INTAS ANIMAL HEALTH

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An Update for Poultry Professionals

Volume 4 I Issue 1 I 2026

Synbiotics as Precision Modulators of Poultry Gut Health and Performance

Synbiotics: Advancing Gut Resilience and Performance

Dear Readers,

In intensive poultry production, gut health is key driver of nutrient utilization, immunity, pathogen control and overall performance, but it is easily disrupted by rapid growth or long laying cycles, heat stress, mycotoxins, dense diets and disease pressure especially in antibiotic-free systems.

Synbiotics, combining probiotics with selective prebiotics, act as precision modulators by establishing beneficial microbes (e.g., Lactobacillus, Bifidobacterium, Saccharomyces) and supporting their survival and activity. This synergy stabilizes the microbiota, limits pathogens through competitive exclusion and antimicrobial effects and increases short-chain fatty acid production (acetate, propionate, butyrate). SCFAs lower gut pH, fuel enterocytes, improve villus–crypt architecture, strengthen tight junctions and mucus barriers, fine-tune mucosal immunity while avoiding excessive inflammation. Early-life use especially during the first post-hatch week can “program” gut development and resilience for lasting benefits.

Synbiotics are associated with better weight gain, improved feed efficiency, enhanced egg output and egg mass, improved carcass traits and reduced mortality under stress or enteric challenge. This issue highlights synbiotics as a reliable and practically deployable approach to protect and optimize poultry gut function in antibiotic-free systems.

We invite you to read this issue and share your valuable feedback/ thoughts by scanning the below QR code or reaching us *via* email at aviglo@intaspharma.com.

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Introduction

Gastrointestinal (GI) tract of poultry is a complex, highly dynamic ecosystem essential for digestion, nutrient absorption, immune competence and overall productivity. In contemporary intensive production systems, maintaining optimal gut health is critical because it directly influences growth performance, disease resistance and product quality. A stable and beneficial gut microbiota plays a central role in this process by supporting efficient digestion, regulating immune responses and preventing pathogen colonization.

For several decades, poultry production relied on subtherapeutic Antibiotic Growth Promoters (AGPs) to enhance feed efficiency and control subclinical infections by modulating gut microbial populations. However, continuous AGP use has contributed to emergence of antimicrobial-resistant bacteria, disrupted gut microbial ecology and raised concerns about antibiotic residues in food and the environment. Owing to these risks, global regulatory policies, especially in the European Union and many Asian markets have progressively restricted AGP use, pushing the poultry industry toward safer and more sustainable alternatives.

In this context, Synbiotics, synergistic combinations of probiotics and prebiotics have gained prominence as next-generation non-antibiotic feed additives. Probiotics introduce beneficial live microorganisms that support microbial balance and immune modulation, while prebiotics provide selectively fermentable substrates that stimulate the growth and metabolic activity of beneficial microbes. Together, synbiotics offer a targeted strategy to optimize gut health, strengthen host defence mechanisms and sustain productivity in antibiotic-free and modern poultry production systems.

Physiological Determinants of Gut Health

Physiology of gut health in poultry has gained increasing importance with intensification of modern production systems in both broilers and layers. Genetic selection for rapid growth and high feed intake in broilers, as well as sustained egg production and metabolic efficiency in layers, has placed substantial physiological demands on GI tract.

In broilers, GI tract often fails to develop proportionally with body weight gain, creating a mismatch between nutrient intake and digestive capacity. In layers, prolonged production cycles, high calcium turnover and continuous nutrient demands impose chronic stress on intestinal function. In both systems, limitations in digestive capacity, absorptive surface area, enzyme secretion and digesta transit time can compromise nutrient utilization and intestinal health.

Optimal gut health in poultry depends on intact intestinal morphology, effective digestive enzyme activity, robust epithelial barrier and stable gut microbiota. Small intestine is responsible for nutrient digestion and absorption, while the caeca function as major microbial fermentation chambers producing short-chain fatty acids (SCFAs). These SCFAs regulate luminal pH, serve as an energy source for enterocytes, enhance epithelial integrity and inhibit pathogenic microorganisms through competitive exclusion. Under intensive production conditions, such as high nutrient-dense diets, heat stress, mycotoxin exposure, mineral imbalances and pathogen challenge microbial homeostasis is frequently disturbed. Resultant dysbiosis leads to reduced villus height, compromised tight junction integrity, increased intestinal permeability and redirection of nutrients toward immune responses rather than growth or egg production, thereby reducing feed efficiency and productive performance.

