Concentration of lead, cadmium and mercury in the blood of human and sheep in the different governorate of Iraq

Mazin Raad Mahmood ALSalman[1], Tamara Natik Dawood[1]

[1]Public Health Department College of Veterinary Medicine University of Baghdad
***Corresponding author e-mail: mazen.raad1104d@covm.uobaghdad.edu.iq**

Received:
Jan. 3, 2023

Accepted:
Feb. 20, 2023

Published:
Mar. 23, 2023

Abstract

This study was conducted to find out the concentration of heavy metals (lead, cadmium, and mercury) in human and sheep blood along the Tigris River (Mosul, Salahuddin, Baghdad, Wasit, and Misan). Blood samples were taken from different regions to study the effect of heavy metal pollutants on human and sheep health. Lead and cadmium concentrations in the blood of humans and sheep in Baghdad, Mousel, and Misan governorates were significantly ($P< 0.05$) higher compared with their concentrations in other governorates; on the other hand, the concentration of lead in the blood of humans and sheep was lowest in Wasit governorate. Mercury were significantly higher ($P<0.05$) only in blood of the human and sheep in Misan governorate.
Keywords: lead, cadmium, mercury, blood human and sheep

Introduction

Heavy metals are harmful because they can cause chronic degenerative changes as a result of their widespread use in industry and consumer items. Because metals are not biodegradable, they can accumulate in the environment and cause harm [1].
Cadmium is a highly toxic metal that, even at extremely low concentrations, can accumulate in the human body and cause irreversible damage to the liver, kidneys, bones, lungs, placenta, brain, and central nervous system [2]. Cadmium concentrations in unpolluted natural waters are usually below 1 g/l [3]. Excessive exposure of the human body to lead results in disturbances of body function, which can be neurological, cardiovascular, hematologic, and reproductive. Blood containing high levels of lead causes inadequate functioning of the central nervous system (CNS) and consequently leads to encephalopathy and edema that mainly affect the cerebellum [4]. Mercury (Hg) appears in three forms in the environment: elemental or metallic mercury (Hg0), inorganic mercury (Hg+, Hg2+), and organic mercury (usually methyl or ethyl mercury) [5]. All Mercury species are toxic, with organic Mercury compounds generally being more toxic than inorganic species [6].
The ability of a material to accumulate in the tissues of organisms through intimate contact with water, air, and soil or through food intake is known as bioaccumulation. Bioaccumulation, on the other hand, is frequently divided into two categories: bioconcentration and biomagnification. Biomagnification is the mechanism by which a bioaccumulating substance's tissue concentration rises as it goes up the food chain across at least two stages [7].

The aim of this study is to find out the concentrations of some heavy metals in human and sheep blood and try to reduce or eliminate these metals in order to preserve public health.

Materials and Methods

This experiment was about collecting samples of human blood and sheep blood from different areas along the Tigris River in Iraq (Mosul, Salahuddin, Baghdad, Wasit, and Misan), as well as water samples, to measure the concentration of lead, mercury, and cadmium. This study lasted three months: February, March, and April 2022. Each blood sample was divided into two parts: (5) ml of blood collected in an EDTA anticoagulant tube (Ethyl Diamine Tetra Acetic Acid) and (5) ml of blood in a gel tube without anticoagulant for measuring blood parameters. The samples were kept in a refrigerator at 4 °C prior to analysis, after which they were sent to the laboratories of the Iraqi Ministry of Science and Technology for measurement of heavy metal concentration.

Lead concentration measurement

The procedure to estimating of lead examination was by atomic absorption spectrometry device flame. [8].

Cadmium concentration measurement

Estimating of cadmium was examined by using atomic absorption spectrometry device, flameless.[8].

Mercury concentration measurement

Mercury estimation were done by using cold vapor atomic absorption spectroscopy (CVAAS). [9].

