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Determination of Heavy Metals Concentrations in Local and Imported Chicken Meat Found in Hilla Province Markets

Dhurgham A. A. Al-Sultany[1*], Ali K. Al-Muttarii[2], Jassim M. Salman[3]

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ABSTRACT

This study was carried out in Hilla province, the chicken samples were collected of both local and imported chicken, the concentration of eight heavy metals (iron, copper, zinc, nickel, manganese, cadmium, lead and chromium) were measured in all samples in order to find if the concentrations of these metals were within or exceeded the permissible limit, The samples were analysis by used the Atomic Absorption spectrophotometer. The result show that for iron, copper, Zinc, nickel, manganese, cadmium, lead and chromium the concentrations were ranged from 70.66 - 81.33 ppm, 0.34 - 0.71 ppm, 6.06 - 8.21 ppm , 6.13 - 8.02 ppm, 0.213- 0.51ppm, 0.276 - 0.833 ppm, 0.733 -1.39 ppm and 0.37 - 0.716 ppm respictively . Generally, the highest heavy metal concentration was recorded in Iraqi house breading chicken. While the lowest concentrations of almost all measured heavy metal in Iraqi Farm breed in chickens.

INTRODUCTION

Heavy metals can reach humans through diet and, different industrial products. The heavy metals can be categorized into crucial such as iron, manganese, zinc copper and selenium which are only toxic if they exceeded the need of the body for that metal and the second category are toxic when exposed to any concentration metal, including lead, mercury, cadmium. The most apparent route of exposure to these metals would be through the food, since the metals are found in food naturally or due to food processing (Okoye, et.al.,2011 and Benouadah, et.al.,2015).

Chicken is a great source of protein, amino acid as well as vitamin in both of its meat and eggs, as compared to beef and due to its low price it is considered source of high quality animal protein, The poultry may have heavy metals and may deliver these to human through food (Elsharawy, et.al.,2015). Many studied worldwide have mentioned the increasing of contaminates in the tissues and meat of chicken (Hassanin, *et al.*, 2014, Mahmoud, *et al.*, 2015 and Ogu, *et al.*, 2018).

This study is an attempt to estimate concentration of heavy metals in comparison with FDA stander for heavy metals. in Iraqi and imported chicken meat found in the supermarkets of Hilla province.

MATERIALS AND METHODS

Samples Collections

In this study eight metals (Fe,Cu, Zn, Ni, Mn, Cd, Pb and Cr) in chicken were collected from local markets September 2014 to September 2015 from six sources [Iraq (house and farm breading), turkey, KSA, Iran and brazil] as follow.

Experimental Work

Digestion and extraction of heavy metals from chicken was carried according to (R.O.P.M.E.1982). After separation of the bones from the muscles chicken meat was cut and mixed and then dried in the oven at $70C^0$. the dried tissues were grinded to fine particles and passed through 0.5 sieve. One gram of the sieved sample was transferred to digestion tube and mixed with 10ml of mixture of concentrated HNO3 and HCIO4 with the percentage of 4:1. The tubes then kept in the shaker for 64 hr. for well mixing. The sample the transfer to a hot plate for evaporation for 32 hr. And samples were transferred to Teflon tubes with acid and deionized water. The samples then was placed on the hot plate for evaporation at 70-$80C^0$ till they became near dried. The resulted sample were diluted in nitric acid (0.5%) and kept for analysis with the Atomic Absorption spectrophotometer. The concentrations of the heavy metals were found using the following equation:

Econ.=(A*B*df)/D

Where:

Econ. Is the metal concentration in the sample (mg/gm dry weight)?

A is the metal concentration resulted from the calibration curve (mg/L)

B is the sample size

df is the dilution factor

D dry sample weight

RESULTS AND DISCUSSION

There was high concentration of iron in all measured samples, the lowest was in Iraqi farm breading chicken with 70.6 ppm and the highest was Iraqi house breading chicken with 81.3 ppm (Fig. 1). Iron is important for all life form. iron is essential element in some enzymes and hemoglobin and DNA synthesis. The iron increase can cause siderosis, while low concentration of iron can cause

[1] College of Sciences, Al-Qasim Green University, Babylon 51013, Iraq
[2] Environmental Studies and Research Center, University of Babylon, Iraq
[3] College of Science, University of Babylon, Iraq
[*] Corresponding author's e-mail: dhurgham-ali@science.uoqasim.edu.iq

anemia (Food and Nutrition Board, Institute of Medicine. 2001and Khan, et.al., 2016). The high concentration meat of chicken could be due to high concentration of iron in their food, or it could be due to high concentration of iron in fertilizers added to the soil to increase crop that is used for feeding chicken (Khan, et.al., 2016 ; Yayayürük, and Yayayürük, 2017).

