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INFLUENCE OF THE SHELL MATERIAL IN THE MICROCAPSULES FORMATION BY SPRAY DRYING

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Abstract: *Microencapsulation is a process of entrapment, packaging or immobilizing an active (core) material, which can be in the state of solid, liquid or gas, within a more stable, protective secondary (wall) material that can be released at controlled rates under specific conditions. There are several microencapsulation techniques such as: spray drying, spray cooling/chilling, freeze drying, extrusion, fluidized bed coating, coacervation, liposome entrapment, coextrusion, interfacial polymerization, radical polymerization, molecular inclusion in cyclodextrins, etc.*
Spray drying has been commonly applied due to their simplicity process, wide availability of equipment facilities, significant merits in terms of reductions in product volume, easy of handling, etc. In the spray drying process the wall materials (shells) and their properties are parameters to be considered to achieve proper encapsulation of the active ingredients (core materials). Some commonly used wall materials and their properties related to spray drying encapsulation, including proteins, carbohydrates, and other materials, or mixtures of some of them.
Proper encapsulation of the active ingredient (core) is essential to achieve this active material protecting the outer.
The aim of this work is encapsulated an essential oil, sage oil, using two differet wall materials in order to determine which is the best wall material.
Scanning electron microscopy (SEM) has been used in order to know the microcapsules morphology.

Key words: *Core, Shell, Gum Arabic, Alginate, Sage oil, Scanning Electron Microscopy (SEM)*

1. INTRODUCTION

The basic process of spray drying involves feeding a prepared solution or dispersion of actives into a spray dryer and then atomizing with a nozzle or spinning wheel in a chamber supplied with hot air; the droplet and hot air is contacted in the chamber and the solvent (water) is evaporated from the droplet by the hot air; the dried particles are then separated by a cyclone or bag-filter from the humid air and collected in powder form [1, 2].

In the process of application of spray drying, the core material is emulsified or dispersing in an aqueous solution of selected wall material. The spray drying encapsulated particles have a typical spherical shape and the particle size can be 10-50µm [3].

The selection of an appropriate wall material it´s an imporatnt parameter to consider in the spray drying microencapsulation process. The ideal wall material should have some specific properties such as good film-forming properties, protection of the core material, control release of the core material, low viscosity at high solide levels, etc. [4,5].

Wall materials as Alginate and Arabic gum are carbohydrates materials that present good emulsifying properties and they can be use in the spray-drying microencapsulation process.

The aim of this work is to encapsulate natural oil, sage oil, using two different wall materials in order to determine which is the most effectiveness. The Scanning Electron Microscopy (SEM) allow us to know the microcapsules morphology and determinate the best wall material.

2. EXPERIMENTAL

2.1 Materials

A low viscosity sodium alginate with a 3,5% (w/w) of concentration and a Arabic Gum from Accacia Tree, both provided by SIGMA ALDRICH were used as shells materials. The active material was an essential oil, sage oil, provided by Esencias Lozano.

2.2 Microcapsules obtention

Spray-drying was performed using a spray-dryer BÜCHI B-290 with a standard 0.5 mm nozzle, it can be seen in figure 1. The same procedure was followed for all the emulsions prepared. First emulsion was composed of Arabic Gum (shell material) and sage oil (core material) with a mass ratio 1:2. Second emulsion was composed of Alginate with a 3,5 % (w/w) of concentration (wall material) and a sage oil (core material) with a mass ratio of 1:2 and 1:3.

Emuslison were prepared at a constant agitation speed of 1200 rpm, during 10-15 min at room temperature.

Two emulsions were spray-dried, separately, under the following conditions: solution and air flow rates, air pressure and inlet temperature were set at 6 mL/min (20%), 26,3m^3/h (75%), 6.0 bar and 160 °C, respectively. The outlet temperature, a consequence of the other experimental conditions and of the solution properties, was around 82 °C. The operating conditions have been selected considering preliminary studies [6].

