

Assessment of Heavy Metal Residues in Excreta of Rock Pigeon (*Columba Livia*) and Domestic Pigeon (*Columba livia Domestica*) in Faisalabad, Punjab, Pakistan

Shahid Hafeez Khan¹, Amjad Saeed², Tanveer Hussain², Junaid Naseer², Ghulam Yasin², Kanwal Irshad³, Usman Ali Tiwana⁴, Atif Latif², Rana Muhammad Shafiq², Rizwana Ashiq⁵, M. H. Hamed and Muhammad Altaf²

- 1 Department of Forestry, Range Management and Wildlife, University of Agriculture, Faisalabad, Pakistan
- 2 Department of Forestry, Range Management and Wildlife, Islamia University Bahawalpur, Pakistan
- 3 Department of Pharmaceutical Chemistry, Government College University Faisalabad, Pakistan
- 4 Range land Research Institute, National Agricultural Research Council, Islamabad, Pakistan
- 5 Department of Zoology, University of Agriculture, Faisalabad, Pakistan
- 6 School of Zoology, Minhaj University Lahore, Pakistan

Abstract: Pollution is the main cause that effects the environment in a degradable condition. For the presence of heavy metals in the atmosphere birds are considered as tremendous bio indicator. Blue pigeon and domestic pigeon (*Coloumba livia*) of Faisalabad are selected to examine the level of heavy metals including Manganese (Mn), Zinc (Zn), Cobalt (Co), lead (Pb) Cadmium (Cd) and Copper (Cu) in several tissues such as heart, lungs, bones, muscles and feathers. Six adult birds were collected from rural, urban and residential and traffic areas of Faisalabad. After collection of sample fresh weight of each sample was measured, then digestion of sample was done by conventional acid digestion method and digested samples were analyzed in the lab by Atomic Absorption Spectrophotometer for the determination of heavy metals. It was concluded that accumulation of heavy metals in the birds depends upon the environmental conditions. Our result showed that concentration of heavy metals is more in rock pigeon as compared to domestic pigeon which may be due to more exposure of industrial waste to rock pigeon. It has inferred from our study that high concentration of heavy metals in the excreta of rock pigeon was due to its high trophic level in food chain.

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1. Introduction

Rich diversity of fauna and flora is present in Pakistan [1-3], they immediately react to anthropogenic impacts [4-6] and these are good bio-indicator of pollution [7-9]. Birds are very sensitive to environmental pollutants and more prone to intoxication as compared to other animals because they are highly sensitive towards the environmental changes [10,11] and known as bio-indicator. Birds disperse toxic agent in the body by respiratory system, rate of metabolism and low content of fat in the body [7]. Birds are very sensitive to environmental toxin and most of the toxin are acquired from food chain. The recent research used excreta of birds for monitoring and analysis of heavy metals [12]. We can determine un-absorbable and absorbable metals in birds through heavy metals analysis of excreta which is non-destructive media. The metals that cannot absorb in the birds are eliminated through excreta [13]. Birds excrete large amount of metals that's why feces become appropriate for assessing the exposure of metals to birds [14]. Bird's excreta is a non-destructive and significant indicator for contamination of bird's diet and environment with metals. It is very easy to collect the bird's excreta from nests and their roosting sites[15].

Heavy metals toxicity has a wide influence on captive avian and wild population leading to death of many species of birds annually. Exposure of heavy metals to birds mostly occurs through contaminated drinking water and food. After ingestion of metals, they

absorb and circulate in the blood stream. These absorbed metals may accumulate in the body especially in feathers or excrete through fecal matter [16]. Birds are considered as the best for monitoring of the environmental changes because they are very sensitive to environmental contamination as compared to other vertebrates [17]. According to Wildlife Protection Act 1972, killing of birds is banned; therefore, no analytical studies can perform on the tissues and organs of birds. Heavy metals excrete through body in the fecal matter and gained attention of researchers to estimate heavy metals contamination in the environment through bird's excreta [18]. So, the excreta of birds are the best indicator of metal pollution in the environment. The present research was designed for estimation of heavy metals contamination in specific region of Faisalabad by determination of heavy metals in excreta of blue pigeon and domestic pigeon.

