www.biogenericpublishers.com

Article Type: Research Article

Received: 06/10/2020

Published: 07/12/2020

Open Access Journal of Biogeneric Science and Research

ISSN 2692-1081

DOI: *10.46718/JBGSR.2020.06.000139*

Some Heavy Metals in Different Parts of Consumed Chickens in Lahijan City – Iran; Health Risk Assessment

Milad Sheydaei[1]*, Ebrahim Alinia-Ahandani[2]**, Zeliha Selamoglu[3], Zahra Alizadeh-Terepoei[4], Ani Boghozian-Gharghani[2]

[1]*Faculty of Polymer Engineering, Sahand University of Technology, P.O. Box 51335-1996, Tabriz, Iran*

[2]*Department of Biochemistry, Payame Noor University, Tehran, P.O. Box 19395-3697, Iran*

[3]*Medical Biology Department, Medicine Faculty, Nigde Omer Halisdemir University, Nigde, Tutkey*

[4]*Department of Biology, Faculty of Basic Sciences, University of Gilan,Rasht, Iran*

*Corresponding author: Milad Sheydaei and Ebrahim Alinia-Ahandani, Faculty of Polymer Engineering, Sahand University of Technology, Iran, Department of Biochemistry, Payame Noor University, Iran

Abstract

Toxic metals sometimes imitate the action of an essential element in the body, interfering with the metabolic process resulting in illness. Their toxicity depends on several factors including the dose, route of exposure, and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals. In this research, we tried assessing some pointed heavy metals such as nickel, arsenic, lead, zinc, and cadmium which were prepared and analyzed in chicken liver, thigh, and breast muscles in Lahijan city. Heavy metal concentrations are associated with the use of inductively coupled plasma atomic emission spectroscopy (ICP-OES). The accessed results expressed the higher rates of heavy metals studied in chicken in some cases compare as world regulation standards. Also, the highest amount of heavy metals was in liver tissue.

Keywords: Food safety; Heavy metals; Chicken; Risk assessment

Introduction

With the development of human societies and the change in the human lifestyle, it has caused many problems for the environment [1-6]. Plastics, industrial effluents and sewage have polluted the water and caused many problems for vegetation, animals, and humans [7-24]. The extinction of many animal and plant species is part of this human negligence. These issues cause new diseases and threaten human health. Nutrition is a key part of human health. Protein products are an essential dietary requirement. Among protein products, chicken is one of the most widely consumed foods due to its easy availability and high nutritional value, so the health of the meat consumed is very important. One of the most important chemical contaminants is heavy metals, causing irreparable damage [25]. If excessive amounts of heavy metals are received through food, due to their accumulative properties, high stability and toxic effects can pose a serious threat to human health [26-42]. Because these compounds are not metabolized in the body, they can be stored in body tissues such as muscles and bones. Heavy metals have the potential to cause diseases such as mental retardation, hearing impairment, immune system dysfunction, brain diseases, blindness, muscle weakness and cancer [27,28-41]. Heavy metals enter the food chain through natural and unnatural pathways. Natural pathways such as mineral erosion, wind, river, groundwater, and volcanic activity. Also, unnatural pathways such as industrial and domestic sewage, pesticides, mines, factory waste, fuel combustion, metal plating and chemical industries. Therefore, there are different ways to contaminate chicken meat, such as contamination of diet, water, air and soil. In this study, the concentrations of heavy metals such as nickel, arsenic, lead, zinc, and cadmium in chicken liver, thigh, and breast muscles in Lahijan city (north of Iran) were investigated using inductively coupled plasma atomic emission spectroscopy (ICP-OES).

Experimental

Materials

The chickens were prepared from the local market of Lahijan and immediately transferred to the laboratory environment and kept at -18 °C until analysis. Also, all other solvents and chemicals were purchased from Merck Chemicals Co. and used as received.

Measurements and Characterization

A PerkinElmer (Shelton, CT, USA) Optima 3300 DV ICP-OES instrument was used for determinations.

Preparation of Samples

Chicken tissue (1g) with HNO3 (60%, 5 mL) kept at room temperature for 24 h. Then, HCLO4 (75%, 2.5 mL) was added and the solution was heated at 140 °C for 1 h to obtain a clear solution. Finally, the solution was filtered, and with HNO3 (2N) to 25 mL.

Determination of Heavy Metal Concentrations in Chicken Tissue Samples

First, the standard curve was drawn using the standard stock solution of the studied metals. Dilution was performed by distilled water. Concentrations were 100, 500, and 1000 µg/kg of heavy metals and the results are shown in (Table 1).

Table 1: Characteristics of heavy metals.

