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Multi-isotope and elemental pattern for tracing the geographical origin of Treviso Red Chicory (NE Italy)

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Food fraud with respect to provenance and authenticity has become a major concern for consumers and food producers who want to defend local production. Food labelling (e.g. as PGI, PDO and CSC) on a geographical basis can protect the regional designation, ensure fair competition, prevent spreading of food pathogen importing only safe food and, last but not least, improve consumer confidence. However, food labelling is primarily based on 'paper work', which is vulnerable to fraud. Therefore, analytical methods allowing for unambiguous verification of origin and thus labelling compliance are needed.
Isotopic and elemental pattern are an effective tool to determine and verify the provenance of food. Stable isotope ratios of carbon, hydrogen and oxygen are largely adopted for the characterization of geographical origin because they are strongly altitude/latitude as well as climate dependent. δ13C isotope ratios reflect the metabolism of different plant types, as well. Stable isotope ratios of δ13C, δ15N and δ34S reflect additionally agricultural practices in the investigated area. The strontium 87Sr/86Sr isotope ratio in plants provides additional information as a geological tracer, since no isotope fractionation occurs during plant uptake from soil and transport from roots to leaves. Therefore, the Sr isotopic system provides a unique link to the soil independent on the plant type. In addition, the multi-element fingerprint of vegetables reflects the elements present in the soil in which they have been cultivated.
This work presents a multi-isotope (δD, δ18O, δ15N, δ13C, δ34S and 87Sr/86Sr) and multi-element approach to assess a unique fingerprint of PGI protected Treviso Red Chicory (Veneto) compared to red chicory produced in Padova, another region North Eastern of Veneto (Italy). Additionally, soil from two different depths (0-20 and 20-40 cm), fertilizers and water (monthly precipitation, irrigation water, groundwater and blanching water) from both sites were investigated to determine the main sources of the chemical tracers. Multivariate data analyses were performed to identify the key parameters of the isotopic and elemental pattern for geographical origin determination of the examined product.