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ORIGINAL ARTICLE

Comparative Study of Heavy Metal Accumulation in Kidney of *Gallus gallus* Within Polluted Areas in Wasit Province

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Abstract

Introduction Continued extraction of oil and the manufacturing of brick from brick factories in Wasit province has made the amount of heavy metals discharged into the atmosphere is gradually grow. As a result, excessive amounts of these pollutants can accumulate and intoxicate humans and animals living nearby, posing a threat to ecosystems, wildlife, and human health.
Methodology In this study, concentrations of Lead (Pb), cadmium (Cd), zinc (Zn), iron (Fe), and copper (Cu), were measured in kidney tissue of *Gallus gallus* being collected from two polluted sites near Al-Ahdeb oil field and Al-Hay brick factories in Wasit province.
Results and Discussion Accumulation levels indicated in this study were significantly higher in samples taken from Al-Hay brick factories than those taken from Al-Ahdeb oil fields, except for Lead (Pb), which was detected to be higher in samples of Al-Ahdeb oil fields. All concentration levels detected were high and considered hazardous to the health of organisms habituating within polluted areas since accumulation in tissues was reported to cause harmful negative effects on kidney function.
Conclusion Accumulation levels indicated in this study were significantly higher in samples taken from Al-Hay brick factories than those taken from Al-Ahdeb oil fields. All concentration levels detected were high and considered hazardous to the health of organisms habituating within polluted areas.

Keywords: Bio-hazard pollutant; Brick factories; Heavy metal contamination; Oil fields.

1 Introduction

The concept of "heavy metals" denotes any element with a high density that seems to be hazardous even in minute doses [1]. Pollution is described as the presence of a pollutant in the ecosystem, such as air, water, or soil, that is harmful to living creatures in the polluted environment [2, 3]. Heavy metals are emitted into the environment through both natural and man-made processes, and the metals expelled persist in the ecosystem [4].

Heavy metal bio-toxicity refers to the negative impacts on the body when they are consumed in large quantities of the bio-recommended threshold [5, 6]. Animal toxicity and poisoning are often induced by exchange and coordination mechanisms [7]. When taken, they interact with biomolecules in the body, such as proteins and enzymes, to form persistent bio-toxic compounds that mutilate their structures and impede their bioreactions [8, 9]. Over the last few decades, there has been an increasing interest in determining heavy metal concentrations in marine habitats, and efforts have been made to locate the pollution intensity of public food supply, especially seafood [10, 11]. As a result, heavy metal pollution in water, sediment, and animals is periodically examined in maritime habitats [12]. However, studies to determine the concentrations of heavy metals in the kidney were less since it does not harbor many compounds accumulated, as does the liver, gills (for marine animals), and lungs [13].

2 Methodology

This study was conducted in Wasit province, Iraq, to measure concentrations of Lead, cadmium, zinc, iron, and copper heavy metals (Pb, Cd, Zn, Fe, and Cu, respectively) accumulated in kidney tissue of wildland bird habitat in the polluted areas. The studied birds are wild chickens (Gallus gallus) and were collected from two polluted sites, area (I), areas near Al-Ahdeb oil fields, and area (II), near Al-Hay brick factories. The detected distance from where the samples were collected was between 500-1000 km within polluted areas.

A total of 20 birds were butchered, 10 from each site, and the relevant samples (kidney) were taken. For 13 days, samples were dried at room temperature (28.4 -33.6oC). Following that, each sample was ground to powder and digested with nitric acid (1gm sample + 10 ml acid). The measurement of (Pb, Cd, Zn, Fe, and Cu) concentrations in samples using an atomic absorption spectrophotometer, SHIMADZU model AA-7000. Detection with atomic absorption was conducted in the U-science laboratory, Al-Diwaniya province.

3 Statistical analysis

The data analysis was carried out using SPSS Statistics 20. By using the Anderson-Darling test, it was possible to determine the normality of the data with a 95% confidence level. The investigation's findings were presented as mean standard deviation (SD). ANOVA was used to determine whether there were any appreciable variations in the concentrations of heavy metals in the kidney (tissue samples) and the locations. A multifactor analysis of variance comparison was used to compare the means. The test result is considered significant if the P value is less than 0.05.

4 Results and Discussion

Under atomic absorption, kidney samples from gallus gallus were analyzed from Al-hay brick factories and Al-Ahdeb oil fields. Kidneys show an extreme trace of Lead in samples from both referred areas (3.385ug\g and 4.276ug\g in Al-hay brick factories and Al-Ahdeb oil Fields, respectively, compared to the control group (0.00395ug\g). However, no significant differences (p value= 0.050) were seen between the two areas, as shown in Table 1 and Figures 1,2.

