

Analysis of Mineral Content in Animal-Based and Plant-Based Milks Using ICP-AES

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Structured Abstract

Background: Plant-based milk alternatives have gained significant popularity in recent years due to increasing health concerns, allergies, and ethical or environmental consideration. While cow's milk is widely known for its high mineral content, questions arise as to whether plant-based milk products can provide a comparable nutritional composition. This study focuses on quantifying essential minerals in both animal-based and plant-based milk products using Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) and Flame Atomic Absorption Spectroscopy (FAAS).

Methods: A total of six milk brands including two cow-based (Dutch Lady, Goodday) and four plant-based (Yeo's, 137 Degrees, Oatside, Farm Fresh) were analyzed. Sodium (Na) and potassium (K) were determined using ICP-AES, while calcium (Ca) and magnesium (Mg) were quantified using FAAS. All milk samples were digested using microwave-assisted acid digestion before analysis to break down organic components and release the target minerals into solution. External calibration curves were created for each element. The linearity of the calibration was evaluated using the correlation coefficient (R^2), where acceptable R^2 values were ≥ 0.995 to ensure reliable quantification.

Results: The precision of measurements were assessed through triplicate analyses of each sample. Replication precision was evaluated based on the relative standard deviation (RSD%). The RSD values across all samples for each element remained within acceptable limit ($<5\%$). This indicates good repeatability and consistency in the measurements. Specific wavelengths were selected for each element based on their characteristic emission or absorption lines. Although the analytical method showed good precision and calibration reliability, some challenges related to matrix effects and potential label discrepancies were noted during the process. These factors underscore the importance of further validation in future studies.

Conclusion: In conclusion, this study demonstrates a reliable and reproducible analytical workflow for quantifying mineral content in milk products using external standard calibration with ICP-AES and FAAS. The method provided acceptable linearity and precision based on R^2 and RSD%, respectively, and can serve as a baseline approach for future studies involving food matrix analysis.

Keywords: External calibration, ICP-AES, FAAS, mineral quantification, milk analysis

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