Determination of heavy metals and selenium content in chicken liver at Erbil city, Iraq

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Abstract

Heavy metal contamination of poultry meat is a critical issue for human health due to associated risks of cytotoxicity and systemic pathologies after ingestion of such metals. A total of twenty chicken liver samples were collected from markets of Erbil city and analyzed for ten heavy metals contents by Inductively Coupled Plasma Optical Emission Spectrometry. The targeted metals were cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), manganese (Mn), nickel (Ni), lead (Pb), mercury (Hg), zinc (Zn) and selenium (Se). The average concentrations (mg/kg) of targeted trace elements were 0.06±0.027, 0.06±0.05, 2.05±0.34, 1.85±0.47, 0.15±0.17, and 33.53±5.24 for Co, Cr, Cu, Mn, Ni, and Zn respectively. Copper (Cu) levels significantly exceeded the maximum permissible limit of WHO. Moreover, the average concentrations of toxic heavy metals and selenium were 0.07±0.037, 0.278±0.10, 0.11±0.083, and 2.01±0.454 mg/kg for Cd, Pb, Hg, and Se respectively. Hg and Pb levels exceeded the permissible limits of WHO. Higher levels of Cu and Hg in poultry may pose a serious threat to consumers which demand countermeasures and precautions to be taken. Iraqi Standards Authority and relevant official institutions are strongly recommended to regulate safe disposal of heavy metal waste in the environment to reduce animal exposure to such metals.

Introduction

Poultry meat and edible offal are important components of human meat meals especially in eastern countries. Chicken meat and edible offal, specially livers, are two of the most commonly consumed poultry products in the Kurdistan Region (Iraq) in various preparations, including fast-food recipes. Liver is the vital organ responsible for metabolism and detoxification of numerous compounds such as therapeutic drugs, chemical toxic compounds, microbial toxins, and heavy metals (Almazroo *et al.,* 2017; Bischoff *et al.,* 2018). Heavy metals are metallic elements mainly found in earth's crust and characterized by high density (greater than 5 $g.cm^{-3}$) in comparison to water (Wang and Shi, 2001).

Certain heavy metals such as copper (Cu), manganese (Mn), nickel (Ni), selenium (Se), chromium (Cr), and zinc (Zn), called micronutrients, are of paramount importance to all organisms in the three domains of life. They play important roles in enzymatic reactions, gene expression regulation (in folding of RNA, ribozymes catalysis, and ribosome functions), and energy metabolism (Draper *et al.,* 2005; Denesyuk and Thirumalai, 2015; Kennelly, 2018). Despite the fact that the aforementioned heavy metals are required at low concentrations, higher concentrations may be toxic to cellular physiology (Kennelly, 2018). Still other heavy metals such as cadmium (Cd), arsenic (As), and lead (Pb) are highly toxic when ingested. They pose a serious threat to cardiovascular system, immune system, fetal cognition development, brain, lungs, kidney, liver, hematopoiesis, and normal cell cycle (Itoh *et al.,* 2014; Jaishankar *et al.,* 2014; Wu *et al.,* 2016).

Industrial revolution and continuous development of agricultural fertilizers have contributed greatly to environmental pollution with high levels of heavy metals. Food chains are not excepted and received a fair share of heavy metal pollutants that accumulate in food chain living components, soil, vegetables, and water (Rai *et al.,* 2019). Human is exposed to heavy metals via consumption of contaminated foodstuff, inhalation of polluted air, and dermal deposition from various sources. The continuous increase in heavy metals levels in food had led to wide investigations on heavy metals sources, bioaccumulation, and potential risks to human health (Mohmand *et al.,* 2015; Rai *et al.,* 2019). Published literature indicate a good correlation between heavy metals contents in animal feed and bioaccumulation level in various meats (Al Bratty *et al.,* 2018; Kim and Koo, 2007; Wu *et al.,* 2016). Frequent consumption of meat harboring high levels of heavy metals can result in accumulation of ingested metals in human tissues leading to toxicity and health hazards. Such implications of heavy metals in health hazards demanded World Health Organization (WHO), The European Food Safety Authority (EFSA), and many other regulatory authorities to set permissible limits for heavy metals in food.

