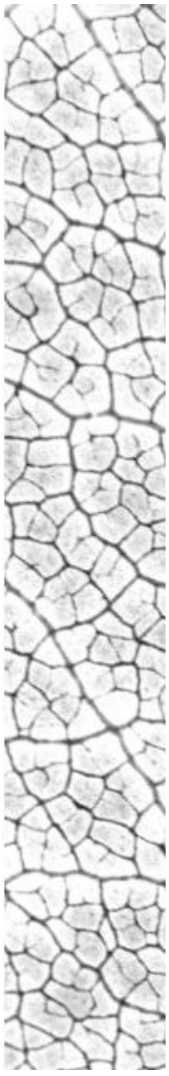

EurAsian Journal of BioSciences
Eurasia J Biosci 14, 395-399 (2020)

Bioaccumulation of some heavy elements in different tissue of *Cotugnia polycantha* and two parasites (*Raillietina tetragona* and *Streptopellia senegalensis)* infected with birds

Nuha Jabbar Abed Alrikaby [1], Afrah A. Maktoof [1*], Alyaa A. Hafedh [2]

[1] University of Thi-Qar, College of Science, Department of Biology, Al-Nassiriya, IRAQ
[2] University of Thi-Qar, College of Science, Department of Pathological Analysis, Al-Nassiriya, IRAQ
*Corresponding author: Afrah.m_bio@sci.utq.edu.iq

Abstract
Heavy metals tend to bioaccumulation in living organisms. Their aggregation has been a noteworthy concern. The present investigation assessed the concentration of five heavy metals in the cestode *Raillietina tetragona* and *Streptopellia senegalensis* and in its host *Cotugnia polycantha* gathered from local market of Al-Nassiriyia City/south of Iraq. Samples (Liver, Kidney, muscle, intestine and two parasities) of 60 infected were chosen for heavy metals examination which achieved by Atomic absorption spectrophotometer. The results showed the bio concentration factors (BCF) in *Raillietina tetragona* is more than in *Streptopellia senegalensis*. The obtained results illustrated the probability of the utilization of birds and two parasites as markers of environmental pollution.

Keywords: heavy elements, *Raillietina tetragona* and *Streptopellia senegalensis*, *Cotugnia polycanth* and Bioaccumulation factors

Abed Alrikaby NJ, Maktoof AA, Hafedh AA (2020) Bioaccumulation of some heavy elements in different tissue of *Cotugnia polycantha* and two parasites (*Raillietina tetragona* and *Streptopellia senegalensis)* infected with birds. Eurasia J Biosci 14: 395-399.

INTRODUCTION

The potential of the utilization of birds as monitors of environmental contamination has been perceived as far back as 1960s because of the expanding proof that birds populaces are particularly delicate with the impacts of human effects on the earth (Denneman and Douben 1993). Large amounts of pollutants have consistently been brought into environment as a consequence of anthropogenic activities, for example, urbanization, traffic, and mechanical procedures. In urban situations, the engine vehicle is one of the significant major source of contamination, for the most part because of fumes emanation and disintegration of tires, motors and brakes, among others (Rayson 1990). Evaluating toxins in various biological system segments is a significant assignment so as to distinguish potential dangers (Gragnaniello *et al*. 2001). With respect of heavy metals, biomonitoring studies may be basic to mirror the potential ecological contamination status and results (Loranger *et al*. 1994, Burger and Gochfeld 2000). In facte, data about pollutants bioavailability should be more reliable when creatures instead of their biotic environment are assessed (Phillips 1977).

