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Encapsulation protects feed additive efficacy

Encapsulation of feed additives is a technology used to protect active ingredients and ensure a consistent and effective product. It also can be used to control the release of feed additives during digestion.

By **EMMA WALL***

THERE are many feed additives on the market claiming to increase the production efficiency of agricultural animals.

Some of these products, however, are sensitive to changes in temperature, pH and other environmental influences that can cause a loss or a decrease in the activity of the feed additive.

Microencapsulation is a procedure whereby a liquid, gaseous or solid substance is packed into a tiny capsule.

This process can be used to protect feed additives because it serves as a shield from the outside environment by surrounding the active molecules with a sealed coating. In addition, this technology can be used to control the release of feed additives during digestion.

Microencapsulation is currently used on many feed additives, including amino acids, essential oils, vitamins and minerals. The types of materials used to encapsulate feed additives include sugars, gums, proteins and lipids (Gibbs et al., 1999).

Additionally, the capsule can be composed of the active ingredient surrounded by a protective coating, multiple protective coatings or simply a matrix composed of the active ingredient and the coating.

The matrix capsules are generally not as effective in protecting the feed additive from environmental factors.

What are the benefits of encapsulation, and why is it important for preserving the efficacy of many feed additives?

According to Putnam, Garrett and Kung (2003), some important reasons for encapsulating agricultural feed products are:

- Masking strong odors and flavors;
- Guaranteeing content (nutrients retained during processing and storage);
- Targeting delivery (different types of encapsulation optimize the release of active ingredients at specific sites of the digestive tract);
- Increasing bioavailability (a result of targeted delivery), and
- Improving performance (the response is more consistent and repeatable due to the consistency of the product).

Importantly, not all encapsulated products are created equally; consequently, there are vast differences in their efficacy and stability.

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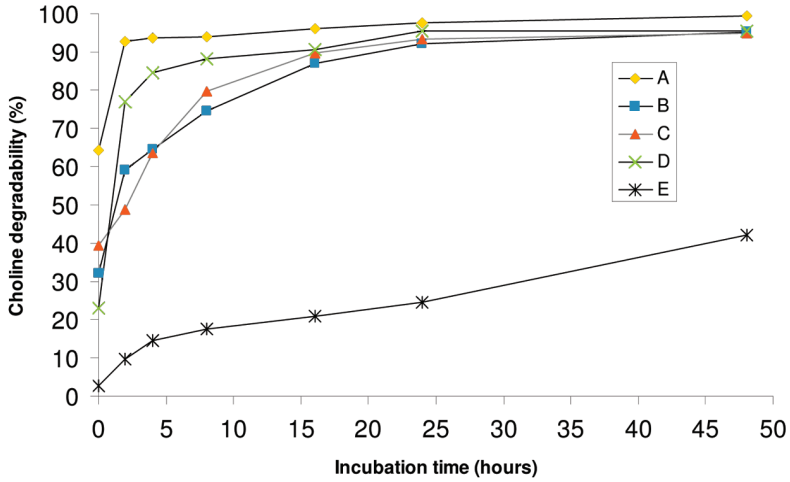
1. Comparison of choline stability across several commercially available, rumen-stable choline products (Elek and Husveth, 2007)



2. Concentration of active essential oils across different plant sources

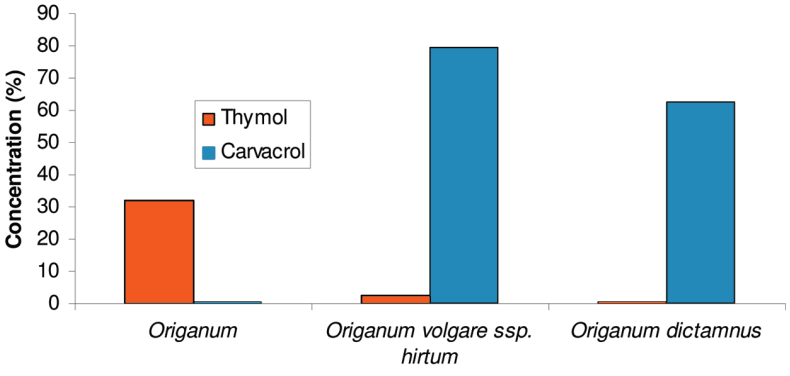


Figure 1 illustrates this problem. Elek and Husveth (2007) compared the ruminal stability of various commercially available rumen-stable choline products and found that four out of five products were at least 50% degraded after only two hours of incubation in the rumen.

Only one product remained intact in the rumen for 24 hours. Clearly, this product is more stable than the others and has a much higher chance of successfully delivering choline to the target organ — the small intestine.

This type of variation is really important to consider when deciding which choline product to use.

If choline is being supplemented to dairy cows, the product should not be degraded in the rumen so the maximum amount can be made available to the animal.

Although the Elek and Husveth experiment did not confirm release at the small intestine, they did show that there were large differences in rumen stability across several commercially available products.

Another important problem that can be solved by encapsulation is variation in the content of the product within a given batch, as well as product consistency across batches.