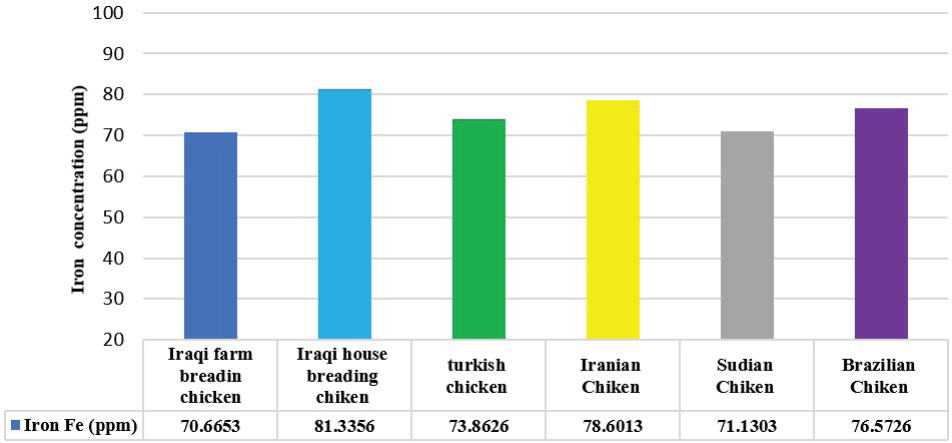

Figure 1: Concentration of iron in different samples of chicken

Copper (Cu) is needed by organisms for variety of metabolic processes and enzymes such as bone formation and keeping the integrity of connective tissues. Acting as cofactor in oxidative stress associated enzymatic activities and in hemoglobin construction and many other important processes. But on the other hand, high dose or intake of Cu can cause many liver and kidney malfunctions (Abduljaleel, 2016 and Ogu, et.al.,2018). Copper concentration measured in this study was ranged from 0.34 in Iraqi farm breading chicken to 0.71 in house breading chicken the result show that the following sequence in the concentration of Cu Iraqi farm breading chicken< Sudian and Brazilian chicken > Turkish chicken > Iranian chicken > Iraqi house breading chicken as illustrated in (Fig. 2). All the sample did not exceed the Egyptian Organization for Standardization and Quality Control (EOS. No. 7136, 2010) which was15.0 µg/g for meat and edible parts (Elsharawy, 2015). And the Australia New Zealand Food Authority which set a limit of 200 ppm (Okoye, et.al., 2011). But according to WHO limit which was 0.4 mg/kg all of Iraqi house breading, Turkish and Iranian chicken were all exceeding that limit(Mottalib,et.al.,2018). the results obtain from this study was highly below the results obtain by (Okoye, et.al., 2011). which found that Cu concentrations ranged from 15.82 up to 47.79 ug/g. While (Iwegbue, et.al.,2008) found that the mean copper concentrations were 0.01 to 5.15 mg/kg-1 in the chicken meat.

