Tikrit Journal for Agricultural Sciences (2023) 23 (2):201-208
DOI: https://doi.org/10.25130/tjas.23.2.17

ISSN:1813-1646 (Print); 2664-0597 (Online)
Tikrit Journal for Agricultural Sciences
Journal Homepage: http://www.tjas.org
E-mail: tjas@tu.edu.iq

Determination of some heavy metals resides in different types of poultry production

Jinan N.A. Bazzaz[1]*, Nidhal Y. Yakub [2] and Ghazy R.Hammad[2]
[1]*College of veterinary medicine ,Salahaddin University-Erbil,Kurdistan Region,Iraq*
[2]*Department of Animal Resources, College of Agriculture Engineering Sciences, Salahaddin University-Erbil, Kurdistan Region, Iraq*

* *Corresponding author: E-mail*: jinan.abdulrahman@su.edu.krd

KEY WORDS:
Heavy metals, Backyard chicken, liver, breast

Received: 06/03/2023
Accepted: 15/05/2023
Available online: 30/06/2023

ABSTRACT

The diet is the main rout of exposer of heavy metals; therefore the evaluation of these metals in human's dietary intake is important. The study examined the concentration of some residues of heavy metals (copper, Arsenic and Lead) in different poultry products such as chicken frozen thigh and breast muscle originating from Brazil and Turkey, Etimad and Shemal local company chicken frozen thigh and breast muscle, local quail frozen thigh and breast muscle as well as local quail eggs. The results of the study indicated that the highest concentrations of Copper (Co) and Arsenic (As) were found in Brazilian frozen thigh and breast muscles compared with other products. However, the concentrations of these metals were within permissible and safe for human consumption. Lead (Pb) concentrations chicken frozen thigh and breast muscle originating from Brazil was found to be high ($p \leq 0.05$) and above permissible level than chicken and quail frozen meat as well as eggs.

تقدير بقايا بعض المعادن الثقيلة في انواع مختلفة من منتجات الدواجن

جنان نجدت عبدالرحمن نضال ياس يعقوب غازي رحمان حمد
كلية الطب البيطري –جامعة صلاح الدين – اربيل – العراق
قسم الثروة الحيوانية – كلية علوم الهندسة الزراعية –جامعة صلاح الدين –اربيل - العراق

الخلاصة

النظام الغذائي هو المسار الرئيسي للتعرض للمعادن الثقيلة لذلك من المهم تقييم هذه المعادن في الاغذية التي يستهلكها الانسان . ركزت هذه الدراسة على تراكيز بعض المعادن (النحاس , الزرنيخ والرصاص) في منتجات الدواجن المختلفة مثل لحوم افخاذ وصدور الدجاج المجمدة برازيلية وتركية المنشأ ومنتجات شركة الاعتماد والشمال المحليتان ,افخاذ وصدور الدجاج المجمد لطيور السمان المحلي بالاضافة البيض السمان المحلي , اظهرت النتائج بان اعلى التراكيز للمعدنين (النحاس والزرنيخ) وجدت في المنتوج البرازيلي من افخاذ وصدور مجمدة

بالمقارنة مع المنتجات الاخرى بالرغم كونها ضمن الحدود المسموح بها للاستهلاك البشري ,كما وجدت تركيز الرصاص في لحوم الافخاذ والصدور المجمدة البرازيلية عالية ($p\leq0.05$) متعدية بذلك الحدود المسموح بها للاستهلاك البشري بالمقارنة مع لحوم الدجاج والسمان المجمدة وبيض السمان.

