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Effect of precipitation, geographical location and biosynthesis on New Zealand milk powder bulk and fatty acids D/H ratios

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D/H ratio measurements provide useful information for the investigation of biogeochemical influences on natural and agricultural produce, particularly with application to food traceability and authentication. Numerous studies have shown that variation of a product's D/H ratio is influenced by both environmental factors and biological processes. This study investigates the D/H ratio of New Zealand milk powder and individual fatty acids, and causal determinants of isotopic variation. One of the key environmental factors is precipitation, and the D/H ratio "isoscaping" of NZ has been undertaken. New Zealand provides a unique geography for these kinds of study in terms of proximity to the ocean and natural geographical variability from sea level to elevations as high as 3700 m.

Milk powder samples were collected from different geographical regions from milk processing units, which were supplied by producers in the immediate region. H/D ratios of bulk milk powder and of individual fatty acids were determined. Initial comparison of the precipitation and milk powder bulk D/H data show a very good differentiation from north to southernmost parts of New Zealand and a relation between rain and milk bulk D/H abundance ratio. Almost 98% of milk FAs are in the form of triglycerides that have been extracted and hydrolysed to free FAs. Free FAs were esterified and analyzed with GC-IRMS. Individual FAs show variation in D/H ratio, and all values are depleted relative to the precipitation data.

The difference in D/H ratio amongst individual FAs reflects the geographical environment and biological processes i.e. micro-organisms activity in the rumen of the cow. Short chain FAs (less than 8 carbons), particularly C4 (Butyric acid), appear to be key determinants. The variation in the data can be rationalized using statistical multivariate analysis.