International Journal of Research Studies in Biosciences (IJRSB)
Volume 2, Issue 2, March 2014, PP 21-24
www.arcjournals.org

Evaluation of Heavy Metals Contamination of Unrefined and Refined Table Salt

Ali Heshmati
Biochemistry and Nutrition Department, Medicine Faculty,
Hamadan University of Medical Sciences and Health Services,
Hamadan, Iran.
a.heshmati@umsha.ac.ir

AliasgharVahidinia
Biochemistry and Nutrition Department,
Medicine Faculty,
Hamadan University of Medical Sciences and
Health Services,Hamadan, Iran

IrajSalehi
Department of Physiology,
Hamadan University of Medical Sciences and
Health Services,
Hamadan, Iran.

Abstract:*Edible salt is the most used food additive worldwide. Therefore, any contamination of table salt could be considered as a health hazard to the consumers. The present study goal is to determine the levels of heavy metals in the table salt refined and unrefined. Eighty one refined salt samples and 81 unrefined salt samples were purchased from retail market in the province of Hamadan, Iran. The level of lead (Pb), cadmium Cd), mercury (Hg), copper (Cu) and Iron (Fe) was determined using atomic absorption spectroscopy method. The levels of Pb, Cd, Hg, Cu, Fe refined salt samples were 0.852 ± 0.277, 0.229 ± 0.012, 0.054 ± 0.040, 1.25 ± 0.245 and 0.689 ± 1.58 µg/g, respectively, and also 1.22 ± 0.320, 0. 240 ± 0.018, 0.058 ± 0.007, 1.89 ± 0.218, 8.75 ± 2.10 µg/g in unrefined salt samples. In comparison to refined salts, analyzed heavy metal contents were generally at high level in unrefined salts. All values for toxic metals were lower than the permitted maximum for human consumption as prescribed by Codex Alimentarius commission.*

Keywords:*Heavy metal, Sodium chloride, lead, Cadmium, Mercury, Iran*

1. INTRODUCTION

Trace elements or heavy metals are widely present in the earth's crust, in air, water and food. Heavy metal contamination in food is a matter ofgreat concern for human healthy because they are toxic in nature and even at relatively low concentrations can cause adverse effects. Although adverse health effects of heavy metals have been known for a long time, exposure to heavy metals continues and in some countries is even increasing [1]. To limit the possibilities of food poisoning in humans caused by ingestion of excessive amounts of trace elements via food and water, highest allow able concentrations of trace elements are fixed.

Human might be exposure heavy metal through inhalation and dermal contact although food and drink is major exposure path for heavy in most people [2]. Edible salt is biological necessities because it provides important two trace element sodium and chlorine for human body and improves food taste and could serve as preservative and elongate shell life and is the most additive used in food industry [1]. Salts such as other food might be contaminated by various chemical substances. The concentration of heavy metals in table salt should be rigorously controlled. Edible salt may contain contaminants in amounts and in such form that may be harmful to the health of the consumer. Some studies showed that the heavy metals in different levels are found at edible salts [1, 3-7]. The aim of this study was to determine lead (pb), cadmium (Cd), mercury (Hg), Copper (Cu) and Iron (Fe) of refined and unrefined table salt samples consumed in the province of Hamadan, Iran and to compare them with the standards established for human health.

2. MATERIALS AND METHODS

2.1 Sampling

Eighty one refined salt samples and 81 unrefined salt samples were purchased from retail market in the province of Hamadan, Iran. Twenty five grams of each sample was used for analysis.

2.2 Reagents and solutions

All material used in the presented study were obtained from Merck, Darmstadt, Germany. Solutions were prepared with double-deionized water. The calibration curve was established using standard solutions prepared in 1 mol HNO3 by dilution from 1,000 mg/l stock solutions. The calibration standards were not submitted to the preconcentration procedure. Approximately 0 .1% solution of Dy2O3 was prepared freshly by dissolving dysprosium (III) oxide (suprapure grade, Merck) in small amounts of nitric acid and diluting to 50 ml with double distilled water. Nitric acid (65%) used for preparing of diluted acid solution was supra pure grade from Merck

2.3 Analysis of Unrefined and Refined Table Salts

Graphite furnace atomic absorption spectroscopy(model AA240 G, Varian, Inc.) was used for measurment of heavy metal (Pb, Cd, Cu, Fe) in edible salt samples.