2. Materials and Methods

This study was performed in district Faisalabad, Punjab, Pakistan. Faisalabad. Among the major crops of District Faisalabad wheat, sugarcane rice and maize are cultivated and when we talk about fruits here comes the citrus, guava and mangoes. A diversity of vegetables is also cultivated in the district. It has an area of 5856 km² and lies at 31°25'7.37"N latitude and at 73° 4'44.79"E longitude. The area situated at a height of 184 m beyond sea level. This district is divided into 6 tehsils and 189 union councils administratively. Out of 6 tehsils, Faisalabad Saddar was excluded because of total urban area. From this district, 160 villages from 80 rural union councils were visited for farmer interview, tree inventory and soil sampling.

The two species of pigeon rock pigeon and domestic pigeon from the district Faisalabad were selected. These species were selected because of their small body size, high metabolic rate, small home range and wide distribution making them suitable as bio-indicators for local heavy metal contamination.

Sample preparation

Dust particles were washed carefully from feathers and tissues by using distilled water accordingly [19]. After this the feathers were kept in hot air oven for 24 hours at 100 °C. Lungs, Muscles, Bones and Heart were taken after post mortem. The samples including tissues and feathers were dried out in hot air hot plate for 24 h at 100°C[20]. Then chore the sections in the food processor and ground to fine particles, to analyze the heavy metals digestion of samples in conical flask.

Digestion of the samples

Heavy metals were analyzed by digestion of 4mL of HNO₃ (conc.) and 0.5g of samples in conical flask. The sample was dipped properly in the acid and left-over night. The following day, 2 mL of H₂O₂ was added in the samples and heated on the hot plate, up to 120°C, until the sample remains 2ml. By using filter paper, the sample was refined, in this way the volume was increased by using 50ml of distilled water were preserved in refrigerator for further analysis. Heavy metal intensities in altered structures were calculated by using atomic absorption spectrophotometer (Model: Hitachi Polarized Zeeman AAS, Z-8200, Japan) at Hi tech Lab UAF, Pakistan. Known quantities of sample were used to make standard curves for each metal. Normal standards of three duplicates were taken for each will power.

Statistical Analysis

All the data was arranged by using MS Excel 2013 and statistical analysis was performed by using SPSS version 17. Additionally, statistical differences of heavy metals between different organs and different species were tested by using one way ANOVA, LSD test.

3. Results

The levels of heavy metal concentration recorded in different organs and tissues of domestic pigeon and rock pigeon (*Coloumba livia*) in both the rural and urban areas of District Faisalabad. These metals are potentially found to be very toxic therefore these are considered in this research.

Distribution of heavy metals in bones of domestic pigeon

Zn is another often faced heavy metal that results in poisonousness when consumed by Aves. There are testified circumstances of naturally occurring Zn poisoning in birds such as Ducks, Nicobar Pigeons, Gray-headed Chachalacas, Macaws and pet birds. However, Zn is also found to be an essential element in feather growth. Zn has high affinity towards keratin and gets deposited into feathers during growth. The results of heavy metals like Cadmium cd, Cobalt Co, Copper Cu, Zinc Zn, lead Pb and Manganese Mn in the bones of Domestic pigeon (*C. livia*) were recorded from rural areas of district Faisalabad.

The data indicated that of all these heavy metals illustrate different levels of concentrations as shown in table 1. It was noted that in the domestic pigeon of the study district, the low concentrations of Co (0.01 mg/kg) and Cd (0.03 mg/kg) was recorded. The concentration of Mn (0.127 mg/kg), Cu (0.310 mg/kg), Pb (0.500mg/kg) was measured while maximum concentration of Zn was recorded in the domestic pigeon (1.810 mg/kg).

