2024

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Inside

Photo credit Shelley Paulson

Hi, I'm Dr. Randel Raub, Director of Research and Nutrition for Kent Nutrition Group, the makers of Sentinel® Horse Feed.

Throughout my life and career, I've had the privilege of working with horses and horse owners from all walks of life.

Whether you're working with high-end competition horses or senior rescue horses, what they consume can make all the difference. That's why our feeds and supplements are purposely formulated by expert nutritionists with one goal in mind: to help improve the health and well-being of the horse and the people who care for them.

In this issue, we'll explore how our formulas and nutrition team can support your veterinary care in a variety of settings and scenarios. These passionate experts are always on hand to answer your questions and help you craft specialized diet plans for the unique needs of your clients' horses.

From managing equine metabolic syndrome (EMS) and insulin dysregulation (ID) to enhancing the well-being of senior horses, we'll discuss feed solutions that may help lower risk factors and keep horses active and healthy longer.

We'll also dive into the latest advancements in extruded feeds, and how they're specially made to be more easily chewed and digested.

Another key area of focus throughout the issue is the equine gut microbiome, as we continue to learn more about its impact on overall health and performance. Additionally, we'll cover strategies for feeding horses prone to equine gastric ulcer syndrome (EGUS), a common concern for performance horses under stress.

At Sentinel, we're committed to providing quality nutrition and education that empowers veterinarians, trainers, and horse owners to make informed decisions. Our ongoing research reflects the latest breakthroughs in nutrition, and we're excited to share them with you. By staying at the forefront, we aim to give every horse the foundation they need to live a healthy, productive life.

Randel Raub, PhD
Director of Research and Nutrition
Kent Nutrition Group | Sentinel Horse Feed

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EQUINE NETWORK

EquiManagement

SHELLEY PAULSON

Equine Nutrition Breakthroughs

Relevant research about feeding horses that every practitioner should know.

Stacey Oke, DVM, MSc

One could argue that the basics of equine nutrition haven't undergone dramatic changes since the domestication of horses. "Back then," when horses were primarily used for work, they were offered forage supplemented with grains, such as corn, oats, and barley. This is fairly similar to what most horses are fed today. But what we know now is there's a lot more to feeding horses than simply providing forage and concentrates in sufficient quantities for adequate energy.

For example, back in the 1950s and '60s, when horses transitioned from being work animals to leisure/performance animals, nutritionists began recognizing they could modify diet to improve performance. In 1975, Slade et al. reported that horses fed a diet containing 12% fat (9% added corn oil) then ridden 67 kilometers (over 8 to 10 hours) performed better and had higher blood glucose concentrations at the end of the ride than horses fed a control diet containing only 3% fat. Today, research groups (e.g., Burron et al. 2024) are focusing on omega-3 and omega-6 fatty acid supplementation to optimize the ratio of these fats and influence inflammatory responses, disease management, and overall health.

Since the mid-1900s, the field of equine nutrition has exploded with the same force as our horses' waistlines. In the past year or two alone, research pertaining to equine nutrition has been prolific, involving studies on supplements, the intestinal microbiome, hay analysis, equine gastric ulcer syndrome, and obesity accompanying equine metabolic syndrome (EMS)/insulin dysregulation (ID). In this article, we'll review some of the research and share the most practical and intriguing findings and updates.

Supplement Science

Several research groups have looked at the effect of supplementing equine diets with various fats. In 2024, Richards et al. found that camelina, flaxseed, or canola oil supplementation improved horses' coat quality. Camelina oil comes from a low-input, high-yield crop and provides a greater amount of α-linolenic acid, an omega-3 fatty acid, than linoleic acid, an omega-6 fatty acid, compared to other dietary fat sources used in equine diets.

In a 2023 study, Li et al. examined a natural plant supplement called ellagic acid (EA) in Thoroughbred yearlings. They theorized that EA could support the underdeveloped gastrointestinal tracts of young horses to promote feed utilization and growth. EA has antioxidant and anti-inflammatory effects (among others) and gets broken down by microbes in the intestinal microbiome to produce urolithins A and B, as well as isourolithin A, which might be responsible for its biologic effects. After supplementing the horses' diets with either EA for 40 days, Li et al. found improved nutrient digestibility, a more diverse fecal microbiome, and enhanced growth. They concluded, "EA mediates these beneficial effects by regulating the abundance and diversity of intestinal flora, optimizing floral structure, promoting beneficial bacterial colonization, and stimulating the secretion of VFAs (volatile fatty acids) to inhibit pathogenic bacterial growth in the intestine, thus improving intestinal health and microfloral diversity."

See page 15 for more recent research on the gastrointestinal microbiome.

Recommending and Interpreting Hay Analysis

In recent years, commercial laboratories have made hay analysis services more available and affordable through a variety of packages.

According to survey results, only 41.5% of veterinarians were confident in their ability to evaluate hay quality based on forage analysis.

SHELLEY PAULSON

"Nutritional management of health conditions such as insulin dysregulation have highlighted the importance of having a hay analysis to know the nonstructural carbohydrate content of hays and determine suitability," explains Catherine Whitehouse, PhD candidate at the University of Kentucky under the advisement of Laurie Lawrence, PhD. "But hay analysis is also an important management practice for determining the nutritional value of the hay, digestibility, and protein and mineral content. It can be a useful piece of information when developing rations for different classes of horses and selecting suitable hays."

As part of her PhD work, Whitehouse and Lawrence distributed a survey to Kentucky Association of Equine Practitioners members to get veterinarians' perspectives on selecting and evaluating hay and the relationship between hay feeding practices, horse health, and behavior.

The results showed that while most veterinarians were very confident or confident about identifying hay types (78%) and evaluating hay quality based on sensory characteristics such as color and smell (73.2%), only 41.5% were very confident or confident in evaluating hay quality based on forage analysis.

