Equine Gut & Reproductive Health

The Role of GI Health in Stallions, Broodmares, and Foals

freedom health llc

By Freedom Health, LLC

Published May 2023

All rights reserved



Introduction

Breeding success depends on healthy stallions, broodmares, and foals. The equine digestive system influences all aspects of equine health, and more practitioners are discovering the impact of gastrointestinal dysfunction on equine reproduction.

Modern advancements in equine reproductive health allow clinicians to support their clients' breeding goals with improved diagnostics, enhanced genetic selection, and assisted reproductive techniques.

Clients dedicate more resources than ever to producing a healthy foal. Are you doing everything you can to support their success?

Equine reproductive management begins long before conception. Research shows that providing breeding stock with balanced nutrition and supporting optimal digestive function can significantly increase the chances of a successful pregnancy.

During foaling season, diarrhea and other gastrointestinal issues in neonatal foals are an ever-present concern for horse owners and equine practitioners. But managing foal gut health begins with supporting immune health in the pregnant mare to facilitate the production of high-quality colostrum.

This paper discusses the link between equine gut health and reproductive management. Learn how optimizing nutrition and immunity in breeding horses by supporting gastrointestinal health in stallions, mares, and foals can improve chances of reproductive success.

Table of Contents

Page 2 **Introduction**

Page 4 **The Link Between Gut Health and Reproduction**

Page 4 • Digestive Function in Breeding Horses

Page 6 • Nutrient Absorption for Reproductive Health

Page 6 • The Gut Microbiota and Immune Health

Page 7 **Supporting Fertility in Stallions**

Page 8 • Stress and Body Condition

Page 8 • Nutrients for Sperm Quality

Page 11 **Feeding Pregnant and Lactating Mares**

Page 12 • Broodmare Nutrition

Page 13 • Colostrum Production

Page 16 **Preventing Gastrointestinal Disease in Foals**

Page 17 • Immunity and Foal Diarrhea

Page 18 • Nutrition for Growth

Page 20 **SUCCEED® Digestive Conditioning Program®**

Page 21 • Jessica Harrington Testimonial

Page 22 **Conclusion**

Page 24 **References**

The Link Between Gut Health and Reproduction

The equine reproductive system can't function optimally if the stallion or mare's health is compromised by poor digestive function. But research suggests gastrointestinal disorders are relatively common in horses and often go undiagnosed (Pellegrini, 2005).

Gastrointestinal dysfunction can lead to poor nutrient absorption. Without balanced nutrition, fertility can suffer in breeding horses and developmental disorders can occur in foals (Robles et al., 2021).

Overall immune health also relies on gut health. Eighty percent of the immune system interacts with the equine gastrointestinal tract, and newborn foals rely on antibodies from their mother's colostrum for the passive transfer of immunity (Perkins and Wagner, 2014).

> 80% of the equine immune system interacts with the GI tract.

Digestive Function in Breeding Horses

The equine digestive tract is a large and complex system pivotal in equine patients' overall health and well-being. While gastric ulcers are a common focus of equine practice, the stomach only makes up eight percent of the equine digestive tract's total volume (Van Weyenberg, 2006).

Supporting hindgut health in breeding horses is critical for meeting increased energy demands to support reproductive processes. Stallions and mares can't maintain the body condition necessary for optimal fertility without efficient fiber digestion by a balanced hindgut microbiota (Morley and Murray, 2014).

These horses also require carefully balanced nutrition to get the nutrients they need to support sperm motility in stallions and foal development in pregnant mares. Nutrition changes to support reproduction should begin before breeding season and continue throughout gestation and lactation (Robles et al., 2021).

> Nutrition supports sperm motility in stallions and foal development in pregnant mares.



Nutrient Absorption for Reproductive Health

Good gut health is essential for optimal nutrient absorption. Most nutrient absorption occurs in the small intestine, where digested nutrients move through the intestinal lining and into the bloodstream for utilization. Enteritis and other diseases that cause small intestine inflammation can reduce nutrient uptake (Feary and Hassel, 2006).

