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A detailed and comparative elemental analysis (Poland vs. Portugal) of espresso coffee

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Coffee is one of the most popular beverages in the world. There are many different types of coffee, but “espresso” has become the favourite in many countries. In Portugal, 80% of people drink coffee daily and prefer to make it as an espresso. Annual *per capita* coffee consumption (dry beans) is estimated at 5 kg, being higher in many other Western European countries, namely the Nordic countries [1]. In Poland, also more than 80% of adults consume coffee every day, but instant coffee still takes up the largest share. National *per capita* consumption (2021) is estimated at between 0.7-2.5 kg [2].

Espresso coffee is prepared by passing water at high temperature (88-92 °C) and under high pressure (8-10 bar) through ground coffee (6-8 g) for 20-30 seconds to produce around 25-40 ml of beverage [1]. The extraction of substances existing in coffee powder is very efficient, so their concentration in coffee (beverage) is also very high.

In this work, we carried out a comparative study of the elemental composition (n=34 macrominerals and trace elements) of espresso coffee from two different European origins: Northern Poland (n=60, areas of Gdańsk, Gdynia and Elbląg) and Northern Portugal (n=22, Porto Metropolitan Area). Samples (5-10 ml) were taken from the beverage as served in cafes, restaurants and gas stations. In order to better document the contribution of coffee (powder) to the final composition of the beverage, water samples were taken in parallel at the same locations. The analysis was performed by ICP-MS.

In both cases, espresso coffee proved to be a concentrated source of many elements (Table 1), with levels much higher than those of water from the same location. Polish waters were globally much more mineralized than Portuguese waters, and generally Polish coffee also showed significantly higher levels of macrominerals and trace elements than the Portuguese ones.

Table 1. Concentration of selected macrominerals and trace element levels in the study samples

Element	Polish coffee	[water]	Portuguese coffee	[water]
Mg (mg/L)	273.7 (134.1)	[11.3 (3.4)]	170.1 (39.5)	[5.7 (0.38)]
P (mg/L)	221.9 (96.7)	[0.35 (0.52)]	173.0 (33.3)	[0.31 (0.34)]
Ca (mg/L)	91.6 (41.8)	[73.7 (19.8)]	51.9 (12.5)	[30.1 (1.0)]
Rb (mg/L)	5.4 (2.5)	[0.003 (0.005)]	5.1 (1.9)	[0.002 (0.000)]
Mn (mg/L)	2.1 (1.2)	[0.009 (0.016)]	0.88 (0.23)	[0.006 (0.007)]
B (mg/L)	1.67 (0.66)	[0.198 (0.223)]	1.34 (0.28)	[0.006 (0.003)]
Zn (µg/L)	863 (749)	[342 (553)]	452 (448)	[110 (119)]
Cu (µg/L)	832 (892)	[126 (161)]	353 (440)	[43 (30)]
Sr (µg/L)	354 (175)	[453 (288)]	212 (63)	[205 (15)]
Ba (µg/L)	171 (105)	[31 (19)]	84 (32)	[23 (18)]
Co (µg/L)	19 (13)	[12.0 (3.1)]	12.0 (8.1)	[19.1 (1.7)]
Cs (µg/L)	13 (12)	[0.02 (0.04)]	12.8 (8.8)	[0.005 (0.02)]

^a Results as mean (SD). In square brackets, the corresponding levels in water.

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