Understanding these physiological constraints in broilers and layers provides a foundation for nutritional strategies aimed at supporting gut functionality. Synbiotics, contribute to physiological gut health by promoting beneficial microbial populations and metabolic activity through enhanced SCFAs production, stabilization of gut pH, and reinforcement of epithelial tight junctions. Synbiotics improve intestinal morphology and stimulate endogenous digestive enzyme activity. These physiological adaptations help maintain digestive efficiency, intestinal resilience and nutrient utilization across different poultry production systems, supporting sustainable growth in broilers and persistent egg production in layers without reliance on antibiotic growth promoters.

Probiotics and Gut Health

Probiotics are live microorganisms that confer health benefits when administered in adequate amounts and play a crucial role in maintaining gut health and productivity in poultry and are widely recognized as sustainable alternatives to antibiotic growth promoters. Following dietary intake, probiotics interact with GI tract to stabilize and maintain a balanced intestinal microbiota while reducing load of gut pathogens through competitive exclusion and production of antimicrobial substances. Probiotics also stimulate host immune responses, enhancing both innate and adaptive immunity and improve antioxidant status, thereby protecting intestinal tissues from oxidative and inflammatory damage. In addition, probiotics increase digestive enzyme activities, leading to more efficient digestion and nutrient utilization. Through these integrated mechanisms, probiotics maintain normal intestinal microbiota, suppress pathogenic bacteria, stimulate immune system, provide antioxidant support and enhance digestive enzyme activity, thereby improving feed efficiency, growth performance, disease resistance and overall health (Fig. 1).

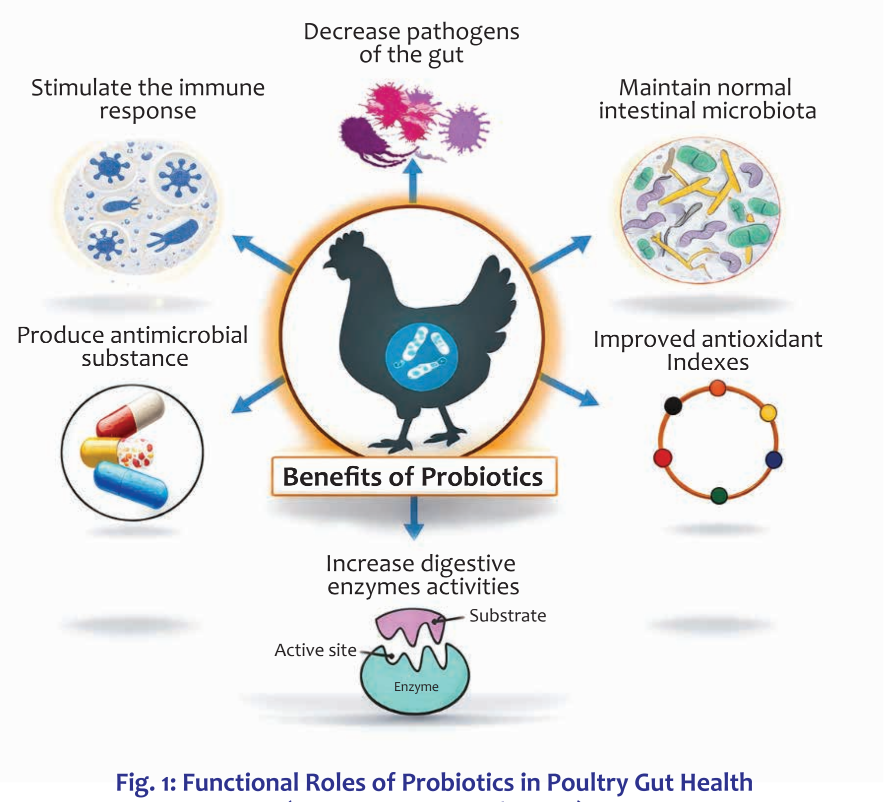

Fig. 1: Functional Roles of Probiotics in Poultry Gut Health
(Source: Rajput *et al.*, 2020)

