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BANSKÁ BYSTRICA, SLOVAK REPUBLIC, 8 – 10 OCTOBER 2018

*The activity has been implemented within the framework of national project
Information and providing advice on improving the quality of environment in Slovakia.
The project is cofinanced by Cohesion Fund of the EU under Operational programme Quality of Environment.*

Risk assessment of *Cu* and *Mo* exposure through consumption of vegetables grown under the impact of Kajaran's mining complex

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Mining industry is one of priority sectors of Armenia's economy.



Impact of mining industry on agriculture



TRANSFER OF TRACE ELEMENTS FROM SOIL TO PLANT



Fruits and vegetables in diet

Fruits and vegetables grown under the impact of mining industry are also sold in the markets of adjacent urban areas.

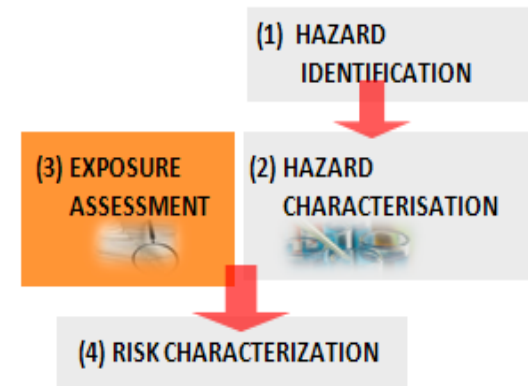
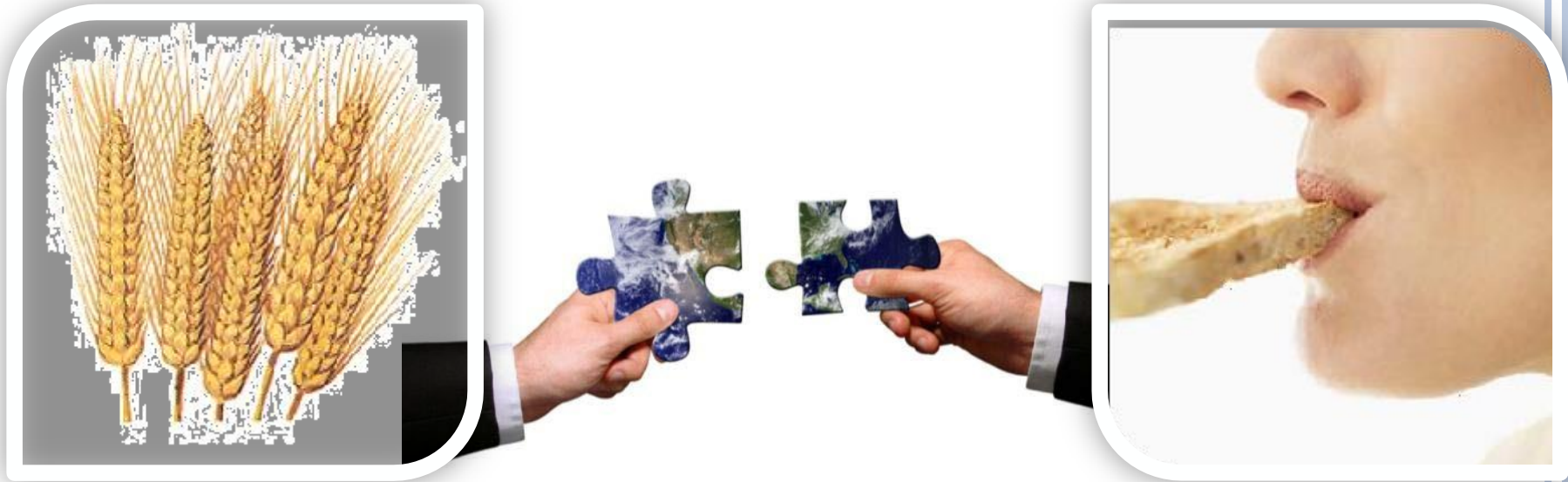




**Study covered
the markets of
KAJARAN
TOWN**

**N 39°09'17,72"C,
E 46°07'46.00**

HUMAN EXPOSURE ASSESSMENT



Material and method

- ✚ **SOPs** was elaborated in compliance with requirements of WHO/FAO.
- ✚ **Food frequency questionnaire** was elaborated to assess a **diet** of local population.
- ✚ Concentrations of trace elements (**Cu, Ni, Pb, Zn, Hg, As and Cd**) in **soil samples** were estimated using a **XRF analyzer (Innov X-5000)**.
- ✚ A **Perkin Elmer AAnalyst 800 AAS** was used to quantify the concentrations of trace elements in the filtrate of digested **plant samples**.
- ✚ **Statistical analyses** were carried out by Microsoft Excel и SPSS (SPSS Ins., Version 11).