Dispersal of heavy metals in feathers of domestic pigeon

Concentration of heavy metals in the feathers of *C. livia* was recorded from area of Faisalabad as shown in Table 1. The results indicated that the feathers of domestic pigeon collected from the different areas of district Faisalabad showed the greater concentrations of Zn (2.020 mg/kg) whereas Pb (1.633 mg/kg), Cu (0.527 mg/kg), Mn(0.383 mg/kg) and Cd (0.070 mg/kg). The lowest absorption of Co was (0.027 mg/kg) recorded in feathers of domestic pigeon in landscape of district Faisalabad.

Distribution of heavy metals in heart of *C. livia* of district Faisalabad

The heart of domestic *C. livia* was collected from the area of district Faisalabad for the estimation of heavy metal contamination. The results indicate that the maximum concentrations of lead (2.868 mg/kg) were recorded in heart of domestic pigeon in the landscape and the concentrations of zinc (1.377 mg/kg), copper (0.497 mg/kg) while cobalt and cadmium (0.010 and 0.010mg/kg) showed minimum levels of concentrations as shown in Table 1.

Distribution of heavy metals in muscles of domestic pigeon

The concentration of heavy metals was observed in muscles of domestic pigeon as indicated in Table 1. By the determination of various, domestic pigeon muscles showed higher concentrations of Zinc (1.813 mg/kg) in rural areas of district Faisalabad. The estimated concentrations of Lead (0.777 mg/kg), Copper (0.533 mg/kg), Manganese (0.153 mg/kg) were recorded while Cadmium (0.063 mg/kg) and Cobalt (0.063 mg/kg) showed lower concentrations in muscles of domestic pigeon in the areas of district Faisalabad.

Distribution of heavy metals in lungs of *C. livia* in district Faisalabad

The levels of heavy metal concentrations were measured in lungs of domestic pigeon of district Faisalabad (Table 1). The higher concentrations of Zn (1.880 mg/kg) was recorded in lungs of *C. livia*. Whereas the concentrations of Pb (0.747mg/kg), Cu (0.383 mg/kg), Mn (0.163 mg/kg) were recorded and Cd (0.050 mg/kg) shows slightly low concentration. There was a little concentration of Co (0.020 mg/kg) in domestic pigeon in district Faisalabad.

Distribution of heavy metals in bones of *Rock pigeon* in district Faisalabad

The results of heavy metals were recorded in bones of rock pigeon from the district Faisalabad. It was noted that in district the highest concentration of Zn (1.563 mg/kg) was recorded. Whereas the concentrations of Pb (1.020 mg/kg), Cu (0.353 mg/kg), Mn (0.080 mg/kg), Cd (0.043 mg/kg) was measured and the lower concentration of Co (0.010 mg/kg) was recorded in the areas of district Faisalabad as shown in Table 2.

Distribution of heavy metals in feathers of *C. livia* in district Faisalabad

The results of heavy metals were recorded in feathers of rock pigeon from the area of Faisalabad. It was noted that highest concentration of Pb (2.260 mg/kg) was recorded. Whereas the concentrations of Zn (1.563 mg/kg), Cu (0.543 mg/kg), Mn (0.353 mg/kg), Cd (0.040 mg/kg) was measured and the lower concentration of Co (0.010 mg/kg) was recorded in the urban areas of district Faisalabad as shown in Table 2.

Distribution of heavy metals in heart of *C. livia* in Faisalabad

The concentration of heavy metals in the heart of rock pigeon was measured from area of district Faisalabad as shown in table 1. The results indicate that the highest concentration of Zn (1.350 mg/kg) was found in heart of rock pigeon. The estimated concentrations of Pb (0.813 mg/kg), Cu (0.493 mg/kg), Mn (0.423 mg/kg), Cd (0.028 mg/kg) and minimum concentration of Co (0.017 mg/kg) was recorded.

