
THE IMPACT OF HIGH CONCENTRATION OF LEAD ON PIGEON FEATHERS

RAJESHWARI Acharya¹ and ASHA Sharma²

¹Department of Zoology, Alok P.G.C, Kekri, Ajmer, INDIA

²Department of Zoology, GGC, Neem ka Thana, Sikar, INDIA

ABSTRACT

A study was conducted to determine the lead concentration in feathers of pigeons from the urban to rural regions of Ajmer city. Metal analysis was performed by atomic absorption spectrophotometry with air acetylene (G.B.C. Advanta) Lead concentration was significantly higher in urban sites compared to rural site. Primary feather of pigeon and tail feather of pigeon in urban sites had significantly higher lead concentration than their rural 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 rural areas and confirm the possibility of using the feather as a biological monitor for environmental lead in birds and the environment.

Keywords: Lead, Pigeon Feathers, AAS, Pollution..

1. INTRODUCTION

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.

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 birds.

Birds continue to breed in urban habitats despite numerous negative attributes to these environments including light, noise, pedestrian and toxic contaminants, such as lead. Urban environment is also contaminated by lead and thus are potentially toxic to wildlife. Lead-based paint and leaded gasoline are two significant sources of lead in the urban environment. 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-Stroebel *et al.*, 2004). Anemia is the primary consequence of lead poisoning in adult (Beyer et al. 1988) and nestling (Kostelecka-Myrcha *et al.* 1997) birds 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).

Bio-monitoring is a new branch of science, and direct quantitative and qualitative assessment of exposure of a group of persons or individual to toxic agents present in the environment. 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. Feathers thus contain information about circulating heavy metal concentration in the blood at the time of their development. 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 primary, secondary and tail pigeon feathers of urban and rural area of Ajmer city. 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 rural regions of Ajmer city by using feathers as biological monitor for environmental lead exposure in birds and the environment.

2. METHOD AND MATERIALS

Feather samples of pigeon (*Columbia livia*) were collected from three different urban areas Bajranggarh circle, Kesharganj and Anasagar, Foyasagar and one rural area Hathikhhera village of Ajmer city. Feathers of pigeon were classified as primary, secondary and tail feather. Each sample was placed in a plastic sealable container before being transferred to the laboratory.

Samples of pigeon feathers were collected simultaneously from different areas (Urban and Rural 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 perchloric 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.

3. RESULTS AND DISCUSSIONS

During the present study in Ajmer city highest lead concentration was found in primary feather of pigeon at Bajranggarh circle i.e. 9.08 ± 0.04 ppm d/w whereas the lowest level was found in Hathikhhera village 1.10 ± 0.05 ppm d/w (Table 1). In secondary feathers the higher concentration was found in Kesarganj i.e. 4.83 ± 0.31 ppm d/w whereas the lower value was in Hathikhhera village 1.16 ± 0.05 ppm d/w (Table 1).

In tail feathers, maximum lead concentration was found at Bajranggarh circle i.e. 8.63 ± 0.33 ppm d/w whereas minimum concentration value was found at Hathikhhera village i.e. 1.36 ± 0.17 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 Bajranggarh circle in primary and tail feather of pigeon.

Table 1: Lead concentration (Mean \pm 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	Experimental feather ($\mu\text{g/g}$ dry wt.)		
		Primary feather	Secondary feather	Tail feather
1	Bajranggarh circle	9.08 ± 0.04 c	5.33 ± 0.29 C	8.63 ± 0.33 c
2	Kesharganj	7.26 ± 0.43 c	4.83 ± 0.31 B	7.43 ± 0.29 c
3	Anasagar	8.83 ± 0.21 c	1.95 ± 0.54 Ns	8.98 ± 0.41 c
4	Foysagar	5.65 ± 0.27 c	1.70 ± 0.32 Ns	5.93 ± 0.37 c
5	Hathikhhera village	1.10 ± 0.05	1.16 ± 0.05	1.36 ± 0.17

a-P(<0.05)	b-P(< 0.01)	c-P (<0.001)	ND
almost significant	significant	highly significant	not detectable

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. According to population data of Ajmer city Bajranggarh circle, Kesharganj, Anasagar and Foysagar is an urban area and Hathikhhera village is a rural area of Ajmer city. 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 Bajranggarh circle (High traffic density area) and as we go in low traffic density area the level of metal decrease gradually. In Bajranggarh circle Lead (Pb) is used in smelting, painting, manufacture of batteries and motor fuels.

This 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 and 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.

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 at variable levels. 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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