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Determination of some heavy metals and potassium bromate in pastries offered in local markets

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ABSTRACT

This study was conducted in the laboratories of the Department of Food Sciences - College of Agriculture - Tikrit University from November - 2020 until January - 2021 with the aim of estimating the extent of contamination of pastries offered in the market with heavy metals and estimating the concentration of potassium bromate. The concentration of heavy metals (Cd, Cu, Ni) in pastries from different origins was estimated, as the cadmium concentration reached (<0.05 mg/kg) and did not exceed the internationally permissible limit. As for copper, its concentration ranged between (1.71 - 0.13 mg/kg) and did not exceed the internationally permissible limits. As for nickel, its concentration ranged between (0.16-0.95 mg/kg), and four samples of all studied samples exceeded the internationally permissible limits. This study showed that the potassium bromate concentration in pastries was between 0.21- (25.24 mg/kg) and all samples were within the internationally permissible limits.

تقدير بعض العناصر الثقيلة وبرومات البوتاسيوم في المعجنات المعروضة في الاسواق المحلية

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الخلاصة

أجريت هذه الدراسة في مختبرات قسم علوم الأغذية – كلية الزراعة – جامعة تكريت من تشرين الثاني – 2020 ولغاية كانون الثاني – 2021بهدف تقدير مدى تلوث المعجنات المعروضة في الاسواق بالمعادن الثقيلة وتقدير تركيز برومات البوتاسيوم. تم تقدير تركيز المعادن الثقيلة (Cd, Cu, Ni) في المعجنات من مناشئ مختلفة, اذ بلغ تركيز الكادميوم (<0.05 ملغم / كغم) ولم يتجاوز الحد المسموح به دوليا. أما عنصر النحاس فقد تراوح تركيزه ما بين (1.71 - 0.13 ملغم / كغم) ولم يتجاوز الحدود

المسموح به دوليا. اما النيكل فقد تراوح تركيزه ما بين (0.16-0.95 ملغم/كغم) وتجاوزت اربعة عينات من كل العينات المدروسة الحدود المسموح به دوليا. واضحت الدراسة هذه ان تركيز برومات البوتاسيوم في المعجنات بلغ ما بين(0.21-25.24) ملغم/كغم وكانت جميع العينات ضمن الحدود المسموح بها دوليا.

الكلمات المفتاحية: معجنات, تلوث, عناصر ثقيلة, برومات البوتاسيوم.

INTRODUCTION

The term food contamination refers to the food containing toxic chemicals and microorganisms that cause disease to the consumer, that the person needs useful and beneficial foods for his body, as food provides him with the basic elements required by the body to survive in order to enable him to perform the tasks that are due to him on the full face (Mcwilliams, 2005). The interest in pollution has increased because it has become an old environmental phenomenon associated with the scientific development that the world is witnessing, as pollution has become a global problem that all countries of the world suffer from, including developed and developing countries. It is appearing on all neighborhoods, and clean air and clean food have become one of the most important requirements that must be provided in our time (Watson, 2004). The sources of food contamination vary, some of which are natural, which is represented by the presence of insects and pieces of them or one of the products of their secretions, as well as the presence of sand or dust grains in the food, or the presence of glass or metal pieces (Nriagum and Simmon, 1990). As for the other part of pollution, it is represented by chemical pollution, for it is the presence of additives to food that exceed the permissible limits and the presence of chemical pesticides used in pest control during the production of agricultural crops that are used as raw materials in food manufacturing. Devices and equipment that come into contact with food are an important source of food contamination, especially those Metals that come in direct contact with food, as well as the presence of chemical residues that are used in cleaning utensils used in food processing, which are not degradable and are cumulative inside the body (Gunther, 1980). And it can cause health problems for consumers of these foodstuffs in the long run, as the damage of chemical residues causes cancerous diseases (Watson, 2004).

Among the sources of natural pollution in food are heavy elements, and the interest in the field of heavy elements has taken a large place, like other areas of pollution in the world, because of the great risks to human health and the environment because of their toxic effects, and the danger of heavy elements lies in the difficulty of detecting them, as they are usually discovered after The emergence of cases of poisoning as a result of the accumulation of heavy metals in foods (Barry *et al*., 2000). Some heavy metals are nutritionally important and necessary for the body (such as Zn, Cu and Fe) and some other elements are highly toxic and biologically ineffective (Halttunen *et al*., 2007). The increase in the consumption of heavy metals more than the human need has several

effects, as it causes many diseases and poisonings, and the damages increase by increasing the intake concentrations as well as the quality (Reilly, 2008). In the case of eating contaminated food that contains heavy elements in concentrations higher than the permissible, then it is toxic because it interferes with the functions of cells, leading to disruption in their work, as well as its cumulative danger as the body cannot get rid of it or remove the toxicity when there are body organs in the long run Causes many diseases (Beckett *et al.*, 2007).

