

## Merits and limitations of multi-element methods for the characterization of food and animal feed items

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From the point of view of elemental analysis, food and feed items are a matrix high in P, K, Ca, Mg, and in case of human nutrition, sometimes of Na. With respect to their mean crust abundance, Al, Si, Fe and Ti are low. In many cases, oxidative digestion with nitric acid under moderate pressure is sufficient to obtain a suitable sample solution rather quickly. Modern multi-element methods permit reading of about 20 elements from one digest simultaneously. They are limited rather by homogenization problems or volatilization losses, than by cross interferences or detection limits. In ICP-OES (optical emission spectrometry) or ICP-MS, non-metals are more difficult to determine than the metals, because they are frequently present as counter ions in the calibrant solutions.

The overall analytical costs largely come from sampling in the field, proper storage, homogenization, drying (freeze drying), and digestion. In spite of this, the interest of the customers is usually limited to a few of them. Some are only interested in Pb, Cd and Hg, which are often termed as the “heavy metals”, because several intoxications have happened in the past, and legal limits have been set. Other concentrate on the essential elements, like Fe, Cu, Mn, Zn, I, Se, in particular for animal nutrition. Diet specialists may require only Na, Ca and Mg. The entire element spectrum of food and feed items is thus hardly found in the literature.

The element contents pattern of a food or feed matrix simultaneously characterizes the level of essentials, hazards, their proportions, and possibly their authenticity. Elements, of which the level is hardly metabolically governed, might reflect the local origin. This refers to the levels of Li, Rb, Cs, Ba, Ti and the rare earth elements. Respective data are scarce, however. As further tools to trace the authenticity, isotope proportions for N, Pb or Sr can be utilized. Unless grown hydroponically, vegetables take the non-metabolically governed elements from local soil. Dairy cows get at least local water and some locally grown grass.

The total content found is not equal to digestibility. This can be approached by sequential leaching in simulated gastric juice and gut environment, but homeostasis and residence time in the digestive tract cannot be precisely simulated. Second, after oxidative digestion, there is no information left like about protein composition or roughage; the latter is important for ruminants.

Characteristic element patterns of cereals, potatoes, carrots, apples, honeys and chocolate, as well as meat, eggs, cheese and milk done by the author, will be presented. Among animal feeds, significant differences between commercial feeds for piglets, cows and laying hens will be demonstrated. Sequential leaching has been done for various vegetables grown in an area contaminated by heavy metals from mine tailings.

### Biography

Manfred Sager has completed his Ph.D. (chemistry) at the University of Vienna, and also had a postdoctoral fellowship at the Max Planck Institute for Metal Research in Germany. After 8 years work in the Institute of Analytical Geochemistry, he joined the Federal Institute for chemical investigations in agriculture, which was finally combined with a lot of others to form the Austrian Agency for Health and Food safety. He achieved the right to teach Inorganic Analytical Chemistry at the University level, in 1995. His papers cover total element and trace element analysis of sediments, soils, mine tailings, green plants, fertilizers, feed and food samples, as well as speciation studies done by sequential leaching techniques. Until January 2013, he has published 16 contributions to books, and 89 papers in peer reviewed journals, beneath serving as an editorial board member.