مجلـــة آفاق للدراسات الإنسانية والتطبيقية كلية الآداب والعلوم الإبيار- جامعة بنغازي
Afaq Journal for Human and Applied Studies Faculty of Arts and Sciences ALAbyar University of Benghazi
ISSUE 3 March 2025 16 رمضان 1445 العـــدد: الثالث مـــارس 2025

Estimation of Heavy Metal Contents Cr, Fe, Cu, Pb & Cd in Meat Products Imported in Al-Marj City, Libya

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DOI: https://doi.org/10.37376/ajhas.vi3.7255 | Publication Date: 16/03/2025 | Acceptance Date:15/10/2024 | Date of Receipt: 10/08/2024

Abstract:

This study was conducted for the purpose of determining the level of concentration of heavy elements chromium, iron, copper, lead and cadmium in some types of processed meat imported in the markets of Al-Marj city, where five random samples were collected from different companies. The content of heavy elements in these samples was measured by an atomic absorption spectrometry. The results showed an increase in the concentration of iron and chromium minerals in the samples, where the results of iron ranged between 0.692 to 2.810 mg/L and chromium between 0.136 to 0.811 mg/L, exceeding the values set by the two global health and food organizations, which were 0.3 and 0.05 respectively. The results of the concentrations of copper, lead and cadmium elements in the samples showed rates below the limit allowed by FAO/WHO. The average concentration of copper in the samples ranged from 0.083 to 0.108 mg/L, lead from 0.070 to 0.110 mg/L, and cadmium from 0.025 to 0.049 mg/L. The study recommended periodic inspection of all foods in the local markets.

Keywords: heavy elements, processed meat, sample contamination, scientific health organization, local markets.

تقدير محتويات المعادن الثقيلة الكروم والحديد والنحاس والرصاص والكادميوم في منتجات اللحوم المستوردة في مدينة المرج، ليبيا

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الملخص:

أجريت هذه الدراسة لغرض تحديد مستوى تركيز العناصر الثقيلة الكروم والحديد والنحاس والرصاص والكادميوم في بعض انواع اللحوم المصنعة المستوردة في اسواق مدينة المرج حيث جمعت خمس عينات عشوائية ومن شركات مختلفة. تم قياس محتوى العناصر الثقيلة في هذه العينات بواسطة جهاز طيف الامتصاص الذري. اظهرت النتائج ارتفاع في تركيز معدني الحديد والكروم في العينات، حيث تراوحت نتائج عنصر الحديد بين296.0 الى 018.2 ملجرام/لتر وعنصر الكروم بين 631.0 الى118.0 ملجرام/لتر,متجاوزة بذلك القيم الموضوعة من قبل منظمتي الصحة والغذاء العالمتين والتي كانت3.0 و 50.0 على التوالي. كما اظهرت نتائج تراكيز عناصر النحاس والرصاص والكادميوم في العينات معدلات اقل من الحد المسموح به من قبل OHW/OAF. فكان معدل تركيز النحاس في العينات يتراوح بين 380.0 الى 801.0 ملجرام/لتر, اما الرصاص كانت من 070.0 الى 011.0 ملجرام/لتر, والكادميوم من 520.0 الى 940.0 ملجرام/لتر. ولقد اوصت الدراسة بالفحص الدوري على جميع الاغذية الموجودة في الاسواق المحلية.

الكلمات المفتاحية: العناصر الثقيلة، اللحوم المصنعة، تلوث العينات، منظمة الصحة العلمية، الاسواق المحلية

Introduction:

The world has been paying close attention to food safety. In recent years, eating a variety of foods has been connected to an increased risk of pesticide, toxin, and heavy metal contamination (Dmello, 2003, P.480). Meat and its byproducts were thought to be abundant in essential components, high biological protein, fat, iron, vitamins, and phosphorus. Meat products are essential to human nourishment, but they can also include dangerous substances (Akan, et al., 2002, P.744) Food additives are widely utilized in the production of processed meat because they enhance the meat's texture, color, flavor, and taste and increase its shelf life(Aymerich, et al., 2008, P. 114),(Bondoc, 2007, P.16).

