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# DETERMINATION OF MINERAL CONTENT IN CRANBERRIES (*VACCINIUM MICROCARPUM*) AND THEIR INFUSIONS CONSUMED IN KOSOVO

## SUMMARY

After water, tea is the most widely consumed beverage in the world. In addition to its use as a beverage, tea is also known as a beverage that can have several health benefits, mainly due to the presence of nutrients. But, on the other hand, even very low concentrations of some metals can be toxic and can cause disorders and serious biological diseases. In this paper we have researched the content of micro and macro elements in chamomile tea samples of five different brands: sample 1 (Croatia), sample 2 (Kosovo), sample 3(Sri Lanka), sample 4 (Slovenia) and sample 5 (Kosovo) found in a local market in Pristina. Concentrations of the elements were determined by the method of atomic absorption spectroscopy (AAS). Microwave was used to decompose samples. Concentrations of metals in chamomile samples were: Na (1908-2480 mg/kg), K (3860-9294 mg/kg), Ca (11972-24269 mg/kg), Mg (1309-4287 mg/kg, Zn (10-33 mg/kg), Fe (86-302 mg/kg), Mn (69-217 mg/kg) and Ni (2-5 mg/kg) On the other hand metal concentrations in infusions of chamomile tea of these five brands at different times (3, 5 and 10 minutes) were: Na (1131-2233 mg/kg), K (3147-8999 mg kg), Ca (9189-22140 mg/kg), Mg (935-3899 mg/kg, Zn (2.1-29 mg/kg), Fe (6-47 mg/kg), Mn (37-177 mg/kg) and Ni (1-2 mg/kg). Of all the macronutrients (Na, Mg, K and Ca), calcium had the highest concentration which ranges from 11972-24269 mg/kg. By comparing the concentrations of all heavy metals (iron, zinc, nickel and manganese) iron content was the highest of all samples, in the range of 86 mg/kg - 302 mg/kg.

**Keywords**: *Vaccinium microcarpum*, cranberry, micro and macro elements, atomic absorption spectrometry.

## INTRODUCTION

Tea is the most consumed beverage in the world after drinking water (Leyden *et al*., 2011). One of the main reasons for the popularity of tea is its

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positive impact on human health, mainly due to the presence of nutrients (Leyden *et al*., 2011; Petrović *et al*., 2015).

Tea is defined as a mixture of crushed plant parts intended for indoor or outdoor use. Important components of tea are flavonoids, tannins, catechins, caffeine, and thiamine, as well as theobromine, theophylline, and negligible amounts of carbohydrates, fats, and proteins. Of particular importance is the determination of minerals in tea which plays an important role in the quality of tea as well as in human health. Minerals are found in plants in form of ions, inorganic and organic salts. The content of mineral elements in plants can vary greatly. Changes in plant mineral content come from a number of factors, including plant species, plant age, soil pathological features, climate, and the implementation of agrotechnical measures. The human body needs adequate concentrations of these minerals to maintain normal function and maintain life. Deficiencies or excesses of minerals in the diet can lead to various health disorders (Perić-Grujić *et al.*, 2009; Mondal *et al*., 2004; Seenivasan *et al*., 2008; Fernandez-Caceres *et al*., 2001; Han *et al*., 2005; Pohl and Prusisz, 2007; Faiku *et al.*, 2019; Faiku *et al.*, 2018).

American cranberry (*Vaccinium macrocarpon* A.) and high bush blueberry (*Vaccinium corymbosum* L.) are perennial flowering plants from the family Ericaceae of the genus Vaccinium, commercial cranberry and blueberry varieties, in general, are indigenous to eastern and central North America including the eastern territories of Canada (Karlsons *et al*., 2018; Trehane, 2004). Commercial production of Vaccinium species in the United States of America has existed since the latter part of the eighteenth century (Eck, 1990).

Many species of *Vaccinium* have a long history of being used for medical purposes. Recent advances in nutrition science have shown that diet has a potential effect on human health and development, dietary guidance is persistent in recommending greater consumption of fruit and vegetables to promote health (Blumberg *et al*., 2016; Istek and Gurbuz, 2017).

There are numerous reports that the use of cranberry has a large number of benefits: affects the prevention of urinary tract infections, slows the spread of cancer and heart disease, lower blood cholesterol, and blood sugar levels, prevents dental disease and their gums, etc (Hwang et al., 2014; Koupy et al., 2015; Shi et al., 2017).

In different blueberries, the presence of essential elements is rarely reported as opposed to the presence of anthocyanins and phenolic compounds which is pretty much reported. (Pyrzynska, 2018). It should be noted, that many external factors as growth environment (soil, geographical conditions), cultivation and fertilization practices are widely diverse in different cranberry and blueberry production and wild harvesting countries and could contribute to the mineral composition of fruits.

