Spoke

Solving Solubility with Science

Encapsulation of Active Ingredients in Food, Beverage, and Beauty products

In this Brief we discuss basic core-shell encapsulation and its applications.

Technical Brief

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Introduction to Encapsulation

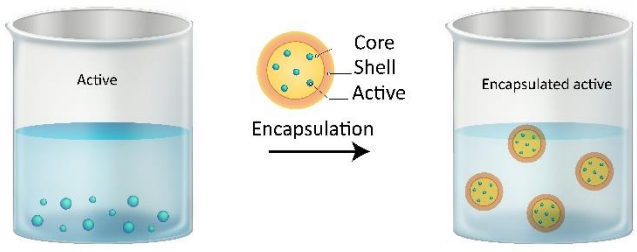
Micro- and nano-encapsulation are used in a variety of situations where enhanced solubility or controlling the release of a functional ingredient or "active" material is necessary. There are many structures that commonly fall under the term “encapsulation.” For this brief, we are going to include only true core/shell architectures where the active material of interest is surrounded with a carefully designed shell using materials chosen to provide a desired benefit. While the definition varies, here we define microencapsulation as particles from 1 micron to 1 millimeter, and nanoencapsulation as particles less than 1 micron in diameter, which is about 500 times smaller than the width of a human hair! This technology is used in creating pill or liquid medicines, food and beverages, vitamins, and even in many industrial applications such as self-healing plastic phone screen protectors.

Reasons for Encapsulation

Increase “solubility”

Encapsulation is used to allow oil-soluble materials to mix more freely in water-based liquids. Much like the separation of salad dressing after sitting, oils and oily materials tend to rise to the top of water because they are naturally hydrophobic, or "water-fearing." Encapsulation allows hydrophobic materials to be dispersed in water and other hydrophilic, or "water-loving" liquids or solids. While this is often described as increasing the solubility, technically we have not changed the solubility of the material in question but rather have encapsulated it in a particle that is water-dispersible (See Fig. 1). The net result is the same, increased concentration of the hydrophobic material in water, but the mechanism is distinct. See future Technical Briefs for more information on other techniques used to enhance solubility. Sign up for ongoing Technical Brief updates here.

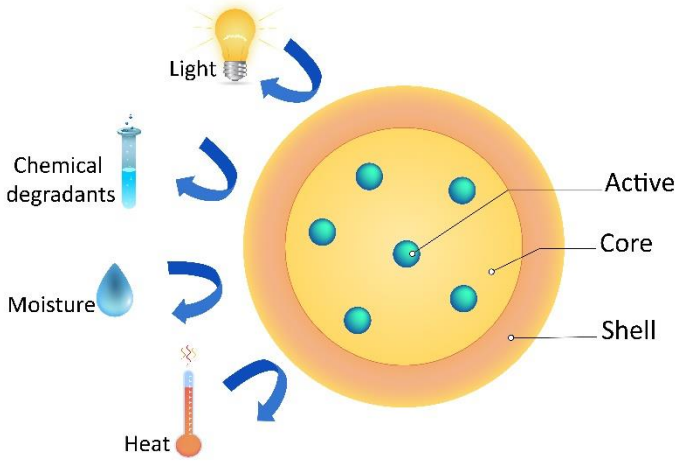
Fig. 1



Prevent degradation

Some sensitive active materials break down easily when they are not protected from the environment by encapsulation. Light, oxygen, pH, moisture from the air, and even metal ions that are in certain formulations can all degrade certain active materials, such as vitamins or plant-based functional ingredients like resveratrol. These materials can often be stabilized through encapsulation that separates them from their surroundings by blocking contact with the offending substance or condition (See Fig 2).