All horses need a balanced diet that meets NRC Nutrient Requirements for Horses. But deficiencies in certain nutrients active in equine fertility and gestation can significantly decrease the chances of reproductive success. These deficiencies can contribute to poor sperm quality, reduced broodmare fertility, and abnormal foal development (Robles et al., 2021).

Nutrients that aren't absorbed in the small intestine rely on the microbiota of the hindgut for digestion. However, the equine gut microbiota also plays a role in overall immunity, which significantly influences reproductive health (Venable et al., 2016).

> GI pathologies reduce nutritive uptake, which contributes to nutrient deficiencies, which contribute to poor sperm quality, reduced broodmare fertility, and abnormal foal development.

The Gut Microbiota and Immune Health

The equine digestive tract is home to millions of bacteria, yeast, fungi, and protozoa that comprise the equine gut microbiota. Research continues to reveal the importance of balanced gut microbiota to digestive health, immunity, neurologic health, and glucose metabolism (Venable et al., 2016).

A balanced gut microbiota consists primarily of beneficial microbes that aid digestion and defend against harmful bacteria and other pathogens. But medications, dietary changes, and stress can unbalance the gut microbiome. Stress is also associated with reduced immunity, and studies show that increases in the stress hormone cortisol can inhibit horse reproduction (Berghold et al., 2007).

Early development of the gut microbiota in foals relies on the mare. Colostrum produced by the mare for the foal to consume immediately after birth provides critical nutritional components that establish immunity and promote a balanced microbiota. A healthy gut supports quality colostrum production in mares, which supports a healthy gut in foals (Mousquer et al., 2021).

A healthy microbiota also helps preserve digestive function in stallions subject to stressful demands during the breeding season.

A healthy gut supports quality colostrum production in mares, which supports a healthy gut in foals.

Supporting Fertility in Stallions

Several genetic and environmental factors influence fertility in breeding stallions, including nutrition. While nutrition alone won't make infertile stallions fertile, poor gut health and nutrition in breeding stallions can significantly limit reproductive success (Varner et al., 2014).

Reproduction increases dietary energy demands in stallions during the breeding season. Research in other animals demonstrates that extreme body weight can increase the risk of infertility. But digestive disease and elevated stress levels can make maintaining optimal body condition for breeding challenging (Mantovari and Balloni, 2011).

Promoting the production of quality sperm is also vital for supporting stallion fertility. Sperm production relies on several nutrients from the diet, including omega-3 fatty acids, polar lipids, and antioxidants. And studies show that deficiencies in these nutrients can reduce sperm concentration and motility (Bazzano et al., 2021).

Efficient digestion is essential for avoiding these deficiencies. If your client has a breeding stallion with low-quality sperm, poor gut health could be to blame.

Sperm production relies on several nutrients from the diet:

- Omega-3 fatty acids
- Polar lipids
- Antioxidants

Stress and Body Condition

Body condition is one the best predictors of reproductive performance in horses. Breeding stallions should maintain a body condition score of 5–6 to support fertility. Stallions often lose condition during the breeding season due to the demands of covering mares if their diets don't meet their energy and protein requirements.(Bazzano et al., 2021).

Studies evaluating salivary cortisol in horses found elevated stress hormone levels in stallions during the breeding season. These results suggest that breeding duties can increase stress levels in stallions (Aurich et al., 2015).

Other studies have established a link between higher stress hormones and an increased risk of gastric ulceration and other gastrointestinal diseases. These digestive health conditions can contribute to weight loss and prevent stallions from getting the energy they need from their diets (Malmkvist et al., 2012).

Targeted management to support optimal digestive function during stressful periods can help prevent weight loss in breeding stallions.

However, excessive body weight is also detrimental to reproductive performance. Obese stallions have worse overall health and lower fertility than fit stallions. Covering mares also requires stamina, so over-conditioned stallions may not have the athletic endurance necessary to perform breeding duties (Hurtgen, 1992).

Owners and practitioners should work together to develop a balanced nutrition program that maintains optimal body condition and closely monitors weight changes in stallions while breeding. A balanced diet also provides essential nutrients that support sperm quality.

