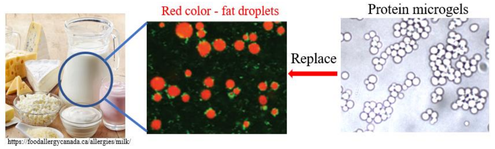
Soft ball-bearing lubrication of size-controllable whey protein microgel for designing fat-reduced food products

Yifu Chu, Lingyun Chen*
Department of Agricultural, Food & Nutritional Science, University of Alberta, Edmonton, Alberta, T6G 2P5, Canada.
*Please contact Lingyun Chen at lingyun.chen@ualberta.ca

INTRODUCTION

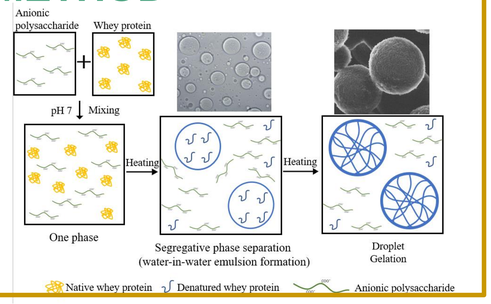
- Food proteins contribute to only **4 kcal per gram**, which is highly expected to be used as **fat replacers** to develop novel low-calorie food.
- Protein microgels are soft colloidal particles that have spherical shapes and can potentially **mimic** the sensory properties of fat droplets, such as **thickness and creaminess**.



AIM

- To develop **uniform size-controllable** whey protein microgels **without** high energy input
- To study the contribution of microgels at the interface and bulk phase for the improved emulsion properties
- To evaluate the **thickening** and **lubricating** capacities of the microgels

METHOD



RESULTS

Objective I. The formation of uniform size-controllable protein microgels

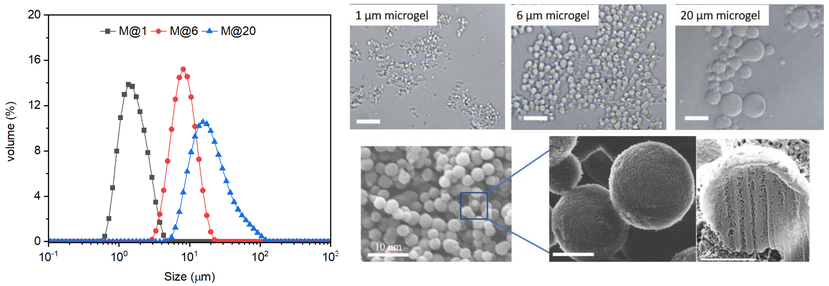


Fig. 1. Size distribution, surface morphology and cross-section morphology of whey protein microgels

Objective III. The tribo-rheological properties of microgels

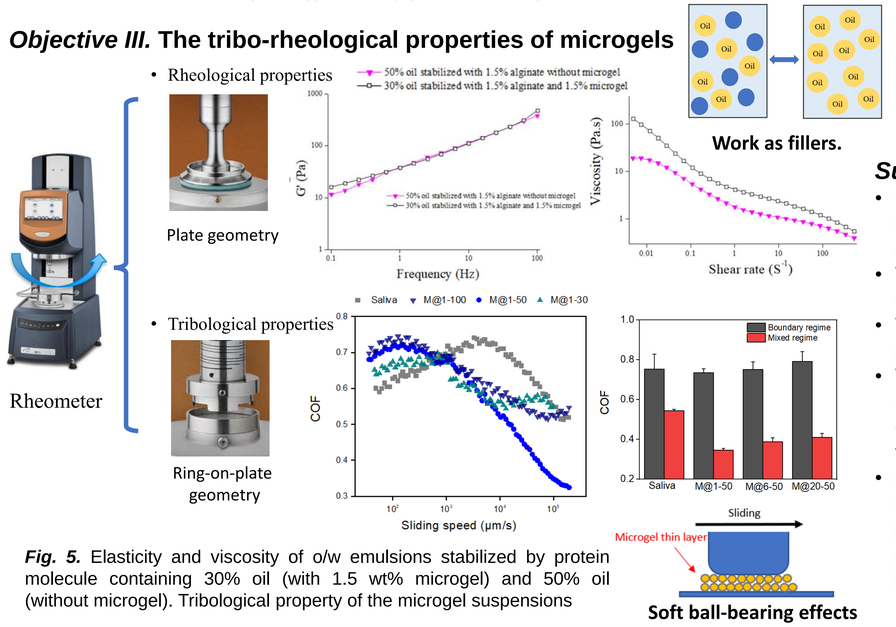


Fig. 5. Elasticity and viscosity of o/w emulsions stabilized by protein molecule containing 30% oil (with 1.5 wt% microgel) and 50% oil (without microgel). Tribological property of the microgel suspensions

Objective II. The effect of microgel on improving emulsion properties

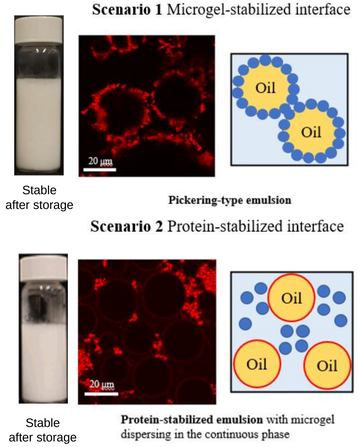


Fig. 2. CLSM images of emulsions stabilized by different formulations

Summary of results

- Uniform and spherical whey protein microgels can be prepared by W/W emulsion method.
- The microgel size can be precisely controlled to **1 μm, 6 μm and 20 μm.**
- The microgels can adsorb at the interface to prepare stable Pickering emulsion.
- The microgels can work as fillers to make 30% oil emulsions show **comparable elasticity** and even **higher viscosity** to that of 50% oil emulsion without microgels.
- Microgels significantly enhanced lubrication effect in the mixed lubrication regime to provide **"soft ball-bearing"** lubrication performance, which was superior to the lubrication behavior of human saliva.

CONCLUSIONS

- A novel method to prepare **uniform** and **size controllable** protein microgels **without** high energy input. This method has the potential to be of interest to the industry.
- The microgels can adsorb at the O/W interface to prepare **stable Pickering emulsions**.
- Adding microgels can make **fat-reduced** emulsions have **comparable** rheological properties to their high-oil counterparts
- The "**soft ball-bearing lubrication effect**" of the protein microgels can potentially enhance the **creaminess** mouthfeel of fat-reduced food products to mimic fat droplets.
- This study can benefit the **fat-reduced food development** to provide fat-reduced food options for healthier outcomes

https://healthystepsnutrition.com/focusing-on-real-food-not-food-products/low-fat-foods/

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