Among conceivable biomonitoring species birds, have been widely used to survey ecological pollutants and in urbain condition especially, *Cotugnia polycantha* are around the world. Free living species which found of old time (Sari *et al*. 2008) and are most generally dispersed among hoppy on the world including Iraq. In certain nations *Cotugnia polycantha* are utilized for human food, additionally utilized as a bioindicator of chemical pollution. Broad studies on trace element concentrations in birds have been conducted in worlds for example, (Betleja *et al*. 1993, Dmowski and Karolewski 1979, Nam and lee 2006, Nyholm 1994). There are few workers on accumulation of toxicants in population of different birds species in particular regions of Iraq (Al-Awadi and Hussein 2016). However, moderately recent studies have revealed that some to accumulate much more trace elements from their hosts helminth parasite are able in different environment (Sures 2004), as for urban territories. Information on the utilization of parasites as potential bioindicators of trace elements contamination are still exceptionally rare and refer almost exclusively to cestode/ mammal models (Sures Some researchers showed that cestodes, nematodes and a canthocephalants can collect

Received: October 2018
Accepted: October 2019
Printed: March 2020

considerable concentrations of heavy metals (Barus *et al*. 2007, Genc *et al.* 2008, Retief *et al.* 2006, Sures and Siddal 2003, Tekn Zan and Kur 2005, 2007, Tenora *et al*. 2000, Thielen, *et al*. 2004, Turcekov *et al*. 2002).

The fundamental objective of the present study was to assess the accumulation of trace metals in the cestode *Raillietina tetragona* and *Streptopellia senegalensis* in *Cotugnia polycantha* in the city of Al-Nassiriya south of Iraq. On the other hand The fundamental goal of the present study was to assessed *Raillietina tetragona* and *Streptopellia senegalensis* as bioaccumulation of heavy metals and to evaluate their utilization as delicate markers of ecological contamination with heavy metals. This goal was accomplished through assurance of the heavy metals As, Co, Ni, Fe and Mn in the two species, in comparison with those in the diverse host tissues (Liver, Kidney, Muscle and intestine).

MATERIAL & METHODS

Sample collection samples of 100 *Cotugnia polycantha* were haphazardly chosen from local market at Al-Nassiriya City to be examined, in this study. Immediately to the lab around the same day, the birds were killed by ether solution. Liver, kidney, Muscle and intestine were immediately removed from all samples to avoid external contamination and stored at - 20 °C until chemical analysis.

Examination of Birds for Internal Parasite

A cut was made on the ventral side from the anal opening to the lower jaw. At that point, two additional cuts were made on the sidelong side to uncover the body cavity with alimentary canal and other internal organs. The surface of the visceral organs and body cavities and serous membranes were examined for parasites by using hand lens. Also, the alimentary channel were removed and cut into parts (stomach and digestive tract) in 0.09% physiological saline for parasite retrieval under a dissecting microscope. Each part was further deliberately cut open to help the rise of parasites. Cestode parasites were additionally perceived by wriggling movements on mergence in the ordinary saline under the microscope (Marcogliese *et al*. 2011).

Parasitological Handling

The gathered cestode were first washed in warm water and afterward kept in 5% formalin and then moved to a 70% ethanol solution. They were handled by the techniques recently recorded as they recolored with acidic acid alum carmine, destined in 70% acid ethanol (i.e. ethanol with a few drop of HCl), dried out through a reviewed ethanol arrangement, explained in clove oil, and mounted in canda balsam as permanent preparations, Carleton (1967). The disengaged worms were extended among slide and cover slip and fixed by glycerin alcohol surrounded with thick Canada balsam and kept in horizontal position (Dehkordi et al 2018, Lucky 1977).

Table 1. Concentration of heavy metals and standard division in different tissue of healthy birds (*Cotugnia polycantha*)

Heavy metals	Liver	Kidney Mean ± SD	Muscle Mean ± SD	Intestine Mean ± SD	P value
AS	Mean ± SD	0.12±0.02	0.10±0.01	0.02±0.001	0.0001
Co	0.09±0.02	0.14±0.01	1.98±0.01	3.00±0.07	0.00001
Ni	0.19±0.02	0.98±0.01	0.40±0.02	0.20±0.02	0.0001
Fe	0.75±0.01	4.12±0.02	10.00±1.58	9.08±1.32	0.0001
Mn	2.15±0.02	1.02±0.05	10.00±1.78	5.03±0.09	0.0001

Identification of Parasites

The identification of the parasite were performed according to Yamagati (1959, 1961 and 1963) additionally by utilizing the description by previous researchers in this field.