Specifically, it is important to be sure that you get what you pay for, that you know exactly how much of an additive you are feeding and that the amount of active ingredients does not vary within batches of the product or across different batches and won't change over time (it remains stable during storage).

This is a particularly important factor to consider when feeding essential oil additives. Even though essential oils have been shown to be effective at improving animal health and production efficiency, their activity is highly volatile because they are very sensitive to changes in temperature and pH.

Therefore, although rumen protection is not needed for essential oil products since their desired action is in the rumen, they do need to be encapsulated to ensure consistency, stability of the active ingredients and repeatable rumen release.

In addition, some essential oils have a strong odor or flavor that could influence feed intake. Importantly, the concentration of some essential oils must be fed within a very small range to be effective and consistent. In fact, for some essential oils, feeding too high of a concentration can result in a negative response.

Research has shown that not only is the concentration of essential oils important for obtaining a response, but so is the consistency with which the active ingredients are delivered to the gastrointestinal tract.

Feeding plant extracts as non-encapsulated blends tends to be highly variable and depends on the variety of the cultivated plant, the growing conditions and the processing methods.

Figure 2 was redrawn from Calsamiglia et al. (2007) and illustrates the effect of plant variety on the concentration of active essential oils in oregano.

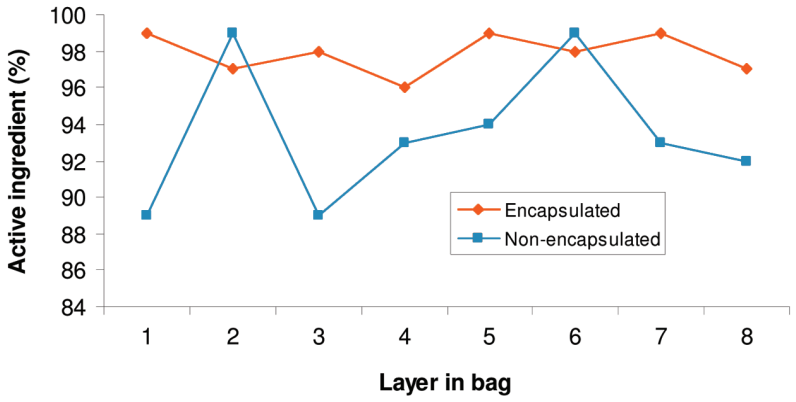
This issue with plant variety, along with the effects of environmental factors, has contributed to contradictory research findings reported in the literature. Thus, it is particularly important to keep this in mind when considering the use of commercial essential oil products and deciding which ones to try.

Figure 3 illustrates the volatility losses associated with a non-encapsulated essential oil blend versus an encapsulated blend. This variation in active components from the non-encapsulated blend demonstrates that there is no way to guarantee that each animal is getting the appropriate dose.

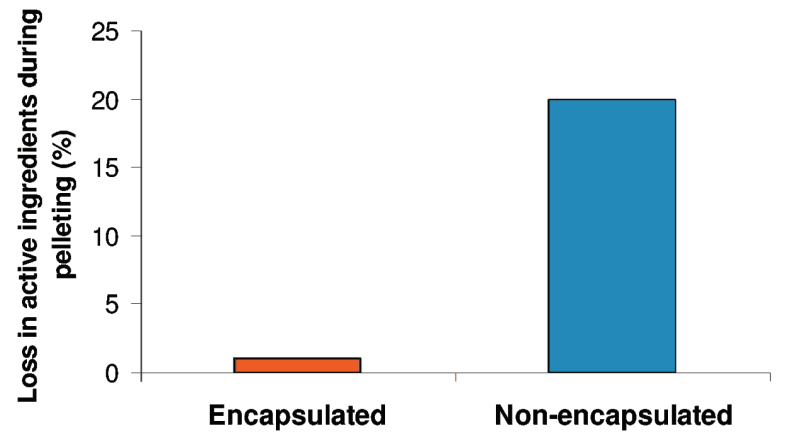
In addition to product variability, the active ingredients in essential oil products are highly volatile and, if they are not protected by encapsulation, will degrade over time during processing and storage. This will lead to decreased efficacy of the product over time, which will, of course, decrease the response of the animal to the additive.

Figure 4 shows data taken from an experiment measuring the loss of active ingredients in an essential oil feed product in both an encapsulated and non-encapsulated form. The loss in active ingredients took place in fewer than 10 minutes, so it is probable that this number would increase during longer processing times.

3. Concentration of active ingredients in different layers of a bag of essential oil feed additives (Pancosma, 2000)



4. Loss of active ingredients during pelleting of encapsulated and non-encapsulated essential oil feed additives (Pancosma, 2009)



Summary

Encapsulation of feed additives is a technology used to protect active ingredients and ensure a consistent and effective product.

Make sure to ask for documentation showing the effect of encapsulation on the feed additive in question. Look for data that clearly illustrate that the

active ingredients are protected from degradation during processing and storage, in the rumen (if applicable) and during any other changes in the environment that might alter their efficacy.

Data should also be requested that show the response of animals to the product, which should be consistent and repeatable across multiple experiments.

References

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