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Accumulation of heavy metal in spleen of gallus gallus within polluted areas in Wasit province

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Abstract--With the continuation of oil extraction and manufacture of brick from brick factories in Wasit province, the heavy metals amounts emitted to the environments are steadily increasing. Hence, can result in high levels of accumulation of these contaminants and intoxication of humans and animals living nearby, that pose a hazard to ecosystems, animals and human health. In this study we detected the concentrations of lead (Pb), cadmium (Cd), zinc (Zn), iron (Fe) and copper (Cu), in spleen tissues of Gallus gallus specimens being collected from two sites in Wasit province. All studied mineral parameters were significantly higher in samples taken from areas near Al-Hay brick factories than those taken from Al-Ahdeb oil fields, this indicates that areas near Al-Hay brick factories are highly polluted and it can be considered unsuitable for living due to the hazardous effect resulted from high rate of accumulation of toxic heavy menials.

Keywords---accumulation, heavy metal, polluted areas.

Introduction

The phrase "heavy metals" refers to any metallic element with a high density that is harmful or dangerous even at low concentrations (Xu et al., 2014). Pollution is defined as the pollutant presence in the environment, such as air, water, or soil, that is hazardous to living beings in the polluted environment (Ronco et al.,2008; Huldani et al.,2022). Heavy metals discharged into the environment by both

natural and manmade processes, and the metals that are emitted remain in the ecosystem (Bellomo et al., 2008). Heavy metal bio-toxicity refers to the adverse effects of heavy metals on the body when taken in excess of bio-recommended limits (Mishra et al., 2005 ; Ansari et al., 2022). Animal poisoning and toxicity are usually caused by exchange and coordination processes (Youn-Joo, 2003). When consumed, they interact with the body's biomolecules, such as proteins and enzymes, to generate stable bio-toxic complexes, mutilating their structures and impeding their bioreactions (Harikumar and Nasir, 2010; Mohammed and Qasim, 2021).

Cadmium toxic effect

Extremely low concentrations of cadmium are considered harmful (Terzano et al., 2010). In humans, continuous long-term exposure induces kidney failure characterized by tubular proteinuria. High amounts of exposure can develop obstructive lung disease, commonly known as cadmium pneumonitis, as a result of inhaled dusts and fumes (Chen, J. et al., 2014). It is defined by chest pain, a cough with frothy and bloody sputum, and the destruction of the lung tissue lining owing to an excess of watery fluids (Georgieva et al., 2014). Cadmium has also been related to bone issues such as osteomalacia, osteoporosis, and spontaneous fractures, as well as high blood pressure and myocardial dysfunction (Förstner, U., and Wittmann, G. T., 2012). Depending on the severity of the exposure, symptoms of consequences include nausea, vomiting, stomach cramps, dyspnea, and muscular weakness (Cheng and Gobas, 2007; Boko et al., 2022). Severe exposure can result in pulmonary edema and, in extreme cases, death. Sub chronic inhalation exposure to cadmium and its compounds can result in pulmonary and renal damage (Smalinskienė et al., 2001).

Lead toxic effect

Lead is the most toxic heavy metal, and the inorganic forms are absorbed by consumption of food and drink, as well as breathing (Kominkova and Nabelkova, 2007). Teratogenicity is a particularly dangerous side effect of lead intoxication. Lead poisoning also inhibits hemoglobin production, as well as kidney, joint, and reproductive system malfunction, cardiovascular system dysfunction, and acute and chronic damage to the central nervous system (CNS) and peripheral nervous system (PNS). Other side effects include gastrointestinal (GIT) and urinary tract damage, leading to bloody urine, neurological dysfunction, and the potential for severe and irreversible brain damage. Organic forms of lead primarily influence the CNS, PNS, GIT, and other biosystems, whereas inorganic forms primarily affect the CNS, PNS, GIT, and other biosystems. Lead harms children by impairing the development of the grey matter of the brain, resulting in low IQ. Lead's acute and chronic impacts result in psychosis (Hordyjewska et al., 2014).