Distribution of heavy metals in muscles of *C. livia* in district Faisalabad

The trend of heavy metal concentrations was measured in muscles of rock pigeon from district Faisalabad. The highest concentration of Zn (1.503 mg/kg) was found in heart of rock pigeon. The estimated concentration of Pb (0.857 mg/kg), Cu (0.020 mg/kg), Mn (0.097 mg/kg) were measured while concentrations of Cd (0.017 mg/kg) and Co (0.020 mg/kg) were slightly lower recorded in heart of rock pigeon from district Faisalabad as shown in Table 2.

Distribution of heavy metals in lungs of rock pigeon

The concentration of heavy metals in lungs of domestic pigeon was recorded district Faisalabad as indicated in table 1. The concentration of metals was followed the order Zn > Pb > Cu > Mn > Cd > Co as (1.563 mg/kg), (0.877 mg/kg), (0.490 mg/kg), (0.250 mg/kg), (0.050 mg/kg) and (0.020 mg/kg) were recorded from urban areas of Faisalabad. As indicated in the results the highest concentration of Zn and lower concentration of Co was found.

Distribution of heavy metals in Bones of *C. livia*

The results of heavy metals in bones of domestic pigeon and rock pigeon were recorded from different areas of Faisalabad. The results indicated that rock pigeon showed concentration of Zn as compared to those of domestic pigeon. The concentration of Zn was recorded (1.810 mg/kg) in rock pigeon while (1.563 mg/kg) was recorded in domestic pigeon. By contrast the concentration of Pb was (1.020 mg/kg) in domestic pigeon and (0.500 mg/kg) in rock pigeon. Similarly, the concentrations of Cu (0.353 mg/kg), Mn (0.080 mg/kg), Co (0.060 mg/kg) and Cd (0.043 mg/kg) were recorded in domestic pigeon while concentrations of Cu (0.310 mg/kg), Mn (0.127 mg/kg), Co (0.020 mg/kg) and Cd (0.030 mg/kg) were measured in rock pigeon in district Faisalabad. The results indicate that the Mn and Zn concentrations were lower in domestic pigeon as compared to rock pigeon collected from the district Faisalabad as indicated in Table 3.

Distribution of heavy metals in feathers of *C. livia*

The concentration of heavy metals like Zn, Pb, Cu, Mn, Cd and Co was recorded in feathers of domestic and rock pigeon collected from district Faisalabad. The results of heavy metals showed that the concentrations of various heavy metals were higher in

domestic pigeon as compared to the rock pigeon. The maximum concentration of Pb (1.020 mg/kg) was found in domestic pigeon as compared to rock pigeon (0.500 mg/kg). In domestic pigeon the concentration of Zn (1.563 mg/kg) was lower while in rock pigeon (1.810 mg/kg) was slightly higher. Similarly, the concentrations of Cu (0.353 mg/kg), Mn (17.000 mg/kg), Cd (0.003 mg/kg) and Co (0.001 mg/kg) were recorded from rural area whereas almost similar concentrations of Cu (24.010 mg/kg), Mn (17.001 mg/kg), Cd (0.004 mg/kg) and Co (0.001 mg/kg) were recorded from urban areas of district Faisalabad as shown in Table 3.

Distribution of heavy metals in heart of *C. livia*

The concentration of heavy metals was measured in heart of domestic pigeon and rock pigeon collected from district Faisalabad. The results indicate that the highest concentration of Pb was recorded in rock pigeon as compare to the domestic pigeon. The concentration of Pb (2.868 mg/kg) was measured in rock pigeon while in domestic pigeon it was recorded (0.0813 mg/kg). The concentrations of Zn (1.377 mg/kg), Cu (0.497 mg/kg), Mn (0.160 mg/kg) were recorded in rock pigeon whereas concentrations of Zn (1.350 mg/kg), Cu (0.493 mg/kg), Mn (0.423 mg/kg) were recorded in domestic pigeon of district Faisalabad. The lowest concentration of Cd was found in rock pigeon while in domestic pigeon it was slightly lower. The Cd concentration in domestic was (0.040 mg/kg) while in rock pigeon it was (0.010 mg/kg). 1 of district Faisalabad as indicated in Table 3.

