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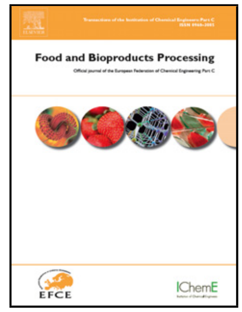

Title: Modeling of Food Drying Processes in Industrial Spray Dryers

Authors: Hugo M. Lisboa, Maria Elita Duarte, Mário Eduardo Cavalcanti-Mata

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Modeling of Food Drying Processes in Industrial Spray Dryers

Hugo M. Lisboa*, Maria Elita Duarte, Mário Eduardo Cavalcanti-Mata

Unidade Academica de Engenharia de Alimentos, Universidade Federal de Campina Grande, Av. Aprigio Veloso 882, 58429-200 Campina Grande, Paraíba, Brasil
*hugom.lisboa80@gmail.com

Highlights:

- Simplified and easy to use Heat-Mass balances were developed to establish operational design spaces and help scale-up;
- Spray drying model extended for glass transition temperature, droplet size and drying kinetics estimates;
- Accurate estimations for different types of food products;
- Increased process knowledge helps troubleshooting and scale-up.

Abstract

The shift from a trial-and-error approach on food product development to a quality-by-design paradigm requires tools that support the scientist in making decisions for the design of research and development activities. Presently, many of these tools require high investments in software or time for implementation. Consequently, the present work had the objective to develop a simplified model of the spray drying process in an industrial spray dryer to support activities of food product development and that can be easily implemented in any software. The model was verified and validated using an industrial spray dryer in food drying processes covering a wide range of operating conditions and food products. The model was further extended so that the scientist could estimate not only key operating parameters such as feed flow rate or drying gas outlet temperature but also final particle size and drying kinetics for a better understanding of the drying phenomenon by spray drying. From the comparison of the experimental and the estimated results it is concluded that the model successfully describes all spray drying operations independently of the product nature. Raw material and laboratory time can be reduced by replacing the traditional trial and error methodologies by using the developed tool. Estimates of wet bulb temperature, dew point and glass transition temperature increase process knowledge preventing process errors. Scale-up is also facilitated by the use of non-dimensional estimated parameters such as outlet relative humidity.

Abbreviations

DOE – Design of experiments

CFD – Computational Fluid Dynamics

Q_{in} – Heat entering spray drying

Q_{feed} – Heat required to dry the feed

Q_{out} - heat coming out of the equipment

Q_{loss} - heat lost to the exterior