**XRF
analyzer**



AAS

VEGETABLES



POTATO



CARROT



PUMPKIN



BEAN




FENNEL

DIET STUDY (FFQ)

- Individual-based approach
- 4 food item food frequency questionnaire (FFQ)





Questionnaire N _____ / _____ / 2017

Dear participant, the following survey is conducted by the Informational-Analytical Center for Risk Assessment of Food Chain of the Center for Ecological-Noosphere Studies of National Sciences of RA. The survey is designed to investigate the consumption of vegetables and fruits among Yerevan residents. When answering to the questions, please, be as honest as possible because your participation is highly important.

We would like to inform that the survey is ANONYMOUS, no personal data will be recorded and the results will be presented in a general format.

Block 1. Consumption data

1. How much and how often do you consume the following products?

Food type	Not consumed	Consumption frequency						Consumption portion (daily)
		1. Every day	2. 2-4 times a week	3. Once a week	4. 2-3 times a month	5. Once a month	Other	
1. Potato								
2. Bell Pepper								
3. Tomato								
4. Cucumber								

2. Where do you usually buy the following products?

Food type	Not consumed	Bazaar							Supermarket					Vegetable garden	Other	Mention the origin of food item, if possible
		1. GEM	2. Mahara	3. Nor-Norq	4. Komitas	5. Shagapart	6. Erebuni	Other	1. Yerevan City	2. SAS	3. Evrika	4. Nor Znotq	5. ITTAN			
1. Potato																
2. Bell Pepper																
3. Tomato																
4. Cucumber																

Block 2. Personal data

21. District: _____

22. Age: _____

23. Gender: 1) M. 2) F.


24. Education: 1) Higher 2) Vocational 3) Secondary

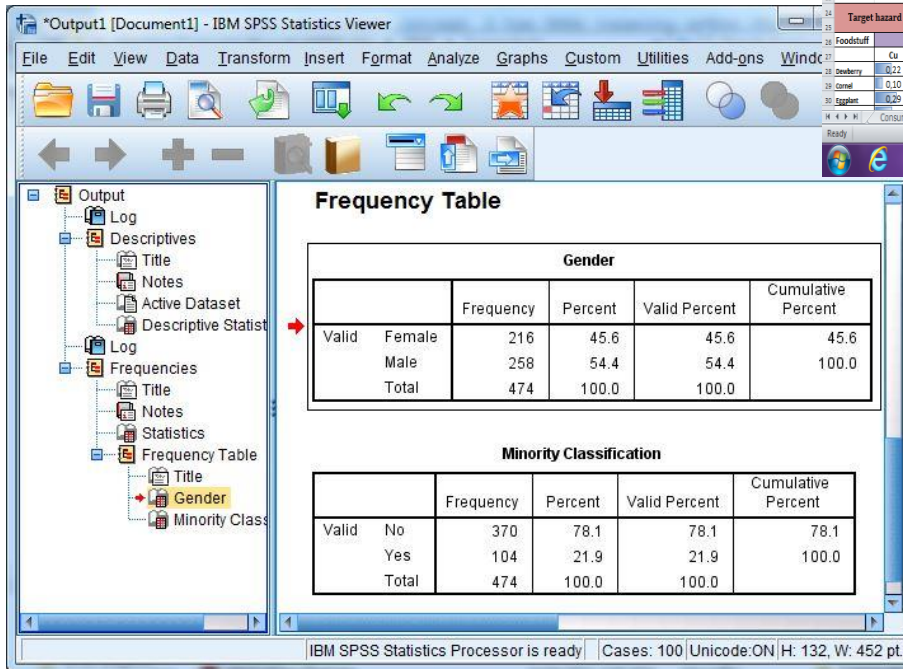
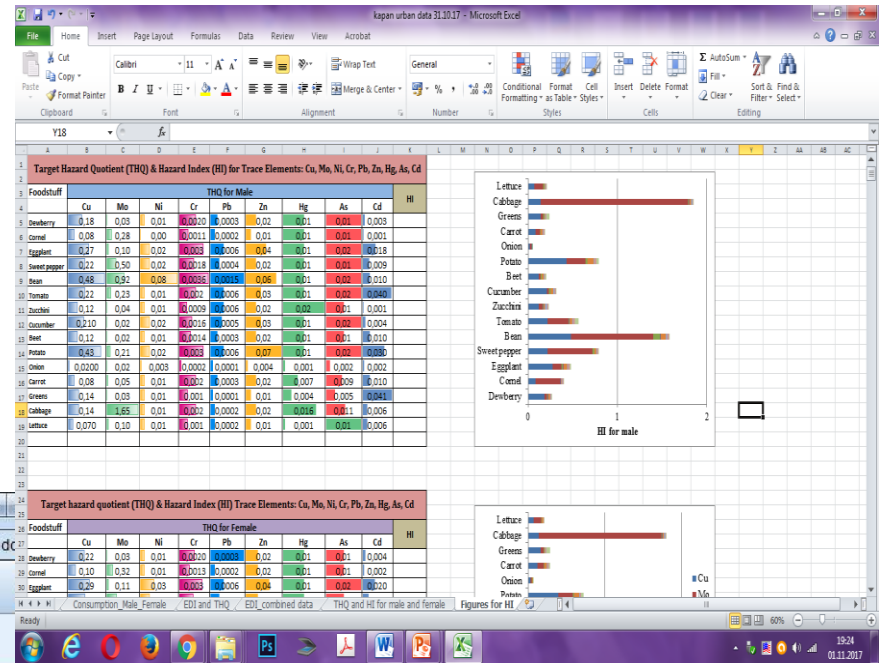
25. Occupation: 1) Employed 2) Unemployed