Sample Arrangement and Convergence of Heavy Metals

Cestoda worms and tissue samples were digested according to the method described by Mascia and his partners in 1990 (Mascia *et al*. 1990). Concentrations of heavy metals (As, Co, Ni, Fe and Mn) of the digested samples and blanks were done utilizing Flam Atomic Absorption Spectrophotometer. The bioaccumulation factors (BFS) were calculated as the proportion of the elements concentration in the parasites to that in various host tissues was determined according the formula (Sures *et al*. 1999).

BFS=conc. of the heavy metals in the parasite tissues
conc. of the heavy metals in the host tissues.

Statistical Analysis

The findings were analyzed by T test, mean, standard deviation to evaluate the significant differences prevalence by the guide of SAS software (2004).

RESULTS & DISCUSSION

In this study, we compare the concentration of different metals in different tissue of healthy birds as it shown in **Table 1**. Our result indicate that Fe was high in most of the studied tissue with a maximum concentration was found in the liver tissue (20.15 µg/g) dry weight. On the other hand, liver tissue has the lowest concentration of As (0.09 µg/g) compare to the other studied tissues. Also, our results showed that Mn concentration was variable in different tissues with the highest being the muscle and the lowest in the liver and it followed the pattern (muscle > intestine > kidney < liver). This result shows a significant difference in the concentration of heavy metals between all different groups under ($p \leq 0.05$). As a bio-indicator of population in urban areas, Cd, Mn, and Zn level was previously studied in the feral pigeon. However, the studies have mainly focused on the evaluation of Pb (Hutton and Goodma 1980, Loranger et al. 1994, Nam *et al.* 2004, Schioloderman *et al.* 1997).

Table 2. Concentration of heavy metals and standard division in different tissue of infected birds (*Cotugnia polycantha*)

Heavy metals	Liver	Kidney Mean ± SD	Muscle Mean ± SD	Intestine Mean ± SD	P value
AS	Mean ± SD	0.24±0.02	0.18±0.02	0.08±0.02	0.0001
Co	0.14±0.02	0.24±0.01	2.01±0.07	3.45±0.02	0.0001
Ni	0.29±0.01	1.50±0.02	0.55±0.03	0.30±0.02	0.00001
Fe	0.89±0.03	6.18±0.03	13.61±0.21	10.02±1.35	0.00001
Mn	3.25±0.02	2.90±0.06	10.77±0.91	9.09±1.12	0.0001

In this study, we also focused on different metals concentration in different tissues of the infected birds as shown in **Table 2**. Our results showed that as and Ni were accumulated with high concentration in the kidney while the level of Co, Fe, and Mn were accumulated in the muscles. It also showed that Co accumulated in the live tissue. This result shows a significant difference in the concentration of heavy metals between all studied tissues under ($p \leq 0.05$). These results indicated that the different distribution of the studied heavy metals is due to the differences in the physiological nature of the tissue. Mersche et al. (1993) have indicated that the accumulation and tissue distribution of metal in the different tissue depended on the duration of exposure, physiological condition of the environmental factors in the host.

We found that several heavy metals were accumulated in kidney tissue which in part due to the kidney tissue has the storage functional role in the body. These result in part supported by the findings reported by others. In 2016, Al-Awadi and Hussein (2016) studied the heavy metals in tissues of birds collected from different area in Najaf. According to his results Co and Mn showed higher concentration in muscle tissue, but Ni showed higher concentration in muscle compared with liver tissues (Adepoju et al 2017, Al- Awadi and Hussein 2016).

Many studies have been focusing on the accumulation of the heavy metals in different species of birds in the world, but very few studies have studied the relationship between trace elements in parasite and birds in Iraq (Al-Awadi and Hussein 2016). Levedeva, 1995 found that As was accumulated in the bones of birds belonging to different trophic levels that were demonstrated. The concentration of some elements (Silver, aluminum, arsenic, cadmium, chromium, cobalt, Iron, Nickle and lead) were high in those primaries (Dauwe *et al*. 2003). Also, Riper and Lester, 2016 showed that the levels of accumulated heavy metals in the birds was changed in different area. On the other side, the trace elements concentration in cestoda worms was higher when compared to the level detected in the pigeon's soft tissue (Torres *et al*. 2010).

