Lead burden on avian feathers

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Abstract: Determination of the lead concentration in feathers of *Columba livia(pigeon)* from the urban to suburban areas of Ajmer was studied. Lead analysis was performed by atomic absorption spectrophotometry with air acetylene (G.B.C. Advanta). Lead concentration was significantly higher in urban areas.Primary and tail feather of pigeon in urban sites had significantly higher lead concentration than in their sub urban counterpart. The result of the present study showed that the feathers of the pigeon contain high concentration of lead, which may reflect lead contamination in urban and sub urban areas and confirm the possibility of using the pigeon feather as a bio indicator for environmental lead contamination.
Keywords: Lead burden ,AAS,Avian feathers

INTRODUCTION

Metallic pollution of the environment is due to elements occurring naturally by erosion of surface deposits of metal minerals as well as from human activities such as mining, smelting , fossil fuels combustion and industrial application of metals. Lead belongs to the group of those heavy metals, which are extensively used by humans. Because of cheapness and unique nuclear properties lead has found diversified uses in science and industries. On a global basis the major source of lead pollution is the combustion of gasoline (petrol) to which either tetraethyl or tetra methyl lead is added as an antiknock compound to increase the octane value. Thus, tetraethyl lead is a potential pollutant of the air as well as the soil near highways and roads with heavy traffic (Rastogi 2017) The concentration of Pb was in the range of 0.092 mg/L (March and April 2008) - 0.192 mg/L (November 2007), in Anasagar Lake ,Ajmer with a mean concentration of 0.122+0.042 mg/L. The average concentration of lead was observed over critical level.(Dutta. et al, 2009)

The sources of lead to water are manufacturing of pesticides, insecticides and storage batteries or from contact with gasoline containing lead activities. Lead poisoning has been recognized for many years. Higher level exposure of lead in the water system, results in metallic taste.(Mathur and Tomar ,2011)

Lead poisoning has long been a concern for public health officials. The impact of lead poisoning in children due to ingestion of paint chips and soil has been studied in depth (Haley and Talbot 2004, Koller et al. 2004, Mathee et al 2004, Niskar et al. 2005). Despite U.S. federal ban on lead based paint and gasoline in 1978 and 1986, respectively, lead residue is still prevalent at hazardous levels in urban and suburban environments and may present a health concern for people and wildlife, particularly bird.
Human exposure to lead and it's compounds occurs mainly in lead related occupations with various sources like leaded gasoline, mining ,industrial processes such as, smelting and it's combustion, pottery, lead based painting lead containing pipes, battery recycling printing of books etc. though it's widespread use has discontinued it is still used in many industries (Wani et al.2015)

Birds continue to breed in urban habitats despite numerous negative attributes to these environments including light, noise, pedestrian and toxic contaminants. Urban environment is also contaminated by lead and thus are potentially toxic to wildlife. Soil lead concentrations are typically higher in larger, older, inner cities compared to those found in rural environments (Mielke 1999). Such elevated levels pose potential health threats to wildlife such as birds living in contaminated urban areas, yet little research has examined this issue.
Lead is primarily transferred from the environment to birds through their diet and secondarily through inadvertent soil consumption (Beyer et al. 2004) Birds accumulate lead in their tissues via multiple mechanisms. Lead moves from soil to plants (Labare et al. 2004) through the root system and is stored primarily in leaves (Olivares 2003) and seeds (Teissedre et al. 1994 and Olivares 2003). Transfer to birds may then occur directly through consumption of fruits or indirectly through phytophagous insects or soil invertebrates (Price et al 1974; Dmowski and Karolewski 1979; Kaminski 1995, Labarea et al., 2004). In addition, birds may consume contaminated soil while foraging. Beyer et al., (1994) suggested that ground-foraging birds also take up lead by inadvertently consuming soil along with their prey).