26. Number of family members: _____

27. Average monthly family income: 1) Up to 70,000 AMD 2) 71 150,000 AMD 3) 151 250,000 AMD 4) 251 400,000 AMD 5) 400,000 AMD and more 6) Refuse to answer

DATA ANALYSIS


Statistical analyses were carried out by Microsoft Excel and SPSS (SPSS Ins., Version 22).



$$\mathbf{EDI = (C \times IR \times EF \times ED) / (Bw \times AT)}$$

C – concentration of trace element (mg/kg)

IR – ingestion rate (kg/day)

EF – exposure frequency (183 day/year, for potato 365 day/year)

ED – exposure duration (for female 69.7, for male 63.6)

Bw – body weight (for female 60 kg, for male 70 kg)

AT – time over which the dose is averaged

THQ & HI

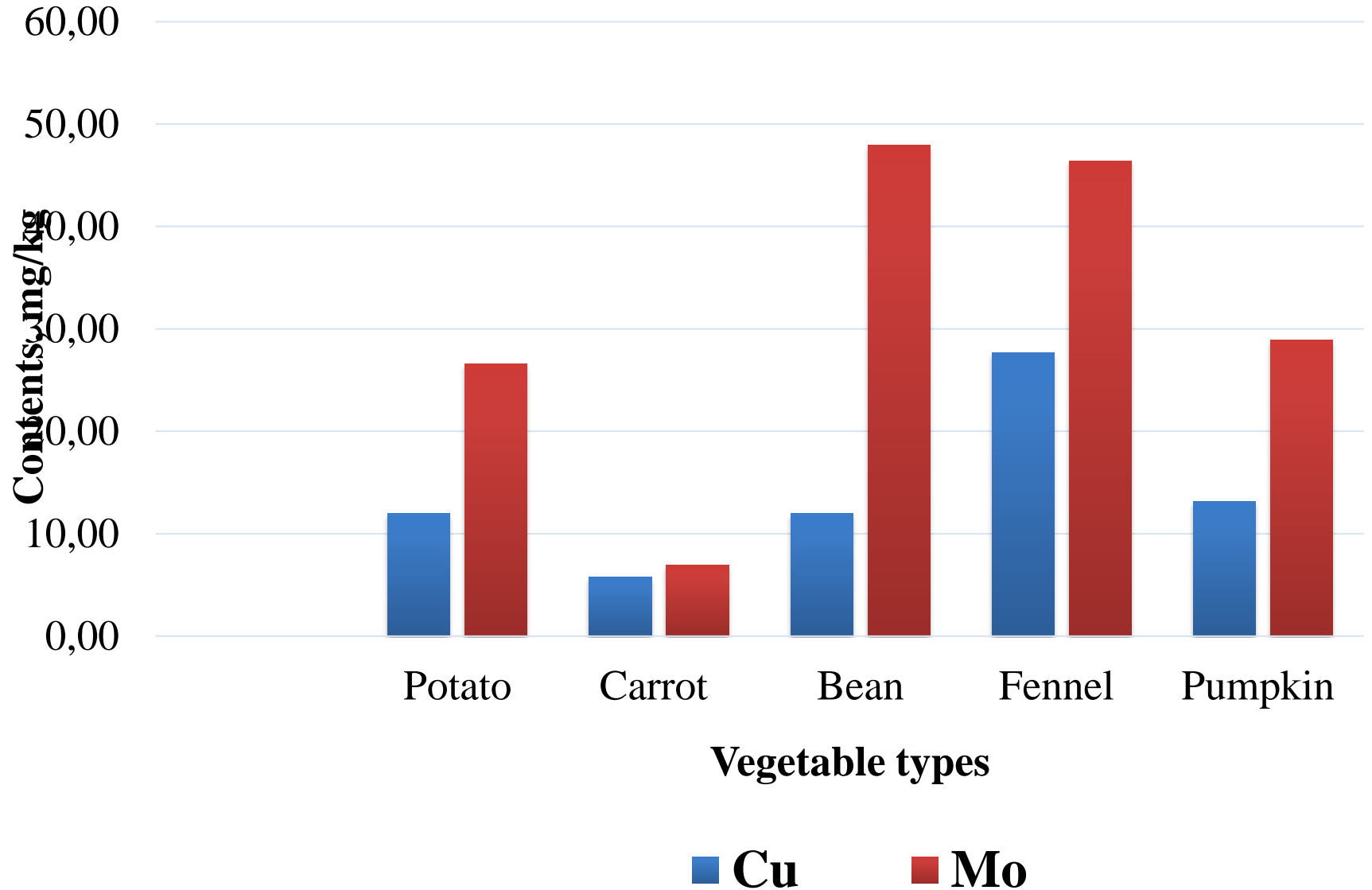
$$\text{THQ} = \text{EDI} / \text{RfD}$$