"In fact, hay sampling and analysis services were not routinely offered to clients," says Whitehouse. "Only 50% of veterinarians had submitted a sample for analysis, with the most-selected reason being to evaluate nonstructural carbohydrates (35%)."

When asked where they would refer clients requesting this service, 11% of veterinarians were unsure, while 67% selected county extension agent and 19% commercial lab.

Whitehouse says the veterinary respondents were familiar with the University of Kentucky Extension program and indicated they would recommend it to their clients looking for nutritional services such as hay sampling and analysis.

"This preliminary survey provides valuable information regarding nutrition-based interactions between veterinarians and their clients that can be used to develop educational materials," Whitehouse says, adding, "The majority of veterinarians agreed it would be useful to have educational resources to share with their clients on selecting hay for different horse types, sensory evaluation of hay, and interpreting a forage analysis. We are looking to develop guidelines to help advise veterinarians and their clients on which chemical analysis to select to provide the necessary nutrient data for their intended goals and how to interpret and apply the results of hay analysis into practical feeding recommendations."

The Elephant in the Barn

"Hands down, one of the biggest topics in equine nutrition in the past several years is obesity," says Shannon Pratt-Phillips, PhD, faculty at North Carolina State University.

Obesity abounds even among athletes. In Pratt-Phillips's own 2023 study, 35% of 377 elite competitive hunter ponies were considered obese, with body condition scores of 7 or higher.

"These findings show that elite competition ponies are dangerously overweight and that adiposity may influence performance in a judged event," she and her colleagues wrote. "This is of grave concern to the horse industry and needs to be addressed."

In addition to the concerns associated with simply being overweight, studies have confirmed the link between obesity, EMS, ID, and hyperinsulinemia-associated laminitis (HAL). Much research has also been generated concerning appropriate feeding of horses for weight management and improving ID (e.g., Macon et al. 2024).

"While the management of ID with diet and exercise has dominated the research front, the effect of obesity casts a wider net," says Pratt-Phillips. "Reproduction, muscle health, and performance are also affected by obesity."

For example, Fresa et al. (2024) report that in addition to contributing to metabolic disorders, obesity is associated with cellular dysfunction and an increase in reactive oxygen species.

Catandi et al. (2024) reported mitochondrial dysfunction in oocytes and granulosa cells, which could potentially contribute to impaired fertility. In that study, granulosa cells, follicular fluid, and cumulus-oocyte complexes were collected from follicles ≥ 35 mm during estrus and after induction of maturation in obese and normal mares. They found that "Obesity promoted several mitochondrial metabolic disturbances in granulosa cells, reduced L-carnitine availability in the follicle, promoted lipid accumulation in cumulus cells and oocytes, and increased basal oocyte metabolism."

Finally, Pratt-Phillips and Ahmad Munjizun, PhD, reviewed obesity's impact on exercise performance (2023) and found it requires animals to perform at a higher workload, puts them at risk for heat stress, might contribute to gait abnormalities, and might hasten osteoarthritis development. "Overweight horses have to work harder, might not be able to perform as well as their leaner counterparts, and will likely have shorter performance careers," Pratt-Phillips says.

Conversations About Equine Weight Management

Because of the serious welfare concerns associated with obesity and the number of affected horses, great effort is needed to swing the needle in the direction where obesity is the exception, not the norm. Tamzin Furtado, BA(Hons), AdvDip, PhD, a social scientist studying the horse owner psychological aspect of equine weight management, has conducted a significant amount of research on human behavior's role in weight management. She has published several studies, including one exploring the psychology of equine weight management and identifying areas where behavior change might be better supported.

"In the past, the veterinary field has assumed most owners of overweight horses either don't know or don't care that their horse is overweight, but this is not often the case," she explains. "It is much more frequent for people to know their horse is overweight, at least on some level, but not have the time or capacity to change."

She adds, "When veterinarians assume an owner doesn't care, then the obvious way to 'help' the owner is by giving them new information. They may say, for example, 'Your horse is fat. If he stays this way his health is at risk; you need to change now.' Unfortunately, humans aren't great at processing long-term risk, so this approach can make people feel defensive. In response, the mechanism owners use to protect themselves is, 'That person is mean/they don't understand me/what I'm going through.' "

Those owners, Furtado says, are generally not being difficult; slow commitment to change is normal, psychologically speaking, and as a species we're adapted to try not to change unless we must.

"To top this off, none of us likes being told what to do," Furtado says. "Therefore, trying to make it simple for people (e.g., by telling them how to change by doubling the exercise and soaking the hay) can make people more resistant to change as they rehearse in their head all the reasons they can't follow the advice they've been given."

Nevertheless, we need to help these owners but with an understanding of the process of change.

"Behavior change science tells us that people are much better at making changes if they're in a positive frame of mind, they feel supported by others, and they feel the change is their choice. This is called self-autonomy theory," relays Furtado.

So, instead of "telling" owners, Furtado recommends inviting people into the conversation and using their own ideas, which is shared decision-making. For example, starting a conversation about weight by asking, "What do you think of the horse's weight at the moment?" allows the vet to get information about the owner's awareness of their horse's obesity, what language they're comfortable with, and how ready they are to talk about it.

"This same approach can be used throughout the conversation, asking questions like, 'What do you think would be the best way to manage his weight?' and 'Would you like me to help tailor that with you?' This approach is much more positively received than the standard, 'Do this, this, and this,' " Furtado says.

Embracing Equine Nutritionists

Furtado published a 2021 study on how to use the science of human behavior change to address weight management. "That article considered the veterinary-client interactions from a behavior change psychology perspective to determine how veterinary professionals can best assist owners," she says. "An approach based on supportive and empathetic conversation is best for leading discussions on weight management, alongside tailored weight loss solutions which are agreed by the owner and the vet."

