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Combining in-vitro and in-silico digestion modelling to improve the predictive power for in-vivo behavior

Abstract: In-vitro food digestion studies are indispensable for providing valuable information about the potential digestibility, absorption and bioavailability of food material. However, a major limitation of in-vitro digestion studies is that they do not account for the dynamic interactions and physiological feedback mechanisms that occur in a living organism. The reality of in-vivo digestion involves the coordination of various organs, including the stomach, intestine, liver, pancreas, and the microbiome. To take these physiological effects into account, a mechanistic computer model for food digestion has been developed on the basis of the complexity of the multitude of chemical and physiological processes in the alimentary tract known from the literature. This model allows fast simulation of digestion and absorption processes relevant for sequences of complete meals for normal adults, including the effects of food texture, interaction between macronutrients, the effect of digestion inhibitors, speed of consumption, and meal order on physiological outcomes such as blood sugar excursions, hunger and satiety. Through adjusted parameterization the model can be adapted for target groups in the population and individualized nutrition. In this way the model may also serve as a digital twin for personalized nutrition. The model has been used to explain in-vivo physiological outcomes of the consumption of a variety of food compositions, predict in-vivo outcomes of new food formulations and has been used to guide new in-vivo experimental studies and to extrapolate the results to altered food compositions and physiological differentiation. However, as a shortcoming it does not yet include microbiome modelling. Its application will be illustrated with a few examples.

Keywords: computer modelling of digestion, digestion physiology

Biography: Dr. George Alexander van Aken is a senior food scientist, with broad expertise in food composition and structure and the functionality in relation to sensory perception and health. He has conducted contract research projects for various food companies and projects at NIZO food research and seconded to Top Institute Food and Nutrition has led fundamental research projects in food structuring, sensory perception, satiation and health. He is currently employed at Royal Cosun, leading the Centre of Expertise of Food Functionality and Health. For the in-silico digestion modelling he initiated his own enterprise insight FOOD inside.

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