Potassium bromate is an additive and is an oxidizing agent. Potassium bromate is used in bakeries for the purpose of improving the qualities of bread and pastries, as the bromate improves flavor characteristics and improves taste and appearance (Emeje *et al*., 2010). When adding bromate to the dough, it increases the bleaching speed and reduces the maturation time, which reduces storage costs and increases the elasticity of the dough (Stuti and D'Souza, 2013). Potassium bromate is an unnatural compound in the form of white crystals that is soluble in water at room temperature, and has poor solubility in ethanol (Korokawa *et al*., 1990). After conducting several studies, it was found that potassium bromate has toxic effects on humans, as potassium bromate has two effects, one of which is by breaking down vitamins E_1, B_2, B_1, A and niacin, which are one of the essential vitamins found in bread products (IARC, 1999). The other effect is that it causes cancerous diseases in humans and animals (Watson, 2004). Potassium bromate has been classified as a human carcinogen through the evidence that has been proven by the International Agency for Cancer, as bromate stimulates the formation of tumors in laboratory animals (Fawell and Walker, 2006).

MATERIALS AND METHODS

A 38 samples of pastries were collected from markets of different governorates, taken from five different origins, and included Iraqi pastries, Turkish pastries, Iranian pastries, Ukrainian pastries, and Jordanian pastries, with two duplicates for each sample.

Estimation of heavy elements

The heavy metals were estimated in the samples using an atomic absorption device (SHIMADZU AA-6200) of German origin according to the method mentioned in (AOAC, 2004), as the ash produced from the incineration process was taken for the purpose of estimating cadmium, nickel and Copper. 5 ml of 5% nitric acid was added to the ash produced after incineration, then filtered using filter paper, and it was estimated using the atomic absorption device for each metal to be

identified and measured by placing the sample in the form of a transparent liquid in the device and estimating its proportion directly.

Determination of potassium bromate

Potassium bromate was estimated according to the method used by (Emeje *et al*., 2010), where 1 gm of each sample was weighed in a sensitive balance and transferred to a test tube and 10 ml of distilled water was added to it and after mixing well, it was left for 20 minutes at laboratory temperature, 5 ml of the filtrate was taken to another test tube and 5 ml of a solution (5% potassium iodide + 0.1 N hydrochloric acid) was added to it, noting changes in color from dark yellow to purple. The focus was estimated using a Spectrophotometer at a wavelength of 540 nm.

RESULT AND DISCUSSION

Estimation of heavy elements

When estimating heavy metals, it was found that the concentration of cadmium for all pastry samples and for all origins was less (<0.05 mg/kg), and it did not exceed the permissible level of cadmium in pastries. It stipulated that if many international organizations concerned with food and its safety, including (Codex-Alimenatrious) stipulated that it should not exceed 0.1 mg/kg(Jawad and Allafaji, 2012). It agreed with the World Health Organization (WHO, 1982) that the permissible limits of cadmium metal for all foods do not exceed 0.05 mg / kg. As for copper, its concentration ranged between (0.13- 1.71 mg / kg), as it reached the highest concentration in the sample Ulker and Nazriz of Turkish and Iranian origen, respectively, and the lowest level in the sample Jordina of Jordanian origin. It did not exceed the concentration specified by many international Codex organizations, including the Food and Drug Administration (FDA),the US Environmental Protection Agency (EPA) and the Australian Standards (Australia Standards), which specified that it should not exceed 10 mg /kg (Lanre-Iyanda and Adekunle, 2012).

As for nickel, its concentration ranged between (0.16 -0.95) mg / kg, as four out of 38 samples exceeded the internationally permissible limits set by the World Health Organization WHO and FAO, Codex- Alimenatrious, which stipulated that no more than 0.5 mg / per gram (Lanre-Iyanda and Adekunle, 2012) and the four samples are Trofino and Anata 0.87 mg / kg of Ukrainian origin and Iranian origin and Mersin 0.67 mg / kg of Turkish origin and Al-Bustani 0.95 mg/kg of Iraqi origin. The level of copper in pastries is (6.73 -9.23) mg / kg.