$$\text{HI} = \Sigma \text{THQ}$$

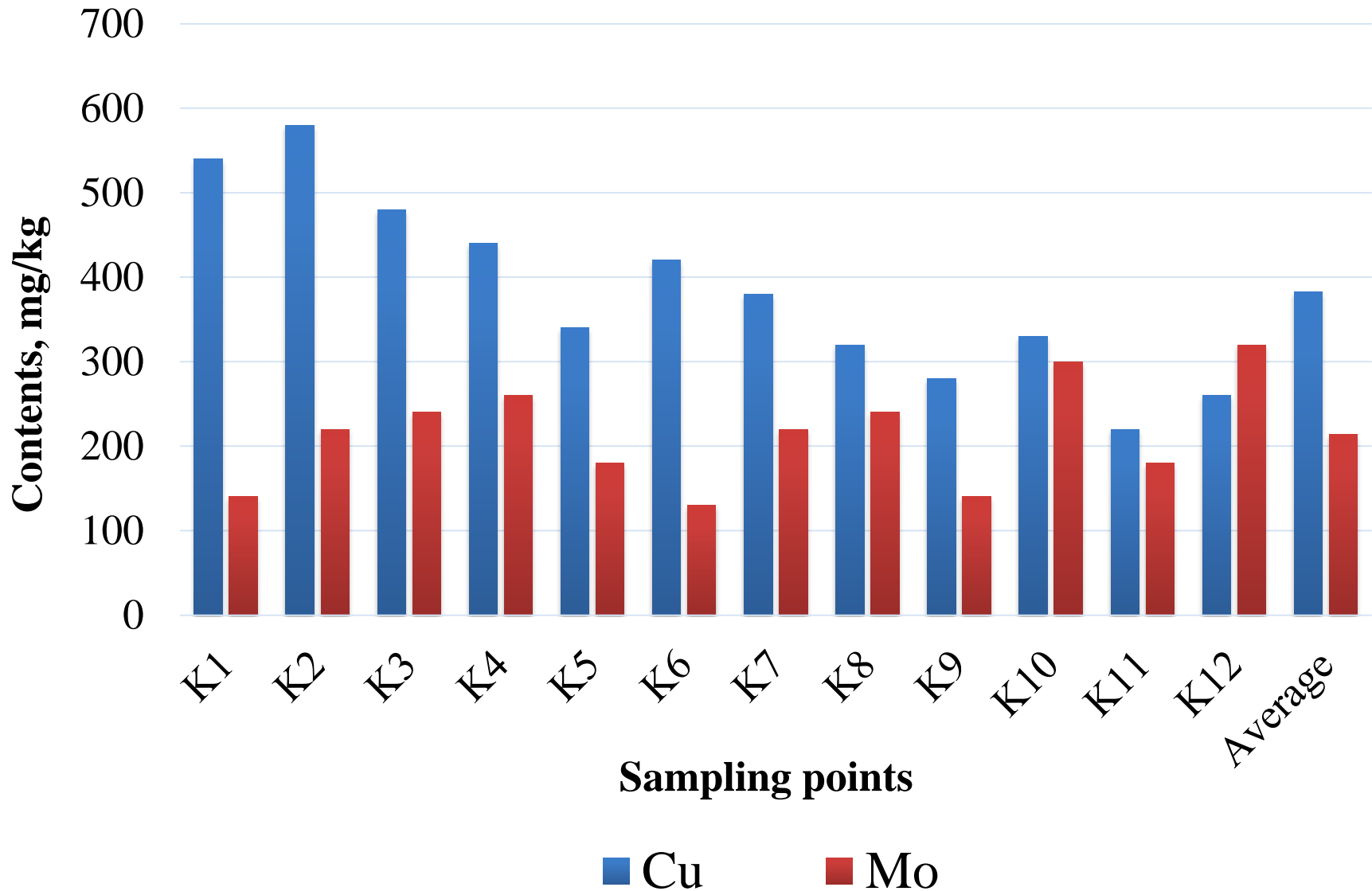
Trace element	Oral reference dose (mg/kg/day)
Cu	0.01
Mo	0.005