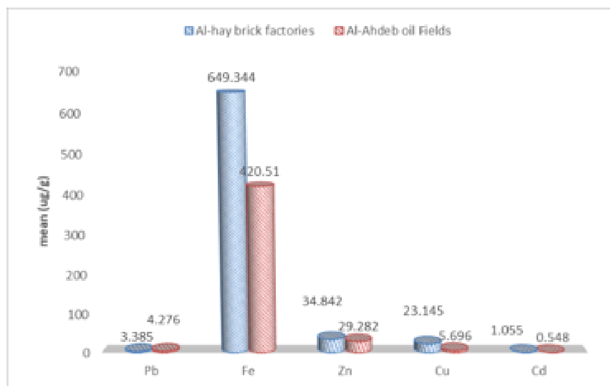

Figure 1: A graph showing the comparison in the mean value of mineral parameters for kidney samples between Al-Hay brick factories and Al-Ahdeb oil field.

Table 1: The Concentration and Purity of viral DNA.

Mineral Parameters	Kidney Samples (ug\g) Al-hay brick factories Mean ±SD	Kidney Samples (ug\g) Al-Ahdeb Oil Fields Mean ±SD	95% confidence	X2	P value
Lead (Pb)	3.385± 0.596	4.276± 0.509	2.964 to 5.000	3.021	0.050
Iron (Fe)	649.344± 113.697	420.51± 56.53	401.6 to 650.93	9.649	0.0193*
Zink (Zn)	34.842± 0.826	29.282± 1.247	20.930 to 40.111	1.853	0.0777
Copper (Cu)	23.145± 0.952	5.696± 1.534	4.826 to 23.828	6.944	0.0115*
Cadmium (Cd)	1.055± 0.101	0.548± 0.182	0.004 to 2.052	7.454	0.0173*

*significant differences ($p<0.05$), X2: chi square, SD: standard deviation.

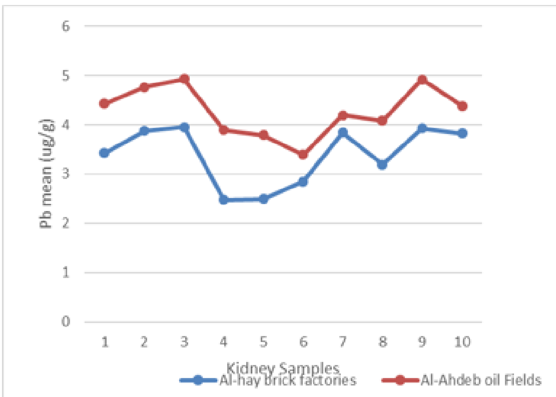

Figure 2: A graph showing the comparison in the mean value of mineral parameters for kidney samples between Al-Hay brick factories and Al-Ahdeb oil field.

Iron levels in kidney samples also elevated in both areas compared to the control group, where it was 275.051ug\g in the control group and 649.344ug\g and 420.51ug\g in Al-hay brick factories and Al-Ahdeb oil Fields, respectively. The difference was at a significant level (p=0.0193) between the two sites, as shown in Table 1 and Figures 1, 3.

The difference in element Zn in between the two above-mentioned sites was not significant (p= 0.0777). The Zink trace was 3 times higher in Al-hay brick factories (34.842ug\g) and Al-Ahdeb oil Fields (29.282ug\g) compared to the control group (10.822ug\g) Table 1 and Figure 4.

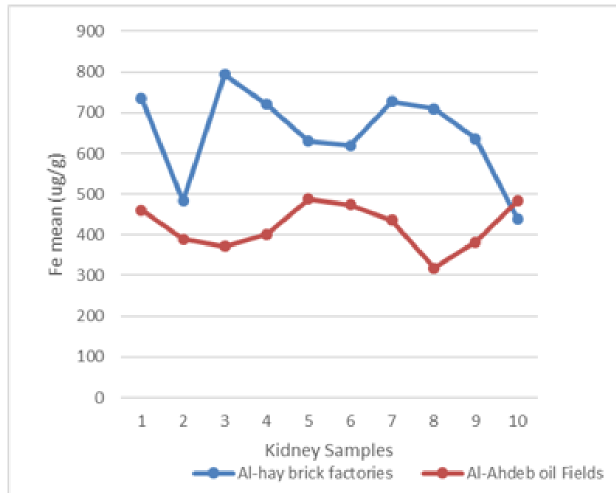

Figure 3: A graph showing the mean value of iron (Fe) for kidney samples taken from Al-Hay brick factories and Al-Ahdeb oil fields.

