Diet, Health and Supporting Healthy Inflammation

Tara Hembrooke, MS, PhD, and Sina Wallace, PhD, University of California, Davis

At the cellular level, metabolites of omega-3 fatty acids enact low- or anti-inflammatory events. In contrast, metabolites of omega-6 fatty acids have strong pro-inflammatory effects. While horses in the wild consume up to five times as many omega-3 fatty acids as omega-6 fatty acids,[1] many of today's grains and complete feeds contain far fewer omega-3 and significantly more omega-6 fatty acids (Table 1). This dietary imbalance may predispose the horse to excessive inflammation, which has been implicated in a whole host of conditions such as joint disease,[2,3] pulmonary disorders,[3-6] laminitis,[7,8] colic of various etiologies,[9] colitis,[10] and chronic skin allergic cases.[11] Flax and algae are natural, plant-based sources of omega-3 fatty acids, specifically α-linolenic acid and docosahexaenoic acid (DHA), respectively, both of which have potent inflammatory-modulating benefits.[12,13] More recently, technological advances have made available a vegetarian-sourced eicosapentaenoic acid (EPA), another significant inflammatory-mediating omega-3 fatty acid.[13]

Multiple trials conducted by researchers at the University of California at Davis and Alamo Pintado Equine Medical Center have demonstrated modifications to the ratio of red blood cell membrane omega-3 and omega-6 fatty acids from horses supplemented with a commercially-available product containing flax and algal DHA* versus either non-supplemented, baseline data or non-supplemented control horses. One study showed that supplementation increased total omega-3 fatty acids in the red blood cell membranes by over 70% (Figure 1), inducing a 40% decrease in the ratio of omega-6 to omega-3 fatty acids. Another study reported a significant increase in alpha-linolenic acid and total omega-3 fatty acids in red blood cell membranes of supplemented horses when compared to non-supplemented controls on the same hay-based diet (Figure 2).

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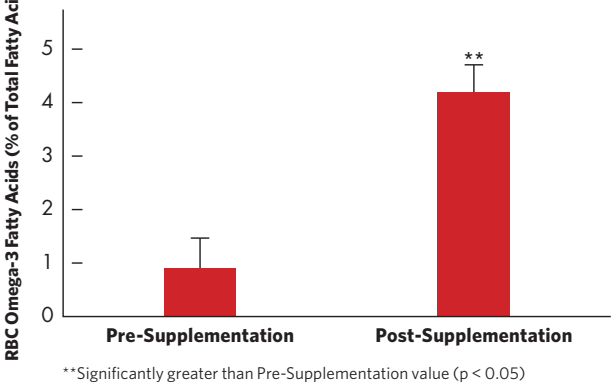
Table 1. **Fatty Acid Ratios in Commercially-Available Supplement* Compared to Common Feedstuffs**

Feedstuff	Omega-3 : Omega-6 ratio
Grass	1 : 0.2
Supplement*	1 : 0.5
Equine Commercial Feeds**	1 : 8.0
Corn	1 : 54.5
Oats	1 : 19.4
Barley	1 : 9.6
Soybean Oil	1 : 7.5
Soybean Meal, Fat Extracted	1 : 6.9

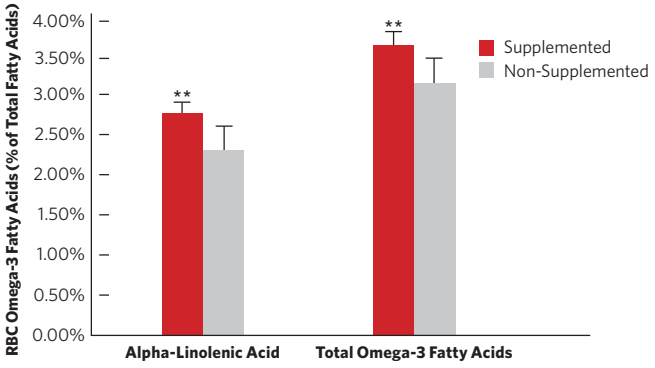
**Average of five equine commercial feeds tested by an independent laboratory. Adapted from Hallebeek and Benyon (2002)[1]

Figure 1. **Cell Membrane Omega-3 Fatty Acids Before and After Supplementation with an Omega-3 Fatty Acid and Micronutrient Product***



**Significantly greater than Pre-Supplementation value ($p < 0.05$)

Figure 2. **Cell Membrane Omega-3 Fatty Acids in Supplemented* vs. Non-Supplemented Horses**