Such discussions and tailored medicine, however, are not always possible for primary equine practitioners because of constraints such as time, patience, or knowledge about change behavior. This is why Furtado, Pratt-Phillips, and other nutritionists agree that veterinarians should consider partnering with nutritionists to tailor diets with owners committed to their horses' weight loss journeys.

"Practitioners can also work with other members of the horse's health care team, such as farriers and physiotherapists, because all these people have an interest in helping maintain healthy body condition, but for different reasons," adds Furtado.

In sum, Pratt-Phillips says, "Obesity increases the risk of laminitis, metabolic dysfunction, and arthritis and has negative consequences on reproduction and performance. These issues can decrease the quality of life for horses. Experienced and formally educated equine nutritionists are available to help horse owners and their veterinarians make dietary management plans to reduce and avoid obesity and improve the welfare of our horses." EM

Sentinel's equine nutrition team is available to help you and your practice make dietary recommendations, educate clients, and provide your patients with quality nutrition. Submit your nutrition questions and get expert advice at **KentFeeds.com/vet-hub**.

Managing EMS & ID Horses

Researchers continue to hammer home the importance of diet when it comes to preventing serious health problems in these horses.

By Nancy S. Loving, DVM

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Worldwide, many horses and ponies are overfed and underexercised—a combination that can easily result in obesity. Fat deposits and obesity induce important changes to a horse's metabolic state, leading to hormonal imbalances and insulin dysfunction, which can snowball into laminitis. Because these conditions are so serious, researchers have dedicated significant time and efforts to understanding obesity's underlying pathophysiology and finding ways to mitigate its adverse effects. With this insight, veterinarians can help educate horse owners on how to achieve preferable body weights in their horses and manage hormonal aberrations in obese animals.

Consider Metabolic Differences in Obese and Nonobese Horses

Obesity contributes to equine health problems such as endocrine dysfunction, insulin dysregulation, laminitis, orthopedic disease, infertility, and poor performance. The term equine metabolic syndrome (EMS) describes a condition often characterized by obesity, insulin dysregulation, and subsequent laminitis. Because gastrointestinal microbiota contribute to the development of metabolic disease, researchers are looking into intricate changes within the microbiome and the metabolome (metabolites of these microorganisms). In a recent study, Coleman et al. aimed to determine if it's possible to identify horses at risk of obesity by characterizing the fecal microbiota and metabolome and serum lipidome of obese vs. nonobese horses.[1]

The study involved two groups of 20 horses from seven farms: 20 obese horses with body condition scores (BCS) ≥ 7 and 20 nonobese controls with BCS of 3-5.

Previous study results have identified decreased fecal microbial diversity in EMS horses. More sophisticated evaluation techniques are homing in on accurate identification by using whole genome sequencing rather than just focusing on sequencing the 16S ribosomal RNA gene. While Coleman et al. did not find microbiota differences between obese and nonobese horses, they noted differences in the GI metabolome (fecal metabolites) resulting from nutrient ingestion, digestion, and absorption as well as differences in the circulating lipidome.

The most telling difference relates to intermediates of the mitochondrial tricarboxylic acid (TCA, aka Krebs) cycle that drives anaerobic respiration of cells to produce ATP energy. The study authors said it's possible that "alterations in energy metabolism of gastrointestinal bacteria contribute to development of persistence of obesity despite appropriate dietary and exercise regimens."

Obese horses showed significant increases in circulating free fatty acids compared to control horses. In humans, increased levels of these lipids contribute to insulin resistance and systemic inflammation. The lipid profile of horses resembles that of obese humans.

Take-Home Message for Veterinarians: Alterations in the metabolome and lipidome of obese vs. nonobese horses suggest these two groups of equids metabolize energy differently. This might help explain why some horses do not lose weight despite feeding and exercise programs designed for weight loss. While these researchers did not appreciate differences in fecal microbiota between the two groups, the differences in metabolites were significant. Going forward, these innate differences might help veterinarians better identify horses at risk of developing obesity and implement interventions early, before related sequelae set in.

9 Dietary Strategies for Managing Hyperinsulinemia

Strategies for dealing with hyperinsulinemia (HI) and EMS include dietary management, exercise, pharmaceuticals, and corrective farriery. The authors of a recent Australian study stress that dietary modification is a critical component to managing HI in horses with EMS.[2]

Insulin-dysregulated horses' insulin response to oral sugars is a significant predictor of laminitis, referred to as hyperinsulinemia-associated laminitis (HAL). Feeding horses at risk of (or that have developed) laminitis centers on preventing hyperinsulinemia. Horses that are highly insulin dysfunctional have exaggerated insulin responses to most feeds even when consuming "small" amounts of nonstructural carbohydrates (NSC).

To help prevent HI following feeding, the study authors recommend a number of dietary strategies:

1. Eliminate feeds high in NSCs, such as grain, pasture, and cereal hay.
2. Implement a weight loss program to minimize biologically active adipokines produced in adipose tissue that play a role in ID development in obese horses. Veterinarians and their clients can accomplish this by:
   - o Restricting energy intake.
   - o Increasing energy output through 30 minutes of moderate exercise three to five times per week, if possible.
   - o Targeting weight loss rates of 0.5-1% body weight each week, tailored to the individual horse.
3. The bulk of the diet should be in the form of hay low (< 10%) in water-soluble carbohydrates (WSC) fed at 1.5-2% body weight. It can be divided into small meals and supplemented with a low-calorie ration balancer.
   - o If a horse isn't responding with weight loss at this amount fed, it is possible to limit forage intake to 1% body weight to more rapidly decrease hyperinsulinemia and body weight by 1% per week.
   - o A study showed that a horse losing 1% of body weight per week did not develop permanent undesirable behaviors or squamous gastric disease. The one issue to watch for with forage restriction is pica and, potentially, sand colic.
4. Weigh hay to know how much to offer.
5. Soaking hay and pouring off the supernatant helps decrease the glycemic and insulinemic response by reducing sugar content up to 31%. Some researchers say soaking in tap water for 30-60 minutes prior to feeding is sufficient, while others recommend soaking for six to eight hours. Longer soaks might reduce the hay's dry matter and mineral content in addition to reducing sugars, making it important to provide the horse with a balancer supplement. They give no guarantee, however, that NSC content will reduce below 10% with this strategy. Start with a low-WSC forage that is safe to feed, and soak for additional benefit.
6. A slow feeder makes hay rations last longer and helps minimize pica and periods of boredom.
7. Another strategy for weight loss involves feeding a 50/50 mixture of hay and straw. Monitor for risk of impaction colic from coarse straw.
8. Restrict pasture access, since NSC intake exacerbates hyperinsulinemia.
   - o If turning at-risk horses out in pasture, limit turnout to short periods and use grazing muzzles.
   - o A grazing muzzle reduces grass intake by 30-80%, depending on muzzle design and horse adeptness.
   - o Turnout in early morning hours is best because grass sugar content is at its lowest. Bring horses in by mid-morning.
   - o Stress to pasture from frost, herbicides, and poor soil nutrients is known to increase sugars within plants such that even early morning pasture is too rich in sugars.
   - o Use poor grazing areas or strip grazing for turnout.
9. Supplement with a prebiotic (such as fructo-oligosaccharides and yeast) that promotes the growth of beneficial gut bacteria to provide a protective effect against insulin resistance and EMS.[3]

Lean horses with EMS that do not display the typical obese appearance are the most challenging to feed. The study authors suggest using oils or rice bran for calorie substitution and supplementing with digestible fiber such as beet pulp without molasses. These supplements do not exacerbate hyperinsulinemia yet help the horse maintain body weight.

Take-Home Message for Veterinarians: Dietary management is key to controlling a horse's insulin response and tendency toward hyperinsulinemia that increases laminitis risk. Weight loss alone does not always resolve ID. The study authors recommend measuring insulin pre- and 60-90 minutes post-ingestion to determine the best dietary strategy for minimizing postprandial insulin response. Each horse responds differently to feeding strategies, so tailor the diet accordingly. Sentinel experts are available to help develop customized feeding programs for affected horses at kentfeeds.com/vet-hub. EM

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The Latest on Extruded Feeds

Understanding extruded feeds and the science behind them can help veterinarians make more informed diet recommendations for clients' horses.

Alexandra Beckstett

COURTESY EQUIMANAGEMENT STAFF

The equine feed industry is packed with options claiming to optimize equine health and performance. You have products manufactured to meet all types of equine energy and nutrient requirements in forms ranging from textured to pelleted to extruded. Among these, extruded feeds have garnered attention because of their unique processing methods and subsequent impacts on digestibility, nutrient availability, and more. For veterinarians, understanding extruded feeds and the science behind them can allow for informed diet recommendations—particularly for horses with specific nutritional needs or health concerns.

Understanding the Extrusion Process

Extrusion technology uses heat, pressure, and moisture to produce a feed product that is not only highly palatable but also has enhanced nutrient digestibility. Extruded feeds undergo a transformation at the nutrient level, breaking down complex carbohydrates and proteins into simpler, more easily digestible forms.

"Extrusion is the most technologically advanced method of equine feed processing," says Jeanne van der Veen, MS, Equine and Specialty Nutritionist with Kent Nutrition Group. "During the extrusion process, the ingredients are pressure-cooked, combining high pressure, heat, and moisture to rapidly cook the ingredients and form the feed."

The ingredients themselves are ground about one-third finer than what they would be in a pelleted feed. "When you grind those ingredients finer, you increase the surface area, and if you increase the surface area of those ingredients, you increase the digestive efficiency of those ingredients," explains Randy Raub, PhD, director of research and nutrition for the Kent Nutrition Group. "Then those ingredients are going to be cooked, if you will, at a higher temperature and for a little longer duration (than pelleted feeds), and then the extruding process facilitates a little bit more steam and pressure to drive them through the die."

As a result, the starch and sugar portions of the feed ingredients gelatinize—what Raub refers to as a kind of "pre-digestion" to ensure those elements don't end up undigested in the horse's hind gut. The protein fraction also undergoes pre-digestion into the individual amino acids—a key step in protein digestion.

"With about 75% of the immune system located in the gut, anytime you can improve the horse's digestive system, you're going to see better health," adds van der Veen.

The Unique Characteristics of Extruded Feeds

An extruded feed has several physical characteristics that give it digestive advantages:

Breaking strength. Extruded feeds break under just 10-15 pounds of pressure compared to pelleted feeds with average breaking strengths ranging from 23-28 pounds (and some upward of 35 pounds), Raub explains. A lower breaking strength facilitates ease of chewing, which is crucial for senior horses and those with dental issues.

Water dynamics. Extruded particles tend to draw up moisture faster than pelleted particles. If you soak pellets in water for about five minutes, for example, they'll be wet, fluffy, and sticky on the outside but remain hard on the inside, says Raub. Extruded particles, on the other hand, will maintain their form without adhering to each other, but will have a mushy consistency throughout. Extruded feeds, therefore, can help prevent choke in at-risk horses.

Fewer fines. Fines are the small crumbles and dust-like particles that collect in a feed bag. "Even though those extruded particles are easier to break, pieces don't break off as easily as with a pelleted feed," says Raub. Extruded feeds will have fewer fines and might produce less wastage and tiny particulates that could irritate horses' respiratory systems.

Density. Extruded particles are light, airy, and less dense than pelleted particles, meaning a pound of extruded product is going to have a greater volume for the horse to consume than a pound of pelleted product. "It will take longer for the horse to chew and consume that given pound of feed, and that's a good thing," says Raub.

All these elements contribute to increased digestive efficiency, which means you might be able to feed less concentrate while delivering the same amount of nutrients to the horse. "That leaves more room for hay in their diet, and that's a good thing every day and twice on Sunday," Raub adds.