Statistical analysis

The program was used to detect the effect of difference locations in study parameters. Least significant difference -LSD test (Analysis of Variation - ANOVA) was used to significant comparison between Estimate of correlation coefficient between variables in this study means [10].

Results and Discussion

Table (1) showed that the lead concentration in the blood of humans and sheep in Baghdad, Mousel, and Misan governorates was significantly ($P<0.05$) higher than its concentration in other governorates. On the other hand, the concentration of lead in the blood of humans and sheep is lowest in the Wasit governorate.

Table (1): Concentration of Lead in the Blood human and sheep in different governorate

Groups/Lead	Human (µg\L)	Sheep (µg\L)
Baghdad	25.33±0.51a	35.13±0.87a
Mousel	24.60±0.82a	34.73±0.64a
Salahuddin	20.33±0.46b	25.73±0.65b
Misan	26.13±0.79a	33.53±0.84a
Wasit	17.80±0.53c	17.73±0.71c
LSD	2.01	1.96

Means with a different small letter in the same column are significantly different (P<0.05)

Table (2) showed the cadmium concentration in the blood of (humans and sheep) of the Baghdad, Mousel and Misan governorates were significantly increase (P<0.05) compare with other governorates.

Table (2): Concentration of Cadmium in the Blood of human and sheep and Differential of them in different governorate

Groups/Cad	Human (µg\L)	Sheep (µg\L)
Baghdad	0.54±0.19a	0.57±0.008a
Mousel	0.52±0.01a	0.51±0.007a
Salahuddin	0.24±0.18b	0.27±0.005b
Misan	0.55±0.005a	0.53±0.006a
Wasit	0.25±0.007b	0.23±0.005b
LSD	0.23	0.12

Means with a different small letter in the same column are significantly different (P<0.05)

Table (3) showed the concentration of mercury were significantly higher (P<0.05) only in blood of the human and sheep in Misan governorate.

Table (3): Concentration of Mercury in the Blood of human and sheep in the different governorate

Groups/Mercury	Human(µg\L)	Sheep(µg\L)
Baghdad	0.00±0.00b	0.00±0.00b
Mousel	0.00±0.00b	0.00±0.00b
Salahuddin	0.00±0.00b	0.00±0.00b
Misan	0.0009±0.00a	0.0007±0.00a
Wasit	0.00±0.00b	0.00±0.00b
LSD	0.0001	0.0001

Means with a different small letter in the same column are significantly different (P<0.05)

The results of tables (1 and 2) showed a significant increase in the concentration of lead and cadmium in the blood of humans and sheep in the governorates of Baghdad, Mosul and Missan. It may be associated with home plumbing systems in which pipes, solder connections, fixtures or service to homes contain lead. Polyvinyl chloride (PVC) pipes contain lead compounds that can leach out and lead to high concentrations of lead in drinking water [11], when plumbing materials containing lead react chemically, lead can end up in drinking water, corrosion is the breakdown or wearing away of the metal from the pipes and fixtures these results were agreed with [12]. Lead exposure from lead-contaminated food and water in sheep has been linked to an increase in blood lead levels [13].showed that due to global warming and increased anthropogenic activities were the main causal factors of water quality upon the cattle health including excess mineral level, high bacterial load, presence of persistent organic pollutants, and high level of heavy metals Arup [14]. The present results are similar to those from studies conducted in highly polluted areas in other countries such as Mexico, Egypt, Italy and Pakistan [15]. [16] discovered cadmium levels in cattle blood in barns in the Mexican province of Leon, while in Peru, cadmium levels in cattle blood were (0.0160.002 mg/kg).Pb and Cd concentrations in 5 dairy barns in the Mexican municipalities of general Zuazua and Marin were reported to be 0.74 and 0.30 mg/kg, respectively [17], which are higher than our results.However, Other studies provide some evidence suggesting that geographic variations (and thus environmental exposures) contribute to blood cadmium levels [18], along with industrial exposure, diet, and ethnicity .[19] Reported that the amount of cadmium in well water was substantially greater than in other areas of the Baghdad Governorate, which may be attributed to increased levels of cadmium in ground water as a result of wide-

spread effects of plant irrigation and as a source of water for animals. Cadmium's simple aqueous chemistry makes it simple to dissolve in groundwater. [20]. [21] revealed that the free chlorine in drinking water was below the standards set by the World Health Organization (WHO) in the period from July up to the end of August 2007. Some variables that affect drinking water, such as the amount of free chlorine, temperature, pH, and the oxidation-reduction potential of water on the sanitising efficiency of chlorine, have been studied and found to follow the same trend as [22].

