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Unraveling the toxic heavy metals accumulation in body profile of Cattle egret (*Bulbus ibis*) for the implication of environmental monitoring: a case of Punjab Province, Pakistan

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Abstract: The accumulation of heavy metals in the ecosystem can have potentially toxic effects on human health. This is one of the most prominent consequences of anthropogenic developments, which threaten biodiversity and the quality of the environment. Industrial effluents and urban waste contain a large number of heavy metals (Cadmium, Lead, Copper, Zinc) highly toxic to the biological system. The present study investigated the status of heavy metals, including Zinc (Zn), Manganese (Mn), Lead (Pb), Copper (Cu), Cadmium (Cd), and Cobalt (Co), in the bones, feathers, hearts, muscles, and lungs of the cattle egret (Bubulcus ibis). Samples of the cattle egret were collected from the Faisalabad division with the help of the concerned wildlife department. Heavy metals were assessed using atomic absorption spectrophotometry and the protocols supplied by Perkin-Elmers Corp. The results revealed that the trend of heavy metals in bones was Zn>Pb>Cu>Mn>Cd>Co, and the same trend was followed in the case of feathers and hearts. However, the trend of heavy metals in muscles and lungs was in the order Zn>Mn>Cu>Co>Cd. Heavy metals were present in the bones, feathers, hearts, muscles, and lungs of the cattle egret. The contamination levels were ascertained from the study, which indicated that the cattle egret is useful in biomonitoring heavy metals. The present study will serve as baseline data that could be further compared with data from other locations for monitoring heavy metal pollution. These investigations will be helpful for assessing heavy metal accumulation under semi-arid climates.

Keywords: Heavy metals; toxic effects; industrial effluents; cattle egret; bio monitoring

1. Introduction

Heavy metals contamination is a great concern at global, regional and local levels and influence the functional and structural integrity of an ecosystem [1]. Heavy metals are ubiquitous, highly persistent, and non-biodegradable with long biological half-lives [2]. Toxic concentrations of heavy metals affect the central nervous system and disrupt the functioning of internal organs of birds [3]. Heavy metal contamination, one of the most prominent consequences of anthropogenic developments, threatens both biodiversity and the quality of the environment [4]. Heavy metals have been identified worldwide in diverse environmental compartments. Many studies have been carried out to investigate the level of their occurrence, accumulation and distribution among birds bodies [5].

Monitoring of trace metals levels into different environmental compartments is of prime importance because of their bio-accumulative characteristics and several health risks into living organism [6]. Studies reported that variety of health effects caused by trace metals contaminants including reproductive impairments, kidney failure and neurological disorder etc. So, many studies shows that trace metals affect the reproductive

health and resulted into embryo mortality increased, lighter eggs, failure of nest building, spermatogenesis failure, decreased egg production, eggshell thinning, reduced hatching success and behavioral changes in birds [7]. Therefore, for the control of trace metals emission and threat to human and wildlife, some agencies are concerned to monitor trace metals into different environmental media at both governmental and public levels [8]. Therefore the contemporary study was designed with the objective to determine the level of different heavy metals in different body parts of Cattle egret and compare heavy metal concentration in Cattle egrets, reside/feeding in sewerage and canal irrigated areas.

2. Methods

Samples were collected from two study sites comprising of the sewerage and canal irrigated areas of the Faisalabad Punjab, Pakistan. Faisalabad is one of the major industrial hubs of Pakistan [9]. Contemporary study areas are also described in detail by [10]. The exponential population growth of the concerned region, coupled with the development of extensive steel factories, industrial activities, steel factories, tanneries, leather garments, pigment factories and sport equipment manufacturer, has resulted in widespread environmental degradation [11].

2.1. Sample collection and preparation

Sample of 8 cattle egret was collected from each of sewerage and canal region, sample was consisted of 4 males and 4 females, 2 males and 2 females from each of two sites. Samples were carried in cages to the animal laboratory. All of the cattle egret organs i.e Bones, feather, heart, muscles and lungs were removed and kept in refrigerator before analysis. The samples (Bones, feather, lungs, muscle and heart) were oven dried at 75 °C to produce a uniform dry mass following particular descriptions [12]. Dry samples were converted into a fine powder through a mortar and pestle, and then transferred to desiccators for evadaing the moisture accumulation.

2.2. Digestion and measurement of the sample

Samples were digested by following a protocol described by the previous studies [13]. A small portion i.e (0.200 g) of each sample was measured and digested by using Selenium/Sulphuric acid mixture (2.5 ml). Samples were heated at approximately 200°C and 3 ml H2O2 (30%) was added at room temperature and it was again exposed at 330°C for two hours. The heavy metals were subsequently analyzed through the implication of atomic absorption spectrophotometer (model 9100 Pye Unicamp) and the average mean values were recorded as the concentration of metals in mg/Kg. All the data were subjected to analysis of variance (Anova) and results were compared by using Fisher's Least significant Difference (LSD) test. All statistical tests were performed by using SAS Statistical software.

