

At Beslemede Probiyotik Kullanımı

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ÖZ

Bu çalışma, probiyotiklerin at yetiştiriciliğindeki potansiyel etkilerini incelemektedir. Probiyotiklerin bağırsak sağlığını destekleyerek sindirimi iyileştirdiği, bağışıklık fonksiyonlarını güçlendirdiği ve üreme performansını artırdığı gösterilmiştir. Bağırsak mikrobiyotası ve at sağlığı arasındaki ilişki ele alınarak, probiyotiklerin bağırsak dengesizliklerini önleyici ve tedavi edici etkileri vurgulanmıştır. Araştırmalar, probiyotiklerin kısrakların gebelik oranlarını artırdığını, tay gelişimini desteklediğini ve üreme organlarındaki enfeksiyon riskini azalttığını göstermektedir. Çalışmada, en uygun probiyotik türleri, dozlama stratejileri ve yönetim uygulamalarının entegrasyonu ele alınmıştır. Sonuç olarak, probiyotiklerin at yetiştiriciliğinde önemli bir yenilik sunduğu, ancak bu alandaki potansiyelin tam olarak anlaşılabilmesi için daha fazla araştırmaya ihtiyaç duyulduğu belirtilmektedir. Probiyotiklerin bilinçli kullanımı, at sağlığını iyileştirebilir ve atçılık endüstrisinin daha sürdürülebilir hale gelmesine katkı sağlayabilir.

Probiotics in Horse Nutrition

Review

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ABSTRACT

This study examines the potential effects of probiotics in horse breeding. Probiotics have been shown to support gut health, improve digestion, strengthen immune functions, and enhance reproductive performance. The relationship between gut microbiota and horse health is discussed, emphasizing the role of probiotics in preventing and treating gut imbalances. Research indicates that probiotics can increase pregnancy rates in mares, support foal development, and reduce the risk of infections in reproductive organs. The study explores optimal probiotic strains, dosing strategies, and integration with management practices. In conclusion, probiotics present a promising innovation in horse breeding; however, further research is needed to fully understand their potential. The conscious use of probiotics can improve horse health and contribute to a more sustainable equine industry.

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1. Introduction

Probiotics, in the form of supplements or food products, have emerged as the most prominent ingredient in the era of functional foods. Probiotics have always been a vital component and commercial target for providing potential health benefits (Hamad et al., 2022). The term “probiotic” was first presented by Werner Kollath in 1953, which is known to be a derivative of the Latin word pro and the Greek

word βιο meaning “for life. Food and Agriculture Organization (FAO) and World Health Organization (WHO) described them as “live microbes when administered in adequate quantities, confer health benefits on host organisms” (Munir et al., 2022). Probiotics, which have been used in animal husbandry for many ailments in recent years, are candidates to become an indispensable food supplement for the equine sector (Hamad et al., 2022; Munir et al., 2022).

Probiotics, which are living bacteria that give health advantages when taken, have become popular in a variety of sectors, including animal husbandry. Probiotics have showed promise in enhancing intestinal health and general well-being in horses (McGilloway et al., 2023; Park et al., 2023; Zaib et al., 2024).

Horses are prone to digestive problems including colic and diarrhea, which can impair their performance and general health. Probiotics, which promote a healthy balance of intestinal flora, can help horses avoid and treat stomach disorders. Probiotics have been demonstrated in studies to enhance digestion, boost nutritional absorption, and reduce inflammation in the gastrointestinal system in horses, resulting in greater overall health and performance (Ganda et al., 2023; MacNicol et al., 2023; McGilloway et al., 2023).

One of the primary advantages of probiotics in horse breeding is their capacity to boost the immune system. The gut microbiota regulates the immune response, and probiotics can help maintain a healthy balance of beneficial bacteria in the gut. Probiotics can help horses avoid infections and diseases by boosting their immune systems, resulting in decreased veterinary expenditures and greater breeding success (Li et al., 2023; MacNicol et al., 2023).

