STUDY REGARDING COFFEE BREW METAL CONTENT

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Abstract
This paper contains data regarding the concentration of some essential mineral elements in certain coffee brews and their mineral supply in the daily-recommended diet. We determined, through flame atomic absorption spectrometry, the concentration of Na, K, Ca, Mg, Fe, Mn, Zn and Cu in brews made with five assortments of coffee. The mean values of the concentrations determined experimentally – 34.90 mg/L (Ca), 21.49 mg/L (Mg), 1.180 mg/L (Na), 522 mg/L (K), 0.158 mg/L (Fe), 0.206 mg/L (Mn), 0.146 mg/L (Zn), 0.027 mg/L (Cu) – allowed the calculus of their mineral supply. Data show that an intake of 300 mL coffee brew covers in a small measure the daily recommended intake of essential elements; therefore, coffee brews cannot be taken into account as far as their mineral supply is concerned.

Introduction
Coffee, an energising drink with pleasant flavour and taste, is one of the most appreciated drinks in the world: about 40% of the world's population drink coffee [6, 10]. Its popularity is increasing due to its numerous beneficial effects on the human body. Recent research show that moderate consumption of coffee is beneficial to human health since it decreases the risk of mortality, prevents the development of colon-rectal cancer, liver lesions and degenerative cirrhosis, and progressive and chronic diseases such as Alzheimer's and Parkinson's disease, type 2 diabetes and coronary heart diseases [3, 8]. Its nutrition and therapy properties are due to the main biological active compounds – carbohydrates, lipids, nitrogenous compounds, vitamins, alkaloids, phenolic compounds and minerals [8].
Roast coffee contains appreciable amounts of minerals – 3.5-4.5% in Arabica and 4.6-5.0 in Robusta [7]. Literature contains numerous data regarding the mineral concentration of different assortments of coffee used to prepare the drink [1, 2, 5, 6, 9], as well as information regarding the analysis techniques and methods used to determine the concentrations of mineral elements in green coffee, roasted and ground coffee, instant coffee and coffee brews [10]. In a study by R. Ashu and B. S. Chandravanshi [1], it is shown that coffee beans (roasted and ground) used to prepare the drink contain important amounts of essential minerals; their distribution is very uneven and it depends on the coffee assortment, country of origin, roasting method, etc. Analysing the distribution of some mineral elements in different brands of coffee powder used to prepare drinking coffee, I. Gogoaşă et al. [5] obtained results comparable to those of Ramato Ashu and Bhagwan Singh Chandravanshi. The concentrations of the analysed elements showed the following values: Ca (1270-1650), Mg (1050-1270), Na (37.31-103.6), K (13800-17500), Fe (24.0-49.0), Mn (13.85-17.50), Zn (5.60-6.70) and Cu (8.20-9.90) and very small amounts (insignificant) of Pb and Cd.
The important concentrations of essential elements determined in different types of coffee used to prepare drinking coffee prompted the investigation of such contents in coffee drinks and the assessment of the mineral supply of such drinks.

The goal of this experiment was to determine the concentration in Ca, Mg**,** Na, K, Fe, Mn, Zn and Cu in brews with five types of ground coffee to assess their mineral supply in the daily-recommended diet and the possibility of using them as supplementary (alternative) sources of essential element.

Experimental

To carry out the experiment, we used brews of five types of powder coffee – Jacobs-Aroma, Jacobs-Krönung, Doncafé-Elita, Fort-Strong Coffee and Nova Brasilia – purchased from local supermarkets from Timisoara, Romania. To prepare the brew, we used 6 g of ground coffee on which we poured 150 mL boiling distilled water [14] that we let to settle for 10 minutes. After removing the coffee grounds with filter paper, the coffee brew was evaporated until almost dry, after which it was added 25 mL solution of HNO_3 0.5 N and evaporated until almost dry. The last operation was repeated, and then the samples were added distilled water and used to determine the concentrations in essential elements. The concentrations of Na, K, Ca, Mg, Fe, Mn, Zn and Cu were determined using flame atomic absorption spectrometry with a Varian AA 240 FS flam atomic absorption Spectrometer. Working parameters such as wavelength, air-acetylene flow, number of readings/determination, volume of un-nebulised sample are recommended by the manufacturer.

Results and Discussion

Results (mean concentrations of samples analyzed in triplicate) of the analysis of essential mineral elements depending on coffee brew are shown in Table 1.

