

New Encapsulation Frontiers

The exploration of chemical microencapsulation could lead food producers to places thought to be unreachable if the methods could be creatively applied or adapted to the food industry.

by Ted Goodwin

Between busy schedules and hectic lifestyles, many people find they have little time to prepare healthy, good-tasting meals anymore. But, these types of meals are essential to maintaining the quality and pace of modern life. One of the current challenges for the food industry is to find ways to make healthy, easy-to-prepare meals that people actually want to eat. Microencapsulation is one technology that food producers have used to develop new or enhanced food products. Physical microencapsulation is the method that has typically been used, but its capabilities are limited. However, chemical microencapsulation, a technology not yet widely used in the food industry, has the potential

to create new opportunities for food scientists to explore.

Inside Microencapsulation

There are two types of microencapsulation: physical and chemical. Physical microencapsulation technology is not new and has been used in the food industry for many years. The physical microencapsulation process works by surrounding a core material made up of tiny particles or droplets with a coating. These microcapsules can be tiny, with the smallest ones being about 100 micrometers in diameter, about the width of the average human hair.

The value of microencapsulation technology rests in the fact that the capsules keep their payload separated from an outside environment until specific conditions occur. There are several possible release mechanisms including: physical rupture, chemical interaction, temperature increase or change in moisture levels. Experienced, innovative encapsulators collaborate with companies to create commercial solutions tailored to specific needs or applications.

Candy Capsules

To envision this technology more easily, think of a candy-coated chocolate as a microcapsule. In this case, chocolate (the core payload) is held inside the candy shell. To prevent getting chocolate all over your hands while eating it, the payload of chocolate is not released until you break the capsule of

candy with your teeth, or let the moisture in your mouth slowly dissolve it. This provides the best of both worlds: the taste of chocolate without the mess.

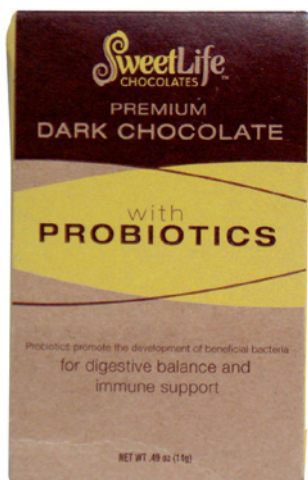
The fact that these candy “capsules” are designed to stay intact until a predetermined event occurs helps to ensure that the core payload remains separated from the outside environment until the desired release time. If the shell melted away too early the chocolate

payload would make a mess, but if it doesn’t break open and dissolve away in your mouth, then you wouldn’t be able to taste the chocolate. In this case, a properly functioning shell improves something that tastes good by making it easier to eat.

Current Uses

This general concept is applicable to food ingredients. Techniques like spray drying are used to increase shelf life

Source: Innova Market Insights



SweetLife Chocolates Premium Dark Chocolate with Probiotics (US) contains microencapsulated lactobacillus helveticus and R0052 bifidobacterium longum R0175.

in products like garlic and baking soda. The process involves encapsulating the ingredient, which prevents moisture and temperature from spoiling it, in a solid material that dissolves under the proper conditions, thereby releasing the payload.

Physical encapsulation makes it easier for food producers to package and handle ingredients like leavening agents used in retail cake mixes. Yeast is encapsulated within a solid, physical shell. The process of combining the encapsulated yeast with the other ingredients in the cake mix breaks the capsules, releases the yeast and allows it to become active.

Microcapsules might help food producers add important nutrients that have an unpleasant taste or odor, like omega 3 fatty acids, by masking their unpalatable qualities. Anyone who has tried pure cod liver or flax seed oil knows that it's tough to get past the unpleasant odor and taste that accompany them. However, these oils are rich in omega 3s, a nutrient essential for normal growth and good health. Physically microencapsulating some of these ingredients and adding them to foods that people eat every day, like juice or yogurt, helps mask their taste and smell.

The Drawbacks

While physical microencapsulation has done wonders for the food manufacturing industry, it is not without its shortcomings. Capsules created through this process sometimes release their payload too early. The microcapsule walls are rigid, and as a result they have a tendency to fracture if they are not handled or stored carefully. Also, the walls are somewhat permeable, meaning the payload can slowly seep out over time. Leaky capsules can cause unpleasant tastes and odors to spoil a product.

Maintaining uniform capsule size during the manufacturing process can be challenging,

so variation in particle size is inevitable. This variation can make homogenous distribution of active ingredients in the final product difficult to achieve. A dish containing microcapsules might have some larger particles that sink to the bottom of the mixture while other lighter ones rise to the top. This phenomenon occurs in products like cake mixes that rely on physically microencapsulated yeast. If the yeast is not evenly distributed, some areas of the mix might rise more than others during the baking process.

While the microcapsules are very small, they may not be small enough to go unnoticed. This could lead to an unpleas-

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ant experience in the form of noticeable grit while eating or drinking something with physically encapsulated particles.

