The Mineral Content of Different Coffee Brands

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Abstract  Given the considerable amount of substances, roasted and ground coffee contributes to the completion of mineral supply with macro- and micro-elements that are essential to the human body. The purpose of this paper is to determine the concentration of minerals: Ca, Na, Mg, K, Fe, Mn, Zn, Cu, Ni, Co, Cr, Pb and Cd from different types of coffee: Jacobs-Aroma, Jacobs-Kronung, Doncafe-elite, Fort-Strong coffee and Nova Brasilia using flame atomic absorption spectrometry (FASS). The experimental results show that macroelements are representing 99.96% from total mass of minerals, the values decreased in the order: K > Ca > Mg >Na, in all coffee assortments. Quantitative contribution of micro-elements in the composition of the different types of coffee is very small (0.04%). This does not minimize at all the importance of these essential bio-elements in body. The micro-elements values decreased in the order: Fe > Mn > Cu > Zn > Ni > Co > Pb > Cd, in all types of coffee. Potentially toxic mineral elements Pb and Cd were detected below the maximum allowed by law, so coffee varieties analyzed are without risk of contamination.

Coffee is a beverage obtained from the roasted beans of the genus Coffea usually prepared thermally, with an energising effect, presenting a specific flavour and taste. Due to its properties, coffee is one of the most familiar beverages in the world: besides caffeine, it also contains an important number of vitamins (E, PP, B1, B2, B9), minerals (K, Mg, Na, Fe, Cu, Zn, P, F, etc.), phenolic acids – whose anti-oxidant properties are well known, and very few calories [3, 4, 5, 7, 8]. The food and therapeutic properties of coffee is given by its main chemical, biochemical, plastic, and energetic properties which meet the physiological needs of the human body, among which minerals. Therefore, the beneficial effects of coffee are determined by their content of macro- and micro-elements that are deeply involved in the human body functioning: hence, the interest in knowing the distribution of these minerals in the different coffee assortments.

On the other hand, coffee beans can accidentally be contaminated by toxic elements from different pollution sources (man-made) or during the processing. The purpose of this paper is to determine the concentration of minerals: Ca, Na, Mg, K, Fe, Mn, Zn, Cu, Ni, Co, Cr, Pb and Cd from different types of coffee: coffee Jacobs - Aroma, Coffee Jacobs - Kronung, coffee Doncafe-elite coffee, Fort - Strong coffee and coffee Nova Brasilia, used for making different coffee recipes.

Literature contains numerous data on the distribution of minerals in the different assortments of cultivated coffee in different geographical areas, as well as a series of mineral analysis techniques. Trace elements as essential bio-elements, even in very low concentrations are particularly important roles: are part of enzymes, vitamins, hormones and pigments. Microelements serve as catalysts in the metabolism of plants and animals. They increase the activity of enzymes, accelerates the biochemical processes in the body, stimulates the synthesis of starch, sugar, pectin and nucleic acids [1, 6, and 11].

Material and Methods

The different types of coffee: Jacobs-Aroma, Jacobs-Kronung, Doncafe-elite, Fort-Strong coffee and Nova Brasilia are available in Supermarket.

In order to achieve the intended purpose are taken three tests for each of the five brands of coffee mentioned above. Samples in quantities of 10 ± 0.0002 g were made of the average of three primary samples of coffee beans ground corresponding to each type of coffee.

Determination of mineral elements studied coffee brands, required two steps: mineralization by calcination, followed by solubilization of inorganic matter in 0.5 N nitric acid and the absorbance spectrophotometry minerals concerned.

Analysis of Fe, Mn, Zn, Cu, Ni, Co, Cr, Pb and Cd content was made with ContrAA-300, Analytik-Jena...
device, by flame atomic absorption spectrometry (FASS) in air/acetylene flame. The device working parameters (air, acetylene, optics and electronics) were adjusted for maximum absorption for each element. The standard solutions (1000 mg/L) were analytical grade from Riedel de-Haen (Germany). The nitric acid 65% solution used was of ultra pure grade (Merck, Germany). All solutions were prepared using deionised water.

Results and Discussions

As shown in Tables 1 and 2, in all kinds of coffee analyzed macroelements predominate, representing a percentage of 99.96% of the total mass of minerals. Among the macroelements, potassium registered the highest values.

<table>
<thead>
<tr>
<th>Description</th>
<th>Macro-elements content, average values [mg/kg dry weight]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ca</td>
</tr>
<tr>
<td>Jacobs–Aroma</td>
<td>1270</td>
</tr>
<tr>
<td>Jacobs–Krönung</td>
<td>1560</td>
</tr>
<tr>
<td>Doncafé-Elita</td>
<td>1350</td>
</tr>
<tr>
<td>Fort–Strong Coffee</td>
<td>1650</td>
</tr>
<tr>
<td>Nova Brasilia</td>
<td>1650</td>
</tr>
</tbody>
</table>

Table 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Micro-elements content, average values [mg/kg dry weight]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fe</td>
</tr>
<tr>
<td>Jacobs–Aroma</td>
<td>38.3</td>
</tr>
<tr>
<td>Jacobs–Krönung</td>
<td>34.5</td>
</tr>
<tr>
<td>Doncafé-Elita</td>
<td>35.5</td>
</tr>
<tr>
<td>Fort–Strong Coffee</td>
<td>49.0</td>
</tr>
<tr>
<td>Nova Brasilia</td>
<td>24.0</td>
</tr>
<tr>
<td>M. A. L.*</td>
<td>-</td>
</tr>
</tbody>
</table>

* Maximum allowable limit[12]

Potassium (K), macro-bio-element vital for normal body nervous system, and to maintain water balance in the body was determined in concentrations between 13800 ppm (Jacobs–Aroma) and 17500 ppm (Fort–Strong Coffee).