The objective of this study is to establish the levels of some mineral and trace elements (Na, K, Ca, Mg Zn, Fe, Mn, and Ni) in these herbs and their infusions that are widely consumed in Kosovo.

## MATERIAL AND METHODS

### Apparatus and Reagents

The analysis of Na, K, Ca, Mg Zn, Fe, Mn, and Ni content were made with the M Series spectrophotometer type GE650416v1.26 Flame Mode Instrument. The device working parameters (air, acetylene, optics, and electronics) were adjusted for maximum absorption for each element. The standard solutions (1000 mg/L) were of analytical grade from Riedel de-Haen (Germany). The ultra-pure grade 65% nitric acid solution was used in the experiment (Merck, Germany). All solutions were prepared using deionized water.

### The analyzed samples

The digestion of tea material was done with a microwave. For analysis the tea leaves samples of around 0.5 g were placed in Teflon digestion vessels; 7 mL $HNO_3$ 65 % and 1 mL $H_2O_2$, 30% were added, and the vessels were capped closed, tightened, and laced in the rotor of the Analytik Jena microwave digestion. The digestion was carried out with the following programmer: step 1- temperature 180 °C, 10 min hold time with the power of 500 Wand and 45 bar pressure; step 2- temperature 180 °C, 15 min hold time, with the power of 500 W and 45 bar pressure. Finally, the vessels were cooled and carefully opened, and digests quantitatively transferred into 50 mL calibrated flasks.

The analyzed samples are commercial samples that were purchased in the markets Pristina - Kosovo in May 2021. Kosovo is situated in the Balkan Peninsula within the longitudes 41° 50′ 58″ and 43° 15′ 42″ and within the latitudes 20° 01′ 30″ and 21° 48′ 02″. Samples of *Vaccinium macrocarpon* teas were taken from different manufacturers (Sample 1 Croatia, sample 2 Kosovo, sample 3 Sri Lanka, sample 4 Slovenia, and sample 5 Kosovo). Infusions were prepared considering the recommended proportion for consumption: 1 bag (ca. 1-1.5 g) for a cup of 200 mL. Boiling water was added to the leaves and kept for 3, 5, and 10 min covered with a watch glass. A 250 µm polymeric membrane was used for filtration and, after cooling, beverages were acidified with distilled nitric acid to obtain a 0.2% (v/v) acid concentration. Quantitative analysis of all samples was performed on the M Series spectrophotometer type GE650416v1.26 Flame Mode Instrument. Experimental data were processed through the Anova software. For this purpose it was applied; Statistical analysis (descriptive statistics).

## RESULTS AND DISCUSSION

Among all the metals tested, WHO classifies Ca, Na and Mg as minerals, Cr, Cu, Fe, Mn, and Zn as trace metals. Minerals or traces of metals, even the same ones, can have high importance and unwanted side effects at the same time for human health. The WHO recommends the Recommended Diet (RDA). RDA for Ca is 1.3 g, Na 1.5 g, Mg 0.42 g, Cr 35 µg, Cu 0.9 mg, Fe 18 mg, Mn 2.3 mg and Zn 11 mg. Table 1 presents data on samples of teas available in a supermarket in Pristina.

**Table 1.** Information on the herbal tea samples researched

| Sample | Herb Latin name | Origin |
|---|---|---|
| 1 | *Vaccinium microcarpum* | Croatia |
| 2 | *Vaccinium microcarpum* | Kosovo |
| 3 | *V. microcarpum* | Sri Lanka |
| 4 | *Vaccinium microcarpum* | Slovenia |
| 5 | *Vaccinium microcarpum* | Kosovo |

Table 2 shows the concentrations of Na, K, Ca, Mg, Zn, Fe, Mn, and Ni in the analyzed chamomile tea samples as well as the mean values, minimum, maximum and median values.

**Table 2.** Concentrations of metals in the analyzed microwave-decomposed *V. microcarpum* tea samples expressed as the dry sample mass.

| **Concentration in mg/kg** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Elements | Na | K | Ca | Mg | Zn | Fe | Mn | Ni |
| Sample 1 (Croatia) | 2289 | 3860 | 23175 | 1309 | 10 | 86 | 69 | 2 |
| Sample 2 (Kosovo) | 2216 | 8468 | 11972 | 2397 | 28 | 186 | 202 | 5 |
| Sample 3 (Sri Lanka) | 1962 | 6609 | 16320 | 2717 | 20 | 127 | 184 | 5 |
| Sample 4 (Slovenia) | 1908 | 8829 | 24269 | 2276 | 23 | 128 | 157 | 2 |
| Sample 5 (Kosovo) | 2480 | 9294 | 17598 | 4287 | 33 | 302 | 217 | 4 |
| Mean | 2171 | 7412 | 18666.8 | 2597.2 | 22.8 | 165.8 | 165.8 | 3.6 |
| Minimum | 1908 | 3860 | 11972 | 1309 | 10 | 86 | 69 | 2 |
| Maximum | 2480 | 9294 | 24269 | 4287 | 33 | 302 | 217 | 5 |
| Median | 2216 | 8468 | 17598 | 2397 | 23 | 128 | 184 | 4 |