> **Breeding season stress ➔ GI disease ➔ low nutritive uptake ➔ weight loss ➔ low energy ➔ low fertility**



Nutrients for Sperm Quality

New research suggests that targeted supplementation with specific nutrients can improve sperm quality and motility in breeding stallions. This research is of significant interest to the equine practitioner as increased sperm motility and concentration are associated with increased chances of success in assisted equine reproduction (Colleoni et al., 2011).

Omega-3 Fatty Acids

Sperm cell membranes contain high omega-3 fatty acid docosahexaenoic acid (DHA) levels. Fresh pasture is a natural source of omega-3 fatty acids in the equine diet, but breeding stallions often have limited access to grazing. Inadequate DHA levels can compromise sperm health and significantly reduce fertility (Brinsko et al., 2005).

One study found that supplementation with DHA improved sperm motility in cooled semen and increased pregnancy rates for stallions that struggled with fertility issues. However, more research is needed to determine optimal intake levels for breeding stallions (Brinsko et al., 2005).

DHA

Found in: Sperm cell membranes

Supplementation:

- May improve sperm motility
- May increase pregnancy rates

Polar Lipids

The high lipid content of the sperm membrane makes these cells vulnerable to oxidative stress, which research suggests can contribute to lower fertility in breeding stallions. One study found that improved oxidative status was associated with increased sperm production during the breeding season (Morte et al., 2008).

Antioxidants

These results support the importance of antioxidants in the diets of breeding stallions. Nutrients like vitamin E, vitamin C, and beta carotene have antioxidant properties and play essential roles in controlling oxidative stress in horses. Enteritis and other intestinal diseases can interfere with the absorption of these nutrients in the small intestine (Garcia et al., 2022).

Other Nutraceutical Ingredients

Research is ongoing on the effects of other nutraceutical ingredients, such as l-carnitine, on stallion fertility. While owners have many options for supplementing specific nutrients in breeding stallions, supplementation can't work without proper digestive function. Therefore, practitioners should consider including targeted digestive support in supplementation programs.

Feeding Pregnant and Lactating Mares

Preparing broodmares for pregnancy and lactation requires practitioners and owners to pay significant attention to gut health and nutrition. Broodmares have unique nutritional requirements during different stages of pregnancy, and poor gut health prevents mares from getting the nutrients they need to support fertility and foal development (Robles et al., 2021).

Normal foal development relies heavily on balanced nutrition in utero. Once the foal is born, nutritional requirements increase significantly to maintain body condition in mares while providing nursing foals with adequate essential nutrients (Doreau et al., 1988).



Often, forage alone isn't enough to meet these requirements. However, an increased volume of concentrates can increase the risk of gastrointestinal disease in horses. As a result, many broodmares benefit from additional digestive support to preserve gut health (Drogoul et al., 2001).

A healthy gut is also critical for broodmare immunity. Foals rely on a passive transfer of antibodies from their mother's colostrum to start building a robust immune system. Research shows broodmare gut health significantly influences colostrum quality and that digestive support can positively impact colostrum production (Bacvarova and Buechner-Maxwell, 2012).

> Foals rely on a passive transfer of antibodies from their mother's colostrum during nursing to start building a robust immune system.

Broodmare Nutrition

Like stallions, body condition score is also a reliable predictor of reproductive success in broodmares. Mares with a body condition score above five have increased fertility, and research shows that mares with lower body condition scores are more likely to conceive while gaining weight.(Morley and Murray, 2014).

However, over-conditioned mares have an increased risk of equine metabolic syndrome and other chronic diseases that can reduce fertility. Practitioners and owners should work together to develop a nutrition program that maintains broodmares at an optimal body condition score of around six during the breeding season and monitor for gastrointestinal disorders that may cause weight loss (Burns, 2016).

> **Body Condition Score**
>
> Mares with a body condition score above five have increased fertility.

Studies also show that feeding patterns can impact fertility in broodmares. One study found that continuous foraging increased conception rates in mares. Free choice forage is also associated with optimal digestive function in horses, which suggests that management practices that promote gut health can also increase reproductive success (Benhajali et al., 2013).