Putting Science Behind the Product

While limited research has been conducted on extruded equine feeds specifically, we do have some insight as to how their form and function benefit the horse:

- Saliva flows from the horse's salivary glands only during mastication, and sodium-bicarbonate-rich saliva acts as a buffering agent against gastric hydrochloric acid.
- Poor mastication and bolting feed can lead to esophageal obstruction.
- Prolonged mealtime can improve nutrient digestibility and gut motility as well as help prevent gastrointestinal disorders such as gastric ulcers and colic.
- Heat-based processing techniques like extrusion improve starch digestibility in the small intestine and might help prevent colic- and laminitis-inducing starch overload in the hindgut.

Raub and his team are adding to our body of knowledge. They're conducting a study to assess horses' jaw movements per pound of extruded feed versus pound of pelleted feed.

"Our hypothesis is that a horse is going to utilize more jaw movement per pound of extruded feed than a typical pelleted feed because it's a greater volume for that horse to consume," he explains. "They're also going to take a little longer to consume that same amount of feed. If the horse takes longer to consume that concentrate portion, it may enhance digestive efficiency. And if they have to move their jaw more per pound of feed, it generates more saliva."

The study horses will wear halters that measure and record jaw movement electronically. Raub's team will use that data to assess the number of chews or jaw movements each horse makes while consuming an entire meal and also measure the time it takes the horse to consume a meal.

Take-Home Message

The extrusion process enhances digestibility and nutrient availability by breaking down complex carbohydrates and proteins into simpler, more easily absorbed forms. These feeds are particularly advantageous for horses with specific health concerns or needs, such as seniors or those prone to choke and gastric ulcers. As the body of research on extruded feeds grows, veterinarians can devise more informed nutrition strategies for their clients' horses. EM

GETTY IMAGES

A forthcoming study will assess horses' jaw movements per pound of extruded feed vs pelleted feed.

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Scan the QR code to watch a video about how horses can benefit from extruded feed.

Feeding Today's Senior Horse

Science-based best practices for older horses of all types and health statuses.

Jennifer Selvig, DVM

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As veterinary care and nutrition options for horses improve, senior horses comprise an increasingly large proportion of the equine patient population. Medications are improving horses' quality of life and usefulness well into their 20s and sometimes 30s, and proper nutrition is an essential part of equine longevity. Most horses must consume 1.5-2% of their body weight daily to maintain condition; however, this is highly dependent on the quality of the feed offered and each horse's individual metabolism. Therefore, feeding senior horses requires some special considerations.

As horses age, feed digestion can be hindered at several levels of the gastrointestinal tract. Poor dentition is the most easily recognized: Worn incisors or the presence of equine odontoclastic tooth resorption and hypercementosis (EOTRH) can make tearing forage difficult or cause pain while prehending feed. Worn, expired, damaged, and missing cheek teeth make chewing and swallowing grass and hay difficult. The small intestine loses some ability to digest protein effectively as horses age. The hindgut loses efficiency to ferment fiber, which reduces the horse's ability to absorb nutrients from long-stem forage. Aged horses are also much more likely to develop pituitary pars intermedia dysfunction (PPID), which can cause muscle atrophy or wasting, especially along the topline.

All these age-related changes mean the feeds and forages offered to senior horses should be of high nutritional value and easily digestible. Protein should comprise properly balanced amino acids, and concentrates should be processed via extrusion or into pellets or flakes to improve digestibility.

Underweight Senior Horses With or Without Poor Dentition

Senior horses commonly struggle to maintain an adequate body condition. If a senior horse can still chew and swallow grass and hay effectively, high-quality forage that is soft and immature is the best option. Horses won't ferment stemmy, overmature forage as effectively. Softer cuttings of alfalfa can easily add calories. For these horses, a "senior" or "complete" feed is not necessarily required, but a high-calorie concentrate, fed at the label recommendations, should be offered. Some pelleted performance feeds might fit the bill; alternatively, a ration balancer with an added calorie-dense supplement can be effective.

For horses that have limited or no ability to chew and digest hay, a complete feed is often the best choice. These feeds, often labeled as "senior," have different types of forage built into them (e.g., beet pulp, alfalfa meal, soy hulls), so a horse can get its fiber requirement from the feed. While horses don't digest these feeds in the same way they do true long-stem forage, they are very useful for horses that cannot digest stemmier fibers. Alternatively, hay pellets, soaked hay cubes, soaked beet pulp, and chopped hay products can be offered as alternatives to regular long-stem forage.

It is important to offer senior feed or alternative forage products at least three times per day to avoid GI tract problems associated with periods of fasting. For an average-sized horse, this might mean offering 15 or more pounds of extruded, pelleted, or texturized feed per day, divided into several meals. In extreme cases of poor dentition, most of these products can be soaked into mashes for ease of consumption.

Overweight Senior Horses With or Without Insulin Dysregulation

While underweight horses can benefit from free-choice forage, overweight horses sometimes benefit from restricted access to forage. If dentition allows, offering a more mature and stemmier hay can help keep overweight horses "busy" eating without providing too many calories. The entire diet should not exceed 1.5% of the horse's body weight. Hay nets, small meals multiple times per day, and grazing muzzles can help make hay last longer if it must be restricted.

For horses with insulin dysregulation (ID), the Equine Endocrinology Group recommends choosing hay with less than 10% nonstructural carbohydrates and adding a low-starch ration balancer. If necessary, soak hay in cold water for 60 minutes before feeding, which reduces some of the sugars. Pasture is not recommended.

PPID With or Without Insulin Dysregulation

Body condition score, degree of muscle wasting, and evidence of ID are the most important factors to consider when feeding horses with PPID. If ID is not present, PPID horses can be fed according to body condition and might benefit from complete feeds if dentition dictates. Additional high-quality amino acid products and pasture grazing might still be appropriate for these patients. PPID should also be treated with appropriate medical therapy.