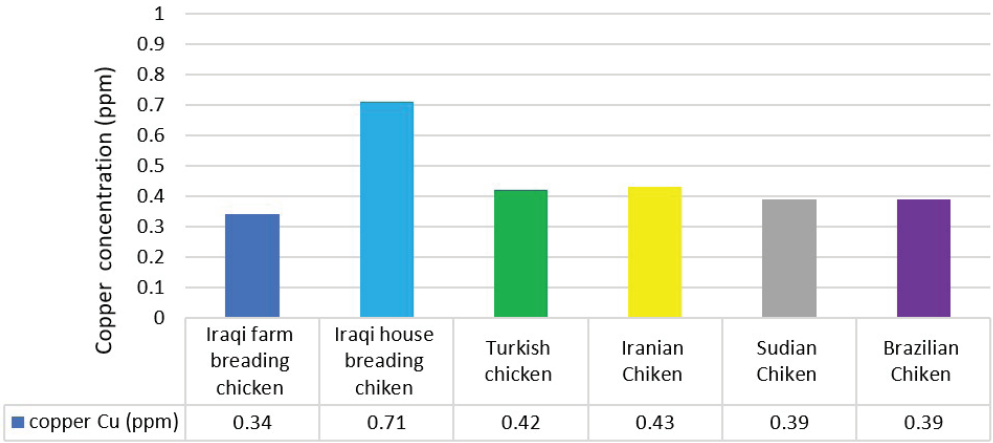

Figure 2: Concentration of copper in different samples of chicken

The concentrations of Zn are illustrated in (Fig. 3). The lowest Zn concentration was recorded in Turkish chicken which contain 6.3 ppm, while the highest concentration of Zn which was 8.21 ppm was recorded in Iraqi house breading Chicken. The concentrations of Zn measured in all samples were below the permissible limit of Zn Set by FAO/WHO of 20 ppm and the limit set by The Commission of the European Communities of 20 ppm as well as way below the limit set by Ministry of Health of the People's Republic of China of 100 ppm (Zhuang, et.al., 2014). Zinc is a vital element in the process of protein synthesis as well as participate inmetalloenzymes.

Zinc is crucial for sustaining growth, reproductive, structural integrity in proteins and in maintaining a strong immune system. zinc deficiency can cause retarded growth, affect the development of bones in chicks, highly depressing immune systemincrease infections, it is estimated that animal meat is responsible for more than 70% of zinc consumed (Salim, et.al.,2008; Soriano-Santos, 2010 and Khan, et.al., 2016). The cause of Zn deficiency can be attributed to low concentration of Zn in soil or water provided for the chickens (Khan, et.al., 2016). The results of this study are harmonized with the findings of (Muhammad, et.al., 2017) which found that the Zn level were below permissible limit in the internal organs of the chicken.

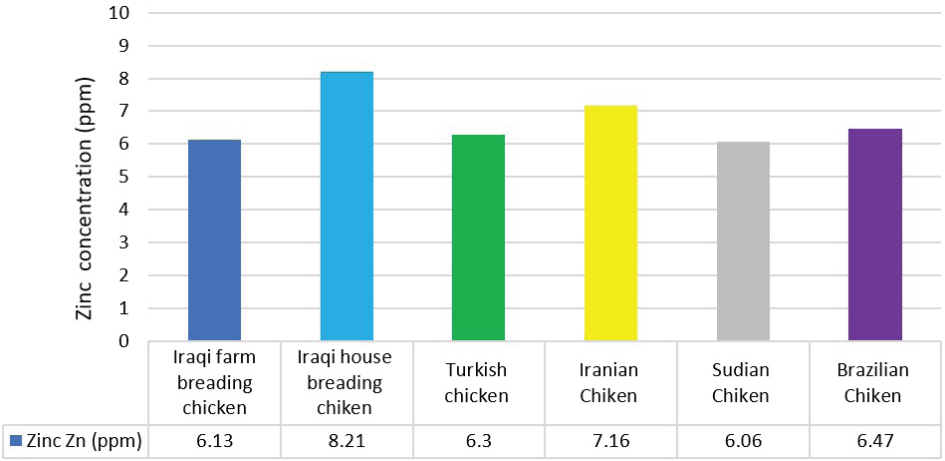

Figure 3: Concentration of Zinc in different samples of chicken

The results of this study show that the Nickel (Ni) concentrations measured in the chicken samples ranged from 6.3 ppm in Brazilian Chicken and the highest was recorded in Iraqi house breeding chicken with the following order: Brazilian chicken > Sudian chicken > Turkish chicken > Iranian chicken > Iraqi farm breading chicken as shown in (Fig. 4). According tothe Egyptian Organization for Standardization which suggested 4.1 ±2.8µg/g dry weight (Mahmoud and Abdel-Mohsein, 2015), the Brazilian and Sudian chicken while the Turkish chicken reach the highestlimit, on the other hand all of Iraqi house and farm breading and Iranian chicken exceed this limit. All the tested samples were exceeding the WHO limit of 0.5 ppm (Reddy, et.al.,2017). The reason for high level of Ni could be due crops polluted with effluent from electroplating plants, battery manufacturing and oil (Imran, et.al., 2015).