The contents of trace elements in vegetables from investigated areas



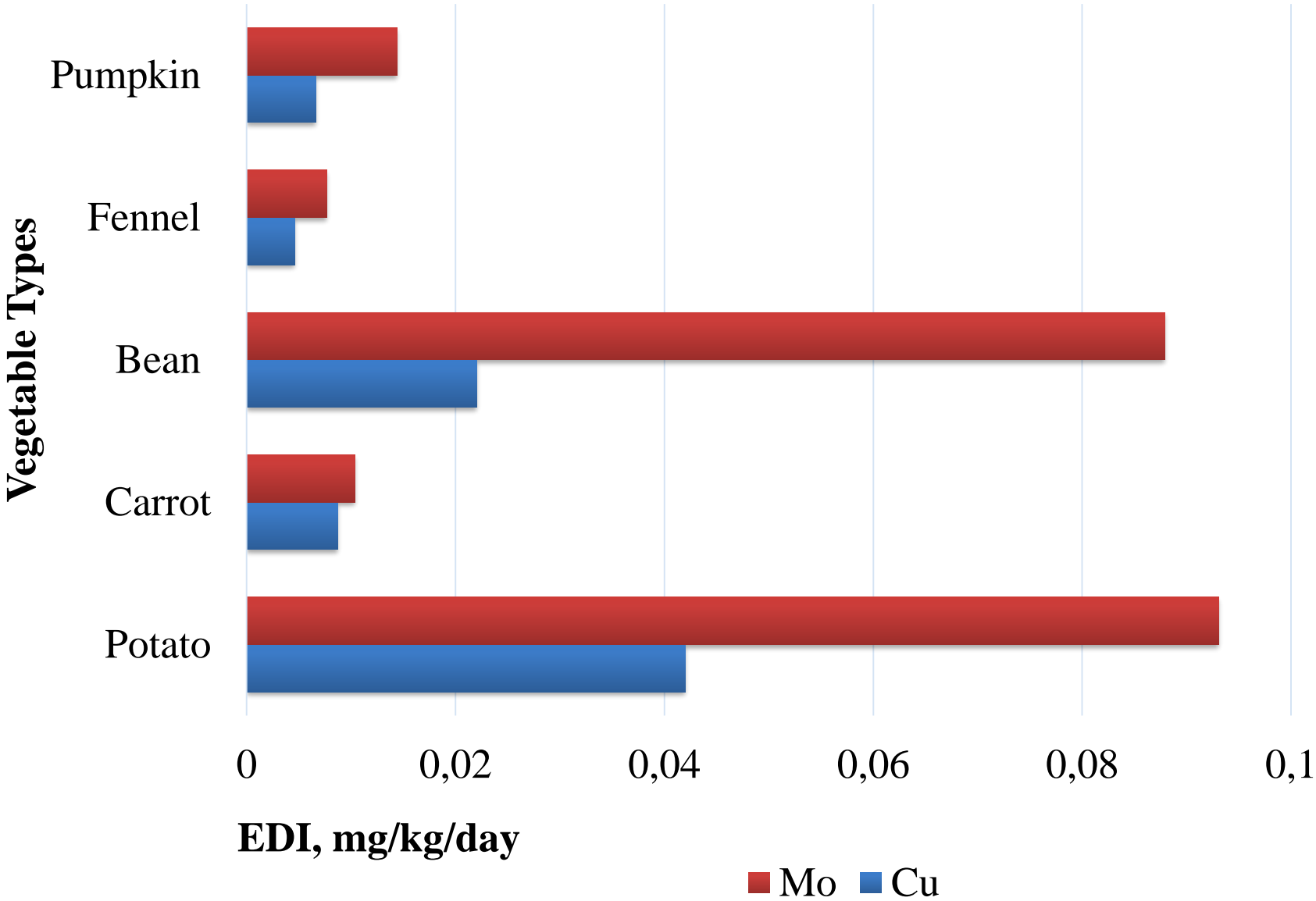
Contents (mg/kg fresh matter) in soil samples



