Beyond Exposure: Advanced Characterization of Food–Micro- and Nanoplastic Interactions Along the Gastrointestinal Tract

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Micro- and nanoplastics (MNPs) are increasingly recognized as emerging food contaminants, yet their biological effects cannot be understood without considering the complex food matrices and dynamic gastrointestinal environment in which exposure occurs. Upon ingestion, MNPs interact with food constituents, digestive enzymes, and biomolecules, resulting in the continuous formation and remodeling of protein coronas that define the particles' biological identity. Understanding these molecular interactions is essential for realistic exposure assessment and for elucidating potential impacts on food safety and human health.

This presentation will summarize recent and ongoing research investigating the interactions of MNPs with food proteins under simulated gastrointestinal conditions. Using complementary analytical approaches, we have examined how food composition, digestion conditions, particle size, surface chemistry, and aging influence particle dispersion and aggregation, protein adsorption, and the composition and evolution of protein coronas. Particular emphasis will be placed on structural and functional changes of adsorbed proteins, including food allergens, and on how these interactions may alter protein digestibility, stability, and biological function. Examples from studies involving milk proteins, food allergens, and complex food matrices will illustrate how digestion fundamentally modifies the nano–bio interface.

The presented findings contribute to a mechanistic understanding of food–MNP interactions at the molecular level and highlight the importance of integrating proteomics with complementary structural, spectroscopic, microscopic, and particle characterization approaches. Such multidisciplinary investigations are essential for advancing the scientific basis of future risk assessment of micro- and nanoplastics within the One Health framework.

Short bio:

Tanja Ćirković Veličković is Full Professor of Biochemistry at the Faculty of Chemistry, University of Belgrade. Her research integrates proteomics, food allergen characterization, and the interactions of micro- and nanoplastics with

biological systems, combining advanced mass spectrometry with bioinformatics and molecular approaches. She coordinated and participated in several European research projects and is actively involved in developing analytical methods and research infrastructures supporting food safety, environmental health, and the One Health concept.