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Land snails and soil as bio-indicators of some heavy metals pollution in Sharqia and Qalyubiya Governorates, Egypt

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Abstract:

Recently, land snails dispersed in the Nile Delta and it considered a perfect environmental pollution bio-indicator for many reasons. In this study, the level of Pb (Lead), Cu (Copper) , Cd (Cadmium) , Mo (Molybdenum) and Zn (Zinc) , heavy metals as bio- indicator of metal pollution by analysis soil and snail samples in Sharqia and Qalyubiya Governorates were determined using atomic absorption device elements. Results showed that most tested elements were higher in the field border (at 5 meter far from the car road) than that inside the infested field (at 100 meter far from the car road).The highest metal concentration was Mo with *Monacha cartusiana* (Müller) (Gastropoda: Hygromiidae) with a value of 260.5411 ppm while the lowest concentration was Zn (soil) with a value of 0.105 ppm in Sharqia Governorate. Regarding Qalyubiya Governorate, Cu with *Eobania vermiculata* (Müller) (Gastropoda : Helicidae) value at 5 meters was the highest 211.275ppm and the lowest element was Cd (soil) at 5 meters 0.2025ppm. Finally, Qalyubiya Governorate was more polluted than Sharqia Governorate. These results indicated that land snails are a suitable bio-indicator of heavy metal pollution.

Introduction

The snails are very important part of the food chain and excellent source of calcium in the ecosystem for the birds during their breeding season. They are intermediate hosts of many parasites (Altaf *et al*., 2017). Land snails are very appropriate as environmental monitor's in-situ because they are sedentary, abundant, of relative longevity, large, easily collected and weighed. Patterns of accumulation of one specific element show a remarkable consistency when different sites are compared (Ademoroti, 1996). Biomonitoring attempts with snails have found an increasing interest during the last decade and several promising projects have already been conducted (Dallinger *et al*., 2000). Nowakowska (2011) used terrestrial snails as bioindicators of the environmental pollution due to their capacity to accumulate heavy metals in their tissues and limited ability to excrete the metals. Heavy metals are natural components of the environment, but they are of concern lately because they are being added to soil, water, and air in increasing amounts. This is because of the rapid growth of population, increased urbanization, expansion of industrial activates, and more (Aksoy *et al*., 2000). Most of the heavy metals are essential elements to living organisms, but their excessive amounts are generally harmful to plants and animals; the poison of heavy metals depends a great deal on their chemical form, concentrations, residence time, etc. (WHO, 1972; Schubrek, 1973 and Mielke and Reagan, 1988). As (WHO, 2000) described, heavy metals, depending on their oxidation state, can be highly reactive and thus toxic to most organisms. They have long residence times in soil and may continue to exert long- lasting harmful effects (Menon *et al*., 2007). Soil is the major collector for heavy metals released into the environment by anthropogenic activates. Heavy metals contamination of soil may pose risk and hazards to humans and the ecosystem through the food chain, drinking of contaminated ground water, reduction in food quality (safety and market ability), reduction in land usability for agricultural production causing doubts on food security, and land tenure problems (Malik , 2004; Manohar *et al*.,2006 and Nica *et al*. , 2012). Paula *et al*. (2012) analyzed the snail *Theba pisana* (Müller) (Gastropoda : Helicidae) as an indicator of soil contamination by trace elements after a mine spill accident, to assess the exposure of animal and human consumption. Trace elements in the soft tissues reached greater concentrations in the contaminated soils than in the non-contaminated soils were only found for As, Cd, Cu, Fe and Hg. Cadmium content in tissues, with a maximum value of 10 mg kg^{-1} (dry matter), was the most worrying result. Trace element concentrations in the snail bodies were still of concern for human consumption; concentrations of As and Cd were sometimes higher than the maximum concentration authorized in food stuffs. Generally, nutritional status of the contaminated snails was not altered; concentrations of the main nutrients (Ca, K, Mg, P and S) were like those of the non-contaminated snails.

