

## Developmental Orthopedic Disease

Developmental orthopedic diseases (DOD) include several conditions that arise in response to alterations in endochondral ossification, i.e., the process by which bones grow.<sup>25</sup> Disturbances in bone growth can result from trauma, genetic predisposition, unusually rapid growth, and nutritional imbalances such as excessive calories, high-starch diets, calcium/phosphorus imbalances, and mineral deficiencies. In addition to controlling the diet, supplemental administration of trace minerals has been associated with an increase in bone density in thoroughbred yearlings, especially when mineral intake is suboptimal.<sup>26</sup> Furthermore, mineral supplementation is generally recommended for growing horses.<sup>25</sup> In addition, copper supplementation of pregnant mares may also reduce the risk of DOD in their foals,<sup>27</sup> and providing supplemental copper to foals has been associated with a reduction in lesions consistent with DOD.<sup>28</sup>

## Conclusion

Dietary supplementation of young and adult horses is a key component to ensuring optimal growth, development, and maintenance of connective tissues, such as bones, ligaments, tendons and cartilage. Providing appropriate amounts of vitamins, minerals -- including silicon -- and omega-3 FAs, such as those in Platinum Performance™ Equine and Osteon™, is one way to achieve this. Not only does this play a role in optimizing exercise performance, but it is critical to the general well-being of all horses.

## Putting it into Practice

- To promote normal healthy bone and connective tissue health, provide a high forage/low concentrate diet. Supplement with Platinum Performance™ Equine to provide omega-3 FAs, silicon, vitamins, minerals and antioxidants.
- In horses recovering from bone or soft tissue injury, supplement with Platinum Performance™ Equine and Osteon™.
- In racehorses in training and racing, supplement with Platinum Performance™ Equine and Osteon™.

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# Supplementing for Bone and Connective Tissue Health

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Connective tissues, such as cartilage, ligaments, tendons, and bone, are critical components of body structure and support and, therefore, are critical for the overall health and performance of horses, whether they are used for pleasure or competition. Many nutrients are required for normal development and maintenance of connective tissues, including silicon, omega-3 essential fatty acids, vitamins, and minerals.

## Silicon

Although traditionally considered a nonessential nutrient, there is now conclusive evidence that silicon plays a significant role in the structure, growth and maturation of bones and connective tissues. Several studies indicate insufficient amounts of silicon in the diet are associated with poor growth rates, developmental abnormalities, and a reduction in the synthesis of bone matrix.<sup>1-4</sup> Conversely, supplementation with silicon stimulates bone formation,<sup>5-7</sup> in part by increasing calcium uptake by bones.<sup>5</sup> This effect may be particularly important during late pregnancy and lactation as bone mineral density decreases during these life stages.<sup>8,9</sup> Silicon also is a key element in the structure of glycosaminoglycans (e.g., chondroitin sulfate, hyaluronic acid),<sup>10</sup> which provide connective tissues resistance to compressive forces, predominantly by attracting water.<sup>11</sup> A final benefit of silicon is its antioxidant effects as supplementation with silicon

increases the activities of superoxide dismutase and glutathione peroxidase in animals and plants.<sup>12,13</sup>

It is very likely horses need a dietary source of silicon. Although grains are typically high in silicon,<sup>14</sup> this form of the element is not easily absorbed.<sup>15</sup> A bioavailable source of silicon is zeolite, which, when ingested, increases plasma concentrations of silicon and improves exercise performance in horses. For example, plasma concentrations of silicon increased in training thoroughbreds supplemented with Platinum Performance™ Equine and Osteon™ (Platinum Performance, Inc.), containing natural zeolite, as did their performance in 201 meter runs over a 4

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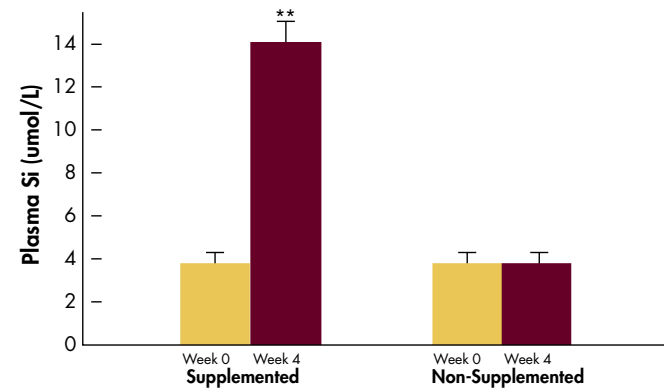
week period when compared to non-supplemented thoroughbreds (Figures 1 and 2).

In another study,<sup>16</sup> thoroughbreds supplemented with zeolite had faster middle distance race times than non-supplemented thoroughbreds, ran nearly twice as far during training before any injury occurred, and had fewer injuries than horses not receiving the silicon supplement. These authors concluded silicon supplementation may allow horses to train at faster speeds for longer periods of time without incurring injury. It is possible that these beneficial effects of silicon supplementation may be due to a more rapid repair of sub-clinical injuries.<sup>17</sup>