Next, we studied the concentration of the heavy metals in *Raillietina*, *tetragona*, and *Streptopellia senegalensis* as shown in **Table 3**. The trend of metal accumulated in the two species was Fe>Mn> As> Co>Ni. This data showed that the level of all the studied heavy metals, except Fe, in the host liver tissue was lower than the level of these metals in Cestoda worms' tissues. We also found that the level of these metals in different host tissue were low compared to the Cestoda worms tissues because the latter comprise only one part of the diet of the birds (Levedeva, 1997). Tekwan et al. (1988) and Modory et al. (2006) have found that Cestoda worms and other trematodes which utilize the liver as the main site of infection impair hepatic xenobiotic-metabolizing. Therefore, we conclude that liver damage by cestoda worm's infection may lead to the accumulation of heavy metals in the host tissues which explain our present studies. However, some metals such as Fe, Ni, Co and Mn are noted to beco-factors for many enzymes and play an important role in many Physiological functions in human and animals and the deficiency of these metals causes disturbances and pathological conditions (Koh *et al*. 1986, Schuhmcher *et al*. 1991).

Table 3. Concentration of heavy metals in *Raillietina tetragona* and *Streptopellia senegalensis* µg/g dry weight

Heavy metals	*Raillietina tetragona*	*Streptopellia senegalensis*
As	1.60	1.33
Co	0.90	0.80
Ni	0.50	0.35
Fe	2.10	2.08
Mn	1.98	1.75

Table 4. The bioconcentration factors for some elements detected in *Raillietina tetragona* and *Streptopellia senegalensis* in relation to birds' tissue

Heavy metals	Liver		Kidney		Muscle	
	R. *tetragona*	S. *senegalensis*	R. *tetragona*	S. *senegalensis*	R. *tetragona*	S. *senegalensis*
As	11.43	9.5	6.66	5.45	8.88	7.39
Co	3.10	2.76	3.75	3.33	0.45	0.40
Ni	0.56	0.39	0.33	0.23	0.90	0.63
Fe	0.64	0.64	0.33	0.33	0.15	0.15
Mn	2.02	1.78	0.68	0.60	0.18	0.16

Our result also showed that as concentrations in *Raillietina tetragona* and *Streptopellia senegalensis* were (1.60 and 1.33 µg/g) dry weight, respectively. When comparing our results to the previous studies, the concentrations reported by Torres *et al*. (2010) are relatively lower in cestoda worms. It is possible that as detoxification include As removal from circulation in the liver, followed by storage in kidney tissue, in this case, in the cestoda.

Table 4 shows the levels of BCF in the two species. Our data showed that the highest BCF of As and Ni was in the intestine while the highest BCF of Fe and Mn was in the liver tissue. Our data also showed that the highest BCF of Co was in the kidney and the BCF in *Raillietina tetragona* was more than *Streptopellia senegalensis*. In general, our data indicate that high BCF was found in different tissue and that might be due to it's easily absorption from the air and intestine. Although more laboratory and field experiments essays are necessary to evaluate the relationship between bioaccumulation in

cestoda parasites of birds and environmental trace elements availability.

We present that *Raillietina tetragona, Streptopellia senegalensis*, and *Cotugnia polycantha* could be consider as a promising bio-indicator system to evaluate environmental As, Co, Fe, Ni and Mn. Although two cestoda/ Rodent system have already been proposed for urban environment (Sures et al. 2003, Torres et al. 2006, 2010). This study presents the BCF which have not been studied before in Iraq.

CONCLUSION

This study presents a potentially suitable biomonitors for environmental heavy metals pollution using the BCF which have not been presented in Iraq before. Also, the present results suggest the usage of cestoda worms is assessment of environmental deterioration by such metals.

