

Stable isotope analysis of light and heavy elements in milk and urine of cattle

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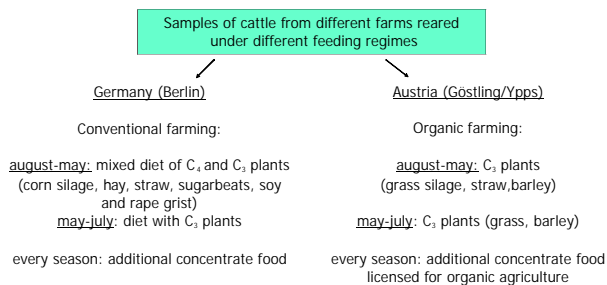
Introduction

- Food adulteration, for example the wrong declaration of food leads to an enormous insecurity of consumers.
- Most commonly the analysis of stable isotope ratios of light elements (C, N, H, S, O) with IRMS is used for traceability and authenticity studies.
- In many cases the determination of one or two isotope ratios (mainly C and N) by IRMS is not sufficient to detect food adulterations.
- In this study the isotope ratios of magnesium and strontium in milk and urine of cattle are measured with MC-ICP-MS and TIMS additionally to the isotope ratios of carbon and nitrogen by EA-IRMS.

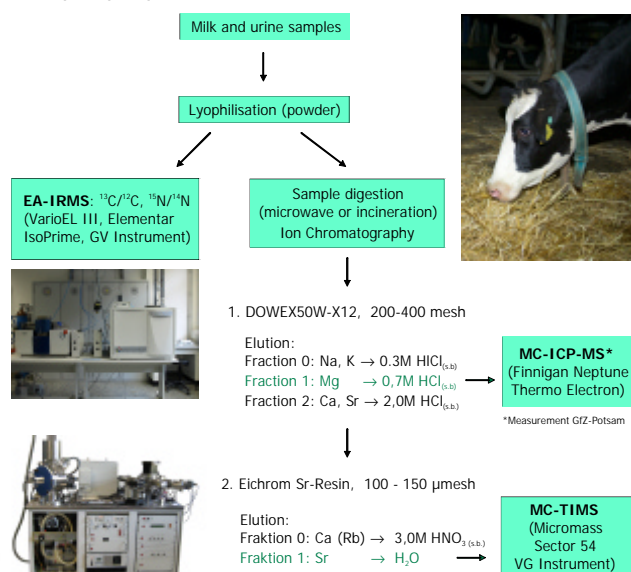
Main question: Can isotope ratios of the heavier elements be an additional tool for tracing the authenticity of beef or other animal products?

Experimental

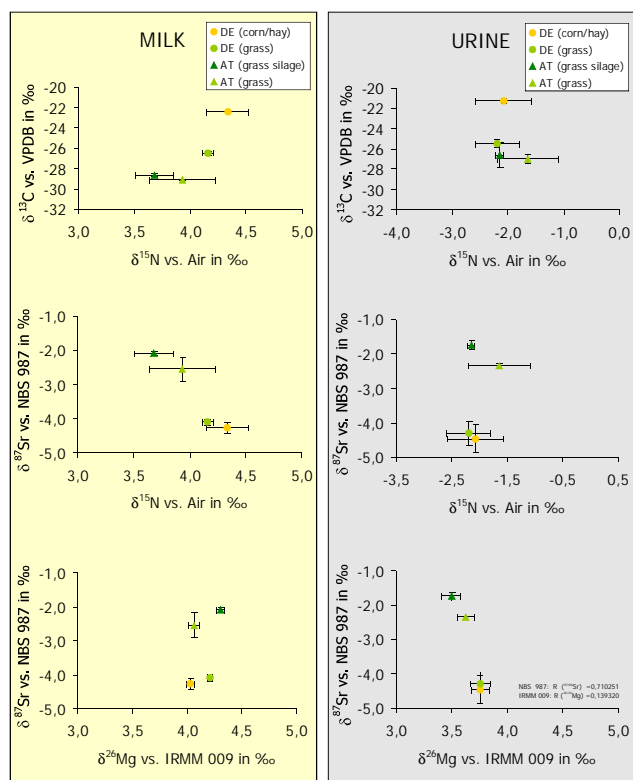
Feeding study



Sample preparation



Results



→ $\delta^{87}\text{Sr}$ values add much stronger informations on samples than $\delta^{26}\text{Mg}$ values

- The $\delta^{13}\text{C}$ values of milk are about 1 to 2 ‰ more negative and the $\delta^{15}\text{N}$ values are about 6 ‰ more positive than the urine samples. This is due to the different sample types and metabolic pathways of the cows metabolism. The $\delta^{87}\text{Sr}$ and $\delta^{26}\text{Mg}$ values are not influenced by the sample type.
- Independent of the different basic isotopic shifts in the bovine matrices there is nearly the same isotopic variation caused by feeding regime and origin of the cows detectable:
 - The $\delta^{13}\text{C}$ values show significant differences between samples of cattle with a diet of C₄ plants and a diet of C₃ plants.
 - The differences between $\delta^{15}\text{N}$ and $\delta^{26}\text{Mg}$ values are less than 0.5 ‰ for variations of both the feeding regime and the geographical origin.
 - The $\delta^{87}\text{Sr}$ values show significant differences between German and Austrian samples and can be a valuable tool for discriminating cattle of different livestock farming or different geographical origin.

Future Work

- Determination of stable isotope ratios of other in bovine milk and urine to test the feasibility for authenticity studies.
- Determination of stable isotope ratios in different bovine matrices such as faeces, hair and horn.
- Element screening with HR-ICP-MS to determine elemental fingerprints in these matrices.

Literature

N. Knobbe, J. Vogl, W. Pritzkow, U. Panne, H. Fry, H. M. Lochotzke, A. Preiss-Weigert, C and N stable isotope variation in urine and milk of cattle depending on the diet, Anal Bioanal Chem (2006) 386, 104-108.