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Determination Of Heavy Metals Concentration In Liver, Meat And Blood Chicken Of Thi-Qar Province, Iraq

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Abstract

Heavy metal contamination poses critical problem for human health because it has the ability to toxicity and bioaccumulation. Chicken is main food in Iraq. In the present study, concentrations of heavy metals (Cadmium (Cd), Lead (Pb), Copper (Cu), and Zinc (Zn)) were determined in Poultry chicken (liver, meat and blood) from some selected areas (markets) in Thi-Qar province, Iraq. The samples were measured by using atomic absorption spectrophotometer. The obtained results declared that concentrations of major studied metals were exceeding than the recommended maximum acceptable levels proposed by FAO/WHO. The highest mean of metals were arranged as: liver product had the values (0.136, 1.388, 2.570 and 31.183) mg/kg, meat (0.120**,** 1.177, 2.303 **,**26.150) µg/g and blood was (0.622 , 0.877**,** 3.370 , and 21.150) µg/g for Cd, Pb, Cu and Zn respectively. Blood has the highest mean of Cd and Cu while meat has the highest mean of Pb.

Keywords: heavy metals, liver, meat, blood chicken

Introduction

Many challenges and problems were threatening the environment especially in the third world countries producing harmful pollution. Increasing of industrial, agricultural and commercial chemicals were the main reasons of pollution which poses a significant health hazard to human beings. Heavy metals contamination due to the rapid development was got a great attention from the scientific investigations. Natural and anthropogenic sources such as industry, and the combustion of fossil fuels in vehicles and energy plants (Sawidis et al., 2011) were the main source of heavy metals in the ecosystem. Furthermore, domestic waste water, application of pesticides, shipping and harbor activities, inorganic fertilizers, mining, and other mining-related processes were elevated heavy metals concentrations (Sankhla et al., 2016: Nadgo´rska-Socha et al.,2013). Trace elements were played essential role in many physiological activities, and both their excess and absence initiate metabolic defects or adverse effect (Badiei et al.,(2006) : Chen et al.,2013). Heavy metals were a serious contaminant problem for human and animal, they had a high capacity to accumulate in food chains (Demirezen and Uruc, 2006). unlike organic contaminants, Heavy metals were persistent and not naturally degradable and their concentration were increased through bio-accumulation (Aksoy, 2008: Sures et al., 2017). Interesting, exposure to

food contaminated by heavy elements lead to accumulation of these element and made a possible subclinical adverse effect(Järup, 2003). Furthermore, low level of some element(As, Pb, Cd, and Cr) were caused clinical signs or diseases (Vinodhini and Narayanan, 2009). so, it is necessary to reduce the risk of heavy metal contamination to product food safety and human health, (Santhi et al., 2008).Since the heavy metals had the ability to contaminate the food and water so, it was vital to evaluate the safe value and analysis the values of chronic intoxications for organism by determining the ratio of metal in milk, urine, blood, liver and kidney (WHO 2006). Basically, there were two kind of heavy metals: first, the biologically essential metals (e.g., Cu, Ni, Zn and Fe) which were transfer to animals and humans through the food chain (Demirezen and Aksoy, 2004) and play important role in biological systems. The second kind was non-biologically essential or toxic metals (e.g., Cd, Pb and Hg) which are toxic even in trace concentrations (Demirezen and Uruc, 2006). Through the food chain, heavy metals were transferred to animals and humans (Abou-Arab, 2001). The most important heavy metals pathways were bioaccumulation and biomagnifications in living organisms which explained pathways of pollutants from one trophic level to another. When the concentration was increased, they were reacted through covalent and ionic bindings with important cellular components, then resulting in damage to cell membrane and alteration of the normal cellular functions. Heavy metal had the ability to alter damaging the DNA structure and the gene code (Bruins et al.,2000). Furthermore, The constant increasing of heavy metals levels in food had led to wide researches on heavy metals sources and bioaccumulation (Mohmand et al.,2015; Rai et al.,2019). Heavy metals had ability to detect in small quantities in the birds and fish. the dangerous that result from heavy metals contamination has a great concern from WHO staff and made a list of proposed acceptable levels of metals contamination in foodstuff. Poultry and their products were a main primary source of protein, energy, minerals vitamins, and minerals due to their nutritious, delicious contents (Bamuwamye et al.,2015). Mostly, increasing of toxic the elements values were produced a great threat for both animals and humans (McCrory et al.,200) The animal products had a good mineral content of animal products is important for healthy human embryonic development (Attia et al., 2016). Therefore, they can use as a bioindicator of pollution by environmental elements (Pappas et al.,2006). Many ways that made poultry exposed to different level of heavy metals poisoning through contaminated poultry feed, sewerage water, industrial effluents and roadside. (Khurshid and Qureshi, 1984). When birds were infected, they were caused a fatal disease to human (Raja et al.,1996). The processing method can also give way to contamination of meat products via the raw materials, spices and water used also during the packaging process (Santhi et al.,2008). chickens can serve as a useful bioindicator species for environmental monitoring (KIM et al.,2010). In Iraq, people are commonly consumed chicken and their product (meat, the heart, kidney and other parts) were a main source of protein. Meat is necessary for growth and maintenance of good health.. Contamination these products by heavy metals was a critical problem facing the human This study is carried out to determine the concentration levels of heavy metals in different part of chicken (liver, meat and blood) Market in Thi-Qar province, Iraq.

