Study the Effects of Heavy Metals (Lead and Cadmium) on Some Biochemicalparameters of Dairy Cattle in Baghdad Province

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Abstract

This study investigatesthe effects of heavy metals (Lead and Cadmium) on some biochemical parameters of dairy cattle in Baghdad province(Taji, Abu Ghraib, Al-Fudilia, Letifia and Youssoufia)regions.Thirty samples of blood from dairy cattle in five different regions were taken to measure the Lead and Cadmium concentration by atomic absorptionwhile serum were collected for measuring, liver enzymes (aspartate aminotransferase AST and alanine aminotransferase ALT) activity,Serum total protein, serum albumin, serum globulin and serum creatinineconcentration.The results showed a significant increase ($p< 0.05$) in the leadand cadmium ion concentration in the blood sample of the dairy cowsin Youssoufia region compared with other region. On the other hand, the total protein and globulin concentration of the dairy cattle in Abu Ghraib region recorded significantly ($p < 0.05$) higher value compared with Letifia region. While Albumin and creatinine concentrations showed non-significant ($p > 0.05$) differences among the different regions. Liver enzyme AST concentration showed significant increase ($p < 0.05$) in the serumof dairy cows in Letifia and Youssoufia regions. However, serum ALT were increased significantly($p < 0.05$) in Letifia than Abu Ghraib region.Concluded from thisstudythatdairy cattle inLetifia and Youssoufia regions were subjected to pollution with heavy metals which caused Increased heavy metal content in the blood of cattle and affect their health by increased the concentration of liver enzyme and reduction of total protein in the blood of dairy cattle compared with other region in Baghdad province.

***Keyword**: ALT, AST, Creatinine, Cadmium and Lead pollutant.*

Introduction

Lead and cadmium are often referred to very toxicto animals and humans as “heavy metals”. The biogeochemical processes have been dramatically changed by indiscriminate human behaviors such as accelerated industrialization, overgrowing urbanization and environmental manipulation. The aggregation of polluted waste water cause to pollute the agricultural soil and the crops growing in that soil, allowing the accumulation of heavy metals; the crops used by the animal for the purpose of grazing or eating will collect in the animal body, otherwise the heavy metals will be able to enter the animal body directly by consuming infected water.Prolonged exposure to heavy metals such as lead and cadmium in livestock causes adverse health consequences.The liver, kidney, brain and other body functions are mainly influenced by heavy metal. The most common heavy metals which are present in industrial and domestic waste are lead, mercury, arsenic and cadmium.[1]

Cd and Pb are spread to red blood cells or proteins following absorption.[2]A large amount of Cd is bound to high-molecular-weight proteins in red blood cells, while a small amount is bound to hemoglobin. However, much of it is bound to hemoglobin rather than the membrane

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of red blood cells when Pb reaches the cell.[3]One of the most susceptible processes is the hematopoietic system, and blood is not only the mode of delivery, but also the vital target of Cd and Pb toxicity.[4]Both metals can contribute to anemia by different pathways.[5,6,7] Cadmium and Pb are transferred to the liver, resulting in damage and reduced function. Histopathological observations may confirm liver injury, which is also followed by elevated blood enzyme levels and decreased protein synthesis.[8]Toxic effects on the kidneys are reflected by disruption to the anatomy of the kidneys and changes in excretory activity.[9,10] It has been proven that cadmium is toxic to the pancreas, endocrine, respiratory, immune, and reproductive systems.[11,12] Pb toxicity has been associated with adverse effects on the nervous, respiratory, and reproductive systems.[13]The bulk of the body burden of Pb is tissue mineralization (bones and teeth).[14]

Materials and Methods:

Thirty samples of blood from dairy cattle's in five different areas included (Taji, Abu Ghraib, Al-Fudilia, Letifia and Youssoufia)of Baghdad citywere taken during the period of summer 2020. Blood samples taken at morning from thedairy cattle by jaguar vein.Whole blood was collected for measuring lead and cadmium concentration by atomic absorption[15]immediately in laboratories of science and technology ministry. The serum was isolatedby centrifugation for 15 minute at 3000 rpm for measuring liverfunction such asAST activity (aspartate aminotransferase) and ALT (aminotransferase) by spectrophotometer,[16] while the Serum total protein, albumin, globulin and creatinineconcentration were determined by usingcolored method kit by spectrophotometer.[17] Statistical data analysis was carried out on the basis of one-way data interpretation. (Analysis of Variation-ANOVA) wasused significant level (P≤0.05) compare between means Estimate of correlation coefficient between variables in this study usingLeast significant difference –LSD test as describe.[18]