Fig. 1: *Spray drying microencapsulation system*

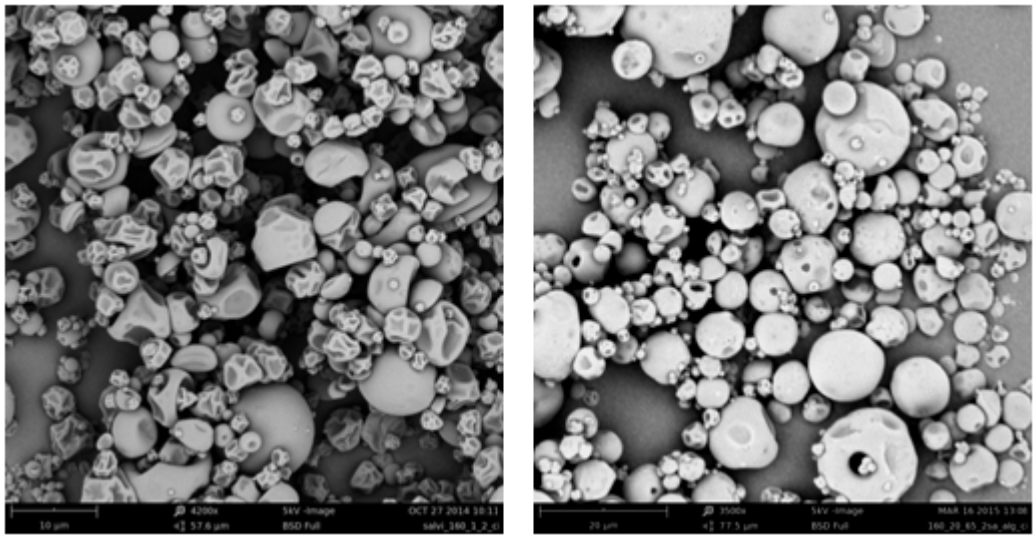
2.3 Instrumental techniques

A scanning electron microscopy Phenom microscope (FEI Company) was used to know the microcapsules morphology. Each sample was fixed on a standard sample holder and sputtered with gold.

3. RESULTS AND DISCUSSION

The wall material has to protection the core material, and in this case prevents the premature release of the core material, sage oil.

Figure 2 shows SEM micrographs of microcapsules composed of different wall materials, but using the same mass ratio (shell/core) materials 1:2.



A) *B)*

Fig. 2: *SEM Micrographs of microcapsules*
A) Shell material: Arabic Gum; B) Shell material: Alginate 3,5% (w/w)

In *Micrograph 2.B* can be observed microcapsules with better spherical shapes than *Micrograph 2.A*. It can be appreciated holes in the microcapsules, these can be problem, because the sage oil can be released prematurely therethrough.

The mass ratio between shell/core materials can be affect at the microcapsule morphology. In order to improve the microcapsules morphology using alginate 3,5% (w/w) as shell material, next micrograph shows microcapsules composed of Alginate 3,5 % (w/w) as shell material and a mass ratio (alginate/oil) 1:3. Certains differences can be observed, microcapsules have spherical shapes.

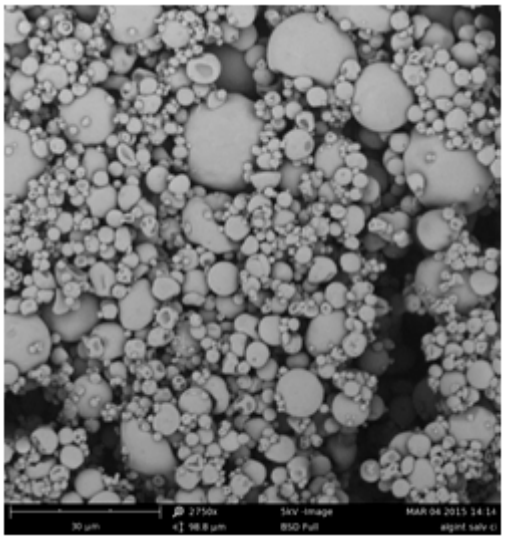


Fig. 3: *SEM Micrograph of microcapsules, mass ratio 1:3*

4. CONCLUSIONS

The present research compares the microcapsules morphology obtained by spray drying microencapsulation method, using two wall (shell) materials. Results show us that both wall materials using the same mass ratio, 1:2, don´t allow obtain microcapsules with spherical shapes, the shape offers best results using alginate 3,5% (w/w) as shell material.

Alginate microcapsules present holes in their walls, with consequent oil loss. Mass ratio between (shell/core) can improve the microcapsules morphology. Also considering in the microcapsules formation, other parameters such as: inlet and oulet temperature, air flow rate, air

pressure, etc.

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