The procedure applied by Soylak et al. (2008) and Peker et al. (2007) was used to heavy metal in all salt samples [6, 8]. Briefly, 2.0 g of salt sample was dissolved in 20 ml of distilled water. After adding 1.0 mg of dysprosium, precipitates of dysprosium hydroxide was formed and ammonia was used to adjust the pH of the solution (pH11). The tube is slowly and carefully shaked for several seconds and allowed to stand for 10 min. The precipitate is centrifuged at 3,000 rpm for 10 min and the supernatant is discarded. A small precipitate adheres to the bottom of the tube. Then, 1 ml of 1 M HNO3 is added to dissolve the precipitate. The final volume was completed to 2.0 ml with distilled water. An aliquot 100 µl of the solution was introduced into Graphite furnace atomic absorption spectroscopy for measurement of Pb, Cd, Fe, Cu.

Hg was measured by using cold vapouratomic absorption spectrophotometery.

2.4 Statistical analysis

All the data analyzed using SPSSP version 17.1. One sample T test used for determination of difference between levels of heavy metal in refined or unreinfed salt samples and maximum limits levels permited in codex standard. Difference between mean of heavy metals in refined or unrefined salt samples was compared by independent t test. $P < 0.05$ was considered as significant differences.

3. RESULT AND DISCUSSION

Tables 1 show the heavy metal content obtained from analysis of table salt samples. The values are reported based on dry weight. Pb, Cd, Hg, Cu and Fe contents in refined salts were lower than it in unrefined salts although there were no significant differences between the two salt groups in Cd and Hg. Concentration of Pb, Cu and Fe was significantly higher in unrefined compared to the refined salts ($P< 0.05$).

Several researchers have reported the presence of trace element in the salts consumed by human [1, 3-7]. Lead is one of the most toxic heavy metal that accumulates in the body and data published in literature indicates that its excessive intake harm different systems and organs such as central and peripheral neural system, gastrointestinal tract, muscles, kidneys and hematopoietic system [9]. The maximum permitted level of lead in food grade salt is 2.0 µg/g according to the Codex legislation [10] and 1.0 µg/g according to the Iranian food standards [11]. In our study, Pb content of refined and unrefined salt samples was 0.852 µg/g and 1.22µg/g respectively, which the first is below the permitted levels and the latter is higher than it. In another report in Iran, Pb concentration was 2.728µg/g (range 0.01-5.8µg/g) [1] and in salt samples from Tehran, lead content was 0.87 µg/g [4] and 0.438 µg/g [1]. In a study done by Pourgheysari et al (2007) in Isfahan, lead content was determined to be 0.57 µg/g in refined salt and 0.61 µg/g in unrefined salt [5]. In the literature, it was reported in the range of 0.5-1.64 µg/g in refined and unrefined table salt samples from Turkey, Egypt and Greece and 0.03µg/g in Brazil [6].

In our study, mean Cd found in refined and unrefined was 0.229 and 0.240 µg/g. These results obtained in the present work were comparable with values reported in other studies. In Turkey, Cd content found in refined and unrefined was < 0.14 - 0.3 µg/g and 0.14 – 0.21 µg/g, respectively In other country such as Brazil, Egypt, Greece has reported 0.01-0.03, 0.18-0.22 and 0.18-0.19 µg/g Cd in edible salts[6]. In some studied done in Iran, Cd amount found in salts was more than it found in our results. In survey done in Tehran, Cd content in kitchen and table salt was 0.91 and 0.65 µg/g, respectively [4].

At low concentration, Copper and Iron are essential for human healthy, although high levels of these elements are toxic. Despite the positive effects of optimal levels of copper, harmful effects may occur if a threshold level is exceeded. Wilson's disease (hepatolenticularic degeneration) is one of the diseases linked to the excess of copper in the body. It results from a dysfunction of the copper transmission process, which occurs due to a lack of suitable enzyme to catalyze the process of copper deletion from detached bonds with albumins and binding to ceruloplasma. The condition leads to neuron degradation, liver cirrhosis, and occurrence of colorful rings on the cornea [12].

