

# Effect of trace impurities in triglyceride oils on phase inversion of Pickering emulsions stabilized by $\text{CaCO}_3$ nanoparticles

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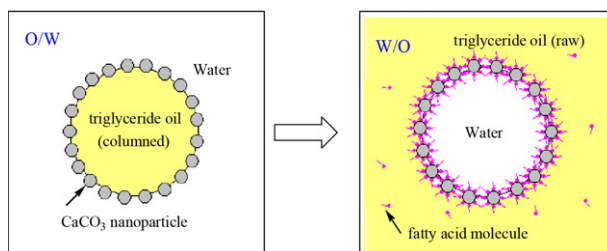
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## HIGHLIGHTS

- ▶ Edible  $\text{CaCO}_3$  nanoparticles are good stabilizer of triglyceride–water emulsions.
- ▶ W/O → O/W phase inversion was induced once oils were alumina-columned.
- ▶ The *in situ* hydrophobization of nanoparticles is responsible for phase inversion.
- ▶ The hydrophobization is achieved by adsorption of trace fatty acids from the oils.
- ▶ Emulsion type can thus be controlled by adjusting the acid number of the oils.

## GRAPHICAL ABSTRACT



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## ABSTRACT

It is known that with alkane or toluene as oil, Pickering emulsions stabilized by unmodified  $\text{CaCO}_3$  nanoparticles are of the oil-in-water (O/W) type. In contrast, when a triglyceride oil such as refined soybean oil or commercial olive oil is used, emulsions stabilized by the same particles are of the water-in-oil (W/O) type. However, if these natural oils are first columned through alumina, O/W emulsions are stabilized as they are with the pure triglyceride triacylglycerin. Since we have shown that unmodified  $\text{CaCO}_3$  nanoparticles can be hydrophobized *in situ* by trace amounts of anionic surfactant such as sodium dodecyl sulfate or sodium carboxylates present in the aqueous phase, it is suggested that an impurity present in refined soybean oil and commercial olive oil has a similar effect. By using complementary experiments including analyzing the structure of the impurities adsorbed by alumina and adding trace amounts of these impurities into the columned oils, we demonstrate that fatty acid impurity present in the unpurified oils is responsible for the hydrophobization of  $\text{CaCO}_3$  nanoparticles and the O/W → W/O phase inversion of emulsions.

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## 1. Introduction

It is well known that the food industry is one of many industries that rely heavily on the use of emulsions and emulsifiers. Products such as soft drinks, milk, cream, salad dressings, mayonnaise, soups, sauces, dips, butter and margarine are all examples of emulsions [1,2]. The most common emulsifiers used in the food industry are amphiphilic proteins, polysaccharides, phospholipids

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