*Sex-based differential digestibility of* emulsions: A study into the digestion of edible emulsions stabilized by different emulsifiers

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The global need to transition to healthier diets produces new food choices, such as plant-based alternatives to dairy, yet sex-based phenotypic differences in food digestion and emulsion bioaccessibility have been scantly addressed in food research. This study will test the hypothesis that emulsions follow distinct digestive pathways in males and females based on a semi-dynamic *in vitro* digestion (IVD) model developed based on clinical data (Lajterer et al., 2022).

First, we report the in vitro digestibility of model emulsions of medium-chain triglycerides (stabilized by beta-lactoglobulin, alpha-lactalbumin, or lactoferrin, and by three non-protein emulsifiers: Tween 80, lecithin, and sucrose esters. Fluorescence microscopy and droplet size analyses of digestive effluent reveal that protein-stabilized emulsions were responsive to physiological differences between males and females, whereas emulsions stabilized by non-protein emulsifiers remained mostly unaffected by sex-based differences in digestive conditions. Absolute differential analyses of emulsion droplet size distribution curves showed that changes in breakdown trajectories were pronouncedly noticeable in gastric effluents which could prospectively impact consumer responses (Perez et al, 2025). Second, bovine milk (BM) and oat-based milk alternative (OM) were studied and found to be differentially degraded in healthy men and women. Interestingly, caseins in BM broke down similarly in both sexes, however β-lactoglobulin showed greater persistence in females. Contrary, OM proteins were more resistant to breakdown in males. Zeta potential analysis showed milk had superior colloidal stability (-29 mV vs. -21-23 mV for OM), suggesting potential phase separation could underlie differences in susceptibility to digestion. Moreover, LC-MS proteomic analyses of milk and oat protein isolates enable comparison of bioaccessible peptides and trajectories of protein breakdown under both IVD models. Thus, this work sheds light on the intricate interplay between emulsifier type, protein source, consumer sex, and digestive kinetics that will facilitate rational design of food emulsions.

References

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