The present study aimed to evaluate the potential for using land snails and soil as biomonitors of heavy- metal pollution at metal levels that are sub- hazardous to humans.

Materials and methods

1.Snails and soil sampling:

Snails and soil specimens were collected from two infested fields. The first filed cited at El-Mohammadia, Meniet El-Kamh district, Sharqia Governorate. While the second at Moshtoher, Toukh district, Qalyubiya Governorate. All collected snails were in adult stage; only fully grown specimens were collected since this is the product consumed by the local population. The snails were put in clean plastic bags and transported to the laboratory. Soil samples were collected at various intervals from the road of cars *viz*5 and 100 meters at a depth of 0-5 cm from the surface around snail sites using a hand grab sampler. Soil samples were kept in a polyethylene bag and later air-dried in the laboratory for determination of heavy metal concentrations.

2. Snails preparation:

In the laboratory, the snails were washed thoroughly with distilled water. The shell was cracked with a wooden hammer, the body was again washed with distilled water and stored at -18^{o} C prior to analysis with Estimate the concentration of elements in the sample by atomic absorption device elements (Perkin-Elmer, 1964) at central Agricultural Pesticides Laboratory, Faculty of Agriculture, Zagazig University.

3. Soil sample processing:

3.1. Weight 1 g of sample and put it in the combustion degree oven 500^{oc} for two days.

3.2. Add a 3 mm nitric acid mm center of acid bear caloric.

3.3. Fully complement the sample after digestion with distilled water to the known size and run.
3.4. So, the sample is ready to estimate the concentration of the elements.

4. Measurement device:

4.1. Open the power and gas pressure regulation.
4.2. Set the item you want to soundings lamp and adjust the wavelength of the element.
4.3. Drawing the curve record on the computer waist measuring 3 concentrations equipped and information focus.
4.4. The introduction of the sample for measurement.
4.5. The computer assigns element concentration in the sample (ppm).

Results and discussion

Heavy metal concentrations in land snails and soil samples collected from Sharqia and Qalyubiya Governorates at different distances away of the road are given. Table (1) showed that two land snails *Eobania vermiculata* (Müller) (Gastropoda: Helicidae) and *Monacha cartusiana* (Müller) (Gastropoda: Hygromiidae) infested the field at Sharqia Governorate and heavy metal concentrations in land snails, soil samples at different distances away of the road. The elements Pb (*M. cartusiana*), Cu (*E. vermiculata*), Cu (*M. cartusiana.)*, Cd (*E. vermiculata)*, Cd (*M. cartusiana*), Mo (soil) Mo (*M. cartusiana*) Zn (*E. vermiculata*) and Zn (*M. cartusiana*) concentrations were higher in the field at 5 m than at 100 m from the cars road. Inversely, elements Pb, Cu and Zn in tested soil samples increase inside the field were 0.2715, 0.2635and 0.1690 respectively, the level of Cd in soil was rather too low to detect. The heavy metals Pb and Mo

values in tested *E. vermiculata* tissues at100 m were higher compared to the distance 5m as 1.6149 and 80.5369, respectively.

Table (1): Concentration of heavy metals in soil and some land snails at Sharqia Governorate.

Elements / Samples	Pb	Cu	Cd	Mo	Zn
Soil at 5 m	0.2710	0.1495	0.0	37.603	0.105
Soil at 100 m	0.2715	0.2635	0.0	33.1985	0.169
***Eobania vermiculata* at 5 m**	1.3333	64.3480	0.541	72.1521	25.7892
***Eobania vermiculata* at 100 m**	1.6149	41.1013	0.4886	80.5369	13.4640
***Monacha cartusiana* at 5 m**	4.7724	35.1660	0.6950	260.5411	40.8302
***Monacha cartusiana* at 100 m**	1.9537	33.594	0.1891	120.0812	20.7345

Pb=Lead, Cu=Copper, Cd=Cadmium, Mo= Molybdenum, Zn=Zinc.