Zinc toxic effect

Zinc has been found to elicit the same symptoms as lead, and can easily be misdiagnosed as lead poisoning. Zinc is thought to be rather non-toxic, particularly when given orally, excess amounts, on the other hand, might create system dysfunctions, impairing development and reproduction. Vomiting,

diarrhea, bloody urine, icterus, liver failure, renal failure, and anemia have all been documented as clinical indications of zinc toxicosis (Nicoara et al.,2009).

Iron toxic effect

Iron poisoning has long been a topic of discussion among doctors, owing to the fact that children are more vulnerable to iron toxicity due to their increased exposure to iron-containing goods. Iron toxicosis manifests itself in four phases. Iron toxicosis is characterized by gastrointestinal consequences after 6 hours of iron overload. Iron toxicosis occurs within 6-24 hours after an iron intake and is regarded to be a time of apparent medical recovery. Iron toxicosis occurs between 12-96 hours after an iron intake and is characterized by shocks, lethargy, tachycardia, hypotension, liver necrosis, metabolic acidosis, and occasionally death. Iron toxicosis occurs within 2-6 weeks following an iron dosage (Coca et al.,2009). Excess intake of iron is a severe concern in industrialized and meat-eating countries since it raises cancer risks. Workers who are significantly exposed to asbestos, which contains about 30% iron, are at a high risk of asbestosis; asbestosis is the second leading cause of lung cancer (Kellum and Hoste, 2008).

Copper toxic effect

Copper is a mineral that is necessary for several bodily activities, including enzyme manufacturing and brain function. Exposure to excessive quantities of copper in water or food, on the other hand, can result in copper poisoning. Genetic factors may also play a role. Excess copper causes oxidative stress, DNA damage, and decreased cell growth. Copper toxicosis is characterized as primary when caused by a hereditary metabolic deficiency and secondary when caused by excessive intake, increased absorption, or decreased excretion due to underlying pathologic conditions. A high copper level in the body can harm the liver, kidneys, heart, and brain. Copper poisoning, if left untreated, can have serious health consequences and could end in death (McCullough, 2008).

Methodolog

This study was conducted in Wasit province, Iraq. The studied birds (*Gallus gallus*) were collected from two polluted areas, area (A), villages near Al-Ahdeb oil fields, while, area (B), villages near Al-Hay brick factories. A collective of 20 birds, 10 from each site, were slaughtered and the needed samples (spleen) were obtained. Samples were dried at room temperature about (28.4 -33.6 °C) for 13 days. Afterwards, each sample were grinded to powder, and digested with nitric acid (1gm sample+ 10 ml acid). The detection of (Pb, Cd, Zn, Fe and Cu) concentration in samples by atomic absorption spectrophotometer, model AA-7000, SHIMADZU brand.

Results and Discussion

Analysing spleen samples fetched from *Gallus gallus* under atomic absorption from the area surrounded to Al-Ahdeb oil fields (0.863 ug\g) illustrates that the traces of Lead (Pb) is comparatively high than AL- hay brick factory (0.0095 ug\g) and control group (0.0091 ug\g). However, there was a significant evaluation (p

<0.0001) in detection of lead (Pb) in samples taken from the area neighbouring to Al-Ahdeb oil fields and Al-Hay brick factories sample as shown in (table 1) and (figure 1, 2).

