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Effect of Air Temperature on the Thermal Degradation of Heat Liable Products in Spray Drying and Monodisperse Drying

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Abstract

Three heat liable protein-based materials β -galactosidase, whey protein isolate (WPI) and egg white (with 30-35% w/w total solids) were dried through conventional spray drying and monodisperse drying respectively with constant inlet air temperature 200 °C and different outlet air temperature. The purpose was to test the hypothesis that monodisperse droplet drying could produce more control over time-temperature experience during drying, resulting in reduced loss of structure or activity. The residual enzyme activity of the dried lactase product was determined by ONPG β -galactosidase assay, and the extent of denaturation of WPI and egg white was determined by differential scanning calorimetry (DSC). Particle size and morphology were also measured and observed.

The results showed that for both spray drying and monodisperse drying, the extent of protein denaturation increased as outlet air temperature increased. In comparison with spray drying, monodisperse drying had a longer residence time using our particular apparatus and gave rise to higher extent of heat degradation for all three materials. The dried products from monodisperse drying showed a narrower particle size distribution but had larger particle size compared to the products from spray drying. The majority of monodisperse dried powders had a multivesicular hallow morphology due to high interior temperature and coalescence of neighbouring particle in flight. The feasibility of using monodisperse drying in real industry is still under investigation. Although the results obtained from this study denied the expectation that monodisperse drying can reduce the thermal degradation of product during drying process, they are still useful in developing the monodisperse drying system and optimizing the operating parameters.

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