Study of Radio Frequency Pasteurization and Drying of *Poria cocos* Solid-state Fermented Product

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INTRODUCTION

The soybean residue and rice bran were the media for *Poria cocos* solid-state fermentation to improve their antioxidant activities. Radio frequency (RF) can rapidly heat up water molecules or ions in food by rapid conversion of electric field; therefore, RF heating can overcome heat transfer resistance to accelerate pasteurization and drying processing of food product [1]. The drying time of 1.6 kg of in-shell walnuts reducing moisture content from 20% to 8% required 100 and 240 min by RF drying and only hot air drying, respectively [2]. After 90 s of RF treatment, the log reductions of *Salmonella* and *Escherichia coli* were 4.29, 4.55 and 4.39, 5.32 log CFU/g, respectively, in creamy and chunky peanut butter respectively, without affecting the quality [3]. Therefore, RF may applied in the downstream processing of *Poria cocos* solid-state fermentation.

METHODOLOY

A 5 kW, 40.68 MHz pilot-scale RF with hot air drying system was used in this study (Figure 1(a)). The size of the parallel electrode plates were 35 cm x 35 cm. A pack of 500 g soybean residue and rice bran = 1:1, with 40% moisture content as *Poria cocos* solid-state fermented medium at 25℃ for 30 days cultivation. After fermentation, one pack product was put on the bottom of RF electrode plate (Figure 1 (b)). The RF power was obtained by adjusting the gap between the electrodes from 14 to 22 cm. The surface temperature profiles and weight loss of 500 g *Poria cocos* solid-state fermented products during RF drying with hot air were measured.

(a)  (b) 

Figure 1. (a) Batch RF hot air heating equipment. (b) Product pack in the RF system.

RESULTS

RF output power was increased with decreasing electrode gap. (Figure 2) The surface temperature required only 60 sec to reach about 100°C at gaps of 14, 15 and 16 cm. (Figure 3) The 500 g fermented product took only 30 sec at the electrode gap of 15 cm to pasteurize, and there was no *Poria cocos* growth (Figure 4). Then it took only 200 sec to dry the fermented product from 40% moisture content to low than 15%. (Figure 5) However, the sterilization of fermented product in an autoclave required 60 min. The drying time of fermented products were 100 min in a 45℃ cold air drier. (Table 1) The polysaccharide and triterpenoids contents in fermented products were no significantly difference between RF and traditional processing, but RF heating could avoid browning and achieve higher whiteness of product. (Table 2)

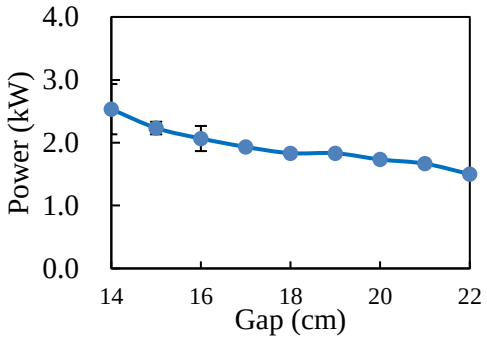

Figure 2. The RF power output at different electrode gaps for 500 g Poria cocos solid-state fermented product.

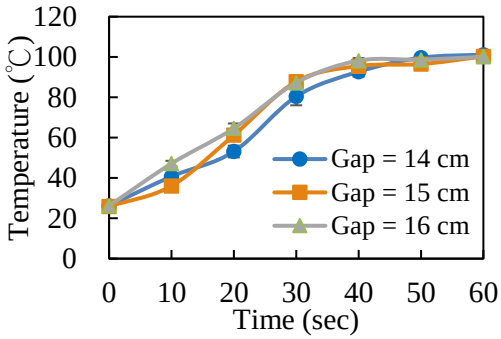

Figure 3. The temperature profile of *Poria cocos* solid-state fermented product at different electrode gap during RF heating.

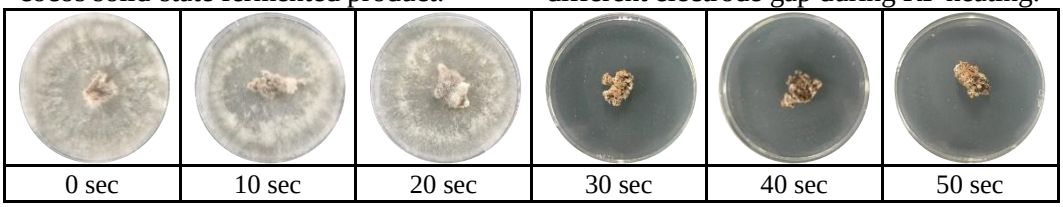

Figure 4. RF pasteurization at electrode gap of 15 cm for *Poria cocos* solid-state fermented product after *Poria cocos* 7 days cultivation.

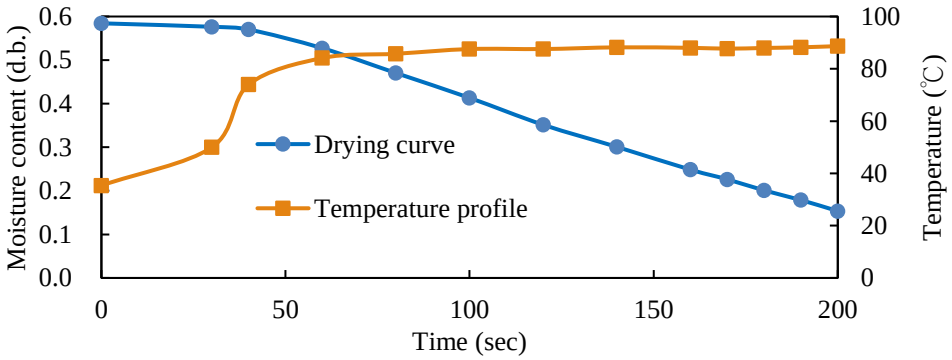

Figure 5. The average temperature profile and drying curve of *Poria cocos* solid-state fermented product during RF drying with gap of 15 cm.

Table 1. The drying rate, drying time and energy consumption of 500 g *Poria cocos* solid-state fermented product by RF drying and 45 °C cold air drying

Drying condition	Drying rate (g/min)	Drying time (min)	Energy consumption (kWh)
RF drying	45.837	3.33 (200 s)	0.34
Cold air drying	0.9089	180	7.38

Table 2. Effect of different pasteurization and drying methods on quality of *Poria cocos* solid-state fermented products

Treatment	Crude polysaccharide (%)	Crude triterpenoids (%)	L*	a*	b*	Whiteness (%)
RF pasteurization & RF drying	9.83 ± 0.24[a]	4.43 ± 0.02[a]	53.30±0.31[a]	9.64±0.03[a]	27.70±0.18[a]	44.86±0.21[a]
121℃ Autoclave & cold air drying	9.35 ± 0.30[a]	4.32 ± 0.01[a]	41.74±0.03[b]	9.68±0.06[a]	22.65±0.15[b]	36.75±0.07[b]

DISCUSSION

RF heating 4 min of *Poria cocos* solid-state fermented products could replace the traditional sterilization 60 min in an autoclave and 100 min drying in a 45℃ cold air drier. RF could significantly decrease time and energy consumption of downstream process. Moreover, RF heating could avoid browning reaction and obtain white *Poria cocos* white mycelium appearance.

CONCLUSION

RF pasteurization and drying of 500 g *Poria cocos* solid-state fermented product required only 4 min, and RF treatment had better quality than autoclave & cold air drying.

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