Feeding to Reduce Oxidative Damage

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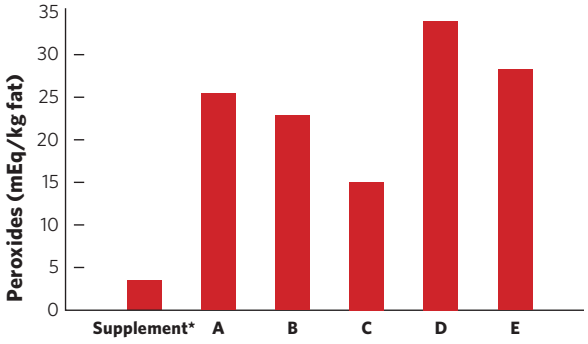
Free radicals are chemicals produced in the body often as a result of normal metabolism or in response to exercise, inhalation of dust and air pollutants, ingestion of rancid feeds, and exposure to ultraviolet light. Free radicals cause oxidative damage to proteins, lipids, and DNA.[1]

Although they are necessary for many physiological functions,[1] when produced in excess or without adequate resolution, free radicals may contribute to several equine diseases.[2-7] For example, an 83% difference in protein carbonyls, a marker of oxidative damage to proteins, was noted in synovial fluid of horses with joint disease compared to non-diseased joints.[8] In another instance, thiobarbituric reactive substances (TBARS), a marker of oxidatively damaged lipids, were reported as three times higher among ponies with chronic laminitis when compared to healthy counterparts.[9] Horses with recurrent airway obstruction show a greater depletion of tracheal epithelial fluid antioxidant status following organic dust exposure as compared to healthy horses.[10] Since oxidative stress is naturally associated with exercise in many animals, including the horse,[11,12] attention must also be directed at the athletic horse. For instance, increased concentrations of TBARS have been detected in Thoroughbred race horses after a simulated race,[12] and thoroughbreds in training have reportedly presented with a reduced endogenous antioxidant status when compared to an antioxidant-supplemented cohort.[13] In fact, various measures of oxidative stress have been correlated with intense exercise in the horse.[14-16]

Free Radicals Can Damage Feeds

Various fats in feeds are susceptible to oxidation and free radical production. Consumption of these rancid feeds could potentially induce oxidative stress within the body. Although omega-3 fatty acids are required for normal cellular function and are pivotal in moderating inflammation, they are highly susceptible to rancidity because of the multiple double bonds within their long carbon chain. Peroxide analysis is a common indicator of feed rancidity. With this in mind, an independent laboratory determined the peroxide concentration in an omega-3 and micronutrient supplement* as well as five commercial equine feeds also containing omega-3 fatty acids (Figure 1). While the level of rancidity in the commercial feeds ranged from 14 – 32 mEq/kg fat, peroxide levels were nearly undetectable in the omega-3 and micronutrient supplement (2.6 mEq/kg fat). In fact, of all the compounds tested, only this supplement had a peroxide concentration within the acceptable and safe range for human consumption (<10 mEq/kg fat; no standards have been established for the horse).[17]

Figure 1. **Peroxide Comparison Between an Omega-3 and Micronutrient Supplement* and Five Commercial Feeds**



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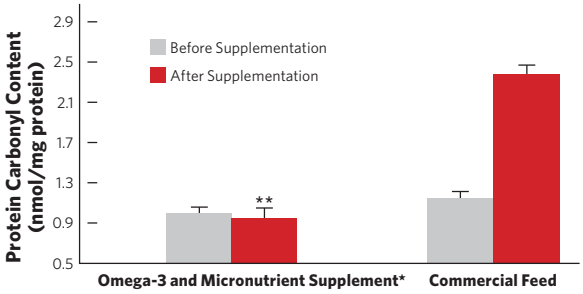
Rancid Feeds and Oxidative Damage

Researchers at the University of California at Davis hypothesized that ingestion of feeds containing rancid fat will encourage free radical damage in the horse. They then tested this hypothesis by comparing levels of oxidative damage in horses after 6 weeks of supplementation with an omega-3 and micronutrient product with a low peroxide content* versus horses supplemented with a commercial feed having a peroxide value of 26 m Eq/kg fat. Both groups had similar post-prandial protein carbonyl levels at baseline, however the level of protein carbonyls in the blood 3 hours af–ter feeding was 61% lower among the omega-3 and micronutrient supplemented* horses when compared to those supplemented with the commercial feed (Figure 2). These findings provide evi–dence that, in contrast to the commercial feed, consum–ing the supplement does not induce protein damage; this beneficial effect of the supplement may be due to the antioxidant content of the supplement.

Figure 2. **Damaged Protein Content Following Six Weeks of Supplementation with an Omega-3 and Micronutrient Product* versus Commercial Feed**



** Significantly lower than Commercial Feed value ($p < 0.05$)

Similarly, blood concentrations of TBARS 3 hours after feeding were 32% lower than the baseline values following 6 weeks of supplementation with the omega-3 and micronutrient product.* In contrast, there was no notable change with the commercial feed (Figure 3). These findings indicate that consumption of the omega-3 and micronutrient supplement not only protects against but reduces oxidative damage to fat.

