concentration in broiler than domestic birds.

Keywords: Broiler (Cock & Hen), Domestic Chicken (Cock & Hen), Heavy metals.

INTRODUCTION

Heavy metals are probably found in all living organisms where they play different roles. They may be components, structural, of control mechanisms, (e.g. in muscles and nerves), and enzyme activator, or redox systems. There are two main classes of heavy metals, essential and non essential metals. Essential metals are (Co, Cr, Cu, Fe, Ni, Zn), and non-essential are (As, Cd, Hg, Pb). A deficiency in essential elements results in improper biological function, essential elements may become toxic when present in excess. Non-essential metals also have toxic effects, when enter into the body. The diet is the major source of entry of most elements into the body. Protein is one of an essential element that is produced by two main resources that are plants and animals. Pakistan poultry industry is deficient to produce proteins substances from animal sources. For this purpose various 66% Pakistanis are lacked or deficient protein in their food material. To increase the level of proteins different metals are added in poultry feed so that the use of protein in human diet is in-sufficient and it's also responsible for getting weight and prevention of diseases. Broiler meat gives large amount of protein trace elements[1]. The broiler diet is mainly contained with nutrients [e.g., phosphorus (P) copper (Cu), zinc (Zn), Manganese (Mn) and arsenic (As) to activate growth, increase feed performance that ensures healthy birds. In other cases, feed supplements are added in excess of the animals' needs and are released in the manure[2]. Heavy metals such as Cu and Fe are necessary to balance and maintain proper metabolic activity in living organisms; there are some other metals (like Pb and Cd) are non-essential which have no important role in the body function[3, 4]. But at high concentrations, they become hazards to living organisms[5]. Hen's eggs are considered as a highly-nutritious food that is very effective and beneficial for human health[6, 7]. However, eggs might contain high levels of heavy metals that originate mainly from water and food. Eggs also contain some mineral content that is becoming increasingly important for health and nutritional value of eggs, the consequences of egg metals on initial stage of embryonic development and its use as bioindicators for environmental metal pollution[8]. Altogether, chicken eggs, milk and dairy product constitute a major source of food around the World. Therefore, screening of heavy metal levels in milk, dairy products and chicken eggs is very importance for toxicological, nutritional and environmental purposes. Lead, cadmium, mercury and arsenic are very toxic metals which accumulate in the form of food chains and have a toxic effect[9]. Heavy metals mention above and some other have direct physiologically toxic effects and are stored in tissues of living organisms[10]. Lead is a poison and can cause serious problems in metabolic path way and neurotoxin that get attachment with essential enzymes and several other active site of cellular components and deactivates them[9]. Lead has also toxic effects on haemopoietic, nervous, gastrointestinal and renal systems of the body. Cadmium is another toxic metal comes from different sources of food in environment[10]. It gets more and more concentrated as cadmium moves through the food chain as it reaches the carnivores where it increases in concentration by a factor of approximately, 50 to 60 time[11]. Toxic effects of cadmium are hypertension, kidney dysfunction, hepatic injury and lung damage. Arsenic is accumulated in animals depending upon the type of food they consume[12]. Exposure to arsenic can cause onset of headache, nausea and severe gastrointestinal irritation[13]. Similarly, copper also causes liver, kidney and brain

damage, if present in higher concentration, which may follow hemolytic crisis [14].

The purpose of this study was to determine the level of heavy metals in different parts (like meat, kidney, heart, lungs, intestine, gizzard and liver) of the broiler and domestic male and female chickens.

MATERIALS AND METHODS

Domestic and broilers chickens were collected from District Bannu, Khyber Pakhtunkhwa, Pakistan to check heavy metals level in all parts of their body. The samples were dried in an oven at 90°C to remove moistures. Then 2 gram of dried meat of each sample was put in a flask and digested with a mixture of concentrated HN03 and H_2S0_4 (3:1 v/v). The digestion process was continued until the solution became clear. The samples were transferred into another flask and diluted to 25mL with distilled water[15]. Estimation of heavy metals like Zn, Mn, Ag, Pb, Cu, Fe, and Ni were estimated by Atomic Absorption Spectrophotometer Perkin Elmer 400.

