Characterization of Galangal Essential Oil/Alginate Microcapsules

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1. INTRODUCTION

Health and hygiene have become essential to human being's way of life. Since cotton fabrics which are the most widely used fabrics can be easily attacked by microbes, antimicrobial finishing protecting consumers from the unfavorable effects of infections and also providing them a comfortable living is much needed.

Galangal, a selective species of Thai's herbs with easy cultivation and low cost, is considered as an environmental friendly antimicrobial agent to serve the consumers' preference on green awareness [1-4]. However, to contact galangal essential oil in high concentration could result in eye and skin irritation and its durability of antimicrobial activity on cotton fabrics against washing could be decreased. To solve these problems, microencapsulation using herbal oil as core and an alginate biopolymer as wall material [5] was introduced to reduce irritation, to control and sustain its durability.

In this study, galangal essential oil/alginate micro-capsules will be prepared by solidifying in liquid (orifice process) between sodium alginate and calcium chloride [6]. The characteristics of the microcapsules in terms of average size, loading capacity and thermal stability have been investigated.

2. EXPERIMENTAL

Materials

Galangal essential oil (extracted by steam distillation and contained 1,8-cineole 55%) was purchased from Thai China Flavours & Fragrances Industry Co., Ltd. Sodium alginate was kindly provided by August Chem Co., Ltd. Calcium chloride and 100% ethanol was purchased from TSL Chem Co., Ltd. and T.C. Sathaporn Group Ltd., Part., respectively.

Preparation of Galangal Essential Oil/Alginate Micro-capsules

Alginate microcapsules containing galangal essential oil were prepared by solidifying in liquid (orifice process) [6]. 1, 3 and 5 mL of galangal essential oil were diluted with ethanol and was then mixed with 25 mL of 1-5% (w/v) sodium alginate aqueous solutions under continuous mechanical stirring at room temperature to make an emulsion.

The obtained emulsion was injected using a syringe into a 250 mL of gel bath containing 5% (w/v) of calcium chloride solution.

The obtained calcium alginate capsules suspension was equilibrated overnight and followed by washing twice with distilled water and dried at room temperature to evaporate water on the capsule surface.

Characterization of microcapsules

The characteristics of the microcapsules in terms of average size, loading capacity and thermal stability have been investigated by Optical microscope, Infrared moisture determination balance (IMDB) at 120°C for 1 hour, ATR FT-IR and isothermal TGA at 37 and 120°C.

3. RESULTS AND DISCUSSION

Characterization of microcapsules

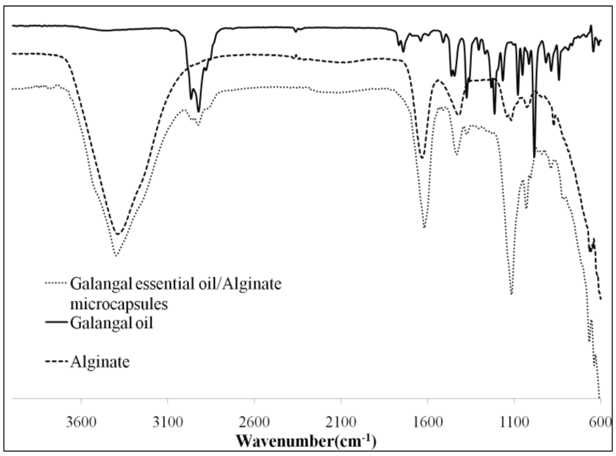

Fig. 1. FT-IR spectrum of galangal essential oil, alginate and microcapsules of 3% (w/v) sodium alginate and 5 mL galangal essential oil content.

FT-IR spectrum was confirmed the prepared microcapsules containing galangal oil, in which a broad peak corresponding to O-H stretching at 3400 cm^{-1}. Galangal essential oil/alginate microcapsules were also found characteristic peak of alginate and galangal essential oil at 2900 and 1600 cm^{-1}, which belonged to C-H stretching and carbonyl stretching, respectively.

Effects of concentration of sodium alginate and galangal oil contents on size and loading capacity of microcapsules

Table 1. Size and loading capacity of galangal essential oil/alginate microcapsules

Sodium alginate concentration % (w/v)	Galangal essential oil content (mL)	Size (μm)	Loading capacity (%)
1	1	-	15.36
	3	-	23.18
	5	-	24.59
2	1	753.45	18.18
	3	813.75	24.37
	5	852.43	28.90
3	1	806.45	23.68
	3	868.80	27.82
	5	969.07	29.73
4	1	950.34	28.30
	3	1064.27	35.27
	5	1112.86	35.90
5	1	1026.32	36.93
	3	1137.40	39.37
	5	1164.32	40.83

Table 1 shows that an increase of sodium alginate concentration and oil content significantly resulted in higher average size of the microcapsules ranging between 750 and 1000 μm.

However, at 1% (w/v) of sodium alginate concentration, microcapsules tended to agglomerate (Fig. 2). IMDB data indicated that maximum oil content in the microcapsules was 40% at 5 mL galangal essential oil content and 5% (w/v) sodium alginate concentration.

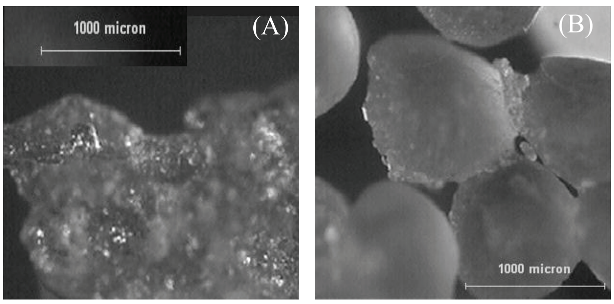

Fig. 2. Microphotographs of microcapsules (x100)
(A) 1% (w/v) sodium alginate and 3 mL oil content,
(B) 3% (w/v) sodium alginate and 3 mL oil content.

Thermal stability of microcapsules

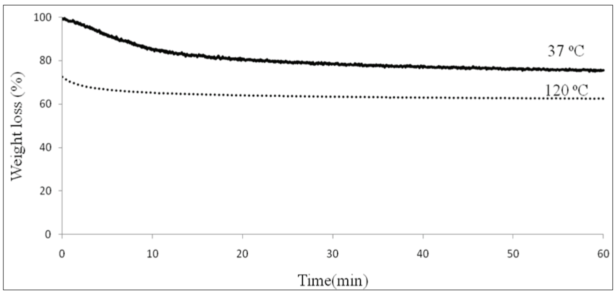

Fig. 3. TGA thermogram of microcapsules of 3% (w/v) sodium alginate and 5 mL galangal essential oil content at 37 and 120 °C

Fig. 3 shows weight loss of microcapsules versus time. All of microcapsules presented similar behavior with one state of weight loss was related to the loss of galangal essential oil and which inflection at about 3 minutes. The residue was about 75% at 37 °C and 60% at 120 °C that corresponding to loading capacity from IMDB. Thus, this confirmed that encapsulation could improve durability of galangal essential oil.

4. CONCLUSIONS

Microencapsulation of galangal essential oil has been done successfully by solidifying in liquid using galangal oil as core material and alginate as wall material. An average size of the microcapsules was in range of 750 – 1000 μm and maximum oil content in the microcapsules was 40%. Finally, durability of galangal essential oil could be improved by micro-encapsulation.

5. ACKNOWLEDGEMENTS

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