Based on the results obtained, in microwave-decomposed samples of all macronutrients (sodium, magnesium, potassium, and calcium), calcium was most present followed by potassium, magnesium, and sodium.

Calcium is involved in a number of important physiological functions e.g., the rhythm maintenance of cardiac muscle and the excitability reduction both for nerves and muscles. Elevated Ca concentration (especially above 2.6 mM) is called hyperkalemia, which could be related to the development of myeloma, hyperparathyroidism, and vitamin D intoxication (Santulli and Marks, 2015). The average daily dose needed for calcium is 1000 mg. The presence of calcium in *V.*

*microcarpum* tea samples ranges from 11972 mg/kg in tea sample 2 (Kosovo) to 24269 mg/kg in tea sample 4 (Slovenia), figure 1(a) and table 2.

The amount of calcium (8900 mg/kg) found by Karlsons *et al*. (2018) in the leaf of *V. microcarpum* cultivated in Latvia is comparatively smaller than the amount of calcium found in *V. microcarpum* tea researched by us.

Potassium is very important because it is necessary for the maintenance of acid-base balance in the body, as well as osmotic pressure. It plays an important role in nerve impulse transmitting muscle contraction because it has the ability to increase the excitability of muscles and nerve cells. Potassium also has an effect on carbohydrate metabolism and membrane transport (Veljković and Vučković, 2010). The potassium content ranges from 3860 mg/kg in sample 1 (Croatia) to 9294 mg/kg in tea sample 5 (Kosovo), figure 1(a) and table 2. Potassium in teas *V. microcarpum* is in the amount of 7412 mg/kg which value is greater than the value found by Karlsons *et al*. (2018) 5400 mg/kg.

The recommended daily intake of potassium varies from 0.4 g for infants, 3.8 g for children aged 4-8 years, and up to 4.7 g for adolescents and adults.

Sodium, along with potassium, participates in the transfer of nerve impulses, affects membrane permeability, and maintains muscle tone. Lack of sodium in the body can cause a drop in blood pressure, which can lead to general weakness and loss of appetite (Veljković and Vučković, 2010). The sodium content in the tea samples consumed in Kosovo ranges from 1908 mg/kg to 2480 mg/kg, figure 1(a) and table 2. The recommended daily intake for infants is 0.12 g, for children aged 4-8 years, and 1.2 mg for adolescents, men, and women about 1.5 g.

Magnesium participates in many biochemical and physiological processes in the body. It is necessary for the normal functioning of many different enzymes (Shils *et al*., 1999). It is present in bones, tissues, organs, and blood. It is also essential for the normal functioning of muscles and the nervous system, supports immunity, makes bones strong, and promotes a normal heart rhythm. In addition, magnesium regulates blood sugar levels, affects blood pressure (Saris *et al*., 2000), and plays an important role in regulating blood pressure.

The magnesium content ranges from 1309 mg/kg in sample 1 (Croatia) to 4287 mg/kg in tea sample 5 (Kosovo), figure 1(a) and table 2. Karlsons *et al*. (2018) during the research of *V. microcarpum* leaf in Latvia have encountered the amount of 2200 mg/kg which compared to the amount of magnesium (2597.2 mg/kg) of the teas researched by us is a low value.

The high levels of potassium, magnesium, and sodium in all tested *V. microcarpum* tea samples are probably due to their high presence in the soil. It is well known that the main source of metals in food comes from the soil on which plant products grow. This brings about a clear link between the composition of the earth and the metals which enter the human body.

Iron is an essential nutrient for all life forms. Iron acts as a cofactor for many enzymes. It is essential for the transport of oxygen and the transfer of electrons. However, daily iron requirements can range between 8-18 mg for humans. Because iron has pro-oxidant activity, it can be toxic in excessive concentrations (Wallace *et al.*, 1992). The concentration of iron in *V. microcarpum* tea in samples 1, 2, 3, 4, and 5 consumed in Kosovo was 86 mg/kg – 302 mg/kg. Thus, iron content ranges from 86 mg/kg in sample 1 (Croatia) to 302 mg/kg in tea sample 5 (Kosovo), figure 1(b) and table 2.