Heavy metal	R^2	Wavelength (nm)	Recognition limit (µg/kg)
Nickel	0.9997	221	1000
Arsenic	0.9988	189	100
Zinc	0.9996	213	300
Lead	0.9999	220	200
Cadmium	0.996	214	150

Calculate Daily Intake (Di) of Heavy Metals and Health Risk

Equation 1 was used to calculate the DI of heavy metals through chicken consumption in mg/kg body weight per day. In Equation 1, C represents the concentration of heavy metals (mg/kg), DC represents the daily consumption of chicken (46.3 g), and BW is the body weight (adults 70 kg) [29,30].

$$DI = (C \times DC)/BW \times 10\text{-}3 \quad (1)$$

The non-carcinogenic risk of exposure to various heavy metals through chicken consumption was calculated according to Equation 2 based on the target hazard quotient (THQ) index. In this equation, RFD is the oral reference dose. RFD for Lead, cadmium, zinc, nickel and arsenic were reported to be 3.5, 0.1, 300, 2, and 3 (mg/kg) per day, respectively [31].

$$THQ = DI/RFD \quad (2)$$

Also, Equation 3 was used to calculate the carcinogenic risk (CR) of heavy metals through chicken consumption. In this equation, CSF is the cancer slope factor (kg.day/mg). CSF has only been reported for arsenic and lead (1500 and 8.5 per day, respectively) [32].

$$CR = DI \times CSF \quad (3)$$

Results and Discussion

The results of heavy metals from the samples are given in (Table 2). As can be seen, the highest amounts of heavy metals are in chicken liver. (Table 3) shows the amount daily consumption, non-carcinogenic risk, and carcinogenic risk of exposure to heavy metals through chicken intake. The international standard for cadmium in food is 50 µg/kg [33]. Cadmium is a carcinogen. Exposure to cadmium increases the risk of lung, gallbladder and lung cancers. The results of this study indicate that the highest concentration of cadmium is in the liver tissue, which may be due to the fact that the liver is responsible for the metabolism of toxins and drugs. The international standard for lead in food is 100 µg/kg, and the maximum daily allowable intake of nickel in an adult is 0.3 mg [34]. Lead can bind to enzymes and proteins in the human body and can interfere with the function of enzymes and protein synthesis [35]. Also, the greatest danger of nickel is its carcinogenic potential [36]. As can be seen from the results, the highest amount of these metals is still in chicken liver. Unfortunately, there is no national standard for arsenic in food in Iran. Among chicken tissues, the highest amount of arsenic is found in the liver. Zinc is an essential metal for humans, but high levels can pose the health risks. The maximum allowable daily intake of zinc in an adult is 60 mg [34-37,38]. As can be seen, the liver has the highest amount of zinc. The results show that the highest amount of heavy metals is present in chicken liver and according to the results of THQ index for all heavy metals studied was less than one, which indicates a low non-carcinogenic risk in chicken intake. But, due to the low price of chicken liver in northern Iran [39,40] , especially in the city of Lahijan, and due to the great interest of the local people in the use of chicken liver in meals (much more than 46.3 g), there is a concern that the people of this region

Table 2: Comparison of average concentrations of heavy metals (µg/kg) in different brands chicken meat in Lahijan.

Samp les	Nickel	Arsenic	Zinc	Lead	Cadm ium	P value
Breast	8±0.03	7±0.02	4670±0.3	19±0.04	9±0.02	0.001
Thigh	27± 0.04	6±0.03	3450±0.5	27±0.06	57±0.02	0.02
Liver	30± 0.003	18±0.03	15310±0.3	33±0.02	70±0.04	0.004

Table 3: DI, THQ, and CR of heavy metals through chicken intake.

Heavy metal	DI	THQ	CR
Nickel	1.33×10^{-5}	0.008	-
Arsenic	$5.97\times^{10-6}$	0.021	8.92×10^{-6}
Zinc	6.1×10^{-2}	0.23	-
Lead	2.67×10^{-5}	0.09	2.4×10^{-7}
Cadmium	2.67×10^{-5}	0.03	-

receive more than the daily allowance intake of heavy metals.

Conclusion

In summary, heavy metals such as nickel, arsenic, lead, zinc, and cadmium were measured in chicken liver, thigh, and breast muscles in Lahijan city (north of Iran). The results showed that the amount of heavy metals studied in chicken is high in some cases and threatens health. Also, the highest amount of heavy metals was in liver tissue. The amount of arsenic in chicken tissues was also a concern. Due to the presence of these heavy metals in the liver, breast and thigh tissues of chickens, their doses are expected to be continuously monitored.

