



USE OF NANOTECHNOLOGY IN EQUINE NUTRITION

by Kathleen Crandell, Ph.D.

Have you ever reached for a nutritional supplement and found the prefix “nano-” in the description or ingredient list? Did you wonder what it meant and whether it conferred a true nutritional advantage? As it turns out, nanotechnology provides great benefits, primary of which involves increased bioavailability.

Nanotechnology refers to the branch of science devoted to manipulating atoms and molecules at nanoscale, that is, having one or more dimensions of the order of 100 nanometers or 100 millionth of a millimeter or less.

Wait, exactly how small is a nanometer?

The prefix “nano” means one-billionth, according to the International System of Units, so one nanometer is one-billionth of a meter. Can’t wrap your head around it?

Here are some everyday examples, compliments of the National Nanotechnology Initiative: a sheet of paper is about 100,000 nanometers thick; there are just over 25 million nanometers in one inch; a single human hair is about 100,000 nanometers wide. Another

comparison from the same group is equally eye-opening: a sphere with a diameter of one nanometer is to a softball as a softball is to Earth.¹

Describing a nanometer as “teeny” is an understatement.

Let’s get back to feeding horses. Why is nanotechnology of interest to veterinarians, nutritionists and horse owners?

Many natural nanoparticles exist, including amino acids, antibodies, even some carbohydrates. These nanoparticles often combine to form larger functional molecules, such as hormones and proteins. Other nanoparticles are synthetic. Whether natural or synthetic, nanoparticles have larger surface areas than their normal-sized counterparts, potentially increasing the amount of a nutrient that can be absorbed by the horse. One scientific review uses coffee grounds as a relatable example: coarse-ground coffee beans yield a different cup of coffee than fine-ground beans.²

Aside from the potential for increased nutrient absorption, other significant benefits of

nanotechnology include the preservation of nutrients and extension of shelf life.³ Simply put, some compounds are inherently unstable and break down rather quickly, but nanotechnology encapsulates the compounds to protect and preserve their viability.

One example of nanotechnology is called nanoencapsulation, described as the incorporation of ingredients into small vesicles or walled materials. Materials used for encapsulation offer several advantages, such as conduits for delivery of fat-soluble ingredients, protection from degradation in the gastrointestinal tract, controlled site-specific release, and greater absorption.

In practical, everyday terms, nanotechnology serves to deliver concentrated nutrients to the horse in a way that is easy to administer to and be absorbed by the horse. It’s exciting technology that puts the companies that use it at the forefront of equine nutrition.

Can you give an example of nanotechnology in equine nutrition?

Vitamin E functions primarily as an antioxidant, an agent that keeps

free radicals from forming and potentially weakening cells and tissues. In addition to its antioxidant responsibilities, vitamin E is vital to immune, cardiovascular, circulatory, neuromuscular, and reproductive health. Many horses derive sufficient vitamin E from consumption of growing pasture throughout much of the year. Supplementation with an effective vitamin E supplement is, however, recommended for all horses that do not consume a significant quantity of green pasture, especially horses that satisfy their forage requirements through hay and hay products (cubes and pellets, for example).

One prominent equine supplement company uses nanotechnology to encapsulate natural vitamin E. Because of its oily nature, vitamin E is hydrophobic (water-shunning). To overcome this, researchers use proprietary technology to encapsulate each nanoparticle with a hydrophilic (water-loving) outer layer. The hydrophilic outer layer allows the nanoparticles to be rapidly and evenly distributed in water-based environments such as the gastrointestinal tract.

The greatest benefit of this unique delivery system is an increase in the bioavailability of vitamin E. Extensive studies in horses have shown that nanoencapsulated natural vitamin E is more bioavailable than all synthetic forms of vitamin E and other forms of natural vitamin E, including natural acetate and natural alcohol formulations. The more vitamin E that is absorbed into the bloodstream, the more available it is for use as a body-wide antioxidant essential for tissue repair and for its essential roles in various body systems.

Do you have another example?

Coenzyme Q10, known also as ubiquinone, is involved in numerous reactions in the body, primarily the production of energy, and is found in highest concentrations in

mitochondria, where its function is to carry protons and electrons, a critical component in the generation of adenosine triphosphate (ATP). ATP is the main energy currency used by all cells, including muscle cells. Coenzyme Q10 is also found in cell membranes, where it boosts cell integrity.

Further, coenzyme Q10 is a powerful antioxidant, protecting cells from free radicals that can damage cells and their DNA. Besides providing direct antioxidant protection, it also improves the antioxidant potential of other antioxidants in the body, like vitamins C and E. Coenzyme Q10 increases the production of other antioxidants that help to mitigate cellular damage, improve blood flow, and protect blood vessels.⁴

One high-quality source of coenzyme Q10 for horses features nanotechnology that allows the fat-soluble coenzyme Q10 to be soluble in water. An early study in horses reported that the concentration of coenzyme Q10 in blood serum is lower compared to humans and some other species, and that supplementation increases the concentration in serum.⁵

Michigan State University reported that supplementing this form of coenzyme Q10 plus N-acetylcysteine resulted in an increase in the antioxidant glutathione in intensely exercised Thoroughbreds, which may support muscle recovery after exercise.⁶ Additional research suggested that coenzyme Q10 facilitates energy production in the mitochondria, supporting overall exercise tolerance and endurance.⁷

Are the descriptors “nanoencapsulated” and “water-soluble” the same?

No, not all water-soluble products use nanotechnology. As mentioned earlier, nanotechnology can be used to make fat-soluble molecules water-soluble, but it is not limited to this use.

Using minuscule particles to increase targeted nutrient absorption maximizes nutritional benefits to horses.

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Kathleen Crandell, Ph.D., received her master's degree in equine nutrition and exercise physiology in 1990 and her doctorate degree in 1996 in equine nutrition and reproduction from Virginia Tech. Her master's research focused on the effects of added dietary fat in exercising young horses, and her doctorate work centered on vitamin A depletion and supplementation in broodmares and growing horses. Since then, she has worked extensively in the equine feed and supplement industry and has served as a nutritional consultant for leading equine supplement companies. In addition to these responsibilities, Crandell has been an invited speaker at many conferences on topics of equine nutrition in the U.S. and around the world.