الكلمات المفتاحية: لحوم الدجاج والسمان ,بيض السمان ,متبقيات العناصر الثقيلة

INTRODUCTION

Food is usually the main sources of human exposure to heavy metals. In the recent years much attention has been focused on the level of heavy metals in domestic animals like fish and other sea food while little interest was given in these metals of poultry meat and edible tissues (WHO, 2000). Thus, the determination of some heavy metals in different imported or locally poultry products has been necessary to report since products of chicken is valuable food source and rich in many of the essential nutrients include protein (essential amino acids), minerals (iron , zinc , selenium), vitamins (vit. E) as well as essential fatty acids especially omega 3 fatty acids (Schonfeldt and Gibson , 2008). However, the chicken products like other food could be contaminated by heavy metals through drinking water, food and technology processing. Contamination with heavy metals is a serious hazard as their toxicity, bioaccumulation and bio-magnifications in the food chain. Lead (Pb) has public health concern due to several hazardous effects which may affect many organs and systems of the body (CNS , blood , kidney , genital system and immune system) with carcinogenic effect and high level of intoxication may result in attacks of abdominal pain until coma and death .(Correia , 2000). Copper (Co) is essential with low concentrations but toxic at high levels however ingestion of excessive doses of copper may lead to severe nausea , bloody diarrhea , hypertension and jaundice .(Gossel and Bricker , 1990).

Arsenic (As) is consider contaminated in food chain through drinker water , food , meat , milk and egg .Arsenic causes anemia , burning sensation of eyes , solid swelling of legs , liver fibroses , chronic lung disease , gangrene of toes , neuropathy and skin cancer and these clinical manifestations were found to be higher significant in exposed people (water arsenic >0.05 mg /L).(Mazumder , 2003). The risk association with exposure to heavy metals in food stuff represent concern problem in human health.Quail is a kind of birds that has a small body like chick and it cannot fly so high like the other birds commonly. In the market, there are many quail meat that sells for consuming people. Quail meat is a sweet and delicate white game meat with extremely low skin fat and low cholesterol value, quail meat is rich in micronutrients and a wide range of vitamins including the B complex, folate and vitamin E and K. It is therefore recommended for people with high cholesterol levels and those who want to maintain a low level of cholesterol. Many study reported that quail eggs are packed with vitamins and minerals even with their small size, their nutritional value is three to four times greater than chicken egg. Regular consumption of quail eggs helps fight against many diseases which is a natural combatant against digestive tract disorders such as stomach ulcers. Quail eggs strengthen the immune system, promote memory health, increase brain activity and stabilize the nervous system. They help with anemia by increasing the level of hemoglobin in the body while removing toxins and heavy metals (Troutman, 1999-2012). Chinese use quail eggs to help treat tuberculosis, asthma, and even diabetes,quail eggs can help prevent sufferer of kidney, liver, or gallbladder stones and remove these types of stones. The nutritional value of quail eggs is much higher than those offered by other eggs with they are rich sources of antioxidants, minerals, and vitamins, and give us a lot of nutrition than do other foods (Lalwani, 2011).

The present study aimed to determine the concentration of copper , arsenic and lead in frozen thigh and breast muscles of chicken and quail from different origin imported and local also quail eggs in Erbil city in Iraq.

MATERIALS AND METHODS

Sample preparation

A total of 165 different samples of poultry products randomly collected from local markets in Erbil city in Iraq. The samples were included frozen Turkish, Brazilizn, local Etimad and Shemal Company and local quail thigh and breast muscles as well as local quail eggs by 15 samples for each product of different origin. The collected samples were transferred to the lab then about 15 g for each product samples dried in oven for 48 h at 60 ◦C. The dried samples were crashed and 5 g taken for detection of metals residues.

Figure 1: Brazilian chicken

Figure 2: Turkish chicken

Figure 3: local quail meat

Samples analyses for metal residue

The residue of Pb, Co and As were determined by using X-ray fluorescence spectrometer (XRF). This equipment was used a brand sky ray (9000), portable XRF device on fluorescence spectrometry, as an instrumental analytical method is capable to determine elemental composition of solid and fluid samples from minimally prepared sample size. Additionally this method can be used for direct analysis for both solid and liquid materials. The samples were shot by the X-ray to excite the atoms within the sample so that a typical characteristic radiation for particular elements is emitted. Energy (wavelength) of these characteristic radiations does change element by element. This fact is considered as the bottom line of the qualitative element analysis. The intensity of characteristic radiation of each element would be measurable to its concentration which permits the qualitative analysis(Rajib et al.,2016).

