Investigation of Blended Milk-Pea Protein Beverage Fouling using Quartz Crystal Microbalance with Dissipation (QCM-D)

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The fouling of beverages containing plant-based proteins seems to be unique when compared to more traditional protein beverages. The influence of thermal treatment on fouling and foulant removal of milk/pea protein blends has been investigated. Fouling of several blends have been evaluated at two temperature ranges: 65°C, 75°C and 85°C and UHT temperatures of 112°C, 122°C and 132°C using a quartz crystal microbalance with dissipation (QCM-D). Removal of the foulant was evaluated using a water rinse, a cleaning solution followed by a final water rinse. The foulant deposition and removal were evaluated at a defined flow rate over the QCM-D sensor with four 15 min phases, including creation of the foulant, removal by an initial water rinse, removal by a 0.1M NaOH cleaning solution and a final water rinse. The shift in frequency (ΔF) and dissipation (ΔD) from the QCM-D sensor were measured during each phase of the experiment.

The frequency shift (ΔF) values were converted to mass density (mg/m^2) adsorbed on the sensor surface using the Sauerbrey model and the fouling rate was expressed as mass density per unit time (mg/m^{2}min). It was observed that blended beverage has a lower fouling rate as compared to skim milk having the same protein content and the fouling rate decreases at all temperatures on addition of pea proteins. The removal of foulant using an initial water rinse was not influenced by temperature and foulant removal of blended beverage is easier as compared to skim milk. Only 25 % of the foulant from skim milk was removed, as compared to 60% for the milk/plant protein blend after the initial water rinse. Ultimately, the NaOH cleaning solution completely removed the foulant from the stainless-steel sensor surface.

The results of the investigation indicate that foulant removal by water differed significantly based on the temperature and concentration of the milk/protein blend. The influence of temperatures during creation and removal of the foulant are important for beverages containing plant proteins.