BY MARCIA KING

Latest on the Omegas

Researchers are continuing to study the benefits and differences of omega-3 and omega-6 fatty acids for horses

Glance through nearly any newspaper or magazine, and you're bound to see ads proclaiming the health benefits of omega-3 fatty acids in the human diet. Interest in the topic is keen: Studies in humans and other species have found omega-3 fatty acids aid in the treatment of skin problems, heart disease, high blood pressure, ulcers, and other disorders, and it could play a role in improving the immune system.

The question: If omega-3 fatty acids benefit human health, can they provide similar benefits for horses? Although there have been only a handful of omega-3 studies for the horse, here's what we do know, and what researchers are hoping to find out.

(Editor's Note: If you are like many of us and don't know your omega-3s from your omega-6s, get up to speed with our Quick Facts sidebar on page 54 before reading on.)

Fat and Food Sources

When it comes to adding energy to the equine diet, a fat is a fat is a fat, but not when it comes to conveying omega-3 and omega-6 properties.

Explains Joe D. Pagan, PhD, president of Kentucky Equine Research near Versailles, Ky., "Some oils are high in omega-6, but lower in omega-3—corn oil, sunflower oil, and safflower oil—while others such as soybean and canola oils are moderately high in omega-6. The oils that contain more omega-3 than omega-6 are flaxseed and linseed oil, but the highest ratio of omega-3 to -6 is found in fish oil."

Ratios vary significantly as well between fresh pasture, hay, and grain. A two-year study conducted by Lori K. Warren, PhD, assistant professor of equine nutrition, University of Florida, found that bahiagrass (a warm-season grass common to Florida and the south-

ERIN RYDER

Omega-3 fatty acids are found in highest concentration in linseed/flax and in fish oils.

the fat in fresh pasture and 18-35% of the fat in hay is made up of omega-3).

"Compare this to cereal grains, where 50% of the fat is omega-6 and very little is omega-3," she notes. "Although forages only contain about 2-3% crude fat, a horse consuming a high-forage diet will actually be consuming a significant amount of omega-3 fatty acids."

Inflammatory Response

Because of promising results in other species concerning inflammation and immune function, researchers are looking for similar effects of omega-3 fatty acids in the equine. So far, results are mixed.

Researchers at Kansas State University (KSU) examined the effects of docosahexaenoic acid (DHA) supplementation in reducing airway inflammation and exercise-induced pulmonary hemorrhage (EIPH).

"EIPH is a major health concern and a cause of poor performance in the equine athlete," reports Howard H. Erickson, DVM, PhD, professor of physiology at KSU. "Preliminary results indicate that DHA alone does not reduce pulmonary inflammation or the amount of EIPH."

The group is doing a follow-up study on DHA/ eicosapentaenoic acid (EPA) combination supplementation and its effects in reducing pulmonary inflammation, EIPH, and joint inflammation.

States co-investigator J. Ernest Minton, PhD, "We think the scientific basis to hypothesize that omega-3 fatty acids can control inflammatory processes in the horse are sound. However, the levels of daily intake of omega-3 fatty acids and whether the ratio of omega-3 to omega-6 is an important consideration to affect various inflammatory conditions in the horse remain to be defined."

Doug Herthel, DVM, owner of Alamo Pintado Equine Medical Center in Los Olivos, Calif., and founder of Platinum Performance supplements for humans and animals, says preliminary results from his studies showed that horses fed an omega-3 formula and hay had "significantly lower levels of inflammatory markers" than horses consuming a hay and mixed grain diet.

At Texas A&M, notes Pagan, horses supplemented with soy oil versus corn oil experienced a reduced inflammatory response to a bout of exercise.