Table 1. Concentration of Na, K, Ca, Mg, Fe, Mn, Zn and Cu in coffee brews (mean values)

Description	Essential elements, mg/L							
	Ca	**Mg**	**Na**	**K**	**Fe**	**Mn**	**Zn**	**Cu**
Jacobs - Aroma	32.87	19.45	1.296	478	0.184	0.229	0.160	0.026
Jacobs-Krönung	39.62	23.75	1.591	543	0.182	0.257	0.163	0.032
Doncafé-Elita	30.46	19.67	0.554	459	0.159	0.178	0.136	0.025
Fort-Strong Coffee	35.51	23.06	1.288	582	0.174	0.175	0.149	0.029
Nova Brasilia	36.04	21.50	1.173	546	0.091	0.189	0.124	0.023
Mean value	***34.90***	***21.49***	***1.180***	***522***	***0.158***	***0.206***	***0.146***	***0.027***

As shown in Table 1 above, the levels of concentration of the analysed bio elements are neatly inferior to the concentrations of the same elements in ground coffee [5]. This is fully justified because the quantum of mineral elements extracted in aqueous brews depends not only on their concentration in the coffee used to prepare the brew, but also on the coffee matrix, on the physical and chemical features of each bio element and, last but not least, on the conditions of preparing coffee brews [1, 13, 14].The distribution of elements in aqueous coffee brews is very uneven: the mean values of their concentrations range within 1.189 mg/L (Na) and 522 mg/L (K) in macroelements, i.e. 0.027 mg/L (Cu) and 0.206 mg/L in microelements. Among macroelements, K is the best represented (522 mg/L), followed by Ca, Mg and Na that have lower values: 34.90, 21.49, and 1.180 mg/L, respectively.

Microelements were determined in much lower concentrations than macroelements: the best represented was Mn (0.206 mg/L), followed by Fe and Zn (in concentrations close to 0.158, i.e. 0.146 mg/), and Cu (0.027 mg/L), respectively.

These experimental values are supported by other researchers in the field [1, 2, 3, 13, 14].

Mean concentrations of mineral elements in the analysed coffee brews (Table 1) and recommendations regarding the necessary mineral elements in humans' daily diet (Table 2) allowed the calculus of the mineral supply of coffee brews per 300 mL of coffee.

Table 2. Reference values regarding the necessary mineral elements in the recommended daily diet [16]

Specification	Mineral supply (%)							
	Na	K	Ca	Mg	Fe	Mn	Zn	Cu
Males aged 19-50	0.02	3.33	1.05	1.53	0.59	2.68	0.40	0.91
Females aged 19-50	0.02	3.33	1.05	2.01	0.26	3.43	0.55	0.91

In our experiment, a daily intake of 300 mL coffee brew (two medium-size coffee cups) supplies minerals in the daily recommended diet for males and females aged 19-50 as shown in Table 3 below.

Table 3. Mineral supply (mean values) corresponding to a daily intake of 300 ml (two cups) of coffee brew

Specification	Mineral element (mg/day)							
	Na	K	Ca	Mg	Fe	Mn	Zn	Cu
Males aged 19-50	0.02	3.33	1.05	1.53	0.59	2.68	0.40	0.91
Females aged 19-50	0.02	3.33	1.05	2.01	0.26	3.43	0.55	0.91

Data shown in Table 3 above show that mineral supply and the degree of coverage of the recommended daily intake of Na, K, Ca, Mg, Fe, Mn, Zn and Cu, corresponding to an intake of 300 mL coffee brew (prepared as shown above), has low and very low values ranging between 0.02% Na and 3.43% Mn. However, we should mention the supplies of potassium (3.33%), manganese (2.68% in males and 3.43% in females) and magnesium (1.53% in males and 2.01% in females); the supplies of natrium, zinc, iron, copper and calcium are insignificant.

We can, therefore, say that mineral supply of the analysed coffee brews has low and very low values and do not contribute appreciably to the necessary mineral supply in the daily diet. This is confirmed by literature [2, 3, 6, and 12].

The supply of minerals can increase slightly with the increase of the amount of coffee used to prepare coffee brew, but this is not always recommended.

Conclusion

Mean concentration of the bio elements in the analysed coffee brews have lower values than the coffee used to prepare the drinks; it varies within broad limits ranging between 1.189 mg/L (Na) – 522 mg/L (K) in macroelements and 0.027 mg/L (Cu) – 0.206 mg/L (Mn) in microelements.

The distribution of essential elements in coffee brews is uneven and it has much lower values than the matter used to prepare them. In general, the distribution of the essential elements follows a descending trend: K>> Ca> Mg> Na, and Mn> Fe≅ Zn>> Cu, respectively.

In our experiment, the mineral supply in the daily-recommended diet of experimental coffee brews had very low values ranging between 0.02% in sodium, 3.33% in potassium and 3.43% in manganese.

Finally, we can say that the analysed coffee infusions are of no importance from the point of view of their mineral supply and cannot be considered appreciable sources of bio elements.

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