Results and Discussion

Lead concentration in the cattle blood of the Youssoufia region showed a significant (P≤0.05) higher concentration than Taji, Abu Ghraib and Latifiaregion, while the lead concentration in cattle blood from the Al-fudilia are significantly (P≤0.05) lower concentration than other region as shows in the table (1).Cadmium concentration in blood of the dairy cattle shows significant increase (P≤0.05) in the Youssoufia region (0.255 ±0.01) compared with (0.218 ±0.01, 0.195 ±0.02, 0.201 ±0.01, 0.205 ±0.01) Taji, Abu Ghraib, Alfudilia and Latifia regions respectively.

Table 1. Lead and Cadmium concentration in blood of the cattle from different region in Baghdad province(µg/dl).

Location	Mean ± SE	
	Pb	Cd
Taji	18.33 ±0.55 b	0.218 ±0.01 b
Abu Ghraib	17.33 ±0.88 b	0.195 ±0.02 b
Alfudilia	15.50 ±0.67 c	0.201 ±0.01 b
Youssoufia	20.67 ±0.33 a	0.255 ±0.01 a
Latifia	16.83 ±0.40 bc	0.205 ±0.01 b
LSD value	1.753 *	0.035 *
Means having with the different letters in same column differed significantly. * (P≤0.05).		

The results in table (1) revealed that Pb and Cd concentrations were elevated significantly (P≤0.05) in Youssoufia region, that may due to this region is the only one from the study regions which supply water from Euphrates rivers. The highly increase of these heavy metal concentrations in the blood of dairy cattle may also be attributed to excessive military operation in this area due to of terrorist intimidation. Cattle maybecome exposed to lead and Cadmium through consumption of lead-contaminated soils, plants, and water, the lead from these sources is not sufficient to produce acute toxicity but these sources may contribute to chronic lead poisoning.[19]

Fadhil*et al.*[20]investigate the effect of some heavy metals (Cadmium, Lead, and Zinc) which release from diesel generator exhausts on workers' health in Al-Ramadi City by measuring Heavy metal concentrations and their effect on variables in the blood and lipids profile in serum. However, the results showed that concentrations of heavy metals recorded are significantly increased compared with the controlled group of Pb.

The concentration of the total protein and globulin were decreased significantly (p< 0.05) in the blood of the dairy cows in Latifia region of Baghdad province compared with their concentration in cows of Abu Ghraib region. While we found that there were non-significant differences in creatinine and albumin concentration in dairy cattle from different regions of Baghdad province.

Table 2. Effect of Lead and Cadmium concentration on the Total protein, Albumin, Globulin and Creatinine in blood of the cattle from different region in Baghdad province.

Location	Mean ± SE			
	Total protein (g/l)	Albumin (g/l)	Globulin (g/l)	Creatinine (mg/dl)
Taji	6.73 ±0.23 ab	3.13 ±0.24 a	3.59 ±0.29 ab	1.48 ±0.05 a
Abu Ghraib	7.01 ±0.28 a	3.25 ±0.21 a	3.75 ±0.28 a	1.31 ±0.05 a
Alfudilia	6.54 ±0.15 ab	2.88 ±0.16 a	3.66 ±0.27 ab	1.43 ±0.08 a
Youssoufia	6.42 ±0.29 ab	2.87 ±0.18 a	3.55 ±0.24 ab	1.40 ±0.10 a
Latifia	6.20 ±0.16 b	3.26 ±0.08 a	2.93 ±0.19 b	1.32±0.07 a
LSD value	0.681 *	0.544 NS	0.756 *	0.502 NS
Means having with the different letters in same column differed significantly. * (P≤0.05).				

