

ASSESSMENT OF HEAVY METALS (*Cd, Pb AND Zn*) CONTENTS IN LIVERS OF CHICKEN AVAILABLE IN THE LOCAL MARKETS OF BASRAH CITY, IRAQ

Reem Th. Hussain, Manal Kh. Ebraheem, Hanady M. Moker

Department of Pharmacology and Clinical Laboratory Sciences, College of Pharmacy,

University of Basrah, Basrah, Iraq

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ABSTRACT

This study was conducted to determine the concentration of Cd, Pb and Zn (using Atomic Absorption Spectrophotometer ASS) in nine brands of chicken livers: (Keyf-i Gezzet, Al Murad, Al Kafeel, Sadia 2, Sadia 1, Karbala, Halal, Faqeeh, in addition to livers of locally breed chicken), which are widely consumed from the local markets of Basrah city. The levels of metals in the chicken livers were ranged between (0.004) µg/g and (0.124) µg/g for Cd; (0.171) µg/g and (3.269) µg/g for Pb; and (4.116) µg/g and (3.266) µg/g for Zn. The results showed that concentration of Pb in four brands exceeded the permissible limits set by WHO/FAO (1) and ANZFA (2). The concentrations of Cd and Zn in all samples were within the tolerance limits.

INTRODUCTION

Food safety is a major public concern worldwide. During the last decades, the increasing demand of food safety has stimulated research regarding the risk associated with consumption of food stuffs contaminated by pesticides, heavy metals and/or toxins (3). The implication associated with heavy metal contamination is of great concern. Heavy metals, in general are not biodegradable, having long biological half-lives and having the potential for accumulation in the different body organs leading to unwanted side effects (4, 5, 6). These metals can pose a significant health risk to humans, particularly in elevated concentrations above the very low body requirements (7).

The risk associated with the exposure to heavy metals present in food product had aroused widespread concern in human health. Improvements in the food production and processing technology had increased the chances of contamination of food with various environmental pollutants, especially heavy metals. Ingestion of these contaminants by animals causes deposition of residues in meat (8). Hence contamination with heavy metals is a serious threat because of their toxicity, bioaccumulation and biomagnifications in the food chain (9). Although contamination of animal feed by toxic metals cannot be entirely avoided given the prevalence of these pollutants in the environment, there is a clear need for such contamination to be minimized, with the aim of reducing both direct effects on animal health and indirect effects on human health (10).

Toxic effects of metals have been described in animals under relatively low levels of metal exposure (11); one of the earliest effects is the disruption of trace element metabolism (12, 13).

Toxic effects of cadmium are kidney dysfunction, hypertension, hepatic injury and lung damage (14). Cadmium chloride at teratogenic dose induced significant alterations in the detoxification enzymes in the liver and the kidney (15).

Lead is a metabolic poison and a neurotoxin that binds to essential enzymes and several other cellular components and inactivates them (16). Toxic effects of lead are seen on haemopoietic, nervous, gastrointestinal and renal systems (17, 18).

Zinc is an essential element in our diet, but too little or too much can be harmful. Without enough dietary intake, people can experience a loss of appetite, decreased sense of taste and smell, decreased immune function, slow healing of wounds, and skin sores. Too little zinc can also result in poorly developed sex organs and retarded growth in young men. If pregnant women do not have enough zinc, babies might have growth retardation. Harmful effects from too much zinc generally begin at levels from 10 to 15 times higher than the recommended dietary allowances of 5, 12, and 15 mg per day for infants, women, and men, respectively. Consuming large amounts of zinc can cause stomach cramps, nausea, and vomiting. Taking in large amounts of zinc over an extended period can cause anemia, damage the pancreas, and lower the levels of high-density lipoprotein cholesterol (the good form of cholesterol) (19, 20). Zinc concentrations were found to be highest in meat, liver, fish and eggs (21).

This study is carried out to determine and investigate the levels of three heavy metals (Cd, Pb and Zn) in eight brands and one local type of chicken livers obtained from many local markets in Al Basrah city, Iraq.

MATERIALS AND METHODS

Sample collection: Frozen samples of livers of chicken from eight different brands (5 samples from each brand) in addition to locally breed and slaughtered chicken (30 samples) were collected from the market of Al Basrah city, Iraq. The samples were collected in polyethylene bags (All estimations were made in triplicates) and transported to the laboratory for analysis. The study was carried out between the periods of May 2010 to April, 2011 (Table 1).