Nickel can be toxic at high dosages to both human and animals. It can introduce to the environment through various activities such as waste incineration fuel combustion. Ni at high concentration may cause respiratory problem and cancers, while the low level of Ni can cause dizziness, asthma and chronic bronchitis, skin rashes as well as birth defects (Imran, et.al., 2015 ; Reddy, et.al.,2017 and Al Bratty, et.al., 2018). The results of this study agree with findings of (Iwegbue, et.al. 2008) which found that the concentrations of Ni range from 1.2- 9.02 ppm.

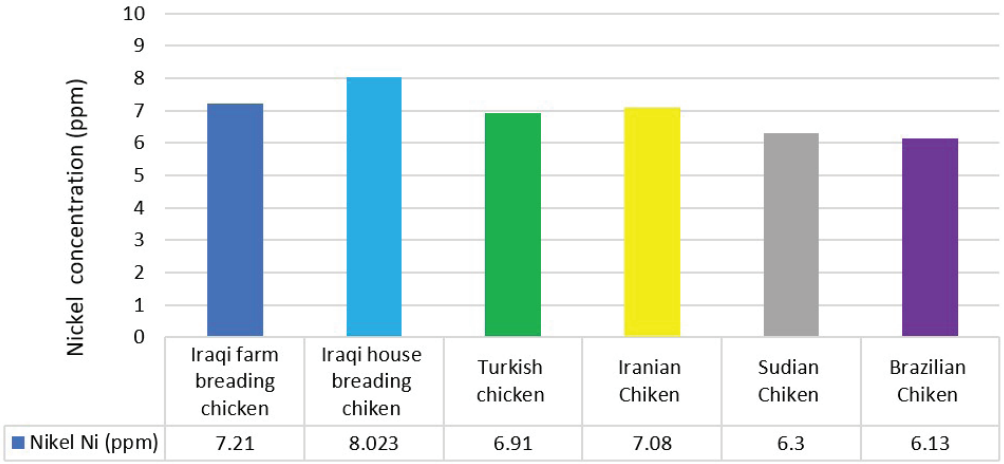

Figure 4: Concentration of nickel in different samples of chicken

The findings of this study state that the manganese concentration in the sample collected from the Hilla province supermarkets ranged from 0.213 ppm in Iraqi farm breading chicken to 0.51 ppm in Iraqi house breading chicken in the following order Iraqi farm breading chicken > Sudian chicken > (Turkish chicken, Brazilian chicken and Iranian chicken) > Iraqi house breading chicken .all samples were below the permissible limit of WHO of 0.5 ppm for Mn (FAO/WHO. 2000), except Iraqi house breading chicken which exceed this limit. The concentration of manganese that accumulate in the chicken depend on the manganese concentration in the food of the chicken(Khan, et.al., 2016). Wei, et.al., 2016 found that Mn concentration ranged from 0.129 µg/kg in breast meat to 0.23 µg/kg in leg meat which was similar the concentration found in this study for Iraqi farm breading, Sudian chicken while for Turkish, Iranian, Brazilian were little higher, on the other hand Iraqi house breading were much higher.