RESULTS AND DISCUSSION

This study was conducted to determine the concentration of heavy metals in different body parts i.e. kidney, liver, heart, muscle and gizzard of broiler and domestic chicken. Present study determination of Mn, Zn, Cu, Fe, Ni, Ag, Cd and Pb in all samples are shown in table 1 and 2.

The heavy metals which were detected in different body parts of broiler and chicken were Cu, Mn, Zn, Ag, Pb, Fe, etc. Higher concentration of Cu, Fe, and Zn were detected in domestic chicken and lower concentrations of these metals were detected in broiler. The required levels of these metals must be used in animal feeds. Required levels of heavy metals are very essential for body growth, but it may cause many health problems not only to broiler itself but also to consumers. Sometime heavy metals cause toxicity due to their toxic effects and bioaccumulation. These often have direct physiological toxic impacts because they may be accumulated in body tissues[1]. In the recent study it was determined that the concentration of heavy metals i.e. Cu, Fe, Mn and Zn were higher in muscle, liver, heart and gizzard. Comparison of heavy metals in different body parts of domestic chicken and broiler showed that manganese, zinc and iron were present in large quantity accumulated in kidney, liver and heart of domestic chicken. Silver (Ag) was only present in liver of domestic chicken and undetected in other parts of the body. Cadmium (Cd) was only one to be found in kidney of domestic birds while Lead (Pb) was found to be present in kidney and liver of domestic chicken. Similarly Zn and Cu were also found to be present in liver, heart and muscle of broiler. Manganese (Mn) was found in liver only. Silver (Ag) was found in heart and liver of broiler. Nickel (Ni) was present in muscle only and Cd was present in liver and gizzard of broiler chicken.

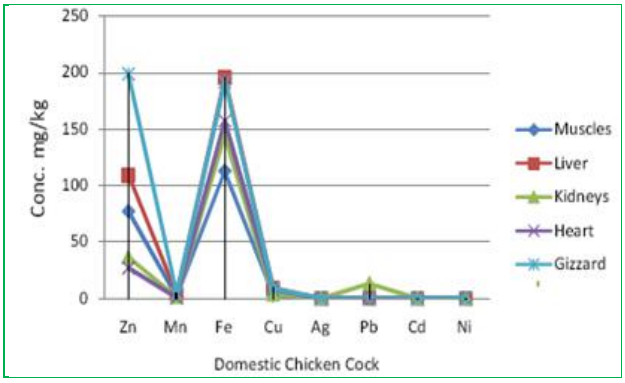

Figure 1: Concentration of Heavy Metals in Domestic (Cock) Chicken (mg/kg)

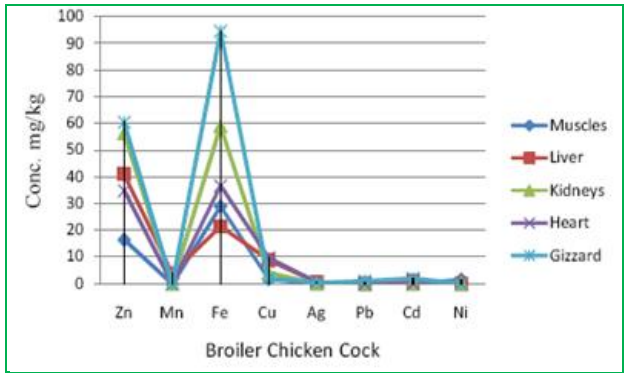

Figure 2: Concentration of Heavy Metals in Broiler (Cock) Chicken (mg/kg)

Table 1: Concentration of Heavy Metals in Domestic and Broiler (Cock) (mg/kg)

Chicken type	Parts used	Zn	Mn	Fe	Cu	Ag	Pb	Cd	Ni
Domestic Cock	Muscles	77.12	1.72	112.89	3.19	Nd	Nd	0.04	Nd
	Liver	109.32	3.84	195.62	9.18	Nd	Nd	Nd	Nd
	Kidney	36.61	1.18	144.65	3.82	Nd	13.09	0.01	Nd
	Heart	27.17	0.837	157.37	7.77	Nd	Nd	Nd	Nd
	Gizzard	199.04	4.27	191.87	8.89	Nd	Nd	Nd	0.45
Broiler Cock	Muscles	16.50	Nd	29.00	1.77	0.086	Nd	Nd	1.56
	Liver	40.87	3.94	21.42	8.89	0.60	Nd	1.09	Nd
	Kidney	56.23	Nd	58.91	4.00	Nd	0.04	Nd	Nd
	Heart	34.75	Nd	36.63	9.67	0.67	Nd	Nd	Nd
	Gizzard	60.31	Nd	94.34	2.19	0.49	1.01	2.00	Nd