### Omega-3 Fatty Acids

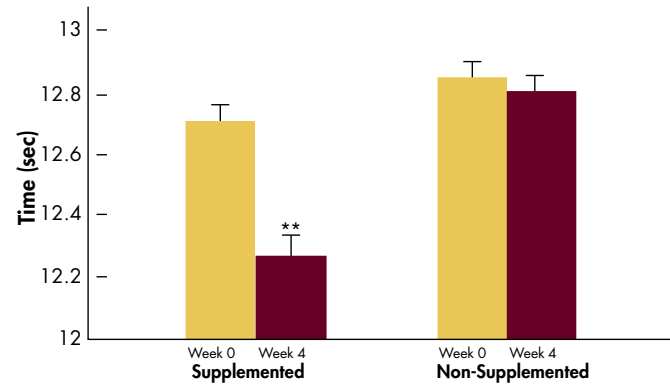
Omega-3 fatty acids (FAs) are also critical for repair and maintenance of connective tissues, possibly by inhibiting the synthesis of various inflammatory cytokines that contribute to bone loss.<sup>18</sup> Additionally, omega-3 FAs decrease loss of calcium in the urine, increase absorption of calcium, and increase its concentration in bones.<sup>19,20</sup> Omega-3 FAs are essential and must, therefore, be consumed in the diet. While pasture grasses and hay generally have a more favorable ratio of anti-inflammatory omega-3 FAs to pro-inflammatory omega-6 FAs, cereal grains, such as corn or oats, provide much higher levels of omega-6 fatty acids. In addition, environmental factors may alter the nutrient composition. For example, an independent

Figure 1. **Plasma Silicon Concentrations among Osteon<sup>™</sup> Supplemented and Non-Supplemented Thoroughbreds**



\*\*Significantly greater ( $p < 0.05$ ) than week 0 and corresponding Non-Supplemented week

Figure 2. **Run Times for Thoroughbreds Supplemented with Osteon<sup>™</sup> versus Non-Supplemented Thoroughbreds**



\*\*Significantly greater ( $p < 0.05$ ) than week 0 and corresponding Non-Supplemented week

laboratory determined that fresh alfalfa hay contains a higher percentage of omega-3 FAs than bailed alfalfa hay. In fact, the omega-3 content was 36% lower six weeks after bailing and 83% lower at ten weeks when compared with fresh alfalfa hay (Figure 3). Due to the

detrimental effects of processing and storage, the best way to add omega-3 FAs to the equine diet is through supplementation.

### Vitamins D, A and C

Vitamins D, A and C are critical for the health of connective tissues. Although vitamin D is synthesized naturally by most animals, horses that are stabled or have insufficient access to relatively fresh hay or pasture may require supplemental vitamin D.<sup>21</sup> As evidence of this, analysis of alfalfa hay revealed that the vitamin D content was nearly 80% lower six weeks after bailing when compared to fresh alfalfa (Figure 4). Vitamin A is obtained by the horse predominantly through consumption of green forage. However, environmental factors such as sunlight, processing, exposure to air, and moisture can significantly decrease vitamin A activity in hays.<sup>21</sup> Vitamin C's role in collagen<sup>22</sup> and bone matrix formation<sup>22</sup> make it a popular supplement and important nutrient for young, rapidly growing horses.<sup>21</sup> In addition, vitamin C supplementation has been recommended for horses with arthritis or soft tissue injury.<sup>23</sup>

### Potassium, Magnesium and Boron

In addition to silicon, other minerals are important to maintain healthy bones. For example, high-grain/low-forage diets tend to be low in potassium,<sup>24</sup> which may be important because the availability of potassium reduces the loss of calcium from bone.<sup>22</sup> Magnesium also is

Figure 3. **Total Omega-3 Content in Alfalfa from Different Times of Cut**

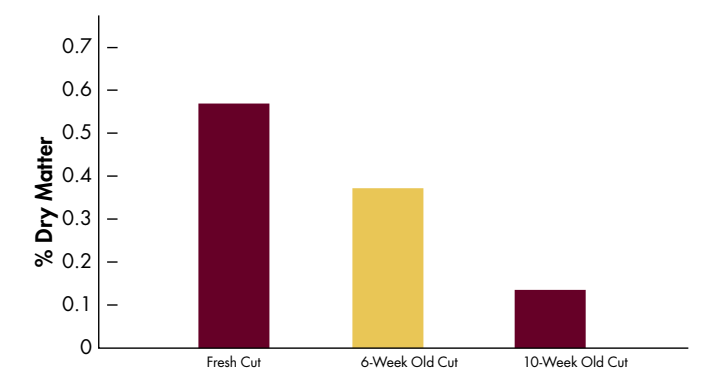
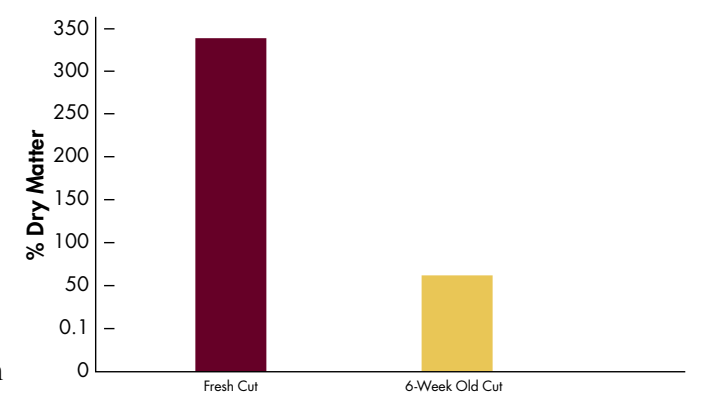


Figure 4. **Vitamin D Content in Fresh and 6-Week Old Bailed Alfalfa**



important to ensure adequate strength of bones by preventing the formation of crystals that lead to brittle bones,<sup>22</sup> and boron helps maintain bone mineral content and density possibly by promoting the generation of steroid hormones.<sup>22</sup>