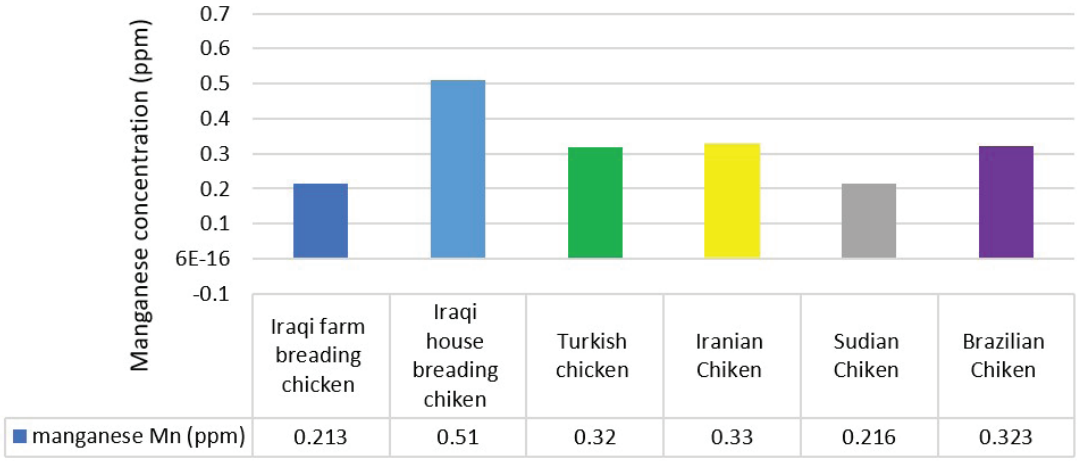

Figure 5: Concentration of manganese in different samples of chicken

The concentrations of cadmium measured in this study are illustrated in (Fig. 6). The lowest Cd concentration recoded was 0.276 ppm in Iraqi farm breading chicken, while the highest was recorded in Iraqi house breading with 0.833 ppm of cadmium. The concentration of Cd in the samples was in the following order Iraqi farm breading chicken > Turkish Chicken > Brazilian chicken > Sudian chicken > Iranian chicken > Iraqi house breading chicken. Only Iranian and Iraqi house breading chicken were above the acceptable limit set by FAO/WHO which was 0.5 ppm (FAO/WHO. 2000). accumulation of Cd in the body of human been can cause several disease and damages such as effecting the kidney function damage to the bones as wellas affecting the reproduction ability(Wei, et.al., 2016). the results of this study were much higherthan the results found by (Abduljaleel, et.al., 2012 and Dhurgham, et.al., 2019) which found that Cadmium concentration were ranged from 0.15 µg g-1 to 0.23 µg g-1 in the chicken internal tissues.

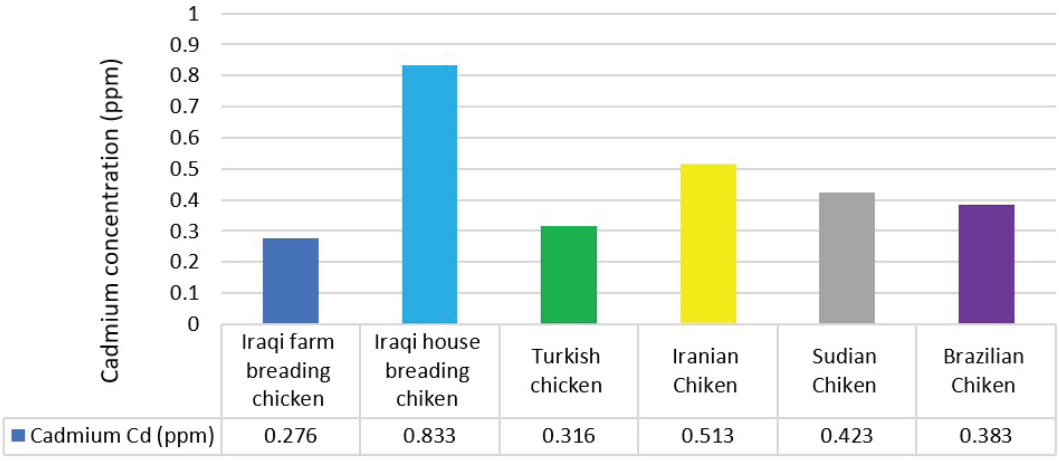

Figure 6: Concentration of cadmium in different samples of chicken

The results show that the lead concentrations measured in this study ranged from 0.72 in Turkish chicken to the highest concentration of 1.39 ppm in Iraqi house breading chicken. The concentration of Pb in samples was in the following order Turkish chicken > Iraqi farm breading > Sudian chicken > Brazilian chicken > Iranian

chicken > Iraqi house breading chicken. All samples exceeded the FAO/WHO and The Commission of the European Communities limit for Pb in meat of 0.05 ppm (Zhuang, et.al., 2014) and also exceeded the Egyptian standers of 0.1 mg/kg (Elsharawy, 2015). The results of this study were much lower than the results found by (Okoye, et.al.,.2011) which found that the average Pb concentration in chicken was 78.65 ug/g. And it was higher than the results found by (Yeasmin, et.al., 2017) which found that the lead concentration ranged from 0.22 mg/kg to 0.37mg/kg in farm B and D respectively. It should be mention that high concentration of lead can cause various health problems such as disturb the liver and thyroid gland function and can cause cancer (Imran, et.al., 2015).

