

Multi-elemental Analysis Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for the Geographical Origin Discrimination of Greek Giant Beans “Gigantes Elefantes”

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Abstract

“Gigantes Elefantes” is a particularly dynamic crop of giant beans cultivated in western Macedonia (Greece). This variety of large beans growing in this area and specifically in the regions of Prespes and Kastoria is a protected designation of origin (PDO) species with high nutritional quality. Mislabeling of geographical origin and blending with unidentified samples are common fraudulent practices in Greek food market with financial and possible health consequences. The last decades, multi-elemental composition analysis is used in identifying the geographical origin of foods and agricultural products. In an attempt to discriminate the authenticity of Greek beans, multi-elemental analysis (Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ga, Ge, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, Se, Sr, Ta, Ti, Tl, U, V, W, Zn, Zr) was performed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) on 320 samples of beans, originated from Greece (Prespes and Kastoria), China and Poland. All samples were collected during autumn of 2021. The obtained data were analysed by Principal Component Analysis (PCA), an unsupervised statistical method, which allows to reduce the dimensionality of the enormous datasets. Statistical analysis revealed a clear separation of beans that had been cultivated in Greece compared with those from China and Poland. An adequate discrimination of geographical origin between bean samples originated from the two Greece regions, Prespes and Kastoria, was also evident. Our results suggest that multi-elemental analysis combined with the appropriate multivariate statistical method could be a useful tool for bean’s geographical authentication.

Keywords

Geographical origin, authenticity multi-elemental analysis, beans, ICP-MS, PCA.

Acknowledgement:

This research has been financed by the Public Investment Programme/General Secretariat for Research and Innovation, under the call “YPOERGO 3, code 2018SE01300000: project title: ‘Elaboration and implementation of methodology for authenticity and geographical origin assessment of agricultural products.

Geographic Origin Determination of Greek Rice (*Oryza Sativa L.*) Using Stable Isotopic Ratio Analysis

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Abstract

It is well known that accurate determination of geographic origin to confront mislabeling and adulteration of foods is considered as a critical issue worldwide not only for the consumers, but also for producers and industries. Among agricultural products, rice (*Oryza sativa L.*) is the world's third largest crop, providing food for more than half of the world's population. Consequently, the quality and safety of rice products play an important role in people's life and health. Despite the fact that rice is predominantly produced in Asian countries, rice cultivation in Greece is of significant importance, contributing to national agricultural sector income. More than 25,000 acres are cultivated in Greece, while rice exports to other countries consist the 0,5% of the global rice trade. Although several techniques are available in order to provide information about the geographical origin of rice, little data exist regarding the ability of these methodologies to discriminate rice production from Greece. Thus, the aim of this study is the comparative evaluation of stable isotope ratio methodology regarding its discriminative ability for geographical origin determination of rice samples produced in Greece compared to those from three other Asian countries namely Korea, China and Philippines. In total eighty (80) samples were collected from selected fields of Central Macedonia (Greece), during October of 2021. The light element (C, N, S) isotope ratios were measured using Isotope Ratio Mass Spectrometry (IRMS) and the results obtained were analyzed using chemometric techniques, including principal components analysis (PCA). Results indicated that the $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$ values of rice produced in Greece were more markedly influenced by geographical origin compared to the $\delta^{13}\text{C}$. In particular, $\delta^{34}\text{S}$ values in rice originating from Greece was -1.98 ± 1.71 compared to 2.10 ± 1.87 , 4.41 ± 0.88 and 9.02 ± 0.75 for Korea, China and Philippines respectively. Among stable isotope ratios studied, values of $\delta^{34}\text{S}$ seem to be the more appropriate isotope marker to discriminate rice geographic origin between the studied areas. These results imply the significant capability of stable isotope ratio methodology for effective geographical origin discrimination of rice, providing a valuable insight into the control of improper or fraudulent labeling. **Acknowledgement:** This research has been financed by the Public Investment Programme/General Secretariat for Research and Innovation, under the call "YPOERGO 3, code 2018SE01300000: project title: 'Elaboration and implementation of methodology for authenticity and geographical origin assessment of agricultural products.

Keywords

Geographical origin, authenticity, rice, isotope ratio mass spectrometry (IRMS).