**RJCES**

## ORIGINAL ARTICLE

# Estimation of Heavy Metal Residues from the Feathers' of Blue Rock Pigeon (*Columba livia*) from Ajmer City, Rajasthan

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**ABSTRACT**
In current scenario the heavy metals occur naturally in the ecosystem with varied concentrations due to anthropogenic sources. The presence of heavy metals in the biosphere is of great ecological significance. As their contamination at certain concentrations and its translocation through food chains which is responsible for their accumulation in the living system. The heavy metals were studied from five selected sites of Ajmer city. Lead, Cadmium, Zinc and Chromium were analysed from feathers of *Columbia livia.*
*Keywords*: Heavy Metal, Accumulation, Bio-indicator, Feathers

## INTRODUCTION

The impact of anthropogenic pressure on biodiversity and associated side effects on human health has received increasing attention over the past decades throughout the world [1]. Various human activities often generate chemical compounds leading to the atmospheric pollution chiefly including pesticides, hydrocarbons and heavy metals [2].

Heavy metals have always been a part of our environment, usually present in very low concentrations at scattered sites and are persistently discharged into the environment from regular sources like volcanic action or weathering of rocks. Heavy metals can be sub-grouped into Manganese (Mn), Iron (Fe), Cobalt (Co), Zinc (Zn) and Molybdenum (Mo)- small concentrations of these elements are necessary for development and life cycles of living beings, yet are harmful if present in high doses. Lead (Pb), mercury (Hg) and cadmium (Cd) are found to be lethal even if present in small concentrations [3].

The natural environment has been gradually contaminated by various forms of pollution, mainly as a consequence of urbanization and the increasing use of fuels by households, vehicles and industry [4]. A serious group of pollutants are heavy metals that pose a threat to all living organisms, with lead being especially considered as highly toxic [5].

The occurrence of heavy metals (arsenic, cadmium, nickel, zinc) in biological system can have pernicious impacts since they have long half-lives [6]. Heavy metals enter the body through food chain and might be eliminated or accumulated. Birds are traditional objects of biological monitoring in polluted ecosystems, especially in territories adjacent to stationary sources of pollution.

Birds can deposit metals either in their plumes (feathers) [7] or can sequester in their eggs, which jeopardize the developing embryo [8]. Feathers are helpful indicators of metal pollution because they are easy to collect non-invasively and we can store them indefinitely. Moreover, the extent of body burden that is in feathers is generally steady for each metal, a moderately high extent of the body burden of some metals is put away in the feathers [9], because of their affinity for the sulfhydryl rich keratin protein and melanin pigments and there is typically a high correlation between levels of contaminants in the food of birds and levels in their feathers [10].

Birds can serve as bio-indicators of wider conditions [11] and they can even be used for predicting future environmental changes. In this sense, the use of wild birds as monitors of environmental contamination offers important information about the effects of the pollutants on these animals and also on the human species [12].

Feathers are metabolically inert after formation, so for those avian species with well known moult schedules, the analyses of specific individual feathers provide unique chemical information. There are

several advantages for feather as monitoring units, first, they are easy to obtain and can be observed for a long period, so feather is useful for long when large number of samples are needed, it has few damages to the population's survival. However, the results may be influenced by feather types and the location of body parts besides the common variations existing in other monitoring more for heavy metal researches. Feathers do not only present mercury but many other heavy metals, as they incorporate to the keratin structure. Magpie (*Copsychuss aularis*) feathers have been found to be very good indicators of environment contamination with heavy metals. The impact of high concentration of lead on feathers of Blue Rock Pigeon from rural and urban areas reported in India, confirmed the possibility of using it as biological monitor for environmental lead. Down and contour feathers are used more for heavy metal researches. To estimate the Heavy Metals Residues (Pb, Zn, Cd, Cr) and their effect on Biological System-*Columba livia.*