Heavy metals contamination of different chicken tissues has been addressed in various published reports globally (Al Bratty *et al.,* 2018; Bortey-Sam *et al.,* 2015; Caldas *et al.,* 2016; Hadyait *et al.,* 2018; Khandia *et al.,* 2015; Nazmul Haque *et al.,* 2019). To the best of our knowledge, there is no previous study addressing the occurrence levels of heavy metals in chicken meat marketed in Erbil city. Therefore, the main objective of this study was to assess the level of some toxic heavy metals and selenium in different collected samples of chicken's liver available in markets of Erbil city.

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Materials and Methods

Samples and reagents

All chemicals used in this study were purchased from Scharlau, Spain. The reagents were of analytical reagent grade quality including 50% (v/v) hydrogen peroxide (H_2O_2) and 65% (v/v) nitric acid (HNO_3). Twenty frozen and fresh chicken liver samples were collected from popular local markets and chicken suppliers in Erbil city (Iraq) during Jun-July 2019. Samples characteristics are summarized in Table 1. Liver samples were cleaned with distilled water, labeled, and stored in polypropylene and preserved in the refrigerator until chemical analysis.

Preparation and digestion of the samples

Metal analysis was performed according to previously published method (Sadeghi *et al.*, 2015). Briefly, liver sample was individually chopped, homogenized thoroughly using stainless steel knife and dried in an oven at 100°C for 12h till constant weights were obtained. Dried samples were pulverized and homogenized by mortar. A weight of 0.70 g was placed into a digestion conical flask containing 5 mL of HNO_3 (65%). The samples were left for acid digestion process using a classic digestion-heater at 150°C for 20 minutes. After cooling, 3 ml of H_2O_2 (50%) were added to complete digestion process to each digestion flask. After completing digestion, each solution was cooled at room temperature and filtered into a flask and the volume was brought to 25 mL with deionized water. Finally, solutions were stored in appropriate plastic bottles for the investigation. The digestion procedures were individually repeated three times for each sample.

Metal analysis

Inductively Coupled Plasma Optical Emission Spectrometry (Spectro, Germany) was employed for the elemental analysis of digestion solutions. The contents of cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), manganese (Mn), nickel (Ni), lead (Pb), mercury (Hg), zinc (Zn) heavy metals and selenium (Se) were determined in all of the digested samples according to standardized procedures (Sadeghi *et al.*, 2015; Deng *et al.*, 2007). Finally, the estimated concentrations were measured in $\mu g \cdot mL^{-1}$ (parts per million) and then converted to $\mu g \cdot g^{-1}$ after using dilution factor (Sadeghi *et al.*, 2015; Deng *et al.*, 2007). Average concentrations were compared to permissible limits set by Codex Alimentarius Commission (FAO/WHO, 2011; CAC, 2019). Limits of detection was calculated according to the following equation;

$$LOD = 3\ RSDb \frac{C}{SBR}$$

where RSDb is the relative standard deviation of 10 replicates of the blank, c is the concentration of the standard, and SBR is the signal to background ratio. Limits of detection and wavelength for each element are in Table 2. All relevant ICP operating parameters were software controlled, allowing easy selection of the optimum operating conditions according to manufacture instructions (https://extranet.spectro.com/-/media/31793ADA-B987-4D37-B597-04AFB66C7C22.pdf). The accuracy and precision of the method was investigated by analyzing the standard reference material SRM 1640 (Trace Elements in Natural Water). The measured value and the certified values were in excellent agreement for all elements.