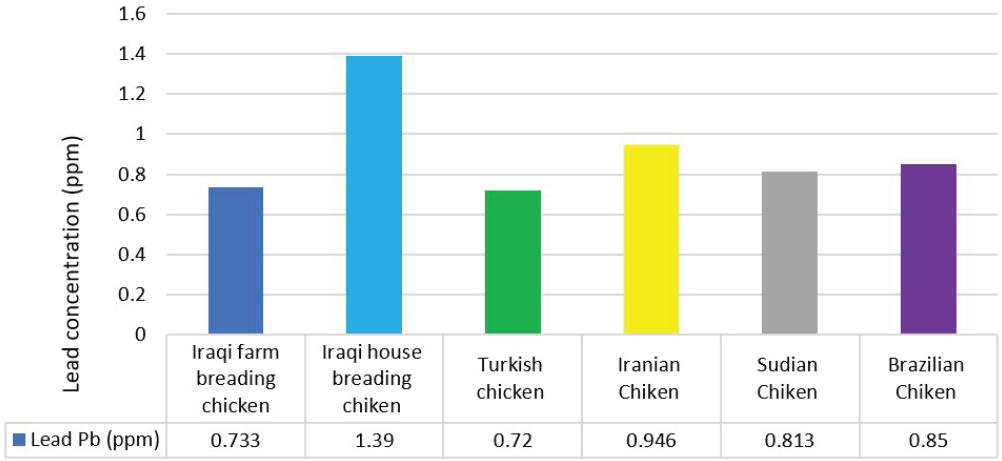

Figure 7: Concentration of lead in different samples of chicken

The last metal measured in this study was chromium, the results state that the Cr concentrations were ranged from 0.37 ppm in Iraqi farm breading chicken to 0.716 ppm in Iraqi house breading chicken. The concentrations of Cr in samples were in the following order Iraqi farm breading chicken > Brazilian chicken > Turkish Chicken > Sudian chicken > Iranian chicken > Iraqi house breading chicken. According to the EU council limit for Cr which was 1 ppm all the samples were below this limit (EU, European Parliament of the Council, Brussels, Belgium. 2001). The chromium concentration in this study recorded an elevated range that the results found by (Yeasmin, et.al., 2017) which found that Cr concentration were in the range of 0.048-0.112 ug/g. while (Ihedioha, et.al.,2014) find that the minimum Cr concentration was 0.13 ug/g and the maximum concentration detected was 2.64 ug/g.

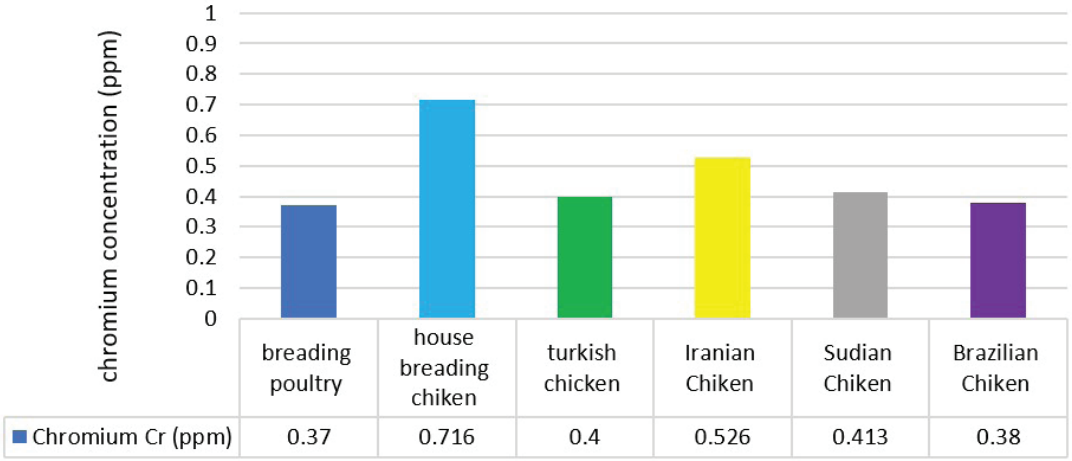

Figure 8: Concentration of chromium in different samples of chicken

CONCLUSIONS

The lowest concentrations of almost all measured heavy metal in Iraqi Farm breed in chickens and Iraqi house breading was the one with the highest heavy metal concentration. Studies on this subject should be carried out since it directly affect the heath who consumed chicken meat in their daily diet.

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