## MATERIAL AND METHODS
### Material
All reagents used were of analytical grade. These includes: Concentrated HNO3, HCl and Acetone. The glassware and plastic containers used were washed with liquid soap, rinsed with water. All the reagents needed were prepared by diluting with distilled water.Feather samples were processed for atomic absorption spectrophotometry, for determination of various metal concentrations in the feather samples, feather samples were washed 3 times with tap water, rinsed with distilled water.
### Sample treatment and Analysis
Feather samples of *Columba livia* were collected from five sites of Ajmer City. Consecutively 3 samples of feathers were collected from each site. After collecting the feather, it was washed by distilled water and acetone alternatively three times to remove any external dirt and contamination. The samples were air-dried before drying in an oven at $105^0$C for 2-3 hrs. Stainless steel scissors was used to cut the feathers into very tiny pieces to allow for easy digestion with the acid. The acid digestion mixture was prepared by mixing concentrated Hydrochloric acid (HCl) and Nitric acid ($HNO_3$) in a 3:1 ratio by Volume. 0.5 g of the dried sample were completely digested then filtered and diluted with 50 ml of distilled water. It was then analysed using an Atomic Absorption Spectrophotometer.
### Study Area
Ajmer is the 5th largest city in Rajasthan with the urban population of around 1,035,410, comprising of 534,688 male and 500,722 females. Ajmer is a low density city with a highly dense inner core, with population density of over 5,000 persons/sq.km according to Population Census 2011.
Five sites were selected for the presence study of heavy metal. Below Table no 1 showing the locations of the sites of Ajmer city.

### Table No1: Geographical Location of sampling sites of Ajmer city

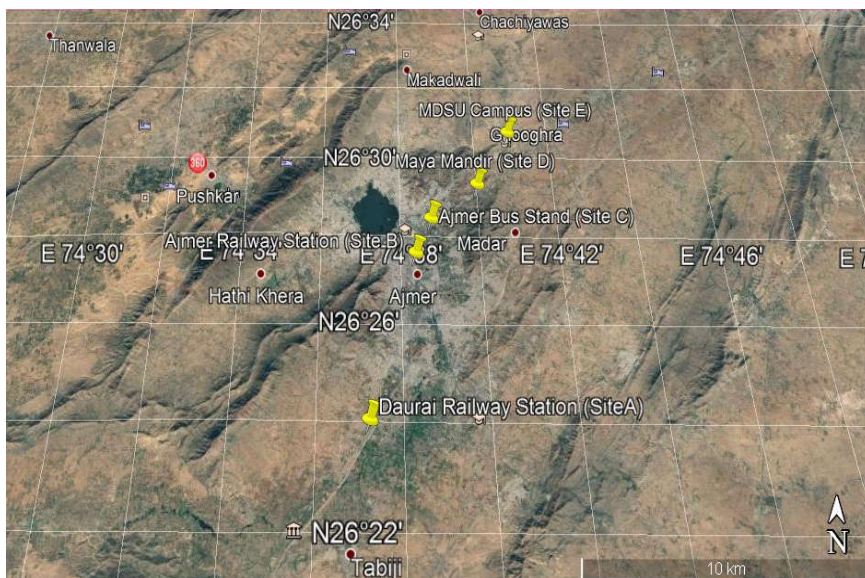| Sampling site number | Site name | Location |
|---|---|---|
| 1. | Daurai Railway Station | Latitude -26.39583 Longitude-74.61927 |
| 2. | Railway Station | Latitude -26.45773 Longitude-74.63798 |
| 3. | Bus Stand | Latitude -26.46859 Longitude-74.64491 |
| 4. | Neaby area of Maya Mandir | Latitude – 26.46868 Longitude- 74.64452 |
| 5. | MDS University Campus | Latitude -26.50752 Longitude-74.68047 |

**Figure No 1 Showing the sampling sites of Ajmer City**

**RESULTS AND DISCUSSION**
*Lead*
The concentration of lead was recorded and significant variation was found at all the sites.  The average value of lead was taken from all the sites of Ajmer city.  It was found that the concentration of lead at site 3 i.e. Bus stand is 36.79 ppm whereas at site 5 i.e. MDS University campus the concentration of lead is 18.14ppm (Table no 2). The Sources of Pb in the environment include fuel additives, lead pigments in paints, batteries, pipes and glazed ceramic food containers, automobiles. Inorganic Pb may be absorbed through the skin, the respiratory system and gastrointestinal tract. Lead in feathers can enter by two routes by endogenously and exogenously.

Range of Pb concentrations in  the present study was higher than Pb concentrations observed by Mansouri [14] in *Egretta gularis* feathers (2.17 to 16.45 ppm) and by Gushit [13] recorded in 16 different bird feathers (0.45 to 2.81 ppm). Pb may interact with calcium metabolism in birds