References

1. Alinia-Ahandani E, Sheydaei M (2020) Overview of the Introduction to the New Coronavirus (Covid19): A Review. J Med Biol Sci Res 6: 14-20
2. Alinia-Ahandani E, Alizadeh-Terepoei Z, Sheydaei M (2020) Some Pointed Medicinal Plants to Treat the Tick-Borne Disease. Op Acc J Bio Sci & Res 1: 1-3.
3. Alinia-Ahandani E, Sheydaei M, Shirani-Bidabadi B, Alizadeh-Terepoei Z (2020) Some effective medicinal plants on cardiovascular diseaaes in Iran-a review. J Glob Trends Pharm Sci 11: 8021-8033.
4. Alinia-Ahandani E, Alizadeh-Terepoei Z Sheydaei M, Peysepar-Balalami F (2020) Assessment of soil on some heavy metals and its pollution in Roodsar-Iran. Biomed J Sci & Tech Res 28: 21977-21979.
5. Alinia-Ahandani E, Fazilati M, Boghozian A, Alinia-Ahandani M (2019) Effect of ultraviolet (UV) radiation bonds on growth and chlorophyll content of Dracocephalummoldavica L herb. J. Biomol. Res. Ther 8: 1-4.
6. Sheydaei M, Alinia-Ahandani E. Ghiasvandnia P (2020) Cancer and the role of polymer-carriers in drug delivery. J Genet Cell Biol 4: 217-220.
7. Alinia-Ahandani E, Alizadeh-Trepoei Z, Boghozian A (2019) Positive Role of Green Tea as An Anti-Cancer Biomedical Source in Iran Northern. Am J Biomed Sci& Res 5: 39-42.
8. Alinia-Ahandani E. Boghozian A, Alizadeh-Trepoei Z (2019) New Approaches of Some Herbs Used for Reproductive Issues in the World: Short Review. J Gynecol Women's Health 16: 1-7.
9. Alinia-Ahandani E, Fazilati M, Alizadeh Z, Boghozian A (2018) The Introduction of Some Mushrooms as an Effective Source of Medicines in Iran Northern. Biol Med (Aligarh) 10(5): 451.
10. Haghighi AH, Sheydaei M, Allahbakhsh A, Ghatarband M, Sadat Hosseini F (2014) Thermal performance of poly(ethylene disulfide)/expanded graphite nanocomposites. J Therm Anal Calorim 117: 525-535.
11. Allahbakhsh A, Sheydaei M, Mazinani S, kalaee MR (2013) Enhanced thermal properties of poly (ethylene tetrasulfide) via expanded graphite incorporation by in situ polymerization method. High Perform Polym 25: 576-583.
12. Allahbakhsh A, Haghighi AH, Sheydaei M (2017) Poly(ethylene trisulfide)/graphene oxide nanocomposites: A study on interfacial interactions and thermal performance. J Therm Anal Calorim 128: 427-442.
13. Bagherinia MA, Sheydaei M, Giahi M (2017) Graphene oxide as a compatibilizer for polyvinyl chloride/rice straw composites. J Polym Eng 37: 661-670.
14. Sheydaei M, Alinia-Ahandani E (2020) Synthesis and characterization of methylene-xylene-based polysulfide block-copolymer/carbon nanotube nanocomposites via in situ polymerization method. J Sulfur Chem 41: 421-434.
15. Sadeghi Nasrabadi H, Kalaee MR, Abdouss M, Sheydaei M, Mazinani S (2013) New Role of Layered Silicates as Phase Transfer Catalyst for In Situ Polymerization of Poly(ethylene tetrasulfide) Nanocomposite. J Inorg Organomet Polym Mater 23: 950-957.
16. Sheydaei M, Jabari H, Ali-Asgari Dehaghi H (2016) Synthesis and characterization of ethylene-xylene-based polysulfide block-copolymers using the interfacial polymerization method. J Sulfur Chem 37: 646-655.
17. Sheydaei M, Kalaee MR, Allahbakhsh A, Samar M, Aghili A, et al. (2012) Characterization of synthesized poly(aryldisulfide) through interfacial polymerization using phase-transfer catalyst. J Sulfur Chem 33: 303-311.
18. Sheydaei M, Kalaee MR, Allahbakhsh A, Moradi Rufchahi EO, Samar M, et al. (2013) Synthesis and characterization of poly(p-xylylene tetrasulfide) via interfacial polycondensation in the presence of phase transfer catalysts. Des Monomers Polym 16: 191-196.
19. Sheydaei M, Allahbakhsh A, Haghighi AH, Ghadi A (2014) Synthesis and characterization of poly(methylene disulfide) and poly(ethylene disulfide) polymers in the presence of a phase transfer catalyst. J Sulfur Chem 35: 5295-5301.
20. Sheydaei M, Talebi S, Salami-Kalajahi M (2020) Synthesis of ethylene dichloride-based polysulfide polymers: investigation of polymerization yield and effect of sulfur content on solubility and flexibility. J Sulfur Chem 1-16.
21. Sheydaei M, Edraki M, Alinia-Ahandani E, Moradi Rufchahi E, Ghiasvandnia P (2020) Poly(p-xylene disulfide) and poly(p-xylene tetrasulfide): synthesis, cure and investigation of

mechanical and thermophysical properties. J Macromol Sci A 1-8.

