



QUALITATIVE ASSESMENT OF HEAVY METALS IN BENGALURU CITY AIR POLLUTION: USING FEW BIOINDICATORS

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ABSTRACT

A study was designed to investigate the accumulation of heavy metals in Bengaluru environment by using some reliable bio-indicators like feathers of the avian community, fur of some animals and human hairs.

Although some heavy metals are essential traces, most of them can be toxic to all forms of life due to formations of complex compounds within the cell. Unlike organic pollutants, the heavy metals once introduced into the environment it becomes difficult to get biodegraded. They persevere perpetually and engender pollution of air, water and soils. Thus analysing this is as vital as they are now considered to induce multiple organ damage even at lower level of exposure. However, concentration cadmium and iron heavy metals indicated in almost all the samples used in the present study. Thus this study provides an apparent repercussion on presence of these heavy metals.

KEY WORDS: Bengaluru, bio-indicators, avian community, fur, human hairs.

1. INTRODUCTION

Human activities has contaminated the natural environment by various forms of pollution due to the urbanization, increasing fuel consumption, industrial effluents, release of pesticides, hydrocarbons and heavy metals (Azimi *et al.*, 2003).

Heavy metals are defined as metallic elements that have a relatively high density compared to metals and are toxic even at low level concentration. Heavy metals also include metalloids, such as arsenic, that are able to induce toxicity even at low level of exposure. Although small amounts of heavy metals can be required for the physiological functions occurring in the body whereas high amounts may cause acute or chronic toxicity. Thereby damaging several parts including blood, liver, kidney, bones, feathers, hair and egg and causes altered biological process (e.g. Ha *et al.*, 2009 in humans). Majority of environmental pollution is prominent in point sources areas such as mining, foundries and smelters and other metal-based industrial operations.

Trace elements such as chromium (Cr),Copper (Cu),Mercury (Hg),Arsenic (As), Cobalt (Co),Manganese (Mn),Selenium (Se),Zinc (Zn) and many others are considered to be heavy metals which on exposure leads to damaged or reduced function of CNS and may lead to certain devastating condition. Hence, the need to check for the presence of heavy metals in environment is very predominant. The analysis was carried out by bio-monitoring strategies, involving the use of indicators, *i.e.*, particular organism that may reflect the contamination of their ecosystem. Birds' feathers, Animal fur and Human hair are considered to be the potential bio-indicators of environmental pollution. These offer several advantages as bio-indicators of metal exposure and collection of these samples are non-invasive. The concentration of heavy metals is higher in these regions than when compared to other tissues and hence easier to detect and quantify.

Experimental evidences have reported that effect of heavy metals has lead to altered pairing behaviour and reproductive success (Fredrick and Jayasena, 2011).

In recent years, environment pollution has become prominent in various developing countries where urban, industrial and agricultural activities are sources of pollution. In this paper, an attempt to assess the presence of these heavy metals (As, Cd, Cr, Pb, Mn, Li, Fe and Zn) in the fast growing metropolitan city of Bengaluru were undertaken using few bio-indicator.

2. MATERIALS AND METHODS

2.1 MATERIALS

- Reagents like concentrated HNO₃, Hydrochloric acid, Acetone, Distilled water were used.
- The glassware, polytene covers; scissors were autoclaved before the analysis.
- Following samples were used for qualitative analysis and were collected from in and around Bangalore city and stored in sterile polytene covers for further work.

| | | |
|---|-------------------------------|----------------------------|
| 1 | Feathers of birds G | Hen, Pigeon, Crow, Eagle |
| 2 | Fur of animals | Cow, Sheep, Goat, Cat, Dog |
| 3 | Human hair H | Human male, Human female |

2.2 PREPARATION

Stored sample were taken and washed thoroughly in alternating distilled water and acetone simultaneously to remove external contamination. These samples were then finely chopped into tiny pieces using sterile scissors and were subjected to drying in oven at 70°C for 2-3 days. Once the samples were dried further studies were carried on.

2.3 SAMPLE TREATMENT

The dried samples were supposed to be dissolved in *aquaregia* [digestion mixture].The mixture was prepared in 3:1 ratio by volume of concentrated hydrochloric acid (HCl) and concentrated nitric acid (HNO₃). 0.5g of samples was weighed and was added into *aquaregia* taken in a test tube till it dissolved. The dissolved sample were then stored in 27⁰ C in sample bottles and finally analysed using chemically analysed for the presence heavy metals

3. RESULTS AND DISCUSSIONS

In the present study, the heavy metals have been detected in the feathers of birds, Fur of animals and Human hair. Among them Cadmium (Cd) and Iron (Fe) is the major detected element in all the samples used for the analysis. The analysis of the work was conducted in the Organic chemistry of P.G. laboratory, Vijaya College, R.V. Road, Bangalore. All the samples were analysed in batches and results were recorded.