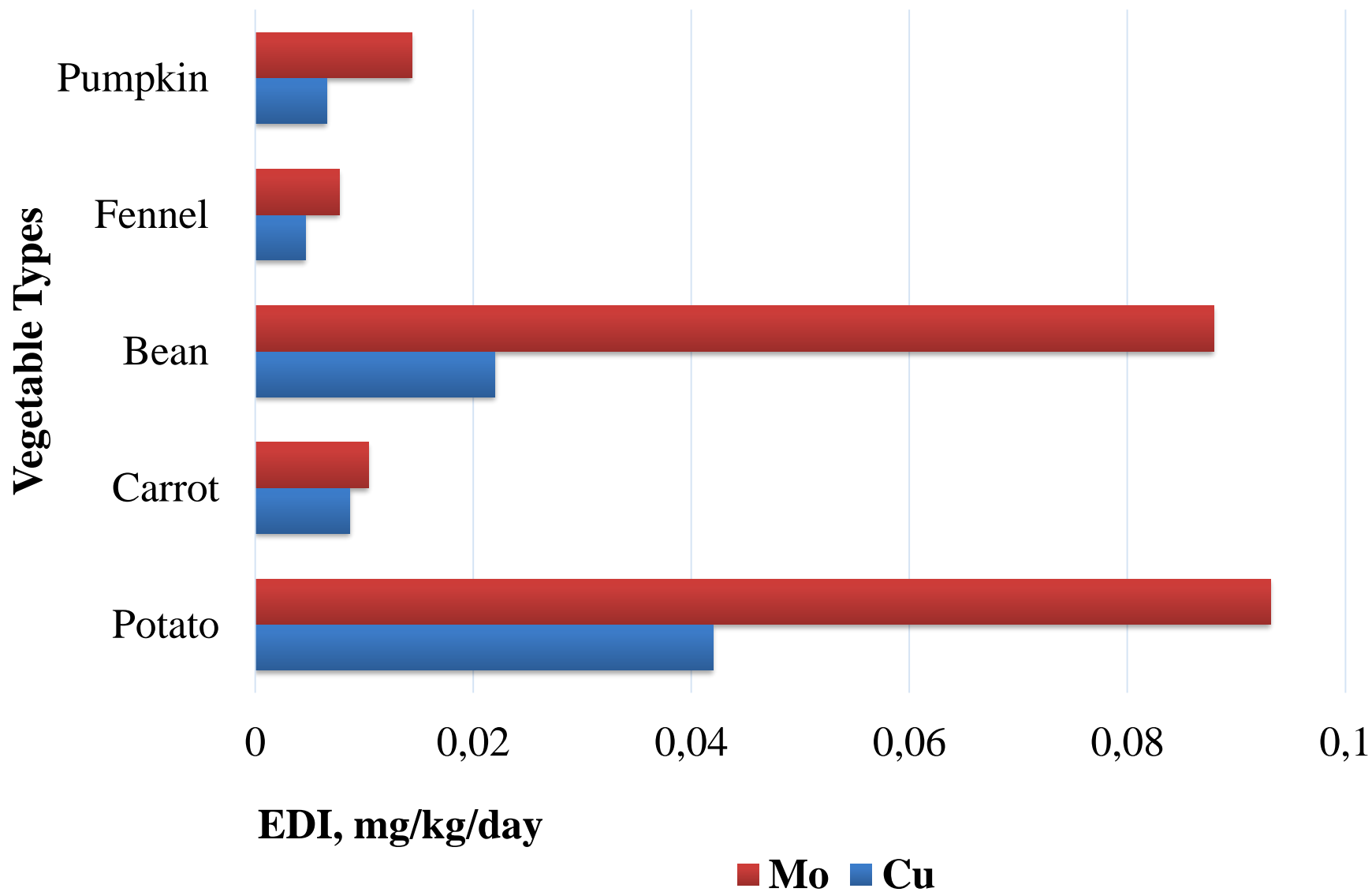
Soil-to-plant transfer factor of Cu and Mo