The decreased in the total protein may due toInorganic lead metabolism consists mainly of a reversible ligand reaction, including the formation of amino acid and non-protein thiol complexes and binding to different proteins. Major extra cellular ligands include albumen and non-protein sulfhydryl's while in red blood cells, the main intracellular ligand is delta- aminolevulinic acid dehydratase (ALAD).[21,22,23,24,25]Our results are in the same trends with other researchers using numerous animal models, route of exposure and dosage. whom they found that heavy metals caused reduction effect on RBC, HGB, and HCT. [26,27,28,29,30]Intravascular hemolysis may be the cause for lowering RBC, HGB, and HCT.[9,29,8]In addition, it is well known that Pb binds to numerous protein groups of -SH, like enzymes [30,6,31,32] and in addition to decreased glutathione levels, the development of substantial MDA and H2O2 increases in RBC.[33] Therefore, As the liver is the main site of plasma protein synthesis, mostly albumin, variations in serum total protein values may suggest liver dysfunction.On the other hand, our results were disagreeing with Burtiset al.[34]Who reported that the levels of creatinine showed a

growing trend. Changes in amounts of urea and creatinine suggest that the excretory activity of the kidney may be compromised even after the administration of a single dose of the toxic metals.

Abdul-Sada[35]found that, cattle reared and managed near the industrial areas in Egypt will exposed cattle to the cadmium and lead toxicity through polluted of their feed and water,and which cause in alterations in the quantities of Cd and Pb in the muscle, liver and kidney, in addition to variations in the profile of plasma hormones and function of liver in those cows which agreed with our results.

Table (3) shows that liver enzyme AST is significantly higher (P≤0.05) in the serum sample of the cows in the Youssofia and Latifia regions (197.91 ±18.80, 206.01 ±25.54) compared with the other regions of Baghdad province.While ALT enzyme concentration increase significantly (P≤0.05) in the cattle of Latifia region (208.07 ±23.12) compared with (136.54 ±11.62, 129.14 ±0.46) Taji and Abu Ghraib respectively.

Table 3. Effect of Lead and Cadmium pollutants on the AST and ALT in blood of the cattle from different region in Baghdad province(U\L).

Location	Mean ± SE	
	AST	ALT
Taji	130.06 ±9.46 b	136.54 ±11.62 bc
Abu Ghraib	104.49 ±2.32 b	129.14 ±0.46 c
Alfudilia	121.86 ±9.95 b	195.08 ±37.52 ab
Youssoufia	197.91 ±18.80 a	145.20 ±16.90 abc
Latifia	206.01 ±25.54 a	208.07 ±23.12 a
LSD value	45.123 *	63.334 *
Means having with the different letters in same column differed significantly. * (P≤0.05).		

The significant increase (P≤0.05) in liver enzymes AST and ALT of the cows in Youssoufia and Latifia regions related to the highly concentration of lead and cadmium heavy metals in the blood of dairy cattle inthese regions.Burtis et al. [(34)]found that Cadmium and Lead concentration in tissues experimental groups treated with a single dose of Cd (15 or 30 mg/kg) had a statistically higher blood concentration and demonstrated significantly higher levels of Cd in the liver compared to the control group ($p < 0.001$).

The results showed that the significant increase of cadmium and lead in the body of cattle causes severe stress conditions on the animals that causes a harmful effect on the liver, kidney, thyroid gland, ovary and tests functions that will increase the level of stress hormones, serum enzymes, thyroxine, triiodothyronine and cortisol level.[36] McNulty[37] observed greater quantities of serum AST and ALT concentration in dairy cows exposed in the environment to lead and cadmium around various manufacturing locations because lead has been involved in induction of hepatic dysfunction. However, the effect of the heavy metals on the liver function may in rat plasma, liver, and kidneys, overall oxidative status and oxidative stress index are induced by.[38]In general, metal absorption, transport, and deposition in tissues and organs rely on several factors, such as the properties

and shapes of the metals, the path, dosage and length of exposure, the capacity to bind to ligands in the cells, and the susceptibility of the organisms.[2,39]

Conclusion

We can conclude that the dairy cattle reared in area polluted with heavy metals caused increased in the concentration of Pb and Cd in the cattle's blood and affect their health by increased the concentration of liver enzyme and reduction of total protein in the blood of dairy cattle in Latifia and Youssoufia regions compared with other region in Baghdad province.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Source of Funding: There is no source of funding

Ethical Clearance : This article collected data from different areas and was obtained acceptance and agreement from owners without details of names and other specific data.

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