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Popular Article

Impact of Probiotics in Ruminants

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Abstract

Among various agricultural sectors, the livestock industry has a pivotal role in ensuring livelihood and food safety for the growing population and economies of countries. A changing climate, food scarcity for animals, increasing demand due to population burden, and low productive animals exert a negative impact on the livestock sector. These challenging factors and rising resistance to antibiotic-based growth promoters demand new and better approaches to improve the health, productivity of animals, and the sustainable growth of the livestock farming. Probiotics are living, non-pathogenic microbes, and their use is increasing nowadays as a substitute for antibiotic-based growth promoters. Probiotics exert a beneficial effect on the production, growth, nutrient intake, digestibility, and health of ruminants by regulating microbial homeostasis and by modifying ruminal fermentation.

Keywords: probiotics, rumen fermentation, microbes

Introduction

Animal husbandry is a dynamic industry that plays a critical role in ensuring food safety by meeting the animal-origin food demand for a growing population. This sector has also grown to be a main source of revenue for farmers and aids in the socio-economic advancement of developing nations (Tona, 2021). Globally, approximately 40% of agricultural goods are animal-based, and ruminants play a vital role in this production. Ruminant animals are pre-gastric fermenters that possess a large compartment for fermentation known as the rumen. To produce valuable nourishment sources, viz., milk and meat for humans, ruminants consume the structural elements of the plant (Öztürk and Gursel, 2021). Mostly in developing countries, ruminants are fed agricultural residues, poor quality roughage, and by-products of industries that are rich in lingo-cellulose, low in fermentable carbohydrates, and higher quality proteins. In addition, the changing climate conditions, viz., high temperatures, prolonged dry season, infertile soil, and food scarcity, also affect rumen fermentation (Galmessa *et al*., 2019).

In ruminants, symbiotic microorganisms, viz., bacteria, protozoa, fungus, etc., execute enzymatic and mechanical fermentation activities during digestion that alter the composition of the feed. Therefore, ruminal fermentation modulation may become a superior option to optimize fermentation for enhancing the production and utilization of nutrients in ruminants (Öztürk and Gursel, 2021).

Probiotics are non-pathogenic live microbes that have the potential to produce favourable effects on the host once consumed by regulating the gut microbes. Nowadays, probiotics are increasingly employed as a substitute for the antibiotics feed-additive to enhance the productivity and health of animals (Kassa, 2016). The most frequently used probiotics in ruminants are Saccharomyces cerevisiae yeast and bacteria such as *Lactobacillus*, *Bifidobacterium*, *Streptococcus*, *Prevotella bryantii*, *Propionibacterium*, *Enterococcus*, and *Megasphaera elsdenii* (Seo *et al.*, 2010; Arowolo and He, 2018). Supplementation of probiotics in ruminants reduces the acetic acid/propionic acid ratio and enhances the fermentation process by increasing the generation of propionic acid, decreasing the protozoal biomass in the rumen, stabilization of ruminal pH, and improving the production in animals (Öztürk and Gursel, 2021).

Mechanism of action of probiotics

Probiotics improve the host's gastrointestinal tract health by enhancing the healthy microbial flora, increasing digestive capacity, absorption, and bio-availability of nutrients. In addition, they also prevent the colonization of pathogenic microbes in the intestine, restore gut microbes, stabilize the pH and enhance mucosal immunity (Kassa, 2016).