When both PPID and ID are present, NSCs should be limited as with obese ID horses. Forage should not exceed 10% NSCs if possible. If the horse is on the thin side, offer low-starch senior feeds or add fat supplements and/or highly digestible fiber products, such as alfalfa pellets, to a low-starch ration balancer.

Free Fecal Water Syndrome

Free fecal water syndrome (FFWS) becomes more likely as horses age. The hindgut loses some capacity to reabsorb water due to leaking between the tight junctions of the cells of the colon walls. FFWS, while not life-threatening, can cause dermatitis on the hind limbs from loose stool that dries on the skin.

Some horses improve in response to a softer and more easily digestible forage (pasture, chopped hay, soft cuttings of hay, etc.). Others improve when fed high-quality pre- and probiotics, including *Saccharomyces*, though study results have indicated the microbiomes of horses affected with FFWS are not significantly different from unaffected horses. Sometimes, switching to a complete feed—eliminating long-stem forage—can improve symptoms.

Equine Asthma

This chronic respiratory condition can worsen as horses age. Minimizing environmental factors that exacerbate asthma is key. Soaking, wetting down, or steaming hay can be very effective in eliminating dust and some mold. Offer only high-quality hay that was put up dry. Commercial options such as hay pellets, hay cubes, and chopped forages can be less-dusty alternatives. Omega-3 fatty acids, such as the DHA found in fish oil, can be effective in regulating the body's inflammatory response and have been shown to improve clinical signs in horses with asthma.

Take-Home Message for Veterinarians: Senior horses can present medical and logistical challenges when it comes to providing them with optimal nutrition. Owners have access to many commercial feed options for this class of horse. The veterinarian's role is to assist in developing effective feed programs by evaluating each individual horse's health status and tailoring available products to its needs. EM

Feeding to Guard Against Gastric Ulcers

What we know and what we're learning about diet's role in preventing gastric ulcer development.

Nancy S. Loving, DVM

ADOBE STOCK

Gastric ulcer syndrome (GUS) is an overriding term for two anatomically distinct types of gastric ulcers: equine squamous gastric disease (ESGD) and equine glandular gastric disease (EGGD). Because they occur in two different parts of the equine stomach, these lesions differ not only in their pathophysiology but also in their treatment and management approaches. Let's review existing and emerging nutritional recommendations for preventing both ESGD and EGGD.

Our Current Knowledge About EGUS Prevention

In general, management is key to both prevention and treatment. According to a recent overview of GUS, dietary management is a strategy of major importance. The authors discussed common-sense feeding recommendations and the most significant factors for GUS prevention: roughage, exercise, and the diet's nonstructural carbohydrate (NSC) content.[1]

Historically, we believed offering horses free-choice forage was the primary strategy to use for ESGD prevention. As time went on, this strategy showed inconsistent results, in part because of "a circadian rhythm of foraging and inconsistent effects of pasture on ESGD." Most horses consume the bulk of their forage intake during daylight hours. Just offering free-choice hay doesn't mean a horse will consume a sufficient amount; the owner might need to measure exactly how much the horse eats. For horses that aren't dealing with obesity issues, the recommendation is to provide forage in the amount of 2% of their body weight per day.

Feeding hay prior to exercise has a buffering effect, with as little as 300 grams of hay protecting against ESGD. Feeding and duration of exercise are not as critical when it comes to preventing EGGD; rather, horses should receive two to three full rest days each week.

A low-NSC diet with the bulk of it fed as forage is considered a good strategy for all equine nutritional plans. Study results show that low-NSC diets and reduced dietary starch can help lower ESGD and EGGD incidence.

Vegetable oil supplementation is invaluable for providing calories to substitute for high-NSC supplements. Dietary oil is beneficial for managing EGGD but has little effect on lesion healing for ESGD. Feeding polyunsaturated fatty acids (PUFAs) helps regulate systemic inflammation, particularly for EGGD prevention and management. Omega-3 fatty acids (fish-oil based) are beneficial for reducing inflammation; in contrast, omega-6 fatty acids (corn oil) might amplify inflammation.

Trials with pectin-lecithin supplements such as beet pulp show encouraging results for reducing the risk of ESGD and improving both ESGD and EGGD. This dietary supplement works best when a horse is not faced with intermittent fasting.

Multiple studies have examined the use of a variety of nutraceutical supplements to prevent GUS:

- In two studies without controls, horses in high-level training were supplemented with licorice root extract, magnesium hydroxide, calcium carbonate, and aloe vera. They experienced fewer and less serious squamous and glandular lesions over 30 days.
- A micronized soy product showed some protection against ESGD.
- A rice extract seemed beneficial for reducing ESGD scores and lesion healing.
- Sea buckthorn berries showed some protection against worsening of EGGD but not ESGD.
- Hyaluronan and schizophyllan improved preexisting ESGD and EGGD lesions.

While these ingredients provide a hopeful look at options for managing GUS, the authors note: "Many of the nutraceutical studies do not account for variabilities in feeding and management changes in different populations." Further, nonclinical models of disease might not be relevant for multifactorial-related clinical disease.

Take-Home Message for Veterinarians: It is most important to focus on dietary management of gastric disease and use nutraceuticals only as an adjunct to comprehensive management practices. The authors of this review study counsel caution when attempting to extrapolate results from other species or from studies that are not evidence-based or lack controls.

The Impact of High Sugar and Starch and Low Roughage and Meal Frequency on GUS

The equine digestive system evolved to intake small portions of forage with frequent browsing and grazing. In response, gastric acid secretion is relatively continuous. With fasting, strong acid levels collect in the stomach. Researchers in Denmark recently evaluated the impact of low forage intake coupled with high NSC intake.[2]

Horses in intense exercise (e.g., galloping) might be affected by gastric acid contacting the nonglandular mucosa. Forage in the stomach provides protection against this "splash effect." Frequent meals that cumulatively provide 1.5-2% of a horse's body weight help mitigate this gastric ulceration risk. Food intake and chewing also stimulate saliva production, which further buffers stomach pH. Feeding only a couple of meals a day with fasting of more than six hours in between increases a horse's risk of developing GUS.