3. Results and Discussion

3.1. Assessment of the heavy metals in the body profile of Cattle egret collected from Sewage:

Results revealed that among all organs of the Cattle egret maximum heavy metals Zn (2.16), Pb (1.65), Cu (0.63), Mn (0.4), Cd (0.05) and Co (0.03) were recorded in the feathers followed by lungs with Zn (1.11), Pb (0.84), Cu (0.41), Mn (0.38), Cd (0.01) and Co (0.01) heavy metals. Analysis of the cattle egret's Bones revealed that it contains Zn (1.05), Pb (0.87), Cu (0.27), Mn (0.15), Cd (0.03) and Co (0.01) respectively. The overall trend of the heavy metals accumulation in the body profile of cattle egret collected from Sewerage region was Zn>Pb>Cu>Mn>Cd>Co (Fig.1).

3.2. Assessment of the heavy metals in the body profile of Cattle egret collected from Canal irrigated regions:

Results revealed that among all organs of the Cattle egret maximum heavy metals Zn (1.81), Pb (1.32), Cu (0.45), Mn (0.28), Cd (0.03) and Co (0.01) were recorded in the feathers

followed by lungs with Zn (0.91), Pb (0.76), Cu (0.27), Mn (0.23), Cd (0.04) and Co (0.02) heavy metals. Analysis of the cattle egret's Bones revealed that it contains Zn (0.96), Pb (0.71), Cu (0.16), Mn (0.11), Cd (0.02) and Co (0) respectively. The overall trend of the heavy metals accumulation in the body profile of cattle egret collected from Canal irrigated areas was Zn>Pb>Cu>Mn>Cd>Co (Fig.1).

During the impact of interaction between samples collected from Sewerage and canal irrigated regions maximum heavy metals were accumulated in the sewerage samples. Heavy metals in the tissues and feathers of different species of birds has been reported by previous studies [13-16]. Results of the contemporary study are in line with the findings of [17] Lucia et al. (2010) who recorded Cd in muscles and feathers of Greylag goose, Mallad, Red knot and Grey plover. Results are of the present experiment are favored by previous result [18] who reported very low Cd concentration in the feathers of bird eiders. The survival and production of animals are impacted by high metal contamination levels [19]. Chronic metal exposure in birds can have negative effects on their development, ability to reproduce, behaviour, resistance, and other physiological processes [20]. Cattle egrets can be collected easily and they can also be helpful for long-term study of potential environmental dangers. The findings of this study provide credence to the notion that cattle egrets might be useful tools for environmental bio monitoring.

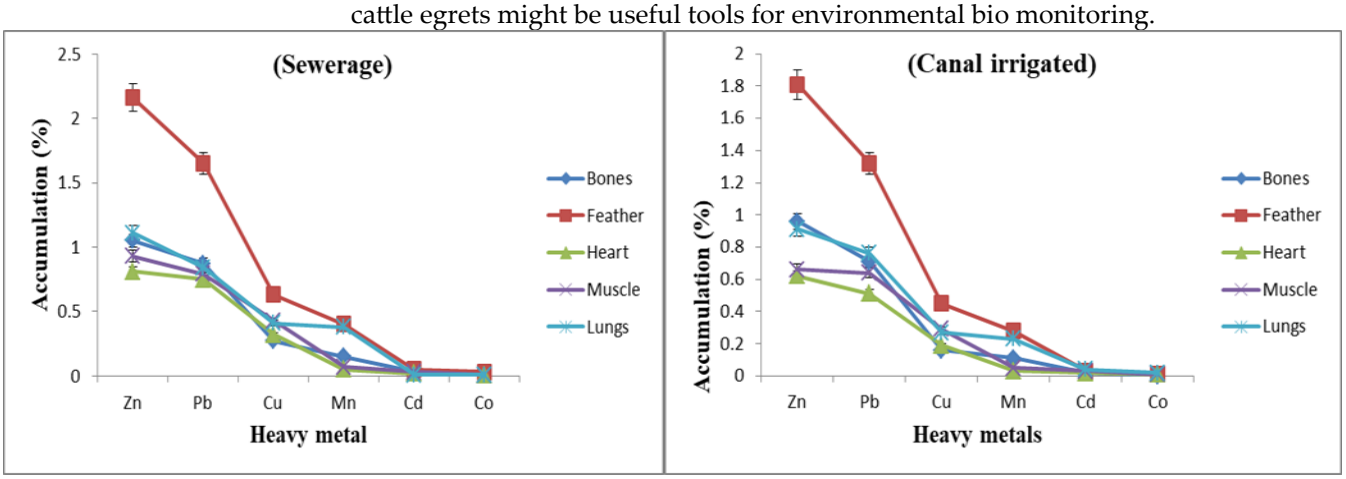

Figure 1. Assessment of the heavy metals in the body profile of Cattle egret collected from and Canal irrigated zones.

4. Conclusion

Present study determined the levels of different heavy metals in different body parts of egrets and compared the concentrations of heavy metals in egrets living/raised in sewage irrigation areas and ditch irrigation areas. It is concluded that the bovine egret has a certain application value in the biological monitoring of heavy metals. It can be further compared with data from monitoring heavy metal pollution at other sites and can help to assess heavy metal accumulation in semi-arid climates.

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