

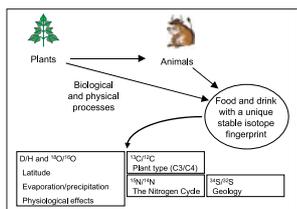


# The Use of Isotope Ratio Mass Spectrometry (IRMS) to Combat Fraud in the Food Industry

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The authenticity of food relates to information on name, ingredients, origin or processing. Examples of fraud include undeclared addition of water or other cheap materials (adulteration), incorrect declaration of particular ingredients and false statements about sources of ingredients (*i.e.* geographic, plant or animal origin). As it is not commercially viable to circumvent isotopic detection, stable isotopes have provided a way by which these types of frauds can be detected.

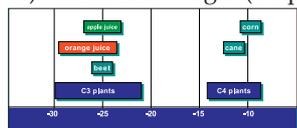
Biological systems discriminate between the isotopes of an element leading to **isotopic fractionation**.



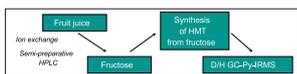
The use of stable isotope measurements is illustrated by the following examples:

## Fruit Juice Adulteration\*

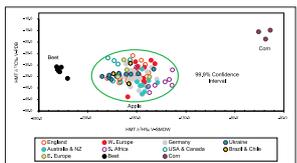
GC-Combustion-IRMS on ethanol from fermented fruit juice can detect cane sugar (C4 plant) in apple juice (C3 plant) but not beet sugar (C3 plant).



GC-Pyrolysis-IRMS of hexamethylenetetramine (HMT), formed via chemical transformation of fructose, provides position specific D/H ratios that relate to the parent sugar molecule.

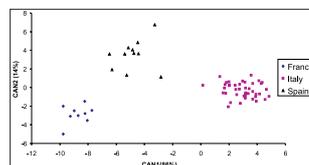


This now enables the detection of beet sugar in apple juice where this was not possible using <sup>13</sup>C values.

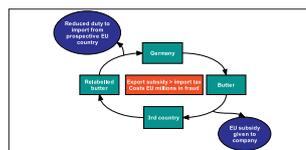


## Geographical Origin of Dairy Products\* Cheese

Cheeses from a variety of European countries were studied by multi isotopic analyses. Application of linear discriminant and canonical discriminant analyses enabled all samples to be classified correctly by their country of origin.

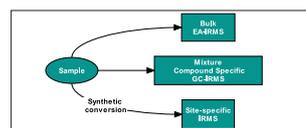


## Circular Trade in Butter



Customs authorities have recently used isotopic data to uncover a major fraud involving the "circular trade in butter".

## Application to Forensic Science



For example:

- Geographical origin of illicit drugs
- Characterisation of drugs (synthetic pathways)
- Synthetic versus natural steroids in sport
- Characterisation of explosives

## Points to Consider

- $\delta^2\text{H}\text{‰}$  and  $\delta^{18}\text{O}\text{‰}$  measurements provide a more powerful discrimination than  $\delta^{13}\text{C}\text{‰}$
- Require use of a reference database of authentic values or internal reference compound for isotopic measurements
- Require isotopic certified reference materials to monitor accuracy. CSL are currently involved in an EU project to develop suitable CRMs for use with GC-IRMS

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