**Table No 2 Concentration of Lead in feather at all selected site of Ajmer City**

| S.No | Site | Concentration (ppm) |
|---|---|---|
| 1. | Daurai Railway Station | 28.14 |
| 2. | Railway Station | 20.61 |
| 3. | Bus Stand | 36.79 |
| 4. | Neaby area of Maya Mandir | 23.08 |
| 5. | MDS University Campus | 18.14 |
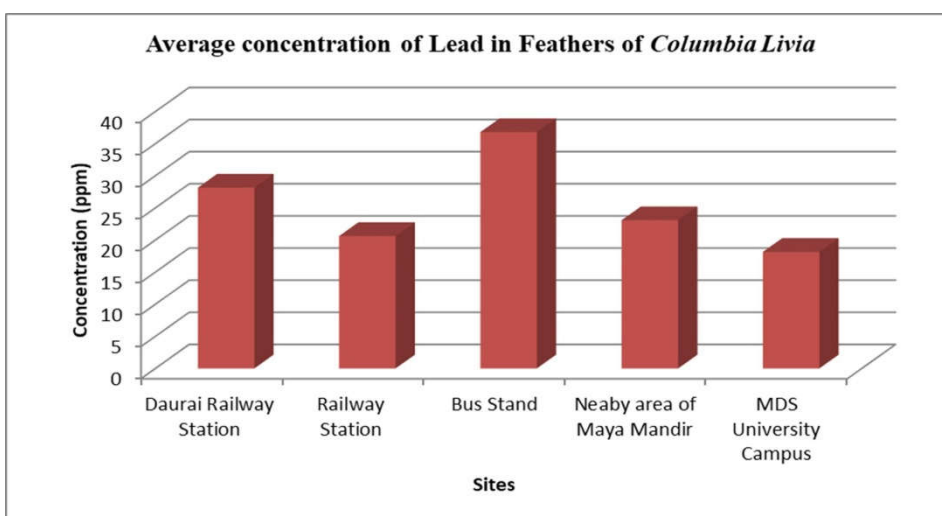

**Graph no 1: Showing the average value of Lead in feather.**

## *Zinc*

The concentrations of heavy metals in feathers, droppings and eggs of birds have been documented worldwide over the years [15, 16, 8]. The table no 3 showing the average concentration of zinc in feather of *Columbia livia.* The concentration of zinc was higher at Daurai Railway Station i.e. 1.762ppm while it was lowest at 0.831ppm i.e. Bus Stand. Zn, an essential element that plays important roles in different metabolic reactions, originates both from natural and from anthropogenic sources. No effects of high concentrations of Zn in biological systems are known. Metals are also generated by many human activities likely to be highest in high density zones.

**Table No 3: Average Concentration of Zinc in feather at all selected site of Ajmer City**

| S. No | Site | Concentration (ppm) |
|-------|------|---------------------|
| 1. | Daurai Railway Station | 1.762 |
| 2. | Railway Station | 1.559 |
| 3. | Bus Stand | 0.831 |
| 4. | Neaby area of Maya Mandir | 1.737 |
| 5. | MDS University Campus | 1.496 |
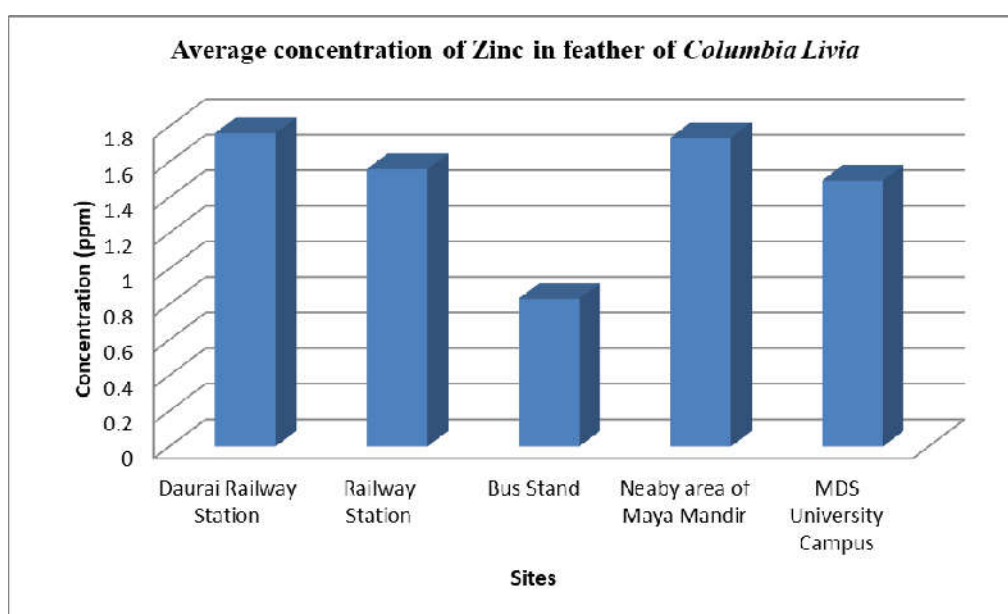


**Graph no 2: Showing the average value of Zinc in feather.**

## *Cadmium*

Cadmium is also a non-essential element; present in the environment as a result of anthropogenic activities, with deleterious effects for birds on egg formation, testicular damage, oviduct malfunctioning and kidney damage [17, 18, 15]. The average concentration of cadmium in feather of *Columbia livia* was higher at two sites i.e. 1.303 ppm at Railway Station (Site 2) and MDS University Campus (Site 5).