Among the probiotics used in poultry, ***Lactobacillus* spp.** is most extensively studied and utilized due to their natural predominance in avian GI tract. Lactobacilli actively bind to intestinal epithelial cells and enhance the mucous layer by stimulating mucin secretion, thereby strengthening the first line of defence against pathogen attachment. They promote proliferation of beneficial bacteria while competitively excluding enteric pathogens such as *Escherichia coli* and Salmonella through nutrient competition, organic acid production and bacteriocin secretion. Dietary supplementation with Lactobacillus improves feed efficiency, enhances gut barrier function *via* increased expression of tight junction proteins and modulates immune responses by reducing pro-inflammatory cytokines while increasing anti-inflammatory mediators. Additionally, Lactobacillus supplementation has been associated with improved antibody production and enhanced cell-mediated immunity, contributing to overall intestinal and systemic health in poultry.

***Bifidobacterium* spp.** are also important probiotics in poultry, contributing to gut health primarily through their fermentative metabolism of indigestible carbohydrates into beneficial short-chain fatty acids (SCFAs), including acetate and lactate. These metabolites lower intestinal pH, inhibit proliferation of harmful bacteria and support epithelial cell proliferation and repair. In broilers, Bifidobacterium supplementation enhances immune organ development, increases serum immunoglobulin levels and improves nutrient utilization efficiency, ultimately resulting in improved growth performance and carcass traits. Moreover, by supporting microbial diversity and immune homeostasis, *Bifidobacterium* spp. is particularly beneficial during early life stages, vaccination periods and environmental or nutritional stress.

Yeast-based probiotics, particularly **Saccharomyces boulardii** have gained increasing attention in poultry nutrition due to their distinct functional properties. Compared with bacterial probiotics, Saccharomyces exhibits greater resistance to heat, bile salts and antibiotics, making it highly suitable for feed processing and survival in challenging gut environments. In poultry, Saccharomyces supplementation enhances intestinal barrier integrity by reinforcing tight junction protein expression and epithelial cohesion. It reduces pathogen adhesion and toxin activity through direct binding mechanisms and competitive exclusion. Furthermore, Saccharomyces promotes beneficial microbial populations, increases intestinal microbial diversity, enhances digestive enzyme activity, improves feed digestion and growth performance, particularly under disease challenge or environmental stress conditions.

Overview of Probiotic Action

- Probiotics stabilize beneficial gut microflora and suppress enteric pathogens through competitive exclusion, antimicrobial metabolite production and reduced intestinal pH, thereby maintaining microbial balance.
- Probiotics strengthen intestinal barrier integrity and immune function by enhancing mucous and tight junction integrity, promoting short-chain fatty acid production, supporting epithelial repair and modulating inflammatory responses (Fig. 2).

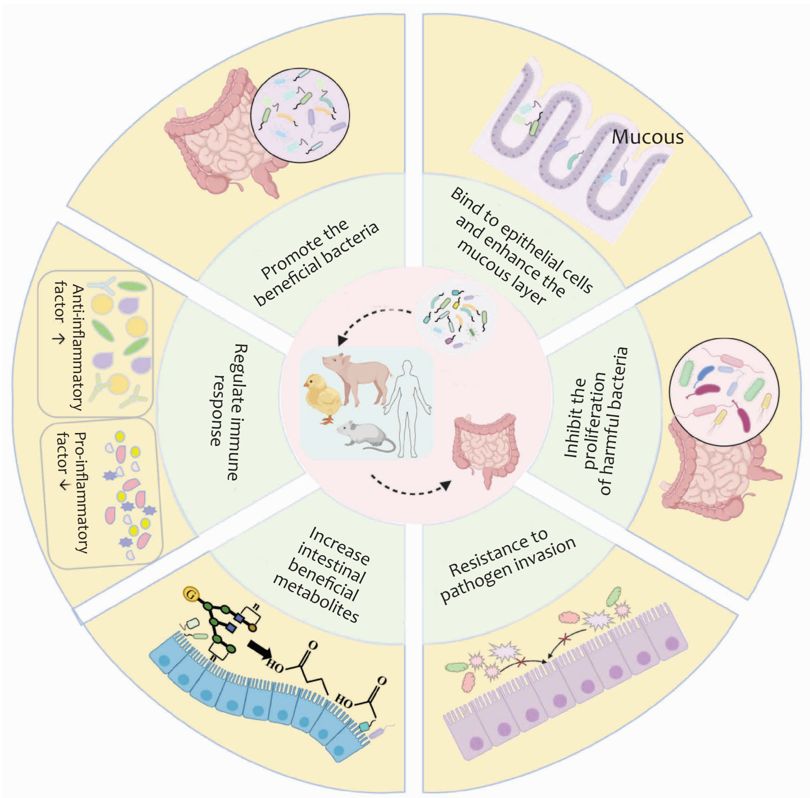

Fig. 2: Mechanism by which Probiotics Promote Intestinal Health
(Source: Yue *et al.*, 2025)