Finally, there are some ingredients, like certain unpleasant-tasting vitamins or dietary lipids that food producers would like to microencapsulate but are not compatible with the physical encapsulation process. The incompatibility could be caused by the high temperatures required for the manufacturing process, which cause the ingredients to spoil, or because of the chemical composition of some ingredients. Chemical microencapsulation, which is a slightly different from the physical method, is a largely unexplored option for the food industry that holds great potential for addressing many of the limitations of physical microencapsulation.

Chemical Evolution

Chemical encapsulation was invented for one specific

purpose: to find an alternative to ink ribbons used inside cash registers. NCR scientists invented and patented the process and turned to Appleton to develop a workable microcapsular coating that led to the introduction of carbonless paper in 1954. The Appleton scientists who continued to work with microencapsulation technology recognized the potential for microencapsulation to extend to other applications beyond carbonless paper. However the ongoing growth and development of the carbonless paper industry kept those scientists focused on supporting Appleton's primary product for decades. More recently the scientists



Source: iStock

with expertise in chemical microencapsulation have begun to use their unique and extensive expertise in microencapsulation to develop specific and often proprietary product solutions in the consumer products industry. At Appleton, these efforts gave birth to Encapsys, a division within the company that uses a collaborative approach between our own scientists and partner companies to develop smart chemistry solutions.

Potential Advantages

Chemical microencapsulation functions in much the same way as physical microencapsulation, but some key differences could prove advantageous for the food industry. In chemical microcapsules, the particle walls are composed of polymerized materials. As a result, they are less permeable and more flexible than the walls of physically microencapsulated particles, making seepage and/or fracture

much less likely. Polymeric walls can also be made much thinner, with walls in chemically microencapsulated particles as low as 0.05 micrometers in thickness as compared to 50 micrometers for physically microencapsulated particles, while also achieving better results. Thinner walls also mean more payload in each particle, and chemically microencapsulated particles have the potential to be up to 95 percent payload as compared to a 50 percent maximum for physically microencapsulated particles.

Chemical microencapsulation also allows for greater control over the size of the particles being produced and can be performed at a lower temperature than physical microencapsulation. As a result, particles could be homogeneously distributed in food products, and some ingredients that could not be physically microencapsulated, because the high production temperatures would lead them to turn rancid, are better suited to the chemical microencapsulation process.

Knowing this, the potential advantages of using chemical microencapsulation in the food industry are apparent. Since chemical microcapsules are less likely to leak or break, they may be better for encapsulating ingredients that, if released early, cause food to become unpalatable or rancid. The smaller capsules could also significantly reduce, or even eliminate, the grit that is caused by physically microencapsulated particles, and would also allow for more homogenous distribution of particles in a finished product. Considering these potential advantages, the use of chemical microencapsulation in the food industry seems worth exploring.

New Frontiers

Chemical microencapsulation has the potential to do things that physical microencapsulation cannot, allowing food producers to include more ingredients desired by health-

conscious individuals in foods that people actually want to eat.

Many nutraceutical ingredients, like omega 3 fatty acids, various vitamins and fiber, are integral parts of our diet, but some people do not like to eat them because of their unpleasant smell and taste. Chemical microencapsulation might provide a way for these ingredients to be included in foods that people eat every day, while remaining unnoticed.

Chemical microencapsulation might also be used to lessen the negative perceptions sometimes associated with processed foods. Not only could more nutraceutical ingredients be included in these products, but the sensory experience could be improved as well. The inclusion of microcapsules that release odors when heated could make a microwaved meal smell like it had been prepared in mom's kitchen. Some ingredients that are added to food products lose their strength, flavor or potency over time. Food producers generally account for this degradation by adding larger quantities of a specific ingredient during production. Chemical microencapsulation of certain food ingredients might reduce or eliminate ingredient degradation, thereby enabling food producers to reduce the volume and, indirectly, the cost of those ingredients without affecting product taste or quality.

The exploration of chemical microencapsulation could lead food producers to places thought to be unreachable if the methods now used to enhance consumer products through microencapsulation could be creatively applied or adapted to the food industry. Through open innovation and collaboration between food producers and encapsulation companies, new processes could be developed to better meet the needs and desires of consumers.

Open Partnership

Open innovation has proven

to be an effective method for developing inventive solutions in an industry or manufacturing setting. At Encapsys, we have developed a strong, open partnership with Procter & Gamble to develop the best possible solutions for their product needs through the use of chemical microencapsulation.

Working closely with P&G, the Encapsys team has created microcapsules that are capable of performing as needed in P&G's products, helping to deliver a heightened consumer experi-

ence while also meeting their business needs. P&G provides the need for microencapsulation technology, and Encapsys delivers the solutions. This same approach, of manufacturers and microencapsulation companies working together to find unique solutions, could be extrapolated beyond the consumer products industry. The scientists that have knowledge and expertise on chemical microencapsulation are not food industry experts. As a result, they are not familiar with the needs and opportuni-

ties of the food production industry. Open innovation and collaboration between microencapsulation companies and food manufacturers could lead to new solutions for old problems or to product opportunities that were believed to be impossible. The only way to find and recognize these solutions and opportunities is through an open dialogue between collaborative partners. ♦

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