The cause of contamination with heavy metals results from the means, equipment, and materials used in the manufacturing stages, in addition to the air and surrounding conditions in the baking atmosphere and the fuel used in that process. The low concentrations of these elements in the product may be due to the baking process, which has a significant impact on the levels of elements, especially copper and other minerals. Elements and it depends on the type, stages and methods of baking processes (Jawad and Allafaji, 2012).

Table (1): The heavy materials content of Iraqi pastries

The sample	Ni (mg/kg)	Cu (mg/kg)	Cd (mg/kg)
Tamuwz	0.20	0.30	< 0.05
albustaniu	0.43	0.45	< 0.05
Khasaki	0.87	0.34	< 0.05
Candie	0.28	1.41	< 0.05
Al-Hamdani	0.35	1.71	< 0.05
Rabat	0.46	0.54	< 0.05
Al'agha	0.33	0.75	< 0.05
Regep	0.25	0.34	< 0.05

Table (2): The heavy metal content of Turkish pastries

The sample	Ni (mg/kg)	Cu (mg/kg)	Cd (mg/kg)
Eti	0.39	0.26	< 0.05
Gusto	0.43	0.45	< 0.05
Mersin	0.67	0.34	< 0.05
Today	0.24	1.41	< 0.05
Ulker	0.16	1.71	< 0.05
Infinity	0.33	0.54	< 0.05
Moreno	0.44	0.75	< 0.05
Lark	0.22	0.96	< 0.05

Table (3): The heavy metal content of Iranian pastries

The sample	Ni (mg/kg)	Cu (mg/kg)	Cd (mg/kg)
Genghese	0.20	0.30	< 0.05
Sohan	0.43	0.45	< 0.05
Anata	0.87	0.34	< 0.05
Wayarmun	0.28	1.41	< 0.05
Nazreez	0.35	1.71	< 0.05
Aydin	0.46	0.54	< 0.05
Isfahan	0.33	0.75	< 0.05
Shibaba	0.25	0.34	< 0.05

Table (4): The content of heavy elements in Ukrainian pastries

The sample	Ni (mg/kg)	Cu (mg/kg)	Cd (mg/kg)
Roshan	0.23	0.34	< 0.05
Kanti	0.20	0.45	< 0.05
Trofino	0.87	0.23	< 0.05
Esmeralda	0.45	0.73	< 0.05
Gronoschki	0.41	1.32	< 0.05
Delicia	0.33	0.25	< 0.05
Gorman	0.34	0.60	< 0.05
Cusc	0.29	0.71	< 0.05

Table (5):The heavy metal content of Jordanian pastries

The sample	Ni (mg/kg)	Cu (mg/kg)	Cd (mg/kg)
Jordana	0.36	0.13	< 0.05
Junior	0.43	0.62	< 0.05
Alnajmu	0.30	1.51	< 0.05
Rivana	0.47	1.10	< 0.05
Lusine	0.29	0.48	< 0.05
Dolsol	0.22	0.78	< 0.05

Determination of potassium bromate

Tables (6, 7, 8, 9, 10) show the results of potassium bromate concentration in pastries, and the concentration ranged between (0.21 - 25.24) mg/kg, where the highest concentration of bromate in Eti sample of Turkish origin, while the lowest concentration in the sample Anata of Iranian origin. As all the studied samples did not exceed the permissible limits recommended by the US Food and Drug Administration (FDA) for the maximum levels of potassium bromate in the range of 50 mg/kg of flour mass, and that 14 out of 38 samples exceeded the permissible limits in the Japanese standard, which was determined to be present at a concentration of no more than 10 mg/kg (Korokawa *et al*., 1990).