In addition to digestive and immunological support, probiotics have been demonstrated to improve reproductive health in horses. The reproductive system is vulnerable to gut bacterial imbalances, and probiotics can help keep a healthy environment for effective breeding. Probiotic supplementation has been proven in studies to boost fertility rates, lower the frequency of reproductive infections, and promote general reproductive health in breeding horses (Silva et al., 2014; Li et al., 2023; MacNicol et al., 2023; Shi et al., 2023). Furthermore, probiotics can help reduce stress and anxiety in horses, which can have a big influence on breeding results. Horses are sensitive animals that can get stressed in high-pressure breeding environments. Probiotics have been demonstrated to relax horses by decreasing stress hormone production and improving overall well-being. By reducing stress levels, probiotics can improve breeding outcomes and increase the likelihood of successful pregnancies (Adams et al., 2022; Ganda et al., 2022). It has been reported that after regular probiotic consumption, horses' performance increased and their digestive systems were regulated (Mirzaei et al., 2022; Perricone et al., 2022).

It is crucial to note that not all probiotics are made equal, and it is critical to choose the appropriate probiotic strain for horses. Different probiotic strains have varied impacts on equine health, so pick a probiotic that is particularly designed for horses. Consultation with a veterinarian or equine nutritionist is suggested to choose the best probiotic supplement for each horse based on their unique needs and breeding goals. When introducing probiotics into horse breeding techniques, it is critical to follow

correct dose and delivery. Probiotics should be supplied as directed by the manufacturer, and the horse's reaction to the supplement should be monitored. Regular monitoring of digestive health, immune function, and reproductive performance can help determine the effectiveness of probiotic supplementation in breeding horses (Ganda et al., 2022; Arnold and Pilla, 2023; Li et al., 2023; Park et al., 2023).

To summarize, probiotics have the potential to transform horse breeding techniques by increasing digestive health (Tanabe et al., 2014), immunological function (Shi et al., 2023), reproductive performance (Silva et al., 2014), and general well-being in horses (Cooke et al., 2021). Breeders can use probiotics to improve their horses' health and performance, resulting in improved breeding outcomes and healthier progeny in the long term. This article aims to offer a detailed overview of the advantages and significance of probiotics in horse breeding methods. The use of probiotics in horse breeding prevents stomach problems, supports digestive system health and improves yield quality and performance. Moreover, it reduces the risk of disease and ensures an overall healthy breeding process. The study highlights that the use of probiotics in horses can be an effective strategy for breeders as well as maximizing the health and performance potential of horses. Finally, the study seeks to educate and advocate the use of probiotics into equine nutrition and breeding programs in order to improve the health and success of horse breeding.

2. Probiotics

Within the current paradigm of animal science, the emerging topic of probiotics has piqued the interest of both academics and practitioners. Probiotics, defined as living microbes that provide health advantages when consumed, offer an exciting frontier in boosting well-being across species. In the context of equine breeding, probiotics provide a viable route for improving horse health and performance. The horse gastrointestinal (GI) tract contains a complex and dynamic ecosystem of bacteria known collectively as the gut microbiome. This complex community is essential for digestion, food absorption, and immune system modulation. Disruptions in this delicate balance can emerge as digestive problems like colic and diarrhea, jeopardizing the horse's general health and performance ability. Probiotics, which promote a healthy balance of beneficial bacteria in the stomach, can demonstrably prevent and treat many diseases. Researchers are still trying to figure out exactly how probiotics provide health advantages. However, multiple possible paths have been found (De Rezende et al., 2012; Angelika, 2014; Ishizaka et al., 2014; Schoster et al., 2014; Tanabe et al., 2014; Kritas, 2018). Probiotics and their effect on health is summarized in Figure 1.

The effectiveness of probiotic supplementation is dependent on the selection of appropriate bacterial strains. Different probiotic strains have varied functions and effects on the host. When selecting probiotic strains for horses, consider the following factors:

- **Species:** Specific probiotic strains belonging to genera such as *Lactobacillus*, *Bifidobacterium* and *Enterococcus* have demonstrated efficacy in horses.