Plant species	Transfer factor of Cu	Transfer factor of Mo
	Range	Range
Potato	0.03	0.084-0.112
Carrot	0.014-0.018	0.026-0.047
Bean	0.027-0.034	0.16-0.2
Fennel	0.067-0.079	0.17-0.44
Pumpkin	0.034-0.040	0.083-0.134

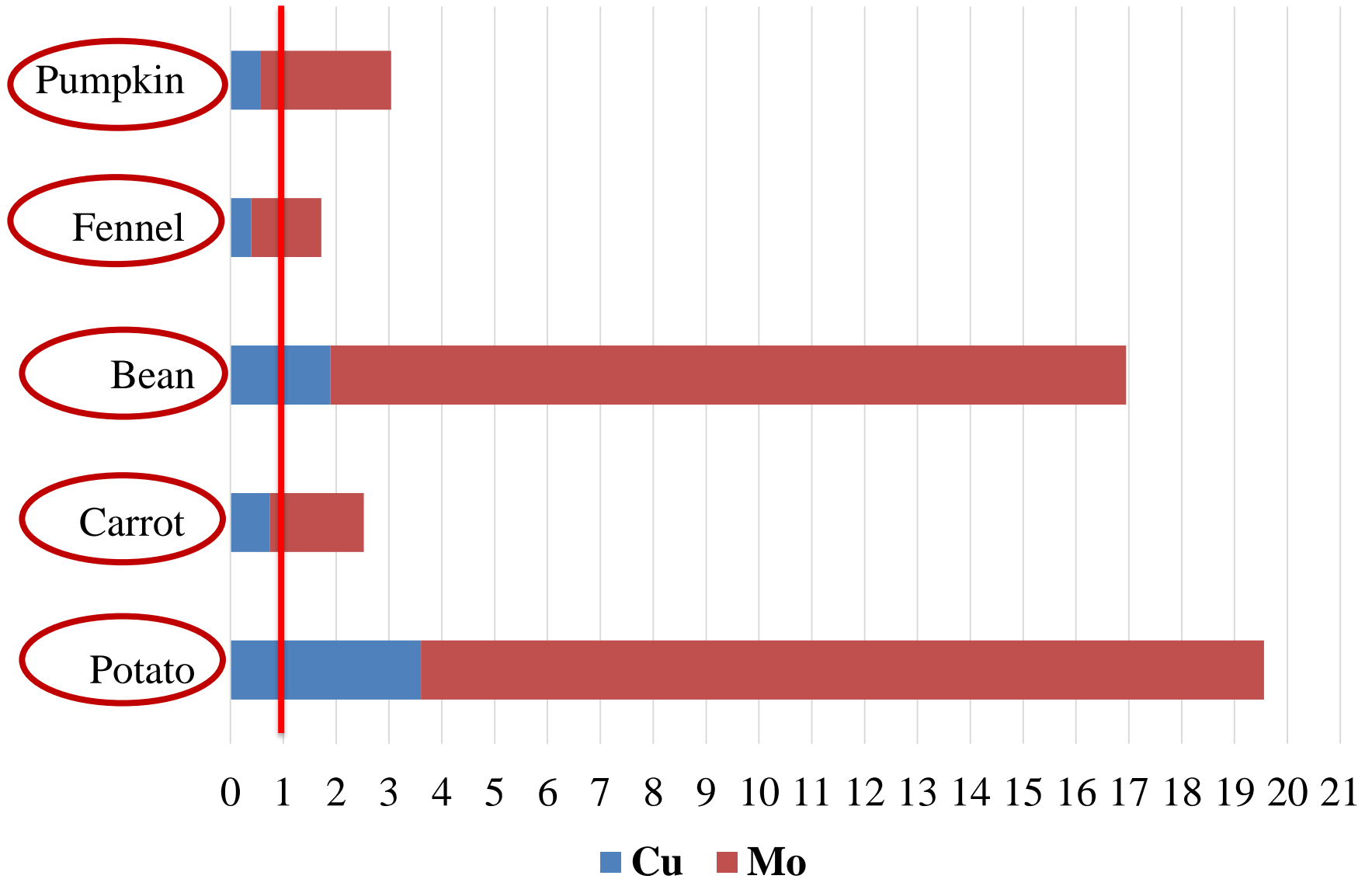
Estimated daily intake (EDI) of Cu and Mo for males