This study also reviewed the effects of a low-forage diet, which increased the number of ulcerative lesions compared to controls. Not only did saliva production decrease, but gastric juices had greater chance of contacting the squamous mucosa, especially during exercise. In contrast, horses fed free-choice forage (hay and/or pasture) develop higher pH in their stomachs due to continuous saliva flow and the presence of forage in the stomach. Alfalfa's high calcium and protein content further buffers stomach acid to protect the squamous mucosa.

The authors noted that despite sufficient forage, if a horse consumes a high-sugar and -starch supplement of more than 1 g/kg body weight per meal, the forage component might not be as protective against the development of ulcerative lesions. Starch digestion produces lactic acid and has adverse effects on the integrity of the stomach mucosa.

A potentially useful therapy that has not yet been studied in horses is a potassium-competitive acid blocker (PCAB) that might negate the need for proton pump inhibitors like omeprazole. This drug binds reversibly to potassium-binding sites to block acid production from parietal cells better than proton pump inhibitors do. It can be administered to fed or fasted horses.

Take-Home Message for Veterinarians: To prevent ESGD, feed forage at a minimum of 1% body weight per day (preferably far more) and maintain sugar and starch intake at less than 2 g/kg/meal (less than 2 pounds per meal). Forage fed at ≥ 2% of body weight does not protect against ESGD when horses are also consuming high-sugar and -starch supplements with each meal.

Dietary recommendations for preventing equine gastric ulcer disease center around a high-fiber and low-starch diet. This strategy is also important for management following cessation of pharmaceutical treatment with proton pump inhibitors. EM

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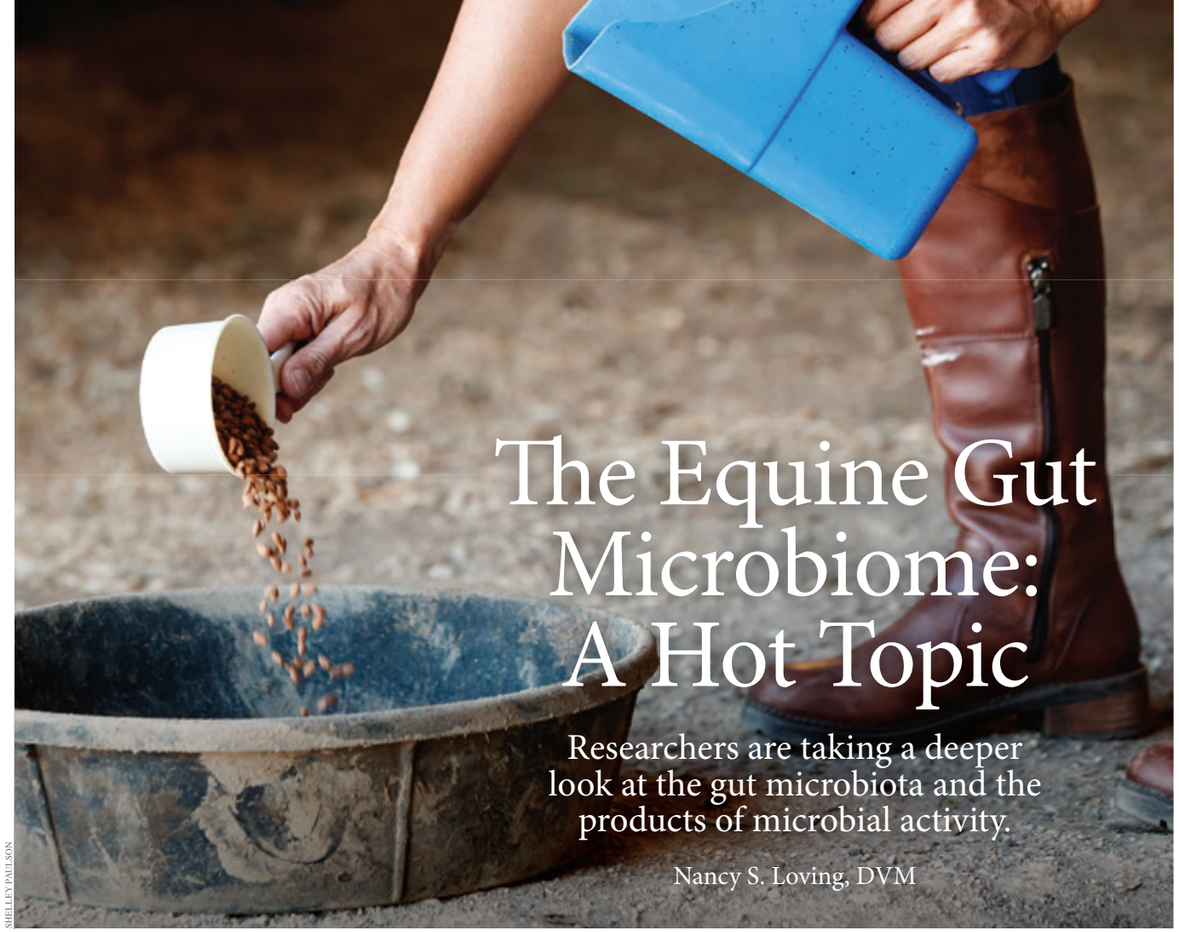

SHELLEY PAULSON

The Equine Gut Microbiome: A Hot Topic

Researchers are taking a deeper look at the gut microbiota and the products of microbial activity.

