EFFECT OF ULTRASONICATION TIME AND OIL LOADING ON LAUREL OIL MICROCAPSULES

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INTRODUCTION

Laurel (*Laurus nobilis* L.), the only European representative of the Lauraceae, is an evergreen tree up to 20 m high, native to the Mediterranean region. The dried laurel leaves are extensively used in home cookery. It is also used as flavouring and preservative in food industry due to its essential oil which has unique flavour, antimicrobial and insecticide activities.

The yield of essential oil of laurel leaves ranged between 0.8% and 1.5% (v/w). 1,8-cineole is the major component of the laurel essential oil which is followed by linalool, trans-sabinene hydrate, α-terpinyl-acetate, methyl eugenol, sabinene and eugenol. These components are very sensitive to oxygen, light, moisture, and heat. However, their stabilities can be increased by using microencapsulation. Emulsification is the most important step of the microencapsulation because it affects physicochemical properties of the final microcapsules. The goal of emulsification is to produce emulsion droplets as small as possible. Various techniques such as Ultra-Turrax homogenization, high pressure homogenization, microfluidisation and ultrasonication can be used for emulsification. Ultrasonication and microfluidisation methods have been preferred in the last decade for microencapsulation. These methods are efficient in decreasing emulsion droplet size, which plays an important role in the surface oil content of microcapsules, and a lower emulsion size increases encapsulation efficiency and stability. Although ultrasonication were used in some microencapsulation studies for emulsification purposes, the effect of ultrasonication time and oil loading still unknown for essential oil microencapsulation. The objective of this work was to study the influence of ultrasonication time and oil loading on the microencapsulation of laurel oil by spray drying, using gum Arabic as wall material.

Table 1. Experimental design and results

Exp	Oil loading (%)	US time (s)	MEY (%)	Oil retention (%)
1	35.61	105.36	52.4	64.1
2	10.00	70.00	54.5	66.6
3	25.00	70.00	57.8	83.5
4	25.00	70.00	50.5	82.9
5	14.39	34.64	50.5	83.0
6	35.61	34.64	46.9	59.6
7	25.00	120.00	55.1	81.6
8	25.00	70.00	58.0	81.9
9	25.00	20.00	58.0	79.2
10	14.39	105.36	59.4	80.6
11	40.00	70.00	43.7	73.2

MATERIALS and METHODS

Materials. The laurel leaves were collected from the trees located in the campus of Akdeniz University. Laurel essential oil is produced by steam distillation and collected oils were stored in -20ºC for about 1 week. Arabic gum (Instant gum BA, Colloïdes Naturels, São Paulo, Brazil) was used as wall material.