The amount of iron (71.31 mg/kg) found by Karlsons *et al*. (2018) in a leaf of *V. microcarpum* cultivated in Latvia is comparatively smaller than the amount of iron found in *V. microcarpum* teas researched by us (165.8 mg/kg).

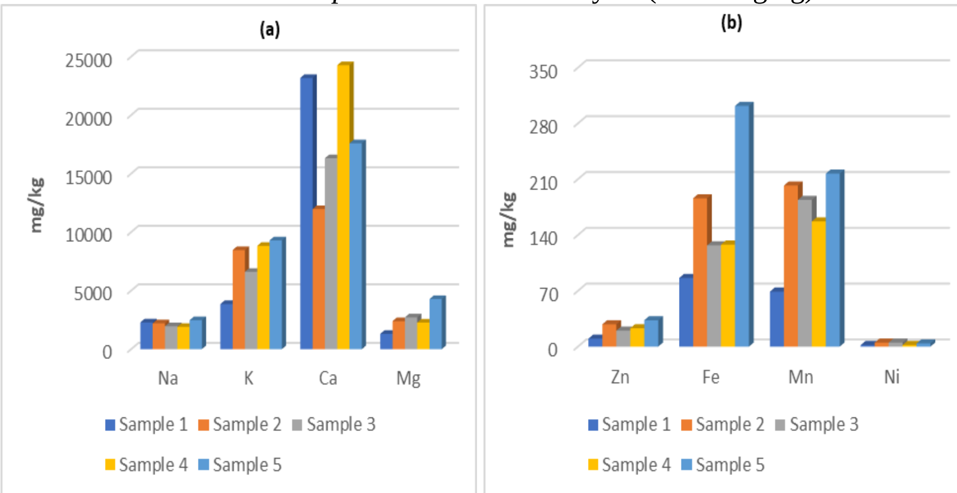


**Figure 1.** Concentrations of (a) Na, K, Ca, Mg and (b) Zn, Fe, Mn, Ni in mg/kg when we used the microwave to decompose samples

Manganese is a micronutrient found naturally in plants and animals (Powell *et al*., 1998). However, overexposure to Mn can have neurological effects which usually result from water consumption with very high levels of it (Powell *et al*., 1998). The manganese content in the samples of *V. microcarpum* tea consumed in Kosovo was in the range from 69 mg/ kg in sample 1 (Croatia) to 217 mg/kg in sample 5 (Kosovo). The amount of manganese (298 mg/kg) found by Karlsons *et al.* (2018) in a leaf of *V. microcarpum* cultivated in Latvia is comparatively bigger than the amount of manganese found in *V. microcarpum* teas researched by us (165.8 mg/kg).

The presence of small amounts of zinc is essential for increasing plant and animal life. Lack of zinc in the body causes growth retardation, anorexia, vomiting, etc. (Morgan, 1985). The amount of zinc in all samples was between 10 to 33 mg/kg, figure 1(b) and table 2. The zinc content in the samples of *V. microcarpum* tea consumed in Kosovo was in the range from 10 mg/kg in sample 1 (Croatia) to 33 mg/kg in sample 5. The amount of zinc found in our samples was approximately the same as the amount of zinc reported by Latvia scientists Karlsons *et al*. (2018). The amount of zinc reported by Karlsons *et al.* (2018) for *V. microcarpum* cultivated in Latvia in 2018 was 26.44 mg/kg, which according to our findings are approximate values.

**Table 3.** Concentrations of metals data (Na, K, Ca, Mg, Zn, Fe, Mn, and Ni; mg/kg) in cranberries tea infusions at different times.

| Sample | Time/min | Na | K | Ca | Mg | Zn | Fe | Mn | Ni |
|---|---|---|---|---|---|---|---|---|---|
| 1 Croatia | 3 | 1131 | 3158 | 18455 | 952 | 2.5 | 44 | 37 | ND |
| | 5 | 2194 | 3469 | 13255 | 935 | 2.9 | 44 | 39 | ND |
| | 10 | 1384 | 3147 | 12691 | 979 | 2.1 | 47 | 41 | 1 |
| 2 Kosovo | 3 | 1212 | 8098 | 9875 | 1150 | 21 | 23 | 156 | ND |
| | 5 | 1383 | 8368 | 9955 | 1143 | 19 | 25 | 159 | 2 |
| | 10 | 1613 | 8153 | 9189 | 1169 | 22 | 32 | 160 | ND |
| 3 Sri Lanka | 3 | 1550 | 6132 | 10247 | 2176 | 5.0 | 16 | 135 | ND |
| | 5 | 1785 | 6129 | 10322 | 2184 | 5.8 | 16 | 139 | 1 |
| | 10 | 1704 | 5965 | 10311 | 2120 | 3.4 | 6 | 140 | ND |
| 4 Slovenia | 3 | 1719 | 8659 | 21886 | 2045 | 19 | 15 | 122 | ND |
| | 5 | 1219 | 8721 | 22140 | 2153 | 21 | 26 | 125 | ND |
| | 10 | 1850 | 8716 | 22050 | 2145 | 17 | 19 | 127 | ND |
| 5 Kosovo | 3 | 2029 | 8967 | 15468 | 3217 | 27 | 37 | 172 | ND |
| | 5 | 2233 | 8999 | 16422 | 3899 | 29 | 30 | 173 | 1 |
| | 10 | 2194 | 8442 | 15526 | 2681 | 21 | 32 | 177 | 1 |