Materials and methods

40 of Fresh samples of chicken for four stations were collected from Thi-Qar province markets, Iraq. Al Nassriah (St1), Al-Gharf (St2), Shatrah (St3)and Al-Dawaya (St4)) were the main districts in Thi-qar . Thi Qar province is located in the southern of Iraq . This area constitutes (2.96%) of the total area of Iraq, The area of the study area is 12900 km, and from an administrative purpose of

view, It's climate was hot and humid in summers. Liver, breast muscles and liver were collected to determine he samples were collected in polyethylene bags (All estimations were made in triplicates) bag then identified and transferred in an ice-box to the laboratory for analysis**.** Estimation of heavy metals Estimation of heavy metals by Flame Atomic Absorption Spectrophotometer (FAAS- Phoenix 986 AA United kingdom -UK.). Each samples was wrapped in plastic bag then identified and transferred in an ice-box to the laboratory for evaluation.

Sample were digested by wet digestion method. Each sample was presented into digested solution of nitric acid (1 N, Trace Metal grade HNO3; Fisher Scientific) at 80°C for 4 h. then the volume of supernatant to estimate the concentrations of elements At the end, clear solution with demonized water then measure. The technique used to measure the metals was described earlier by (Playle et al.,1993).

Statistical analysis

Statistical analysis of the study samples was carried out using the Statistical Package for Social Science (SPSS) version 17.0.

Results and Discussion

Heavy metals contamination is the most important risk to human health in Iraq. Food product contamination was amplified with the increasing of environmental pollution. The main sources of heavy metal were fossil fuels industrial wastes, irrigation with effluent water, fertilizers and pesticides (Ping et al.,2014). The mean values ± standard deviation of cadmium, lead, copper, zinc concentrations in four big markets at Thi-Qar proven were estimated. Results in table 1 was showed the concentrations of heavy metals in chickens liver samples of studied station were varied. The mean concentrations of Cadmium (Cd), Lead (Pb), Copper (Cu) and Zinc (Zn)were found to be 0.136-0.039, 0.560-0.139, 2.570-0.505, and 31.183-7.330 mg/kg of dry weight respectively. The mean concentration of Cd was high in St (1) then St (2). While the lowest mean was in St (4). Mean concentration of cadmium (Cd) in liver samples was significantly lower than permissible limit specified by FAO/WHO. The detected concentration of Pb was exceed the permissible limit. For Cu, mean concentrations for all stations were exceeding the permissible limit. The results of present study were exposed that Zn mean concentration of the studied station occurred within the permissible limit. The present study was exposed that the mean concentration of lead and copper elements were high in all studied station with significant difference between them. Interestingly, these mean were higher than the standard permissible levels, Pb was 0.1 mg/kg and cu was 0.4 mg/kg according to FAO/WHO. St (1) has the high mean concentration because it located in the big center of city and there was heavy movement of road traffic. In addition to there were many polluted areas near it. Contaminated industrial area has spread in a high ratio causing throwing away of waste material without recycling process.The mean concentration in present study was higher than the other studied (Aljaff et al., 2014) in Kurdistan. For cd, the present results were less than in Malaysia (0.159 mg/kg) (Abduljaleel et al.,2012) and Iran (0.37 mg/kg) (Sadeghi et al., 2015).The present result for lead was higher than other results reported by many studies from Saudi Arabia (0.14 mg/kg) (Al Bratty et al.,2018), and less than Nigeria (0.171 mg/kg) (Ogbomida et al.,2018; Akan et al.,2010). Lead element can spread through paint, gasoline and contaminated water. Lead toxicity was very hazard for human especially for children and adult causing neuropathy, liver apoptosis, renal toxicity and haemolytic anemia

