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# 学 位 論 文 要 旨
# Dissertation Abstract

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学位論文題目：
Title of Dissertation

**Physico-Chemical Properties of Soy Soluble Polysaccharide (SSPS) Oil-in-Water Emulsions: Effect of SSPS Type, Dispersed Phase Type and Addition of Stabilizing Polysaccharides**
**（大豆水溶性多糖類 (SSPS) による O/W エマルションの物理化学的特性 ―SSPS の種類、分散相の種類及び安定剤として添加した SSPS 以外の多糖類の影響―）**

学位論文要旨：
Dissertation Abstract

Food emulsions remain of key interest to major sectors of the food industry. The behaviour of oil-in-water (O/W) emulsions in foods is defined by the three parts of the system; the fat or oil; the interfacial material; and the aqueous phase. Many studies investigating characteristics of emulsions have been conducted for a long time and large volumes of information is available. Despite the vast amount of information available on food emulsions, new areas of interest always come up. Recently, more and more consumers have become more conscious about their health condition, giving a lot of pressure on the food manufacturers. Consumption of natural foods has been encouraged from all corners of the globe, resulting in an increased number of consumers who check the food label to see the ingredients. Synthetic food emulsifiers are henceforth becoming less popular in the food industry. The search for new viable natural emulsifiers is therefore an area of current interest to many food scientists and producers.

Soy soluble polysaccharide (SSPS), extracted from the by-product of soy protein isolation, is a newly found natural emulsifier that has been proven to be an excellent emulsifier with comparable characteristics to other established emulsifiers. Hence, it is the aim of this thesis to fully characterize the physico-chemical characteristics of emulsions produced by different types of SSPS. Successful characterization of SSPS stabilized emulsions may lead to improved awareness of the existence of SSPS and its capabilities.

Impact of the type of SSPS (i.e. SSPS-L; SSPS-M; and SSPS-H differentiated by their respective extraction conditions) and the type of oil (i.e. Perilla seed oil - PSO; palm kernel oil - PKO; and n-Hexadecane) was examined through analysis of the differences in average droplet diameter, droplet size distribution (DSD) and emulsion rheological properties. Oil/water interfacial tension strongly depended on SSPS type. SSPS-L was the most capable in reducing interfacial tension against PSO, PKO and

hexadecane followed by SSPS-M and lastly SSPS-H. Irrespective of oil type, at 20 % oil content, SSPS-L and M were better emulsifiers for achieving small droplets due to their high protein content. Both SSPS (type L and M) solutions and their respective emulsions regardless of oil type exhibit Newtonian flow behavior while SSPS-H solution and the respective emulsions show shear-thinning behavior. Emulsion viscosity was influenced by both SSPS and oil types with SSPS-H and hexadecane producing high viscosity emulsions. This study provided important information on the performance of different types of SSPS against different types of oils which can be used in formulating food and beverage systems.

The incorporation of relevant amounts of non-adsorbing hydrocolloids to O/W emulsions is a suitable alternative to reduce creaming. The effect of incorporating xanthan gum (XG) or guar gum (GG) in SSPS stabilized O/W emulsions was studied. The emulsions contained 6 %wt. of SSPS, 20 %wt. Perilla Seed Oil (PSO), an omega-3 vegetable oil, and variable amounts of XG or GG ranging from 0.03 to 0.3 %wt. The presence of minute amounts of XG or GG in fresh emulsions significantly decreased the emulsion droplet size (EDS) although such low concentrations did not provide enough continuous phase viscosity to arrest creaming. Emulsion microstructure indicated the presence of flocculation even at high concentrations of XG or GG caused by a depletion mechanism. All emulsions with XG or GG exhibited pseudoplastic behavior while the control emulsions showed an almost Newtonian behavior. Emulsion droplet polydispersion generally decreased with increase in the continuous phase viscosity indicating the importance of continuous phase viscosity in the dissipation of shear energy throughout the emulsion during homogenization. The characteristics of the emulsions were closely related to the rheological changes of the continuous phase.

Hydrocolloid emulsifiers, SSPS, gum arabic (GA), and octenyl succinate starch (OSA-S), were investigated for their ability to produce O/W mayonnaise-like emulsions. XG was used as a stabilizer and thickener. Oil content above 60 %wt. could not be completely emulsified by all three types of emulsifiers. Floating oil could be observed on top of the emulsion samples immediately after preparation. Long term emulsion stability depended on the amount of dispersed phase with higher dispersed phase contents conferring more stability due to a strong network of droplets formed in the system. The formation of Pickering emulsions was confirmed in OSA-S stabilized emulsions. All emulsion systems showed pseudoplastic behavior, similar to typical mayonnaise, which increased with an increase in the dispersed phase volume. It was concluded that hydrocolloid emulsifiers could be used to replace egg yolk in the production mayonnaise.

The results contribute to the knowledge of the behavior of different types of SSPS when used in formulating various food products. This information might be used as a reference by food producers who may find interest in adopting SSPS as a legitimate emulsifier.