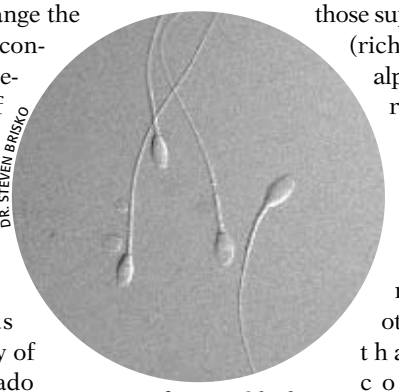
Red Blood Cells

Scientists from Southern Illinois University Carbondale confirmed that increased levels of omega-3 fatty acids lead to increased levels in blood plasma and red blood cells.

"We found that the specific omega-3 fatty acids that are the most beneficial to health did get into the red blood cells, and their concentrations were roughly equivalent to the amount the horses were eating—the more they ate, the higher the concentration," writes investigator Sheryl S. King, PhD, professor of animal food science and nutrition, in the Southern Illinois University Carbondale *News*. "It did take a very long time for the concentration to increase. We didn't actually see it (in blood) until after we had stopped feeding the product, but it stayed around much longer there (59 days after stopping supplementation) than it did in the plasma."

Preliminary results from Herthel's recent studies on his Platinum Performance Equine showed supplementation increased omega-3 content by 78% and decreased omega-6 by 40% in red blood cells after six weeks of supplementation.

"The ability to change the membranes (which control transport of materials from one side of the cell to the other) is useful in decreasing inflammation in general," he notes.



DR. STEVEN BRISKO

Omega-3 fatty acids have the potential to affect not only sperm quality, but sperm quantity as well.

Stallion Fertility

Studies at Texas A&M, the University of Arizona, and Colorado State University (CSU) examined effects of DHA on sperm output and semen quality.

"Each study showed the same trend, although each study showed a slightly different effect," notes CSU researcher Ed Squires, PhD, honorary Dipl. ACT. "Our study showed an increase in the total number of motile sperm using Magnitude, a pelleted, top-dressed product manufactured by United Bionutrition and distributed by Bioniche Animal Health.

"We evaluated fresh, cooled, and frozen semen, as did the other studies; we saw a major effect on fresh semen and 24-hour cooled semen. For horses that have semen that might not cool very well, there's no question that they're feeding it helps during the cooling process.

"One study even showed an increase in the percentage of morphologically normal sperm and an increase in the concentration of the semen. Omega-3 fatty acids have the potential to affect not only sperm quality, but sperm quantity," he adds.

Mares and Foals

Can the fatty acid composition of a broodmare's diet affect the fatty acid composition of her milk and the fatty acids passed along to the foal? If so, can increased levels of omega-3 convey extra immunity to the foal? The answers, respectively, are yes and maybe.

In separate trials at the University of Florida, Warren found that:

- From foaling through 16 weeks post-foaling, mares fed a control diet (no fat supplementation), corn oil supplements (rich in omega-6), or a 50/50 mix of corn and linseed oil (rich in omega-3) passed along fatty acid levels in their milk and plasma reflective of omega-3 and -6 levels they consumed.
- Beginning one month prior to foaling and continuing 12 weeks post-foaling, mares receiving no additional omega-3, those supplemented with milled flax (rich in the omega-3 fatty acid alpha-linolenic acid), or mares receiving fish oil (rich in the omega-3 fatty acids EPA and DHA) saw similar results as above. Mares and foals fed fish oil produced an earlier inflammatory response than the other two groups, suggesting that omega-3 could confer an early advantage in responding to infection, although omega-3 supplements had no effect on the antibody content of mare colostrum, milk, and foal serum.
- A study similar to the above (fish oil vs. milled flax vs no supplementation) in yearlings found no differences in immune function or inflammation among the groups, except for an earlier inflammatory response in yearlings that had been fed fish oil. However, because all of the yearlings were on fresh pasture, total amounts of omega-3 might not have been very different. "That suggests we can't ignore what forage provides," Warren notes.

Researchers at Kansas State conducted similar studies, likewise finding that omega-3 supplementation of broodmares

change the levels of fatty acids in milk and in utero.