Statistical analysis

The obtained data were subjected to one-way analysis of variance (ANOVA) using SAS program (2002-2003).The Duncan multiple range test (1955) was used to compare the differences between the means. The level of significance was chosen at $p \leq 0.05$ and the results are presented as mean ± standard error.

RESULT AND DISCUSSION

Tables 1 and 2 exposed the concentration of heavy metals exposed the concentration in frozen thigh and breast muscle samples of chicken as well as local quail meat and eggs sold in Erbil markets. The ranges of metal concentrations found in the chicken thigh muscle samples were as follows: Co: 0.96 to 1.57 ppm, As: 1.37 to 1.82 ppm and Pb: 0.00 to 0.55 ppm. The ranges of metal concentrations found in the chicken breast muscle samples were as follows: Co: 1.o3 to 1.67 ppm, As: 1.58 to 1.82 ppm and Pb: 0.00 to 0.50 ppm. The metal concentrations found in the local quail products were as follows: Co: 1.12, 1.01 and 1.28 ppm and As: 1.24, 1.24 and 1.70 ppm for thigh, breast and egg, respectively. However, Pb metal was not detected in the local quail products. The significant difference in the Co, As and Pb was recorded among the chicken thigh samples and quail products (Table 1). The Brazilian and Turkish thigh sample contained a high concentration of Co, As and Pb, while the thigh samples obtained from Shemal and Etimad company contained low concentration of these metals. Significant increased in Co, As and Pb were also shown among the chicken and quail breast muscle samples, breast samples of Turkish and Brazilian origin appeared to have higher content of Co, As and Pb, but the Shemal and Etimad company samples had a lower content of Co, As and Pb. Additionally, The results of Co and Pb as shown in Table 1 and 2 for local quail products were the lowest concentration. The concentrations of analyzed metal except Pb in thigh muscles obtained from Brazilian origin were all within the tolerance limit. This meat (Brazilian origin) analyzed may have a potential health risk to consumers.

Table 1: The concentration of heavy metals in thigh muscles of different origin chicken and quail eggs witch consumed in Erbil city

Metals	Thigh muscle					Local quail eggs	IPL
	Brazilian origin	Turkish origin	Shemal company	Etimad company	Local quail		
Co	1.57±0.04 a	1.53±0.05 a	1.16±0.05 bc	0.96±0.04 d	1.12±0.04 c	1.28±0.08 b	200
As	1.82±0.06 a	1.57±0.03 bc	1.52±0.05 c	1.37±0.04 d	1.24±0.04 e	1.70±0.06 ab	2
Pb	0.55±0.05 b	0.43±0.04 a	0.00 c	0.00 c	0.00 c	0.00 c	0.5-1.0

Bearing different letters are significantly different ($p \leq 0.05$) between rows.
IPL: INTERNATIONAL PERMISSIBLE LIMITS

Table 2: The concentration of heavy metals in breast muscles of different origin of chicken and quail eggs witch consumed in Erbil city

Metals	Brazilian origin	Turkish origin	Shemal com.	Etimad com.	Local quail	IPL
Co	1.67±0.03a	1.65±0.04a	1.36±0.05 b	1.03±0.03c	1.01±0.03 c	200
As	1.82±0.07a	1.77±0.04 a	1.66±0.04 ab	1.58±0.03 b	1.24±0.04 c	2
Pb	0.50±0.03 a	0.49±0.03 a	0.00 b	0.00 b	0.00 b	0.5 in solid 1 in liquid

Bearing different letters are significantly different ($p \leq 0.05$) between rows.

