



A small stomach relative to overall size means the horse was designed to eat continuously or at least small meals frequently

More Than a Gut Feeling

RECENT STUDIES PROVIDE INSIGHTS
ON GASTROINTESTINAL TRACT HEALTH

By AMANDA DUCKWORTH

IF THE DIFFERENT parts of a horse could compete in a race to win the title of “most important in terms of good health,” a likely photo finish between the feet and the gut would follow.

It is unlikely anyone would argue about the necessity of soundness, but equally, a distressed digestive system can lead to a number of issues ranging from stress to death. Colic, colitis

(diarrhea), and equine gastric ulcer syndrome (EGUS) are just some issues equines routinely face.

The foregut and hindgut make up the two major components of the equine digestive system. The foregut comprises the esophagus, stomach, and small intestine while the hindgut consists of the cecum, large colon, small colon, and rectum.

Dr. Lydia Gray explains the size differential in “Nutrition: The Key to Unlocking Your Horse’s Health” for the American Association of Equine Practitioners (AAEP).

“Relative to a horse’s overall size, its stomach is very small, making up less than 10% of its entire digestive tract and holding only about two gallons,” Gray said. “On the other hand, the colon makes up almost half of the horse’s digestive tract and can hold about 15 gallons. These two differences are important and should affect the way a horse is fed.

“The horse’s small stomach means it was designed to eat continuously or at least small meals frequently. The large colon is actually a fermentation ‘vat’ staffed by bacteria that ferment fiber the horse is unable to digest itself, manufacturing nutrients like energy and B-vitamins.”

Within their intestinal tracts, horses have a community of microorganisms known as microbiota that interact in the hindgut. Every horse has its own gut microbiota, as unique as a fingerprint. Gaining a better understanding of this area potentially can improve equine gut health in the future. In November 2019, *Animal Microbiome* reviewed this important field of study in “The gut microbiome of horses: current research on equine enteral microbiota and future perspectives.”

“Understanding the complex interactions of microbial communities including bacteria, archaea, parasites, viruses, and fungi of the gastrointestinal tract (GIT) associated with states of either health or disease is still an expanding research field in both human and veterinary medicine,” researchers explained. “GIT disorders and their consequences are among the most important diseases of domesticated *Equidae*, but current gaps of knowledge hinder adequate progress with respect to disease prevention and microbiome-based interventions.”

As more research gets underway in

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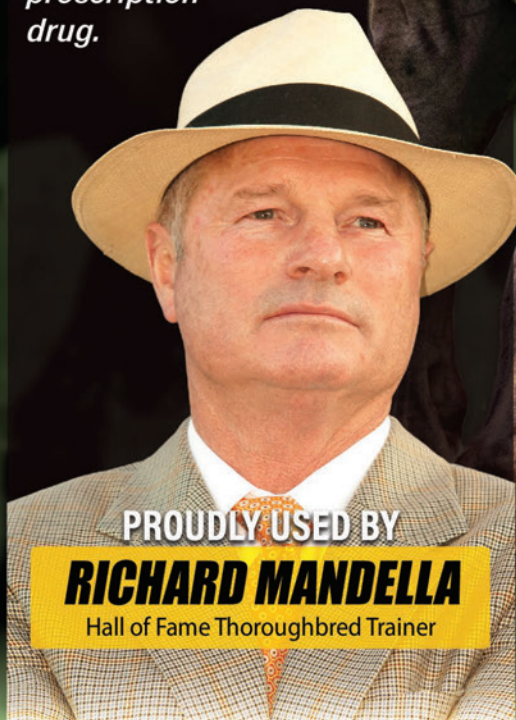
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this realm, one study went back to the very beginning to see how factors such as location, habitat, and domesticity could impact gut health in equines. In February 2022, *Communications Biology* published “Gut Microbiome Characteristics in feral and domesticated horses from different geographic locations.”

“The horse gastrointestinal tract includes two large fermentation chambers, the colon and the cecum, and the well-being and survival of horses rely on the undisturbed fermentative function,” explained researchers. “These chambers are inhabited by diverse microbiota, including bacteria, protozoa, and fungi; however, the composition and activity of the microbiome remain largely unknown.

“In this study the fecal microbiota of horses from five different locations and habitats across three continents were investigated. The results show significant differences in the microbiome of horses, depending on geographic origin and habitat.”