The present data in Table (2) mentioned that three land snails infested the field *E. vermiculata*, *M. cartusiana* and *T. pisana* in Qalyubiya Governorate. Most tested heavy metals were higher in the field border (at 5 m) than at 100m. On the other hand, Cu, Cd and Mo increased in soil samples taken at 100 m more than at 5m. 1.1175, 0.2045, 14.3785 and 0.8015 ppm respectively. Pb and Zn these elements increase inside the field in case of *E. vermiculata* where samples recorded 8.7075and 98.2 ppm respectively. On the other hand, Cd, Mo and Zn increased in *M. cartusiana* samples taken from inside the field (at 5 m) more than from the field border where recorded 1.5425, 56.08 and 55.35 ppm, respectively. All elements in *T. pisana* samples were higher at 5m than at 100m. Results in this study cleared that the heavy metals in Qalyubiya Governorate were more than in Sharqia governorate, except Molybdenum which was high. Generally, Molybdenum was the most elements present in Sharqia governorate, while Cu was the most element present in Qalyubiya Governorate. The heavy metals copper (Cu) and lead (Pb) is based on the use of Cu as a major constituent of agricultural pesticides, which the snails are inadvertently exposed to.

However, Pb has been an additive of petroleum products which gets introduced into the environment during burning of the fossil fuels and ultimately become deposited on the leaves and soil where the snails dwell (Otitoloju *et al*., 2009). Cadmium has no biological function and is highly toxic to plants and animals. The major hazard to human health from cadmium is its chronic accumulation in the kidney where it can cause dysfunction if the concentration in the cortex exceeds 200mg/kg fresh weight. Cardiovascular disease has been related to ingestion and inhalation of Cadmium. (Gomot, 1997). Vyskocil and Viau (1999) a low order of toxicity of molybdenum compounds has been observed in humans. Molybdenum toxicity is associated with copper intake or depleted copper stores in the body. Wegwu and Wigwe (2006) reported that the low concentration of Zinc may be attributed to zinc-deficient soils, consequently the debris available to the snails is zinc-poor; combined with the fact that zinc is an essential metal of a high turnover rate it may results in a low tissue content of the element. Paula *et al*. (2012) a potential risk for animal and human consumption of *T. pisana*. it seems thus advisable to avoid collecting this species for human consumption in the affected area. Periodic monitoring is recommended to assess the evolution of potential risk for animal consumption. The study of the effects of metals and other contaminants on the physiology of organisms leads to the development of several toxicity tests that can be used as a tool for environmental assessment. There are many ways in which toxificants affect the individual, such as reduction of growth, feeding activity, reproductive capacity, and metabolite storage. Feeding and growth responses of the animals are broadly accepted ecotoxicological endpoints (Carbone and Faggio, 2019).

Theba

Table (2): Concentration of heavy metals in soil and some land snails at Qalyubiya Governorate.

Elements / Samples	Pb	Cu	Cd	Mo	Zn
Soil at 5 m	1.0465	0.7955	0.2025	6.523	1.1605
Soil at 100 m	0.7005	1.1175	0.2045	14.3785	0.8015
***Eobania vermiculata* at 5 m**	4.8575	211.275	7.005	49.92	72.05
***Eobania vermiculata* at 100 m**	8.7075	67.4375	1.76	44.5125	98.2
***Monacha cartusiana* at 5 m**	17.935	55.455	1.5	44.945	39.875
***Monacha cartusiana* at 100 m**	9.535	34.16	1.5425	56.08	55.35
***Theba pisana* at 5 m**	7.32	105.2675	1.765	66.735	35.16
***Theba pisana* at 100 m**	5.965	30.435	1.245	49.4475	18.2675

Pb=Lead, Cu=Copper, Cd=Cadmium, Mo= Molybdenum, Zn=Zinc.

It is concluded that land snails were found to be a good bio-indicator for air pollution. The variation in heavy metal concentrations between the studied locations is due to heavy traffic load and anthropogenic activities.