Studies on immunity levels in foals from omega-3-supplemented broodmares showed higher immunity levels in the milk, but no increase in blood samples from the foals, says KSU researcher Joann Kouba, PhD, horse teaching and research specialist. There were no foal height or weight differences in foals from supplemented or control mares.

"The jury is still out, because a follow-up study did not find significant differences in milk IgG levels," Kouba says.

On the Horizon

Kouba is now focusing on reproductive function, particularly estrous cycle characteristics, between mares eating omega-3 supplements versus those fed a normal horse diet that's richer in omega-6.

"It's an interesting area because of the connection between omega-3 and prostaglandin levels," she says. "There may or may not be a connection in terms of reproductive function." Results are expected to be made public soon.

Also nearing completion is an investigation by Warren concerning antioxidant effects of omega-3: Does adding more omega-3 fat to the horse's diet increase the production of free radicals, thereby increasing their need for antioxidants like vitamin E? Or do omega-3 fatty acids actually have antioxidant properties of their own?

Take-Home Message

Despite the hype and tantalizing promises of varied products, there are still many facts yet to be gathered concerning the role of omega-3 fatty acids in the equine diet. Stay tuned for further developments!

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ABOUT THE AUTHOR

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QUICK FACTS

Essential Fatty Acids

Essential fatty acids (EFA) are polyunsaturated fats needed for various metabolic processes. The body does not produce EFA, they are provided through the diet.

"Alpha-linolenic and linoleic acid are both EFAs," explains Lori K. Warren, PhD, assistant professor of equine nutrition at the University of Florida. "It is these fatty acids that have the greatest biological activity in the body."

Sources

"Omega-3 fatty acids are found in highest concentration in marine (fish) oils and in linseed/flax," says Ray Geor, BVSc, MVSc, PhD, Dipl. ACVIM, professor and Paul Mellon Distinguished Chair at Middleburg Agricultural Research and Extension Center, Virginia Polytechnic and State University.

Other sources contain omega-3 in varying amounts, reports Mary Beth Gordon, PhD, regional veterinary nutritionist at Land O'Lakes, Purina Mills LLC. Those include canola oil, soybean oil, walnut oil, walnuts, mustard oil, tofu, and fish (herring, salmon, oysters, trout, tuna, crab, etc.). "Omega-6 is found in varying amounts in borage oil, corn oil, cottonseed oil, grapeseed oil, peanut oil, primrose oil, safflower oil, sesame oil, soybean oil, sunflower oil, pine nuts, and brazil nuts," says Gordon.

Although hay and pasture forages are low in total fat content, most of the fat is made up of omega-3 fatty acids. In contrast, cereal grains such as oats and corn offer primarily omega-6 fatty acids.

Effects of Ratios

"There has been considerable work in other animal species and in humans to show that omega-3 supplementation affects the ratio of omega-3:omega-6 in blood and in tissues, with alterations in the fatty acid composition of plasma (cell) membranes," says Geor. "This effect is most evident when fish oil is fed. This change in composition alters the responses of cells under stress conditions such as an inflammatory insult, with the result being a moderated inflammatory response when compared to non-supplemented animals."

What this Means

"Actions produced by omega-3 fatty acids in lab animals, humans, and other species demonstrate a decreased inflammatory response and are said to improve osteoarthritis and bone formation, reduce allergic hyperactivity, and reduce exercise-induced bronchial constriction," states Joe Pagan, PhD, president of Kentucky Equine Research. "The actions produced from the omega-6 are just the opposite; they increase the inflammatory response, increase allergic hyperactivity, and increase exercise-induced bronchial constriction."

These ideas have been pursued in horse studies. "There is evidence that supplementation with linseed or fish oils alters fatty acid profiles and the responses of inflammatory cells when they are evaluated 'in the test tube,' with moderation in production of inflammatory substances by these cells," Geor says.