Distribution of heavy metals in muscles of *C. livia*

The distribution of heavy metals in muscles of rock pigeon and domestic pigeon from areas of district Faisalabad as indicated in table 3. The results shows that the levels of heavy metals varies in rock pigeon and domestic pigeon. The highest concentration of Zn was estimated in rock pigeon as compare to the domestic pigeon. The Zn concentration was (1.813 mg/kg) in rock pigeon while (1.503 mg/kg) was in domestic pigeon. Lower concentrations of Co and Cd was observed in rock pigeon as compared to the domestic pigeon. Co concentration was (0.063 mg/kg) and Cd (0.063 mg/kg) in rock pigeon while concentrations of Co (0.020 mg/kg) and Cd (0.017 mg/kg) was found in domestic pigeon. The concentration of Pb (0.777 mg/kg) in rock and (0.857 mg/kg) was recorded in domestic pigeon. Whereas the concentrations of Cu (0.533 mg/kg) and Mn (0.153 mg/kg) estimated in rock pigeon although in domestic pigeon levels of Cu (0.417 mg/kg) and Mn (0.097 mg/kg) was recorded.

Distribution of heavy metals in lungs of *C. livia*

The concentration of heavy metals was estimated in lungs of rock pigeon and domestic pigeon of district Faisalabad as indicated in table 3. The results of this study show that the maximum concentrations of Zn were measured in rock pigeon as compare to the domestic one. In rock pigeon Zn concentration was (1.880 mg/kg) while in domestic pigeon (1.563 mg/kg) was observed. The concentrations of other heavy metals like Pb (0.747 mg/kg), Cu (0.383 mg/kg) was recorded from rock pigeon whereas Pb and Cu concentrations (0.877 mg/kg), (0.490 mg/kg) estimated from domestic pigeon. In rock and domestic pigeon concentration of Cd (0.050 mg/kg) was almost same and concentration of Co is also recorded as the same that is (0.020 mg/kg).

Distribution of heavy metals in different body parts of domestic pigeon in district Faisalabad

The distribution of heavy metals like Cu, Co, Cd, Mn, Pb and Zn were estimated in body parts of domestic pigeon in district Faisalabad as shown in Tab.1. The highest concentrations of cadmium was estimated in feathers (0.070 mg/kg) while in muscles (0.063 mg/kg), lungs (0.050 mg/kg) and bones (0.030 mg/kg). The concentration of Cd was (0.010

mg/kg) in heart of domestic pigeon. The concentrations of Co was higher in muscles (0.063 mg/kg) while in other organs such as heart (0.010 mg/kg), feathers (0.027 mg/kg), bones (0.020 mg/kg) while in the lungs of domestic pigeon concentration of Co was (0.020mg/kg).

In domestic pigeon the highest mean Cu concentrations was estimated in muscles (0.533 mg/kg). Whereas in feathers (0.527 mg/kg), heart (0.497 mg/kg), lungs (0.383 mg/kg) and bones (0.310 mg/kg) concentrations of Cu was recorded. The concentrations of Mn in different body parts of house crow follow the sequence: feathers> lungs> heart>muscles > bones i.e. (0.383 mg/kg), (0.163 mg/kg), (0.160 mg/kg), (0.153 mg/kg) and (0.127 mg/kg) recorded in domestic pigeon of Faisalabad district.

The highest Pb concentrations was estimated in heart (2.868 mg/kg) while in feathers (1.633 mg/kg), muscles (0.777 mg/kg), lungs (0.747 mg/kg) and in bones (0.500 mg/kg) of domestic pigeon were estimated. Zn concentrations were recorded in different body parts of domestic pigeon. The maximum concentration was in feathers that is (2.020 mg/kg) while in lungs (1.880 mg/kg), heart (1.377 mg/kg) while in muscles and bones of domestic pigeon slightly similar concentrations of Zn was recorded i.e in muscles. (1.813 mg/kg) and in bones (1.810 mg/kg) as indicated in the below Table 1.

