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DEPARTMENT OF FOOD TECHNOLOGY  
MASSEY UNIVERSITY  
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*EMULSIFYING PROPERTIES OF  
SODIUM CASEINATE*

A THESIS  
PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF  
MASTER OF TECHNOLOGY IN FOOD TECHNOLOGY AT  
MASSEY UNIVERSITY

BY

MAGESH SRINIVASAN

1995

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DEDICATION

TO MY BROTHERS

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## ABSTRACT

The main objectives of this study were to determine the influence of compositional and processing parameters on: (i) the protein surface coverage and protein surface composition and (ii) the creaming stability, for emulsions stabilized by sodium caseinate.

Emulsions were usually prepared from 2.5% (w/w) protein solution and 30% soya oil. In some cases, emulsions were made with varying concentrations of caseinate or soya oil. The mixture was usually homogenized at 102/34 bar at 55°C and in some cases the mixture was homogenized at varying pressures.

Surface coverage of protein in freshly prepared emulsions was determined from analysis of the aqueous phase, using Kjeldahl. SDS-PAGE was used to identify the unadsorbed protein components in the aqueous phase.

As the concentration of caseinate was increased from 0.5 to 7.5% (w/w) the protein load increased; the protein load attained a plateau value of 1.3 mg/m<sup>2</sup> when the caseinate concentration was in the range 2 - 4% (w/w). Further increases in caseinate concentration markedly increased the protein load with a value of 3.55 mg/m<sup>2</sup> at 7.5% caseinate concentration. At low concentrations of caseinate (below 2%),  $\beta$ -casein adsorbed at the surface of oil droplets in preference to other caseins while at higher concentrations of caseinate, no distinct preference of any caseins was observed.

As the fat concentration was increased from 5 to 20% (w/w), the protein load decreased from ~ 9.9 to 3.7 mg/m<sup>2</sup>, but further increases in fat concentration caused only slight decreases in the protein load. At high fat concentration (50%)  $\beta$ -casein was adsorbed in preference to other caseins.

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As the homogenization pressure was increased from 34 to 340 bars, the protein load decreased from  $\sim 2.2 \text{ mg/m}^2$  to  $\sim 1.5 \text{ mg/m}^2$ .  $\beta$ -Casein was preferentially adsorbed at the surface in emulsions homogenized at pressures above 204 Bar.

Variations in the pH of sodium caseinate solution prior to emulsification from 6.0 to 8.5 caused a slight decrease in the protein load (from  $\sim 1.8$  to  $1.6 \text{ mg/m}^2$ ). However, the sodium caseinate solutions adjusted to pH 2.0 or 3.0 prior to emulsification showed considerably greater protein loads ( $\sim 2.7 \text{ mg/m}^2$ ). There was no preferential adsorption of any of the caseins in different pH emulsions.

Addition of calcium chloride to sodium caseinate solutions above 0.08% w/w, resulted in large casein particles/aggregates which subsequently adsorbed on to the oil surface resulting in higher protein loads ( $\sim 5.8 \text{ mg/m}^2$ ). Addition of calcium chloride increased the adsorption of  $\alpha_s$ -casein at the interface.

The protein loads of different emulsions prepared from sodium caseinate manufactured under different processing conditions decreased in the order of freeze-dried laboratory made sodium caseinate ( $\sim 2.1 \text{ mg/m}^2$ ) > sodium caseinates made under mild manufacturing conditions ( $\sim 1.4 \text{ mg/m}^2$ ) > sodium caseinate manufactured under normal conditions ( $\sim 1.2 \text{ mg/m}^2$ ) = freeze dried sodium caseinate manufactured under severe heat treatments ( $\sim 1.2 \text{ mg/m}^2$ ) = spray dried sodium caseinate manufactured under severe heat treatment ( $\sim 1.2 \text{ mg/m}^2$ ) = commercially made sodium caseinate ( $\sim 1.2 \text{ mg/m}^2$ ).  $\beta$ -Casein was preferentially adsorbed in freeze-dried laboratory made sodium caseinates and sodium caseinate made under mild manufacturing conditions. There was no significant preferential adsorption

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for the other sodium caseinates.

A stability tube was designed to study the extent of creaming under gravity at 20°C for 24 hours in these sodium caseinate-stabilized emulsions. The results were expressed as stability rating, defined as per cent change in fat in lower aqueous phase after creaming.

In general, the stability rating increased with an increase in caseinate concentration. Emulsions containing caseinate concentrations of 4 and 5% (w/w) showed little fat separation under these conditions. The stability rating also increased with an increase in fat concentration in the emulsions indicating that high fat emulsions were more stable than emulsions containing low fat concentrations. As expected the stability rating increased with increase in homogenization pressure (i.e., decrease in oil droplet diameter). Emulsions prepared from sodium caseinate solutions, adjusted to pH 2.0 and 3.0, were found to be more stable than those prepared at pH 6.0, 7.0 and 8.5. Addition of calcium chloride to the sodium caseinate solution at 0.02 and 0.04% (w/w) had no effect on the stability rating of emulsions, but further additions of calcium chloride caused a marked increase in stability rating with no visible fat separation. Variations in the processing conditions (i.e. pasteurization temperatures, cooking temperatures, washing temperatures) during the manufacture of sodium caseinate had no significant effect on the stability of emulsions.

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