What You Should Know

"Don't be afraid of omega-6 fatty acids because they are essential, necessary nutrients," states Warren. "Some inflammation, which is supported by omega-6, is needed to fight infection and heal tissues. It's when the body goes overboard that we are concerned. "We don't know enough about omega-6 in horses to condemn it. In fact, many of the scary references to omega-6 come from the human perspective."

The average human diet consists of about 30% fat, contrasting with the average horse diet (even fat-added diet) of about 5% fat.

"Horses just don't consume the same kind of diet as humans, so the impact of omega-6 might not be as great in horses, especially when we're talking about negative impact. That being said, we are trying to find out if we need to modify some of the fats we are adding to the horse's diet to make sure we're not causing problems—unknowingly causing inflammation," says Warren.

Reality Check

"Evidence is lacking that supplementation is effective in the prevention or control of disease conditions in horses or in the management of athletic or old horses," Geor notes. "People need to be realistic with expectations. There also is little information concerning the 'dose' of omega-3 needed for any potential benefit."

Adds Gordon, "Although some horses may benefit from fatty acid supplementation, there is not sufficient evidence at this time to support the statement that every horse needs it. If a horse is receiving access to quality forage and balanced concentrated feedstuffs, then he may not need additional fatty acids."—*Marcia King*

Feeding to Reduce Oxidative Damage and Improve Health

Tara Hembrooke, Sina Wallace, University of California, Davis

Free radicals are chemicals produced in the horse's body either as a result of normal metabolism, or in response to exercise, inhalation of dust and air pollutants, ingestion of rancid feeds, and exposure to ultraviolet light. Free radicals cause oxidative damage to proteins, lipids, and DNA, and contribute to several equine diseases. For example, in one of the first studies examining the relationship between oxidative stress and laminitis, Neville et al. reported that thiobarbiturate reactive substances (TBARS), a marker of oxidative damage to lipids, were three times higher among ponies with chronic laminitis when compared to healthy ponies. Although further studies in this area are warranted, it appears that oxidative stress may be related to the development and progression of laminitis.

Oxidative stress associated with exercise may also lead to the degradation of various joint components, such as collagen, proteoglycans, and hyaluron. Increased concentrations of TBARS have been detected in Thoroughbred race horses after a simulated race, and other measures of oxidative stress have been correlated with intense exercise as well. Furthermore, significantly increased concentrations of protein carbonyls, a marker of oxidized proteins, have been detected within diseased joints of horses and in the circulation and muscle after strenuous exercise. Additionally, exercise-induced oxidative stress has been associated with pulmonary hemorrhage, exertional rhabdomyolysis, and impaired performance.

Figure 1. **Peroxide Comparison Between Platinum Performance™ and Five Complete Feeds**

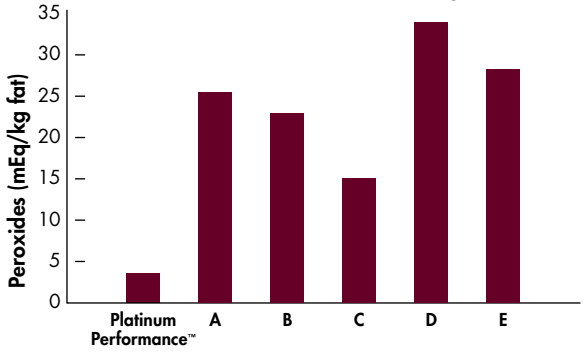


Figure 1. Average peroxide value of Platinum Performance™ was significantly lower compared to five complete feeds containing omega-3 fatty acids.

Free Radicals Can Damage Feeds

Free radicals also damage fats in feeds, causing the fats to become rancid. This rancidity can then cause oxidative damage in the body. Although omega-3 essential fatty acids are required for normal cellular function and are pivotal in reducing inflammation in the horse, they are highly susceptible to rancidity. As an indicator of rancidity, an independent laboratory determined the peroxide concentrations in Platinum Performance™ and five complete feeds containing omega-3 fatty acids (Figure 1). While the level of rancidity in the complete feeds ranged from 14 mEq/kg fat to 32 mEq/kg fat, it was nearly undetectable in Platinum Performance™ (2.6 mEq/kg fat). In fact, out of all the compounds tested, Platinum Performance™ was the only one within the acceptable and safe range for peroxides (1 - 10 mEq/kg fat).

