KER®
Targeted Nutrition

TECHNICAL REVIEW SHEET

EO-3™

Source of omega-3 fatty acids DHA and EPA

EO-3™ is a rich source of the long-chain omega-3 fatty acids docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) in a palatable liquid form. EO-3 can be fed to all classes of horses, including foals, breeding stock, and performance horses, to improve the critical ratio of omega-3 to omega-6 in the diet, provide preferential precursors for production of local hormones, and regulate gene expression to positively affect insulin sensitivity.

Supplementation with DHA and EPA is beneficial for:

- Metabolic function
- Inflammatory response
- Cardiovascular function
- Immune function
- Fertility of mares and stallions

Features and Benefits

- Features a highly refined formula for improved stability, clarity, and deodorization with a minty-apple flavor for enhanced palatability
- Provides a safe, environmentally friendly source of DHA and EPA from a sustainable species of fish renowned for the absence of heavy metal accumulation due to its position at the bottom of the food chain
- Increases circulating levels of DHA and EPA, as well as levels within red blood cells, more effectively than plant-based sources of omega-3s
- Direct supplementation with DHA and EPA avoids competition with omega-6 fatty acids and rate-limiting enzymatic processes, enabling more efficient production and use of less inflammatory forms of local hormones

Feeding Recommendations

Top-dress 1 ounce (30 mL) per day on feed for 1,100-lb (500-kg) horses and 1/2 ounce (15 mL) per day for ponies. For best results, introduce EO-3 to the ration gradually over a period of 5-10 days.

Servings and Container Sizes

Serving Size

1-2 oz (30-60 mL)

Container Sizes

32 oz (32 servings)

1 gallon (128 servings)

5 gallon (640 servings)

Typical Analysis

Nutrient	per 1 oz (30 mL)
Crude Fat	98.0%
Eicosapentaenoic Acid (EPA)	3,200 mg
Docosapentaenoic Acid (DPA)	500 mg
Docosahexaenoic Acid (DHA)	2,300 mg
Total Omega-3 Fatty Acids	6,000 mg
Omega-3:Omega-6 Ratio	8:1

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Developed by:
Kentucky Equine Research®
World Leaders In Equine Nutrition

Now that the advantages of fat are accepted almost universally by horsemen, scientists are delving deeper into how certain fats help horses. Researchers have focused their attention on two distinct families of long-chain polyunsaturated fatty acids (PUFAs): the omega-3 family and the omega-6 family. The omega-3 family stems from alpha-linolenic acid (ALA), and the omega-6 family originates from linoleic acid (LA), both of which are considered "essential fatty acids" because they are instrumental in the life cycle, yet they cannot be manufactured in the body and must be obtained from dietary sources.

