

A Nutritive Supplement

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In order to treat these gastric and colonic ulcers in horses, the author devised a feed supplement to target each aspect of the problem. The hope was to create a digestive conditioning program that would normalize conditions in the GI tract while still allowing horses to be rigorously trained.

This feed supplement was subsequently tested on 80 horses in Ohio. The key ingredients of this patent-pending formula include:

Polar Lipids

Lipids represent a large class of molecules that include fatty acids, phospholipids (lecithin), galactolipids and triglycerides. They play a key role in the structure and function of cellular membranes and are found in much of the plant material already in equine diets. As a consequence of their ubiquity, lecithins and lipids are considered to be a GRAS (generally regarded as safe) supplement.

Oat oil is rich in polar lipids, particularly galactolipids. These are rare in animals, but are the most common lipids in plants as well as the most abundant form of lipids on the planet. Animals generally lack the enzymes needed to synthesize these polyunsaturated polar lipids, and so they must acquire them in the diet. These dietary polar lipids are important in forming the tight junctions between the epithelial cells lining the gut. Cells connected in this fashion present a unified barrier against digestive juices, toxins and pathogens. When these junctions are disrupted, the defensive wall is breached, and injury in the form of an ulcer may result. Adding polar lipids to the diet has been shown to protect the intestinal mucosa and to strengthen the impermeability of the barrier.^{1 2 3}

Lipids are also essential components of the myelinating oligodendrocytes in the brain and have been found to be important in the maintenance of neuronal organization and function.⁴

As well as galactolipids, oat oil is rich in trienols and tocopherols, powerful anti-oxidants that sweep free radicals out of the system before they can damage the surrounding tissue.

Polar lipids are versatile emulsifiers, stabilizing oil-water mixtures. They provide an ideal nutrient delivery vehicle, capable of ferrying both fat- and water-soluble molecules into the tissues. Fat-soluble nutrients include vitamins A, K, D and E. Polar lipids, especially galactolipids, have been shown to increase bio-availability of such nutrients by up to 500%.

After transporting their nutritive load, polar lipids are readily absorbed in the gut (after digestion by bile salts), where they supply extra energy to the horse.⁵

Beta-glucan

Beta-glucan is a polysaccharide derived from yeast, barley and oats that has several profound effects on typical animal systems. It has been known for years to reduce LDL cholesterol levels in the blood.^{6 7} More significantly, it moderates the release of sugars from the digestive system, helping to prevent the sugar highs and lows that often afflict animals that are fed only two or three times a day on an energy-rich high carbohydrate diet.⁸ Studies have shown that beta-glucan is effective in reducing post-prandial glycemic peaks by up to 50%.⁹

Although more equine studies are needed, research has implicated bacteria in the formation of ulcers in many animals. It has been difficult to culture bacteria from horse stomachs, but colonic bacteria are known to include a wide variety of pathogenic species. Beta-glucan serves an important role here as the most potent known stimulator of the immune system. It arouses macrophages, which have a specific beta-glucan receptor, to mount a full-blown immune system response to pathogenic microbes and helping to heal damaged tissue.^{10 11 12}

Beta-glucan also creates a gel, slowing the transit of digesta through the gut and allowing starches to be digested earlier in the system, thereby reducing the negative effects of starch in the hind gut.^{13 14}

Glutamine

Glutamine is the most abundant amino acid in humans as well as horses. Glutamine deficits can result in diarrhea, villous atrophy, mucosal ulceration, increased intestinal permeability and necrosis.¹⁵

Glutamine is a muscle fuel and also supplies nitrogen to the immune cells of the intestinal mucosa, which help to prevent pathogenic organisms from entering the circulatory system. Glutamine is considered to be a nonessential amino acid under normal conditions, because the body can create as much as is needed from scratch. But when the digestive system is stressed – for instance by ulcers or malnutrition – large amounts of glutamine are consumed, and supplements may be needed to replenish the supply.^{16 17}

Threonine

Threonine is an essential amino acid and an important component of the mucin produced by the goblet cells distributed throughout the intestinal tract. By assisting metabolism and nutrient absorption, threonine contributes to a smoothly functioning GI tract. A deficiency of threonine slows the regeneration of the gut wall and depresses the production of mucus.^{18 19}

Threonine is especially useful for wound healing and for treating stress, but it is also an essential link in the production of immunoglobulins.²⁰

Nucleotides

Although the GI tract is covered in mucus, the acids and enzymes nevertheless take a toll on the enterocytes lining the gut wall. The cells there are constantly dividing, ultimately managing to totally replace the intestinal lining about every three days.

This continuous cell division requires the replication of millions of DNA molecules every second. In turn, each DNA molecule is made up of several billion nucleotides. This represents an impressive amount of energy-intensive chemical synthesis. Clearly, maintaining an adequate level of nucleotides is a major, ongoing problem for the digestive system.

In general, DNA is synthesized through a complicated pathway that creates fresh nucleotides de novo. However, in the presence of pre-made nucleotides, the body can down-regulate this synthesis and instead use an enzyme named HGPRT to scavenge the intact nucleotides, improving the efficiency of cell repair.

In addition to simple maintenance, cell division is also critical for the repair of damaged tissue, including ulcers. DNA synthesis is thus a limiting factor in the healing process as well.

In times of stress, certain cells of the digestive system – including the mucus-producing goblet cells – are incapable of meeting the increased demand for nucleotides. Under these conditions, nucleotide supplements in the diet have been proven to be beneficial. Studies have shown that nucleotide supplements increase mucosal thickness and protein levels as well as speeding up intestinal recovery after chronic diarrhea and intestinal damage.²¹

Nucleotide supplements have been shown to increase the maturity and growth of normal enterocytes while reducing their dependence on exogenous glutamine.²² The mechanism for this is not totally understood, but for intestinal villi to grow, stem cells in the crypts must divide and push their way up the length of the villi.²³ Exogenous DNA may enhance this process, perhaps explaining the extra crypt depth and increased surface area noted with nucleotide supplements.

Dietary nucleotides also seem to have an important beneficial effect on the intestinal microflora, stimulating the growth of beneficial bacteria and inhibiting pathogens. This may be due to yet another effect of dietary nucleotides reported in a NASA study and elsewhere: stimulation of the immune system.^{24 25} In particular, lymphocytes and erythrocytes are not able to synthesize the purine-based nucleotides at all. For these cells, available nucleotides are essential to proper functioning.

Mannan Oligosaccharides

Extracts of yeast (*saccharomyces cerevisiae*) have been found to bind pathogens,²⁶ perhaps because their mannan oligosaccharide (MOS) content mimics the carbohydrates in the enterocyte membranes. Pathogens are fooled into binding with MOS instead of the enterocytes, and are subsequently flushed out of the digestive system. Along with the pathogens go the toxins they would have produced.²⁷

MOS can be digested by the enzymes of certain beneficial bacteria. So, in addition to discouraging pathogenic bacteria, MOS also promotes the growth of beneficial microbes such as *lactobacillus*.

MOS also stimulates the immune system²⁸ and encourages the growth of intestinal villi, showing improved digestion and absorption of nutrients in various animal studies.^{29 30} Mannans are also on the GRAS list.

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