International Journal for Research in Applied Sciences and Biotechnology

ISSN: 2349-8889
Volume-9, Issue-1 (January 2022)

www.ijrasb.com

https://doi.org/10.31033/ijrasb.9.1.18

Hazard Coefficient of Copper Present in Mint Herbal Tea Infusions in Relation to the Age of Surveyed Preschool Children

Nisveta Softić[1], Halid Makić[2], Nenad Stojanović[3], Jasmin Sefer[4] and Husejin Keran[5]
[1]Public Health Institute of Central Bosnia Canton, BOSNIA & HERZEGOVINA
[2]Faculty of Biotechnical, University of Bihać, BOSNIA & HERZEGOVINA
[3]Faculty of Agriculture, University of Banja Luka, BOSNIA & HERZEGOVINA
[4]Faculty of Technology, University of Tuzla, BOSNIA & HERZEGOVINA
[5]Faculty of Technology, University of Tuzla, BOSNIA & HERZEGOVIN

[1]Corresponding Author: nisveta.softic@gmail.com

ABSTRACT

Providing the population with sufficient quantities of hygienically healthy food is the foundation of public health protection. According to the current BiH Law on Food, the main goal is to ensure a high level of human health protection, and the measures applied should be based on risk assessment. Regular food monitoring is one of the key public health problems, and this paper presents the quantitative risk of copper intake by consuming mint herbal tea infusions. The average copper concentration in the 20 analyzed samples of mint herbal tea infusions was 0.0028 ± 0.0125 mg / kg, while the value of the average daily intake was less than the oral reference dose for copper, so that the hazard coefficient itself was <1 , and consuming the analyzed infusions of herbal mint tea has no harmful effects on the health of the surveyed children.

Keywords- Risk assessment, hazard coefficient, herbal tea, heavy metals.

I. INTRODUCTION

In the modern world, chemical hazards are ubiquitous, and the human body is exposed to an increasing number of both anthropogenic and natural origins (1). Herbal tea infusions, after water, are the most commonly consumed beverage in the world. This can be attributed to their pleasant taste and smell, but also to their health effects (2). Copper is a heavy metal that is one of the essential elements for the human body, so deficiency as well as excessive concentrations can cause side effects (3,4,5). The recommended daily intake of copper for children aged 4 to 8 years is 440 µg / kg, or 1mg / day (6.7). Although copper is an essential metal, excessive intake can have various toxic effects on the functioning of the organism. Acute exposure causes vomiting, stomach cramps and diarrhea, while chronic exposure to copper manifests itself in damage to the liver and neurological system (8). In order to minimize the risk to human health from contaminants in food, the BiH Food Law prescribes regular monitoring of the same, all with the aim of a high level of protection of human life and health (9).

II. MATERIAL AND METHODS

For analysis on copper content, 20 samples of mint herbal tea from different manufacturers were sampled on the free market. They were made from infusions by holding a filter bag in 100 ml of deionized hot water for 5 minutes. After5 minutes, the filter bag was removed and the infusion was allowed to cool to room temperature, after which the copper concentration was measured in each of the 20 prepared infusions by the AAS method, as well as in the blank determination. Standard copper solutions with concentrations of 0.001.0.01, 0.05 and 1 mg/l were used to calibrate the AAS. An anonymous survey of randomly selected 200 preschool children collected data on body weight, age, frequency and amount of consumption of these infusions of herbal mint tea. Of the 200 children surveyed, 14 were 4 years old, 66 were 5 years old, and 120 were 6 years old. The copper hazard index, as an instrument for quantitative health risk assessment of anonymously surveyed children consuming these infusions of herbal mint tea, was calculated as the ratio of average daily metal intake (I) by consuming these infusions of herbal mint tea and the corresponding oral reference dose for copper (RfD) (10):

$$HQ_{Cu}=I/RfD$$

To calculate the average daily intake of copper by consuming infusions of this herbal tea, data obtained by anonymous survey and analysis of infusions on copper content by AAS are needed, according to the formula (11):

$$I = \frac{C x C_r x E_f x E_d}{Bw x At} \quad (mg/kg\ BW/day)$$

Where: I-average daily intake (mg/kg /BW/day), C-average copper concentration in sampled herbal teas (mg/kg), Cr- average ingestion rate (ml/person *day), Ef- average exposure frequency to mint herbal tea infusion (days / year), Ed= exposure