Fig. 2

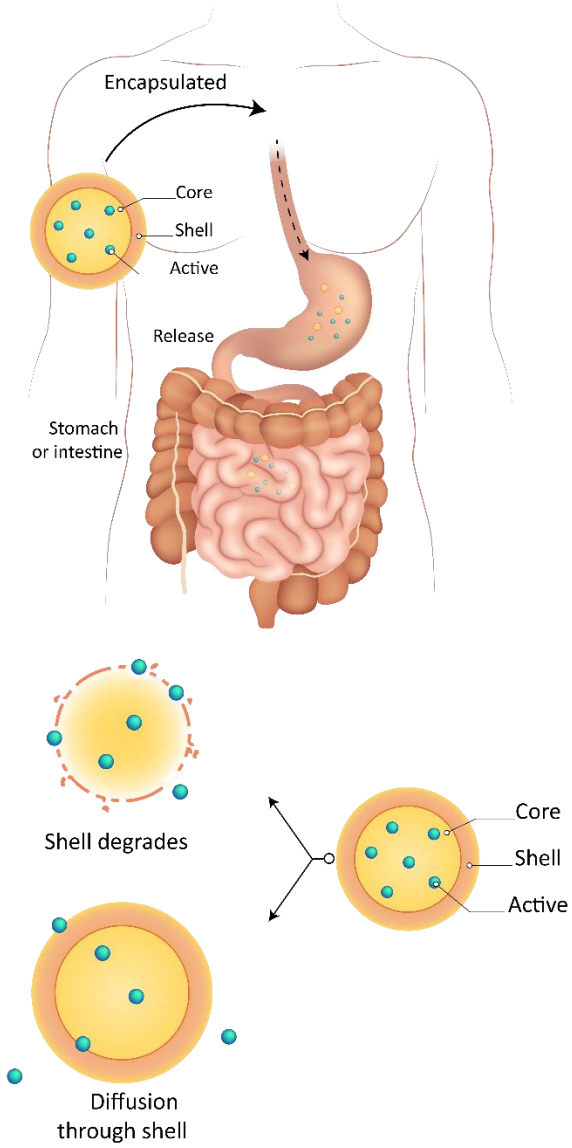


Control release

Controlling the release profile of an active material over time is another use of encapsulation technology. Typical controlled release systems allow active compounds to be delivered to the body over time in a way that provides the most beneficial interaction with the body. For example, extended-release systems allow patients to take pills once or twice a day rather than many times throughout the day, avoiding "spikes" in concentration in the body. Some encapsulated ingredients can even be delivered over the

course of weeks to months. Other systems in food or beverages allow for flavors or other beneficial compounds to be activated by certain "triggers" such as heating or chewing (See Fig 3).

Fig. 3

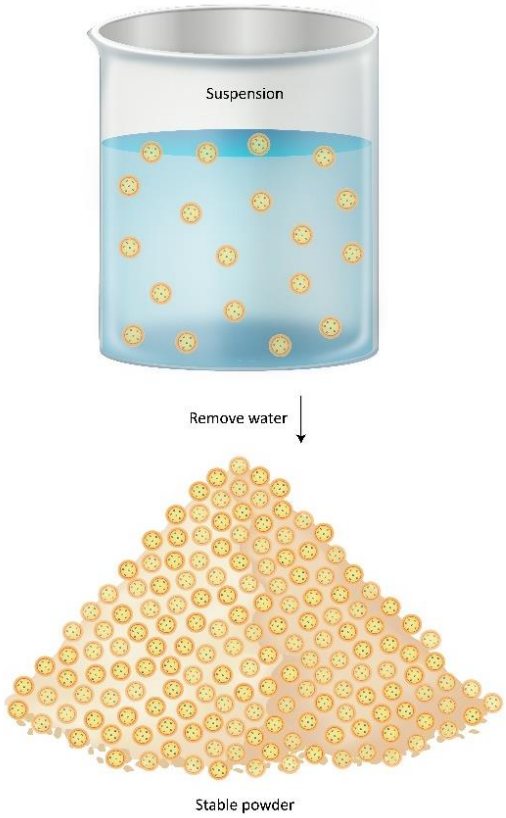


The precise way the shell regulates the release of the core varies from system to system but, generally speaking, there are two mechanisms. The first is where the shell degrades over time allowing the active core to escape. The second is where the shell acts like a membrane allowing the core material to diffuse through it. These two approaches, alone and in combination, allow for a tremendous variety of encapsulation systems and a huge range of release profiles.