ND: Not detected.

The concentration of nickel in all samples was lower than that of other metals and ranged from 2 mg/kg to 5mg/kg, figure 1(b) and table 2. Nickel is known to aid in pancreatic function and insulin production (Petrović *et al*., 2015). Table 3 shows the metal concentrations in *V. microcarpum* tea infusions at different times 3, 5, and 10 minutes, and table 4 presents descriptive statistics.

**Table 4.** Descriptive statistics of the concentration data (Na, K, Ca, Mg, Zn, Fe, Mn, and Ni; mg/kg) in cranberries tea infusions at different times samples.

| **Parameters** | **Na** | **K** | **Ca** | **Mg** | **Zn** | **Fe** | **Mn** | **Ni** |
|---|---|---|---|---|---|---|---|---|
| Mean | 1680 | 7008.2 | 14519.47 | 1929.87 | 14.51 | 27.47 | 126.8 | 1.2 |
| Minimum | 1131 | 3147 | 9189 | 935 | 2.1 | 6 | 37 | 1 |
| Maximum | 2233 | 8999 | 22140 | 3899 | 29 | 47 | 177 | 2 |
| Median | 1704 | 8153 | 13255 | 2120 | 19 | 26 | 139 | 1 |

The data in table 3, shows that the mineral content in the analyzed samples of *V. microcarpum* tea infusions is in a wide range.

The amount of sodium in samples of *V. microcarpum* tea infusions was as follows: sample1-Croatia (1131 mg/kg-2194 mg/kg); sample 2-Kosovo (1212 mg/kg-1613 mg/kg); sample 3-Sri Lanka (1550 mg/kg-1785 mg/kg); sample 4-Slovenia (1219 mg/kg-1850 mg/kg) and Sample 5-Kosovo (2029 mg/kg-2233 mg/kg). Sodium concentration ranges from 1131 mg/kg sample 1-Croatia, figure 2 (a) to 2233 mg/kg sample 5-Kosovo figure 6 (a). The average value of sodium concentration in the five samples analyzed was 1680 mg/kg. The amount of sodium was greater than the amount of manganese, iron, zinc, and nickel and was less than the amount of calcium, potassium, and magnesium.

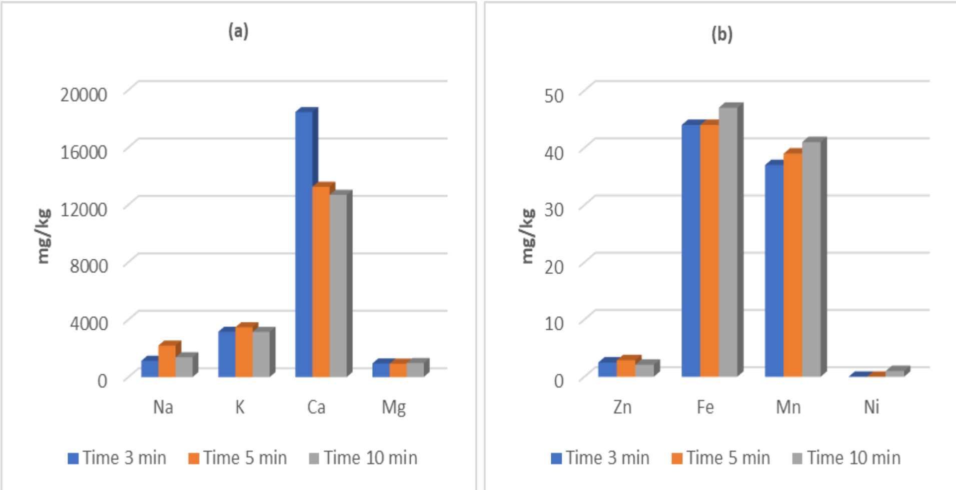


**Figure 2.** Concentrations of (a) Na, K, Ca, Mg and (b) Zn, Fe, Mn, Ni in mg/kg at different times in sample 1 (Croatia).