Prebiotics and Gut Health

Prebiotics are non-digestible feed components that beneficially influence poultry health by selectively stimulating growth and metabolic activity of advantageous gut microorganisms. Functionally, prebiotics serve as substrates utilized by intestinal microbiota to confer health benefits to host, primarily by restoring microbial balance and maintaining intestinal homeostasis. In poultry, prebiotics have gained increasing importance as functional feed additives because of their ability to enhance gut health, improve immune competence and reduce the colonization of foodborne pathogens, thereby supporting sustainable and antibiotic-free production systems.

In poultry GI tract, prebiotics escape enzymatic digestion in upper gut and reach the caeca, where they undergo microbial fermentation. This process selectively promotes the proliferation of beneficial bacteria such as Lactobacillus and Bifidobacterium and leads to production of short-chain fatty acids (SCFAs) including acetate, propionate and butyrate. SCFAs lower intestinal pH, inhibit growth of harmful bacteria, provide energy to intestinal epithelial cells and enhance tight junction integrity. Additionally, SCFAs play an important role in regulating immune signalling pathways and strengthening intestinal barrier, thereby improving nutrient absorption, mineral bioavailability and immune regulation in poultry (Fig. 3).

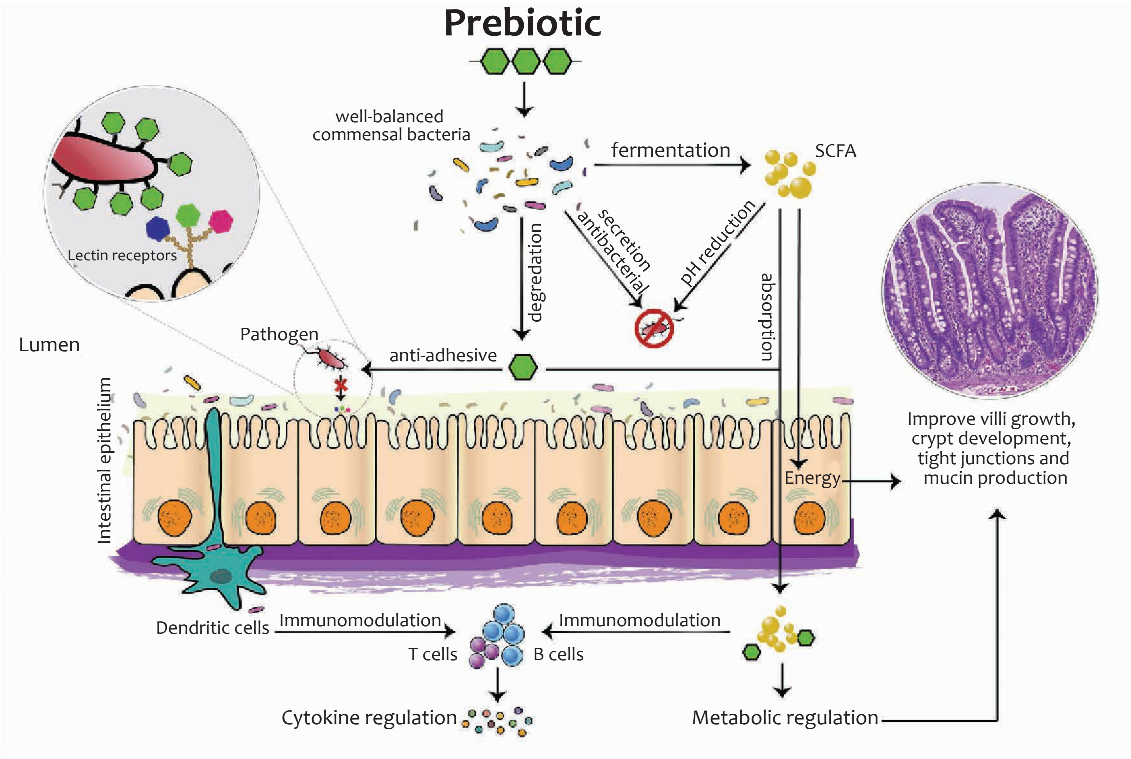

Fig. 3: Potential Mechanisms of Action of Prebiotics
(Pourabedin and Zhao, 2015)

