



Dmitrowicz, A., Mystkowska, I. and Sijko-Szpańska, M. (2026)
'Content of macro- and trace elements determined by ICP-OES
in brews from whole-bean and freeze-dried coffee roasted to different degrees',
Journal of Elementology, 31(3), ,
available: <https://doi.org/10.5601/>



RECEIVED: 20 March 2026

ACCEPTED: 1 June 2026

ORIGINAL PAPER

Content of macro- and trace elements determined by ICP-OES in brews from whole-bean and freeze-dried coffee roasted to different degrees

Aleksandra Dmitrowicz^{1,2}, Iwona Mystkowska³,
Monika Sijko-Szpańska²

¹ Faculty of Health Sciences

John Paul II University in Biala Podlaska, Biala Podlaska, Poland

² Regional Research Centre on Environment,

Agriculture and Innovative Technologies EKO-AGRO-TECH

John Paul II University in Biala Podlaska, Biala Podlaska, Poland

³ Department of Dietetics

John Paul II University in Biala Podlaska, Biala Podlaska, Poland

Abstract

Coffee is one of the most widely consumed beverages worldwide, and its mineral composition varies significantly depending on roasting parameters and product form. This study aimed to assess the content of macronutrients (K, Mg, Ca, Na, P) as well as trace and potentially toxic elements (Al, Co, Cr, Fe, Mn, Ni, Sr, Zn) in brews made from coffee beans roasted to five levels (5/10-9/10) and from two variants of freeze-dried instant coffee (5/10 and 6/10). Brews were prepared at a standardized coffee-to-water ratio of 6:100 (m/v), at 92°C for 5 minutes, digested with HNO₃ and H₂O₂, and then the concentrations of elements were determined by the ICP-OES method. Potassium was the predominant element in all brews, with mean concentrations of 287 mg L⁻¹ in whole bean coffees and 688 mg L⁻¹ in freeze-dried coffees. The concentrations of macronutrients in freeze-dried coffees were 1.51-2.36 times higher than in whole-bean coffee, reflecting the greater content of soluble solids in the instant product. In contrast, iron concentrations were practically identical in both product forms regardless of the degree of roasting, suggesting differences in the physicochemical form in coffee beans. It was demonstrated that roast degree affects element concentrations in a curvilinear manner, with maximum extraction occurring at 7/10-8/10, while intense roasting (9/10) led to a 35-55% reduction in concentrations relative to maximum values. The results indicate that dark-roasted coffee contains lower concentrations of minerals than medium-roasted coffee, which may have nutritional implications for consumers who regularly drink coffee as a source of magnesium and potassium in their diet. Concentrations of arsenic, cadmium, and lead remained below the method's limit of quantification in all samples, confirming the safety of the analysed brews with respect to toxic metal content.

Keywords: coffee mineral profile, degree of roasting, freeze-dried coffee, ICP-OES

Aleksandra Dmitrowicz, MSc, Faculty of Health Sciences, John Paul II University in Biala Podlaska, Siderska 95/97, 21-500 Biala Podlaska, Poland; e-mail: a.dmitrowicz@akademibialska.pl

* This paper was prepared under the Research Development Fund No. PB/8/2024 (TJO-27) of John Paul II University in Biala Podlaska.