IPL : INTERNATIONAL PERMISSIBLE LIMITS

The worldwide commercial poultry industry well developed and is the largest supplier of animal protein and good source of essential amino acids, vitamins, and minerals for human consumption in the form of meat and eggs. The chicken meat has good advantages in comparison with beef meat but some time poultry may carry heavy metals and other elements which may be naturally present in air, water, soil and poultry food or can reach it as human activities such as industrial and agriculture processes (Jarup, 2003; Islam et al., 2007 and Hassanin et al., 2014). The metals in relation to harmful effect on health are lead, arsenic, mercury, copper, cadmium and tin .The toxic effect of these metals including the central and peripheral nervous system, gastrointestinal and genital system damage of tubular cells in gizzards, hepatic toxicity, immune system and carcinogenesis (Pikkemaat, 2009). In view of the fact that people in Erbil city prefer consumption of both imported and local frozen chicken and quail meat and eggs. Therefore, the present study determines the concentration level of some heavy metals such copper (Co), arsenic (As) and lead (Pb) in frozen thigh and breast muscle of different poultry origins and local quail eggs sailed in Erbil province local markets, Kurdistan region - Iraq. In graph 1 note that trace Co record significantly higher level in thigh muscle of Brazilian and Turkish origin (1.57 ± 0.04 and 1.53 ± 0.05 ppm) while local quail eggs and thigh, thigh Shemal and Etimad Company contained lower concentration this may belong to level of trace in feed which fed to the bird during rearing period in the farm. Copper is essential substances to human life as it's involved in absorption, storage and metabolism of Iron but in high doses it can cause anemia, liver and kidney damage and stomach irritation .fortunately the level obtained in the present study showed positive value and found to be in lower concentration than permissible limit (200 ppm; ANZFA) even Brazilian and Turkish origin samples elevate high level. The same results come to light by breast muscle samples of same origin graph 2. These findings agree with results detected by (Alsharawy, 2015 and Abdulmajeed et al., 2012).

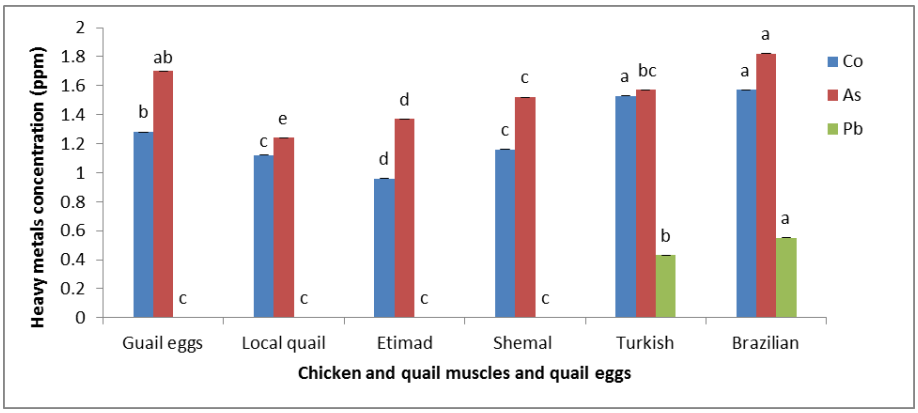

Figure 1: concentration of heavy metals in thigh muscles and quail eggs.

Arsenic is a steel gray metal , it occur naturally in the environment can't destroyed it exerts it's toxic effect through an impairment of cellular respiration by inhalation of various mitochondria enzymes and un coupling of oxidative phosphoryation (Parttolla and Tchnounwou, 2005). It's clear in graph No.(1) that all samples were within permissible level (2 ppm) as set by ANZAF (2001), even Brazilian product which appear highest level (1.82 ± 0.06 ppm) and local quail eggs (1.70 ± 0.06 ppm) instead of both near the limits, while lower level elevated by Turkish origin, Shemal local company, Etimad local company and local quail thigh. This may due to little As level in drinking water of birds in rearing period since water one of the important sources of metal accumulation inside chicken and quail tissues. Similar results donate in graph No.(2) in which Brazilian chicken breast raised highest level of As (1.82 ± 0.07 ppm) without differ significantly from that of Turkish product and Shemal local company meat, nevertheless local quail breast manifest the lower level of this metal (1.24 ± 0.04 ppm) between other poultry products analyzed .These corresponding with the finding of Mohammad et al. (2013).

