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Interfacial and emulsifying properties of sucrose ester in coconut milk emulsions in comparison with Tween

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ABSTRACT

In this study, sucrose esters were presented as a promising alternative to petrochemically synthesized Tweens for application in coconut milk emulsions. The interfacial and emulsifier properties of sucrose ester (SE), mainly sucrose monostearate, had been investigated in comparison with Tween 60 (TW), an ethoxylate surfactant. The interfacial tension measurement showed that SE had a slightly better ability to lower the interfacial tension at coconut oil–water interface. These surfactants (0.25 wt%) were applied in coconut milk emulsions with 5 wt% fat content. The effects of changes in pH, salt concentration, and temperature on emulsion stability were analyzed from visual appearance, optical micrograph, droplet charges, particle size distributions, and creaming index. Oil droplets in both SE and TW coconut milk emulsions extensively flocculated at pH 4, or around the pI of the coconut proteins. Salt addition induced flocculation in both emulsions. The pH and salt dependence indicated polyelectrolyte nature of proteins, suggesting that the proteins on the surface of oil droplets were not completely displaced by either added nonionic SE or TW. TW coconut milk emulsions appeared to be thermally unstable with some coalesced oil drops after heating and some oil layers separated on top after freeze thawing. The change in temperature had much lesser influence on stability of SE coconut milk emulsions and, especially, it was found that SE emulsions were remarkably stable after the freeze thawing.

1. Introduction

Sucrose esters, or sugar-based surfactants, are in current interest because they are produced from natural resources such as sucrose and vegetable oil. They are biodegradable and more biocompatible when compared to other petrochemically synthesized surfactants. Sucrose esters are non-toxic and safe for food and are approved as a food additive under food regulations and laws in several countries i.e. Japan, USA, and EC. It had been reported that sucrose esters have excellent emulsifying properties and be able to apply in various food products (Garti, 2001). Their wide range of hydrophilic–lipophilic balance (HLB), depending on degree of esterification of fatty acids and sucrose, provides ultimate application of sucrose esters to each product type.

Coconut milk is one of food emulsions that require additional surfactants or emulsifiers to improve emulsion stability. Several recent works have been carried out on physicochemical characterization of coconut milk employing other small molecule surfactants such as Tweens and sodium dodecyl sulfate (Tangsuphoom & Coupland, 2009a,b), however, data on sucrose esters remain fewer. In those studies, coconut milk emulsions after addition of surfactants were reported to smaller in average droplet size, decrease in total surface protein concentration, and change in droplet surface charges (Tangsuphoom & Coupland, 2008b, 2009a).

This study aims to gain more understanding on the relationship between interfacial properties and stability of coconut milk emulsions with addition of sucrose ester. We described the comparative interfacial and emulsifier properties between sucrose ester (SE), mainly sucrose monostearate, and Tween 60, or polyoxyethylene sorbitan monostearate (TW). Their structures were displayed in Fig. 1. The difference between the carbohydrate and ethoxylate headgroups provided an interesting comparison. Their adsorption behaviors at the coconut oil and aqueous interface were investigated by the interfacial tension measurement. The coconut milk emulsions prepared with SE and with TW were processed at different temperatures (121 °C, 100 °C and −20 °C) and their stability was investigated at different pH (2–8) and salt concentrations (0 and 20 mM $CaCl_2$).

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