Statistical analysis

All data were analyzed in version 21 of IBM SPSS package. One-sample t test was employed to test for heavy metal load difference between samples items and comparison of concentration means to the maximum permissible limits. One-way ANOVA analysis was performed to meta-analyze the difference of reported heavy metal levels in studies from Iraqi and other countries. Significance level was set to 0.05.

Results

A total of twenty chicken liver samples were selected randomly and collected from supermarkets in Erbil city and local chicken supplies. Five liver samples were drawn from frozen chicken (CL 1-5) and the remaining samples were obtained from chicken slaughterhouses (CL 6-20). The details of collected samples and their origin are presented in Table 1. The average weight of liver samples was 68.7 ± 36 g.

Total load of heavy metals

The mean concentrations of detected heavy metals are depicted graphically in Figure 1. The average content of heavy

Table 1. Characteristics of collected chicken liver samples.

Sample	Brand/type	Sample status	Sample origin (City)	Weight (g)
1	Al Shemal	Frozen	Local (Erbil)	60.1
2	Al Etimad	Frozen	Local (Erbil)	62
3	Dorsa Morgh	Frozen	Imported (Iran)	52.2
4	Dondurulmu Piliç Ci er	Frozen	Imported (Turkey)	52.7
5	Time Food	Frozen	Imported (UAE)	55
6	Broiler	Alive	Local (Erbil)	57
7	Broiler	Alive	Local (Erbil)	60
8	Broiler	Alive	Local (Erbil)	67
9	Broiler	Alive	Local (Duhok)	62
10	Broiler	Alive	Local (Duhok)	70
11	Broiler	Alive	Local (Duhok)	102
12	Golden Comet	Alive	Local (Erbil)	34
13	Golden Comet	Alive	Local (Erbil)	38
14	Golden Comet	Alive	Local (Erbil)	40
15	Country Chicken	Alive	Local (Erbil)	35
16	Country Chicken	Alive	Local (Erbil)	39
17	Country Chicken	Alive	Local (Erbil)	42
18	Parent Broiler	Alive	Local (Erbil)	110
19	Parent Broiler	Alive	Local (Erbil)	126
20	Parent Broiler	Alive	Local (Erbil)	155

UAE; United Arab Emirates.

metals in chicken livers ranged from 1.98 to 8.98 mg/kg of dry weight. There is a significant difference between samples in terms of average heavy metal load ($p<0.001$). Poor association has been found between liver weight and total heavy metal load ($r^2=0.1795$).

Trace elements metals

The details of trace elements metals detected in chicken liver samples are summarized in Table 3. Nickel was detected in only 40% (8/20) of samples, while chromium was found in 55% (11/20) of samples. Other trace element metals (Co, Cu, Mn, and Zn) were detected in all samples. Of note, the means of Co, Cr, Ni, and Zn did not exceed the permissible limit specified by WHO/FAO (Table 3). Indeed, the mean concentrations of these elements were significantly lower than maximum permissible limits of WHO. About 15% of samples exceeded the permissible limit of Zn, while all samples significantly exceeded the permissible limit of Cu ($p<0.001$).

Toxic heavy metals, metalloids and Selenium

The mean concentrations of toxic heavy metals are summarized in Table 4. Mean concentration of cadmium (Cd) in liver samples was significantly lower than permissible limit specified by WHO (t_c=-27.745, $p<0.0001$). Additionally, average of