Table (3) showed the concentration of mercury were significantly higher ($P<0.05$) only in blood of the human and sheep in Misan governorate. Variant effects of high concentrations of mercury on human health have been documented and for these reasons, it is of primary importance to monitor the mercury status in the marshlands especially in regions such as the southeast Iraq where people rely on marshlands as food sources or for food production [23]. Mercury is one of the heavy metals that are suspected [24]. To be of potential danger not only to the ecological integrity of the marshlands but also to the health and livelihood of the local people in southeast Iraq, many people in the area rely on the marshlands as sources of food (e.g. fish) and fish consumption is major way by which mercury is ingested by human [25][26]. [27] Heavy metal pollution threatens agriculture and other human food sources.

The addition of heavy metals leads to many changings in the metabolic activity of microorganisms which is represented by a decrease in the ATP concentration and respiration rate [28]. Many enzymes secreted by microorganisms contribute to the recycling of materials and nutrients that exist in the soil.

References

1) Sainio EL,Jolanki R,Hakala E, Kanerva L,(2000).Metals and arsenic in eye shadows . Contact Dermatitis; 42(1):5-10.
2) Damek-Poprawa M, Sawicka-Kapusta K. (2004). Histopathological changes in the liver, kidney and testes of bank voles environmentally exposed to heavy metal emission from the steelwrks and zinc smelter in Poland Environ Res.;96:72-78.
3) Friberg L, Nordberg G F, Vouk V B. (1986). Handbook of the toxicology of metals. Vol. II. Amsterdam, Elsevier, pp. 130–184.
4) Pal M, Sachdeva M, Gupta N, Mishra P, Yadav M, Tiwari A (2015). Lead exposure in different organs of mammals and prevention by curcumin-nanocurcumin: A review. Biol Trace Elem Res;168:380-91.

5) Xiang, L., Li, Y. W., Wang, Z. R., Liu, B. L., Zhao, H. M., Li, H., ... & Li, Q. X. (2020). Bioaccumulation and Phytotoxicity and Human Health Risk from Microcystin-LR under Various Treatments: A Pot Study. Toxins, 12(8), 523.

6) Leopolda K, Foulkesb M, Worsfold P. (2010). Analytica Chimica Acta .663 :127–138 .

7) Xiang, L., Li, Y. W., Wang, Z. R., Liu, B. L., Zhao, H. M., Li, H., ... & Li, Q. X. (2020). Bioaccumulation and Phytotoxicity and Human Health Risk from Microcystin-LR under Various Treatments: A Pot Study. Toxins, 12(8), 523.

8) Bryson, P. D. (1996). Mushrooms. Bryson PD. Comprehensive review in toxicology for emergency clinicians. 3rd ed. Washington, DC: Taylor and Francis, 685, 93.

9) Gallagher, C. M., & Meliker, J. R. (2010). Blood and urine cadmium, blood pressure, and hypertension: a systematic review and meta-analysis. Environmental health perspectives, 118(12), 1676-1684.

10) Zbaar S. A. & Marbut S.m. (2009).Heavy metal contamination of drinking water in the city of Baiji.thesis from Department of biochemistry, College of medicine , Tikrit University.

11) Salman ,K & Dawood,T.N . (2021). Investigation of Heavy Metals Pollutant (Lead and Cadmium) in Water, Indian Journal of Forensic Medicine & Toxicology. Vol. 14 No. 4.