Table (1) List of chicken livers' brands and detailed information for each of them

#	Brands of Chicken livers	Manufacturer	Manufacturing Date	Expiring Date	Notes
1	Keyf-i Gezzet	Turkey	Aug. 2010	Aug. 2011	Imported frozen
2	Al Murad	Brazil	Feb. 2010	Aug. 2011	Imported frozen
3	Al Kafeel	Brazil	May. 2010	May. 2011	Imported frozen
4	Sadia 2	Brazil	Sep. 2010	Aug. 2011	Imported frozen
5	Sadia 1	Brazil	Jul. 2010	Jun. 2011	Imported frozen
6	Karbala	Brazil	Oct. 2010	Aug. 2011	Imported frozen
7	Halal	Brazil	Oct. 2010	Sep. 2011	Imported frozen
8	Faqeeh	KSA	Jan. 2011	Dec. 2011	Imported frozen
9	locally breed and slaughtered chicken	Iraq	—	—	Fresh chicken

Sample preparation: The collected samples were decomposed by wet digestion method for the determination of various metals. A known quantity, 2 g of each sample (livers) was introduced into the digestion flask and digested in a solution of nitric acid (1 N, Trace Metal grade HNO₃; Fisher Scientific) at a temperature of 80°C for 4 h. At the end of this time, the supernatant was taken and its volume was measured to calculate the concentrations of Cd, Pb and Zn. The technique used to measure the metals was described earlier by (22).

Elemental analysis of samples: Determination of Cd, Pb and Zn in chicken liver samples were made directly on each of the final solutions using Biotech engineering ltd., UK- Phoenix - 986 Atomic Absorption Spectroscopy (AAS).

Statistical analyses: All statistical analyses were performed with (Open office program) for Windows.

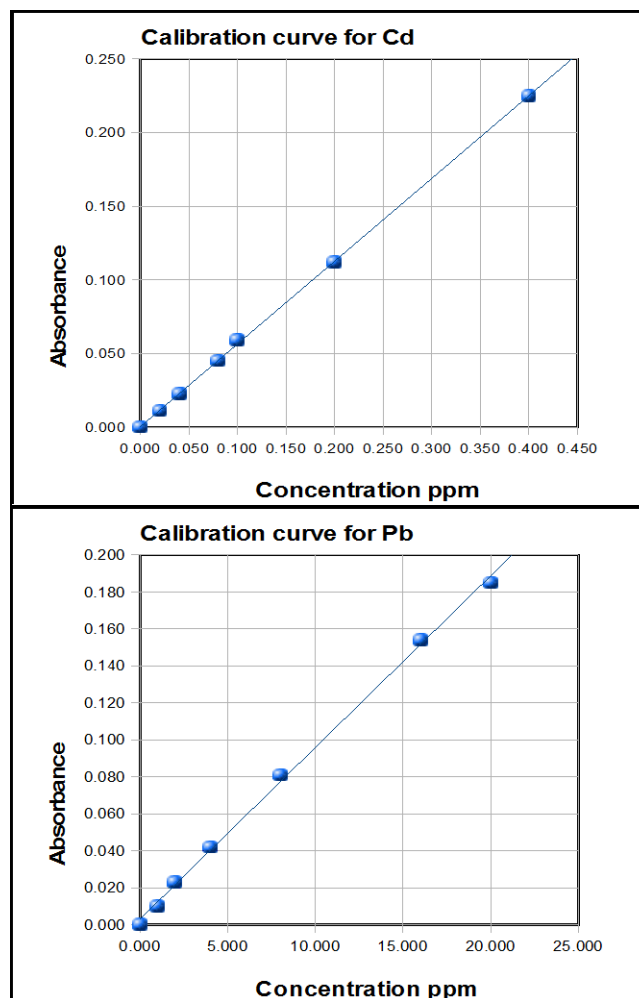
RESULTS

The concentrations of heavy metals in the livers of chicken are presented in Table (2). Cd levels ranged between (0.004) µg/g and (0.124) µg/g. Pb levels ranged between (0.171) µg/g and (3.269) µg/g. Zn levels ranged between (4.116) µg/g and (3.266) µg/g. Fig (1) shows calibration curves for determination of Cd, Pb and Zn in the chicken livers.

Table (2): Concentrations of heavy metals in livers of Chicken brands taken from Al Basrah city markets, Iraq.

#	Brands of Chicken Livers	Conc. of Cd ($\mu\text{g/g}$)	Conc. of Pb ($\mu\text{g/g}$)	Conc. of Zn ($\mu\text{g/g}$)
1	Keyf-i Gezzet	0.019	2.060	4.116
2	Al Murad	0.016	0.423	3.801
3	Al Kafeel	0.004	0.171	3.266
4	Sadia 2	0.033	1.105	3.299
5	Sadia 1	0.015	0.369	3.417
6	Karbala	0.033	0.832	3.561
7	Halal	0.017	0.832	3.835
8	Faqeeh	0.078	2.577	3.985
9	Local chicken livers	0.124	3.269	4.101