References

Ademoroti, C. M. A. (1996): Environmental chemistry and toxicology. Fludex Press Ltd. Ibadan. 5 (2): 134–146.

Aksoy, A.; Sahin, U. and Duman, F. (2000): *Robinia pseudo-acacia* L. as a possible biomonitor of heavy metal pollution in Kayseri. Turkish Journal of Botany, 24 (5): 279–284.

Altaf, J.; Naureen, A. Q. and Muhammed, J. I. S. (2017): Terrestrial snails as bioindicators of environmental degradation. J. Bio. and Env. Sci., 10 (1):253–264.

Carbone, D. and Faggio, C. (2019): *Helix aspersa* as sentinel of development damage for biomonitoring purpose: A validation study. Mol. Reprod. Dev. , 86:1283-1291.

Dallinger, R.; Berger, B.; Gruber, C. and Sturzenbaum, S. (2000): Metallothioneins in terrestrial invertebrates: structural aspects, biological significance and implications for their use as biomarkers. Cell and Molecular Biology, 46: 331–346.

Gomot, A. (1997): Dose-dependent effects of cadmium on the growth of snails in toxicity bioassays. Archives of Environmental Contamination and Toxicology, 33:209–216.

Malik, A. (2004): Metal bioremediation through growing cells. Chemosphere, 30: 261–278.

Manohar, S.; Jadia, C. D. and Fulekar, M. H. (2006): Impact of Ganesh idol Immersion on water quality. Indian Journal of Environmental Protection, 27: 216 – 220.

Menon, M.; Hermle, S.; Günthardt-Goerg, M. S., and Schulin, R. (2007): Effect of heavy metal soil pollution and acid rain on growth and water use efficiency of a young model ecosystem. Plant and Soil, 297(1-2): 171 –183.

Mielke, H. W. and Reagan, P. L. (1988): Soil as an impact pathway of human lead exposure. Environ. Health perspect., 106 (1): 217–229.

Nica D. V.; Bura, M.; Gergen, I.; Harmanescu, M. and Bordean, D. M. (2012): Bio accumulative and oncological assessment of heavy metal transfer in a soil-plant-snail food chain. Chemistry Central Journal, 6: 55 –60.

Nowakowska A. (2011): Land snails as bioindicators of environmental pollution: mini review. Urban Fauna: 317– 323.

Otitoloju, A. A.; Ajikobi, D.O. and Egonmwan, R. I. (2009): Histopathology and bioaccumulation of heavy metals (Cu and Pb) in the giant land snail, *Archachatina marginata* (Swainson). The Open Environmental Pollution and Toxicology Journal, 1: 79 – 88.

Paula, M.; Jos´e, A.; Engracia, M.; Pilar, B.; Rosa, L.; Angel, C.; Francisco, C. and Jos´e, M. M. (2012): The snail *Theba pisana* as an indicator of soil contamination by trace elements: potential exposure for animals and humans. Published online in Wiley Online Library: 28 January.

Perkin-Elmer, C. (1964): Analytical methods for atomic absorption spectrophotometry: Norwalk, Conn.

Schuberk, G. (1973): Heavy metals toxicity and environmental pollution. In: Metal ions in biological systems, Dhar, S. K.(ed). Plenum press New York pp 376.

Vyskocil, A. and Viau, C. (1999): Assessment of molybdenum toxicity in humans. J. Appl. Toxicol., 19 (3):185–192.

Wegwu, M. D. and Wigwe, I. A. (2006): Trace metal contamination of African giant snail (*Archachatina marginata*) from Southern Nigeria. Chem. Biodivers., 3: 88 – 93.

WHO (World Health Organization) (1972): Health hazard of human environment report, Geneva.

WHO (World Health Organization) (2000): WHO Air Quality Guidelines for Europe. 2nd ed. WHO Regional Publication, European Series No. 91. Copenhagen, Denmark: World Health Organization Regional Office for Europe.