Before bioactivity there is bioavailability – Static and dynamic in vitro for studying carotenoid digestion and bioaccessibility

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BEFORE BIOACTIVITY THERE IS BIOAVAILABILITY - STATIC AND DYNAMIC *IN VITRO* MODELS FOR STUDYING CAROTENOID DIGESTION AND BIOACCESSIBILITY

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The consumption of many secondary plant metabolites has been associated with a decreased risk of developing several chronic health complications, such as type 2 diabetes, cardio-vascular diseases, and certain cancers. Carotenoids are the most abundant liposoluble phytochemicals in human tissues, and have shown to be implicated in modulating transcription factors such as NF-κB and Nrf2, altering the expression of genes involved in inflammation and oxidative stress, in addition to their direct antioxidant effects. However, their bioavailability is low, with absorption being often below 20%, although there is a large variation depending on host and food matrix factors. This is in part due to their low aqueous solubility, requiring emulsification in form of mixed micelles prior to their uptake in the small intestine.

Thus, it is paramount to understand dietary factors influencing carotenoid bioavailability, a prerequisite for their bioactivity. For example, dietary fibers, lipids, and matrix maceration may be important determinants for carotenoid absorption. As human studies are time consuming, costly, and restricted by ethical concerns, models predicting their release from the food matrix (bioaccessibility) and changes in their profiles prior to absorption are in great demand.

A predominant problem of in-vitro techniques to simulate digestion of secondary plant metabolites, including carotenoids, rests in the large variation of digestion conditions applied. Usually, in-vitro models include the simulation of the oral phase of digestion, the stomach, the small intestine, and – less frequently – colonic fermentation. According to the targeted observation, i.e. studying micellarization for screening purposes or resembling more closely in-vivo conditions, a variety of models have been suggested. For instance, varying parameters included the time of digestion, pH, type and amount enzymes employed, electrolyte concentrations, amount and source of bile salts used, filtration/centrifugation methods to determine the bioaccessible fraction, and using either static (pre-set concentration or enzymes, salts etc.) or dynamic conditions (varying concentrations of digesta constituents). As a drawback, this variability of conditions has severly impeded comparisons across different studies and their estimated impact under in vivo conditions.

In this presentation, critical factors that impact the studying of carotenoid digestion and bioaccessibility in vitro and that were reviewed by a group of participants from the EU COST ACTION FA 1005 INFOGEST are highlighted[1], and suggestions for standardization of conditions are proposed.

Keywords: carotenoids; inflammation, digestion, bioaccessibility, mixed micelles, matrix, in-vitro digestion

References:

(1) M. Alminger, A.-M., Aura, T. Bohn, C. Dufour, S.N. El, A. Gomes, S. Karakaya, M.C. Martínez-Cuesta, G.J. McDougall, T. Requena, C.N. Santos. Static and dynamic i*n vitro* models for studying secondary plant metabolite digestion and bioaccessibility (2014). Compr Rev Food Chem Food Saf. In press.