22. Sheydaei M, Kalaee MR, Dadgar M, Navid-Famili MH, Shockravi A, et al. (2011) Synthesis and characterization of a novel aromatic polysulfide in the presence of phase transfer catalyst. 27th World Congress of the Polymer Processing Society,
23. Wang M, He Y, Sen B (2019) Research and management of plastic pollution in coastal environments of China. Environ Pollut 248: 898-905.
24. Krueger MC, Harms H, Schlosser D (2015) Prospects for microbiological solutions to environmental pollution with plastics. Appl Microbiol Biotechnol 99: 8857-8874.
25. Zazouli MA, Bandpei AM, Ebrahimi M, Izanloo H (2010) Investigation of cadmium and lead contents in Iranian rice cultivated in Babol region. Asian JChem 22: 1369-1376.
26. VarolM, Sünbül MR (2018) Biomonitoring of trace metals in the Keban dam reservoir (Turkey) using mussels (Unio elongatulus eucirrus) and crayfish (Astacus leptodactylus). Biol trace elem res 185: 216-24.
27. Demirezen D, Uruç K (2006) Comparative study of trace elements in certain fish, meat and meat products. Meat scie 74: 255-260.
28. Millour S, Noël L, Kadar A, Chekri R, Vastel C, et al. (2011) Pb, Hg, Cd, As, Sb and Al levels in foodstuffs from the 2nd French total diet study. Food Chem 126: 1787-1799.
29. Hosseini SS, Nikoukar A, Dourandish A (2012) Price transmission analysis in Iran chicken market. Int J Agri Manag Dev 2: 243-53.
30. Dadar M, Adel M, Nasrollahzadeh Saravi H, Fakhri Y (2017) Trace element concentration and its risk assessment in common kilka (Clupeonella cultriventris caspia Bordin, 1904) from southern basin of Caspian Sea. ToxinRev 36: 222-227.
31. Fakhri Y, Mousavi Khaneghah A, Hadiani MR, Keramati H, Hosseini Pouya R, et al. (2017) Non-carcinogenic risk assessment induced by heavy metals content of the bottled water in Iran. Toxin Rev 36: 313-321.
32. Fathabad AE, Shariatifar N, Moazzen M, Nazmara S, Fakhri Y, et al. (2018) Determination of heavy metal content of processed fruit products from Tehran's market using ICP-OES: a risk assessment study. Food chem toxicol 115: 436-446.
33. Committee on Specifications, Food Chemicals Codex, of the Committee on Food Protection National Research Council (1972) Food chemicals codex.2nd ed. Washington: National Academy Press P.222-250.
34. Joint FAO/WHO Expert Committee on Food Additives (2002) Evaluation of certain food additives and contaminants.57 report. Hong Kong:World Health Organization 25: 110-171.
35. Kazemeini H, Rahimi E, Kharrattaherdel A, Nozarpour N, Ebadi A (2010) Cadmium concentration in muscle, liver and kidney of sheep slaughtered in Falavarjan abattoir, Iran. Toxicol indust health 26: 259-63.
36. Coogan TP, Latta DM, Snow ET, Costa M, Lawrence A (1989) Toxicity and carcinogenicity of nickel compounds. Crit. Rev. Toxicol 19: 341-84.
37. Alinia-Ahandani E (2018) Milk-increasing medicinal plants. J Pharm Sci Res 10(4).
38. Alinia-Ahandani E, Kafshdar-Jalali H, Mohammadi Ch (2019) Opened Approaches on Treatment and Herbs' Location in Iran. Am J Biomed Sci & Res 5(5).
39. Ahandani EA, Gawwad MRA, Yavari A (2013) Extraction and preparation of psoralen from different plant part of psoralea corylifolia and psoralen increasing with some elicitors. J. Plant Biol. Res 2: 25-37.
40. Alinia-Ahandani E, Nazem H, Boghozian A, Alizadeh Z (2019) Hepatitis and some effective herbs: A review. EAS J. Parasitol. Infect. Dis 1: 20-27.
41. Alinia-Ahandani E (2018) Milk-increasing medicinal plants J Pharm Sci Res.10: 4.
42. Ahandani IA, Asadisamani M, Biranvand M (2010) The introduction of nettle. Monthly of Barzegar 1042 :43.

*Corresponding author: Milad Sheydaei and Ebrahim Alinia-Ahandani, Email: Mi_sheydaei@sut.ac.ir; M.sheydaei@yahoo.com; ebi.alinia@gmail.com