Effects of lead poisoning in birds can have both physiological and behavioural impacts. Physiological effects include anemia (Pain 1989 Franson 1996), emaciation (Beyer et al., 1988, Kaminski and Matus 1998) and brain damage (Dieter and Finley 1979, Douglas- Strocbel et al., 2004). Anaemia is the primary consequence of lead poisoning in adult (Beyer et al. 1988) and nestling birds (Kostelecka-Myrcha et al 1997) and can severely affect body conditions and survival. Classic behavioural symptoms of lead poisoning include increased aggressiveness (Janssens et al 2003) and difficulty

with flying, landing, and walking (Sanderson and Bellrose 1986). Such behavioural difficulties may affect a bird's ability to attract a mate, build a nest, and adequately feed nestlings (De Francisco et al. 2003).
The use of bio indicators such as blood, serum, plasma, hair, nail etc. has been a subject of study by international agency and few researchers (Liang et al 2016). Feathers thus contain information about circulating heavy metal concentration in the blood at the time of their development (Gushit J., et al, 2016) . Moreover feathers can be easily collected and stored at room temperature and a small number can be removed without causing damage. This paper deals with metal levels of Pb in tail feathers of pigeons in urban and sub urban area of Ajmer. The main aim of this study was to determine the exogenous or endogenous origin of lead (Pb) contamination detected in feathers of pigeon in urban to sub urban regions of Ajmer by using feathers as bio indicator for environmental lead exposure in birds.

1. A MATERIALS AND METHOD

Samples of pigeon feathers (*Columbia livia*) were collected from three different urban areas Vaishali nagar, Kesharganj and Agra gate and one suburban area Kayad area of Ajmer city. Only molted feathers were collected around the nesting of pigeons.

Samples of pigeon feathers were collected simultaneously from different areas (Urban and sub urban area of Ajmer). Each of the feather (1 gm) was sealed in a plastic cover after it was washed. For the digestion samples were taken in glass tubes, nitric acid and per- chloric acid (8:2 ratios) were added to each sample. The entire rack of tubes was then placed in the water bath; they were kept in the water bath for 8 to 9 hours or until the samples were clear. These samples were transferred to beakers. To every beaker 15-20 drops of 30% hydrogen peroxide were added and digestion was continued until 0.5 ml to 1 ml of colourless liquid remained. After cooling each sample was diluted up to 10 ml with deionized water and transferred to the plastic containers. For lead analysis double beam atomic absorption spectrophotometer was used.

Statistical analysis of data was based on Ipsen and Feigel's (1970) method used. The level of significance was set at <0.001. Arithmetic means and standard errors are represented in the table.

2. OBSERVATION:

Table no.1: Lead concentration (Mean ± S.E ppm/dw) in the feather of pigeon (Columbia livia) in the urban and rural areas of Ajmer city, India.

S.No.	Sample area	Feather (ug/g dry wt.)		
		Primary feathers	Tail Feathers	
1	Vaishali nagar	8.89 ± 0.04 c	7.63 ± 0.33 c	
2	Kesar Ganj	5.65 ± 0.27 c	7.43 ± 0.29 c	
3	Agra Gate	8.13± 0.21 c	8.98± 0.41 c	
4	Kayad Area	1.18± 0.06	1.34 ± 0.18	

a-P(<0.05) almost significant b-P(< 0.01) significant c-P (<0.001) highly significant

3. RESULTS AND DISCUSSIONS

During the present study in Ajmer city highest lead concentration was found in primary feather of pigeon at Vaishali nagar area i.e. 8.89 ± 0.04 ppm d/w whereas the lowest level was found in Kayad area 1.18± 0.06 ppm d/w (Table 1).
In tail feathers, maximum lead concentration was found at Agra Gate area i.e. 8.98 ± 0.41 ppm d/w whereas minimum concentration value was found at Kayad Village area i.e. 1.34 ± 0.18 ppm d/w. Table 1 also shows that the lead concentration of different region of Ajmer city was highly significant at the level of 1 < 0.001 at Vaishali nagar area in primary feathers and Agra Gate in tail feather of pigeon. It must be remembered that even as little as 0.16 mg Pb/Kg body weight of the bird has a toxic effect on its organs.(Sonika Kushwaha ,2016).