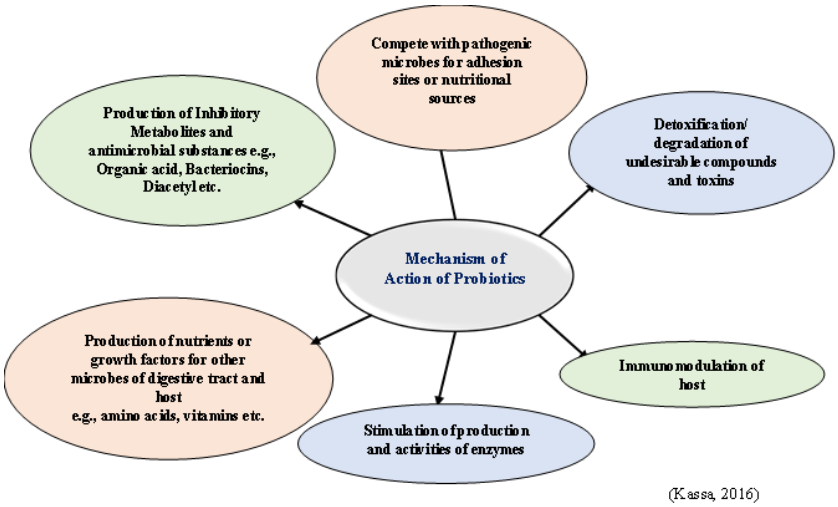

Fig. 1: Mechanism of action of probiotics

Effect of probiotics on intake and digestibility of feed

The quality and quantity of feed taken by the animals influence their daily output. Probiotics regulate the pH of the rumen by stimulating starch-consuming ciliate protozoa that compete with amylolytic bacteria, which mainly produce lactate. Some strains of yeast also provide the nutrients (peptides and vitamins) and cofactors that are necessary for the microbes utilizing lactate. The stabilized pH, nutrients, and growth factors produced by yeasts exert a beneficial effect on the proliferation and activities of fibre-digesting cellulolytic microbes. Therefore, probiotics also help in the prevention of ruminal acidosis by balancing the ratio of VFA (volatile fatty acids) generated in the rumen (Kassa, 2016; Arowolo and He, 2018). *Aspergillus oryzae* and *Lactobacillus plantarum* probiotics improve the performance of animals by producing fibre-digesting enzymes and breakdown of carbohydrates into simpler glucose forms, respectively (Khalid *et al.*, 2011). Probiotics increase feed intake by enhancing the flavour and palatability of feed. They also enhance the digestibility of dry matter, fibres, organic matter, and crude protein along with enhancing energy and nitrogen retention in animals. Therefore, probiotics improve the cellulolytic bacteria, stabilize ruminal pH, reduce the interval between feed intake, and increase the degradation of fibres and digestibility of the lower quality forage by altering the pattern as well as the rate of ruminal fermentation (Kassa, 2016; Arowolo and He, 2018).

Effect of probiotics on the growth of animals

Due to the tendency of resistance development against antibiotic-based growth promoters, probiotics are emerging as a better alternative growth promoter in animals. Probiotics promote the growth of ruminal and intestinal epithelial cells by improving ruminal fermentation and VFA production. Thus, these feed supplements enhance the ability of nutrient absorption by epithelial cells (Nalla *et al.*, 2022). Furthermore, probiotics also enhance the growth in animals by improving microbial protein synthesis, fibre degradation by cellulolytic microbes (Kassa, 2016), and the ratio of growth hormone to insulin-like growth factor-I (Nalla *et al.*, 2022). Therefore, probiotics may enhance weight gain by increasing feed intake, nutrient utilization ability, feed conversion rate, nitrogen retention, and reducing the excretion of vital nutrients in animals (Arowolo and He, 2018; Schofield *et al.*, 2018).

Effect of probiotics on productivity of animals

Manipulation of ruminal fermentation by probiotics modifies nutrient digestibility, the efficacy of fibres-degradation, absorption, and bioavailability of nutrients in the intestine. Moreover, they also alter the numbers of cellulolytic bacteria and volatile fatty acids in the rumen (Kassa, 2016; Nalla *et al.,* 2022). As probiotics increase the population of beneficial microbes in the rumen and enhance the synthesis of crude proteins of microbial origin. These feed additives improve the quality, quantity, and intestinal absorption of metabolizable proteins, which are turned into milk proteins. Therefore, probiotics enhance milk output and protein content (Ma *et al.,* 2020; Suntara *et al.,* 2021b). After absorption, volatile fatty acids play an important role in the synthesis of milk. Probiotics improve the ruminal pH, total VFAs production, and ratio of acetic and propionic acid, resulting in enhanced fat content of milk (Sun *et al.,* 2021). Therefore, probiotic supplementation in ruminants improves productivity by modifying ruminal fermentation.

Effect of probiotics on animal health

In an appropriate quantity, probiotics exert a beneficial impact on animal health by maintaining microbial homeostasis in the gastrointestinal tract and enhancing the immune response. The microbiome of the rumen and gut is a diverse mixture of various bacteria, fungi, and ciliated protozoa. The healthy microflora exerts a positive impact on animal health by enhancing the relative biomass of beneficial microflora, preventing the mucosal invasion and colonization of pathogens, and regulating immunological homeostasis. Furthermore, general health benefits are also provided by probiotics by increasing the feed conversion ratio, stabilizing the pH, controlling acidosis, enhancing the uptake of nutrients and promoting the epithelial growth of the rumen and intestine (Abd El-Tawab *et al.,* 2016; Nalla *et al.,* 2022). Probiotics inhibit the pathogen's growth and maintain health by producing bacteriocins, creating an acidic environment and facilitating the degradation of toxins. Probiotics that increase the immunoglobulin level have a beneficial effect on immune response and improve disease resistance, growth performance, and defence mechanisms of animals (Kassa, 2016).

Conclusion

Probiotics help in maintaining the microflora homeostasis, stabilizing the pH of the rumen, improving digestibility, protecting from pathogens colonization, and enhancing the feed intake and conversion ratio in animals. Therefore, these feed additives exert a beneficial impact on the growth, production, and health of ruminants by modifying ruminal fermentation.

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