

2nd IUPAC Symposium on Trace Elements in Food: An introduction*

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Abstract: The 2nd IUPAC Symposium Trace Elements in Food (TEF-2) presented contributions within a wide range of issues, from trace element bioavailability, toxicological and nutritional aspects of trace elements, to trace elements in fortified foods and in food supplements, discussed from both a speciation and a legislation point of view.

Keywords: trace elements; food; quality control; quality assurance; uncertainty of measurement; reference materials.

INTRODUCTION

The 2nd IUPAC Symposium Trace Elements in Food (TEF-2) presented contributions within a wide range of issues, from trace element bioavailability, toxicological and nutritional aspects of trace elements, to trace elements in fortified foods and in food supplements, discussed from both a speciation and a legislation point of view. These issues, addressed by leading scientists coming from all over the world to TEF-2, might at first glance appear similar to those addressed by the first TEF Symposium in Warsaw in 2000. However, taking a closer look, it is evident that the advances in methods of isotopic analysis, in speciation, and in quality control and assurance since 2000 have resulted in much progress, in particular in the research on bioavailability, toxicological, and nutritional aspects of trace elements in food.

Advances in trace element analysis remain the cornerstone of the symposium, and methods to determine the authenticity and geographical origin of foodstuffs based on the relation to the region where it is grown or produced were presented and discussed. The importance of improving the measurement capabilities as a part of analytical quality control and quality assurance was highlighted. This includes a systematic approach to the uncertainty of the measurement results, as well as the use of reference materials as a crucial tool for the analysis.

ISSUES FOR TODAY

Relevance to society

The trends in choice of trace element research topics toward contributions more directly relevant to the needs of society and treating aspects of human health and prevention of disease rather than food contaminants and toxicology is evident. Data collection on the well-known toxic trace elements lead, cadmium, and mercury focus on less-known foods and prelegislative aspects, and research on other trace elements such as arsenic and selenium highlights the importance of speciation, for the latter especially

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in relation to effective food supplementation. Progress in research in platinum-group elements as contaminants, mainly coming from car catalytic converters, is another issue of potential relevance.

Methods of analysis for trace elements remain central to the TEF-2 Symposium. Food authentication, using isotopic composition of the food determined by mass spectrometric methods of analysis, is of interest to the consumer, who wishes to be reliably informed about the origin of the food labelled as of a certain origin.

Important risk management decisions linked to consumer protection are taken based on the measurement results from food surveillance programs and data from control laboratories. The measurement capabilities of the food laboratories are crucial. In order to be comparable, measurements must be traceable to the same system of reference and include a realistic estimation of the measurement uncertainty. The use of reference materials is a tool to overcome this problem.

EXAMPLES

Vicious circle of speciation analysis

The “vicious circle” of speciation analysis previously discussed may be about to be broken by progress in the areas of analytical methods and certified reference materials (Fig. 1) [1].

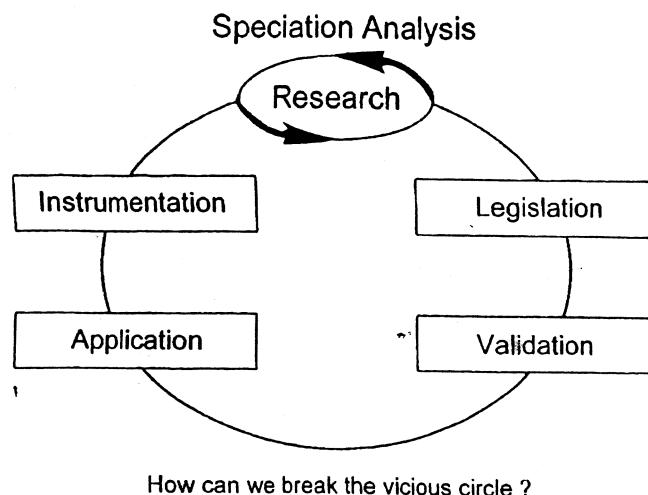


Fig. 1 The vicious circle of speciation analysis.

The progress of research in speciation so far fails to significantly influence legislation. Consequently, legislators continue to build almost exclusively on expressing the content of trace elements in a matrix only by the total content, disregarding which chemical species there may be present in the sample. Hence, analytical control of the legislation will provide data for the total content of the trace elements only. Species-specific legislation could contribute, but has unfortunately not yet done so in any significant way. There will then be no challenge to produce simple and fast, species-specific analytical methods, which could in turn provide the more relevant speciation data. The challenge is, therefore, to break the vicious circle. Some scientific basis for a breakthrough was presented by the colleagues contributing to this symposium in the areas of the development of species-specific analytical methods, though few, if any, can yet be called simple, fast, or robust.

Arsenic

Arsenic presents a highly relevant example of the importance of speciation in relation to legislation concerning food safety. The chemical forms of arsenic dominating in most seafoods, arsenobetaine, is generally considered of no food safety concern, whereas inorganic arsenic is highly toxic and should be monitored and controlled in relevant foods and in drinking water. An attempt to introduce international maximum levels for inorganic arsenic in food in the Codex Alimentarius General Standard for Contaminants and Toxins in Food was shelved in 1998, as no cheap and robust method of analysis was available [2]. However, arsenic in drinking water remains a pertinent human health problem in some parts of the world, and recently high levels of inorganic arsenic in hijiki seaweed caused concern in the United Kingdom and throughout Europe via the EU Rapid Alert System. A robust method of analysis for inorganic arsenic and production of a species-specific reference material for inorganic arsenic, possibly produced on the basis of seaweed, could contribute to break the vicious circle in this case.

From the Danish Monitoring System for Food

The Danish Monitoring System for Food (DMSF) has since 1983 collected analytical data for the content of a considerable number of vitamins, minerals, and contaminants in foods sold in Denmark. Combined with comprehensive and detailed information about food consumption in the country, the DMSF also provides information about the development of the content of trace elements in the foods eaten by the Danes [3].

The intake of lead for an adult in Denmark, for instance, has decreased to 95-percentile intake of just 9 % of the provisionally tolerable weekly intake (PTWI) as laid down by the Joint Expert Committee on Food Additives and Contaminants (JECFA) of the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). For cadmium, however, the 95-percentile intake remains more stable since several years on a level of 33 % of the PTWI, giving raise to concern, as there is no safety margin to the PTWI [3].

The intake of selenium from food is rather low in Denmark, with most Danes having an intake of 40–60 µg/d only, or less. Several contributions to TEF-2 discussed selenium supplementation in doses up to or above 100–300 µg/d. Here again, selenium speciation is important, as the bioavailability and retention of the various selenium species, including both inorganic and organic selenium species, is markedly different. Fortified foods and food supplementation is an area of specific interest in this connection.

AND FOR TOMORROW

TEF-2 may become a milestone on the road ahead for the research in trace elements in food. Based on the discussion in TEF-2, some prominent issues for the TEF-3 scheduled to take place in Pau, France, in October 2008, could again be species-specific analytical data and bioavailability. Trace element toxicology, which played a small role in TEF-2, should become more prominent.

The analytical specialists will present fast and robust methods of analysis, including chemometric methods, which will enable the risk managers to make progress. Species-specific food supplementation and fortification of food will become an issue of increasing relevance to society in the years to come. Finally, during TEF-3 it is foreseen that results will be presented on the interaction between trace elements in food—surely an issue for tomorrow.

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