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Multi-isotopic provenancing of biological products: possibilities and limitations of predicting origin in irrigated agricultural systems.

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Adulteration and fraud related to food and biological products is an increasing problem globally. Traceability is required throughout supply chains to ensure product quality and enhance consumer confidence. Environmental attributes at the origin of growth, including water sources, soil chemistry and climate, produce unique isotopic signatures in biological products that act like fingerprints. Agricultural management practices such as irrigation may modify isotopic signatures at a site. Models that link isotopic signatures in food to environmental processes and attributes can be used to trace geographic origin.

$\delta^{2}H$, $\delta^{18}O$ and $^{87/86}Sr$ signatures of *Vitis vinifera* and associated source waters are investigated to determine the impact of irrigation application on grape isotope signatures. Irrigation treatments were applied to Shiraz vines in the Barossa region to examine the effect of irrigation source and amount on $\delta^{2}H$, $\delta^{18}O$ and $^{87/86}Sr$ isotope signatures of grapes at harvest. Bioavailable $^{87/86}Sr$ in paired samples of labile soil extract and fruits grown at the same location are examined to determine if bioavailable $^{87/86}Sr$ is less sensitive than $\delta^{2}H$ and $\delta^{18}O$ to variation in plant species or seasonal climate differences.

Within season, grape $\delta^{2}H$ and $\delta^{18}O$ show significant differences due to source of irrigation applied. Comparison of grape isotopes from subsequent seasons demonstrates the amount of variation due to seasonal climate differences can be greater than isotope variation due to different irrigation source. Despite this, the amount grape isotope variation due to irrigation source remained similar in both years. Bioavailable $^{87/86}Sr$ of fruits are consistent at this location despite species and seasonal variation.

Rising consumer demand for evidence of food origin and production processes has generated an increased in the application of isotope analysis to determine origin of food and other products. Evolving regulatory landscapes may require independent, data driven confirmation of origin or management practices of agricultural products for authenticity and quality control. Findings from this research will demonstrate feasibility of isotopic provenancing for Australian agricultural products and inform required input data to develop predictive isoscape models for agricultural products, grown with a mix of water from different sources.