- **Strain Specificity:** Different strains within the same genus can exhibit distinct effects. Selecting strains with documented benefits in horses is crucial.
- **Spore Formation:** Spore-forming bacteria offer advantages in terms of viability during storage and transit through the harsh acidic environment of the stomach. By carefully analyzing these criteria, researchers and practitioners may choose probiotic strains with the highest potential to improve horse health and performance (Weese et al., 2008; De Rezende et al., 2012; Cooke et al., 2021; Lagounova, 2022).

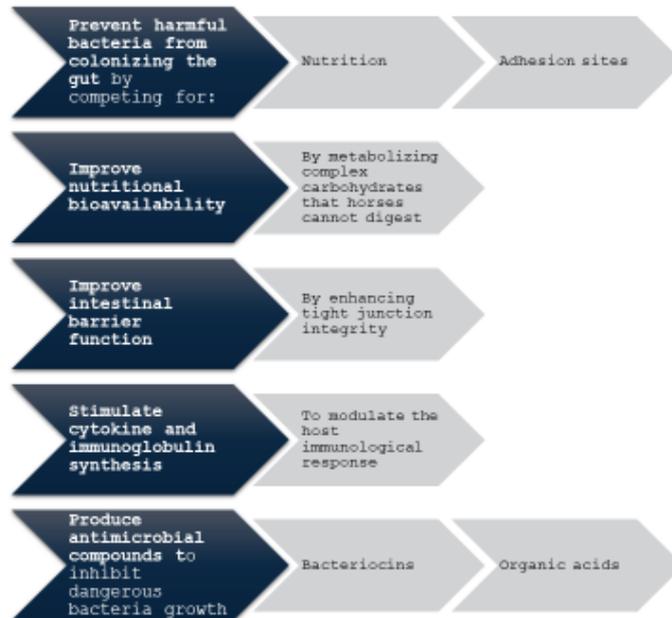


Figure 1. Probiotics and their effect on health

3. The Paramount Importance of Gut Health in Horses

The horse gastrointestinal (GI) tract contains a complex and dynamic ecosystem of bacteria known collectively as the gut microbiome. This complex ecosystem is critical to various physiological processes that are essential for horse health and performance. A robust gut microbiome supports:

- **Efficient Digestion:** The equine digestive system relies heavily on microbial fermentation in the hindgut to break down complex carbohydrates like cellulose and hemicellulose into absorbable nutrients. A healthy gut microbiome ensures efficient digestion, maximizing nutrient utilization and energy extraction from the horse's diet.
- **Nutrient Absorption:** Short-chain fatty acids (SCFAs) produced by gut bacteria are a significant energy source for horses. Additionally, gut microbes contribute to the absorption of essential vitamins and minerals, such as vitamin K and B vitamins. A balanced gut microbiome optimizes nutrient absorption, promoting overall health and performance.
- **Immune System Regulation:** The gut-associated lymphoid tissue (GALT) represents the largest component of the equine immune system. The gut microbiome interacts extensively with the GALT,

influencing immune responses and inflammatory processes throughout the body. A healthy gut microbiome fosters a robust immune system, enhancing the horse's ability to resist pathogens (Wilmink et al., 2020; Cooke et al., 2021; Lagounova, 2022). This information is summarized in Figure 2.