Distribution of Heavy metals in different body parts of rock pigeon

The distribution of heavy metals was estimated in different organs of rock pigeon collected from area of Faisalabad as shown in table 2. The results indicate the variations in mean concentrations of trace elements. The highest mean concentration of Cd was recorded in feathers (0.090 mg/kg) while in lungs (0.050 mg/kg), bones (0.043 mg/kg), heart (0.028 mg/kg) and muscles (0.017 mg/kg). The highest mean concentration of Co was estimated in bones (0.060 mg/kg). The concentration of Co in feathers (0.030 mg/kg), in heart (0.017 mg/kg). In lungs and muscles the concentration of Co shows the same results that is (0.020 mg/kg).

The mean concentrations of Cu were recorded in different organs of rock pigeon. Higher concentration of Cu was found in feathers of rock pigeon and lower mean concentration of Cu was in bones of rock pigeon. The estimated levels of heavy metals in bones (0.353 mg/kg), feathers (0.543 mg/kg), heart (0.493 mg/kg), muscles (0.417 mg/kg) and lungs (0.490 mg/kg) was recorded. The distribution of Mn was estimated in different body parts of rock pigeon. The higher mean concentration of Mn was observed in heart (0.423 mg/kg) whereas in feathers (0.353 mg/kg) and lungs (0.250 mg/kg), In muscles (0.097 mg/kg) and in bones of rock pigeon concentrations of Mn was recorded as (0.080 mg/kg) as shown in the below given table.

Similarly, the mean concentration of Pb was observed in different organs of rock pigeon. The distribution of metals follows the order: feathers> bones> lungs> muscles> heart i.e. (2.260 mg/kg), (1.020 mg/kg), (0.877 mg/kg), (0.857 mg/kg) and (0.813 mg/kg) was estimated. The mean concentration of Zn was recorded in different body parts of rock pigeon collected from different areas of Faisalabad. The highest concentration of Zn was measured in feathers (1.787 mg/kg). The similar concentration of Zn was recorded in bones and lungs that was (1.563 mg/kg). Whereas in muscles (1.503 mg/kg), and in heart (1.350 mg/kg). Overall, mean concentrations of Zn was higher in all the five body parts of rock pigeon.

Distribution of heavy metals in different body parts of *C. livia* in district Faisalabad

The distribution of heavy metals was estimated in different organs of rock pigeon and domestic pigeon collected from the district Faisalabad as shown in table 3. The results indicate the variation in levels of heavy metals in rock as well as in domestic pigeon. The higher mean concentration of Cd was recorded in feathers (0.090 mg/kg) while in bones (0.043 mg/kg), heart (0.040 mg/kg) and muscles (0.017mg/kg) of domestic pigeon.

In rock pigeon the concentration of Cd was also higher in feathers (0.070 mg/kg). The distribution of Cd in muscles was (0.063 mg/kg), bones (0.030 mg/kg), heart (0.010 mg/kg) recorded. Whereas concentration of Cd is same in lungs of both the domestic and rock pigeon.

The mean concentration of Co was estimated in domestic pigeon. The higher concentration of Co was found in bones (0.060 mg/kg). The contamination of Co in feathers (0.030 mg/kg), heart (0.017 mg/kg) and concentration of Co in muscles and lungs showed the same results that was (0.020 mg/kg). Similarly, concentrations of heavy metals were measured in rock pigeon. Co concentrations in muscles (0.063 mg/kg), feathers (0.027 mg/kg), heart (0.010 mg/kg) and the same concentration of cobalt of (0.020 mg/kg) was recorded in lungs and bones of the rock pigeon. Cu mean concentration was recorded in domestic and rock pigeon of the district Faisalabad. The concentration of Cu was higher in feathers (0.543 mg/kg) of domestic pigeon as compared to the rock pigeon (0.527 mg/kg). Cu concentration was recorded in heart (0.493 mg/kg), lungs (0.490 mg/kg), muscles (0.417 mg/kg) and bones (0.353 mg/kg) of domestic pigeon. Whereas the mean concentration of Cu was recorded in muscles (0.533 mg/kg), heart (0.497 mg/kg), lungs (0.383 mg/kg) and bones (0.310 mg/kg) of rock pigeon.