12) Jiang, Li, L., Lai, B., J., Dai, W. R., Li, X., Liu, W. F., et al. (2017). [Change in peripheral nervous conduction velocity in patients with occupational chronic mercury poisoning and related influencing factors]. Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi 35 (8), 598–602. doi:10.3760/cma.j.issn.1001-9391. 2017.08.011.

13) Giri, A., Bharti, V. K., Kalia, S., Arora, A., Balaje, S. S., & Chaurasia, O. P. (2020). A review on water quality and dairy cattle health: a special emphasis on high-altitude region. the contaminated water. Soil Tillage Res 94(2):503–509.

14) Endale T. D. & Aregay B. G. (2020). Chemical Composition and Heavy Metals Analysis of Raw Cow's Milk. J Environ Anal Toxicol, Volume 10:3.

15) Rodríguez, F.H., S_anchez, A.E. & Rodríguez, S.M. (2005). Metales Pesados en Leche Cruda de Bovino. Rev. Salud Pública Nutr. 6 (4), 137–141.

16) Watanabe T, (2004). Gender-related difference, geographic variation and time trend in dietary cadmium intake in Japan. Sci Total Environ.;329:17–27.

17) Chia S-E, Chan O-Y, Sam C-T, Heng BH.1994. Blood cadmium levels in non-occupationally exposed adult subjects in Singapore. Sci Total Environ.;145:119–23.

18) Castro, J., L_opez de Roma~na, D., Bedregal, P., L_opez de Roma~na, G., Chirinos, D., (2020). Lead and cadmium in maternal blood and placenta in pregnant

women from a mining-smelting zone of Peru and transfer of these metals to their newborns.J. Toxicol. Environ. Health Sci. 5 (8), 156–165.

19) Barakat, M.(2011). New trends in removing heavy metals from industrial wastewater.Arabian Journal of Chemistry, 4(4):361-377.

20) Najim, H. N. and Aziz, R. T. (2012). Evaluation of some Limiting Factors affecting Water chlorination at Baghdad / Al-Kurch District.

21) Mohammed, Z. A.; Hussein, S.M. and Abbas, O.S. (2009). Detection of trihalomethane (chloroform) in drinking water in Baghdad city. Vol.33 No2: Iraqi J. Vet.Med.

22) Mergler, N., Saadati, H., Hassonizade, P., Barati, M., Ahmadi, Z.; Nazari. (2007). Water, Soil &Sediment Laboratory of Khuzestan Water & Authority Department of Toxicology&Pharmacology, Pharmacy School, Ahvaz Jondisha pour, University of medical Sciences.

23) Bakir, S.F. Damluji, L. Amin-Zaki,(1973). Methylmercury poisoning in Iraq, Science 181 230-241.

24) National Research Council, Toxicological Effects of Methylmercury, National Academy Press, Washington, 2000.

25) Mahdii, B,A,. &Turki, A.M.(2020) . Estimating Soil Pollution Range with Heavy Metals in Some Areas of Baghdad City. Medico-legal Update, April-June 2020, Vol. 20, No. 2.

26) Fadhil, S. H.; Abed AL-Kafour, Kh. F. & almehemdi, A. F. (2013). Determination the concentrations of some heavy metals and studying the blood variables for the diesel generators workers blood in ramadi city. Alanbar for science journal (1):7:206-217.

27) Licata, P., Trombetta, D., Cristani, M., Giofre, F., Martino, D., Calo, M., & Naccari, F. (2004). Levels of “toxic” and “essential” metals in samples of bovine milk from various dairy farms in Calabria, Italy. Environment International, 30(1), 1-6.

28) Enb, A., Abou Donia, M. A., Abd-Rabou, N. S., Abou-Arab, A. A. K., & El-Senaity, M. H. (2009). Chemical composition of raw milk and heavy metals behavior during processing of milk products. Global Veterinaria, 3(3), 268-275.