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Can Stable Isotope combined with Trace Element Analysis distinguish between pure and g.g.A. (protected geographical indication, P.G.I.) certified Pumpkin Seed Oils?

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Styrian Pumpkin Seed Oil is a premium single seed vegetable oil that is uniquely linked to the geographic region of Styria where it is grown and produced. In 1996, the strong regional ties of this typical Styrian speciality were recognised by the EU-Commission who declared "Styrian Pumpkin Seed Oil P.G.I." as a Protected Geographical Indication (article 5 VO(EWG) Nr. 2081/92). In 1998, more than 2,000 domestic pumpkin seed producers and 30 oil mills formed an association of Styrian pumpkin seed oil producers, which is now called the "Gemeinschaft Steirisches Kürbiskernöl g.g.A.". This producers' association was formed in order to protect the regionality and the high quality of Styrian Pumpkin Seed Oil P.G.I. Procedures implemented by this producers' association document every step in the process from pumpkin seeds to seed crushing in oil mills and finally bottling of Styrian Pumpkin Seed Oil P.G.I., keeping a contiguous record of all production steps including annual harvest amounts. This permits full traceability of every bottle of Styrian Pumpkin Seed Oil P.G.I from harvest to the finished, bottled products found on the shelf of delis and even supermarkets.

Despite these efforts of the producers' association, there have been repeated claims of g.g.A. (P.G.I.) certified bottles of Styrian Pumpkin Seed Oil (PSO) having been analysed independently and shown to contain either mixtures of Styrian and non-Styrian PSO or no Styrian PSO at all. Since keeping records of annual harvest amounts of pumpkin seeds would make it very difficult for an "over-production" by mixing or substitution of alien PSO's to go unnoticed, we formed the hypothesis that the red-flagged bottles could have been counterfeits containing alien PSO with bottles sporting fake g.g.A. seals and fake serial numbers. An alternative hypothesis was that the chosen method of detection of allegedly misrepresented g.g.A. Styrian PSO resulted in a high number of false negatives thus incorrectly rejecting genuine Styrian PSO as alien PSO and mixtures of Styrian PSO with alien PSO.

To investigate the potential of multivariate stable isotope analysis as a means to correctly distinguish between genuine Syrian PSOs and other PSOs, we purchased 13 + 1 PSOs (13 different brands) from high-street and on-line shops. Samples were given alpha-numerical sample IDs and were analysed in a single-blinded fashion. Based on 2H, 13C and 18O abundance values alone sensitivity and specificity were 0.75 (1 false negative; 3 true positives) and 0.86 (1 false positive; 6 true negatives), respectively.

However, when combining stable isotope data with trace element data, sensitivity and specificity both improved with no false negatives or false positives being detected. Chemometric statistical analysis clearly separated the 3 g.g.A. certified Styrian PSOs from all but one other PSO, which was also a genuine Styrian PSO in as much as it was pressed from genuine Styrian pumpkin seeds though not by a Styrian oil mill and thus not qualifying for the g.g.A. mark.