Research Article

Heavy metals accumulation trends in scavenger birds from different landfill and dumping sites of Punjab

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Abstract

Landfills and dumping areas host huge assemblages of scavenger birds (crows, mynahs, housesparrows etc.). Feeding on landfills and dumping sites can cause several problems and toxic effects on wildlife due to heavy metals (HM) exposure with environmental concerns. This study was designed to explore the preferential accumulation of Chromium (Cr), Nickel (Ni), Lead (Pb), and Cadmium (Cd) in blood and feather of scavenger bird samples that existed in the area of Lakhodair landfill, Mehmood Booti Waste dumping site of Lahore, and Muhammad Wala Waste dumping site Faisalabad. The metals deposition was examined by Atomic Absorption Spectroscopy (AAS). The results showed the Pb concentration was significantly higher ($P \leq 0.05$) and the Cd concentration was the lowest in birds of waste dumping sites. The concentration of the metals in the blood and feather varies in different species of birds trend as $Pb > Cr > Ni > Cd$. Findings of present study suggest that environmental pollution of heavy metals is increasingly becoming a problem due to adverse effects to scavenging birds.

Keywords: Bioaccumulation; Dumping sites; Heavy metals; Landfill; Scavenger birds

Introduction

Landfills are the chief form of solid waste concentration in many urban areas [1, 2]. Landfill sites often host feeding assemblies comprising of the huge amount of Scavenger birds of the comparatively small variety of species. Scavengers are animals that consume dead organisms that are died due to ecological reasons other than predation [3]. Scavengers perform a vital part in the atmosphere by ingesting decomposed animal

and plant materials. Decomposers complete this procedure, by consuming the remnants left by scavengers [4]. Heavy Metals (HM) usually refers to a category of metallic element and metalloids with an atomic concentration of more than $4g / cm^3$ or 5 times greater than water. Though, the chemical properties of the heavy metals are the most influencing factors compared to their density [5, 6].

Avifauna is used as bio-indicators and is easy to classify, track, and sample the pollutant levels in their tissues assimilate sequential and spatial exposure [7]. The use of birds as an indication pertains to pollution indicating that bird populations are most sensitive to human activities [8]. The concentration of heavy metals in birds can be evaluated through accumulation in organs like the liver and kidney, muscles, bone, fat, eggs, feathers, and manures, etc [9]. A benefit of using those feathers is they can be easily collected and sampled without upsetting the health and form of studied species [10]. Most commonly used birds in bio-monitoring studies include birds of prey because of their place in the upper part of food chains and the local addition of pollution levels within their prolonged household boundaries [11]. Birds due to their presence on the top of the food web accumulate more metals in their tissues as compared to other animals that are present in the lower part of the food web [12]. The use of feathers to monitor heavy metal pollution is most common because feathers can easily be sampled and processed [13].

When the feathers are linked to the bloodstream through blood vessels during the short period of growth, metals may bind to the protein molecules in the feather [14]. Heavy metal concentrations can vary in birds depending upon their feeding habits in the food web.

The present study was designed to evaluate the heavy metal concentration in the blood and feather samples of scavenger birds living in close vicinity with landfill and waste disposal sites. Further, atomic absorption spectrophotometer was used to identify heavy metals including cadmium (Cd), chromium (Cr), nickel (Ni), and lead (Pb) concentrations in the blood and feather samples

Materials and Methods

Study area and experimental design

To study heavy metals accumulations in the Scavenger birds, blood and feather samples were collected from the vicinity of Lakhodair landfill Lahore and Mehmood Booti Lahore, Muhammadwala Faisalabad waste dumping sites (Fig. 1).

Figure 1. Study area and sampling sites from district Lahore and Faisalabad

Blood sample size

Total blood samples (n=20) were collected from landfill and waste dumping sites, in the vicinity of Lakhodair landfill Lahore (n=5) and Mehmood Booti Lahore (n=5), Muhammad Wala (n=5) Faisalabad, and control site BhainiPind Lahore (n=5).

Feathers sample size

Total feather samples (n=20) were collected from landfill and waste dumping sites, in the vicinity of Lakhodair landfill Lahore (n=5) and Mehmood Booti Lahore (n=5), Muhammad Wala (n=5) Faisalabad, and control site BhainiPind Lahore (n=5).

Sampling of blood

Adult scavenger birds, comprising of Crows, Mynahs, Sparrows, etc. captured from landfill and waste dumping sites for blood sampling before release using large mesh nets with the help of local hunters. Sampling was preferably performed in the early morning hours which was the time of birds feeding. Blood samples (3-5ml) were collected in EDTA coated vacutainers to prevent the blood from clotting. Blood was stored at -20°C for further heavy metals analysis [15].

Sampling of feathers

The feather samples of each bird were collected from birds surrounding the area of waste dumping and landfills in Faisalabad and Lahore. The feather sample was kept in polythene bags and carried to the laboratory for further analysis.

Samples preparation and digestion

Digestion of blood sample for heavy metals

One ml of blood added in 100 ml of digestive flasks mixed with 10 ml of concentrated nitric acid. The flask's contents were stirred for 20 minutes and samples were cooled at room temperature after heating by adding 5 ml of per-chloric acid by constant stirring until the appearance of white fumes and the quantity of the sample reduced to 2–3 ml. A 50 ml amount of re-distilled water was finally added. The concentration of heavy metals

(Cr, Ni, Cd, and Pb) in blood assessed by using Atomic Absorption Spectrophotometer (Hitachi Polarized Zeeman AAS, Z-8200, Japan) methodology related to Riaz and colleagues [16].