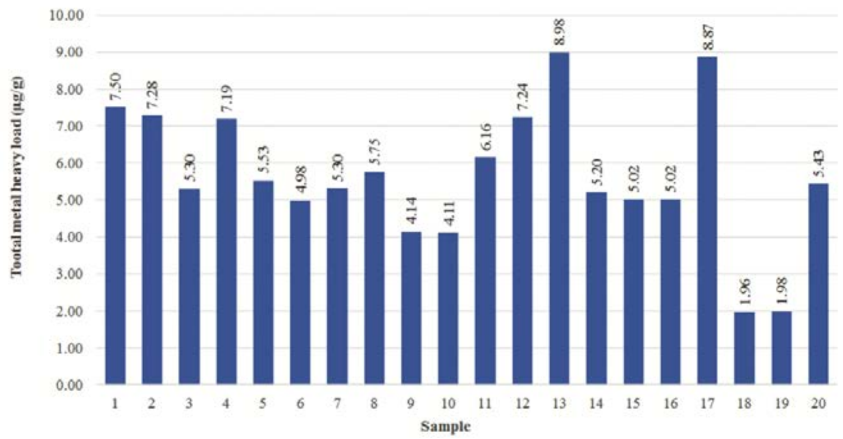

Figure 1. The means of total heavy metals concentration in chicken liver samples.

Table 2. Limits of detection (LOD) for the selected wavelengths (lines) for some elements.

Element	Wavelength (nm)	LOD 3σ (µg/L)
Co	228.615	0.654
Cr	267.716	0.67
Cu	324.754	1.1
Mn	257.610	0.08
Ni	231.604	0.95
Zn	213.856	0.2
Cd	214.438	0.333
Pb	220.351	3.44
Hg	184.950	1.1
Se	196.090	6.8

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

Sample	Co	Cr	Cu	Mn	Ni	Zn
1	0.074 ± 0.011	0.121	2.61 ± 0.51	2.14 ± 0.23	ND	45.07 ± 18.55
2	0.044 ± 0.034	0.042	3.37 ± 0.65	2.03 ± 0.45	0.004	50.22 ± 8.88
3	0.084 ± 0.033	0.101 ± 0.035	2.18 ± 0.12	1.94 ± 0.16	ND	30.69 ± 7.58
4	0.035 ± 0.014	0.054	1.56 ± 0.24	1.47 ± 0.82	0.019	52.26 ± 7.00
5	0.072 ± 0.017	0.051	2.51 ± 0.40	2.49 ± 0.23	ND	31.18 ± 3.19
6	0.066 ± 0.011	0.035 ± 0.033	2.32 ± 0.59	2.30 ± 0.47	ND	28.29 ± 6.44
7	0.061 ± 0.024	0.047	2.48 ± 0.51	2.16 ± 0.86	0.222	40.60 ± 8.34
8	0.061 ± 0.037	ND	2.21 ± 0.20	2.95 ± 0.56	ND	26.35 ± 3.86
9	0.069 ± 0.022	0.024 ± 0.028	1.97 ± 0.15	2.08 ± 0.14	0.328	22.38 ± 3.07
10	0.047 ± 0.015	ND	1.50 ± 0.37	1.79 ± 0.92	ND	19.28 ± 11.00
11	0.061 ± 0.055	ND	2.21 ± 0.19	2.16 ± 0.27	0.211	42.16 ± 6.57
12	0.069 ± 0.044	0.032 ± 0.053	2.60 ± 0.64	2.24 ± 0.45	0.267	49.89 ± 6.77
13	0.060 ± 0.013	0.128	2.40 ± 0.59	2.37 ± 0.22	ND	54.86 ± 1.48
14	0.068 ± 0.013	ND	2.06 ± 0.98	2.29 ± 0.82	ND	24.10 ± 11.06
15	0.083 ± 0.011	ND	1.16 ± 0.13	1.23 ± 0.90	ND	25.96 ± 2.03
16	0.073 ± 0.046	ND	1.04 ± 0.10	1.18 ± 0.60	ND	26.10 ± 2.90
17	0.039 ± 0.019	ND	1.86 ± 0.23	1.64 ± 0.37	ND	46.38 ± 8.14
18	0.039 ± 0.011	0.073 ± 0.015	1.53 ± 0.02	0.968 ± 0.075	0.092	12.15 ± 0.65
19	0.076 ± 0.077	ND	1.53 ± 0.31	0.807 ± 0.172	ND	8.60 ± 2.68
20	0.034 ± 0.028	ND	1.95 ± 0.19	0.849 ± 0.071	0.039	34.03 ± 3.84
Mean	0.06 ± 0.027*	0.06 ± 0.05*	2.05 ± 0.34**	1.85 ± 0.47	0.15 ± 0.17*	33.53 ± 5.24*
WHO PL	1.0	1.0	0.4	NS	0.5	50