Lead is being released into the environment from many sources as a result of widespread use of chemical and human activities and became one of the most serious pollutants posing dangerous health hazards man and other creatures. In India 700-750,000 metric tons of lead is recycled each year with perhaps 50%being recycled in the informal sectors such as battery smelting. (Ericson et al.,2016) .According to population data of Ajmer city Vaishali nagar, Kesar Ganj And Agra Gate areas are highly populated places, whereas Kayad area is less populated area of Ajmer. Present results clearly indicate that the levels of metals in feathers increased with traffic density as the highest

concentration of metal in feathers was detected in those collected from Vaishali nagar (High traffic density area) and as we go in low traffic density area the level of metal decrease gradually.

This Vaishali nagar road is frequented by both diesel and petrol using vehicles and exhaust has no escape route and particulate matter ultimately settles down on the ground and the vegetation.
Particulate matter that has settled down on the soil is ultimately drained to the nearest water body which may serve as a drinking water source for humans apart from inhalation of polluted air. This high concentration of lead should be expected.

Janssens et al., 2001 reported that Lead concentrations were high in outermost tail feathers of adult Great tits (*Parus major)* inhabiting the vicinity of a metallurgic factory near the city of Antwerpen, Belgium. In the same study, Pb concentrations decreased at a site considered as an 'unpolluted' control one because it was located 20 km away from the factory, away from industrialization and urbanization.

The study has demonstrated that feathers of common resident birds collected from the ground can be used for coarse monitoring of the levels of trace elements in the environment. The study shows that among all feathers higher concentration of lead was observed in primary feathers. This may be supported by the evidences like it takes more days to grow and hence more concentration of metal may accumulate in the feathers through blood circulation and it has been proved by many workers that heavy metals mostly accumulate in the feathers during its growth. The reason of higher level of lead in primary and tail feathers may be due to external deposition of metals because they are more in contact with the atmosphere. It may also be explained that when the wing is folded, innermost primaries may thus be protected from external contamination. Outermost primaries may also be more preened than the innermost primaries.

Birds are ideal as models for lead toxicity because they rely on visual and vocal communication, a trait they share with human, whereas rodents rely largely on tactile, olfactory and ultrasonic mode of communication. In contrast feather is an ideal tool for sampling and testing. It can be obtained easily, painlessly and can be sent to the laboratory without special handling requirements. Also, feather can be used as an indicator for both acute and chronic lead exposure since lead is stored in the feather months after digestion and can reflect metabolic changes of the body over long. In human chronic effects of metal toxicity include anaemia, fatigue, gastrointestinal problems and anoxia. Lead can causes difficulties in pregnancy, high blood pressure, muscle and joint pain. Other effects include damage to the gastrointestinal tract (GIT) and urinary tract resulting in bloody urine, neurological disorder and can cause severe and permanent brain damage. While inorganic forms of lead, typically affect the CNS, PNS, GIT and other bio systems, organic forms predominantly affect the CNS. Lead affects children; particularly in the 2-3 years old range by leading to the poor development of the grey matter of the brain, thereby resulting in poor intelligence quotient (IQ). Its absorption in the body is[6] enhanced by Ca and Zn deficiency.

Lead (Pb) is physiological and neurological toxic to humans. Acute Pb poisoning may results in a dysfunction in the kidney, reproduction system, liver and brain resulting in sickness and death the threats even at extremely low concentrations notably serious effect of lead toxicity is its teratogenic effect. Lead poisoning also causes inhibition of the synthesis of haemoglobin; cardiovascular system and acute and chronic damage to the central nervous system (CNS) and peripheral nervous system (PNS).(Singh et al.2011). Int. J. Res. Chem. Environ. Vol. 1 Issue 2 Oct. 2011(15-21)

4. CONCLUSION

According to the results of the present investigation, it can be concluded that the lead content of the feathers of columbia livia in different region of Ajmer city may indicate that the soil and dust of these sites are contaminated with lead (Khan et al 2008). Heavy metals exert toxic effects on soil microorganism hence results in the change of the diversity, population size and overall activity of the soil microbial communities may decrease soil productivity. (Asharaf and Ali, 2007). . In addition, the results support the use of feathers as an appropriate tool to study lead pollution in birds and the environment.

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