REFERENCES

Adepoju AO, Oyewo EO, Adigun MO (2017) Perception of cassava farmers of climate change on cassava production in Ido local government area of Oyo State, Nigeria. Current Research in Agricultural Sciences, 4(3): 61-67.

Al-Awadi HM, Hussein SM (2016) Compared study to bio- accumulation of some heavy metals in the tapworms Railltina tetragona and some tissues Columbia livia in the province Najaf. Journal of kufa for agricultural science 8(2): 133-144.

Betleja J, Cempulik P, Kwapulinski J, Lebedeva NV, Loska K, Wiechula D (1993) Ecotoxicological Characteristics of the Winter Habitat of the Moor-Hen (Gallinula chloropus), Pollutants in Environment 3: 142-147.

Burger J, Gochfeld M (2000) Metal levels in feathers of 12 species of seabirds from Midway Atoll in the northern Pacific Ocean. Sci Total Environ 257: 37-52. https://doi.org/10.1016/S0048-9697(00)00496-4

Dauwe T, Bervoets L, Pinxten R, Blust R (2003) Variation of heavy metals within and among feathers of birds of prey: effects of molt and external contamination. Environmental Pollution 124: 429-436

Dehkordi AAE, Jahangiri A, Talaiekhozani A, Heidari A (2018) Pilot-Scale Evaluation of CO2 Loading Capacity in AMP Aqueous Solution beside the Improvers HMDA-NH3 under a Series of Operational Conditions. Journal of Environmental Treatment Techniques, 6(4): 74-80.

Denneman WD, Douben PET (1993) Trace metals in primary feathers of the barn owl (Tyto alba guttattus) in the Netherlands. Environ Pollut 82: 301-310. https://doi.org/10.1016/0269-7491(93)90133-9

Dmowski K, Karolewski M (1979) Cumulation of Zinc, Cadmium and Lead in Invertebrates and in Some Vertebrates according to the Degree of Area Contamination, Ekol. Pol 27: 333-349.

Gragnaniello S, Fulgione D, Milone M, Soppelsa O, Cacace P, Ferrara L (2001) Sparrows as possible heavy-metal biomonitors of polluted environments. Bull Environ Contam Toxicol 66: 719- 726. https://doi.org/10.1007/s001280068

Hutton M, Goodman GT (1980) Metal contamination of feral pigeons Columba livia from the London area: part 1—tissue accumulation of lead, cadmium and zinc. Environmental Pollution Series A, Ecological and Biological 22(3): 207-217.

Koh TS, Judson GJ (1986) Trace elements in sheep grazing near a lead- zinc smelting complex at port Pirie South Australia. Bull Environ Contam Toxicol 37: 87-95.

Lebedeva NV (1997) Accumulation of Heavy Metals by Birds in the Southwest of Russia. Russian Journal of Ecology 28(1): 41-46.

Loranger S, Demeters G, Kennedy G, Forget E, Zayed J (1994) The pigeon (Columba livia) as a monitor for manganese contamination from motor- vehicles. Arch Environ Contam Toxicol 27: 311-317. https://doi.org/10.1007/BF00213165

Loranger S, Demeters G, Kennedy G, Forget E, Zayed J (1994) The pigeon (Columba livia) as a monitor for manganese contamination from motor-vehicles. Arch Environ Contam Toxicol 27: 311-317. https://doi.org/10.1007/BF00213165

Morley NJ, Lewis JW, Hoole D (2006) Pollutant-induced effects on immunological and physiological interactions in aquatic host-trematode systems: implications for parasite transmission. Journal of Helminthology 80(2): 137-149.

Nam DH, Lee DP (2006) Monitoring for Pb and Cd pollution using feral pigeons in rural, urban and industrial environments of Korea. Sci Total Environ 357: 288-295. https://doi.org/10.1016/j.scitotenv

Nam DH, Lee DP, Koo TH (2004) Factors causing variations of lead and cadmium accumulation of feral pigeons (Columba livia). Environmental monitoring and assessment 95(1-3): 23-35.

