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Authentication of bell peppers using boron and strontium isotope compositions

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The wrong declaration of food in terms of geographical origin and production method is a major problem for the individual consumer and public regulatory authorities. The authentication of food matrices using H-C-N-O-S isotopic compositions is already well established. However, specific questions require additional isotopic systems, which are more diagonstic for the source reservoires involved or production methods used. Here we present B and Sr isotopic compositions of bell peppers from Europe (Germany, Austria, Netherlands, Spain) and Israel to verfiy their origin.

The bell peppers' B isotopic compositions between different locations are highly variable (d11BNISTSRM951 -8 to +35 %■), whereas the 87Sr/86Sr ratios are all close to modern seawater Sr isotopic composition of about 0.7092 (0.7078 to 0.7107), but still can reliably be distinguished. Distinct isotopically heavy and light B isotopic fingerprints are obtained for bell peppers from Israel and the Netherlands. Samples from Germany, Austria, and Spain display overlapping d11B values between 0 and +12 %■. Bell peppers from Israel show high d11B values (+28 to +35 %■) combined with 87Sr/86Sr ratios slightly more unradiogenic than modern seawater (ca 0.7079). Bell peppers from the Netherlands, however, show low d11B values (-8 %■) combinded with 87Sr/86Sr ratios of modern seawater (approx. 0.7085).

Mainly based on diagnostic B isotopic compositions bell peppers from Israel and the Netherlands can be related to a specific geographical growing environment (Israel) or production method (Netherlands).

The isotope fingerprints of bell peppers from the Netherlands are consistent with growing conditions in greenhouses typical for the Netherlands vegetable farming. Using optimized production methods crops in greenhouses were supplied with nutritients by liquid fertilizers on artificial substrates. As most fertilizers derive from non-marine salt deposits, fertilization typically imprints invariant d11B values close to zero to the crops. Such d11B values have been observed for bell peppers from the Netherlands.

Bell peppers from Israel on the other hand show B and Sr isotopic compositions typical for the natural B and Sr backround of the region (Vengosh et al, 1991 & 2007). As both, the high d11B values and 87Sr/86Sr ratios of about 0.7079 are reported for various surfaces and groundwaters of the region, the dominant source of B and Sr of the bell peppers appears to be irrigation. However, B coming from the soil in in varying amounts will also contribute significantly to the bell peppers B-balance and is presumably responsible for the scattering of B isotopic compositions in bell peppers from Israel. The combination of B and Sr isotope ratios therefore may be diagnostic for bell peppers from Israel and neibouring countries.

Vengosh et al. 1991, Geochim. Cosmochim. Acta 55 , 1689–1695.
Vengosh et al. 2007, Applied Geochemistry 22, 1052-1073.