Enzyme thermo-stability can be compatible with bioavailability

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Bioavailability and thermostability are two key attributes that characterize high-quality commercial feed enzymes. These sophisticated additives are natural proteins with very high efficiency (bioavailability), but before they reach the animal gut, where they exert their beneficial actions, they must remain protected against high temperatures (and humidity) as encountered so frequently throughout the feed manufacturing process. Technological advances have enabled the use of suitable protective coatings that easily dissolve when the enzyme product reaches the animal's gut.

Understanding thermostability

In general, enzymes produced from microorganisms are more stable than enzymes produced from plants and animals. Most thermostable enzymes are derived from thermophile microorganisms that grow at high temperatures (above 55°C). Notable exceptions are a few thermostable enzymes identified in organisms growing at lower temperatures (for example, amylase from Bacillus licheniformis).

Commercial applications

In the animal feed industry, enzymes can be added to the feed through a premix together with vitamins and other additives, through a separate enzyme premix in combination with other selected feed enzymes, or as a liquid application after pelleting. The most convenient and effective way to use feed enzymes is generally in the dry but protected form. The challenge for most enzymes in an un-protected state starts when enzymes are exposed simultaneously to high moisture and high temperature. Today, in many modern feed mills, processing temperatures typically exceed 80°C for periods of time ranging from only a few seconds to several minutes. When moisture is added into the equation it creates a very challenging environment.

How a thermostable enzyme is formulated

The formulation process for dry feed enzymes. It can be a simple mixture of the enzyme with carriers that offer little or no protection, up to quite complicated enzyme formulations that have a protective coating. For example, DSM's enzymes are available in a granulated and thermostable form (the so-called Coated Thermostable granulates–CT granulates) that provides state-of-the-art protection under commercial conditions, whilst it enables for a virtually dust-free (and thus, safe for workers) environment, and an easy-flowing application. Within the CT granulates, the enzymes are enclosed in the inner core (the central part of the granule), where the enzyme is kept in its three-dimensional form stabilized against heat and moisture in a matrix of minerals and carbohydrates. A protective layer of vegetable oil, kaolin, and calcium carbonate covers this inner core. These layers offer heat resistance during feed manufacturing and storage, but upon ingestion, they are readily degraded, releasing the enzyme. This advanced granulate form also permits long-term storage with virtually no change in enzyme activity even inside premixes containing aggressive ingredients such as choline.

Thermostability does not affect bioavailability

Today, with modern methods such as those employed in the manufacturing of DSM's CT granulated enzymes, products can be highly resistant without the fear of sacrificing bioavailability.

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