For the study, researchers examined the fecal microbiome of 57 domestic and feral horses. Among their discoveries,



A recent study found that wild horses carry a higher abundance of eukaryote and viruses and a lower amount of archaea than their domesticated counterparts

they concluded that a higher abundance of eukaryota and viruses and lower amount of archaea were found in feral animals when compared with domestic ones. Meanwhile, they found that domestic horse microbiomes are enriched in genes conferring resistance to tetracycline, leading them to conclude this likely reflects the use of this antibiotic in equine management.

“The data revealed major differences between feral and domesticated animals, thus demonstrating the evolutionary role of domestication-associated antibiotics, feed, and environment,” concluded researchers. “In the future, these results could lead to novel targets

for modulating microbiome and for the characterization of new combinations of horse microbes to develop effective microbiome-restoring approaches.”

One of the most obvious clues something has disrupted the delicate balance of the equine gut is the softening of a horse’s stool. Researchers examined the differences in “Comparative Analysis of Gut Microbiota Between Healthy and Diarrheic Horses,” which was published by *Frontiers in Veterinary Science* in May 2022.

“Increasing evidence reveals the importance of gut microbiota in animals for regulating intestinal homeostasis, metabolism, and host health,”

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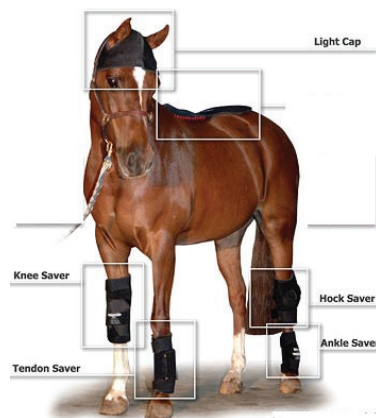
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explained researchers. “The gut microbial community has been reported to be closely related to many diseases, but information regarding diarrheic influence on gut microbiota in horses remains scarce.”

For the study, 16 horses—eight that presented as normal, and eight experiencing diarrhea—were used. Researchers compared gut microbial changes in horses during diarrhea and concluded that the alpha diversity of gut microbiota in diarrheic horses decreased observably, accompanied by obvious shifts in taxonomic compositions.

“Compared with the healthy horses, the relative abundances of Planctomycetes, Tenericutes, Firmicutes, Patescibacteria, and Proteobacteria in the diarrheic horses were observably decreased, whereas Bacteroidetes, Verrucomicrobia,

and Fibrobacteres were dramatically increased,” concluded researchers. “Moreover, diarrhea also resulted in a significant reduction in the proportions of 31 genera and a significant increase in the proportions of 14 genera. Taken together, this study demonstrated that the gut bacterial diversity and abundance of horses changed significantly during diarrhea. Additionally, these findings also demonstrated that the dysbiosis imbalance of gut microbiota might be an important driving factor of diarrhea in horses.

“The results showed that diarrhea dramatically decreased the gut microbial diversity and altered the taxonomic composition, characterized by a reduced percentage of intestinal beneficial bacteria. This study fills in the gaps in the characteristics of gut microbiota in healthy and diarrheic horses and con-

veys a vital message that gut microbial dysbiosis might be one of the causes of diarrhea in horses. Importantly, this study contributes to the prevention and treatment of diarrheic horses from the gut microbial perspective.”

As unwelcome as diarrhea is, when it comes to horses and gut health, perhaps nothing concerns owners more than the risk of colic. It is a complex issue, with no set answer. In April 2022, *Open Veterinary Journal* explored this topic in “Changes in the gut microbiome and colic in horses: Are they causes or consequences?”

“The gut microbiome is a compound for millions of microorganisms that co-exist in an organized way and contribute to the fermentation of different types of indigestible fibers by the small intestine,” explained researchers. “Some

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techniques, such as the massive sequencing of the 16S ribosomal RNA gene, have made it possible to obtain information about the abundance and functionality of the microorganisms that compose the equine gut microbiome and the interaction with their environment. Recent studies have identified the change in the composition of the intestinal microbiome during and after a colic episode, although is not clear if it is a cause or a consequence.”

For the review, researchers aimed to explain whether there is a direct relationship between colic and the changes that happen in the microbiome. To do so, they examined previously published research.

“The bacterial community composition in horses with colic is different from healthy horses, characterized by a less diverse population and changes in the relative abundance of some phyla and bacteria species,” they concluded. “In healthy animals, a predominance of the phyla Firmicutes and Bacteroidetes has been identified while in horses with colic these phyla decrease and Proteobacteria increases. However, more studies are required to establish a causal relationship between these alterations and the presentation of colic in horses.”