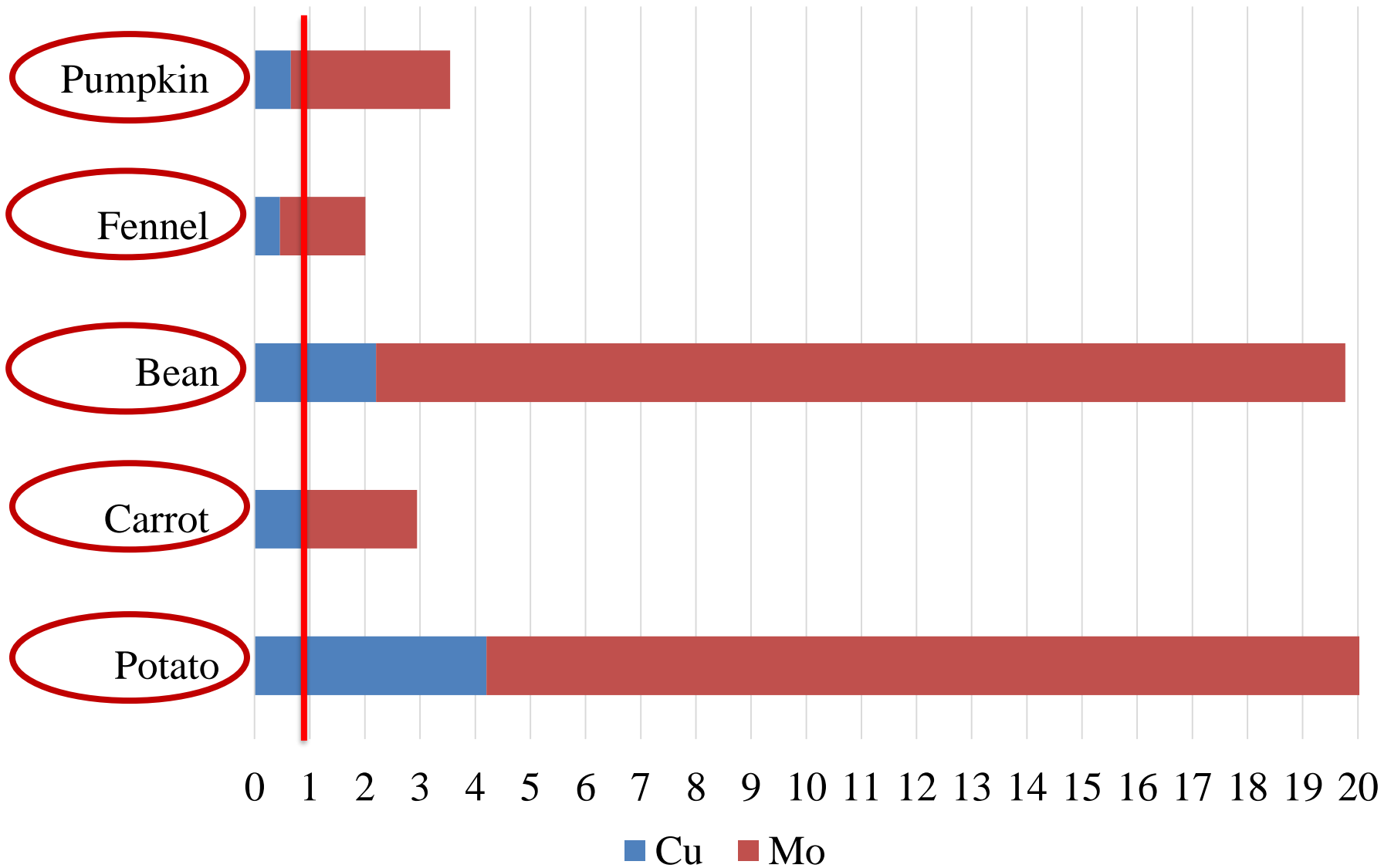
Estimated daily intake (EDI) of Cu and Mo for females



HAZARD INDEX (HI) FOR MALES



HAZARD INDEX (HI) FOR FEMALES



CONCLUSIONS

- The investigation of soil-to-plant transfer of **Cu** and **Mo** indicated poor response of studied vegetables towards these element uptakes

- The **EDI** of **Mo** for all investigated vegetables exceeded the reference value, meanwhile **EDI** values of **Cu** exceeded the reference value only for potato and bean.

- The **estimated cumulative daily intake** both for male and female **exceeded** the reference dose both for **Cu** and **Mo**.

- **HI > 1** values obtained indicated that **there is a risk posed to the health of local population by more than one trace element.**



***THANK YOU FOR YOUR
KIND ATTENTION***

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