Pregnant mares have energy requirements similar to nonpregnant ones until mid to late pregnancy. Most fetal growth occurs during the last three months of gestation when nutrient requirements increase significantly. Broodmares need higher dietary energy and protein levels during this stage to support fetal development (Fowden et al., 2019).

Deficiencies in vitamins and minerals during pregnancy can contribute to the occurrence of developmental disorders in foals. Supplementations may be necessary to avoid common deficiencies in selenium, copper, calcium. and vitamin E. Gastrointestinal diseases during pregnancy can contribute to deficits by preventing adequate nutrient absorption even when mares eat a balanced diet (Peugnet et al., 2016).

Lactation is a highly physiologically demanding stage for broodmares. Their nutritional requirements increase the most during this stage to provide nursing foals with enough nutrients for growth. Mares will sacrifice their own protein, mineral, and calorie stores for milk production when their diets don't meet these requirements (Doreau et al., 1988).

Lactating mares need constant access to high-quality forage, but many can't meet their nutritional requirements for milk production without additional concentrates. However, grain is associated with several equine gastrointestinal diseases that can further decrease feed efficiency (Clarke et al., 1990).

Digestive support can promote optimal gut health in broodmares to limit the risk of weight loss during lactation. Loss of condition during lactation in mares consuming an appropriate diet could indicate an underlying gastrointestinal disorder.

Colostrum Production

Before mares begin milk production, they produce hundreds of milliliters of colostrum. This thick, sticky, yellowish fluid contains higher protein, fat, vitamins, minerals, and sugar levels than milk. Colostrum also contains maternal immunoglobulins, critical for establishing immunity in newborn foals (Barreto et al., 2020).

Immunoglobulins are a class of proteins used by the immune system to defend the body against infection. Broodmares transfer the building blocks of immunoglobulins from their bloodstream into the colostrum during the final few weeks of pregnancy. Pre-foaling vaccinations help increase the antibodies in the colostrum and protect newborn foals from disease (Wilson et al., 2010).

Colostrum quality varies depending on the concentration of immunoglobulins, or IgG content. Keeping broodmares in optimal body condition with quality nutrition during gestation is critical for supporting the production of quality colostrum. Weight loss or nutrient deficiencies due to poor gut health during pregnancy can lead to low-quality colostrum (Sobral et al., 2023).

Broodmares are also subject to management changes during pregnancy and after foaling that disrupts their digestive system. Changes in routine can elevate stress levels in horses, contributing to gut microbiota disruptions and compromised immune function. Mares with lower immunity have lower serum immunoglobulin levels (Knight et al., 1989).

Colostrum immunoglobulin content is strongly correlated to serum immunoglobulin levels in mares. Therefore, maintaining mare immune function is critical for improving colostrum quality. Research suggests that nutritional support that promotes a balanced gut microbiota and healthy intestinal lining can enhance immunity in broodmares and increase IgG content (Carter et al., 2006).

Just as gut health influences immune health in broodmares, the immunity provided by colostrum directly impacts gastrointestinal concerns in newborn foals (Palmer, 1985).

Colostrum

Before mares begin milk production, they produce hundreds of milliliters of colostrum.

- Contains higher protein, fat, vitamins, minerals, and sugar levels than milk.
- Also contains maternal immunoglobulins, critical for establishing immunity in newborn foals.



Preventing Gastrointestinal Disease in Foals

Diarrhea in foals is one of the most prevalent clinical problems practitioners face during the breeding season. Producing a healthy foal is the primary goal of equine reproduction, but many foals struggle with gastrointestinal diseases during their first months of life (Palmer, 1985).

The naive immune system of newborn foals makes them susceptible to harmful environmental pathogens that cause digestive problems. Foals also don't have a fully stabilized gut microbiota at birth. The establishment of the gut microbiota in foals is subject to ongoing research. Still, studies suggest the mare's microbiome, colostrum, and nutrition all influence the initial colonization of the equine digestive tract (Mousquer et al., 2021).



Foals rely on colostrum from their mother for the passive transfer of immunity immediately after birth. High levels of colostrum IgG are essential for the health of the newborn foal. By ensuring foals get adequate colostrum during their first 24 hours of life, practitioners can help limit the risk of diarrhea in young foals (Kohn et al., 1989).