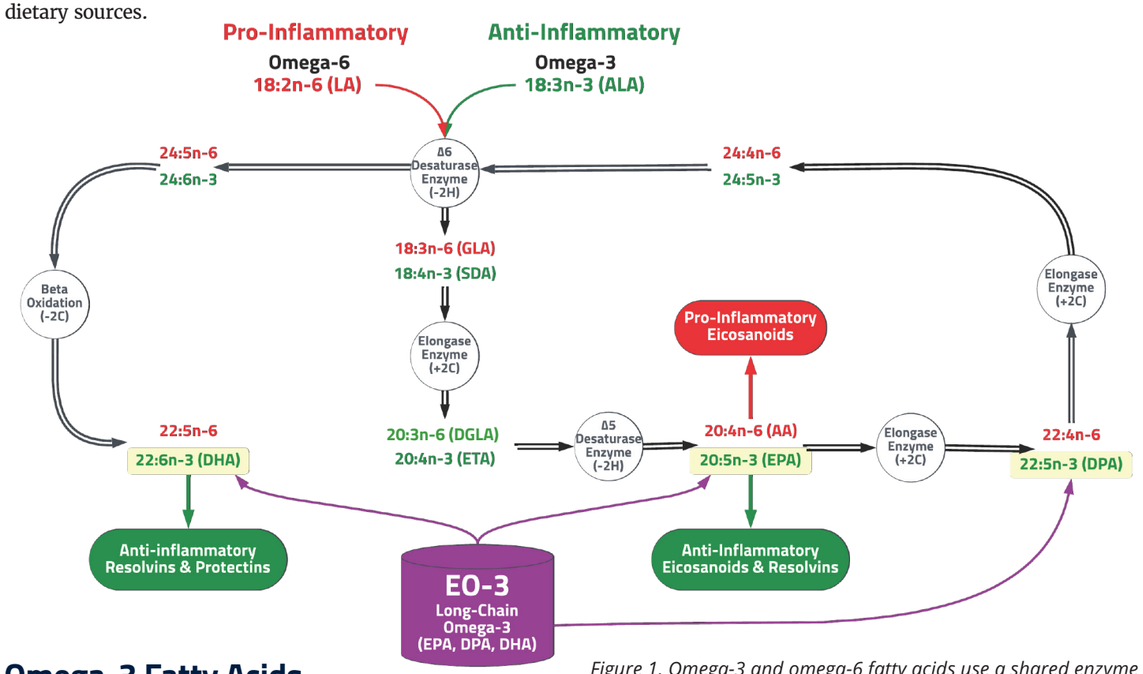


Figure 1. Omega-3 and omega-6 fatty acids use a shared enzyme pathway to produce the respective inflammation-resolving or pro-inflammatory end products. The Δ6 Desaturase enzyme serves as a rate-limiting step as it is used twice. Excess LA negatively inhibits elongation and conversion of ALA due to competition for multiple enzymes. Supplying DHA and EPA substrates directly bypasses this rate-limiting enzyme competition.

Omega-3 Fatty Acids

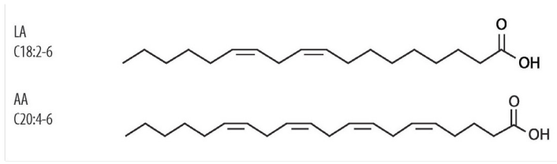
The term omega-3 references the location of the first double bond positioned three carbon atoms from the terminal end of the fatty acid chain. The omega-3 family stems from alpha-linolenic acid (ALA), found predominantly in leafy plants and flaxseed (linseed), which contains 18 carbon atoms.

DHA and EPA are long-chain omega-3 fatty acids that are 22 and 20 carbons long, respectively. DHA and EPA are found almost exclusively in fish, namely cold-water species at the top of a food chain based largely on algae that manufacture DHA and EPA.

Omega-3 fatty acids are transformed into various "anti-inflammatory" compounds through an enzymatic pathway shared with the omega-6 fatty acids (Figure 1).

Omega-6 Fatty Acids

The primary source of omega-6 fatty acids in the diet is linoleic acid (LA), which is derived from the oils of seeds and grains. Corn, sunflower, and safflower oils contain abundant quantities of LA. LA serves as a precursor for arachidonic acid (AA), which is an intermediate in the formation of various "pro-inflammatory" cytokines and eicosanoids (Figure 1).



The Omega-3 to Omega-6 Ratio: A Balancing Act

Omega-3 and omega-6 fatty acids must be balanced within the body in order for both to be effective. The significant biological difference between omega-3 fatty acids and omega-6 fatty acids is related to their roles as precursors of inflammatory and immune intermediaries. For example, each fatty acid is necessary for the production and distribution of prostaglandins. The prostaglandins that evolve from consumption of omega-3 and omega-6 fatty acids have different effects on inflammation processes in the body.

The inflammatory response from cytokines and prostaglandins that originate from the omega-3 fatty acids DHA and EPA is moderate compared to the response from cytokines and prostaglandins derived from omega-6 fatty acids, which are considered "pro-inflammatory" by comparison. While scientists have not pinpointed the optimal ratio of omega-3 fatty acids to omega-6 fatty acids for horses, most believe a ratio of 2 to 4:1 may be optimal.