Fig (1): Calibration curves for determination of Cd, Pb and Zn in the livers



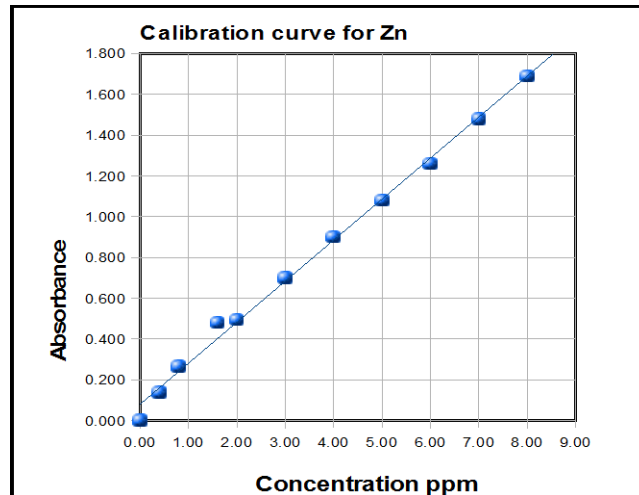
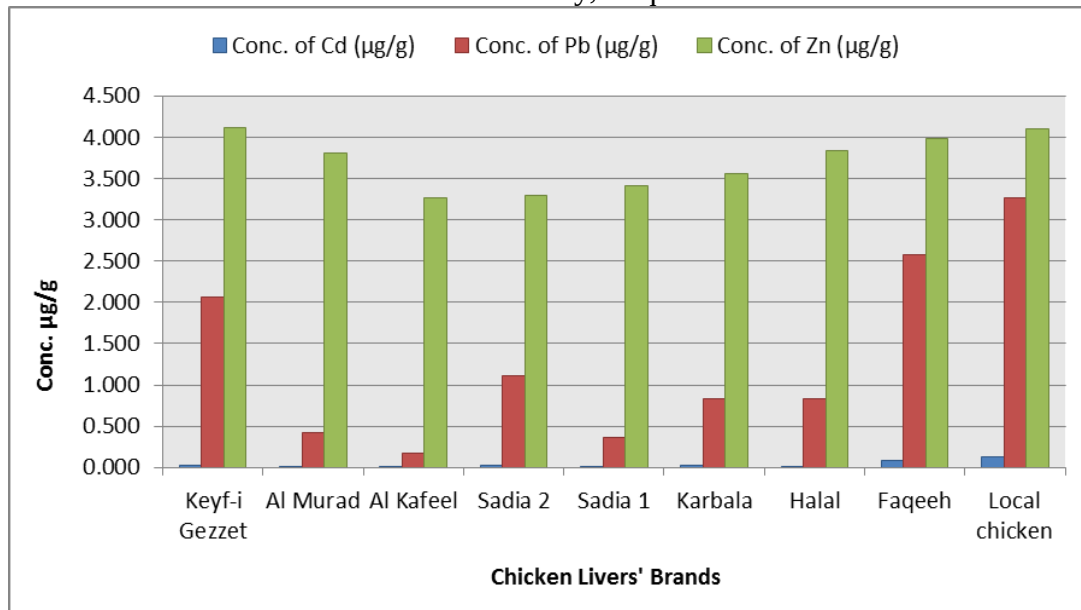


Figure (2): Mean Concentrations of Heavy Metals in Chickens' livers from Markets of Al Basrah city, Iraq



DISCUSSION

The major route of entry of most elements into the body is through the diet. The source of metals in the environment is the combustion of fossil fuels, mining industries, waste disposal, and domestic sewage. Farming and forestry also contribute to the metal content in the environment because of fertilizers and pesticide used (23).

In Iraq, chicken livers are available in the markets in cheap prices related to other products coming from different sources; either imported to Iraq from different countries by many trading companies, or obtained from locally breed and slaughtered chicken. Livers of chicken are foodstuffs, in which the metals present are mainly originated from the feed or drinking water of the chickens, or through manufacturing processes, in

addition to air pollution with some heavy metals that may be found around the poultry raising areas.

The highest cadmium (Cd) concentration was observed in the (**Local chicken livers**) (0.124 µg/g) Table (B), while the lowest (0.004 µg/g) was in the liver of (**AlKafeel**) Fig. (2). Cadmium is toxic to virtually every system in the animal body. It is almost absent in the human body at birth, however accumulates with age (24). Cadmium accumulated in the kidney and liver over long time have been reported by (25) that cadmium interacts with a number of minerals mainly Zn, Fe, Cu and Se due to chemical similarities and competition for binding stage. It is also reported that Cd can affect Ca, P and bone metabolism in both industrial and people exposed to Cd in general environment (26). (27) and (28) detected cadmium levels in the livers and kidneys of cattle in Poland and they found the cadmium concentration to be higher than the permissible limit set by (1). Similarly, (29) found higher levels of cadmium and zinc in the livers and kidneys of the hens and chickens, which exceeded the official tolerance levels. From the results of the present study, the concentration of cadmium in all the samples studied were found to be lower than the **0.5 ppm (µg/g)** permissible limit set by (1), this was similar to the results obtained by (24).