> Diarrhea in foals is one of the most prevalent clinical problems. By ensuring foals get adequate colostrum during their first 24 hours of life, practitioners can help limit the risk of diarrhea in young foals.

Good digestive function is essential for foals to get the nutrition they need to support healthy growth. Nursing foals rely on milk to meet their nutritional requirements. When horses transition to solid feedstuffs, digestive support can help limit the gastrointestinal risks associated with weaning stress (Carter et al., 2006).

Immunity and Foal Diarrhea

While foals have a functional immune system at birth, they have low antibodies that aren't optimized for pathogens. Unlike human females, mares have six tissue layers separating the fetus from circulation. Only small molecules can reach the foal in utero, making the transfer of large antibodies from the mare to the foal impossible during gestation (Wilsher and Allen, 2012).

Antibodies are proteins used by the immune system to counteract disease-causing pathogens. The foal's naive immune system leaves the suckling unprotected from viral and bacterial infection at birth. As a result, foals depend heavily on the passive transfer of antibodies from mare colostrum after birth for immune strength (Perkins and Wagner, 2014).

The newborn digestive tract can only absorb large antibodies during the first 18 hours of life. Then, the gut closes gradually. At 24 hours, newborn foals can't absorb antibodies through the intestinal walls into the bloodstream. If neonatal foals fail to get adequate colostrum during this window, or the colostrum doesn't contain enough IgG, they have an increased risk of bacterial infections that can contribute to diarrhea (Kohn et al., 1989).

> The newborn digestive tract can only absorb large antibodies during the first 18 hours of life.

Colostrum also contains antimicrobial enzymes and proteins that protect the foal's gut from colonization with harmful microbes. Foals develop a gut microbiota by ingesting amniotic fluid, colostrum, milk, and mare feces. The gut microbiota changes as the foal begins to consume new food sources. Harmful microbes can easily disturb the dynamic balance of the foal microbiota if foals don't have immunity from colostrum (Lindenberg et al., 2019).

Foal diarrhea, or scours, is a significant health concern in foals. Even if diarrhea isn't related to infection, this condition can quickly cause dehydration and even become fatal in foals. While some research suggests probiotics can aid the management of diarrhea in adult horses, few studies support the use of probiotics for foal gut health (Magdesian, 2005).

Proper environmental management can help limit exposure to harmful pathogens and encourage foals to develop healthy gut microbiota. However, supporting quality mare colostrum production has the most significant impact on preventing future incidences of diarrhea in neonates.

Research suggests that mare microbiota also significantly influences the development of the foal microbiota. So, feeding management and digestive support that promotes a healthy gut in the mare are vital for establishing the microbial ecosystem of the foal's gut (Quercia et al., 2019).

Nutrition for Growth

Nutritional deficiencies in growing foals can lead to developmental disorders that impact long-term health and soundness. Therefore, gastrointestinal disorders in foals can have lasting impacts on horse health if they prevent foals from getting the nutrition they need to support healthy growth (Becrova, 2012).

Healthy foals quadruple their weight during the first five months of life, so supporting milk production in the lactating mare and gut health in the nursing foal is critical. When foals transition to alternative feed sources, they frequently begin by investigating forage feed intended for the mare (Becvarova, 2012).

Healthy foals quadruple their weight during the first five months of life.

Owners can gradually introduce concentrates to foals after three months of age. Practitioners should help ensure owners select a feed that provides adequate fortification as part of a balanced, forage-based diet. Promoting feed efficiency and digestive function is vital, as excessive grain intake is a risk factor for developmental orthopedic disease (DOD).

The skeleton is vulnerable to these diseases while the foal grows. Angular limb deformities can affect rapidly growing foals at 60 days of age, and diligent management is critical before the physical closure of the fetlocks occurs in 90-120 day-old foals. But the physeal plates of the carpus and knees don't close until 18 months of age.

Nutrient deficiencies, excesses, and imbalances can all affect skeletal development and increase the risk of osteochondrosis dissecans (OCD) during this time. However, weaning also occurs during this stage of the foal's life (Lepeule et al., 2009).