(Khalafalla et al.,2011). The obtained results are in agreement with that obtained by Zalewski (2003). Copper with suitable ratio is vital element for human health otherwise high ratio intakes formed health problems liver and cause chromosomal mutation fish (Sarkar et al., 1983). copper was concentrated in liver in high ratio comparing with the other organs. The result was higher than (khan,et al., 2015: Sharmeen et al., 2014). It well known that liver was exposed to toxic elements through obtains all the material that entered the gastrointestinal tract so it had the highest concentration of heavy metal.

Table 2 was showed the mean and standard deviation for heavy metals concentration in meat of chicken. The highest mean of Cd was 0.120 while the lowest mean was 0.040. For Pb, the highest mean was 1.177 and the lowest mean was 0.120. The highest mean for Cu was 2.303 while the lowest mean was 0.472. For Zn, the highest mean was 26.150 and the lowest man was 3.663. The mean standard of all studied metals was high in St(1) and low in St(4).The mean concentration for Cd and Zn in meat was within the allowable level while the mean concentration of copper and lead were more than the allowable level. Results of copper element was higher than those by (Ei-Salam et al.,2013) about 2.513 in poultry samples and ((Ersoy et. al., 2015)) in chicken breast samples. There were variation between the studied stations which happened as a result of exposed the chicken to different sources of contamination that varied between the stations. Khan et al., (2012) revealed that metals have been moved via poultry feeds to poultry chickens. copper results were higher other studies (Faten et. al., 2014). Interestingly, the Cadmium concentrations level in meat were depended on the concentrations of Cd in the feed and increased with the age of the animal. Elsharawy ,(2015) stated that cadmium has the capacity to accumulate in the human body and induce kidney dysfunction, hypertension, hepatic injury and lung damage. The reasons behand the rising of heavy metals concentration in meat were the pollution of feed and water for poultry in addition to slaughter and shops places (Ghimpeteanu et al.,2012).

Table 3 was showed the mean concentration of heavy metals in blood chicken samples. The highest mean was 0.622 and lowest mean was 0.025 in for Cd. While the highest mean for Pb was and the lowest mean 0.143 in. The highest mean for Cu was 3.370 while the lowest mean was 0.338. Zn mean concentration was 21.150 and the lowest mean was 3.330. St (1) has higher mean concentration for all studied metals. The results of present study were exposed that St (1) has the highest mean concentration for the fourth studied element and exceed the acceptable levels. St(1) was showed significant difference than other stations. In current study, lead and cadmium had exceed the limited level in blood of chicken especially in St(1) cause this station has the biggest market among the studied stations. It was located in the center of city with high traffic movement, many factories, industrial places and agriculture area that use many types of Chemical fertilizers. The results of present study were exposed that the increasing of heavy metals may result from human activities and generators use which made the main source of air pollution and increase the ratio of heavy metals. Naturally, blood is media that participate in transport of all the nutrients and toxic materials therefore, Burger and Gochfeld (2000) was proposed that 0.4 mg/kg Pb levels in blood resulting adverse physiological effects. Lead is accumulated in the bones, blood then the other organ. Large mount of lead uptake resulting from increasing of free lead in blood (Ersoy etal., 2015)

Table 1. Mean concentrations of trace elements metals in chicken liver samples expressed as in mg/kg (mean ±SD).