Feedstuffs have varying levels of omega-3 and omega-6 fatty acids. The natural diet of horses—primarily fresh and dried forages—contains more omega-3 fatty acids than diets consisting of a mixture of forage and cereal grains. Grains possess more omega-6 fatty acids than forage. Studies have shown that pasture-fed horses have higher levels of plasma omega-3 and lower omega-6 compared to grain-fed horses.

Corn oil, historically the most popular fat supplement offered to horses, as well as safflower oil, canola oil, and sunflower oil, is rich in omega-6 fatty acids. Feeding one or more of these, especially in combination with a high-grain diet, supplies an excess of omega-6 fatty acids (LA) and the pro-inflammatory pathway prevails, contributing to an overabundance of pro-inflammatory compounds.

Once this happens, it's impossible to correct the imbalance by simply providing greater intake of omega-3 fatty acids from ALA. Studies have shown that ALA is very poorly converted to DHA or EPA, and supplementation with ALA, such as from flax meal or oil, does not result in increases in DHA and EPA.

Therefore, direct supplementation of DHA and EPA is required in order to offset the imbalance, circumvent the competition for enzymes, and support the production of the less-inflammatory compounds if restoration of hormonal balance and physiological benefits are desired.

The Benefits of Omega-3 Fatty Acids

Over the last few decades, many studies have been undertaken to investigate the potential benefits of supplementation with omega-3 fatty acids.

These studies indicate that omega-3 fatty acids, particularly the long-chain PUFAs DHA and EPA, play important roles within the body which confer a wide range of benefits to the horse. However, researchers have consistently found that these benefits depend on direct supplementation of DHA and EPA, since ALA supplementation does not elicit the same response.

Reduced inflammatory response. Of particular interest is the reduction of inflammatory response linked to omega-3 fatty acids. This has implications for horses affected by numerous inflammatory conditions such as those affecting joints, like osteoarthritis and developmental orthopedic disease, as well as respiratory conditions (inflammatory airway disease, recurrent airway obstruction, asthma), allergic reactivity, laminitis, and skin conditions like pruritis (itchiness).

Performance. Performance horses are the perfect candidates for supplementation of omega-3 fatty acids since they typically consume diets containing too many omega-6 fatty acids. Scientists studying the effects of a combined dose of DHA and EPA on reducing signs of exercise-induced pulmonary hemorrhage (EIPH) and pulmonary inflammation found fewer red blood cells and higher levels of interleukin 10, a cytokine with potent anti-inflammatory properties that prevents tissue damage during exercise, as well as fewer eosinophils, indicating less airway inflammation in post-exercise samples collected from the lungs of supplemented horses.

Metabolism. Insulin resistance and glucose tolerance are significant concerns in horses with metabolic disease and obesity. Studies at Kentucky Equine Research demonstrated that insulin resistance can be induced by feeding high-fat diets and that supplementation with a marine-derived oil rich in DHA and EPA improved glucose clearance, reversing the dietary effect. Research indicates that supplementation with long-chain omega-3 fatty acids can be beneficial for horses faced with metabolic challenges, including positively altering insulin response.

EO-3 supplies the long-chain omega-3 fatty acids DHA and EPA, compounds with positive effects on reproduction, bone development, and numerous inflammatory conditions in horses.

The Benefits of Omega-3 Fatty Acids (cont.)

Reproduction. Reproductive advantages of omega-3 fatty acids are abundant. Stallions supplemented with EPA and DHA showed a significant boost in the number of normally shaped sperm, increased concentration of spermatozoa in the semen, as well as positive effects on sperm viability and motility and cold tolerance, with subfertile stallions deriving greater benefit. Supplementation of broodmares with DHA and EPA benefits both the developing fetus and suckling foal since DHA and EPA are provided by the mare first via the placenta, then from the mare's colostrum and milk. Broodmares on diets high in omega-3 fatty acids may produce richer colostrum and their foals seemed to have a stronger immune system. Supplemental marine-derived omega-3 fatty acids have been shown to decrease the occurrence of postmating-induced endometritis (PMIE), particularly in mares bred with frozen semen, and is recommended to improve follicular growth, positively influence hormone concentrations, reduce the risk of placentitis, improve endometrial scores, and expedite post-foaling uterine involution in mares.

