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Use of Synbiotics: A New Era in Animal Nutrition

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Abstract

As global demand for animal-based protein rises, concerns about antibiotic overuse in livestock have prompted the search for safer, more sustainable alternatives. Synbiotics is combinations of probiotics (beneficial microbes) and prebiotics (non-digestible fibres that nourish them) offer a promising solution. By enhancing gut microbiota balance, synbiotics support digestion, immunity, and overall health in animals. Synbiotics outperform probiotics or prebiotics alone, improving nutrient absorption, enzyme activity, and resistance to pathogens. Benefits have been observed across various species: from reduced diarrhea and improved growth in calves and pigs, to enhanced immunity and enzyme function in fish and poultry. Synbiotics also influence blood and biochemical parameters, such as cholesterol and protein levels, particularly in broilers and aquaculture species. However, results vary by species, strain, and dietary context, with limited impact on performance or blood chemistry. Despite promising outcomes, scientific understanding of synbiotic mechanisms and optimal formulations remains incomplete. Ongoing research is essential to determine effective combinations and dosages tailored to specific livestock, paving the way for their broader adoption as alternatives to antibiotic growth promoters.

Keywords: synbiotics, animal nutrition, feed additive

1. Introduction

The global demand for animal-based protein, such as meat, milk, and eggs, is steadily increasing. At the same time, there is growing concern about the overuse of antibiotics in livestock, which can contribute to the development of antibiotic-resistant bacteria. As a result, researchers and farmers are actively searching for safer and more effective alternatives to support animal health and growth without relying on antibiotics. One such promising alternative is the use of synbiotics, which are a combination of probiotics and prebiotics. Probiotics are live beneficial microorganisms that help improve digestion and gut health, while

prebiotics are non-digestible food ingredients that serve as nourishment for these helpful bacteria. The idea behind combining them is that probiotics alone may not survive or function properly in the animal's digestive system without the support of prebiotics. When used together, prebiotics help probiotics thrive, making their health benefits more effective.

Synbiotics work by enhancing the balance of good bacteria in the gut, which plays a key role in digestion, immunity, and overall animal well-being. Studies suggest that using synbiotics may lead to better survival and activity of beneficial microbes in the gastrointestinal tract compared to using probiotics or prebiotics alone. According to the Food and Agriculture Organization (FAO) of the United Nations, the term "synbiotic" should only be used when the combination of probiotic and prebiotic leads to a clear, synergistic health benefit. To create a successful synbiotic, it is important to choose probiotics and prebiotics that have already shown positive effects on their own. Ideally, the prebiotic should be selected to match the specific needs of the probiotic strain, which helps them work together more effectively. Some common examples of synbiotic are Lactobacilli + inulin, Bifidobacteria + FOS, Lactobacilli + FOS, Bifidobacteria and Lactobacilli + inulin, Lactobacilli + lactitol, Bifidobacteria + GOS. Besides introducing beneficial bacteria into the gut, synbiotics also help support the growth of the animal's natural, helpful microbes, leading to a healthier gut environment.

2. Mechanism of Action

The gastrointestinal tract contains a complex and diverse community of microorganisms that play a vital role in supporting the host's overall health. These microbes contribute to various essential functions, including breaking down drugs, producing nutrients, protecting against harmful pathogens, detoxifying the body, and helping to regulate the immune system. Research in animals has shown that changes in these gut microbial populations can impact immune function, support better growth, and enhance overall performance. There

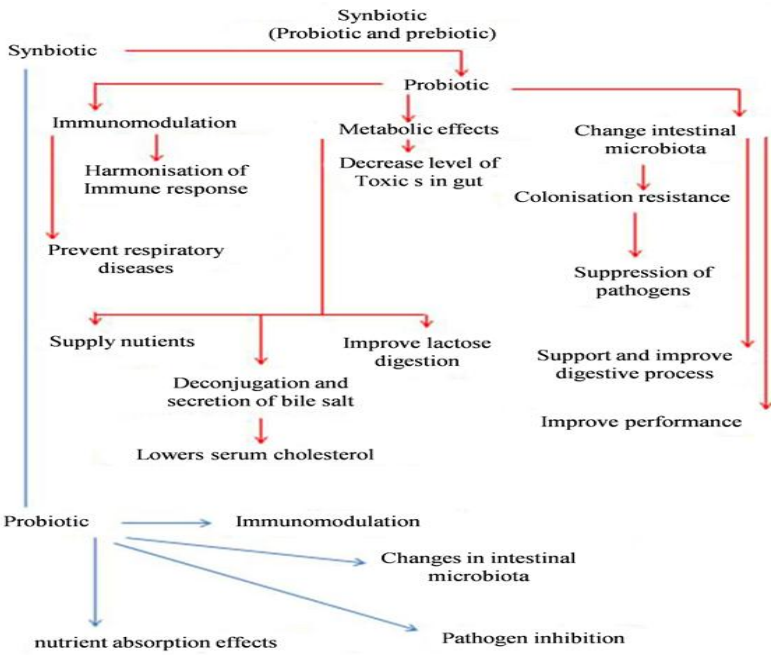

Figure 1: Mechanism of action (Jalil, 2022)

is growing evidence backing the use of probiotics, prebiotics, and especially synbiotics for these purposes. The mechanism behind synbiotics involves modifying the gut microbiota by introducing beneficial live microbes along with non-digestible compounds that act as their food. This dual action helps improve the balance and function of the intestinal microbial ecosystem, as illustrated in Figure 1.

