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

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Food Technology

at Massey University, Manawatū, New Zealand

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2018

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 ℃ 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.

Acknowledgements

Firstly, I would like to express my sincere gratitude to my supervisors Professor Richard Archer and Dr. Jeremy Smith for them giving me the chance to conduct this project and guiding me the direction to broaden my thinking. I am also thankful for their help and support throughout the whole project. The knowledge and experiences that I achieved from this project are invaluable.

My special thanks go to Dr. Jim Q Chen for helping me with understanding the rationale of reaction kinetic and calculations; and Professor Patrick Morel for the assistance on data analysis and statistical problems.

I sincerely appreciated the support from the following people:

- Mr John Pedley for helping with the electrical issues, heating system and insulation of the heater stack.
- Mr Garry Radford, Mr Byron McKillop and Mr Warwick Johnson for their support on spray drying and other equipment in the pilot plant.
- Ms Michelle Tamehana for the help with spectrophotometer and rheometer.
- Mr Steve Glasgow for his guidance on Kjeldahl determination, moisture content and water activity measurement.
- Mr Chris Hall for the training and help with DSC measurement.
- Mr John Sykes for his assistance on particle size measurement.
- Mr Trevor Loo for training me on nano-DSC technique.

I would also like to thank the other postgraduate students and interns who helped me during the project, especially Jolin Morel, Lukas Frieler who helped me a lot on the monodisperse drying system and Sarah Priour who gave me advice on DSC measurement.

Thanks also to Dr. Michael Parker, Ms Yvonne Parkes, Ms Pip Littlejohn and Ms Hannah Hutchinson for their administrative assistance. Mr Matt Levin for his IT and network support.

I am also grateful for the support and understanding from all my friends and flatmates especially Xin Wang, Lisanne Fermin and Xuan Song. Special thanks to my parents for giving me continuous love and encouragement. I could not have done it without you all.

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