Meat that has been contaminated with heavy metals coming from manufacturing procedures, contaminated feed, contaminated drinking water, growing animals close intimate contact with them through food consumption, especially with meat and items produced from meat)Sabir, et al., 2003, P.98),(Blunden &bWallace, 2003, P.1651-1652). Since heavy metals are not metabolized in the body after ingestion and not bioaccumulation in human tissues, they are exceedingly poisonous and dangerous to the general public's health. This is because they are not broken down during the processing of meat. Heavy metal bioaccumulation is influenced by a number of variables, such as the target organ, bioavailability, metal properties, and consumer age(Harmanescu, et al., 2011, P.2),(Vasile, et al., 2014, P.2412)

It is commonly recognized that trace elements like zinc (Zn) and copper (Cu) as well as heavy metals like lead (Pb) and cadmium (Cd) can bioaccumulation and biomagnifying. Exposure to such metals may have a variety of toxicological effects on humans(Thompson & Darwish, 2019, P.1-14).

This study attempts to determine the levels of heavy metals, iron (Fe), lead (Pb), copper (Cu), cadmium (Cd), and finally Chromium (Cr), in some samples of processed meats imported into Libyan markets because of the topic's significance for science, health, and culture. This is done in order to determine whether the concentrations of certain metals surpass the global maximum allowable level, as set forth in the guidelines of global organizations like the Food and Agriculture Organization (FAO) and the World Health Organization (WHO).

Materials and method

Collection of samples

Five samples were collected from some processed and imported meats from the markets of the city of Al Marj -Libya to estimate some of the heavy elements in them, and they were as follows: the first sample, beef luncheon meat, country of manufacture, Egypt, Al-Bedaya Company, the second sample, beef luncheon meat, country of manufacture, Egypt, Al-Halwani Company, and the

third sample, beef luncheon meat, country of manufacture. Egypt, Original Company, the fourth sample of pastrami meat, country of manufacture: Egypt, Al-Bedaya Company, fifth sample: chicken luncheon meat, country of manufacture: Turkey, Al-Shahya Company.

Samples preparation.

The collected samples were decomposed by wet digestion method for the determination of various metals.The samples were digested. 2 g of each sample was taken and placed in a 100 ml cup, and 15 ml of the digestion solution was added to it, which was prepared at a ratio (1:3) of nitric acid HNO3(65%) and hydrochloric acid HCl(36%), respectively(Moorthy, et al., 2016, P.352). The mixture was homogenized and then left overnight at room temperature, after which the mixtures were heated in a water bath at a temperature of 80°C for two hours. followed by samples dilution and subjected to the filtration step.

Determination of Heavy metals

The concentration of heavy metals (Cr, Fe, Cu, Pb, Cd) in the products of the digestion samples was measured using an atomic absorption spectrophotometer (Thermo scientific Ice 3300AAS) instrument,(U.S.A).

Results and discussion

Five samples of processed and imported meat were taken from the markets of Al- Marj city, Libya, in the year 2024, and they were arranged as in Table 1. The concentrations of the heavy elements iron, chromium, cadmium, lead, and copper were measured, and the results of the obtained concentrations were compared with the rates allowed by the Food and World Health Organizations (FAO/WHO, 2003).

Table 1 shows the order, types and country of manufacture of the samples

Samples	Type of processed meat	Company and country of manufacture
S1	Beef luncheon	Egypt / Al-Bedaya Company
S2	Beef luncheon	Egypt/Al-Halawani Company
S3	Beef luncheon	Egypt/Original Company
S4	Beef pastrami meat	Egypt / Al-Bedaya Company
S5	Chicken luncheon	Türkiye / Shahiya Company

The concentration of heavy metals in samples of processed meat shown in table below(2) . The results of chromium in the samples S1, S2, S3, S4 and S5, where the concentration was respectively 0.811, 0.503, 0.295, 0.583 and 0.136 mg/L above the limit allowed by the World Health Organization and the World Food Organization, which set at 0.0.5mg/L as a maximum.

The results also showed that the concentration of iron as in Table (2) was very high compared to the permissible limit set by the World Health and Food Organization at 0.3mg/L. The results were as follows: S1=0.692, S2=2.103, S3=2.810, S4=1.105 and S5=1.500 mg/L.

The results for the rest of the elements copper, lead and cadmium were within the safe and permissible limits by FAO/WHO as in Table

(2). The range of copper concentration in the samples was 0.083 to 0.108 mg/L, which is within the permissible safe concentrations. As well as the cadmium element, the results were the concentration of the element in all samples according to the permissible limit by FAO/WHO, which was between .0.025 and 0.049 mg/L, while the concentration of the lead element showed the results of the two samples S2 = 0.108 and S4 = 0.110 mg/L were within the maximum permissible limit, while the rest of the samples were less than the recommended limit by by FAO/WHO.