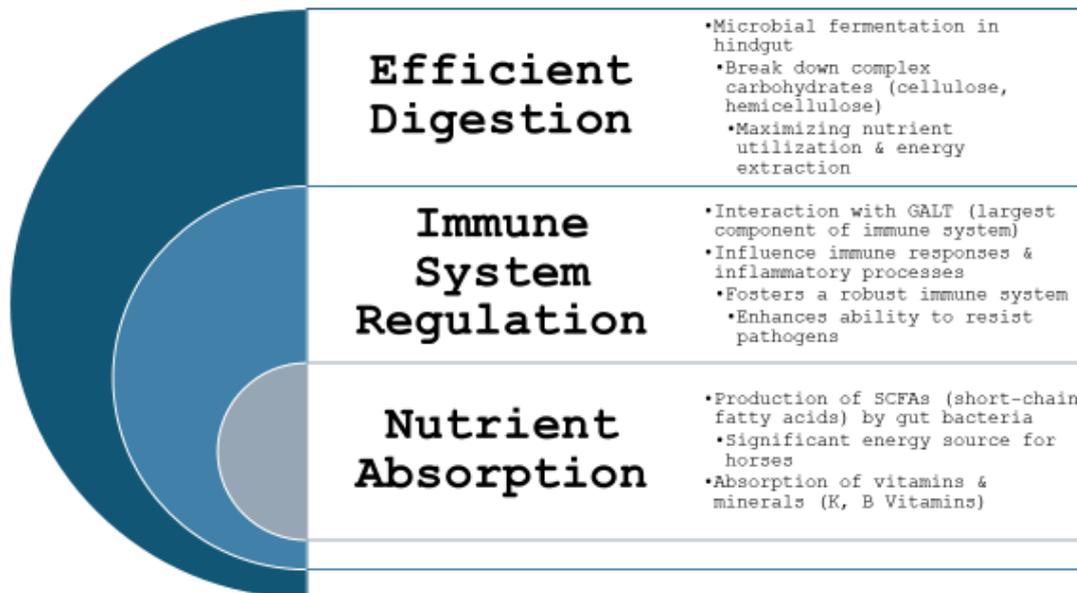


Figure 2. A robust microbiota and its support on horse health

Disruptions in the delicate balance of the gut microbiota, known as dysbiosis, can cause a cascade of negative repercussions for horses.

- **Digestive Disorders:** Dysbiosis can impair digestion, leading to conditions like colic, diarrhea, and impaction. These conditions can compromise nutrient absorption, hinder performance, and decrease overall well-being.
- **Diminished Nutrient Utilization:** An imbalanced gut microbiome may lead to reduced production of SCFAs and impaired absorption of essential vitamins and minerals. This can result in nutritional deficiencies, decreased energy availability, and impaired growth and development.
- **Heightened Susceptibility to Infections:** A compromised gut barrier and dysregulation of the immune system associated with dysbiosis can increase susceptibility to bacterial and viral infections. This can pose significant health risks and economic burdens for horse owners.

Maintaining a healthy gut flora is critical for horses' overall health and performance. A healthy gut environment promotes efficient digestion, food absorption, and immunological function, laying the groundwork for a healthy and vibrant horse herd (Berreta et al., 2021; Berreta and Kopper, 2022; Ivannikova et al., 2023).

4. The Significance of Probiotics in Horse Breeding Programs

Probiotics provide several benefits to horse breeding operations by enhancing digestive health and immunological function. The complex link between intestinal health and reproductive function in horses is receiving increased scientific attention. The gut microbiome not only aids digestion and nutrition absorption, but it also plays an important role in regulating the hormonal and immunological responses that support healthy reproduction. Gut health has a substantial influence on reproductive function, as mentioned below:

- **Hormonal Regulation:** The gut microbiome modulates the production and metabolism of sex hormones, such as estrogen and progesterone, which are essential for regulating estrous cycles and ovulation in mares and testosterone production in stallions. Dysbiosis can disrupt this delicate hormonal balance, potentially leading to reproductive irregularities and decreased fertility.
- **Immune System Regulation:** A healthy gut microbiome fosters a balanced immune response, preventing excessive inflammation within the reproductive tract. Conversely, dysbiosis can trigger inflammatory processes that can impair reproductive function by hindering sperm motility, fertilization, and embryo development.
- **Nutrient Availability:** Essential nutrients derived from digestion by gut microbes play a critical role in supporting reproductive health. Deficiencies in these nutrients due to dysbiosis can compromise reproductive function in both mares and stallions (Silva et al., 2014; Cooke et al., 2021; Lauková et al., 2023; Cooke et al., 2024).

Probiotic supplementation has been shown to improve horse fertility in a variety of ways.