In Poultry, Various oligosaccharides and monosaccharides reduce pathogen colonization by blocking the receptor sites used by pathogens for attachment to epithelial cell surface. Among the commonly studied prebiotics, **fructo-oligosaccharides (FOS)** have demonstrated significant potential in poultry nutrition. FOS selectively stimulate beneficial bacterial populations and enhance SCFAs production, resulting in reduced intestinal pH and suppression of pathogenic bacteria. FOS fermentation promotes epithelial energy metabolism and modulates immune cell activity, including macrophages, dendritic cells, T cells and B cells contributing to balanced cytokine production. In broilers and laying hens, dietary FOS supplementation has been associated with improved gut barrier integrity and reduced adhesion and colonization of pathogens such as *Salmonella Enteritidis*, thereby enhancing bird health and food safety.

Isomaltooligosaccharides (IMO) represent another effective class of prebiotics that enhance populations of Lactobacillus and Bifidobacterium while suppressing pathogenic microorganisms. IMO fermentation increases SCFAs production, which supports intestinal epithelial health and limits pathogen survival. IMO also contributes to immune modulation by influencing cytokine secretion and immune cell interactions, ultimately improving disease resistance. In poultry, IMO supplementation has been linked to improved growth performance, enhanced immune responses and reduced colonization by *Salmonella* spp. and avian pathogenic *Escherichia coli*.

Galactooligosaccharides (GOS) support gut health by selectively enriching beneficial microbiota and reinforcing the intestinal mucosal barrier. GOS supplementation enhances mucin secretion and increases secretory immunoglobulin A (IgA) levels, which collectively improve mucosal defence and reduce pathogen attachment. The role of GOS in modulating inflammatory pathways, including downregulation of NF-κB mediated inflammatory signalling a pathway increasingly implicated in enteric inflammation and growth suppression in poultry, thereby reducing intestinal inflammation and promoting epithelial integrity (Fig. 4).

Mannan-oligosaccharides (MOS) derived primarily from yeast cell walls, function as prebiotics by binding type-1 fimbriae of enteric pathogens such as Salmonella and *E. coli* thereby preventing epithelial adhesion. MOS also modulate immune responses through interaction with gut-associated lymphoid tissue and have been associated with improved gut morphology and reduced pathogen shedding in poultry.

Inulin a plant-derived prebiotic, also plays a crucial role in maintaining poultry gut health. In caeca, inulin is fermented by beneficial bacteria, resulting in increased SCFAs production and reduced intestinal pH. These changes promote epithelial cell health, strengthen the intestinal barrier and suppress harmful bacterial populations. Inulin supplementation increases beneficial bacterial populations, reduce *E. coli* counts, improves intestinal morphology and enhance resistance to enteric pathogens, collectively contributing to improved gut stability and performance.