Colic in a younger horse is also an important area of study,



According to increasing evidence, gut microbiota is important to the horse's overall health

as age-related disparities in survival have been noted in multiple studies, across many species, including horses, humans, and pigs. In the case of colic, being younger is not better. In November 2021, *Animals* (Basel) published the review “Age-Dependent Intestinal Repair: Implications for Foals with Severe Colic.”

“Colic in foals cannot always be prevented, so understanding the causes, symptoms, and patterns of injury and healing can improve interventions available to improve outcomes for young patients,” said researchers. “Presently, the neonatal defect in restitution identified in the pig model in a prior study is thought to be due to the relatively immature ENS in the postnatal period. The mechanisms of ENS maturation are not yet well characterized, and research to identify contributions of dietary inputs, microbiota, the ENS, and stress will be critical.

“In equine patients, this enteric glial network maturation may vary from other species as the foal microbiome may be greatly impacted by coprophagy beginning in the first week of life and natural creep feeding of small amounts of grain, hay, and grass within the first two months of life, well before true weaning. Understanding how these processes drive maturation of intestinal repair mechanisms in foals can inform the development of new management strategies, preventative measures, and clinical interventions to mitigate the severity of injury and enhance repair responses to reduce morbidity and mortality rates among foals experiencing severe colic.”

The microbiome is delicate, so it should come as no surprise it is affected by more than things such as location or a severe distress such as colic. Common factors such as age, obesity, and weight-loss can all have a significant impact. In December 2018, *Frontiers in Microbiology* published “The Equine Gastrointestinal Microbiome: Impacts of Age and Obesity.”

“Gastrointestinal microbial communities are increasingly

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being implicated in host susceptibilities to nutritional/metabolic diseases; such conditions are more prevalent in obese and/or older horses,” explained researchers. “This controlled study evaluated associations between host-phenotype and the fecal microbiome/metabolome.”

For the study, 35 Welsh Mountain ponies were monitored over the course of two years. They were divided by control, obesity, and whether they were considered aged or not. Feces were sampled on the final three days of hay-feeding periods.

“Copy numbers for fecal bacteria, protozoa, and fungi were similar across groups, whilst bacterial diversity was increased in the obese group,” researchers said. “Over 500 bacterial op-



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erational taxonomic units (OTUs) differed significantly between host-phenotype groups. No consistent pattern of changes in discriminant OTUs between groups were maintained across groups and between years.

“The current study demonstrates that host-phenotype has major effects on equine fecal microbial population structure. Changes were predominantly

associated with the obese state, confirming an obesity-associated impact in the absence of nutritional differences. Clear biomarkers of animal-phenotype were not identified within either the fecal microbiome or metabolome, suggesting functional redundancy within the gut microbiome and/or metabolome.”

In March 2020 the same research team published “The equine gastrointestinal microbiome: impacts of weight-loss” in *BMC Veterinary Research*.

“Obesity is an important equine welfare issue,” explained the researchers. “Whilst dietary restriction is the most effective weight-loss tool, individual animals range in their weight-loss propensity. Gastrointestinal-derived bacteria play a fundamental role in host-health

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and have been associated with obesity and weight-loss in other species.”

For the study, researchers evaluated the microbiome of 15 obese Welsh Mountain pony mares in the same 11-week period across two years. Eight were studied in the first year while seven were in the second. The ponies had a four-week pre-diet phase before seven weeks of dietary restriction. During the final three days of both phases, their feces were collected for study.

“Losses in body mass ranged from 7.11% to 11.59%,” researchers concluded. “Changes in the fecal microbiome composition following weight-loss included a reduction in the relative abun-



A study of Welsh Mountain ponies determined that obesity is an important equine welfare issue

dance of Firmicutes and Tenericutes and a reduction in indices of bacterial diversity. Pre-diet diversity was negatively associated with weight-loss. Pre-diet fecal acetate concentration was a strong predictor of subsequent weight-loss and negatively associated with Sphaerochaeta (Spirochaetes phylum)

abundance.

“Weight-loss in this group of ponies was associated with lower pre-diet fecal bacterial diversity and greater pre-diet acetate concentration. Overall, these data support a role for the fecal microbiome in weight-loss propensity in ponies and provide a baseline for research evaluating elements of the fecal microbiome in predicting weight-loss success in larger cohorts.”

The inner workings of the equine gut make up a complex puzzle with many pieces throughout a horse’s life. Continued study and understanding of the internal balance horses need to thrive can only help owners and veterinarians better cope with inevitable issues that are likely to arise. **BH**

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