- **Improved Fertility Rates:** By promoting a healthy gut microbiome, probiotics may contribute to improved hormonal regulation and nutrient absorption, potentially leading to increased fertility rates in mares and stallions.
- **Reduced Reproductive Infections:** Probiotics can help maintain a healthy vaginal and uterine environment in mares, potentially reducing the risk of infections that can hinder breeding success.
- **Enhanced Embryonic Development:** A balanced gut microbiome in mares may contribute to a more favorable uterine environment for successful embryo development and pregnancy.
- **Research on the use of probiotics in horse breeding is ongoing, but previous research suggest encouraging outcomes. Fertility rates improved in mares fed with certain probiotic strains. Probiotic supplementation reduced the prevalence of reproductive tract infections in mares.**

Probiotic therapy resulted in improved sperm motility and morphology in stallions. While further study is needed to completely understand the mechanisms of action and improve probiotic usage for horse reproduction, the available information implies a good influence on breeding results (Lauková et al., 2020; Massacci et al., 2020).

4.1. Probiotics and Mare Health

Probiotics, notably *Lactobacillus paracasei*, have been investigated for their probiotic qualities and possible advantages. While the precise effects of probiotics on mare fertility are not specifically addressed in the sources supplied, the probiotic qualities of specific strains, such as *Lactobacillus paracasei* 10K, have been emphasized for possible health benefits. The sources cover the advantages of probiotics in a variety of situations, including metabolic problems and dental health, but do not particularly address their usage during pregnancy and nursing in mares. However, the ability of probiotics, particularly those generated from equid milk, to maintain tooth health implies a larger role in health maintenance. While the sources do not specifically highlight probiotics' direct impact on postpartum health and foal development, the overall advantages of probiotics on gut health and immunity may indirectly aid to postpartum recovery and maybe influence foal development. Probiotics' beneficial impacts on gut health and immunological function may have consequences for general postpartum health and well-being, as well as foal growth and development (Jones, 2019; Barba et al 2020; Malaluang et al., 2022; Malaluang et al., 2024).

4.2. Probiotics in Stallion Management

Although the sources do not particularly address the effect of probiotics on stallion fertility, they do emphasize the significance of gut health and probiotics' function in maintaining a healthy gut flora. Given the importance of gut health in general well-being, including its possible impact on fertility, adding probiotics into stallion management methods may indirectly boost fertility by increasing gut health. The direct use of probiotics to improve sperm quality and quantity in stallions is not covered in the available publications. However, probiotics' ability to promote gut health and overall well-being may indirectly lead to greater reproductive health, including sperm quality. Further study may be required to determine the particular effects of probiotics on sperm parameters in stallions. While the sources do not go into the specifics of including probiotics into stallion diets and management techniques, the general advantages of probiotics on gut health and overall well-being indicate that incorporating probiotics into stallion diets may be useful. Probiotics may help stallions' intestinal health, immunological function and general health, all of which are necessary for peak performance and reproduction (Cooke et al., 2021; Cooke, 2023; Cooke et al., 2023).

4.3. Probiotics and Foal Health

The sources do not explicitly address the role of probiotics in early gut colonization in foals. However, the overall effects of probiotics on gut health and immunity imply that early probiotic exposure may help shape foals' gut flora, potentially impacting their long-term health and development. While the offered sources do not mention the particular advantages of probiotics for neonatal health and immunity in foals, the overall good effects of probiotics on gut health and immune function may apply to newborn foals. Probiotics may help to balance the intestinal microbiota and boost immunological development

in newborn foals, thereby improving their health and resilience. Although the sources do not specifically address the long-term effects of probiotics on foal growth and development, the general advantages of probiotics on gut health, immunity, and overall well-being imply that early probiotic exposure may have a long-term impact on growth and development. Probiotics may help foals grow and develop optimally by fostering a healthy gut microbiota and immune system (Freccero et al., 2021; Goodman-Davis et al., 2021; Berreta and Kopper, 2022; Cooke et al., 2023; Shi et al., 2023; Mienaltowski et al., 2024).