Polyunsaturated Fatty Acid Composition of Commonly Used Oils

Oil Type	Omega-3 Concentration	Omega-3:Omega-6	Predominant Omega-3 Source
EO-3	35%	12	EPA and DHA
Flax Oil	54%	4.15	ALA
Soy Oil	7%	0.14	ALA
Rice Bran Oil	1%	0.03	ALA
Corn Oil	1%	0.02	ALA

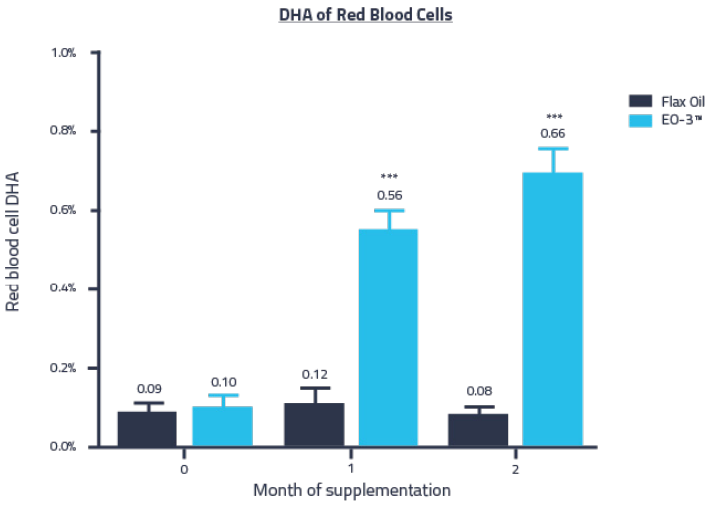
EO-3: Preferential Source for Omega-3 Fatty Acid Supplementation

Only marine-derived oils are direct sources of EPA and DHA. EO-3 is a stabilized and flavored marine-derived oil that is a direct source of DHA and EPA. With the highest percentage of long-chain omega-3 fatty acids as well as the highest ratio of omega-3 to omega-6 fatty acids when compared to other commonly fed oils, EO-3 is the most potent, effective source of long-chain omega-3 fatty acids available.

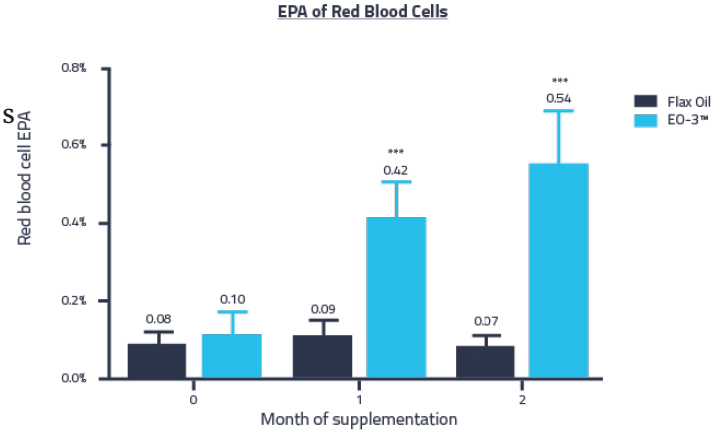
Horses supplemented with EO-3 benefit from an increase in blood plasma, synovial fluid, and lung surfactant concentration of essential omega-3 fatty acids as well as increased incorporation into phospholipid membranes of cells such as red blood cells.

The consumption of EPA and DHA from a source such as EO-3 is the only way to ensure that these fatty acids are available for production of the "less-inflammatory" compounds and other metabolites beneficial for the horse's overall health and well-being.

While palatability is often a concern when feeding marine-derived oils, studies have shown EO-3 to be highly palatable. EO-3 undergoes advanced refining that removes odor-causing compounds and improves stability and features a proprietary minty-apple flavor developed by Kentucky Equine Research. These advances in processing and flavor deliver superior palatability.



Red blood cell DHA following supplementation with EO-3.



Red blood cell EPA following supplementation with EO-3.