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## Research Article

# Trace element concentration in *Raillietina echinobothrida* and *Aporina* sp. in comparison to their host tissues in laughing dove, *Streptopelia senegalensis* collected from Nasiriya city, southern Iraq

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**Abstract:** The present study aimed to assess the accumulation of five heavy metals in the cestode, *Raillietina echinobothrida* and *Aporina* sp., compared to their host, *Streptopelia senegalensis* collected from the Al-Nasiriya city, southern Iraq. Samples of liver, kidney, muscle, intestine and Cestoda of 60 infected birds were collected for Cadmium, Copper, Lead, Chromium and Zinc measurements. The results showed a higher accumulation of the studied metals in the bird tissue and two Cestoda. Zn in the liver had the highest accumulation rate. Based on the results, *Raillietina echinobothrida* and *Aporina* and their host *Streptopelia senegalensis* can be considered promising bioindicators to evaluate environmental heavy metals, especially Cd, Cd, Pb, Cr and Zn.

**Keywords:** Pollution, Bird, Heavy metals, *Raillietina*, *Aporina*.
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## Introduction

During past decades, efforts for biomonitoring of environmental pollution have increased (Burger & Gochfeld 2000). Heavy metals are found naturally in the ecosystem, but anthropogenic activities have continuously released large quantities of pollutants that increase their concentration (Pacyna & Pacyna 2001; van der Gon et al. 2007). The use of intestinal parasites as indicators of environmental pollution has attracted interest in the last decade (Sures 2001). There is a relationship between pollution and parasitism. There are researches regarding the effect of pollution on the distribution and abundance of parasites in specific hosts or ecosystems (Lafferty 1997; Vidal-Martinez et al. 2010). Birds have been widely used to evaluate environmental pollution, especially in urban environments e.g. laughing dove, *Streptopelia senegalensis* is used as a bioindicator of pollution and its populations in the urban area have decreased in the last decades (Nam et al. 2004; Klein et al. 2008).

The role of parasites in evaluating environmental pollution has emerged by recognizing their ability to accumulate heavy metals at much higher levels than their host (Taraschewski 2000) i.e. there are many evidences that parasites can absorb heavy metals in much higher concentrations than their hosts (Malek et al. 2008; Vidal-Martinez et al. 2010). Therefore, it was suggested that the parasites cause some physiological and behavioral changes that could change the host's feeding, affecting the accumulation of heavy metals (Abed Alrikaby et al. 2020; Al-Hussaini & Maktoof 2021).

The laughing dove has worldwide distribution and is also used for human food, ornamental purposes, and as a bioindicator of chemical pollution (Nam et al. 2004; Klein et al. 2008). This study aimed to assess the accumulation of trace elements of

**Table 1.** Heavy metals concentrations (mean ±SD, µg/wet g) in tissues of pigeons *S. senegalensis*.

| | | Mean±SD | Mean±SD | Mean±SD | Mean±SD |
|---|---|---|---|---|---|
| cd | Infected birds | 0.05±0.06 | 0.28±0.08 | 0.08±0.04 | 0.38±0.05 |
| | Not infected | 0.05±0.01 | 0.24±0.01 | 0.03±0.01 | 0.06±0.01 |
| Cu | infected birds | 0.39±0.05 | 0.43±0.03 | 0.42±0.06 | 0.32±0.04 |
| | Not infected | 0.18±0.01 | 0.09±0.02 | 0.14±0.02 | 0.1±0.03 |
| Pb | infected birds | 0.46±0.03 | 0.29±0.04 | 0.25±0.09 | 0.09±0.03 |
| | Not infected | 0.06±0.01 | 0.10±0.03 | 0.12±0.06 | 0.03±0.01 |
| Cr | infected birds | 0.41±0.04 | 0.37±0.05 | 0.34±0.09 | 0.21±0.04 |
| | Not infected | 0.02±0.01 | 0.03±0.01 | 0.02±0.01 | 0.06±0.02 |
| Zn | infected birds | 29.13±4.01 | 30.01±6.01 | 25.23±3.01 | 40.01±5.01 |
| | Not infected | 19.03±2.01 | 20.00±4.02 | 15.00±2.00 | 38.02±3.02 |

Cadmium, copper, lead, chromium, and zinc in the *Raillietina tetragona* and *Aporina* sp. and in their host *S. senegalensis* collected from Al-Nasiriya city in southern Iraq.

## Materials and Methods

A total of 80 *S. senegalensis* were bought from the local market at Al-Nasiriyah city, including 35 males and 45 females collected from January and May of 2019. The laughing doves were dissected, and their kidney, liver, pectoral muscle and intestine were removed and sampled.

