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## An Opportunistic Evaluation of Heavy Metal Accumulation in House Sparrow (*Passer domesticus*)

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### Editorial

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#### ABSTRACT

Birds on prey are excellent indicators of healthy ecosystem, as they are top predators occupying multiple trophic levels and various ecological niches. Predatory birds are especially best bio-indicators of bio-accumulative compounds such as methyl mercury because these compounds bio-concentrate in their prey. The use of feathers to evaluate exposure of birds to heavy metals like mercury is a common method. Early formed feathers are molted up to several times per year, and new feather growth quickly followed by replaced molted feathers. In the present experiment the opportunistic samples of dead house sparrows were collected and analysed for the accumulation of lead, zinc, cadmium and mercury by Atomic Absorption Spectrometry. From the results it was found that the level of these heavy metals are higher in the samples collected from the urban areas than the rural areas and also higher when compared with permissible limits of FAO.

### INTRODUCTION

Biodiversity is a key component for sustainable environment. But the pressure on the environment caused by economic development and other human activities made it difficult to protect the natural areas that are large enough to accommodate entire ecosystem. On the other hand ecosystem needs to be treated with care, because they provide goods and services that are vitally important for human well-being <sup>[1]</sup>.

House sparrows are widely distributed indicator around the world. In India the population of House sparrow (*Passer domesticus*) was highly populated and ranking globally. As they are generally associated with human habitation, they tend to stay in the region with structures built with many holes under the tiles. These sites may select for nest construction and feeding. According to the latest report by various environmental organizations, there has been decline in their numbers (80%) during the past decades in India. Their recent decline around the world has put them in the Red list of the International Union for the Conservation of Nature <sup>[2]</sup>.

Birds are traditional objects of biological monitoring in polluted ecosystems, especially in territories adjacent to stationary sources of pollution. Extensive studies on heavy metal concentration in birds have been conducted in many polluted regions. It is very important to keep several criteria when selecting the bird species for bio monitoring. Among them the criteria such as, common occurrence, habitat, easy capturing, clearly identified individual territory size, homogeneity of the material, well known biology of species, breeding possibility for laboratory tests as well as bioaccumulation capacity were taken into account <sup>[3]</sup>.

Mora <sup>[4]</sup> investigated the heavy metals and metalloids in egg contents and egg shells of passerine birds from Arizona, United States. He reported that Al, Ba, Cr, Cu, Mn, Se, Sr, and Zn, were detected primarily in egg contents of all bird species. Ar, Ni and Pb were detected primarily in egg shells. Swaileh and Sansur <sup>[5]</sup> monitored the heavy metal pollution using house sparrow in West Bank of Columbia and reported that the concentrations of Cu, Cd, Pb and Zn were measured in different tissues and organs

of male and female juvenile (1-4 weeks old) and adult house sparrows. Tissues and organs had the following order of metal richness: liver > stomach > bone > lung, feathers > muscles > egg contents, brain > heart > egg shell.

Elezaj et al.,<sup>[6]</sup> studied the seasonal effects of environmental heavy metal pollution on tissue accumulation of lead, cadmium, zinc and copper in house sparrow (*Passer domesticus*) in Mitrovica town and Celtine village of Albania. They found that the highest concentration of lead was found in femur, tibia, sternum, kidney, liver and heart

## METHODOLOGY

### Sampling site

The sample for heavy metal analysis was collected from the opportunistic dead samples obtained from different rural and urban sites of Virudhunagar District (**Figure 1**).

### Sample preparation

The samples were dissected in the laboratory and the feathers, bones and tissues were separated. Then the sample was transferred to clean acid washed petridishes separately and oven dried at 60 °C until the samples is dried well. The sample was digested in a mixture of super-pure nitric acid and perchloric acid (2:1 v/v).The volume of digestion mixture was 10 times the samples mass in gram.



**Figure 1.** shows that dead House sparrow sample due to electrocution in an urban site. The sample was collected and subjected to preparation and analysis before decomposition.

After soaking the specimens in the acid mixture overnight at room temperature, the mixture was gradually heated to 200 °C in a sand bath over a period of 3 hours. Digestion was then continued until no fumes were observed and the mixture became pale yellow. Mixtures were then diluted to 25 ml with double distilled water and filtered with the help of filter paper according to Nwabueze<sup>[7]</sup>

### Sample analysis

The final concentration of Pb, Zn, Cd and Hg present in the muscle, bone and feather were analysed through Atomic Absorption Spectrophotometer (Shimadzu AA-6300).