Stabilize dried powder

Encapsulation of food products in tasteless matrices often allows for removal of water to create dry powders that are free-flowing and stable until they are resuspended in liquid. Water is removed for transport and storage, lowering shipping costs and loss from microbial spoilage. Drying can be achieved by spray-drying, lyophilization (freeze drying), or oven drying. These powders are designed to resuspend easily, such as sports drinks, baby formula, or hot cocoa in milk (See Fig 4).

Fig. 4

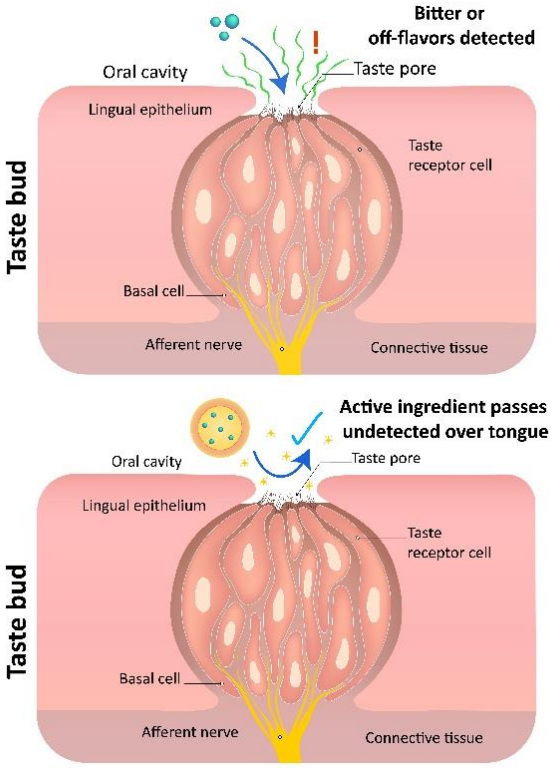


Improve flavor

Taste masking by encapsulation is used to help deliver bitter actives or those with undesirable flavors in beverages, foods, or medications. Carefully chosen encapsulation materials form a barrier that blocks the interaction with the taste buds, without reducing its beneficial properties in the body. This is often achieved using a "shell" material, such as a complex sugar, that will not dissolve on the tongue but will break down in the digestive tract. The final product formulation will typically also include desirable flavors that improve the experience

Fig. 5

of the consumer while the beneficial properties of the active are delivered in the body (See Fig 5).



Conclusion

Encapsulation systems are successful when they segregate active materials from their surroundings. The shell provides a barrier that keeps the "good stuff" (active) in and the "bad stuff" (degradants) out.

Additional functions are added by the encapsulant, such as controlled release of the encapsulated material over time. Effective use of encapsulation techniques can improve a product's performance and deliver more effective benefits to the consumer.

Encapsulation enables beneficial nutrients to become a more pleasant and convenient part of the consumer's day. They can also become part of a favorite beverage, such as tea, soda, sparkling water, or even an alcoholic beverage. By protecting sensitive nutrients from the elements and disguising off-flavors of actives, these ingredients can be formulated into complex beverages or even into beauty care products without losing their effectiveness.

Spoke Sciences has technologies that do just this – we solve the solubility problem. Please contact us if you would like to learn more.

Spoke Sciences is a technology development company comprised of industry veterans with decades of experience formulating complex pharmaceutical, personal care and food products.

We seek to deliver the most advanced functional products on the market. We can help solve your pain points around the solubility of plant-based materials.