Table 1
Statistical analysis of mineral parameters

Mineral Parameters	Spleen Samples (ug\g)		95% confidence	X ²	P value
	Al-hay brick factories	Al-Ahdeb oil Fields			
	Mean ±SD	Mean ±SD			
Lead (Pb)	0.0095± 0.0014	0.863± 0.387	0.0086 to 0.9104	64.21	<0.0001*
Iron (Fe)	644.213± 79.37	855.835± 79.001	595 to 893	14.72	0.0034*
Zink (Zn)	40.879± 2.333	33.889± 2.160	39.4 to 42.3	1.961	0.0648
Copper (Cu)	12.429± 0.489	8.754± 1.558	12.1 to 12.7	0.259	0.3651
Cadmium (Cd)	0.455± 0.0524	0.009± 0.005	0.0002 to 0.488	45.08	<0.0001*

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

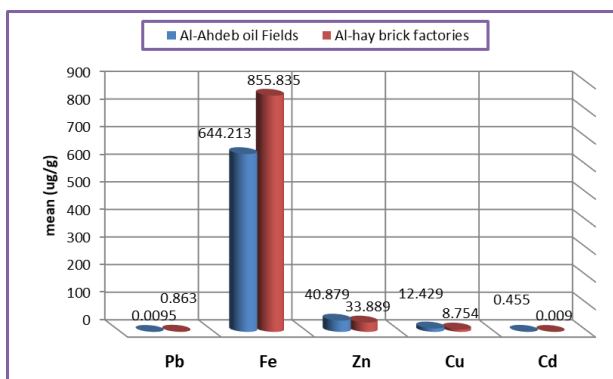


Figure 1. A graph showing the mean value of mineral parameters for spleen samples taken from Al-Hay brick factories and Al-Ahdeb oil field

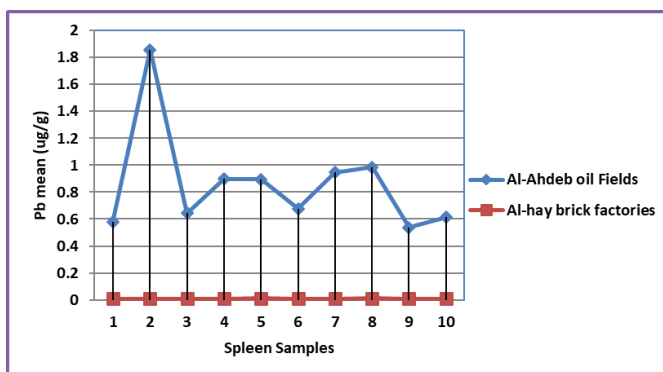


Figure 2. A graph showing the mean value of Lead (Pb) for spleen samples taken from Al-Hay brick factories and Al-Ahdeb oil field

The Iron traces in same tissue were also evaluated in samples from same surrounding areas, compared to control samples (263.47 ug\g). Iron level follows the same trend of Lead (Pb) in spleen which was significantly high (p value =0.0034 ug\g) as compared with Al-Ahdeb oil Fields (855.835 ug\g) to Al-hay brick factories samples (644.213 ug\g) as shown in (table 1) and (figure 1, 3).

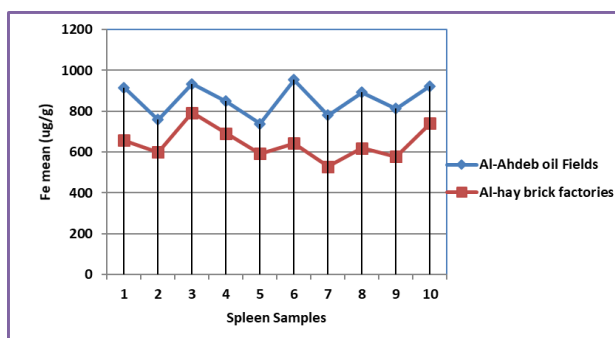


Figure 3. A graph showing the mean value of iron (Fe) for spleen samples taken from Al-Hay brick factories and Al-Ahdeb oil field

The evaluation clearly states that the ratio of Zn traced was much more compared to control group (8.878 ug\g), however no significant difference (p value =0.0648) was seen between both the areas of sample collection. The amount of Zn traced was 40.879ug\g in Al-hay brick factories and 33.889 ug\g in Al-Ahdeb oil Fields as shown in (table 1) and (figure 1, 4).

