Encapsulation of flavour compounds in wax particles

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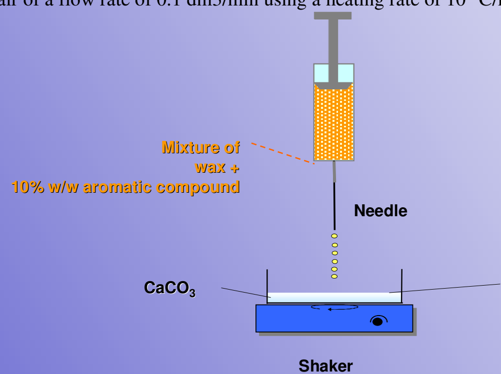
INTRODUCTION

The subject of this study was the development of flavour alginate formulations aimed for thermally processed foods. Flavours can be among the most valuable ingredients in any food formula. Even small amounts of some aroma substance can be expensive, and because they are usually delicate and volatile, preserving them is often a top concern of food manufacturers. Encapsulation describes different processes to cover an active compound with a protective wall material and it can be employed to treat flavours so as to impart some degree of protection against evaporation, reaction, or migration in a food. In this study, Carnauba wax was employed as the matrix for flavour encapsulation, since waxes are untoxic, inert, stable and cheap materials.

MATERIALS AND METHODS

Carnauba wax (Carl Roth GmbH) was slowly heated in a water bath (BODALEC&HAVOIC) up to the melting temperature (80 ^{0}C). In the liquid wax 10 % w/w of an aromatic compound (Ireks Aroma, Zagreb) - nectar, caramel, cherry, coconut or molasses was added. The obtained mixture was extruded through glass syringe and stainless steel needle (0.5 mm) to disperse spherical droplets. The produced wax droplets were collected on the 5 mm tick layer of $CaCO_3$ powder. After drying on room temperature, the obtained wax beads, 3 mm in diameter were investigated by DSC-TGA technique.

The thermal behavior of the particles was investigated employing the simultaneous DSC-TGA technique using a TA Instruments model SDT Q-600 (New Castle, Delaware, US). The samples (mass approx. 10 mg) were heated in a standard alumina sample pan. All experiments were performed out under dynamic air of a flow rate of 0.1 dm3/min using a heating rate of 10 °C/min run.



Production of beads

Wax bead with entrapped aroma

DSC-TGA Instrument

RESULTS AND DISCUSSION

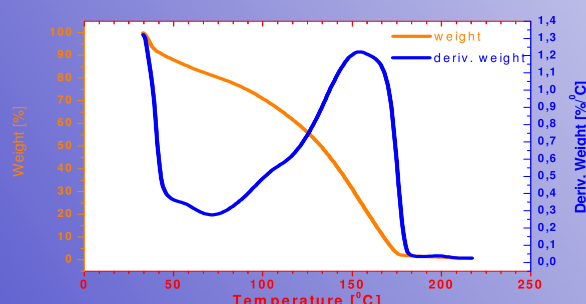


Figure 1. TG and DTG curves of nectar.

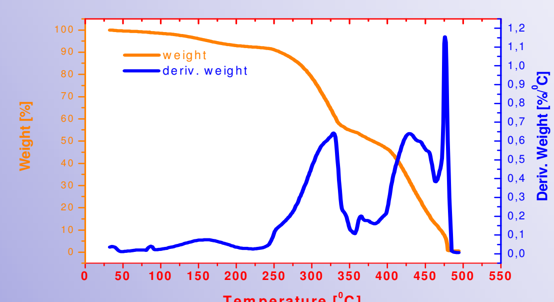


Figure 2. TG and DTG curves of wax beads entrapping approx. 10 % w/w nectar.

The TG and DTG curves of the nectar in the 20-500 °C temperature range are shown in Figure 1. It can be seen that evaporation of nectar starts immediately with a maximum at 75 °C according to the DTG curve. The analysis showed that all the nectar have been completely lost during the heating process up to the 170 °C which is undesirable effect when a retention during the baking processing is required. Figure 2 shows TG and DTG curves of the nectar encapsulated wax beads. The release of nectar occurs over a relatively wide range of temperature and it proceeds in several steps. According to prior measurements of aroma-free wax beads (Figure 3), the mass loss up to 250 ^{0}C on Figure 2 can be attributed to the aroma release (proved by a plateau up to 250 °C on Figure 3), while at higher temperatures nectar evaporation is accompanied by degradation of the wax carrier. For a comparison, only 8 % of nectar is released from capsules up to 230 °C , which is usually final backing process temperature, supporting the conclusion that nectar is mostly encapsulated inside the matrix (not only physically adsorbed at the surface of the bead) and that the encapsulation enables sustained release of the flavour agent.

Table 1. Percentage of released aroma on 230 ^{0}C.

Aroma	Released amount of free compound [%]	Released amount of encapsulated compound [%]
Nectar	100	7.9
Caramel	97.1	4.4
Coconut	97.2	10.5
Molasses	95.6	3.4
Cherry	100	4.2

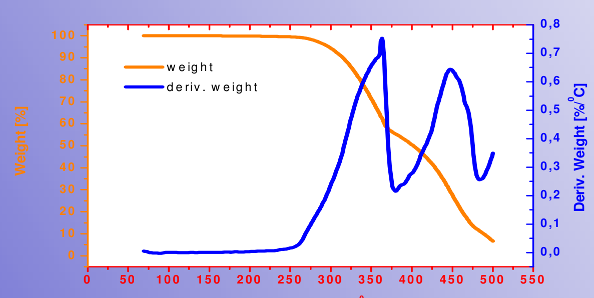


Figure 3. TG and DTG curves of aroma-free wax beads.

Table 1 shows comparison of percentage release of free and encapsulated aromatic compounds up to 230 ^{0}C. Obviously, encapsulation provides from 9 (for coconut) to 28 (for molasses) times lower loss of flavour agents during heating mimicking backing process.

CONCLUSION

Carnauba wax appears to be very promising matrix for the immobilisation of flavour compounds. It enables strong retention of aromas during heating. In order to achieve desirable aroma release, further investigations are planned based on determining the optimal size of the encapsulating particles and heating conditions, as well as optimization of methods to produce uniform and spherical beads.