**Table No 4: Average Concentration of Cadmium in feather at all selected site of Ajmer City**

| S. No | Site | Concentration (ppm) |
|-------|------|---------------------|
| 1. | Daurai Railway Station | 0.551 |
| 2. | Railway Station | 1.303 |
| 3. | Bus Stand | 1.237 |
| 4. | Neaby area of Maya Mandir | 0.825 |
| 5. | MDS University Campus | 1.303 |
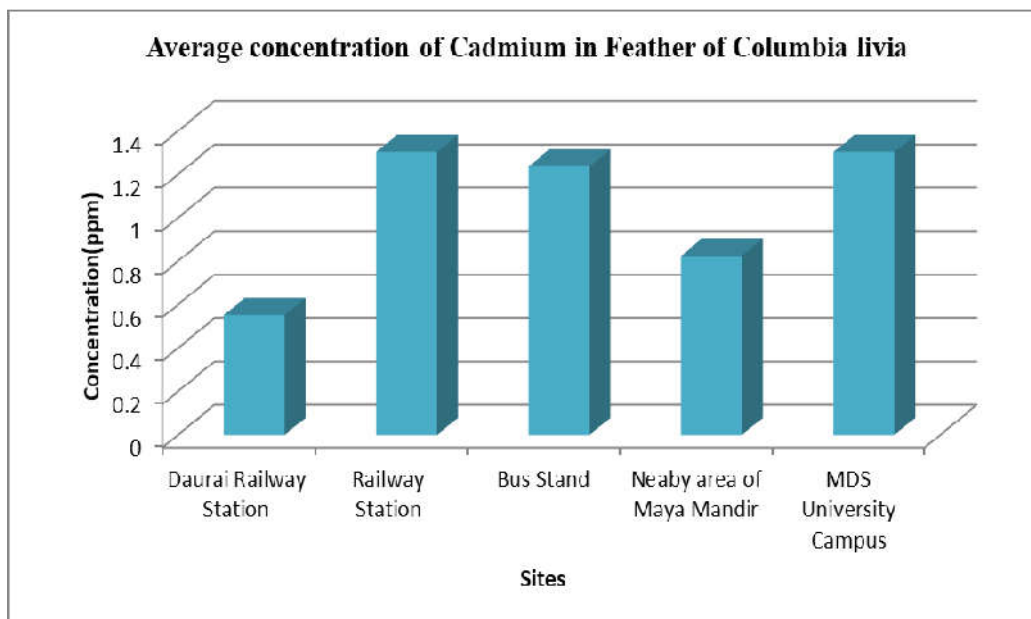
Graph no 3: Showing the average value of Cadmium in feather.

*Chromium*

The type of foraging behaviour would indeed strongly influence the variability in the levels of pollutants which pigeons experience: if pigeons use a restricted area, concentrations of pollutants in the feathers would differ according to their geographical origin, whereas long flight distances would shade differences. The concentration of chromium was high at Daurai Railway station i.e. 1.819 ppm and lowest at MDS university campus i.e. 0.115ppm, at Maya Mandir the concentration of chromium was 1.437ppm while at Bus stand, Railway station it was 1.653ppm, 0.902ppm respectively.
Chromium is no longer considered an essential element for animals and may cause deleterious effects on reproductive health of different avian species [15].
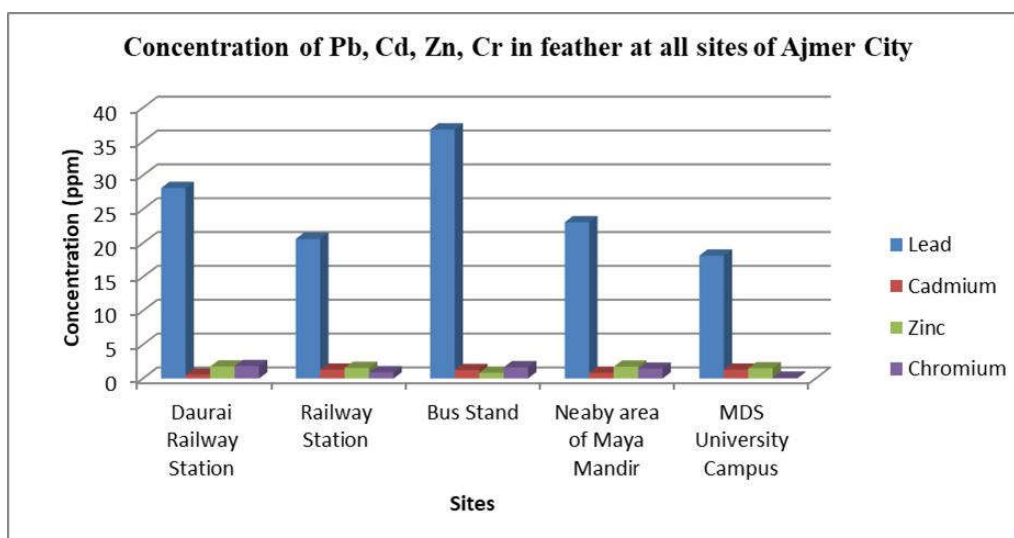
Table No 5: Average Concentration of Chromium in feather at all selected site of Ajmer City