Table (2) concentrations of Cr, Fe, Cu, Pb and Cd in the samples and the permissible limits of FAO/WHO

Metals Samples	Concentration of metal (mg/L)				
	Chromium	Iron	Copper	Lead	Cadmium
Permissible limit by FAO/WHO	0.05	0.3	0.2	0.1	0.05
S1	0.811	0.692	0.084	0.070	0.025
S2	0.503	2.103	0.107	0.108	0.046
S3	0.295	2.810	0.093	0.098	0.039
S4	0.583	1.105	0.108	0.110	0.049
S5	0.136	1.500	0.083	0.093	0.032

Conclusion

As it became clear from the results of this study, iron and chromium showed high rates compared to the rates recommended by international organizations, and these rates may be the cause of many diseases, for example, the high concentration of iron in meat and food products may be the cause of diseases such as low blood pressure, stomach membrane erosion disease, varicose veins and others(Robotham &Litman, 1980,P. 878),(Aisen, et al., 1990, P.2-45). High concentrations of chromium in meat products may cause cancer, fetal malformations and other serious illnesses(Sremoyee, 2015, P.171). On the other hand, the results of the study on the elements copper, lead and cadmium in all samples showed that they were within the safe limits set by FAO/WHO.

Recommendations

1. This study recommends increasing and deepening research in the field of food contamination with various contaminants, especially heavy metals.
2. Increasing control and conducting heavy metal analysis on meat and its products in the Libyan markets, whether local or imported.
3. Rationalizing the use of chemical fertilizers and agricultural pesticides because they may be a source of pollution with heavy metals.
4. The study also recommends educating people about the dangers of pollution and the toxicity of these elements in meat, meat products and other foods on human health.

References

[1]. Aisen P et al.(1990) Iron poisoning. Int Rev

Exp pathol.31: 1-46.

[2]. Akan, J.C., Abdulrahman, F.I., Sodipo, O.A. and Chiroma, Y.A. (2010) Distribution of heavy metals in the liver, kidney and meat of beef, mutton, caprine and chicken from Kasuwan Shanu market in Maiduguri Metropolis, Borno State, Nigeria. Res. J. Appl. Sci. Eng. Technol., 2(8): 743-748.

[3]. Aymerich, T., Picouet, P.A. and Monfort, J.M. (2008) Decontamination technologies for meat products. Meat Sci. 78(1-2): 114-129.

[4]. Blunden,S.and Wallace,T.(2003). Tin in canned food: a review and understanding of occurrence and effect. Food and Chemical Toxicology 41 (12) 1651–1662.

[5]. Bondoc, I. (2007) In: de la Brad II, editor. Tehnologia şş Controlul Calităţii Laptelui şş Produselor Lactate. Vol. 1. Iaþi Publishing, Romania. P.14-19

[6].Dmello, J.P.F.(2003). Food Safety: Contaminants and Toxins. GABI publishing, Wallingford, Oxan, UK, Cambridge , MA, P 480.

[7]. FAO/WHO.(2003). Joint FAO/WHO Food standards Programme Codex Committee on Food Additives And Contaminants.

[8]. Harmanescu, M., Alda, L., Bordean, D., Gogoasa, I. and Gergen, I. (2011) Heavy metals health risk assessment for population via consumption of vegetables grown in old mining area; a case study: Banat County, Romania,chemistry central journa,5:64.

[9].Moorthy.K.S, T. Sivaruban .& S. Barathy. (2016) Assessment of heavy metal pollution and contaminants in the cattle meat, Jr. of industrial Pollution Control 32(1) 350-355.

[10]. Robotham JL, Lietman PS(1980) Acute iron poisoning . Areview. Amj dis child 134(9)875-879.

[11]. Sabir,S.M. Khan,S.W. and Hayat,I.(2003). Effect of Environmental Pollution on Quality of Meat in District Bagh,Azad Kashmir. Pakistan Journal of Nutrition 2 (2): 98-101.

[12].Sremoyee Chatterjee.(2015).Chromium toxicity & its health hazards. International journal of advanced research. 3(7): 167-172.

[13]. Thompson, L.A., Darwish, W.S., 2019. Environmental Chemical Contaminants in Food: Review of a Global Problem. J. Toxicol. ID2345283. P.14.

[14]. Vasile, H.G., Elena, C., Ana, L. and Pararin, B. (2014) Heavy metals contamination levels in processed meat marketed in Romania. Environ Eng. Manag. J., 13(9): 2411-2415.