Table (6): The concentration of potassium bromate in Iraqi pastries

Samples	$KBrO_3$ (mg/kg)
Tamuwz	8.76
albustaniu	11.33
Anata	25.24
Wayarmun	4.66
Nazreez	16.50
Aydin	10.11
Isfahan	9.35
Shibaba	1.31

Table (7): The concentration of potassium bromate in Turkish pastrie

Samples	$KBrO_3$ (mg/kg)
Eti	0.21
Gusto	1.30
Mersin	18.51
Today	9.20
Ulker	19.42
Infinity	8.73
Moreno	5.33
Lark	4.67

Table (8): The Concentration of potassium bromate in Iranian pastries

Samples	$KBrO_3$ (mg/kg)
Genghese	8.76
Sohan	11.33
Anata	25.24
Wayarmun	4.66
Nazreez	16.50
Aydin	10.11
Isfahan	9.35
Shibaba	1.31

Table (9): The concentration of potassium bromate in Ukrainian pastries

Samples	$KBrO_3$ (mg/kg)
Roshan	6.49
Kanti	7.88
Trofino	22.32
Esmeralda	11.85
Gronoschki	12.68
Delicia	13.49
Gorman	0.23
Cusc	1.56

Table (10): Concentration of potassium bromate in Jordanian pastries

Samples	$KBrO_3$ (mg/kg)
Jordana	0.21
Junior	1.30
Alnajmu	18.51
Rivana	9.20
Lusine	19.42
Dolsol	8.73

The reason for the presence of potassium bromate is due to its use as an improved material for bread and pastries in order to obtain large-sized products and is added to flour for the purpose of increasing the bleaching of flour, as well as used in water purification (Ergetie and Hymete, 2012).

CONCLUSION

The proportion of cadmium, copper and nickel in all samples of origin within the internationally permissible limits, except four samples that exceeded the permissible limits of nickel. All studied samples contained potassium bromate within the permissible limits.

CONFLICT OF INTEREST

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

REFERENCES

A.O.A.C. (2004). Association of Official Chemists, 12th ed., Washington, D.C.

Barry, P., Kelly, A. and Macintosh, D. (2000). Analysis of dietary intake of selected metals in the NHEXAS Investigation. J. Env. Health Persp., 109(2), 4-6.

Beckett, W. S., Nordberg, G. F. and Clarkson, T. W. (2007). Routes of exposure, dose and metabolism of metals: Handbook on the Toxicology of Metals.

Emeje, M. O., Ofoefule, S. I., Nnaji, A. C., Ofoefule, A. U. and Brown, S. A. (2010). Assessment of bread safety in Nigeria: Quantitative determination of potassium.

Ergetie, Z., and Hymete, A. (2012). Determination of potassium bromate in bread samples from five bakeries in Addis Ababa, Ethiopia. International Journal of Pharmacy and Industrial Research, 2(4), 397-399.

Fawell, J. and Walker, M. (2006). Approaches to determining regulatory values for carcinogens with particular reference to bromate. Toxicology, 221(2-3), 149-15.

Gunther, F. A. (1980). Interpreting pesticide residue data at the analytical level. In Residue reviews (pp. 155-171). Springer, New York, NY.3.

Halttunen, T., Finell, M. and Salminen, S. (2007). Arsenic removal by native and chemically modified lactic acid bacteria. International journal of food microbiology, 120(1-2), 173-178.

IARC. International Agency for Research on Cancer (1999). In: IARC Monographs on Evaluation of Carcinogenic Risks to Humans, 71:1285-1290.

Jawad, I. and Allafaji, S. H. (2012). The levels of trace metals contaminants in wheat grains, flours and breads in Iraq. Aust J Basic Appl Sci, 6(10), 88-92.

Kurokawa, Y., Maekawa, A., Takahashi, M. and Hayashi, Y. (1990). Toxicity and carcinogenicity of potassium bromate--a new renal carcinogen. Environmental health perspectives, 87, 309-335.

Lanre-Iyanda, T. Y. and Adekunle, I. M. (2012). Assessment of heavy metals and their estimated daily intakes from two commonly consumed foods (Kulikuli and Robo) found in Nigeria. African journal of food, agriculture, nutrition and development, 12(3), 6156-6169.

McWilliams, M. (1993). Foods: experimental perspectives. Macmillan.

Nriagu, J. O. and Simmons, M. S. (1990). Food contamination from environmental sources. John Wiley and Sons.

Reilly, C. (2008). Metal contamination of food: its significance for food quality and human health. John Wiley and Sons.

Stuti, M. A. R. I. A. and D'Souza, D. O. R. I. S. (2013). Effects of potassium bromate on the kidney and haematological parameters of swiss albino mice. Bioscan, 8(3), 1011-1014.

Watson D. (Ed.). (2004). Pesticide, veterinary and other residues in food. Woodhead publishing.

WHO, World Health Organization (1982). Toxicological evaluation of certain food additives and food contaminants WHO Food series 17, Geneva.