Selenium bioavailability: current knowledge and future research requirements[1–5]

Susan J Fairweather-Tait, Rachel Collings, and Rachel Hurst

ABSTRACT

Information on selenium bioavailability is required to derive dietary recommendations and to evaluate and improve the quality of food products. The need for robust data is particularly important in light of recent suggestions of potential health benefits associated with different intakes of selenium. The issue is not straightforward, however, because of large variations in the selenium content of foods (determined by a combination of geologic/environmental factors and selenium supplementation of fertilizers and animal feedstuffs) and the chemical forms of the element, which are absorbed and metabolized differently. Although most dietary selenium is absorbed efficiently, the retention of organic forms is higher than that of inorganic forms. There are also complications in the assessment and quantification of selenium species within foodstuffs. Often, extraction is only partial, and the process can alter the form or forms present in the food. Efforts to improve, standardize, and make more widely available techniques for species quantification are required. Similarly, reliable and sensitive functional biomarkers of selenium status are required, together with improvements in current biomarker methods. This requirement is particularly important for the assessment of bioavailability, because some functional biomarkers respond differently to the various selenium species. The effect of genotype adds a potential further dimension to the process of deriving bioavailability estimates and underlines the need for further research to facilitate the process of deriving dietary recommendations in the future. *Am J Clin Nutr* 2010;91(suppl):1484S–91S.

INTRODUCTION

To derive selenium requirements and establish dietary recommendations for optimal health, estimates of selenium bioavailability are needed. A literature review on the bioavailability of selenium from foods was published in 2006 (1), and it highlights the dependence of bioavailability on food sources associated with different forms of selenium and emphasizes the importance of the assessment of bioavailability with the use of functional assays. Data on chemical speciation and metabolic transformations (in conjunction with information on the relation between selenium intake and status and health outcomes) are required to assess selenium bioavailability and the longer-term health consequences that result from different intakes.

DIETARY REQUIREMENTS

The 1991 UK Dietary Reference Values (2) used data from older literature and estimated that between 55% and 65% of dietary selenium is absorbed. The 1993 Population Reference Intakes published by the European Scientific Committee for Food (3) concluded that for selenium "all usual dietary forms are absorbed quite efficiently." The 2000 report of the US Food and Nutrition Board (4) suggested that most dietary selenium is highly bioavailable: >90% of selenomethionine is absorbed; selenocysteine appears to be absorbed very well; ≈100% of selenate is absorbed, but a significant fraction is lost in the urine; and >50% of selenite is absorbed (depending on luminal interactions) and is better retained than selenate. There is clearly a need to review dietary recommendations in light of more recent data, in particular, information on dietary forms of selenium and the relationships between intake and health outcomes.

SELENIUM SPECIATION

A recent review (5) provides information on the forms of selenium in food and associated health effects; technical approaches used for speciation have also been reviewed recently (6, 7). The analysis of forms of selenium in food is a challenging task; there are currently no methods that can reliably extract 100% of the selenium from foods without potentially affecting the species, and the techniques are established in only a few laboratories worldwide. Therefore, care has to be taken to extract as much selenium as possible while still retaining the form that is present in the food as consumed; conditions that are devised to maximize the extraction of selenium from a food matrix may cause changes in chemical form. Ideally, the measurements should be made in food that has gone through processing (eg, cooking) followed by simulated gastrointestinal digestion, be-

[1] From the School of Medicine, Health Policy and Practice, University of East Anglia, Norwich, United Kingdom.

[2] Presented at the workshop ''Micronutrient Bioavailability: Priorities and Challenges for Setting Dietary Reference Values,'' held in Barcelona, Spain, 11–12 June 2009.

[3] This article does not necessarily reflect the views of the Commission of the European Communities and in no way anticipates future policy in this area.

[4] Supported by the Commission of the European Communities, specific RTD Programme "Quality of Life and Management of Living Resources," within the 6th Framework Programme (contract no. FP6-036196-2 EURRECA: EURopean micronutrient RECommendations Aligned).

[5] Address correspondence to SJ Fairweather-Tait, School of Medicine, Health Policy & Practice, University of East Anglia, Norwich, NR4 7TJ, United Kingdom. E-mail: s.fairweather-tait@uea.ac.uk.

First published online March 3, 2010; doi: 10.3945/ajcn.2010.28674J.

Am J Clin Nutr 2010;91(suppl):1484S–91S. Printed in USA.