The meat, fish and poultry category of foods was not a major source of dietary Cd, but these foods were important sources of Cu, Fe and Zn. Liver and kidney are the principal meat sources of Cd, although kidneys are eaten less frequently than liver. In view of the Cd intakes of all age groups in relation to (1) provisional tolerable intakes, it is considered important that Cd in the food supply does not increase. With respect to domestic animals, milk, liver and kidney are the important source foods. Depending on Cd concentration, a serving of liver could easily double the day's intake of Cd (30).

Lead (Pb) as observed in the (**Local chicken livers**) showed the highest concentration of (3.269) µg/g and each of (**Faqeeh**), (**Keyf-i Gezzet**) and (**Sadia 2**) also showed high concentrations (2.577, 2.06 and 1.105) µg/g respectively (Fig. 2), while (**AlKafeel**) had the lowest concentration (0.171µg/g) among all of the samples.

The (**Local chicken livers**) which had the highest concentration of Pb refers to a serious contamination with Pb in chickens breed and slaughtered in Basrah and other governorates that Basrah markets take their poultry from. The sources of pollution may be located near the breeding area, like industrial and chemical factories which will result in the contamination of feed, water, as well as the air inhaled by the animals. The other brands that showed high levels of Pb may be contaminated from feed, water, air pollution in addition to the manufacturing processes in the countries they imported from.

Similar results obtained by (24) who determined lead concentration in liver of caprine, and (27) who reported higher concentration of lead than the permissible limit in the liver and kidney of animals. (31) showed that 86% of samples of liver were contaminated more than the limits set by the country's regulations.

The results revealed that the concentrations of lead in the livers of chicken taken from (**AlMurad**, **AlKafeel**, **Sadia 1**, **Karbala** and **Halal**) were lower than the permissible limit of **1 ppm (µg/g)** (2).

Zinc (Zn) concentration was found to be highest in the liver of (**Keyf-i Gezzet**) with (4.11 µg/g) (Fig. 2). The concentrations of zinc in all the samples studied were less than the permissible limit **10-50 ppm (µg/g)** set by (2). (32) Mentioned that Zinc is necessary for the function of various mammalian enzymes and the permissible concentration of Zn in food is around 10-50 µg/g wet weight (33), while the concentration of Zn in samples analyzed (meat "Lamb, beef", intestine, eggs, broiler, and local breed chicken) were found to be 0.86-27.64 µg/g wet weight. Similar results were obtained by (24), who found that Zn levels were within the standard limits in meat and livers of all studied animals.

CONCLUSION

From the results of this study, the concentrations of all metals in the chicken were statistically significant. The comparing among the brands of chicken livers, there did show significant differences in the levels of heavy metals. Hence, the concentrations of (Cd and Zn) were within the tolerance limits except some concentrations of (Pb), which were higher than the (2) tolerance limits. We recommend the need to identify sources of pollution in the local places of raising poultry and reduction of these sources through direct supervision, as well as activating the role of censorship on imported foodstuffs and the detection of heavy metals due to their influence on human health.

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تقدير محتوى العناصر الثقيلة (الكاديوم والرصاص والزنك) في أكباد الدجاج المتوفرة في الأسواق المحلية لمدينة البصرة، العراق

ريم ثناء حسين منال خليل ابراهيم هنادي محسن موكر
فرع الأدوية والعلوم المختبرية السريرية، كلية الصيدلة، جامعة البصرة، البصرة، العراق

الخلاصة

جاءت هذه الدراسة لتحديد تراكيز كل من الكاديوم والرصاص والزنك باستخدام جهاز الامتصاص الذري في تسعة أصناف من أكباد الدجاج المتوفرة في الأسواق المحلية لمدينة البصرة والتي تستهلك بشكل واسع وهي: (**Keyf-i Gezzet**)، المراد، الكفيل، سادية 2، سادية 1، كربلاء، حلال، فقيه، بالإضافة إلى الأكباد المأخوذة من دجاج تمت تربيته في مراكز الدواجن المحلية). كانت نسب المعادن المدروسة تتراوح بين (0,004 و 0,124) مايكروغرام/غرام لعنصر الرصاص، وبين (0,171 و 3,269) مايكروغرام/غرام لعنصر الكاديوم، وبين (4,116 و 3,266) مايكروغرام/غرام لعنصر الزنك. لقد أظهرت النتائج أن تركيز الرصاص في أربعة أصناف من الأكباد قد تعدت النسب المسموح باستهلاكها حسب منظمة WHO/FAO (1) و ANZFA (2). وكانت نسب كل من الكاديوم والزنك ضمن النسب المسموحة بها لكافة الأنواع المدروسة.

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