Nancy S. Loving, DVM

The intestinal tract has a significant impact on a horse's overall health. As such, equine researchers have focused much attention on the diversity of the gastrointestinal microbiome. These intestinal microbial residents affect local mucosal immunity, produce short-chain fatty acids (butyrate, propionate, and acetate) for energy, and develop tolerance to antigens. As a whole, these features help define a horse's well-being. For instance, immune modulation within the intestines comprises 60% of a body's immune function. A balanced microbiome and its bacterial byproducts contribute to metabolic health. And the gut-brain axis has significant impacts on a horse's behavior.

Researchers have extended beyond the microbiome to look deeper at the gut microbiota's metabolic impacts. While the diversity of bacterial species within a horse's intestinal tract is important, each horse is an individual with differing bacterial constitutions. Further, these bacteria are in a constant state of change depending on the food ingested, the horse's environment, medication given, season, and daily stressors.

No longer are researchers just looking at the collection of which individual bacteria—the microbiome—inhabit the gastrointestinal tract. Rather, they are looking at the products of microbial activity and subsequent function: This is referred to as the metabolome. These are smaller molecules that result from digestion of what a horse has consumed, including medications. Such molecules are important in cell signaling processes from chemicals they produce. The genes intestinal bacteria express are referred to as metatranscriptome, which describes the RNA and identifies which genes are "turned on."

Another area of exploration currently underway is the "exfoliome," which are the cells exfoliated from the intestinal lining as a normal process of epithelial renewal. By looking at mRNA within feces, researchers can determine which genes the epithelial cells lining the gastrointestinal tract express.

What the Microbiome Tells Us About NSAIDs' Effects on the Equine GI Tract

Back in 2019, researchers examined the effect of non-steroidal anti-inflammatories (NSAIDs) on gastrointestinal injury in the horse and how they might mitigate these adverse effects through nutritional

intervention with omega-3 fatty acids, antioxidants, L-glutamine, and prebiotics, probiotics, and postbiotics. In a 2024 study, researchers at the University of Georgia's College of Veterinary Medicine analyzed the metabolome, microbiome, and exfoliome in horses with intestinal injury.[1]

This study involved 20 geldings split into two groups of 10 each—one group received oral phenylbutazone (4.4 mg/kg) once daily for nine days; the other group received a placebo paste. The research team collected feces and performed gastroscopy (with squamous scoring) on Days 0 and 10. Evaluation of microbiota DNA and rRNA, metabolomic (metabolites), and exfoliome RNA indicated that phenylbutazone incorporates into intestinal epithelial cells to cause mitochondrial injury and oxidative stress.

Under normal homeostatic conditions, the gastrointestinal mucosa is hypoxic to maintain an anaerobic environment that supports the many facultative or obligate anaerobes residing in the gut microbiota. Changes in the oxygen content from oxidative stress within the gut lumen alter the microbiota, metabolome, and exfoliome within the equine intestinal tract. Consequently, aerobic bacteria thrive where they wouldn't normally, while certain obligate anaerobes—especially those responsible for butyrate production—diminish. These changes can potentially lead to inflammation and causative injury to the intestinal mucosa from oxidative stress and the occurrence of unfolded proteins along the endoplasmic reticulum. Such injury is reversible once the NSAID is eliminated. Appropriate supplementation (see recommendations in the next section) can further mitigate the adverse effects of NSAIDs.

'Feeding the Microbiome' Can Help Prevent Gut Dysbiosis

The objective of "feeding" the microbiome is to nourish the favorable gut bacteria. Feeding in this context relies not just on nutrition but also exercise, medications, and a horse's environment, daily routine, tasks, travel, competition, and stress.

Diet is a key element in feeding gut microbiota. In another recent study, researchers examined management strategies to prevent gut dysbiosis in horses.[2]

The authors posed the following dietary recommendations for optimal gastrointestinal health of the microbiome:

- At least 60% of a horse's diet, and preferably more, should be high-quality forage. This promotes good function of the bacteria that ferment fibers to produce short-chain fatty acids such as butyrate and help maintain stable bacterial communities.
- Processed grains and concentrates should be limited as much as possible due to poor small intestinal digestion that causes them to spill over into the large colon where they ferment to cause acidosis and bacterial cell death.

Supplementation with pre-, pro-, and postbiotics can affect intestinal bacterial health. Here's how:

- Prebiotics—psyllium, beet pulp, fructo-oligosaccharides from plants, and good-quality forage—are useful in that they are fiber-based and can provide nutrition to existing and beneficial gut microorganisms.
- Examples of probiotics include live organisms such as *Saccharomyces* (a yeast), *Lactobacillus*, *Bifidobacterium*, and *Enterococcus*, which are lactic-acid-producing bacteria. Yeast has probiotic functions for fiber digestion. *Saccharomyces* might provide the best benefits to microbiota modulation, based on study results.
- Concerningly, many probiotics lack reliable evidence for efficacy—the contents of a commercial bucket often do not contain the labeled organisms or amounts of those organisms within those products. Further, live organisms might not be able to sufficiently bypass the equine stomach's acidity to colonize the large colon where they are needed; cecal fermentation might further diminish their viability.
- Postbiotics are metabolites and soluble byproducts like butyrate produced by gut microorganisms after feeding on fiber. Butyrate provides energy and nutrition to intestinal epithelial cells to further strengthen tight junctions between the cells. This optimizes the gut barrier's integrity to prevent leaky gut syndrome.

Take-Home Message for Veterinarians: Researchers are currently examining metabolomic data from within the microbiome to identify biomarkers that could indicate leaky gut problems. This information might help veterinarians and nutritionists tailor a diet specific to a horse's needs to favorably alter gut microbiome bacteria and affect the metabolome products' activity and function. Specific diets—based on the above components—promote proliferation of favorable bacteria and production of their metabolites (metabolome). This can stabilize intestinal pH and other intestinal environmental factors important to ensuring a healthy microbial balance in the equine gut, which in turn contributes to the horse's overall health. EM

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