

responses among infants,<sup>15</sup> and similar reductions in allergic responses to feeds have been reported in rat offspring.<sup>16</sup> Furthermore, zinc homeostasis, a mechanism in the development and progression of Alzheimer's disease, is altered in rat pups whose mothers had changes in their dietary intake of omega-3 fatty acid during pregnancy.<sup>17</sup> The high degree of immune-modulation that occurs during the perinatal period,<sup>18</sup> in conjunction with the effects of omega-3 fatty acid intake during pregnancy and lactation on allergic responses and metabolic alterations, suggest that many immune-related chronic diseases may be influenced in the offspring by making appropriate alterations in the maternal diet, including supplementation with omega-3 fatty acids.

### Summary

Provision of a diet adequate in both macro- and micronutrients is the foundation for equine fertility and reproduction. However, inclusion of supplemental nutrients, including omega-3 fatty acids and antioxidants, may contribute to the prevention of poor fertility parameters and improve reproductive performance. All of these considerations may help increase the reproductive capacity of horses as well as aid in the prevention of chronic diseases as foals develop and mature.

### Putting it into Practice

- To ensure the overall health of the breeding mare, provide a high-forage diet supplemented with vitamins, minerals, and omega-3 fatty acids.
- To avoid undue oxidative stress, reduce intake of rancid feeds.
- For optimal overall mare health and to help ensure a healthy foal, supplement with omega-3 fatty acids, antioxidants, trace minerals and vitamins, such as those in Platinum Performance™ Equine.

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PLATINUM PERFORMANCE™ EQUINE HEALTH SERIES

13

## Feeding the Mare for Fertility and Reproduction

Tara Hembrooke, PhD, MS

Nutrition plays a pivotal role in fertility and reproduction, with an impact on both the male and female. In addition to a well-balanced diet, supplementation with specific nutrients can improve fertility and reproductive success through several routes, most notably the number and quality of eggs, the environment for the developing fetus, and the health of the neonate. Not only can adequate intake of omega-3 fatty acids and antioxidants provide the foundation for continued reproduction, but supplementation with these nutrients can also help improve pregnancy outcomes.

### Fertility and Pregnancy Success

Omega-3 fatty acid consumption affects fertility rates in females. For example, ovulation is increased in rats consuming a high omega-3 fatty acid diet but is decreased when the diet contains an excess of omega-6 fatty acids.<sup>1</sup> While the mechanisms underlying these effects are not fully known, one possible link could be fatty acid-induced changes in prostaglandin synthesis.<sup>2</sup> Indeed, increased concentrations of markers associated with chronic inflammation have been suggested as predictors of female infertility and spontaneous loss of pregnancy.<sup>3,4</sup> To examine a possible effect of omega-3 fatty acids on fertility, researchers at Colorado State University's Equine Reproduction Lab studied mares, ages ranging from 6 to 25 (average = 20 yrs), most of which had histories of suboptimal fertility. At the start of the study, the mares were consuming a hay diet supplemented with a commercial complete feed. Eggs were harvested from the mares and implanted into recipient mares, either as fertilized eggs (embryos) after assisted fertilization in vitro or as unfertilized

eggs, after which the recipient mare was inseminated. Pregnancy success rates were approximately 23% per transfer.

The mares were then fed a mostly hay diet supplemented with 2 scoops/day of Platinum Performance™ Equine Wellness and Performance formula as a source of omega-3 fatty acids for 8 to 16 weeks. Eggs were once again harvested from these mares and transferred to recipient mares. This time, however, the pregnancy success rates in the recipient mares significantly increased to 51%, which was a 129% increase (Figure 1). One possible explanation for the improvement in fertility could be alterations in the inflammatory state of the donor mares. For example, serum concentrations of TNF- $\alpha$ , a pro-inflammatory cytokine associated with poor pregnancy outcomes in women,<sup>4</sup> decreased more

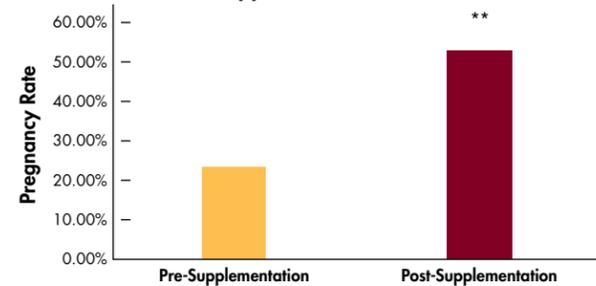




than 51% while concentrations of IL-13, a cytokine with anti-inflammatory properties, increased nearly 90% after supplementation with Platinum Performance™ Equine (Figures 2 and 3). Although other factors may have affected pregnancy rates, the results suggest that supplementation affected viability of follicles and/or eggs from the mares in this study. Very little research has been performed to examine the role of the ovary in subfertility in the mare, although it could have a profound effect on reproductive success, especially in older problem mares, as seen in this study.