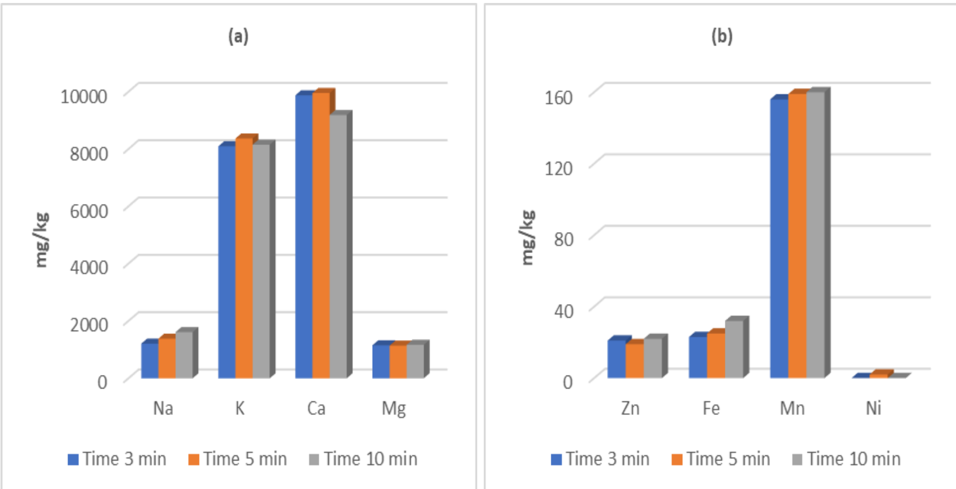


**Figure 3.** Concentrations of (a) Na, K, Ca, Mg and (b) Zn, Fe, Mn, Ni in mg/kg at different times in sample 2 (Kosovo).

The amount of potassium in samples of *V. microcarpum* tea infusions was as follows: sample 1-Croatia (3147 mg/kg-3469 mg/kg); sample 2-Kosovo (8098 mg/kg-8368 mg/kg); sample 3-Sri Lanka (5965 mg/kg-6132 mg/kg); sample 4-

Slovenia (8659 mg/kg-8721 mg/kg) and Sample 5-Kosovo (8442 mg/kg-8999 mg/kg). Potassium concentration ranges from 3147 mg/kg sample 1-Croatia (figure 2) to 8999 mg/kg sample 5-Kosovo, figure 6 (a). The mean value of potassium concentration in the five analyzed samples of tea infusions was 7008.2 mg/kg, table 5. The amount of potassium was greater than the amount of magnesium, sodium, manganese, iron, zinc, and nickel, and was less than the amount of calcium.

The amount of calcium in samples of *V. microcarpum* tea infusions was as follows: sample1-Croatia (12691 mg/kg-18455 mg/kg); sample 2-Kosovo (9189 mg/kg-9955 mg/kg); sample 3-Sri Lanka (10247 mg/kg-10322 mg/kg); sample 4-Slovenia (21886 mg/kg-22140 mg/kg) and Sample 5-Kosovo (15468 mg/kg-16422 mg/kg).

Figures 3 (a) and 5 (a), show that the amount of calcium ranges from 9189 mg/kg sample 2-Kosovo to 22140 mg/kg sample 4-Slovenia. The average value of calcium concentration in the five analyzed samples of *V. microcarpum* tea infusions consumed in Kosovo was 14519.47 mg/kg, table 5. So the amount of calcium was greater than the amount of all the other elements that were analyzed during our research.

The amount of magnesium in samples of *V. microcarpum* tea infusions was as follows: sample 1-Croatia (935 mg/kg-979 mg/kg); sample 2-Kosovo (1143 mg/kg-1169 mg/kg); sample 3-Sri Lanka (2120 mg/kg-2184 mg/kg); sample 4-Slovenia (2045 mg/kg-2153 mg/kg) and Sample 5-Kosovo (2681 mg/kg-3217 mg/kg).

