UNIVERSITI TEKNOLOGI MARA

THE DEVELOPMENT OF A NEW CARRIER MATERIAL FROM *CENTELLA ASIATICA L*. TO REDUCE STICKINESS OF SPRAY-DRIED PINEAPPLE POWDER

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MSc

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Spray drying process is an effective drying technology for fruit preservation that involved in transforming dehydrated atomized droplets into a fine dry particles. Commonly, starch derivative maltodextrin (MD) was used as a carrier material to improve physical properties and produce non-sticky spray-dried fruit powders. However, due to an amorphous nature of MD and rapid dehydration process, the dried powder will develop either into complete amorphous state or some microcrystalline disperse in the amorphous mass. As a result, it tends to absorb a high amount of moisture when expose to a humid environment, causing a plasticizing effect and reducing the glass transition temperature, subsequently, becoming sticky and cakey. Therefore, an alternative cellulose-based carrier material with potential of higher degree of crystallinity from *Centella Asiatica L.* (*CAL*) was introduced as a new drying agent and incorporated with MD as a mixture carrier material. The effect of this new mixture carrier was investigated using pineapple spray drying process as a case-study at different operating conditions. It was expected that the presence of more crystalline MD-*CAL* mixture will increase the glass transition temperature and reduce hygroscopicity of pineapple powder, hence, produce less sticky and cakey product. Firstly, *CAL* powder was prepared and its moisture sorption isotherm was determined. The result showed that the powder was well-formed with Type III; *Flory-Huggins* isotherm similar to many dry powders and suitable for storage and consumption. The moisture sorption reaction was enthalpically-driven ($T_\beta > T_{hm}$) and spontaneous (ΔG = +0.0501 kJ/mol). The characteristics of *CAL* powder and MD were analyzed and the knowledge was very useful to get further understanding of their influence on the spray-dried pineapple powder. From the study, it was found that the degree of crystallinity, glass transition temperature, and hygroscopicity of *CAL* powder were significantly higher ($p < 0.05$) than MD. The degree of crystallinity results of these materials was correlated with the glass transition temperature property but it contradicted their hygroscopicity behaviors. The hygroscopicity of *CAL* powder (16.22 ± 1.79 g of water/ 100 g of sample) was significantly higher ($p < 0.05$) than MD (5.01 ± 0.28 g of water/100 g of sample), and could led to cakey spray-dried product. This characteristics *CAL* powder is suggested because of the differences in their initial moisture content, hydrophobicity, and/or porosity. After *CAL* and MD were characterized, spray drying experiments were conducted at a different combinations of inlet air temperature, feed flowrate, and MD:*CAL* ratio using response surface methodology (RSM). Based on the models, all the independent variables significantly affected the process recovery, glass transition temperature, and hygroscopicity of pineapple powder with *p*-values less than 0.05. The optimum operating conditions of inlet air temperature, feed flowrate, and MD:*CAL* ratio were recorded at 176.6°C, 10 ml/min, and 2.88:1, respectively. The addition of *CAL* powder as a carrier material in the spray drying process has provided a potential of less sticky pineapple powder due to the increase of process recovery and glass transition temperature. However, further investigation need to be conducted on the interaction between the final product and the surrounding moisture. This is because the product become more susceptible to the moisture when the concentration of *CAL* powder increases and it could enhance the caking effect.

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