

A global survey of the stable isotope and chemical compositions of bottled and canned beers as a guide to authenticity.

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# A global survey of the stable isotope and chemical compositions of bottled and canned beers as a guide to authenticity

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### Highlights

- â€¢ A dataset is presented for the chemical and isotopic analysis of 162 beers from around the globe
- â€¢ Data provide a benchmark to assess products believed to be substitute or counterfeit
- â€¢ The authors present the isotopic composition of the beers in a geo-spatial framework (alcoscapes)
- â€¢ The isotopic composition of a beer can be assess against the stated country of origin

â€¢ Mapped data provide a means to assess products for which no genuine sample can be obtained

## Abstract

This study presents a dataset, derived from the analysis of 162 bottled and canned beers from around the globe, which may be used for comparison with suspected counterfeit or substitute products. The data comprise  $\delta^2\text{H}$  and  $\delta^{18}\text{O}$  compositions of the whole beer and  $\delta^{13}\text{C}$  compositions of the dry residue (mostly sugar) together with the concentrations of five anions (F, Cl,  $\text{NO}_3$ ,  $\text{SO}_4$ ,  $\text{PO}_4$ ) and seven cations (Ca, K, Mg,  $\text{SiO}_2$ , V, Mn, Sr).

A strong correlation, consistent with natural waters but offset from the Global Meteoric Water Line, was observed between the  $\delta^2\text{H}/\delta^{18}\text{O}$  composition of the beers. The extent of the offset could be explained by the brewing process and the alcohol and sugars present in the beers. Correlations between inorganic analytes were consistent with the addition of salts in the brewing process.

Beers were classified as follows: ale, lager, stout or wheat-beer and the chemical composition was found to be characteristic of the assigned type, with lagers being the most readily classified. A combination of chemical and isotopic data was found to be characteristic of the geographical origin (on a continental scale) and could most easily identify beers from Australasia or Europe. A global map of  $\delta^{18}\text{O}$  data revealed a geo-spatial distribution that mirrored existing maps of the isotopic composition of annual precipitation. This confirmed a commonsense view that local precipitation will be the primary source for the water used in brewing. Using this *isoscape* (or *alcoscape*) it may be possible to assess the geographical origins of samples for which genuine comparative samples cannot be obtained.



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## Keywords

Alcoholic beverages; Authentication; Beer; Chemical profile; Country of origin; Isotope

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