Weaning is a stressful period for foals and the accumulation of stress can significantly affect digestive health. But poor digestive function during this period can impede growth and contribute to other health problems. Research suggests practitioners and owners can mitigate these risks during weaning by providing digestive support to weanling foals (Carter et al., 2007).



SUCCEED® Digestive Conditioning Program®

SUCCEED® Digestive Conditioning Program® (DCP) is a patented supplement formula that supports a healthy gastrointestinal tract in stallions, broodmares, and foals (and all horses). This natural approach to total gut health helps maintain digestive function through a daily nutritional program that fits readily into your clients' breeding programs.

Every ingredient in SUCCEED® is backed by detailed research and scientific support for its usefulness in correct digestion:

- Oat Flour (rich in Beta Glucan)
- Oat Oil (rich in Polar Lipids)
- Irradiated Dried Yeast (The Saccharomyces Cerevisiae Strain of Yeast)
- L-Threonine
- L-Arginine

“My aim is to get all my horses to win when I have them and I feel using SUCCEED® helps me when trying to achieve this goal. To achieve winners, I need my horses to be 100% in fitness and in health. That’s why I use SUCCEED® as a gut health feed supplement for my horses, seeing an improvement in them straightaway once adding it to their diet. We use it day to day, and it is improving our horse’s overall health and their performance on the track. I recommend SUCCEED® to everyone as it’s a product I trust, and believe it enables my horses to achieve and maintain their optimum performance.”



Jessica Harrington
Horse Trainer, Ireland

SUCCEED®
Digestive Conditioning Program®
Every horse at its best!™

For a SUCCEED® Digestive Conditioning Program™ trial please contact:

Sandra Hughes ROI - 0873781739 | shughes@freedomhealthllc.com

Emma Hardy UK - 01522309946 | ehardy@freedomhealthllc.com

Conclusion

This paper examined the link between equine gut health and reproduction through the effects of digestive function on nutrition and immunity in stallions, mares, and foals. Although research is ongoing to understand how gastrointestinal health affects reproductive success, studies consistently show that better gut health translates to better outcomes for equine reproduction veterinarians and breeders.

By supporting optimal gut health in breeding horses from conception to weaning, practitioners can help their clients produce a healthy foal and achieve their goals.

freedom health llc

Manufacturers of SUCCEED®

The Equine Digestive Health Experts



References

Aurich, J. et al. Effects of season, age, sex, and housing on salivary cortisol concentrations in horses. Domest Anim Endocrinol. 2015.

Barreto, I. et al. Chemical composition and lipid profile of mare colostrum and milk of the quarter horse breed. PLoS One. 2020.

Bazzano, M. et al. Use of nutraceuticals in the stallion: Effects on semen quality and preservation. Reprod Domest Anim. 2021.

Becvarova, I. & Buechner-Maxwell, V. Feeding the foal for immediate and long-term health. Equine Vet J. 2012.

Bedding, P. & Pellegrini, F. Effect of using a nutritive supplement on equine gastric ulcer incidence and severity, and on digestive tract bleeding. Freedom Health. 2006.

Benhajali, H. et al. Temporal feeding pattern may influence reproduction efficiency, the example of breeding mares. PLoS One. 2013.

Berghold, P. et al. Effects of reproductive status and management on cortisol secretion and fertility of oestrous horse mares. Anim Reprod Sci. 2007.

Brinsko, S. et al. Effect of feeding a DHA-enriched nutraceutical on the quality of fresh, cooled, and frozen stallion semen. Theriogenology. 2005.

Burns, T. Effects of common equine endocrine diseases on reproduction. Vet Clin Equine Pract. 2016.

Carter, S. et al. Effect of adding SUCCEED® to the diet of pregnant mares 90 days pre-foaling. Freedom Health. 2006.

Carter, S. et al. Studying the effects of the SUCCEED® Digestive Conditioning Program® on the development of Standardbred horses at weaning. Freedom Health. 2007.