Calcium and magnesium were found in all kinds of coffee in the relatively appropriated concentrations, however, ten times lower than potassium. Calcium, essential macro-bio-element important for strengthening teeth and bones and for normal functioning of the muscles, nervous system and cardiovascular system, was determined in concentrations of the same order of magnitude in all kinds of coffee, with the range of 1270 ppm (Jacobs–Aroma) and -1650 ppm (Fort–Strong Coffee and Nova Brasilia).

Regarding magnesium, macro-element essential to the normal functioning of the muscles, nervous system and energy production, reproduction and immune systems, values of concentrations detected are between 1050 ppm (Jacobs–Aroma) and 1270 ppm (Fort–Strong Coffee).

Sodium, macro-element that has the ability to maintain constant water balance outside the cell and involved in maintaining acid-base balance, was determined in much lower concentrations than the other three macro-elements. Thus, the sodium concentration levels ranging from 37.31 ppm (Doncafé-Elita) to 103.6 ppm (Jacobs–Krönung).

Quantitative contribution of micro-elements in the composition of the different types of coffee is very small (0.04%). This does not minimize at all the importance of these essential bio-elements in body.

Iron, essential micro-bio-element necessary for oxygen transport by red blood cells, essential in the production of hemoglobin and some enzymes, was determined in higher concentrations compared to other trace elements, in all kinds of coffee. The concentrations
determined are relatively close, in the range of 24 ppm (Nova Brasilia) to 49 ppm (Fort–Strong Coffee). Manganese, necessary for healthy bones and nervous system, was detected in smaller quantities than iron, but relatively similar in all varieties analyzed, in the range of 13.85 ppm (Doncafé-Elitia) and 17.50 ppm (Jacobs–Krönung).

Zinc, essential micro-bio-element, mainly for maintaining the health of the reproductive system and immune cells, was determined in the range of 5.60 ppm (Nova Brasilia) to 6.70 ppm (Jacobs–Krönung). Copper, necessary to the formation of melanin in the metabolism of iron, was determined in slightly higher amounts than zinc but less than manganese and iron. Copper concentrations in analyzed varieties of coffee were in the range from 8.20 ppm (Jacobs–Aroma) to 9.90 ppm (Fort–Strong Coffee). It is known that zinc and copper, in high concentrations, above certain concentration limits may become toxic. Maximum admissible limits (LMA) are 30 ppm for Zn and 10 ppm for Cu.

Comparing the values of Zn and Cu concentrations, potentially toxic heavy metals determined in different coffees analyzed with the maximum permitted by legislation, we find that they are below the levels of toxicity. Therefore, although we note some values at the upper limit of the maximum concentration, these are not exceeding over LMA signals.

Nickel, microbioelement which stimulates the liver and pancreas functions, was determined in much lower concentrations comparative to Fe, Mn, Zn and Cu, but with values higher than Co and Cr, where the concentration of nickel has a value of 0.61 ppm (Jacobs–Krönung), the rest of values are ranging from 2.40 ppm (Jacobs–Aroma) to 2.91 ppm (Fort–Strong Coffee).

Cobalt, microbioelement that is a component of vitamin B12, plays a essential in the formation of red blood cells, known for its vasodilating properties and so on, helps to maintain the integrity of the nervous system, the body's self-defense and activates certain enzymes, prevents (together with iron ) anemia etc., the concentration in the products concerned do not exceed 0.55 ppm (Jacobs–Aroma). In Jacobs–Krönung, cobalt is not found in the detection limit of the device. Therefore mineral content of cobalt in coffee varieties analyzed is quite small.

Chromium, essential microbioelement participating in regulating blood sugar level was determined in very small quantities. With one exception, coffee Nova Brasilia – where was determined at a concentration of 0.07 ppm, cobalt is found below the detection limit of the device (< 0.02 ppm). Lead is a toxic heavy metal, its maximum allowable ground coffee was 1 mg/kg (1 ppm) [12]. In all kinds of coffee analyzed were not detected amounts of Pb over the limit of 0.02 ppm, values well below the maximum allowed by legislation. So, all these types of coffee are without risk of contamination by Pb.

Cadmium is most pronounced heavy metal with toxic nature from of all the metals analyzed. That is why the maximum allowed by European Community legislation in coffee is very low, below 0.05 mg/kg. Cadmium concentration values determined in all kinds of coffee analyzed are below the detection limit of the device (< 0.002 ppm) and below the maximum permissible limit. As a result the products studied are without risk of contamination with Cd.

Comparing the values obtained in this work with other values in the literature [1,2,9,10], we can conclude that are no significant differences.

Conclusions

Experimental results obtained from the analysis of coffee brands studied, confirm that the distribution of mineral elements in different coffees is uniform. Quantitative contribution of macroelements representing 99.94% from all minerals, the values decreased in the order: K> Ca> Mg >Na, in all coffee assortments.

Contribution of micro-elements is only 0.04 % from all minerals, but this should not detract anything from the role and importance of essential bio-elements for our body. Microelements values decreased in the order: Fe>Mn>Cu>Zn>Co>Pb>Cd.

Potentially toxic mineral elements or character pronounced toxic to the body Zn and Cu or Pb and Cd were detected below the maximum allowed limits, so coffee varieties analyzed are without risk of contamination.

Given the considerable amount of substances, roasted and ground coffee contributes to the completion of mineral supply with macro- and micro-elements that are essential to the human body.

As a final conclusion we can say coffee varieties analyzed is characterized by significant content of bioelements minerals and very low concentrations, significant toxic elements.

References

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12.***. ORDIN nr. 975 din 16 decembrie 1998 privind aprobarea Normelor igienico-sanitare pentru alimente. Limite maxime de arsen și metale grele în alimente.