Recent Molecular Advances in Equine Nutrition from Test Tube to Practice

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The use of molecular techniques has increased our understanding of biological systems; in particular how genes and proteins operate within a cell or organ in response to various stimuli. These techniques can be used to study modes of action or mechanisms in disease states, or in response to applied management or nutritional changes. While applied and basic research are often conducted independent of one another, the real advantages to the equine industry will come from the use of molecular techniques to address applied challenges and/or opportunities within the industry. Therefore, the overall goal of our research has been to use basic and molecular tools to investigate modes of action resulting from changes in nutrition or management.

We investigated active nutrient transport capacities of the small and large intestine, the effects of feed withdrawal on intestinal transporter gene expression and function, as well as other measurements pertaining to gut health (gut barrier function and gastrointestinal morphology). This novel and thorough approach to characterize sectional differences (fore- and hind- gut) of nutrient absorption has resulted in quantitative measures of active transport capacity for glucose, phosphorus, glutamine, lysine, and di-peptides in the horse. This research demonstrates that by-products of fermentation in the cecum such as microbial proteins and hydrolyzed phytate phosphorus, can be absorbed in the colon. Previously unidentified in the hindgut of the horse, we reported the expression of the di- and tri-peptide transporter, PepT1, as well as the neutral amino acid transporter, ASCT2, and transport of their substrates. We observed that nutrient transporters for glucose (SGLT1), glutamine (ASCT2) and for di-peptides (PepT1) can be regulated by diet, implying biological relevance to feeding management strategies.

Feed withdrawal in horses pre- or post-surgery, prior to or during horse shows, during transport, or for other management reason is common. It is therefore important to understand how the removal of nutrients impacts gut health and/or disease susceptibility. The use of molecular techniques has provided a basis for the roles of certain core nutrients during times of feed withdrawal. For example, nutrients such as glutamine play a major role in proliferation and repair in the gut, serve as a major energy substrate, and may provide a means of assessing nutritional stress in the gut. Recent data concludes that following a feed withdrawal, the need for glutamine increases up to 116% in the proximal jejunum, and the gene expression of its transporter (ASCT2) increases by 78%. Additional studies utilizing molecular techniques to address nutritional challenges in the horse include how hormone loss due to ovariectomization impacts the homeostatic regulation of calcium and phosphorus in the horse.

To improve nutrition and feeding management practices in horses, knowledge regarding how and where nutrients are absorbed, utilized and regulated under varying physiologic stressors (disease, exercise, reproductive status, etc.) is needed. The integration of applied and basic research facilitates a better and more complete understanding of mechanisms underlying common health and nutritional challenges facing the equine industry.

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