3. Effect of Synbiotic on Growth and Performance

The gut-associated lymphoid tissue (GALT) and gastrointestinal microbiota are crucial for digestion and immune regulation. Beneficial microbes aid in vitamin production, immune stimulation, and inhibiting harmful bacteria. Synbiotics-combinations of probiotics (e.g., *Bifidobacterium*) and prebiotics (e.g., inulin, chicory)-show stronger antimicrobial effects than either component alone, as confirmed by agar diffusion assays. Gut microbiota acts like a metabolic organ, and synbiotic supplementation has been shown to enhance immune markers such as immunoglobulins in sheep and lysozyme activity in fish. Challenge tests in fish have demonstrated synbiotics' protective role against pathogens like *Vibrio* spp. Beyond animals, synbiotics are being studied for benefits like managing intestinal inflammation, preventing infections, improving mineral absorption, and enhancing feed efficiency. For instance, *Lactobacillus*-based synbiotics have reduced diarrhea and improved performance in weaning pigs.

Research suggests that synbiotics can support animal growth and health by enhancing gut function and creating a more favorable digestive environment, especially in early-weaned pigs. In finishing pigs, synbiotics including *Ficus-indica var. saboten* have been shown to reduce harmful gas emissions like ammonia and sulfides. In aquatic species such as zebrafish and common carp, synbiotics have significantly improved growth and digestive enzyme activity. However, not all studies show performance benefits; for instance, some synbiotic treatments in pigs and sheep did not improve feed efficiency or growth performance.

In fish such as rainbow trout, Japanese flounder, yellow croaker, and cobia, results have been mixed-while synbiotics enhanced enzyme activity and maintained health, they often had limited or no effect on survival rates. In poultry, several studies found that synbiotics improved final body weight and feed conversion ratio, particularly in broilers and ostrich chicks. Moreover, synbiotics were linked to reduced cholesterol levels and changes in blood biochemistry, likely due to the prebiotic's ability to bind bile acids and enhance cholesterol excretion. Lastly, prebiotics derived from *Aspergillus oryzae* have shown promising results in improving protein digestibility, fat absorption, and nitrogen retention in pigs, further supporting the potential of synbiotics as alternatives to antibiotic growth promoters.

4. Effect of Synbiotic on Blood and Biochemical Parameter

Several studies have evaluated the effects of synbiotic supplementation on hematological and biochemical parameters in animals. Key blood markers influenced by synbiotics include triglycerides, cholesterol (total, HDL, and LDL), glucose, albumin, globulin, total serum protein, and hematocrit. In ewes, synbiotics were shown to positively affect white blood cell count and leukogram profiles. In lambs, diets containing both probiotics and prebiotics led to a reduction in total cholesterol levels and an increase in HDL-cholesterol.

However, in sheep, synbiotic supplementation had no significant effect on blood urea nitrogen, glucose, or albumin levels. In aquatic species such as the humpback grouper (*Cromileptes altivelis*), synbiotics improved glucose and triglyceride levels, as well as hematological markers like hematocrit, hemoglobin, and phagocytic activity. Similarly, an increase in hematocrit was noted in other studies with fish fed synbiotic-enhanced diets. Results regarding triglycerides were mixed-some fish fed diets containing mannan-oligosaccharides (MOS), fructo-oligosaccharides (FOS), or *Bacillus clausii* showed reduced triglyceride levels, while others showed no significant change. In rainbow trout, synbiotics increased total serum protein, but effects on albumin/globulin ratio and triglycerides were not statistically significant. In some cases, synbiotics did not significantly alter total serum protein.

In poultry, responses to synbiotics were more consistent. Broiler chickens showed improved cholesterol profiles and hematological markers following synbiotic supplementation. Several studies also reported that synbiotics helped regulate organic acid concentrations and reduce serum cholesterol. Additionally, synbiotic-fed birds showed increases in uric acid, creatinine, packed cell volume, and urea levels compared to control groups.

5. Conclusion and Future Perspective

Research has shown that the intestine serves as a dynamic environment inhabited by both beneficial and harmful microorganisms, each playing distinct roles in either supporting or disrupting host health. The gastrointestinal tract hosts a complex microbial ecosystem that contributes to various physiological functions, including nutrient synthesis, defense against pathogens, detoxification, drug metabolism, and immune regulation. Studies in animals have highlighted that shifts in these microbial populations can impact overall health, with substantial evidence supporting the use of probiotics, prebiotics, and especially synbiotics.

Synbiotics are believed to offer enhanced benefits over the use of either component alone. In recent years, they have become increasingly utilized in animal production systems for improving growth performance, optimizing gut health, boosting blood parameters, enhancing intestinal structure, and helping control pathogenic bacteria. However, despite their potential,

data on the application of synbiotics in animal science remain limited. Experts emphasize the need for further research to clarify their preventive and therapeutic effects, mechanisms of action, ideal dosages, treatment durations, and the most effective combinations of probiotic strains and prebiotic types tailored to specific animal species and outcomes.

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