ISSN: 2349-8889
Volume-9, Issue-1 (January 2022)

https://doi.org/10.31033/ijrasb.9.1.18

duration in years, Bw-average bodyweight and At-average exposure time in days.

III. RESULTS AND DISCUSSION

The results of the analysis of 20 samples of dry matter of mint herbal tea and the same number of samples of prepared infusions of this tea for copper content are shown in Table 1.

Table 1: Average copper concentration in dry matter samples and in mint herbal tea infusions

Sample	Number of analyzed samples	Average copper concentration (mg/kg)	Standard deviation
Dry matter ofmint herbal tea	**20**	**11,2841**	**1,2919**
Infusion of herbal mint tea	**20**	**0,0028**	**0,0125**

From Table 1, it can be seen that the average value of copper in tea dry matter was 11.2841mg/ kg, while in mint tea infusion it was 0.0028 mg / kg. Based on the following parameters collected by anonymous survey and analysis of samples: C=0.0028 mg/kg, Cr=0.2 ml, Ef=288 days/year, Ed=2, Bw=21.395 kg, At=730 (2 years) days, the value of the average daily intake of copper (I) was calculated by consuming the analyzed samples of mint herbal tea infusions (Table 2).

Table 2: Average daily intake of copper by consuming herbal tea infusions in relation to the age of the surveyed children

Age of surveyed children	Average daily consumption of Cu (mg/kg BW/day)
4	**$3{,}377x10^{-5}$±0,000002434**
5	**$2{,}889x10^{-5}$±0,000003339**
6	**$2{,}504x10^{-5}$±0,000003494**

The highest value of the average daily intake of copper was in children aged 4 years, $3.377x10^{-5}$ ± 0.000002434 mg / kg BW / day, while the lowest was in children aged 6 years, $2.504x10^{-5}$ ± 0.000003494 mg / kg BW / day.

Based on the value of the average daily intake and tabular data for the oral reference dose (RfD) for copper, prescribed by the European Food Safety Authority (EFSA) (10), the value of non-carcinogenic hazard coefficient for copper HQCu was calculated in relation to the age of surveyed children (Table 3).

Table 3: Values of the oral reference dose and quantitative values of copper hazard coefficients in relation to the age of the surveyed children

Age of surveyed children	RfD (mg/kg BW/day)	Hazard coefficient of Cu HQ_{Cu}
4	**1,0**	**$4{,}281x10^{-5}$±0,0000031**
5	**1,0**	**$3{,}662x10^{-5}$±0,0000042**
6	**1,0**	**$3{,}174x10^{-5}$±0,0000044**

The value of the copper hazard coefficient in relation to age was the highest in children aged 4 years, $4.281x10^{-5}$ ± 0.0000031, and the lowest in children aged 6 years, $3.174x10^{-5}$± 0.0000044.

Diagram 1 graphically shows the values of copper hazard coefficients by consuming mint herbal tea infusions, prepared by holding filter bags in water for 5 minutes, compared to the age of the surveyed children.

