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Food for thought: How to integrate nutrition into training programs and recovery? Perspectives and lessons from human and equine exercise physiology

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The focus of this session is to provide an overview of how well, or poorly, our current knowledge of applied nutrition in humans can be applied to the performance horse. We consider both endurance events as well as speed / power events such as jumping. Many attempts have been made to apply human nutritional strategies to horses, but many of these have not worked because of differences in nutrient processing from the intestinal level through to intracellular signalling mechanisms. Dietary strategies cannot readily be copied from human exercise physiology and pasted into the nutrition programs of performance horses. We will try to identify some strategies that work well in both horses in humans.

In human sport nutrition some athletes (e.g. swimmers) have a complete dietary program aligned with their training programme. So every meal is functional as either preparation or recovery from a specific training session. The goals of this program are to a) train with optimal fuel availability, b) to promote depletion of one or more muscle fuels, which in turn can be used to c) optimize adaptation. A couple of these nutritional programmes will be highlighted that may provide some inspiration for development of similar nutritional strategies for the performance horse.

Muscle glycogen loading

Muscle glycogen is a major fuel source for sustaining power and speed in both human and equine performance. Moderate to high intensity exercise results in high rates of muscle glycogen degradation, and muscle glycogen stores need to be replenished post-exercise to avoid residual 'fatigue' effects. Eric Hultman's seminal work from the 1960s showed that exercise induced depletion of the muscle glycogen followed by ingestion of carbohydrate-rich foods resulted in elevated muscle glycogen stores. His work showed that in humans muscle glycogen stores can be fully recharged within 24 hours. It was also shown that the pre-exercise muscle glycogen content was a primary determinant of capacity to perform high intensity exercise. These key findings led to the development of

many types of muscle glycogen loading paradigms in humans. In horses, however, muscle glycogen resynthesis rates are 3-4 times slower than in humans, and when muscle glycogen loading approaches were attempted in horses they were without success (see Waller and Lindinger for review). Also, high levels of dietary carbohydrate increase the risk of laminitis in horses (Frape 1988).

Fat adaptation

The idea that carbohydrate intake should be high in periods of training has been challenged by 'fat adaptation' diets. With this nutritional strategy athletes (principally endurance) consume a high fat – low carbohydrate diet for two or more weeks while continuing to train. This results in a number of biochemical adaptations within the body and muscle that allows for increased rates of fat oxidation during periods of exercise without subsequent loss of the ability of muscle to later store appreciable amounts of glycogen (Yeo *et al.* 2011). Volek *et al.* (2015) have suggested that this keto-adaptation could extend human performance beyond current expectation, which could be beneficial for some endurance-type athletes, including horses (Treiber *et al.* 2008; Harris 2009).

Protein and amino acids

The inclusion of protein and / or specific amino acids has been an area of active research in both humans (Margolis and Rivas 2014) and horses (Oliveira *et al.* 2015). In humans, dietary protein and amino acids are often used to achieve an anabolic effect, and as an aid in recovery the endurance athlete because of effects on increasing the rate of muscle glycogen resynthesis. A similar effect of increased amino acids on muscle mass appears to occur in horses (Graham-Thiers and Kronfeld 2005) and dietary leucine may increase the rate of muscle glycogen resynthesis in horses (Essen-Gustavsson *et al.* 2010; Urschel *et al.* 2010). For the most part, studies examining increased amino acid provision have shown increased nitrogen balance in plasma and muscle, but this has not yet been translated to possible effects on training adaptations (mitochondrial biogenesis), performance and post-exercise recovery (Graham-Thiers and Bowen 2011).

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