Table 1: Qualitative analysis of heavy metals in avian feathers

| Sl.No | Samples | Presence of Heavy metals |
|-------|---------|---|
| 1 | Hen | Cd ⁺² , Fe ⁺³ , Ni ⁺² , Zn ⁺² , Ca ⁺² , Mg ⁺² , Na ⁺ |
| 2 | Pigeon | Cd ⁺² , Fe ⁺³ , Zn ⁺² , Ca ⁺² , Mg ⁺² |
| 3 | Crow | Cd ⁺² , Fe ⁺³ , Ni ⁺² , Zn ⁺² , Na ⁺ |
| 4 | Eagle | Cd ⁺² , Fe ⁺³ , Ca ⁺² , Na ⁺ |

Table 2: Qualitative analysis of heavy metals in fur of animals

| Sl.No | Samples | Presence of Heavy metals |
|-------|---------|---|
| 1 | Sheep | Mo ⁺⁶ , Fe ⁺³ , Ca ⁺² , Na ⁺ |
| 2 | Cow | Cd ⁺² , Fe ⁺³ , Ca ⁺² , Mg ⁺² , Na ⁺ |
| 3 | Goat | Cd ⁺² , Fe ⁺³ , Ca ⁺² , Na ⁺ |
| 4 | Cat | Fe ⁺³ , Ca ⁺² , Na ⁺ |
| 5 | Dog | Fe ⁺³ , Ca ⁺² , Na ⁺ |

Table 3: Qualitative analysis of heavy metals in Human hairs

| Sl.No | Samples | Heavy metals present |
|-------|--------------|--|
| 1 | Human male | Cd ⁺² , Fe ⁺³ , Zn ⁺² , Mg ⁺² , Na ⁺ |
| 2 | Human female | Cd ⁺² , Hg ⁺² , Fe ⁺³ , Ca ⁺² , Mg ⁺² , Na ⁺ |

Considering the results of feathers of birds from Table -1, Hen's feather is the major carrier of all seven heavy metals and Eagle's feather is found to be least with four heavy metals whereas Pigeon and Crow's feather with five heavy metals respectively. The above experimental studies on avian feathers coincide with the result with Gulshit *et al* 2016.

Human feeding of a poultry meat and Pigeon meat has indirect risk of their health and there may be a chance to get ingested into the body of human and has high risk factor.

Similarly, further investigation in the fur of sheep, goat, cat and dog were considered. The result showed that the Molybdenum (Mb) heavy metal was identified only in the fur of sheep whereas Calcium (Ca) and Sodium (Na) were found in all the fur of animals. (Table-2)

Experimental studies were further carried out using the human male and female hair (Table 3) which showed the presence of common heavy metal such as iron, cadmium, magnesium and sodium. Mercury and Calcium is alone identified only in human female hair whereas absent in human male hair. Whereas Zinc (Zn) is identified in male hairs only.

Thus the various heavy metal identified in different sources of samples revealed that Hen's feather is the highest carrier of heavy metals whereas fur of cat and dog showed least number of heavy metals.

4. RISKS OF PRESENCE OF HEAVY METALS/TRACE ELEMENTS

- 1) Nickel:** Nickel exposure can cause allergic reactions, stomach ache, chronic bronchitis and carcinogenesis in humans.
- 2) Cadmium:** Higher concentrations of cadmium effects the metabolic processes through replacement of essential elements at the active sites of biologically important molecules, thus indirectly inducing nutritious deficiencies.
- 3) Zinc:** Zinc plays important roles in different metabolic pathways, originates both from natural and from anthropogenic sources.



4) Iron: Iron may be hazardous to the environment; special attention should be given to plants, air and water. It is strongly advised not to let it into the environment because it persists in the environment.

5) Calcium: Calcium phosphide is very toxic to many organisms. Rather than that there are no such chronic effects.

6) Sodium: Sodium powdered form is highly explosive in water and a poison combines and uncombined with many other elements. This chemical is not mobile in solid form although it absorbs moisture very easily.

7) Mercury: Mercury can lead to kidney damage, stomach disruption, damage to intestines, reproductive failure and DNA alterations.

8) Magnesium: This has very little effect as it lacks toxicity property even when accumulated in environment.

9) Molybdenum: Molybdenum can be highly toxic at larger doses. Experiments have shown that too much molybdenum causes foetal deformities.

5. CONCLUSION

Our present study confirmed that analysing of metal content in avian feathers, fur and hair provides a reliable, non-invasive method of monitoring ecological consequences of the environment. Thus these samples can serve as bio indicators for the assessment of heavy metal pollution in the environment. Further studies can be carried out using any of biological tissues available in the nature and action can be carried out in that direction

Thus study of concentration of heavy metals and its variations can throw a light to the fact that there are significant fluctuations in the level of contamination of the environment where these animals, birds and humans reside.

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