Nyholm NEI (1994) Heavy metal tissue levels, impact on breeding and nestling development in natural populations of pied flycatcher (Aves) in the pollution gradient from a smelter. Ecotoxicology of soil organisms: 373-382.

Phillips DJH (1977) Use of biological indicator organisms to monitor trace-metal pollution in marine and estuarine environments: review. Environ Pollut 13: 281-317. https://doi.org/10.1016/0013-9327(77)90047-7

Rayson MJT (1990) An investigation into the effects of vehicular pollution on the U.K. and North American environments. M.Sc. dissertation, University of Surrey, UK.

Riper C, Lester M (2016) Changing Levels of Heavy Metal Accumulation in Birds at Tumacacori National Historical Park along the Upper Santa Cruz River Watershed in Southern Arizona.

Schilderman PAEL, Hoogewerff JA, Schooten F-J, Maas LM, Moonen EJC, Os BJH, et al. (1997) Possible relevance of pigeons as an indicator species for monitoring air pollution. Environ Health Perspect 105(3): 322- 9.

Schilderman PAEL, Hoogewerff JA, van Schooten F-J, Maas LM, Moonen EJC, van Os BJH, van Wijnen JH, Kleinjans JCS (1997) Possible relevance of pigeons as an indicator species formonitoring air pollution. Environ Health Perspect 105: 322-329. https://doi.org/10.2307/3433270

Schuhmacher M, Bosque AM, Domingo LJ, Carbella J (1991) Dietary intake of lead and cadmium from foods in Tarragona province, Spain. Bull Environ Contam Toxicol 46: 320-28.

Sures B (2004) Environmental parasitology: relevancy of parasites in monitoring environmental pollution. Trends Parasitol 20: 170-177. https://doi.org/10.1016/j.pt.2004.01.014

Sures B, Scheible T, Bashtar AR, Taraschewski H (2003) Lead concentrations in Hymenolepis diminuta adults and Taenia taeniaeformis larvae compared to their rat hosts (Rattus norvegicus) sampled from the city of Cairo, Egypt. Parasitology 127: 483-487. https://doi.org/10.1017/S0031182003003901

Sures B, Scheible T, Bashtar AR, Taraschewski H (2003). Lead concentrations in Hymenolepis diminuta adults and Taenia taeniaeformis larvae compared to their rat hosts (Rattus norvegicus) sampled from the city of Cairo, Egypt. Parasitology 127: 483-487. https://doi.org/10.1017/S0031182003003901

Sures B, Sidall R, Taraschewski H (1999) Parasites as accumulation indicators of heavy metal pollution. Parasitol Today 15: 16-21. https://doi.org/10.1016/S0169-4758(98)01358-1

Tekwani BL, Shukla OP, Ghatak S (1988) Altered drug metabolism in parasitic diseases. Parasitol Today 4: 4-10.

Torres J, Foronda P, Feliu C, Miquel E, Jordi C (2010) Trace Element Concentrations in Raillietina micracantha in Comparison to Its Definitive Host, the Feral Pigeon Columba livia in Santa Cruz de Tenerife (Canary Archipelago, Spain) Arch Environ Contam Toxicol 58: 176-182.

Torres J, Peig J, Eira C, Borra s M (2006) Cadmium and lead concentrations in Skrjabinotaenia lobata (Cestoda: Catenotaeniidae) and in its host Apodemus sylvaticus (Rodentia: Muridae) in an urban dumping site in Spain. Environ Pollut 143: 4-8. https://doi.org/10.1016/j.envpol.2005.11.012

Torres J, Peig J, Eira C, Borra s M (2006) Cadmium and lead concentrations in Skrjabinotaenia lobata (Cestoda: Catenotaeniidae) and in its host Apodemus sylvaticus (Rodentia: Muridae) in an urban dumping site in Spain. Environ Pollut 143: 4-8. https://doi.org/10.1016/j.envpol.2005.11.0

Turceková L, Hanzelová V, Spakulova M (2002) Concentration of heavy metals in perch and its endoparasites in the polluted water reservoir in Eastern Slovakia. Helminthologia 39(1): 23-28.