“Formation of olive oil oleogels with anhydrous milk fat fractions”

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Introduction:

In response to increasing nutritional concerns and regulatory pressures to eliminate trans fatty acids and reduce saturated fat content in processed foods, the development of alternative lipid structuring systems has gained significant scientific and industrial attention. Oleogelation, the entrapment of liquid oils within a gel-like matrix, enables the creation of semi-solid fat analogs with improved lipid profiles [1]. Anhydrous milk fat (AMF), characterized by a high content of saturated triacylglycerols and a complex polymorphic behavior, represents a novel natural material for oleogel formation [2]. This study aimed to identify the optimal dry fractionation temperature of AMF and the minimum effective concentration required to structure olive oil into a stable oleogel.

Methods:

Dry fractionation of AMF was performed via sequential centrifugation at progressively increasing temperatures (30°C, 35°C, 37°C, and 40°C), allowing separation of distinct high-melting stearin fractions. These were blended with extra virgin olive oil in different ratios (from 5:95 to 15:85 w/w) to identify the minimal concentration required for gel formation. The samples were evaluated macroscopically and thermally characterized using micro-differential scanning calorimetry (μDSC). The effect of ultrasound treatment on gel consistency and melting behavior was also assessed.

Results:

The 15:85 stearin-to-olive oil ratio using fractions obtained at 40°C yielded the firmest self-standing oleogels. Notably, this stearin originated from the AMF fraction previously obtained at 37°C, indicating that both the pre-fractionation step and final crystallization temperature influence the gelation performance. μDSC analyses demonstrated that the thermal behavior (melting and crystallization points) of these oleogels closely resembled that of native AMF, indicating similar structural organization. Ultrasound treatment marginally enhanced gel cohesiveness but did not significantly alter melting temperatures.

Conclusions:

AMF fractions, particularly those isolated at higher crystallization temperatures, exhibit strong gelation capabilities in olive oil systems. These oleogels may serve as viable saturated fat replacers in food formulations, pending further optimization for stability, scalability, and functional performance in real food matrices.

References:

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[2]. Małkowska, M., Staniewski, B., & Ziajka, J. (2021). Analyses of milk fat crystallization and milk fat fractions. *International Journal of Food Properties*, *24*(1), 325-336.