Rancid Feeds and Oxidative Damage

Having seen the huge difference in peroxide concentrations between the complete feeds and Platinum Performance™, researchers at the University of California at Davis tested the hypothesis that ingestion of feeds containing rancid fat cause free radical damage in the horse. This hypothesis was tested by comparing levels of oxidative damage in horses after 6 weeks of supplementation with Platinum Performance™ or one of the complete feeds having a mid-range peroxide value of 26 mEq/kg fat. The level of protein carbonyls in the blood of horses 3 hours after feeding was 61% lower after 6 weeks of supplementation with Platinum Performance™ when compared to the complete feed (Figure 2), thus providing evidence that in contrast to the complete feed, consuming Platinum Performance™ does not induce protein damage.

Figure 2. **Damaged Protein Content Three Hours after feeding Platinum Performance™ vs. Complete Feed**

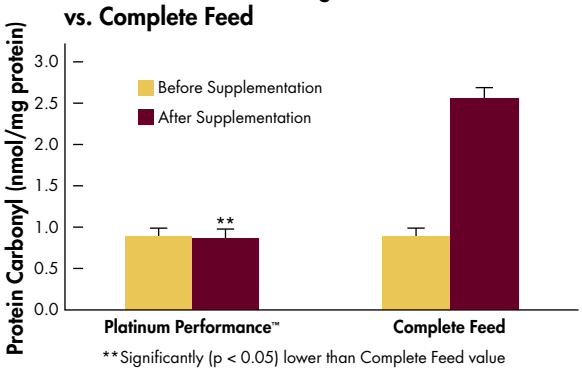


Figure 2: Compared to a commercially available complete feed, protein carbonyl content in blood 3 hours after feeding was lower following six week of supplementation with Platinum Performance™.

Similarly, blood concentration of TBARS 3 hours after feeding was 32% lower after 6 weeks of supplementation with Platinum Performance™ when compared to the complete feed (Figure 3), indicating that consuming Platinum Performance™ reduces fat damage.

Figure 3. **Damaged Fat Content Three Hours after feeding Platinum Performance™ vs. Complete Feed**

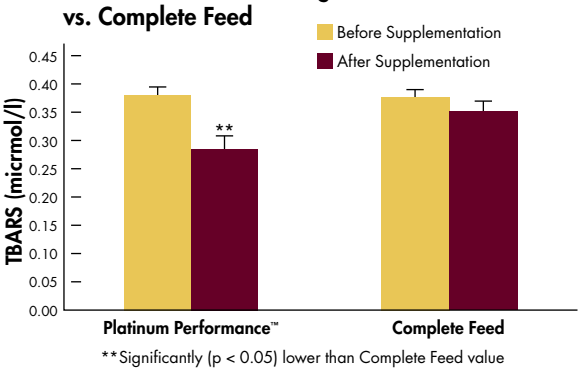
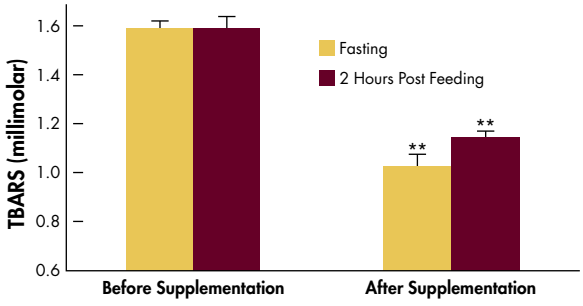


Figure 3: Compared to a commercially available complete feed, TBARS content in blood 3 hours after feeding was lower following six weeks of supplementation with Platinum Performance™.