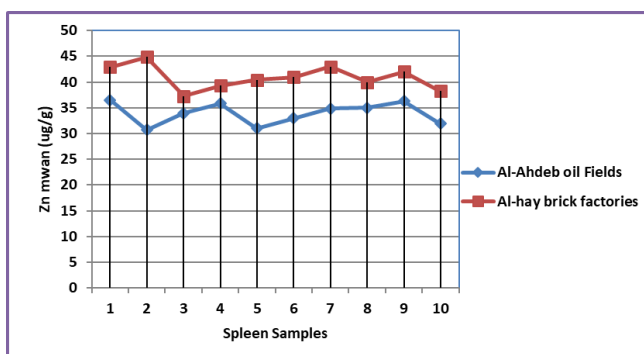


Figure 4. A graph showing the mean value of zinc (Zn) for spleen samples taken from Al-Hay brick factories and Al-Ahdeb oil field

The other heavy metal detected in present study was Copper. Compared to control group (3.943 ng/g), both site show evaluation in the traces of copper in collected spleen samples 12.429 ug\g from Al-hay brick factories and 8.754 ug\g from Al-Ahdeb oil Fields. An observation for Copper level is with no significant difference. (p value =0.3651 ug\g) as shown in (table 1) and (figure 1, 5).

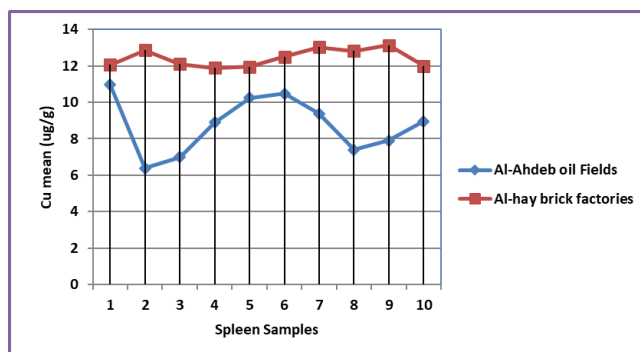


Figure 5. A graph showing the mean value of copper (Cu) for spleen samples taken from Al-Hay brick factories and Al-Ahdeb oil field

Interestingly, there was about 62.3 folds increase in trace of Cadmium in spleen samples from Al-hay brick factory areas (0.455ug\g) compared to control group (0.0073ug\g) which was not seen in Al-Ahdeb oil Fields samples (0.009ug\g). High significant differences (p value ≤ 0.0001) was seen in Cadmium trace between Al-hay brick factories and Al-Ahdeb oil Field samples as shown in (table 1) and (figure 1, 6).

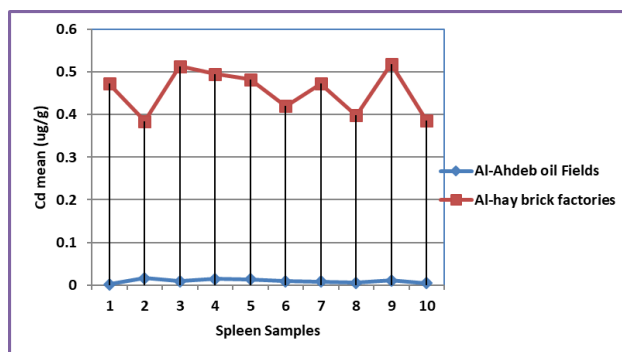


Figure 6. A graph showing the mean value of cadmium (Cd) for spleen samples taken from Al-Hay brick factories and Al-Ahdeb oil field

Conclusion

All studied mineral parameters were significantly higher in samples taken from areas near Al-Hay brick factories than those taken from Al-Ahdeb oil fields, this indicates that areas near Al-Hay brick factories are highly polluted and it can be considered unsuitable for living due to the hazardous effect resulted from high rate of accumulation of toxic heavy menials. Also, it should be noted, that the varying percentage of accumulatio between the two regions aforementioned, might be due to the fact that those responsible for managing the oil field installed filters to reduce the amount of pollutant emitted from combustion of gas emitted from oil extraction operations.

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