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COMMENTARY

Metabolic energy changes during exercise in equines

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Abstract: High-intensity exercise can lower skeletal muscle energy levels in equines. Publications have substantiated this decline in muscular adenosine triphosphate (ATP) levels following intense exercise sessions. Adequate energy levels are crucial for the maintenance of cellular integrity and function. D-ribose, a natural occurring carbohydrate, enhances the regeneration in muscular ATP levels following stressful conditions and has the potential to play a substantial role in energy recovery following high-intensity exercise. The following commentary addresses the altered metabolic energy state during exercise in equines.

Keywords: equines, energy, ATP, D-ribose

Commentary

Skeletal muscle function is dependent on adequate cellular levels of adenosine triphosphate (ATP). The production of ATP is continuous; however, during states of metabolic stress, such as ischemia, hypoxia, and high-intensity exercise, these levels are reduced, and studies have shown that the recovery can be prolonged.[1] Utilization of ATP without concomitant regeneration produces a cellular energy deficiency. Furthermore, continued catabolism of adenine nucleotides eventually produces nucleosides, which can potentially diffuse across a cell's membrane, further limiting ATP regeneration.

During high-intensity anaerobic exercise, the cell's ability to produce adequate levels of ATP is stressed, where demand can exceed supply. Human studies have reported a decline in skeletal ATP levels following high-intensity exercise, where as much as 3 days are required for complete return.[1] Similar results have been reported in equines subjected to high-intensity training/racing conditions. Hodgson reported a decline in equine skeletal muscle ATP levels during periods of high-intensity exercise.[2] Harris et al reported a minimal decrease in skeletal muscle ATP levels in horses during treadmill exercise at a speed of 10 m/sec, but a significant decline up to 47% was observed when equines were paced at a 12 m/sec.[3] Because of a presumed decline in muscular energy levels following high-intensity exercise, race horses are routinely rested following a race to maximize a return in muscular energy levels. In conjunction with a deficiency in energy levels with high-intensity exercise, oxygen free radical production increases during times of muscular stress.

D-ribose, a natural occurring pentose carbohydrate, regenerates ATP levels following stress.[1] D-ribose has shown to reduce the drain on energy molecules during ischemia (Figure 1). In humans, the supplementation of D-ribose around high-intensity exercise has demonstrated a lower decline and a shortened recovery interval in regenerating

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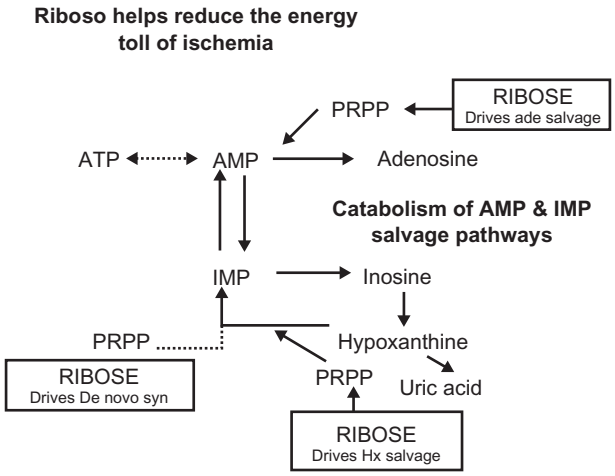

Figure 1 Ribose regulates activity of de novo and salvage pathways of nucleotide metabolism.
Abbreviations: ATP, adenosine triphosphate; AMP, adenosine monophosphate; PRPP, 5-phosphoribosyl-1-pyrophosphate; IMP, inosine monophosphate; Hx, hypoxanthine.

muscular ATP levels. D-ribose has also shown a benefit in limiting the increased production of oxygen free radicals following stress.[4]

Equine trainers and owners have noted benefits with either D-ribose alone (20 to 60 g/dose), or in combination with other ingredients, such as glucosamine, chondroitin sulfate, dimethylglycol, vitamins, and minerals.[5] Subjectively, many have observed an enhanced energy state the day of and following the race, with less down time following a race and less post race joint swelling, not requiring significant therapies.[5] D-ribose has also shown energy benefits to the heart during stressful conditions without untoward consequences. Schneider et al reported the enhancing recovery of ATP levels and function with D-ribose following global myocardial ischemic stress.[6] This natural carbohydrate should be given consideration for its enhancing energy benefits following stressful conditions, including high-intensity exercise.

Disclosure

The authors declare no conflicts of interest in this work.

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