| S. No | Site | Concentration (ppm) |
|---|---|---|
| 1. | Daurai Railway Station | 1.819 |
| 2. | Railway Station | 0.902 |
| 3. | Bus Stand | 1.653 |
| 4. | Neaby area of Maya Mandir | 1.437 |
| 5. | MDS University Campus | 0.115 |
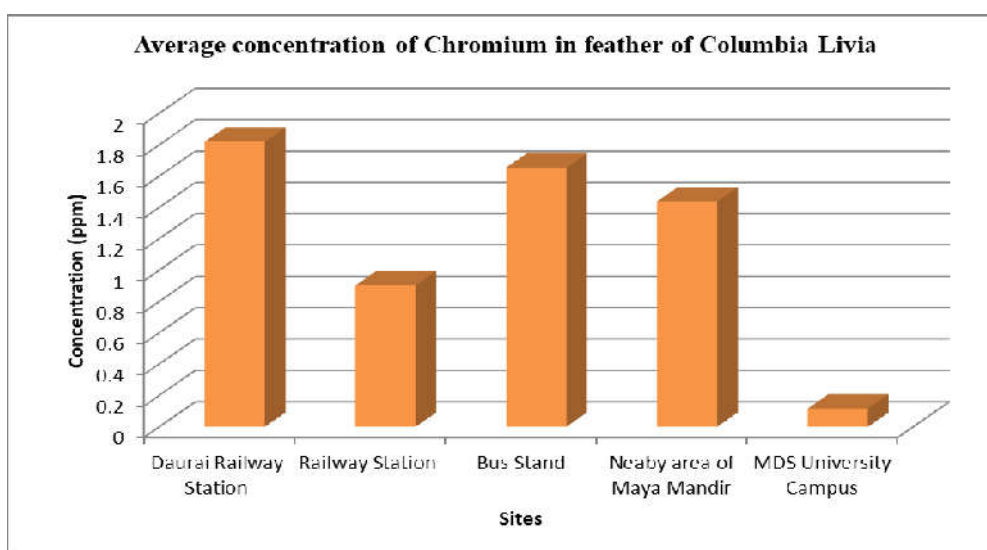


Graph no 4: Showing the average value of Chromium in feather.

**Graph no 5: Showing the average value at all the five study sites of Ajmer City**

From Graph no 5 it was found that the lead was found in high concentration at all the sampling sites. According to Burger and Gochfield [7] Pb levels of 4 mg/kg in bird feathers are associated with negative effects such as delayed parental and sibling's recognition, locomotion, impaired thermoregulation, depth perception, lowered nestling survival and abnormal feeding behaviour. Such high Pb concentration in feathers provides evidence for the significant pollution of habitats with this heavy metal and for its probable bioaccumulation in feathers.

**CONCLUSION**

The present study concluded the alarming situation in Ajmer in concern to the presence of Heavy metal residues. At the all five studies sites the Lead was found in highest concentration. Inorganic Pb is well known for its deleterious effect on the skin, respiratory system and gastrointestinal tract. Simultaneously other heavy metals observed (Cd, Cr, Zn) might also cause severe health issues as they propagate in various food chains and food webs. These pollutants have well known impacts on health in different concentrations. Thus, surely affecting the human and animal (birds, fishes, mammals etc.) health of study area too. Regular monitoring of environmental contaminants or pollutants such as heavy metals is essential to plan the remediation strategies. Hence the bird's feathers can be considered as the effective and easy source to assess not only the health of the species but also the fluctuations in contaminant levels in the environment where they live.

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