**Significantly greater than Non-Supplemented ($p < 0.05$)

Nutrigenomics versus Drug Therapy

The study of the diet's effect on gene expression is called nutrigenomics and is an area often investigated in humans with chronic diseases.[14] One particularly intriguing area of nutrigenomics is the effect of different nutrients on the level of inflammation in the body and the subsequent development or progression of various diseases.[15] Important inflammatory markers are tumor necrosis factor-alpha (TNF-α), interferon-gamma (IFN-γ) and a multitude of interluekins (IL). In the horse, TNF-α, IFN-γ and IL's are required for adequate responses to substances that cause illness or disease, such as bacteria. However, continued or over-expression can cause the inflammatory responses that characterize various acute and chronic diseases. For example, increases in TNF-α, IL-1beta and IL-6 are documented in horses with acute traumatic joint disease and osteochondritis dissecans,[16] colic,[17,18] and/or laminitis.[7,8,19] In addition, both TNF-α and IFN-γ are increased in horses with airway disease.[4,20]

Many anti-inflammatory drugs block a single point in the enzyme cascade that regulates lipid mediators of inflammation and does so for a short period of time. In contrast, dietary manipulation of the substrates used by these enzymes alters the rate of mediator production by limiting the reactants entering the pathway. As a result, dietary modulation is a more flexible and longer lasting method for modulating inflammation. To investigate potential effects of supplementation on inflammation, researchers at the University of California at Davis conducted an observational study comparing levels of inflammatory markers in 63 horses fed different diets. Expression of TNF-α and IFN-γ genes in horses consuming oat hay and alfalfa with an omega-3 and micronutrient supplement* was ~60% lower than horses consuming other feeds (Figures 3 and 4).

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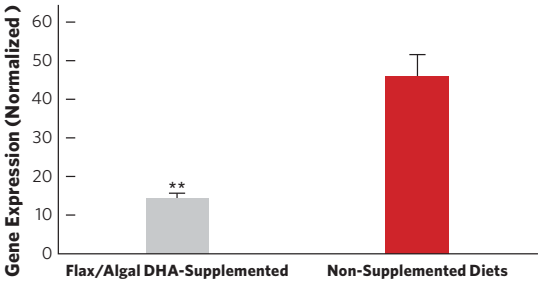
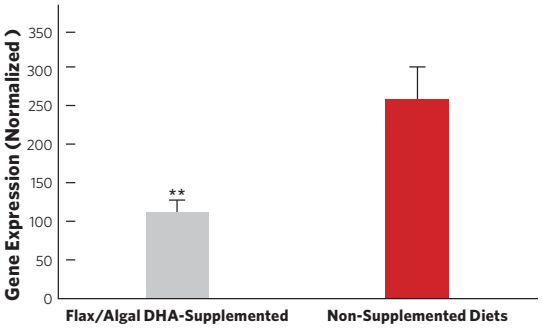
Figure 3. **TNF-Alpha Gene Expression Among Horses Consuming Oat/Alfalfa Hay Diet Supplemented with Flax/Algal DHA Product* vs Non-Supplemented Horses on Various Other Diets**



**Flax/Algal DHA-Supplemented significantly lower than non-supplemented ($p < 0.05$)

Figure 4. **Interferon-Gamma Gene Expression Among Horses Consuming Oat/Alfalfa Hay Diet Supplemented with Flax/Algal DHA Product* vs Non-Supplemented Horses on Various Other Diets**



**Flax/Algal DHA-Supplemented significantly lower than non-supplemented ($p < 0.05$)

A further regression analysis suggested that individual dietary components significantly impacted expression of TNF-α (Table 2).

Table 2. **Dietary Components Affecting TNF-α Gene Expression**

Diet Component	Effect on TNF-α Expression	Level of Significance
Corn Oil	Increased	P = .0004
Rice Bran	Increased	P = .042
Pasture Feeding	Decreased	P = .076

Bottom Line

Consumption of a flax and algal DHA supplement* increases incorporation of omega-3 fatty acids into red blood cells and lowers the expression of the pro-inflammatory cytokines TNF-α and IFN-γ. Reduced inflammatory responses in horses could potentially protect them from inflammation-related chronic diseases. In order to curtail excessive inflammation, it is important to maintain horses on an anti-inflammatory diet.

Putting it into Practice

- Reduce feeds with an imbalance of omega-3 to omega-6 fatty acids, such as grains, corn oil, and some commercial feeds.
- Avoid feeds with high levels of rancidity.
- Increase intake of forage and pasture grazing.
- Supplement with omega-3 fatty acids and antioxidants.

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