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ABSTRACT

THE ABILITY TO RECONSTITUTE FOOD EMULSION STRUCTURES AFTER DISSOLVING SPRAY-DRIED PREPARATIONS IN WATER

This thesis was aimed to compare the emulsion structure resulting from rehydration of microcapsules obtained by spray drying with the structure of emulsion subjected to spray drying. The primary o/w emulsions, stabilized with whey proteins (WPC 80) dispersion containing an *evening primrose oil* (OLW) as the oil phase were prepared by the membrane method.

At the beginning of the research, the degree of hydration of the WPC powder and the conditions of pressure homogenization of the obtained dispersion were determined. Due to the surface tension, the specific surface of the protein molecules and the emulsification capacity in relation to the OLW, the optimal initial purification of the water phase was dissolution of WPC at room temperature and pH = 8.0 and hydration for 15 min, followed by homogenization under a pressure of 25 MPa.

The composition of the emulsions was determined as a result of model experiments carried out using a rotor-stator device at the shear rate comparable with the one existing at the membrane wall. The most important quality criterion of the emulsion was its stability within 4 hours expressed by the stability index k_{240}. Emulsion composed of 30% w/w dry solids, consisting of 16,6% WPC 80 powder, 75,1% of maltodextrin and 8,3% OLW, was utilized for all subsequent experiments.

To produce o/w emulsions, an experimental unit enabling scaling-up of the system in the future, was designed and assembled. The primary o/w emulsion to be subjected to spray drying was produced using an asymmetric, ceramic microfiltration membrane with a nominal pore diameter of 0.8 μm. As a circulating water phase, consisting of the hydrated dispersion of whey proteins as an emulsifier and maltodextrin as a carbohydrate component, was used. The operating conditions of the system - i.e.: pressure drop of the liquid flowing with a capacity of $1.9 \cdot 10^{-4}$ m^3/s (700 dm^3/h), equal to 70 kPa, and critical pressure (30 kPa), necessary to force the oil into the circulating emulsion, were determined experimentally.

Particle size distribution (PSD) both in the emulsions and in the microcapsule powders revealed a complex, polydisperse structure of the analysed products. In every case the resultant PSD curve was composed of 3 PSDs curves representing fractions of different range of particle sizes. The regenerated emulsions contained distinctly smaller oil droplets than those before drying. The additional experiment showed that when the emulsion was sprayed, the oil droplets were broken and became smaller. The regenerated emulsions contained almost 3 times smaller drops of oil than liquid before drying. The PSDs of the emulsion obtained after spraying in the dryer without air flow and the emulsion regenerated from microcapsules powder become comparable. It was found that the structure of the emulsion regenerated from the spray-dried powder reflects the structure of the emulsion being formed in the drying chamber during the drying process.

Key words: emulsion, membrane emulsification, spray drying