Studies of encapsulation and stability of *Ganoderma lucidum* fermentative product

Chuang, Chia-Ying (莊佳穎) Chen, Su-Der* (陳淑德)

Department of Food Science, National Ilan University, Taiwan

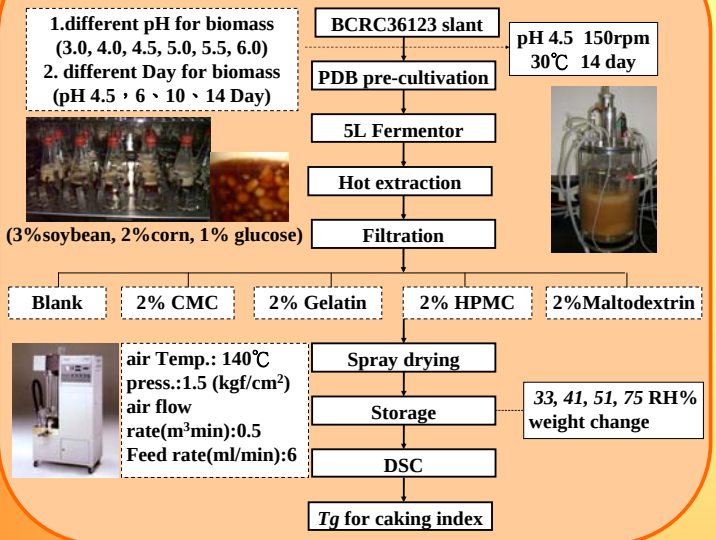
Abstract

The aim of this study was to investigate the potential of use spray-drying process from different amorphous matrices to inhibit the caking/collapse of spray-dried *Ganoderma lucidum* fermentative powder. *Ganoderma lucidum* submerged cultivation in PDB medium was in a shake flask for cell growth two week. Then it was changed to grain medium in 5L fermentor, and that was operated at 30℃, initial pH 5.5, 1v.v.m. and rotation speed 150 rpm about three day. The crude polysaccharide concentration of *Ganoderma lucidum* fermentative supernatant was over 10g/L. *Ganoderma lucidum* fermentative supernatant was mixed with different amorphous matrices (maltodextrin, gelatin, carboxymethyl cellulose (CMC), and hydroxypropylmethylcellulose (HPMC)), and they were spray-dried to obtain encapsulated powder. The encapsulated *Ganoderma lucidum* fermentative powders were stored under different relative humidity (RH), and then their weight changes and glass transition temperature were measured. The *Tg* of encapsulated *Ganoderma lucidum* fermentative powders decreased with increased moisture content, and all product in the ruby type at 75%RH environment. Weight change parentage of the encapsulated fermentative powders was CMC> glatine> blank> maltodextrin> HPMC after 3 days storage. The results showed that HPMC and maltodextrin as amorphous matrices provided fermentative powders better product stability.

Introduction

***Ganoderma lucidum* is one of the most famous traditional Chinese medicines and health foods. Its extracellular polysaccharides have been proven to inhibit the growth of several cancer cells and stimulate human immunity. The submerged fermentation has received great interest in Asian countries as a promising alternative for efficient production of *G. lucidum* metabolites. The *G. lucidum* fermentative powder is produced by spray-dried encapsulation technology; however, caking occurs in dried fermentative powder due to recrystallize, surface wetting during storage. Different amorphous matrices addition for encapsulation provides good stability of spray-dried powder products. Glass transition data (*Tg*) can be measured by differential scanning calorimetry (DSC), and it can explain collapse occurrence during storage at different relative humidity.**

Materials and Methods



Results and Discussion

***Ganoderma lucidum* was cultivated in the PDB medium with different initial pH (3.0-6.0) (Fig. 1), and the optimal initial pH for mycelial growth was 5.0 with yield 2.6g/L. The suitable cultivation time for mycelial growth was about 14 days (Fig. 2). Therefore, the initial pH of media may affect cell membrane function, cell morphology and biosynthesis. When activated *G. lucidum* mycelia were transferred to grain medium in 5L fermentor, the maximum polysaccharide production rate was at the first day, and the maximum polysaccharide concentration was 11.2mg/mL on the third day (Fig. 3). Fig. 4. showed that moisture absorption order of the spray-dried *G. lucidum* fermentative powder with different amorphous matrices was CMC > G > B > HPMC > MD stored under different RH% (33, 41, 51, 75) 3 days. The DSC thermograms of encapsulated *G. lucidum* powders (Fig. 5) showed the Tg at 33% were higher than those at 75% stored at 25 ℃ three days. The CMC and gelatin were increased moisture-absorbing rate, HPMC and maltodextrin were good for inhibiting moisture absorption and caking phenomenon (Fig. 6).**

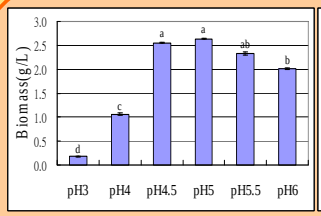


Fig. 1 Effect of initial pH on mycelial biomass dry weight

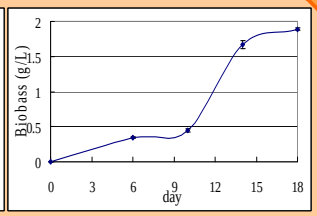


Fig. 2 Effect of cultivation days on mycelial growth (initial pH 4.5)

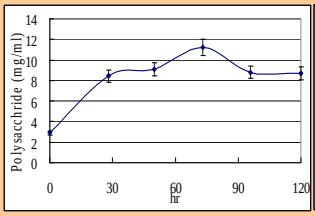


Fig. 3 Polysaccharide concentration curve in 5L-fermentor

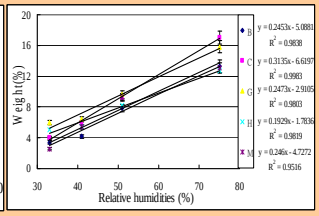


Fig. 4 Moisture absorption rate in different relative humidity

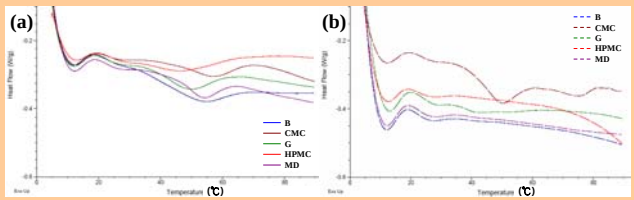


Fig. 5 DSC thermograms showing the *Tg* at different RH in 25 ℃ (a) 33% (b) 75%

Fig. 6 Pictures of spray-dried powders stored at 25 ℃ with different RH three days, Blank: (a) 33% (b) 75% ; HPMC: (c) 33% (d) 75%

Conclusion

The optimal initial pH for *Ganoderma lucidum* mycelial growth was 5. The maximum polysaccharide of *G. lucidum* production in 5L stirred fermentor (150rpm, 30℃, 1vvm) was 11g/L at the third day. The encapsulated *G. lucidum* powders were spray-dried at 0.5 m³/min 140℃ hot air, 1.5 kgf/cm² nozzle pressure and 6 ml/min feed rate condition. The moisture absorption order of the spray-dried powder was CMC > G > B> HPMC > MD; therefore, HPMC and MD were good amorphous matrices for inhibiting moisture absorption and caking phenomenon during storage due to their rubbery state.