*Significantly lower than maximum permissible limit ($p<0.001$), **significantly higher than maximum permissible limit ($p<0.001$). PL: Permissible limit, ND: Not detected, NS: not specified yet.

lead (Pb) concentration significantly exceeded the permissible limit (t_c=7.954, p<0.001). On the contrary, about 45% of samples exceeded the permissible limit set by WHO for mercury. The average of Hg in samples exceeded the limit was 0.11 mg.kg^{-1} which was significantly higher than the limit (p=0.0281).

Meta-analysis

Locational variations between studies in terms of heavy metals in chicken liver samples were analyzed. Findings of previous studies from Iraq and other countries were analyzed with our findings. Meta-analysis showed no significant difference between locations of analyzed previous reports (Table 5) in terms of trace elements contents (p=0.489, F_c=0.84). The variations between locations in terms of toxic heavy metals and metalloids are summarized in Table 5. No ANOVA test was done for these metals due to lack of data, especially pertaining to Hg levels.

Table 4. Concentrations of toxic heavy metals in chicken liver samples expressed as mean ± SD (mg.Kg^{-1}).

Sample	Cd	Pb	Hg	Se
1	ND	ND	0.152 ± 0.118	2.35 ± 0.24
2	ND	ND	0.286	2.21 ± 0.58
3	ND	ND	0.099 ± 0.091	2.02 ± 0.79
4	0.006 ± 0.01	ND	0.134 ± 0.116	1.97 ± 0.45
5	ND	0.176	ND	2.23 ± 0.50
6	ND	ND	0.083 ± 0.082	1.78 ± 0.45
7	ND	0.329	0.138	1.70 ± 0.90
8	ND	ND	0.103 ± 0.042	2.85 ± 0.10
9	ND	ND	ND	2.14 ± 0.41
10	0.034 ± 0.059	ND	0.007	2.03 ± 1.01
11	ND	0.216	0.123 ± 0.149	2.10 ± 0.57
12	0.115 ± 0.078	0.394	ND	2.41 ± 0.70
13	0.150 ± 0.088	ND	0.075	2.95 ± 0.15
14	0.079 ± 0.015	ND	0.043 ± 0.02	2.61 ± 0.62
15	0.064 ± 0.010	ND	0.113 ± 0.058	1.56 ± 0.12
16	0.054 ± 0.027	ND	0.170	1.56 ± 0.22
17	ND	ND	0.048 ± 0.013	3.27 ± 0.80
18	0.029 ± 0.006	ND	0.130 ± 0.106	0.708 ± 0.082
19	ND	ND	0.080	0.763 ± 0.282
20	ND	ND	0.100	0.975 ± 0.357
Mean ± SD	**0.07 ± 0.037***	**0.278 ± 0.100****	**0.11 ± 0.083****	**2.01 ± 0.454**
WHO PL	**0.3**	**0.10**	**0.1**	**NS**

*significantly lower than maximum permissible limit (p<0.001). **significantly higher than maximum permissible limit (p<0.001). PL: permissible limit. ND: not detected

Discussion

Presence of heavy metals in meats is a public hazard due to the cytotoxicity of such metals and disruption of normal cellular processes. Poultry meat and edible offal are not excepted and are known to associate with risks to consumers including humans. This study evaluated the concentrations of heavy metals (trace elements and toxic metals and metalloids) in chicken liver samples collected from Erbil city, Kurdistan Region, Iraq.