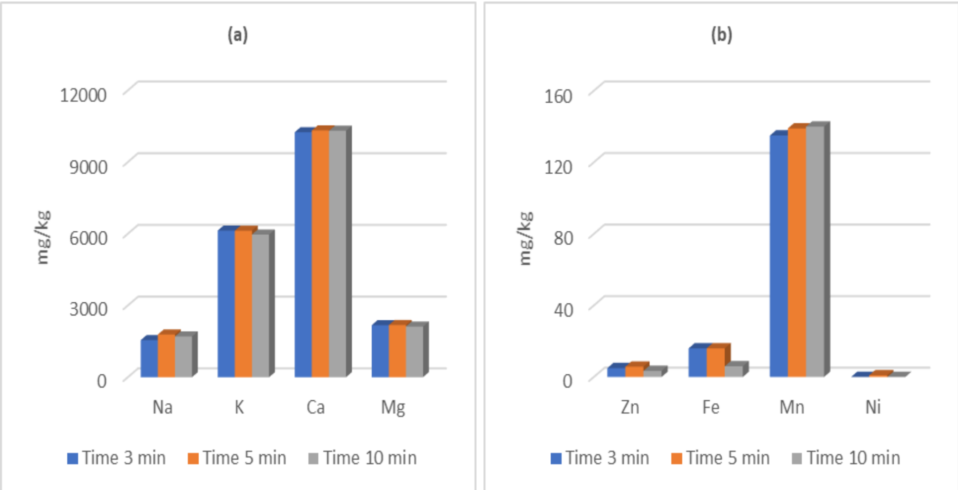


**Figure 4.** Concentrations of (a) Na, K, Ca, Mg and (b) Zn, Fe, Mn, Ni in mg/kg at different times in sample 3 (Sri Lanka).

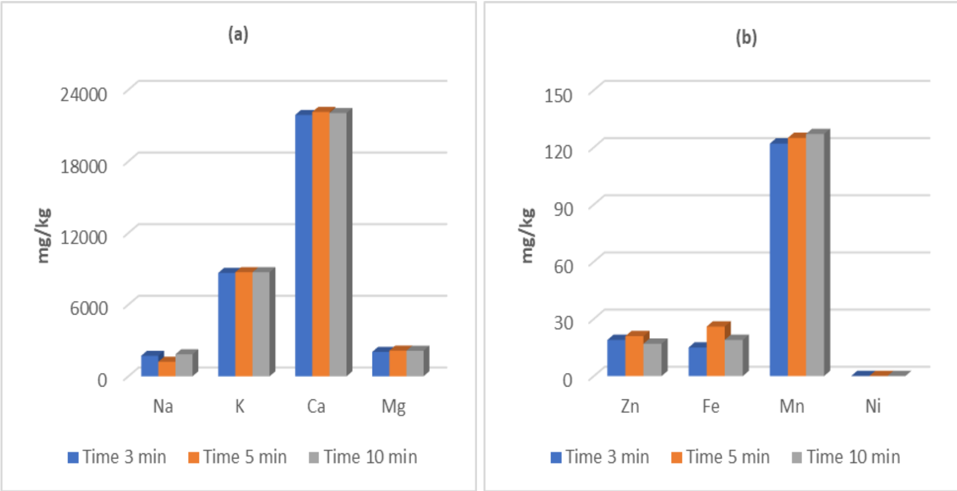


**Figure 5.** Concentrations of (a) Na, K, Ca, Mg and (b) Zn, Fe, Mn, Ni in mg/kg at different times in sample 4 (Slovenia).

The magnesium concentration ranges from 935 mg/kg sample 1-Croatia (figure 2) to 3899 mg/kg sample 5-Kosovo, figure 6 (a). The average value of magnesium concentration in the five samples analyzed was 1929.87 mg/kg, table 5. So, the amount of magnesium was greater than the amount of sodium, manganese, iron, zinc, and nickel and was less than the amount of calcium and potassium.

The amount of zinc in samples of *V. microcarpum* tea infusions was as follows: sample1-Croatia (2.1 mg/kg-2.9 mg/kg); sample 2-Kosovo (19 mg/kg-22 mg/kg); sample 3-Sri Lanka (3.4 mg/kg-5.8 mg/kg); sample 4-Slovenia (17 mg/kg-21 mg/kg) and Sample 5-Kosovo (21 mg/kg-29 mg/kg). Also from figures 2 (b) and 6 (b), it can be seen that the amount of zinc ranges from 2.1 mg/kg sample 1-Croatia to 29 mg/kg sample 5-Kosovo. The average value of zinc concentration in the five analyzed samples of *V. microcarpum* tea infusions consumed in Kosovo was 14.51 mg/kg, table 5. So the amount of zinc was greater than the amount of nickel and was much smaller than the amount of other elements that were analyzed in *V. microcarpum*tea infusions during our research.

The amount of iron in samples of *V. microcarpum* tea infusions was as follows: sample1-Croatia (44 mg/kg-47 mg/kg); sample 2-Kosovo (23 mg/kg-32 mg/kg); sample 3-Sri Lanka (6 mg/kg-16 mg/kg); sample 4-Slovenia (15 mg/kg-26 mg/kg) and Sample 5-Kosovo (30 mg/kg-37 mg/kg). Also from figures 2 (b) and 6 (4), it can be seen that the amount of iron in *V. microcarpum* tea infusions ranges from 6 mg/kg sample 3-Sri Lanka to 47 mg/kg sample 1-Croatia. The average value of iron concentration in the five analyzed samples of *V. microcarpum* tea infusions consumed in Kosovo was 27.47 mg/kg, table 5, while from Petrović reports, the level of iron concentration in chamomile teas (*Matricaria chamomilla* L.) was 1.9 to 7.4 mg/kg, (Petrović et al., 2015), which has values much lower than our results and I think this may be as a result of research into different teas.