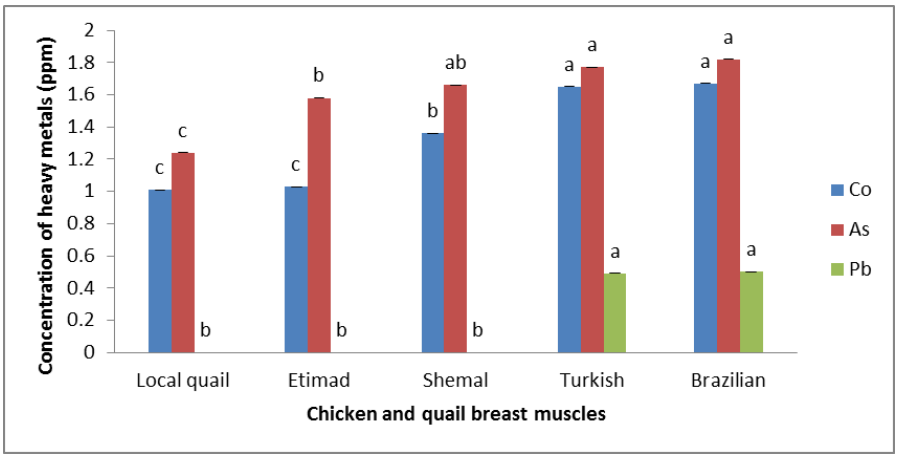

Figure 2: Concentrations of heavy metals in breast muscles of different origin.

The consumption of polluted food is the main source of Lead (Pb) intake in non-smoking population (Ciobanu et al., 2012). Lead is known to induce reduced cognitive development and intellectual performance in children and increase blood pressure and cardiovascular diseases in adults

(WHO,1993).As shown in graph No.(1) the product of Brazilian origin record the highest level of Pb and above the permissible limit 0.5 ppm as set by ANZFA (2001) , while in Turkish origin the level under limit (0.43 ± 0.04 ppm) which mean that this product not safe. Pb pollutant out of control may be due to great number of exciting factories in the region as a result of industry development .In the other hand graph No.(2) showed that Pb level in both imported products near the limit, these feedback matching results of Chelebi et al. (2015) which detect Pb level in thigh and breast tissues of chicken but little under tolerance limit. Likely all samples in Shemal local company, Etimad local company, local quail meat and local quail eggs raised zero level of Pb so it's favorable condition that the metal no detected in local products because lead toxic substances with no known physiological function, it means the products can be consumed safely by people in Kurdistan region without fear. The findings of this study were similar to that obtained by (Mohammed et al., 2013).

CONCLUSIONS

We concluded the level of Co was higher in Brazilian and Turkish origin products and lower in local ones but below international permissible limit. Lead was not detected in local chicken and quail meat and eggs but above the tolerance in Brazilian thigh and near the limit in both imported breast muscles.

CONFLICT OF INTEREST

The authors declare no conflicts of interest associated with this manuscript.

ACKNOWLEDGMENTS

We thank the staff of the [Animal Resources, College of Sciences of Agriculture Engineer, University of Salahaddin] for their technical and general support.

REFERENCES

Abduljaleel, S.A, Shuhaimi , O.M. and Abdulsalam ,B. (2012).Assessment of trace metals content in chicken (Gallus gallusdomesticus) and Quail (*Coturnix coturnix* japonica) Tissues FromSelangor (Malaysia). Journal of Environmental Science Technology. 5: 441-451.

ANZFA,(2001).Australia New Zealand Food authority. Wellington , New Zealand 6036.

