Review paper **IL 5**

FROM MOLECULES TO MARKET: PHYSICAL CHEMISTRY TOOLS FOR FOOD INTEGRITY AND CONSUMER TRUST

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ABSTRACT

Food systems are becoming increasingly complex due to globalization, extended supply chains, emerging food fraud practices, and growing consumer demand for transparency and authenticity. In this context, physical chemistry plays a crucial role in understanding the molecular and physicochemical properties of foods and transforming analytical information into practical tools for food integrity, safety, and quality assurance.

This presentation explores the contribution of modern physical chemistry approaches to the evaluation of food authenticity and consumer trust, with particular emphasis on non-destructive analytical techniques and digital innovation. Spectroscopic methods such as Near-Infrared Spectroscopy (NIR) and Hyperspectral Imaging (HSI), combined with chemometric and artificial intelligence-based data analysis, are increasingly being applied for rapid characterization of food matrices, detection of adulteration, assessment of quality parameters, and traceability studies.

Special attention will be given to applications in honey and olive oil value chains, where molecular fingerprinting and physicochemical profiling can support the identification of botanical/varietal and geographical origin, detection of fraudulent practices, and development of more transparent supply chains. The presentation will further discuss the integration of portable analytical devices, digital spectral databases, and data-driven approaches as emerging tools for real-time food authentication and quality monitoring.

Beyond analytical performance, the presentation highlights the broader societal and regulatory relevance of physical chemistry tools in strengthening food integrity systems, supporting evidence-based policies, enhancing market transparency, and increasing consumer confidence. The transition “from molecules to market” illustrates how molecular-level information can be translated into practical solutions that contribute to safer, more sustainable, and more trustworthy food systems.

Keywords: Physical chemistry; food integrity; food authenticity; spectroscopy; hyperspectral imaging; chemometrics; honey; olive oil; food safety; consumer trust.