Our results are consistent with previous studies on Content of toxic and essential metals in recrystallized and washed table salt in Shiraz, Iran[3].

Table 1.*Contents of Pb, Cd, Hg, Cu and Fe (µg/g) in refined and unrefined salts.*

	Mean ± S.D			**range**			**Iranian food standard**		**Codex Standards**
	Refined salts	Unrefined salts		Refined salts	Unrefined salts				
Pb	0.852 ± 0.277a	1.22 ± 0.320b		0.430 - 1.520	0.45 -1.870		1.0		2.0
Cd	0.229 ± 0.012a	0.240 ± 0.018a		0.110 ± 0.650	0.090 - 0.900		0.2		0.5
Hg	0.054 ± 0.040a	0.058 ± 0.007a		0-0.170	0.25 – 0.180		0.05		0.1
Copper	1.25 ± 0.245a	1.89 ± 0.218b		0.96 – 2.08	1.05 – 2.41		2.0		2.0
Iron	6.89 ± 1.58a	8.75 ± 2.10b		4.1 – 9.87	5.3 – 11.2		10.0		-

Means in the same row having the same letters are not significantly different at $P< 0.05$

4. Conclusion

In conclusion, all values for toxic metals were significantly lower than the permitted maximum for human consumption as prescribed by Codex and ISIRI. Pb was generally at higher concentration in all the analyzed samples whereas Hg was at lower level in the investigated samples. In comparison to refined salts, analyzed heavy metal contents were generally at high level in unrefined salts.

Acknowledgments

The authors would like to thank the Vice chancellor of research and Technology of Hamadan University of Medical Sciences and Health for financial helps.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] Cheraghali AM, Kobarfard F, Faeizy N. 2010. Heavy metals contamination of table salt consumed in iran. Iranian journal of pharmaceutical research. 9(2):129-32.

[2] Zukowska J, Biziuk M, 2008. Methodological evaluation of method for dietary heavy metal intake. Journal of Food Sciences. 00(0):R1– R9.

[3] Eftekhari MH, Mazloomi SM, Akbarzadeh M, Ranjbar M. 2014. Content of toxic and essential metals in recrystallized and washed table salt in Shiraz, Iran. Journal of environmentalhealth science and engineering. 12(10): 1-5.

[4] JahedKhaniki GR, Dehghani MH, Mahvi AH, Nazmara S. 2007. Determination of Trace Metal Contaminants in Edible Salts in Tehran (Iran) by Atomic Absorption Spectrophotometry. Journal of Biological Sciences.7: 811-814.

[5] Pourgheysari H, Moazeni M, Ebrahimi A. 2012. Heavy metal content in edible salts in Isfahan and estimation of their daily intake via salt consumption. International Journalof Envirment Health Engineering 1(1):41-45.

[6] Soylak M, Peker D, Turkoglu O. 2008. Heavy metal contents of refined and unrefined table salts from Turkey, Egypt and Greece. Environ Monit Assess. 143(1-3):267-72.

[7] Zarei M, Eskandari MH, Pakfetrat S. 2011. Determination of Heavy Metals Content of Refined Table Salts. American-Eurasian Journal of Toxicological Sciences. 3(2): 59-62.

[8] Peker DSK, Turkoglu O, Soylak M. 2007. Dysprosium (III) hydroxide coprecipitation system for the separation and preconcentration of heavy metal contents of table salts and natural waters. Journal of Hazardous Materials. 143: 555-560

[9] Ciobanu C, Slencu BG, Cuciureanu R. 2012. Estimation of dietary intake of cadmium and lead through food consumption.Revista medico-chirurgicala a Societatii de Medici siNaturalisti din Iasi. 116(2):617–623.

[10] Codex Alimentarius Commission. 2006. Codex standard for food grade salt. CX STAN 150-1985, Amend, 3–2006. 1–7.

[11] Institute of Standards and Industrial Research of Iran (ISIRI). 2005. Food grade salt specifications. No. 26, 3rd revision.

[12] DiDonato, M. and Sakar, B. 1997 .Review: Copper transport and its alterations in Menkes and Wilson diseases, Biochimica et BiophysicaActa, 1360, 3–16.