The detected concentration of Co and Cu were 0.06±0.027mg/kg and 2.05±0.344 mg/kg respectively. These concentrations are more than ten-fold higher than reported in previous study in Sulaimani city, Kurdistan (0.006 & 0.158 mg/kg) (Aljaff *et al.*, 2014). The mean of Co in this study (Table 3) was below the maximum permissible limit in poultry (1.0 mg/kg) set by Codex Alimentarius Commission (CAC, 2019; FAO/WHO, 2011). However, higher levels of Cu were reported from Pakistan (1.49 mg/kg) and (1.60 mg/kg) (Hadyait *et al.*, 2018; Khan *et al.,* 2015), Saudi Arabia (1.28 mg/kg) (Al Bratty *et al.,* 2018), Bangladesh (4.37 mg/kg) (Mottalib *et al.,* 2018), and Turkey (10.82 mg/kg) (Duman *et al.,* 2019). These metals are essential micronutrients but are toxic at high level and can reach the foodstuff during food processing, agricultural activities, metals-contaminated

Table 5. Location variations between studies in terms of trace elements contents in chicken liver samples (g g^{-1}).

Location (Reference) Trace element	Co	Cr	Cu	Mn	Ni	Zn
Erbil, Iraq (This study)	0.06+0.03	0.06±0.05	2.05±0.34	1.85±0.47	0.15±0.17	33.53±524
Sulaimani, Iraq (Aljaff *et al.*, 2014)	0.006±0.0	0.087±0.0	0.16±0.0	0.09±0.0	0.09±0.0	1.34±0.0
Selangor, Malaysia (Abduljaleel *et al.,* 2012)	0.27±0.12	5.13+0.69	9.67±1.60	7.11±1.77	1.91±0.96	78.86±21.45
Benin, Nigeria (Ogbomida *et al.*, 2018)	0.05+0.03	0.08±0.05	4.36±1.02	3.61±1.20	0.02+0.01	43.36±13.08
Toxic metals	**Cd**	**Hg**	**Pb**	**Se**		
Erbil, Iraq (This study)	0.07±0.04	0.11+0.08	0.28±0.10	2.01+0.45		
Diyala, Iraq (Al-Zuhairi *et al.*, 2015)	0.095+0.0	NT	0.095±0.0	NT		
Basrah Iraq (Hussein *et al.*, 2012)	0.04+0.03	NT	1.29±1.09	NT		
Jazan, Saudi Arabia (AL Bratty *et al.,* 2018)	0.01+0.003	NT	0.14+0.04	NT		
Mashhad, Iran (Sadeghi *et al.*, 2015)	0.37±0.09	NT	3.79±3.64	NT		
Selangor, Malaysia (Abduljaleel *et al.*, 2012)	0.16±0.11	NT	0.35+0.18	2.01±0.60		
Benin, Nigeria (Ogbomida *et al.*, 2018)	0.29±0.34	0.034+0.036	0.17±0.19	NT		

NT: not tested.

chicken feed (Agade *et al.,* 2019; Gall *et al.,* 2015).

No permissible limit for Mn has been published by FAO/WHO or European Food Safety Agency. The average concentrations of Zn and Mn found in the present work are higher than previously published in Iraqi studies analyzed chicken meat samples including liver samples in Sulaimani and Diyala cities (Table 5) (Aljaff *et al.,* 2014; Al-Zuhairi *et al.,* 2015). However, the detected level of Ni in this study (0.15 mg/kg) was lower than the levels reported by the aforementioned Iraqi study in Diyala (0.414 mg/kg). No detectable level of Ni was also reported from Saudi Arabia (Al Bratty *et al.,* 2018). Nonetheless, high concentrations of Mn in chicken liver samples were reported from Pakistan (6.26 mg/kg) (Khan *et al.*, 2015), Turkey (9.45 mg/kg) (Duman *et al.,* 2019) and as high as 119 mg/kg (Yayayürük & Yayayürük, 2017). Lower levels of zinc were also reported from chicken liver samples analyzed in Saudi Arabia (20.72 mg/kg) (Al Bratty *et al.,* 2018), Sulaimani city (Aljaff *et al.,* 2014). On the contrary, higher concentrations were documented in Turkey (100.87 mg/kg) (Duman *et al.,* 2019). The detected level of Cr found in this study (0.06 mg/kg) was lower than WHO maximum limit but significantly higher concentration was recently reported from Bangladesh (6.368 mg/kg) (Mottalib *et al.,* 2018).