In a follow-up study, blood concentrations of TBARS and protein carbonyls were measured in horses before and after 3 weeks of supplementation with Platinum Performance™ in addition to their normal diet of hay. Blood TBARS concentrations in fasted horses were reduced by 36% ($p < 0.0001$) at the end of the 3 week supplementation period, and by 30% ($p < 0.0001$) 2 hours post-feeding (Figure 4). Additionally, blood concentration of protein carbonyls in fasted horses was reduced by 10% at the end of the 3 week supplementation period ($p = 0.04$), and by 11% 2 hours post-feeding ($p = 0.03$; Figure 5).

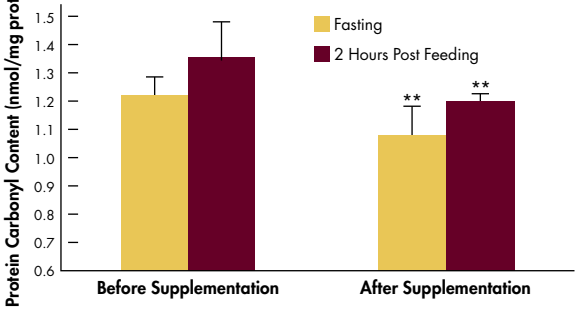
Figure 4. **Damaged Fat Content Before and After Three Weeks of Supplementation with Platinum Performance™**



**Significantly ($p < 0.05$) lower than Before Supplementation value

Figure 4. TBARS content in blood was lower at both fasting and 2 hours post-feeding following 3 weeks of supplementation with Platinum Performance™.

Figure 5. **Damaged Protein Content Before and After Three Weeks of Supplementation with Platinum Performance™**

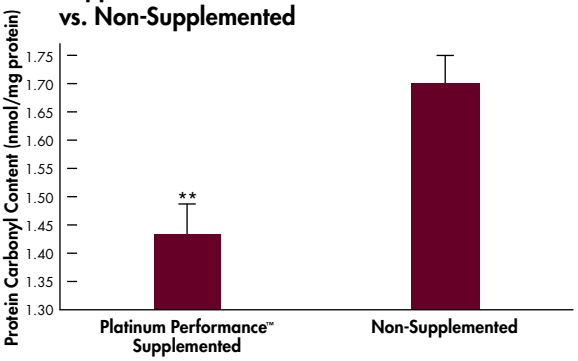


**Significantly ($p < 0.05$) lower than Before Supplementation value

Figure 5. Protein carbonyl content in blood was lower at both fasting and 2 hours post-feeding following 3 weeks of supplementation with Platinum Performance™.

While the results of these two controlled studies demonstrate that oxidative stress is reduced in horses consuming a diet of hay supplemented with Platinum Performance™, even more striking differences were noted in a study comparing blood concentrations of protein carbonyls in 113 horses on different farms being fed various combinations of common feeds. In this study, horses supplemented with one to four scoops of Platinum Performance™ per day had an 18% lower level of blood protein carbonyls ($p = 0.032$) when compared to non-supplemented horses (Figure 6). Therefore, regardless of the type of feed consumed, horses supplemented with Platinum Performance™ had significantly less oxidative damage than non-supplemented horses.

Figure 6. **Damaged Protein Content in Horses Supplemented with Platinum Performance™ vs. Non-Supplemented**



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

Figure 6. Protein carbonyl content in blood was lower in horses supplemented with Platinum Performance™ compared to non-supplemented horses.

CONCLUSION

Free radicals can lead to oxidative stress, which has been associated with various equine diseases. In both controlled and observational studies, Platinum Performance™ reduced oxidative stress in horses, as measured by blood concentrations of protein carbonyls and TBARS. These findings suggest that horses consuming Platinum Performance™ may be protected against chronic levels of oxidative stress.

Neville, R., et al., Evaulation of urinary TBARS in normal and chronic laminitic ponies. Equine Vet J, 2004. 36(3): p. 292-4.