Clarke, L. et al. Feeding and digestive problems in horses: Physiologic responses to a concentrated meal. Vet Clin North Am Equine Pract. 1990.

Colleoni, S. et al. New methods for selecting stallion spermatozoa for assisted reproduction. J Equine Vet Sci. 2011.

Doreau, M. et al. Energy requirements and the feeding of mares during lactation: A review. Livest Prod Sci. 1988.

Drogoul, C. et al. Feeding and microbial disorders in horses: 2: Effect of three hay:grain ratios on digesta passage rate and digestibility in ponies. J Equine Vet Sci. 2001.

Feary, D. & Hassel, D. Enteritis and colitis in horses. Vet Clin Equine Pract. 2006.

Fowden, A. et al. Physiological development of the equine fetus during late gestation. Equine Vet J. 2019.

Garcia, E. et al. Dietary supplements of vitamins E, C, and β-carotene to reduce oxidative stress in horses: An overview. J Equine Vet Sci. 2022.

Hurtgen, J. Evaluation of the stallion for breeding soundness. Vet Clin North AM Equine Pract. 1992.

Kohn, C. et al. Colostral and serum IgG, IgA, and IgM concentrations in Standardbred mares and their foals at parturition. J Am Vet Med Assoc. 1989.

Lepeule, J. et al. Association of growth, feeding practices, and exercise conditions with the prevalence of Developmental Orthopaedic Disease in limbs of French foals at weaning. Prevent Vet Med. 2009.

Lindenberg, F. et al. Development of the equine gut microbiota. Sci Rep. 2019.

Magdesian, K. Neonatal foal diarrhea. Vet Clin Equine Pract. 2005.

Malmkvist, J. et al. Behavior and stress responses in horses with gastric ulceration. Appl Anim Behav Sci. 2012.

Mantovani, R. & Bailoni, L. Energy and protein allowances and requirements in stallions during the breeding season, comparing different nutritional systems. J Anim Sci. 2011.

Morley, S. & Murray, J. Effects of body condition score on the reproductive physiology of the broodmare: A review. J Equine Vet Sci. 2014.

Morte, M. et al. The quantification of lipid and protein oxidation in stallion spermatozoa and seminal plasma: Seasonal distinctions and correlations with DNA strand breaks, classical seminal parameters and stallion fertility. Anim Reprod Sci. 2008.

Mousquer, M. et al. Factors influencing the composition and balance of foals' microbiota. Res Soc Dev. 2021.

Palmer, J. Gastrointestinal diseases of foals. Vet Clin North Am Equine Pract. 1985.

Pellegrini, F. Results of a large-scale necroscopic study of equine colonic ulcers. J Equine Vet Sci. 2005.

Perkins, G. & Wagner, B. The development of equine immunity: Current knowledge on immunology in the young horse. Equine Vet J. 2014.

Peugnet, P. et al. Management of the pregnant mare and long-term consequences on the offspring. Theriogenology. 2016.

Quercia, S. et al. Early colonisation and temporal dynamics of the gut microbial ecosystem in Standardbred foals. Equine Vet J. 2019.

Robles, M. et al. Nutrition of broodmares. Vet Clin North Am Equine Pract. 2021.

Sobral, G.G.D. et al. Effect of supplementation with saccharomyces cerevisiae and β-glucans to mares during late gestation on colostrum quality and passive transfer of immunity in foals. J Equine Vet Sci. 2023.

Van Weyenberg, S. et al. Passage rate of digesta through the equine gastrointestinal tract: A review. Livestock Sci. 2006.

Varner, D. et al. Stallion fertility: A focus on the spermatozoon. Equine Vet J. 2014.

Venable, E. et al. Role of the gut microbiota in equine health and disease. Anim Front. 2016.

Wilsher, S. & Allen, W. Factors influencing placental development and function in the mare. Equine Vet J. 2012.

Wilson, W. et al. Passive transfer of maternal immunoglobulin isotype antibodies against tetanus and influenza and their effect on the response of foals to vaccination. Equine Vet J. 2010.



www.succeed-vet.com

877-734-6588

SUCCEED® is a registered trademark of Freedom Health LLC. © 2023. All Rights Reserved