Similarly, Mn concentration was recorded in body parts of domestic pigeon and blue pigeon collected from the district Faisalabad. The Mn mean concentration was recorded in heart (0.423 mg/kg), feather (0.353 mg/kg), muscles (0.097 mg/kg), bones (0.080 mg/kg) and lungs (0.0250 mg/kg) of domestic pigeon. Whereas estimated concentration of Mn was found in feathers (0.383 mg/kg), lungs (0.163 mg/kg), heart (0.160 mg/kg), muscles (0.153 mg/kg) and bones (0.127 mg/kg) of rock pigeon. The highest concentration of Mn was found in heart of rural domestic pigeon as compared to the blue pigeon.

The distribution of Pb was estimated in different body parts of domestic pigeon and rock pigeon collected from district Faisalabad. The concentration of Pb was recorded in domestic pigeon such as in feathers (2.260 mg/kg), bones (1.020 mg/kg), lungs (0.877 mg/kg), muscles (0.857 mg/kg) and heart (0.813 mg/kg). Nonetheless, Pb concentration in heart (2.868 mg/kg), feathers (1.633 mg/kg), muscles (0.777 mg/kg), lungs (0.747 mg/kg) and bones (0.500 mg/kg) were recorded. The results indicate that the higher concentration of Pb was found in heart of rock pigeon instead of the domestic one.

The mean concentration of Zn was measured in domestic pigeon and blue pigeon collected from different areas of district Faisalabad. Zn cause toxicity when it is frequently ingested by birds. The concentration of Zn was recorded in bones (1.563 mg/kg), feathers (1.787 mg/kg), heart (1.350 mg/kg), muscles (86.333 mg/kg) and lungs (86.667 mg/kg) of rural house crow. Whereas in urban area the concentration of Zn was measured in bones (68.500 mg/kg), feathers (81.667 mg/kg), heart (62.833 mg/kg), muscles (71.8333 mg/kg) and lungs (75.667 mg/kg). Higher concentration of Zn was recorded in feather of rural house crow as compared to the house crow of urban area.

Table 1. Distribution of Heavy metals in different body parts of domestic pigeon in district Faisalabad

Domestic Pigeon	Metals (mg/kg)											
	Cd		Co		Cu		Mn		Pb		Zn	
	Mean	STDV	Mean	STD V	Mean	STD V	Mean	STD V	Mean	STD V	Mean	STD V
Bones	0.03	0.01	0.02	0.01	0.31	0.02	0.127	0.015	0.5	0.026	1.81	0.046
Feathers	0.07	0.017	0.027	0.006	0.527	0.021	0.383	0.012	1.633	0.047	2.02	0.07
Heart	0.01	0.01	0.01	0	0.497	0.032	0.16	0.01	2.868	0.06	1.377	0.042

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Muscles	0.063	0.015	0.063	0.006	0.533	0.021	0.153	0.012	0.777	0.01	1.813	0.049
Lungs	0.05	0.01	0.02	0.01	0.383	0.025	0.163	0.015	0.747	0.02	1.88	0.026

Table 2. Distribution of Heavy metals in different body parts of rock pigeon in district Faisalabad.

