

Summary

Application of the Langmuir Technique in the Study of Physicochemical Properties of Monolayers Formed by Vegetable Oils

Vegetable oils constitute an important group of raw materials of significant nutritional and technological relevance. The properties of these systems, particularly their behavior at interfaces, play a crucial role in determining quality, oxidative stability, and functionality in food products. Therefore, understanding the mechanisms governing the molecular organization of lipids and the changes occurring under oxidative processes is essential.

The aim of this study was to determine the effect of chemical composition and oxidative processes on the physicochemical properties of monolayers formed by selected vegetable oils. The analyses were performed using the Langmuir monolayer technique, which enables the characterization of surface properties under interfacial conditions. The study included both fresh oils and oils subjected to accelerated aging, as well as the evaluation of their properties in oil-in-water (O/W) emulsion systems. It was demonstrated that all analyzed oils form stable monolayers with differentiated mechanical properties, depending on the fatty acid composition and the content of bioactive compounds. Oils rich in monounsaturated fatty acids exhibited greater stability and resistance to compression, whereas oils with a high content of polyunsaturated fatty acids showed a higher susceptibility to structural destabilization. It was found that oxidation processes lead to a deterioration of oil quality and significant changes in the molecular organization of monolayers, resulting in reduced mechanical stability. A relationship between surface properties and emulsion stability was also observed—oils forming more ordered and viscoelastic interfacial layers promoted the formation of systems with greater stability.

The obtained results indicate that the surface parameters of lipid monolayers may serve as useful indicators for assessing the quality, oxidative stability, and functionality of vegetable oils. Moreover, they can be applied in the design of stable emulsion systems in food technology.

Keywords: Langmuir monolayers, vegetable oils, surface properties, oxidative stability, lipid oxidation, oil-in-water (O/W) emulsions, interfacial rheology.

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Kamińska