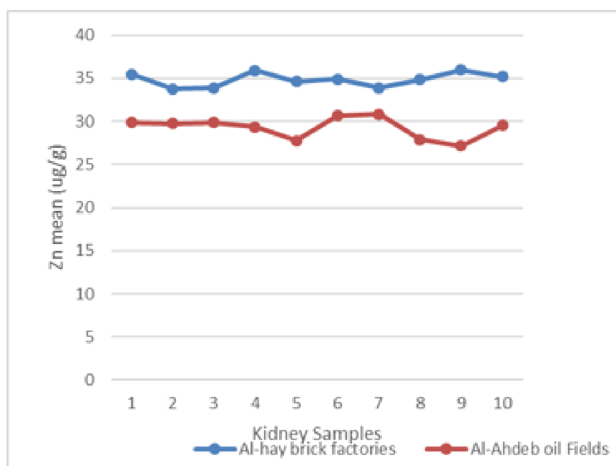

Figure 4: A graph showing the mean value of zinc (Zn) for kidney samples taken from Al-Hay brick factories and Al-Ahdeb oil fields.

The level of copper in samples of the kidney was significantly less (p=0.0115) in Al-Ahdeb oil Fields

(5.696ug\g) compared to those from Al-hay brick factories (23.145ug\g), but both are still higher than the control level (3.822ug\g) as shown in Table 1 and Figure 5.

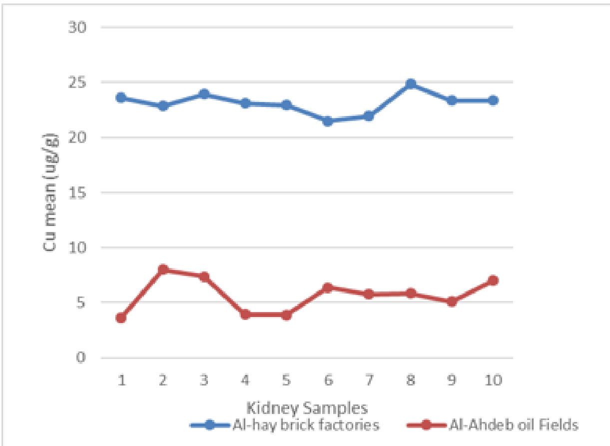

Figure 5: A graph showing the mean value of copper (Cu) for kidney samples taken from Al-Hay brick factories and Al-Ahdeb oil fields.

The same trend of copper profile was noticed when analyzing cadmium trace in kidney samples with more tracing levels compared to the control group (0.00675 ug/g). The level was significantly less ($p=0.0173$) in Al-Ahdeb oil Fields (0.548ug\g) compared to those from Al-hay brick factories (1.055ug\g), shown in Table 1 and Figures 1, 6.

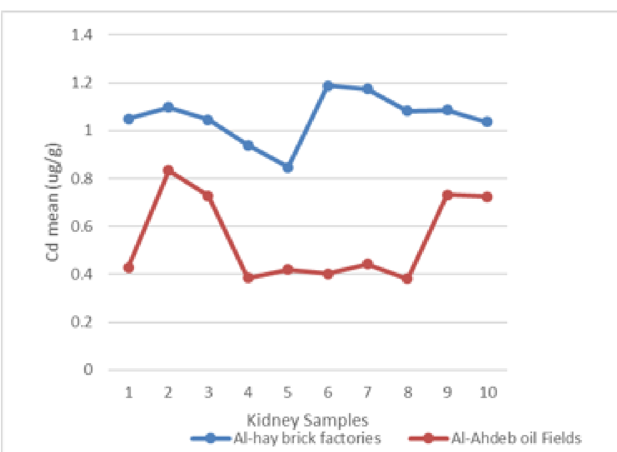

Figure 6: A graph showing the mean value of cadmium (Cd) for kidney samples taken from Al-Hay brick factories and Al-Ahdeb oil fields.

5 Conclusions

Accumulation of heavy metal in kidney tissues is lightly studied by researchers, given its role in the body compared to the liver and lungs or gills for marine animals. Furthermore, studies for pollutant concentrations in wild animals are also not preferable compared to marine animals. In general, accumulation levels indicated in this study were significantly higher in samples taken from Al-Hay brick factories than those taken from Al-Ahdeb oil fields, except for Lead (Pb), which was detected to be higher in samples of Al-Ahdeb oil fields. All concentration levels detected were high and considered hazardous to the health of organisms habituating within polluted areas since accumulation in tissues was reported to cause harmful negative effects on kidney function. An additional study is recommended on humans and higher animals would help to understand the capacity of these pollutants on health, furthermore suggest a safer facility to be used by the mentioned industries, perhaps biodegradation of oil and pollutants by microorganisms that would make it less hazardous environment and safe to habitat in future.

Conflict of Interest: No conflicts of interest exist between the authors and the publication of this work.
Ethical consideration: The ethical committee approved the study at Wasit University, Kut, Wasit, Iraq.

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