Rock pigeon	Metals (mg/kg)											
	Cd		Co		Cu		Mn		Pb		Zn	
	Mean	STDV	Mean	STDV	Mean	STDV	Mean	STDV	Mean	STDV	Mean	STDV
Bones	0.043	0.015	0.06	0.01	0.35	0.055	0.08	0.01	1.02	0.089	1.56	0.07
Feathers	0.09	0.04	0.03	0.01	0.54	0.057	0.35	0.032	2.26	0.082	1.79	0.046
Heart	0.028	0.003	0.017	0.006	0.49	0.058	0.42	0.064	0.813	0.059	1.35	0.056
Muscles	0.017	0.006	0.02	0	0.42	0.012	0.1	0.032	0.857	0.092	1.5	0.031
Lungs	0.05	0.01	0.02	0.01	0.49	0.03	0.25	0.05	0.877	0.032	1.56	0.012

Table 3 Comparison of distribution of heavy metals in domestic pigeon and rock pigeon from district Faisalabad

Metals (mg/kg)	Status	Bones		Feathers		Heart		Muscles		Lungs	
		Mean	STDV	Mean	STDV	Mean	STDV	Mean	STDV	Mean	STDV
Cd	Domestic	0.043	0.015	0.09	0.04	0.04	0.026	0.017	0.006	0.05	0.01
	Rock	0.03	0.01	0.07	0.017	0.01	0.01	0.063	0.015	0.05	0.01
Co	Domestic	0.06	0.01	0.03	0.01	0.017	0.006	0.02	0	0.02	0.01
	Rock	0.02	0.01	0.027	0.006	0.01	0	0.063	0.006	0.02	0.01
Cu	Domestic	0.353	0.055	0.543	0.057	0.493	0.058	0.417	0.012	0.49	0.03
	Rock	0.31	0.02	0.527	0.021	0.497	0.032	0.533	0.021	0.383	0.025
Mn	Domestic	0.08	0.01	0.353	0.032	0.423	0.064	0.097	0.032	0.25	0.05
	Rock	0.127	0.015	0.383	0.012	0.16	0.01	0.153	0.012	0.163	0.015
Pb	Domestic	1.02	0.089	2.26	0.082	0.813	0.059	0.857	0.092	0.877	0.032
	Rock	0.5	0.026	1.633	0.047	2.868	0.063	0.777	0.015	0.747	0.023
Zn	Domestic	1.563	0.07	1.787	0.046	1.35	0.056	1.503	0.031	1.563	0.012
	Rock	1.81	0.046	2.02	0.07	1.377	0.042	1.813	0.049	1.88	0.026

4. Discussion

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted. There are varied variances in what way numerous animals maintain copper homeostasis in the organization, and birdies seem to bear advanced intensities of Cu than a lot of mammals. Certain information has recommended that water polluted with antifouling dyes can be a basis of copper heavy drinking in pigeons. There have been news of Mute Swans bearing copper remainders of equal to 1000 mg/kg

[21]. The results of this study showed that the bird species are bio indicator of heavy metals in the study area. Study of feathers and tissues provide standard statistics for heavy metal concentration in *Coloumba livia* from the area of district Faisalabad. Between the two species rock and domestic pigeon, the trace metal absorptions vary considerably, and this recommends alike experience in the direction of the both species to poisonous chemicals free from adjacent industrialized and city extents. The heavy metals like Zn and Cu were recorded beyond the permissible limits in birds except for Cd and Pb. The decline of the bird species in the study area might because of heavy metal toxicity especially by Zn and Cu that were found beyond the permissible limits in the species. The heavy metal contaminants in the atmosphere are transported to individuals through the food chain or atmospheric pollution, and prolonged exposure can pose danger to the reproductive success and serious health concerns not only to pigeon species, but to humans as well.

5. Conclusions

Study of feathers and tissues provide standard statistics for heavy metal concentration in *Coloumba livia* from the area of district Faisalabad. Between the two species rock and domestic pigeon, the trace metal absorptions vary considerably, and this recommends alike experience in the direction of the both species to poisonous chemicals free from adjacent industrialized and city extents. The heavy metals like Zn and Cu were recorded beyond the permissible limits in birds except for Cd and Pb. The decline of the bird species in the study area might because of heavy metal toxicity especially by Zn and Cu that were found beyond the permissible limits in the species.

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