## RESULT

The elements Pb, Zn, Cd and Hg are considered to be effective pollutants which occur in ecological junctions of birds which are major threatening factors for the survivability of House sparrow (*Passer domesticus*). It has been observed that notable level of mercury accumulation in the bone and muscle (**Table 1**)<sup>[8]</sup>. Especially the level of mercury accumulation was very higher in bone (848.09) compared to the muscle (707.49) than the FAO permissible limit. Notably lead accumulation was also higher in muscle (47.13). But in the case of rural sampling, these accumulate were lower than urban accumulates.

**Table 1.** Concentration of different heavy metals (in ppm) present in House sparrow sample collected from an urban site.

Samples (1gm of dry weight)	Urban				Rural			
	Lead	Zinc	Cadmium	Mercury	Lead	Zinc	Cadmium	Mercury
Muscle	47.13	43.78	0.17	707.49	1.2	32.4	0.12	102.4
Bone	3.12	25	0.20	848.09	2.3	27.2	0.05	388.42
Feather	5.44	48.99	0.23	394.75	1.9	31.5	0.13	167.23
*Permissible limit	2.5	50	2.5	500	2.5	50	2.5	500

\*FAO/WHO<sup>[8]</sup>

Though the level of mercury accumulation was at ppm concentration but the site of accumulation in bone and muscle are serious and life threatening factor for house sparrow. These accumulation will lead to loss of strength in the respective bone and muscle and it will dismantle the whole system.

## DISCUSSION

The bioaccumulation of lead and other metals in avifauna can lead to a variety of problems, both neurologically and physically. Some of these problems include smaller clutch sizes, reduced fertility, hatching failure, nestling mortality, lowered growth rate, and behavioral abnormalities of nestlings. In a larger scope, heavy metals affect reproductive mechanisms of birds. Since the diet of young house sparrows consists mainly of the bottom invertebrates collected in the close surroundings of nest, sediment pollutants may easily get into the avian body. Kekkonen<sup>[9]</sup> analyzed Aluminum, Chromium, Manganese, Iron, Copper, Zinc, Cadmium and lead heavy metals in the liver samples of house sparrows taken from urban and rural places of Finland and reported that the levels of all heavy metals were higher in samples of urban sites except for Chromium when compared to the samples taken from rural places.

In the samples of bone taken from the urban study sites, the concentration of lead and mercury were higher than the permissible limit. Similar kinds of results were reported by Elezaj et al.<sup>[6]</sup> who studied the accumulation of heavy metals in bones of house sparrows in Mitrovica town and Celtine village and found higher concentration of heavy metals than the permissible limit. In feathers, the concentration of lead was higher than the permissible limit in urban study sites while comparing with the rural sites. Hofer and Holzapfel<sup>[10]</sup> reported that the concentration of Zinc was significantly higher when compared to the other metals in the passerine nestlings at brown field site of United Kingdom.

The present investigation revealed that the concentration of heavy metals was higher and mostly above the permissible limit in the house sparrow of urban environments when compared to the concentration of heavy metals in rural environment. Similar kind of difference in accumulation of heavy metals was supported by Swaileh and Sansur<sup>[5]</sup> who monitored the urban heavy metal pollution using the house sparrow, *Passer domesticus* and reported that the adult house sparrows collected from rural areas were found to have significantly less Cu, Pb, and Zn (but not Cd) concentrations than those from urban environments.

Heavy metals along with other pollutants decrease the amount of invertebrates in the cities which are used as food for the house sparrow nestlings. Vincent<sup>[11]</sup> found annual productivity (as number of fledged young) to be lower in urban areas due to starvation of chicks when their diet contained a high proportion of vegetable material or ants instead of invertebrates which may be indirectly affected by the heavy metal sedimentations in the soil and plant leaflets. Duenas et al.<sup>[12]</sup> reported that the house sparrows living in urban sides of Spain were exposed to toxic chemical released from industries and hence they found to have low hemoglobin value and low anti-toxicant value when compared with rural study sites. To conclude, presence of heavy metals is one of the factors that might have indirectly played a part in the decline of urban house sparrows.

## CONCLUSION

Birds are direct indicators of ecosystem. In this study birds indicate the higher degree of pollutants accumulation in urban sites. Hence this indicates urban areas were fully exploiting the mercury and lead in several ways. The usage cannot be completely eradicated due to modernization but it can be restricted and lot of birds can be protected. One such major factor was accumulation of pollutants. Hence it has enlisted into the Red list of birds in London by British Ornithologist Union. To protect the life stage of House sparrow essential measures should be taken such as constructing artificial nest and preserving the natural nest.

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