Boron isotope compositions of food: A potential tool for food authentication

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Boron (B) and its isotopes have been used for a long time in geo- and environmental sciences to study mixing and fractionation processes as well as sources of anthropogenic contamination. The authentication of food using isotopic compositions of specific reservoir- and process-sensitive elements is a relatively new and growing application in isotope-chemistry. Unlike some well-established stable and radiogenic isotope systems (H-C-N-O-S-Sr-Pb) the use of B isotopes for food authentication is almost unexplored. However, due to essential role of B for embryonic development and organogenesis in plants and animals and the enormous range of isotope compositions found in nature B potentially is a very interesting isotope system to verify the origin and possible cultivation methods of various types of food.

First data on vegetables, corn and milk show that B mass fractions in these organic matrices are in the low mg/kg-range making B isotope ratio determinations a very challenging task.

The preliminary analytical procedure to determine B isotope compositions of food utilizes dry ashing to remove the organic matrix, B-specific AMBERLITE ion-chromatography for boron/matrix separation and a standard-sample-standard bracketing ICP-MS method for B isotope ratio measurements. Within the determined uncertainty B isotope compositions for separated NBS 951 and BAM-I001 overlap with the certified values indicating accurateness of the used procedure. To further verify the accuracy of the used analytical procedure and to improve the data quality, alternative methods for B isotope determinations (TIMS $Cs_2BO_2{}^+$, $BO_2{}^-$) will be tested.

Preliminary B isotope data for NIST Corn Bran reference material (SRM 8433) and a green bell pepper from Israel show relatively positive δ^{11}B values which are extremely different to the average negative δ^{11}B value of the continental crust and presumably most soils. Fertilisation with fertilizers high in δ^{11}B may partially have caused the observed δ^{11}B values. However, as most fertilisers are mined from continental salt deposits (low in δ^{11}B; e.g. Palmer and Helvací, 1995) this reason appears unlikely. Boron isotope fractionation during weathering and re-precipitation of secondary mineral phases (e.g. Lemarchand et al., 2007), intake and/or transport of B by the plant could have caused the observed high δ^{11}B values of the corn and bell pepper. Improvement of the applied analytical procedures as well as more date of δ^{11}B values in food should shed more light on these findings.

References

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