The average level of Cd observed in this study is lower than reported in previous studies conducted in Iraq (0.095 mg/kg) (Al-Zuhairi *et al.,* 2015), Malaysia (0.159 mg/kg) (Abduljaleel *et al.,* 2012), Nigeria (0.29 mg/kg) (Ogbomida *et al.,* 2018), and Iran (0.37 mg/kg) (Sadeghi *et al.,* 2015). One the other hand, higher contents that exceeded the permissible limit of FAO/WHO (0.3 mg/kg) have recently been reported from Bangladesh (0.627 mg/kg) (Mottalib *et al.,* 2018). It's well-known that cadmium not only has no function in human body but also has a toxicity even at low levels due to its low excretion rate (Wu *et al.,* 2016). Poultry can be exposed to Cd simply by contact with paints, electronic wastes, plastics, and cadmium-plated items and batteries (Rashid *et al.,* 2013). Cadmium exposure is implicated in hepatotoxicity, respiratory diseases, and cancers of lung, kidney, and prostate (Rahimzadeh *et al.,* 2017).

Exposure to organic mercury is linked to sever neurotoxicity in humans (Spiller, 2018). Detected concentrations of mercury exceeded the permissible limit set by FAO/WHO was in 40% of samples. The mean concentration of Hg in the present work was 0.11 ± 0.08 mg/kg. This level is three-fold higher than reported in a recent study in Nigeria (Ogbomida *et al.,* 2018). On the contrary, a higher level (0.252 mg/kg) was reported in chicken liver samples collected from markets in Izmir city in Turkey (Yayayürük & Yayayürük, 2017). It should be noted that literature regarding Hg levels in poultry is scarce.

Lead in chicken liver samples was (0.28 mg/kg) two-fold higher than permissible limit of Codex Alimentarius Commission (0.1 mg/kg). This finding is even higher than reported by many reports from Saudi Arabia (0.14 mg/kg) (Al Bratty *et al.,* 2018), and Nigeria (0.171 mg/kg) (Ogbomida *et al.,* 2018). A worth mentioning point is that lead toxicity is mainly affecting hematopoiesis, kidney function, reproductive and central nervous systems (Assi *et al.,* 2016).

Average selenium level found in this study is 2.01 mg/kg which is significantly greater than documented (0.0174 mg/kg) in previous study in Sulaimani city (Aljaff *et al.,* 2014). However, a similar level of selenium was found in a Malaysian study (Abduljaleel *et al.*, 2012). Till date, there is no permissible limit for selenium set by Codex Alimentarius Commission (WHO/FAO) or European commission. It was recently found that selenium assist mercury in its cellular toxicity by giving up its binding pockets in thioredoxin reductases and glutathione peroxidases enzymes to mercury. Mercury binding instead of selenium results in permanent inactivation of such enzymes (Spiller, 2018).

Conclusions

Trace elements metals of Co, Mn, Ni, Zn, and Cr in chicken liver samples collected from markets in Erbil city, Kurdistan (Iraq) did not exceeded the permissible limits of FAO/WHO. Likewise, average concentration of toxic heavy metals and metalloids did not exceed the maximum limits specified by WHO. However, Cu, Pb, and the heavy metalloid Hg exceeded the permissible limits in poultry set by WHO. These findings reflect the quality and safety of chicken meat sold in the markets. Iraqi Standards Authority is strongly advised to take precautions to lower the risks of poultry exposure to Hg and Pb. Further investigations with larger sample size accompanied by risk assessment of heavy metal exposure in chicken is guaranteed to reveal a clearer picture of heavy metals in chicken meat in Erbil city.

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