Chelebi,N.A.; Bzzaz ,J.N.A.;Yakub , N.Y. ;Bazzaz ,A.A. and Hammad ,G.R.,2015.Heavy metal residues in frozen chicken meat consumed within Erbil province .Merit research journal of medicine and medical science.Vol.3(11)pp:517-520.

Correia ,P., Oliveira ,E.O. and Oliveira ,p.(2000).Simultaneous detection of Cd and Pb in food staff by electro thermal atomic absorption spectrometry.Anal.Chim.Acta.405 :205-211.

Guha Mazumder, D.N. 2003.Chronic arsenic toxicity : clinical features, epidemiology and treatment ; experience in west Bangal .Journal of Environmental Science and Health , part A, 38(1), pp:141-163.

Duncan DB (1955). Multiple range and Multiple F ted. Biometric. 11: 1-42.

Elsharawy ,N.T.M.2015.Some heavy metals residues in chicken meat and their edible offal in new vally.2th conference of food safety ,Suez University ,faculty of Vet. Med. Volume 1 .pp:53-60.

Hassanin, F.S., Hassan , M.A.,Mahmoud ,A. M. and Mohamed ,E. A.(2014). Heavy metal residues in some chicken meat products. Behna Veterinary Medicine Journal , 27(2) 256-263.

Grossel , T.A. and Bricker , J.D. 1990. Principles of clinical toxicology .2nd Ed. , Raven Press. New York , pp:153-192.

Islam , M.S. , M Azizul Islam Kaziam , Moazzem Hossain .(2007).Propagation of heavy metals in poultry feed production in Bangladesh .Bangladesh Journal of Scientific and Industrial Research.42.(4) , 465-474.

Jarup , L.(2003).Hazards of heavy metal contamination. British Medical Bulletin , 68:167-182.

Lalwani P. 2011.Quail Egg Nutrition. http://www.buzzle.com/articles/quailegg-nutrition.html Accessed 15th April 2012. [27] Lee I.M., Cook N.R., Gaziano J.M., Gordon D., Ridker P.M., Manson J.E

Mohammed , A. , Kolo, B. and Geidam, Y.A.(2013).Heavy metals in selected tissues of adults chicken layers(Gullus spp.)Arpn journal of science and technology, Vol. 3 No.5.pp:518-522.

Partolla A. K. and Tchounwou P. B.(2005). "Serum acetyl cholinesterase as a biomarker of arsenic included neurotoxicity in Sprague dawley rats" , International Journal of Environmental Research and Public Health , 2(1) pp.80-3.

Pikkemaat , M. , Rapallinib , M. , Dijka , S. and Elferinka , J.(2009).Comparison of three microbial screening methods for antibiotic using routine monitoring samples. Analytica chemical Acta , 637:298-304.

Rajib A. , SaifulIslam A.T.M. , Ahmed R., Rahman T. , Rahman A. , Ismail A.B. (2016).Detection of chromium (Cr) using X-ray Fluorescence Technique and Investigation of Cr Propagation from poultry Feeds to Egg and chicken Flesh .American Journal of Engineering.

SchonfeIdt , H.C. and Gibson, N.(2008).Changes in the nutrient quality of meat in an obesity context. Meat Science., 80: 20-27.

Statistical Analysis System (SAS) (2002-2003). User's guide for person computer. Release V.9.1 SAS Institute Inc. Cary, NC, USA.

Troutman.(1999-2012).What Are the Benefits of Quail Eggs? http://www.ehow.com/list_6671158_benefits-quail-eggs_.html Accessed 9th May 2012.

WHO(world health organization).Evaluation certain food additives and contaminant. Technical report series .WHO , Geneva , 1993 ; 837.

World health organization .(2000).Lead in : safety evaluation of certain food additives and contaminant. Fifty third meeting of joint FAO/WHO Expert committee on Food Additives (JECFA).Food Additives Series.44:273-312.