Station	Cd		Pb		Cu		Zn	
	Mean	**SD±**	Mean	**SD±**	Mean	**SD±**	Mean	**SD±**
St. 1	0.136[a]	0.015	1.388[a]	0.635	2.570[a]	0.778	31.183[a]	2.008
St. 2	0.100[ab]	0.001	0.560[b]	0.211	1.901[a]	0.192	25.786[a]	4.515
St. 3	0.081[c]	0.025	0.243[b]	0.040	1.937[a]	0.500	29.086[a]	1.727
St. 4	0.039[d]	0.025	0.139[b]	0.062	0.505[b]	0.381	7.330[b]	4.245
Total	**0.089**	**0.040**	**0.582**	**0.587**	**1.728**	**0.900**	**23.346**	**10.275**
LSD	**0.07**		**1.26**		**1.91**		**12.69**	
WHO	**0.3**		**0.10**		**0.4**		**50**	

Table 2. Mean concentrations of trace elements metals in chicken meat samples expressed as in mg/kg (mean ±SD).

Station	Cd		Pb		Cu		Zn	
	Mean	**SD±**	Mean	**SD±**	Mean	**SD±**	Mean	**SD±**
St. 1	0.113[a]	0.010	1.177[a]	0.579	2.303[a]	0.399	26.150[a]	4.203
St. 2	0.120[a]	0.043	0.513[b]	0.119	1.588[b]	0.30	23.120[a]	4.599
St. 3	0.074[ab]	0.021	0.272[b]	0.114	1.223[b]	0.270	24.753[a]	0.585
St. 4	0.040[c]	0.007	0.120[b]	0.046	0.472[c]	0.396	3.663[b]	1.568
Total	**0.086**	**0.039**	**0.520**	**0.494**	**1.396**	**0.750**	**19.421**	**9.956**
LSD	**0.09**		**1.13**		**1.31**		**12.1**	
WHO	**0.3**		**0.10**		**0.4**		**50**	

Table 3. Mean concentrations of trace elements metals in chicken blood samples expressed as in mg/kg (mean ±SD).

Station	Cd		Pb		Cu		Zn	
	Mean	**SD±**	Mean	**SD±**	Mean	**SD±**	Mean	**SD±**
St. 1	0.622[a]	0.460	0.877[a]	0.427	3.370[a]	1.404	21.150[a]	1.224
St. 2	0.056[b]	0.051	0.280[b]	0.163	1.241[b]	0.218	20.120[a]	3.627
St. 3	0.070[b]	0.018	0.175[b]	0.022	1.090[b]	0.121	19.420[a]	1.152
St. 4	0.025[b]	0.015	0.143[b]	0.111	0.338[b]	0.246	3.330[b]	1.846
Total	**0.193**	**0.325**	**0.369**	**0.370**	**1.510**	**1.329**	**16.005**	**7.896**
LSD	**0.87**		**0.88**		**2.72**		**8.29**	
WHO	**0.3**		**0.10**		**0.4**		**50**	

Conclusion

The results of the study established that heavy metals (Cd, Pb, Cu, and Zn, were presence in all the analyzed samples. Generally, liver was found to have the highest significant level of metals and the meat and blood has the lowest levels. When we compared our result concentration of heavy metals in our samples between the studied stations, there were showed a significant difference. The result also showed that the concentration of Cd, Pb, Cu, and Zn were

exceeded the acceptable limits set by FAO/WHO. The concentrations of heavy metals samples were within the acceptance limits in St(4). More governmental efforts are needed to improve the environment quality in Iraq.

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