So the amount of iron was greater than the amount of zinc and nickel and was much smaller than the amount of Ca, K, Mg, Na, and Mn which were analyzed in *V. microcarpum* tea infusions during our research.

The amount of manganese in samples of *V. microcarpum* tea infusions was as follows: sample1-Croatia (37 mg/kg-41 mg/kg); sample 2-Kosovo (156 mg/kg-160 mg/kg); sample 3-Sri Lanka (135 mg/kg-140 mg/kg); sample 4-Slovenia (122 mg/kg-127 mg/kg) and Sample 5-Kosovo (172 mg/kg-177 mg/kg). The manganese concentration ranges from 37 mg/kg sample 1-Croatia, figure 2 (a) to 177 mg/kg sample 5-Kosovo, figure 6 (a). The mean value of manganese concentration in the five analyzed samples of *V. microcarpum* tea was 126.8 mg/kg, table 5. Krstić reported that their actions on Mn in different tear samples ranged from 1.82-651.04 mg/kg (Krstić *et al*., 2021). Also, Podwika and Kleszc reported high Mn levels in teas of different types and different colleagues also reported high Mn ranging from 457 to 2210 mg/kg (Podwika *et al*., 2018), hence our comparable results, table 5.

In most of the samples analyzed nickel was below the detection limit. Figures 2 (b), 3 (b), 4 (b), and 6 (b) show that the amount of nickel ranges from 1 mg/kg (sample 1-Croatia, sample 3-Sri Lanka and sample 5-Kosovo) to 2 mg/kg (sample 2-Kosovo).

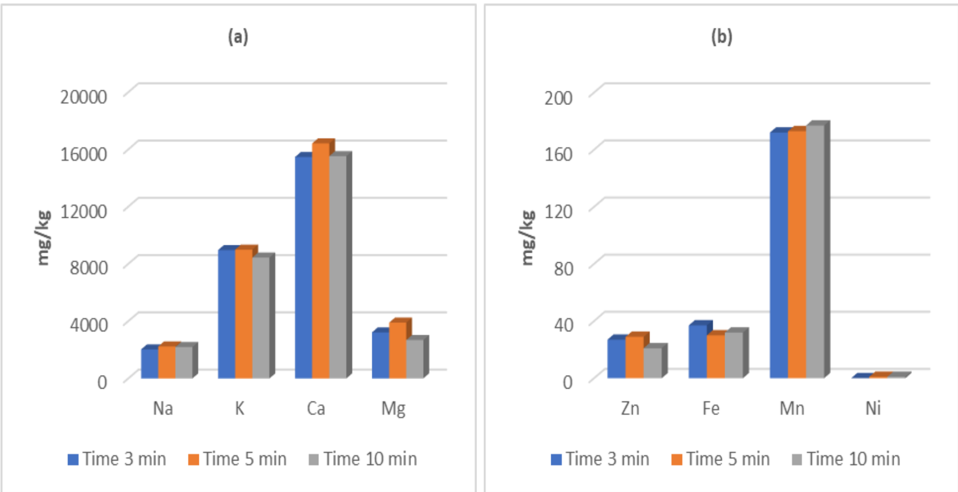


**Figure 6.** Concentration of (a) Na, K, Ca, Mg and (b) Zn, Fe, Mn, Ni in mg/kg at different times in sample 5 (Kosovo).

The average value of nickel concentration in the five analyzed samples of *V. microcarpum* tea infusions consumed in Kosovo was 1.2 mg/kg, and it is comparable to the values reported by Krstić for the Sambucusnigra L. tea type, where the concentration level is 0.97 mg/kg (Krstić, 2021).

## CONCLUSIONS

In this research, we have analyzed the content of micro and macro elements in *V. microcarpum* tea samples found in a local market in Pristina. Metal concentrations were determined by the method of atomic absorption spectroscopy. So, the objective of this study was to determine the levels of some minerals and trace elements (Na, K, Ca, Mg, Zn, Fe, Mn, and Ni) of the five trademarks which are widely consumed in Kosovo.

Based on the results obtained in this paper, the presence of micro and macro elements in *V. microcarpum* tea samples were within the permissible limits, including the presence of heavy metals. All samples of *V. microcarpum* tea which were tested showed high concentrations of macro elements that can meet the daily needs of these nutrients.

Finally, we suggest that there is a need for more rigorous and consistent controls of the herbal products available in our markets.

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