5. Practical Considerations and Recommendations

When choosing probiotic strains for horse breeding operations, look for strains that have been shown to improve gut health, immunological function, and general well-being in horses. The search results highlight a few potential probiotic strains:

- *Lactocaseibacillus paracasei* 10K, isolated from Kazakhstani mare's milk, has been identified as having high probiotic potential and could be a promising candidate for use in horse breeding operations.
- *Lactobacillus plantarum* strains isolated from mare and donkey milk have shown high probiotic potential, including the ability to survive and form biofilms in the oral cavity, as well as antimicrobial and coaggregative abilities against cariogenic and periodontitis-related pathogens.
- *Lactobacillus* spp. and *Bifidobacterium* spp. are commonly represented in poultry probiotics and have been shown to promote gut health, immune stimulation, and enteropathogen control in horses (Schoster et al., 2016; Elghandour et al., 2020; Hu et al., 2020; Lambo et al., 2021; Lauková et al., 2023).

These findings indicate that adding probiotics into equestrian management practices can have far-reaching effects on horse health and production. However, the search results do not provide detailed dose and administration guidelines for probiotics in horses. However, it is typically advised that you follow the probiotic manufacturer's advice or speak with a veterinarian to establish the proper dosage and delivery technique based on the probiotic strain and the needs of your horse. To successfully include probiotics into overall equine management practices, they must be considered as part of a holistic approach to supporting horse health and well-being. Probiotics should be administered in concert with other management methods, including as optimal feeding, immunization, and parasite control, to maximize their effectiveness. Furthermore, monitoring the horse's reaction to probiotic supplementation and making adjustments as needed is critical to ensure the overall success of the management plan (Hu et al., 2020; Lambo et al., 2021; Lauková et al., 2023).

An example of probiotic use in horses can be as follows: A probiotic mix (Di-a-zyme 256 Equine, Tarımsan, Türkiye) consisting of *Bacillus subtilis* 1.3×10^{11} cfu/kg, *Bacillus licheniformis* 1.3×10^{11} cfu/kg, *Lactobacillus farciminis* 1×10^{11} cfu/kg, *Saccharomyces cerevisiae* 3×10^{11} cfu/kg, *Lactobacillus acidophilus* 1×10^{11} cfu/kg when given the horses, significant gains are achieved. It is recommended to consume 0.05 g/kg of this mixture regularly at each meal for one month. In order not to disrupt the

intestinal flora, probiotic consumption is regularly interrupted. This interruption period is recommended to be at least one week. Regular probiotic use has been reported to have positive effects on the digestive and immune systems as well as on the pregnancy rate (Gülhan and Boynukara, 2018; Jacobs et al., 2024; Kaya et al., 2024).

6. Conclusion

In conclusion, the emerging subject of probiotic supplementation in horse breeding programs shows enormous promise for improving the health and well-being of both mares and foals. Probiotics, by promoting a healthy gut microbiota, have been shown to improve numerous aspects of horse health, including fertility, pregnancy success rates, lactation efficiency, and foal growth. Probiotics have been shown in studies to increase stallion fertility, sperm quality, newborn health, and foal immunological competence. However, in order to fully realize the potential of probiotics in equestrian breeding, further study is required. It is critical to go deeper to find and define a broader range of probiotic strains that are especially designed to improve horse health. Furthermore, creating effective dosing regimens, fine-tuning delivery procedures, and smoothly incorporating probiotics into comprehensive horse management programs are critical steps toward optimizing their advantages. Horse breeders may make a substantial contribution to their horses' general health and well-being by emphasizing ongoing probiotic research and actively incorporating it into equine management methods. This proactive strategy not only promotes a robust breeding population, but it also demonstrates a dedication to sustainable and responsible animal husbandry techniques, assuring the equestrian industry's sustained prosperity for generations.

Conflict of Interest

The authors declares that has no conflict of interest.

Summary of Researchers' Contribution Rate Declaration

Authors declare that they have contributed 50% - 50% to the article.

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