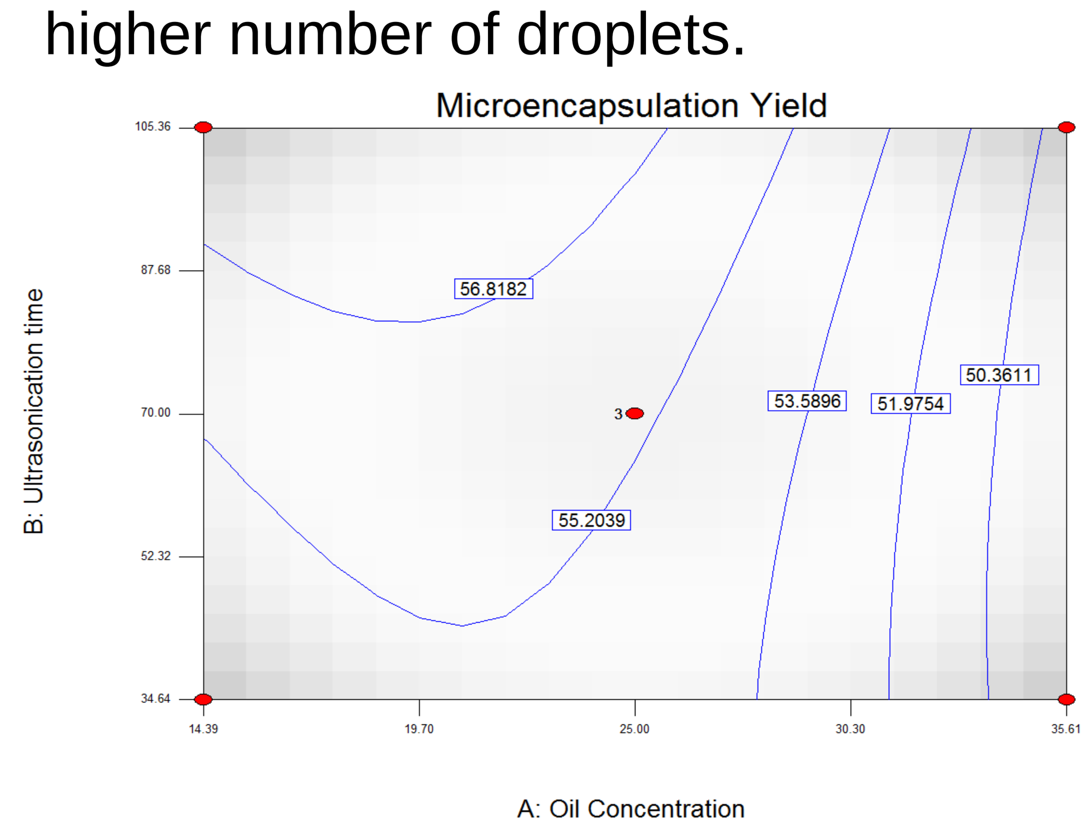
Preparation of emulsions. Twenty five grams of Arabic gum were completely dissolved in 100 mL of distilled water at room temperature using a magnetic stirrer (Daihan MSH-20A). After complete dissolving of wall materials, the essential oil (Table 1) was added and mixed for additional 1 min. Emulsions were formed in a jacketed beaker constantly cooled by circulated tap water using an ultrasonic homogenisator (Bandelin HD3200 equipped with KE-76 probe) at 88W power for variable time according to central composite design (Table 1). The probe dipped into centre of the solution for 1 cm height.

Microencapsulation by spray drying. Spray drying was performed in a laboratory scale spray dryer (Büchi Mini Spray Dryer B-290, Switzerland). The inlet air temperature of the spray dryer was adjusted at 180°C. The nozzle was operated by compressed air at 600 L/h. The aspiration rate of drying air was 35 m^3/h (100%). After conditioning, the emulsions at ambient temperature were pumped into drying chamber through two fluid nozzles by a peristaltic pump at a fixed feed rate (35%, 9.2 mL/min).

Analyses: Product yield was calculated from the rate of collected samples to dry matter of feed emulsion. Oil retention was determined by steam distillation.

RESULTS AND DISCUSSIONS

Microencapsulation yield. Microencapsulation yield is an important parameter for the optimization of spray drying process because of stickiness problem. According to results the microencapsulation yield of laurel essential oil microencapsulation ranged between 43.6 and 59.4 (Table 1). Quadratic model for the microencapsulation yield was significant at $P < 0.10$ level and the linear and quadratic terms of oil loading was significantly important which indicates that the microencapsulation yield of the process mainly governed by the oil loading. Additionally, microencapsulation yield increased until a certain oil loading level (~20% oil loading), then decreased. This could be related to insufficient amount of the wall material to cover higher number of droplets.



Oil Retention. Oil retention varied from 59.6 to 83.5% (Table 1) and did not significantly affected whether ultrasonication time nor oil loading. Similar to this finding, Huynh et al. (2008) also reported that oil loading did not affected the oil retention for lemon myrtle essential oil. Although it is not significant, oil loading increased the oil retention until a certain level about 22-23%. After this level, oil retention decreased with increasing oil loading. This phenomenon could be explained by shortening the diffusion path to surface of the particle. Additionally, because fixed amount of wall material used in this study, amount of the wall materials could be insufficient to cover high amount of oil droplets which also causes loss in the volatiles.