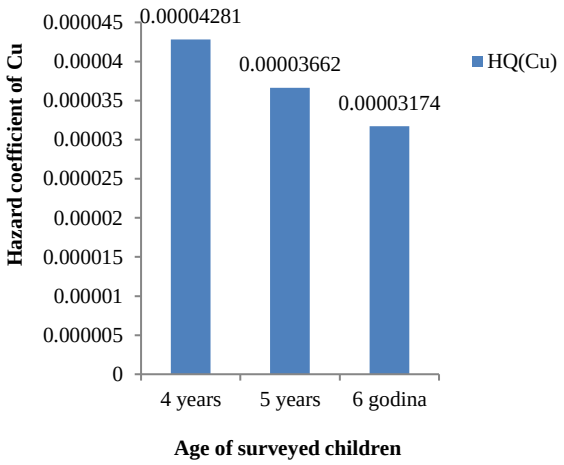

Diagram1. Graphic representation of HQCu values in relation to the age of the surveyed children

Diagram 1 clearly shows the decrease in the value of the hazard coefficient with increasing age of children, from a maximum of $4.281x10^{-5}$ ± 0.0000031, to a minimum of $3.174x10^{-5}$ ± 0.0000044.

IV. CONCLUSION

The results of this study showed that the average daily intake of copper by consuming infusions of herbal mint tea decreases with age, because with age the body weight and body surface area of children increases. As the average daily intake of copper decreases with age, the hazard coefficients of copper ingested by consuming infusions of herbal mint tea decreases as well. Since the values of HQ_{Cu} hazard coefficients are less than the oral reference dose of copper (RfD_{Cu}), that is the value of the ratio of average

ISSN: 2349-8889
Volume-9, Issue-1 (January 2022)

https://doi.org/10.31033/ijrasb.9.1.18

daily intake and oral reference dose of copper is <1, there is no risk to children's health from this intake by consuming herbal mint infusions prepared by filter bags in water for 5 minutes.

LITERATURE

[1] Ingenbleek,L., Lautz, L., S., Dervilly, G., Darney, K., Astuto, M., C., Tarazona, J., Liem, A., K., D., Kass, G., E., N., Leblanc, J., C., Verger, P., Le Bizec, B., and Dorne, J., L., C., M., (2020): *Risk Assessment of Chemicals in Food and Feed: Principles, Applications and Future Perspectives;* Environmental Pollutant Exposures and Public Health, pp. 1-38 DOI: 10.1039/9781839160431-00001

[2] Hollman, P., (2009): *Bioactives of tea*, Aterosclerosis Supp l10(2):S1-11

[3] Gibney M.,J.; Vorster H.,V. i Kok F.,J.,(2009): Introduction to Human Nutrition: Blackwell Publishing

[4] Mahmoud, M.G.; Mona, A.K.;Eglal, R.S., (2019): *Optimization and Validation of an Analytical Method for the Determination of Some Trace and Toxic Elements in Canned Fruit Juices Using Quadrupole Inductively Coupled Plasma Mass Spectrometer*.J AOAC Int 102: 262-270

[5] Yang, M.H., Yuh, C.S., Yu, T.C., Jerzy, M., (1999): *Comparative Determination Of Ba ,Cu , Fe , Pb And Zn In Tea Leaves By Slurry Sampling Electrothermal Atomic Absorption And Liquid Sampling Inductively Coupled Plasma Atomic Emission Spectrometry* Talanta 47(5): 1263-1270

[6] NAP, National Academy Press,(2001): *Dietary reference intakes for vitamin A, vitamuin K, boron, chromium, copper, iodine, iron, manganese, molybdenium, nickel, silicon, vanadium and zinc*, Washington DC : Institute of medicine. Iron, ISBN 0-309-07279-4, 2001

[7] SCF. *Opinion of the Scientific Committee on Food on the tolerable upper intake level of copper. Scientific Committee on Food*, European commission; 2003

[8] Berkow R., Beers H.,M. i Fletcher J.,A. (2008):*The Manual of Medical Information*, Medicinski priručnik za pacijente, Drugo hrvatsko izdanje, Placebo d.o.o, Zagreb

[9] Zakon o hrani BiH (SlužbeniglasnikBiH br. 50/04)

[10] EFSA- OpenFoodTox: EFSA´s chemical hazards database, march 27, 2020 (available on: https://zenodo.org/record/3693783#.YfjzaNXMKUl)

[11] Ahmetović N.; Keran H., (2018): Analiza i upravljanje rizicima u hrani - Tuzla : IN SCAN d.o.o., 2018