Digestion of Feather sample for heavy metals analysis

To determine the level of heavy metals in feather samples of scavenger birds, feather samples were washed 3 times and cleaned with the distilled water and acetone to get rid of the external contamination [17]. The feather samples were then dried at 20°C for 2 hours in an oven and cut into small pieces, 0.5g weighed, and transferred into the flasks by adding about 1.0 ml of HNO₃ and 0.25 ml of per-chloric acid using a burner. Initially, samples were heated at low to high temperatures. After heating feather samples were cooled at room temperature and added 2-3 ml distilled water to make the final fraction. The digested samples for heavy metals analysis (Cd, Cr, Ni, and Pb).

Instrumentation

Standard digestion of samples and analysis were completed according to Association of Official Agricultural Chemists (AOAC), 1990 [18]. Absorption Spectrophotometer (Hitachi Polarized Zeeman AAS, Z-8200, Japan) used for analyses, detection, and concentration of heavy metals in blood and feather samples of scavenger birds.

Statistical analysis

Statistical data were analyzed with IBM SPSS software version 23. The metal concentrations analyzed by one-way ANOVA examined by Tukey Multiple Comparison test to compare metals concentration in different birds of the study sites. P values ($p \leq 0.05$) were considered significant.

Results

Heavy metals Cd, Cr, Ni, and Pb concentration estimated in blood and feather samples of scavenger birds in the vicinity of Muhammadwala Faisalabad waste dumping

site, Lakhodair landfill, and Mehmood Booti waste dumping site Lahore. Blood and feather samples of birds residing in Bhainipind were also collected considered as a control site. Investigation of heavy metals residue Cd, Cr, Ni, and Pb was done by Atomic Absorption Spectrophotometer (AAS).

Pb concentration in blood and feather of *Passer domesticus* (House sparrow) high in

comparison to other birds (Fig. 2a, 2d). Results showed Cd minor deposition in blood and feather of *Corvus brachyrhynchos* as compared to other metals at all study sites (Fig. 2b, 2e). The mean value of Ni in the feather of *Acridotheres tristis* higher compared to other birds (Fig. 2f). The mean value of Cd in the blood of *Acridotheres tristis* higher compared to other birds. (Fig. 2c, 2f).

Figure 2. Showing the concentrations of Heavy Metals (a) Blood of *Passer domesticus* (b) Blood of *Corvus brachyrhynchos* (c) Blood of *Acridotheres tristis* (d) Feather of *Passer domesticus* (e) Feather of *Corvus brachyrhynchos* (f) Feather of *Acridotheres tristis*. Bars representing the values of mean $\pm$ SD

Discussion

The heavy metals level in the blood and feather samples of scavenger birds from Lakhodair landfill Lahore, Mehmood booti waste dumping site Lahore and Muhammadwala Faisalabad waste dumping site were estimated. Metals have been identified to modify hormonal response, cause difference in the plumage thickness,

decreased genetic diversity, decreased bone calcification, poor fledging, lethargy, and abnormal incubation conduct [19].

Pb degradation does not occur in the direct metabolic pathway of biodegradation and can accumulate in bird feathers and blood at high focuses. Due to the high affinity of Pb for sulfur, Pb is deposited in feathers, presumably bound to the sulfhydryl groups in

keratin [19, 20]. In the current study, Pb levels in blood samples of birds was found significantly higher in the blood samples of birds from Lahore and Faisalabad waste dumping sites. Pb bioaccumulation patterns were consistent with previous studies [21-24].

Cr levels in the blood samples of birds collected from site. 1 (Lakhodair landfill), 2 (Muhammadwala), and site.3 (Mehmood booti) investigated and found that chromium concentration in bird's blood was comparatively higher at all study sites. Ni is considered a cofactor for the attachment of some hormones and is an important component of different cellular processes. Cr fixations neurotoxic impacts in birds were at that point proposed and results of some studies detailed the upper limit of deposition in blood and feather of birds [25, 26].

Excessive ingestion of Ni can lead to cell death, weakened reproductive functions, and modified hormonal and enzymatic activity, oxidative and neurotoxicity. In the current study, a high level of Ni was observed in bird's feather samples than blood. The Ni levels estimated in feathers of birds by Abdullah and coauthors [22] announce that anthropogenic sources like mining and waste burning are known to rise Ni in the environment.

Cadmium (Cd) is considered as one of the toxic heavy metals that is most lethal [27]. The present study evaluated the lowest concentration of Cd in blood and feather samples. However, the Pb levels were observed higher among all birds were above the permissible level for blood and feather samples.

There were various critical links between deposition of metals in blood and feathers, proposed regulations pathway, uptake capacity, or comparative detoxification processes.

Conclusion

The current study is designed to describe a

persistent availability of a variety of food at landfill and dumping sites attracting a huge number of birds. The existence of Cattle egrets and House crows, sparrows, and other birds recorded in huge numbers, their scavenging and communal behaviors possibly depress other species of birds from manipulating food properties on the occupied site of the landfill. Even though man-made activities extremely developed sites feeding the scavenging species population from the landfill show multifaceted environmental associations among its members. The present research found the greater level of metals Cd, Pb, Ni, Cr in blood and feather samples of birds from Muhammadwala Faisalabad dumping site, Mehmood Booti dumping site Lahore and Lakhodair landfill Lahore. Findings of the present study provide insight towards hazards due to exposure of heavy metals to periodic outlines of local and regional bird populations to location and management practices of the landfill and dumping sites.

Authors' contributions

Conceived and designed the experiments: A Riaz, Performed the experiments: N Said, Analyzed the data: MA Riaz & A Rehman, Contributed materials/ analysis/ tools: A Riaz, UA Ashfaq & M Ilyas, Wrote the paper: A Riaz & N Said

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