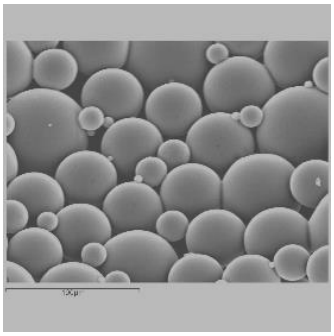
MICRO AND NANOENCAPSULATION

Description

Coating of powdery solid products or liquids with a film of polymeric or fatty material giving rise to micron or nanometer size systems. As a coating material different types of polymers can be used: natural (as alginate and chitosan), semisynthetic (as cellulose derivatives) or synthetic (aliphatic polyesters, polyorthoesters, polyalkylcyanoacrylates ...). These polymeric materials may be biodegradable (by the action of environmental agents or by enzymes or body fluids) or non-biodegradable (which may lead to systems with high persistence). Fatty substances with different melting points can also be used. Two types of structures can be obtained: reservoir type, in which the encapsulated substance is surrounded by the coating material forming an insulating cover from the outside; or matrix type, wherein the encapsulated substance is dispersed, in the form of micro/nanometric particles or at the molecular state, in a matrix of the coating material. The encapsulated substance may be released from the micro or nanoparticles by degradation or melting of the coating, by mechanical rupture of the system or by slow diffusion through the structure. By suitable selection of the type of coating material and the structure of the micro or nanoparticles, the release rate of the encapsulated substance or the conditions under which it is produced can be modulated.

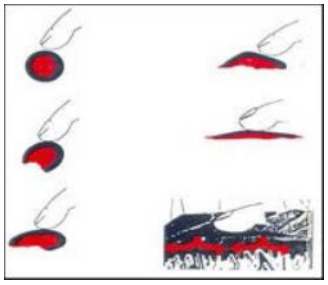
How does it work?

We have implemented different techniques for obtaining micro and nanoparticles loaded with different active ingredients. The selection depends on:
- **The characteristics of the material to be encapsulated**: if it is a solid or a liquid; its hydro/liposolubility; its stability in different solvents; its stability against high temperatures, its chemical compatibility with the coating material.
- **The coating material used**: its selection directly depends on the objective of the encapsulation.
- **The size of the system and the equipment available**: we have implemented a wide variety of high-energy and low-energy techniques, which are developed in a liquid medium, which are developed in a gaseous medium..., and which allow us to obtain systems with sizes ranging between 10nm and 1000µm.



Microparticles of a drug to be administered once a month

Among the works carried out with these technologies are:
- Microencapsulation of chemically incompatible vitamins using the simple coacervation technique, in order to incorporate them in the same formulation.
- Microencapsulation of sodium butyrate by a variant of the solvent evaporation technique from non-aqueous emulsions and using polymers of pH-dependent solubility in order to achieve a delayed release of the active substance at the intestine level after their oral administration.



Application on skin of a microencapsulated cosmetic product.

- Microencapsulation of perfumes, using the complex coacervation technique; for their application in adhesive strips which release the perfume after breaking the microcapsules.
- Microencapsulation of insecticides by means of the interfacial polymerization technique, obtaining a non-biodegradable coating that prevents the toxicity of the insecticide on mammals, birds and fish in an accidental ingestion or contact, but which the insects break with their jaws and ingest the insecticide.
- Microencapsulation of opioid antagonists, through the solvent evaporation-extraction technique using biodegradable polymers. The systems release the drug over a long period of time, after their subcutaneous administration, improving compliance in patients undergoing opioid withdrawal treatment.
- Microencapsulation of oils, using complex coacervation and spray drying techniques; in order to protect them against oxidation, avoid their unpleasant odor and taste, and transform them into a free-flowing powder product, easily incorporated into different processed food products.
- Microencapsulation of proteins by means of the solvent evaporation-extraction technique from multiple emulsions. After their parenteral administration, a prolonged release of the active is achieved, avoiding its exposure to the tissue proteases that cause its degradation.
- Microencapsulation of probiotics, by gelation techniques, to maintain their viability over time.

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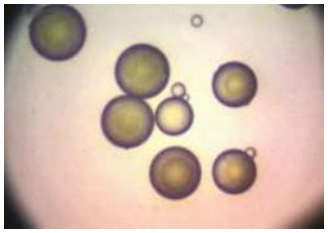
- Micro and nanoencapsulation of antitumor drugs, using solvent evaporation-extraction and phase inversion temperature (PIT) techniques. For intracranial administration, achieving a prolonged release of the antitumor, or for intravenous administration, favouring its passage through the blood-brain barrier.
- Micro and nanoencapsulation of cannabinoids, using solvent evaporation-extraction, nanoprecipitation and PIT techniques. To facilitate their handling and dosage, prolonging the release of the active ingredients after their subcutaneous administration, improving their bioavailability compared to that presented by the oral or sublingual route, and increasing their capacity for skin penetration.
- Micro and nanoencapsulation of antibiotics: using solvent evaporation-extraction and nanoprecipitation techniques, for use as prophylactics in surgical infections, prolonging their antimicrobial efficacy without side effects associated with oral or intravenous administration.



Microcapsules with an insecticide inside.

Advantages

Some of the reasons why it is of interest to micro- or nanoencapsulate an active are: to avoid losses of volatile substances (aromas in food, perfumes in cosmetics, drugs), to combine incompatible substances in the same product (in pharmacy, in agriculture), to avoid environmental contamination (phytosanitary products in agriculture), to avoid the alteration of active ingredients by environmental agents (in agriculture, pharmacy, cosmetics, etc.), to avoid the irritating action of certain drugs when they are administered, to increase the duration of the effect of the drug substances due to a slow release after their administration, to improve the absorption of drugs through the skin or oral mucosa, to target active molecules towards their therapeutic targets reducing adverse reactions...

Where has it been developed?

This technique has been developed at the University Institute of Industrial Pharmacy, located in the Faculty of Pharmacy. The Institute has all the necessary equipment to apply most of the micro and nanoencapsulation techniques: reactor tanks; valve, piston and ultrasonic homogenizers; blade, propeller and turbine agitators, coupled to heating systems and conductivity meters; microfluidic equipment; spray drier. Additional equipment is also available for the collection and conditioning of the resulting product (filtration equipment, centrifuges, drying chambers, lyophilizer), and for the analysis and control of micro and nanosystems (HPLC, DSC, DSL particle size analyzer, equipment for release studies, cell culture unit, etc.)

And moreover

The following services are offered:

- Micro and nanoencapsulation of any type of materials.
- Advice on the advantages, technique and variables of the micro or nanoencapsulation process.
- Resolution of formulation problems.
- Analysis and control of micro and nanoparticles, including content release studies, evaluation in cell lines and stability studies.
- Training of personnel: theoretical and practical teaching of the different techniques of micro and nanoencapsulation.

Researcher in charge

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Figures:

Please attach the images you want to incorporate in the email so as not to lose image quality. You can include 2 or 3 figures, which will have an explanatory function and will also serve to lighten the text and make the offer more attractive).

Insert figure captions here:

Figure 1. Microparticles of a drug to be administered once a month

Figure 2. Application on skin of a microencapsulated cosmetic product.

Figure 3. Microcapsules with an insecticide inside.

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