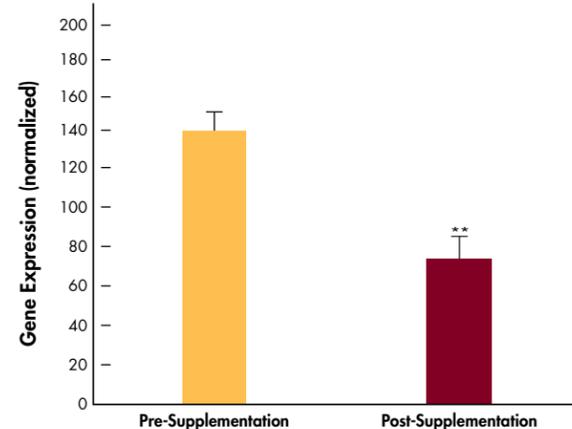
Another factor that may play a role in low fertility rates is oxidative damage due to excessive production of free radicals and/or insufficient defenses against oxidative stress. Although there is strong evidence to support a role of oxidative damage in sperm number and function,

Figure 1. **Pregnancy Success Rates Per Transfer Before and After Supplementation with Platinum Performance™**



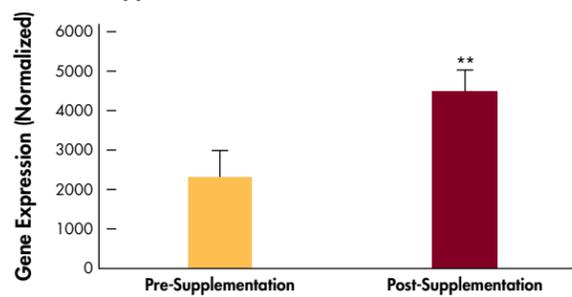
\*\*Significantly greater than Pre-Supplementation value (p < 0.05)

Figure 2. **TNF-alpha Gene Expression Before and After Supplementation with Platinum Performance™**



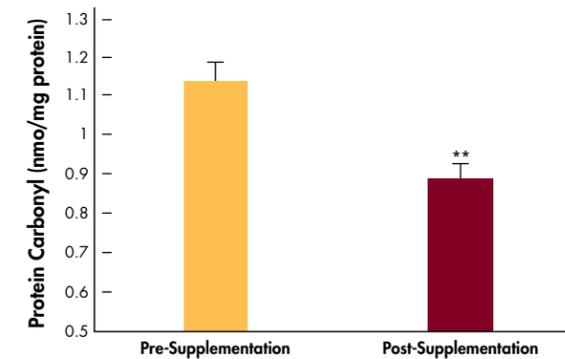
\*\*Significantly less than Pre-Supplementation value (p < 0.05)

Figure 3. **IL-13 Gene Expression Before and After Supplementation with Platinum Performance™**



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

Figure 4. **Damaged Protein Content in Blood Rate Before and After Supplementation with Platinum Performance™**



\*\*Significantly less than Pre-Supplementation value (p < 0.05)

implications on the female side are less clear. However, the connection between oxidative stress and low oocyte quality and poor fertility rates is growing.<sup>5</sup> For example, women with unexplained infertility have higher levels of reactive oxygen species in peritoneal fluid, which bathes the uterus, fallopian tubes and the ovaries, as compared to fertile women.<sup>6</sup> Further support for a role of oxidative stress in poor fertility rates in women arises from studies documenting that concentrations of both enzymatic and non-enzymatic antioxidants are significantly lower in follicular fluid of cigarette smokers when compared with women who do not smoke<sup>7,8</sup> and that these reduced concentrations of antioxidants often coincide with poor fertilization success rates.<sup>8,9</sup> Furthermore, dietary supplementation of mice with the

antioxidants, vitamins C and E, resulted in improvements in both the quantity<sup>10,11</sup> and quality<sup>11</sup> of retrieved oocytes when compared to unsupplemented, older mice. Among the mares in the CSU fertility trial, circulating concentrations of blood protein carbonyls (Figure 4), a measure of oxidized systemic proteins, decreased significantly, suggesting that an improvement in the balance between the production and elimination of free radicals occurred after supplementation with Platinum Performance™ Equine Wellness and Performance formula. This improved oxidative state may have contributed to healthier eggs with a greater likelihood of successful fertilization and development.

### Foal Health

Not only do omega-3 fatty acids improve fertility and pregnancy rates in the mare, they also have a significant role in the growth, development, and overall health of offspring. Docosahexaenoic acid (DHA) has long been identified as an important component in the neural development of the fetus.<sup>12</sup> In addition, increased intake of omega-3 fatty acids has improved gestation time and birth weights in people.<sup>13,14</sup> Recently, it has been suggested that the susceptibility of the fetus to chronic diseases may be altered by changing the mother's intake of omega-3 fatty acids. For example, supplementation with eicosapentaenoic acid (EPA) and DHA during pregnancy can contribute to an alleviation of allergic