Where Nd indicate not detected

Table 2: Concentration of Heavy Metals in Domestic and Broiler (female) (mg/kg)

Chicken type	Parts used	Zn	Mn	Fe	Cu	Ag	Pb	Cd	Ni
Domestic Cock	Muscles	44.72	9.98	74.00	6.22	Nd	2.23	Nd	Nd
	Liver	74.84	4.32	130.25	10.07	0.86	7.56	Nd	Nd
	Kidney	32.90	1.08	219.87	1.90	Nd	1.52	Nd	Nd
	Heart	25.40	0.34	139.5	5.08	Nd	Nd	Nd	Nd
	Gizzard	170.23	8.62	67.91	5.43	Nd	Nd	Nd	0.54
Broiler Cock	Muscles	23.17	Nd	19.52	8.20	Nd	Nd	Nd	Nd
	Liver	46.43	0.24	1.01	7.28	0.062	Nd	Nd	Nd
	Kidney	34.70	Nd	4.77	Nd	Nd	2.16	Nd	Nd
	Heart	37.18	Nd	5.67	2.97	0.35	Nd	Nd	Nd
	Gizzard	3.86	Nd	2.94	Nd	Nd	Nd	0.91	Nd

Where Nd indicate not detected

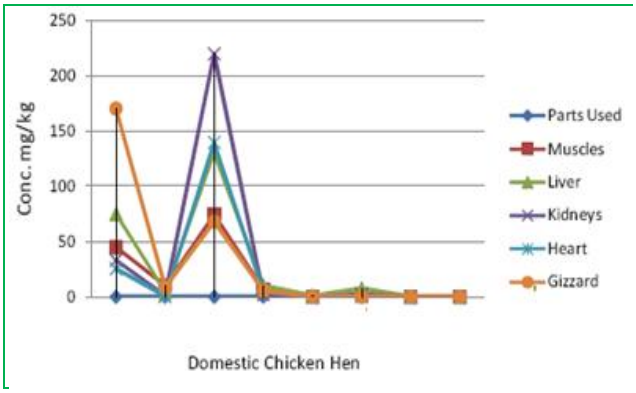

Figure 3: Concentration of Heavy Metals in Domestic (Hen) Chicken (mg/kg).

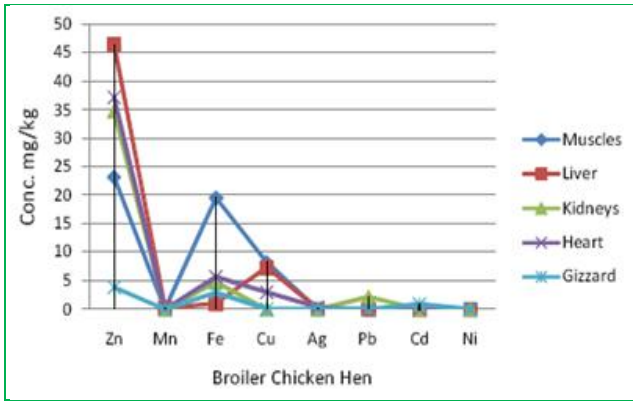

Figure 4: Concentration of Heavy Metals in Broiler (Hen) Chicken (mg/kg).

CONCLUSION

The study showed that Zn, Mn, Fe and Cu were present nearly in all parts of the body of both broiler and domestic chicken while Pb, Cd, Ag and Ni were present in some parts and undetected in most of the body parts. The sample checked for the concentration of heavy metals clearly showed that the concentration of Zn, Mn and Fe were found to be present more in domestic chicken than broiler chicken. This indicates that the food of domestic chicken contains more heavy metals than the broiler chickens.

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