All digestive tracts were removed and examined for cestodes Helminthes using a stereomicroscope, and *R. tetragona* and *Aporina* sp. from birds were discovered and collected. The 2 g of the liver, kidney, muscle, and intestine tissues and the cestodes were digested individually by adding 5 ml of $H_2No_3$ (65%), 5 ml of absolute $H_2So_4$ and 1 ml of $H_20_2$ in a digestive tube put on an electric heater 250°C. The filtered solution was moved to 25ml tubes, and the volume was poured with distilled water (Taraschewski 2000). The heavy metals were measured using atomic absorption spectrophotometer using a hollow cathode of each metal. The bioaccumulation factor (BFs) was determined as the ratio of the heavy metal in the parasites to that of the host tissues where it had been collected (Sures et al. 1999).

**Statistical analysis:** Data were expressed as mean±SD and $P<0.05$ was considered as statistically significant. The mean values of each element between the three groups were compared using ANOVA (Croxton et al. 1982).

## Results

The concentrations of heavy metals in different tissues of *S. senegalensis* are shown in Table 1. Based on the results, Zn had the highest concentration in all tissues (liver, 29.13; kidney, 30.01; muscle, 25.23, and intestine, 40.01), while Cd, Cu, Pb and Cr had lower concentrations in all tissues. The results showed significant differences in the concentration of heavy metals between the studied tissues ($P\leq0.05$).

The concentrations of heavy metals in *R. tetragona* and *Aporina* sp. are shown in Table 2. The highest concentrations were for the zinc (2.12, 2.0 µg/wet g, respectively) and the lowest for Pb (0.60, 0.45 µg/wet g, respectively). In *R. tetragona,* the heavy metals in relation to those tissues of *S. senegalensis*, the highest accumulation factors were found for cd (liver, 2.4; kidney, 4.28; muscle, 15, and intestine, 3.16). In addition, high accumulation factors were calculated for Cu (liver, 2.87; kidney, 2.60; muscle, 2.66, and intestine, 3.5) (Table 3). In *Aporina* sp., compared to the heavy metal concentrations of the host tissues, *S. senegalensis*, the highest accumulation factors were found for cd (liver, 2.05; kidney, 3.60; muscle,

**Table 2.** Heavy metals concentrations (µg/wet g) in tissues of *R. tetragona* and *Aporina* sp.

| Parasite | Cd | Cu | Pb | Cr | Zn |
|---|---|---|---|---|---|
| *R. tetragona* | 1.20 | 1.12 | 0.60 | 0.77 | 2.12 |
| *Aporina* sp. | 1.01 | 1.03 | 0.45 | 0.65 | 2.00 |

**Table 3.** Accumulation factor [C] parasite /[C] host tissue for some elements detected in *R. tetragona* in relation to *S. senegalensis* tissue.

| | liver | Kidney | Muscle | Intestine |
|---|---|---|---|---|
| cd | 2.4 | 4.28 | 15 | 3.16 |
| Cu | 2.87 | 2.60 | 2.66 | 3.5 |
| Pb | 1.30 | 2.07 | 2.4 | 6.6 |
| Cr | 0.01 | 2.08 | 2.26 | 3.66 |
| Zn | 0.07 | 0.07 | 0.01 | 0.05 |

**Table 4.** Accumulation factor [C] parasite /[C] host tissue for some elements detected in *Aporina* sp. in relation to *S. senegalensis* tissue.

| | liver | Kidney | Muscle | Intestine |
|---|---|---|---|---|
| cd | 2.05 | 3.60 | 12.62 | 2.66 |
| Cu | 2.64 | 2.39 | 2.45 | 3.09 |
| Pb | 0.98 | 1.55 | 1.8 | 3.22 |
| Cr | 1.58 | 1.75 | 1.91 | 16.62 |
| Zn | 0.07 | 0.06 | 0.08 | 0.05 |

12.62, and intestine, 2.66). Relatively high accumulation factors also were recorded for Cu (liver, 2.64; kidney, 2.39, muscle 2.45, and intestine, 3.09) (Table 4).

## Discussion

Many studies have revealed the accumulation of heavy metals in the organs of bird species (Mateo, R. & Guitart 2003; Deng et al. 2007; Horai et al. 2007). Based on the results, Zn in the liver had the highest accumulation rate (29.13), similar to the findings of Scheuhammer (1987), but was relatively lower than the value (49.91) reported by Klein et al. (2008). Zn has an essential role in many metabolic processes, particularly in the activation of enzymes and regulation of gene expression. The relatively higher concentration of Zn was detected without a severe effect on the health of an organism. In addition, Zn, in interaction with other toxic elements such as Cd and Pb may reduce their toxicity (Miller & Mackay 1980). In the present study, Pb in the liver (0.46) was lower than those values reported in this species in Korea (Miller & Mackay 1980), while its concentration was higher than those (0.18) reported by Scheuhammer (1987). The highest mean Cd concentration was found in the kidney (0.28), which was much lower than the value (0.68) reported by Jordi et al. (2009) in the kidney of and it was higher than that value in the study of Scheuhammer (1987). In the present study, a high accumulation factor was found in different tissues and it might be because of easy absorption of them via the intestine and air. Based on the results, *R. echinobothrida* and *Aporina* sp. and their host, *S. senegalensis* can be considered promising bioindicators to evaluate environmental heavy metals, especially for Cd, Cd, Pb, Cr and Zn.

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