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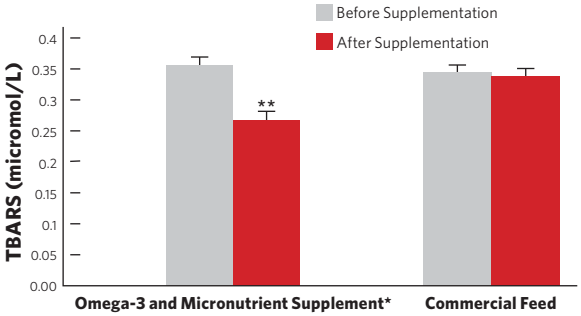
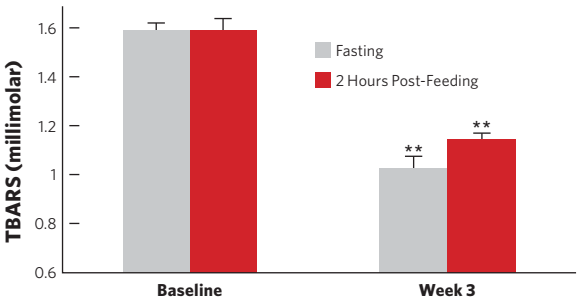
Figure 3. **Damaged Fat Content Following Six Weeks of Supplementation with an Omega-3 and Micronutrient Product* vs a Commercial Feed**



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

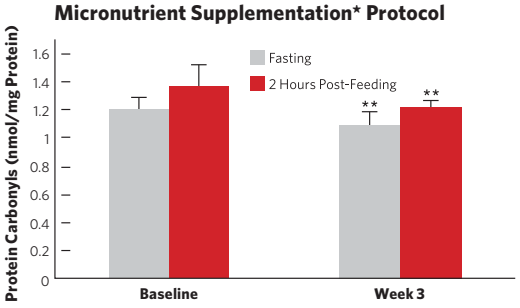
In a follow-up study, blood concentrations of TBARS and protein carbonyls were measured in horses on a normal hay diet be–fore and after 3 weeks of supplementation with the omega-3 and micronutrient product.* TBARS were reduced by 36% ($p < 0.0001$) at fasting and by 30% ($p < 0.0001$) 2 hours post-feeding (Figure 4) after the 3-week supplementation period. Additionally, as shown in Figure 5, following 3 weeks of supplementation, blood concentrations of protein carbonyls in the horses at fasting were reduced by 10% ($p = 0.04$) and by 11% 2 hours post-feeding ($p = 0.03$).

Figure 4. **Damaged Fat Content Before and After an Omega-3 and Micronutrient Supplementation* Protocol**



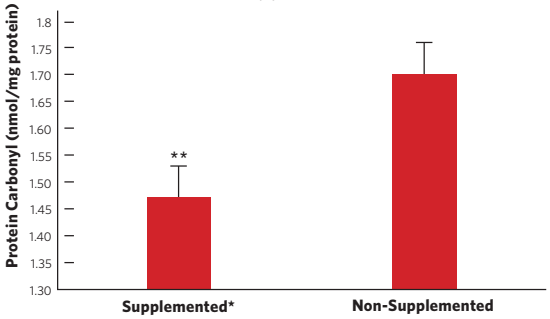
** Significantly lower than Baseline values ($p < 0.05$)

Figure 5. **Damaged Protein Content in Blood of Horses Before and After 3 Weeks of an Omega-3 and Micronutrient Supplementation* Protocol**



** Significantly lower than Baseline values ($p < 0.05$)

Figure 6. **Damaged Protein Content in Horses Supplemented with an Omega-3 and Micronutrient Product* vs. Non-Supplemented Horses**



** Significantly less than Non-Supplemented

While the results of these two controlled studies demonstrate that oxidative stress is reduced in horses consuming a diet of hay supplemented with omega-3 and micronutrients, even more striking results were noted when blood concentra–tions of protein carbonyls were measured in 113 horses from various farms fed assorted combinations of common feeds. In that study, horses supplemented with one to four scoops of the omega-3 and micronutrient product* per day had an 18% lower level of blood protein carbonyls ($p = 0.032$) when compared to non-sup–plemented horses (Figure 6). Therefore, regardless of the type of feed consumed, supplemented horses had significantly less oxidative damage than 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, supple–mentation with an omega-3 and micronutrient product* reduced or controlled oxidative stress in horses, as measured by blood concentrations of protein carbo–nyls and TBARS. These findings suggest that horses consuming omega-3s and micronutrients may be protected against chronic levels of oxidative stress.

Putting it into Practice

- Avoid feeds with high levels of rancidity.
- Supplement with antioxidants.
- Increase intake of forage and pasture grazing.

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