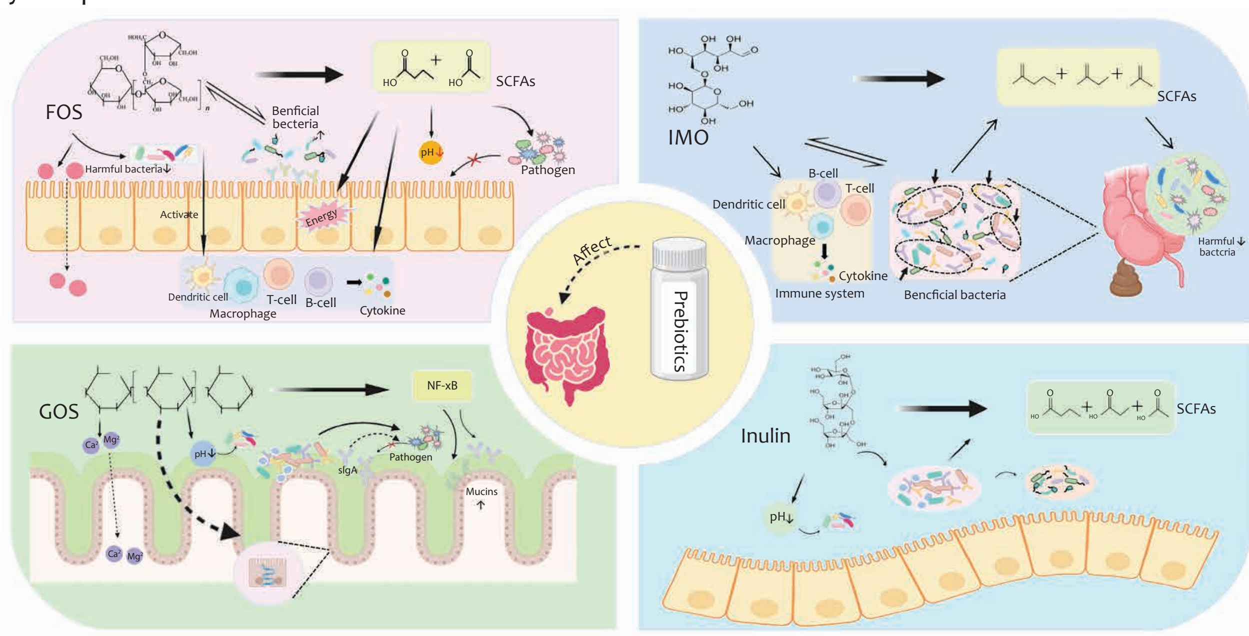

Fig. 4: Role of Different Prebiotics on Intestinal Health
(Source: Yue *et al.*, 2025)

Mechanisms of Synbiotic Action

Synbiotics combine probiotics and prebiotics in formulations that enhance survival, colonization and metabolic activity of beneficial microorganisms beyond what either component achieves individually. Their coordinated modulation of gut microbiota, improvement of epithelial structure and targeted immune regulation collectively support more efficient nutrient utilization, stronger resilience to enteric challenges and improved production performance in modern poultry systems.

First-Week Synbiotic Programming of Gut and Immunity

First week post-hatch is a critical window for gut programming because the intestinal microbiota is still being established while epithelium, mucosal barrier and innate immune sensing systems are rapidly maturing. Synbiotics are particularly suited to this period because they combine beneficial microbes with a selective fermentable substrate, improving early microbial survival and establishment and accelerating maturation of gut barrier function. When provided early (from hatchery and starter feeding), synbiotics can shape early innate immune tone within intestine, supporting more balanced host–microbe signalling during starter phase and contributing to improved feed efficiency later. *In Ovo* delivery of synbiotics further extends this concept by priming gastrointestinal tract before hatch, embryo's exposure to prebiotic–probiotic combinations can influence early intestinal and immune development, supporting maturation of mucosal immunity and metabolic readiness around hatch. Functionally, synbiotics are commonly associated with improved intestinal morphology and absorptive capacity, including favourable villus–crypt architecture and enhanced markers of nutrient utilization, consistent with strengthened epithelial integrity during early growth. Under early-life stressors such as high stocking density, synbiotics can help stabilize microbial communities, reduce dysbiosis-related disruptions in gut structure and protect epithelial barrier function, thereby improving resilience when chicks are most vulnerable.

Synergistic Modulation of Gut Microbiota

Synbiotics are designed to act synergistically, which means prebiotic selectively fosters the growth and activity of co-administered probiotic, enhancing its survival and colonization in gut more effectively than either alone. This synergy results in a more pronounced shift in gut microbial ecosystem toward beneficial bacteria (e.g., Lactobacillus, Bifidobacterium, Enterococcus) with concurrent suppression of pathogenic populations like *E. coli* and Salmonella. Increased beneficial bacteria reduce pathogen adhesion and colonization through competitive exclusion and bacteriocin production.

Increased Production of Beneficial Metabolites

Synbiotics enhance the fermentation of dietary carbohydrates in gut, particularly in caeca, leading to increased production of short-chain fatty acids such as acetate, propionate and butyrate. These metabolites lower intestinal pH, thereby inhibiting pathogenic bacteria and serve as important energy sources for enterocytes, promoting mucosal growth and villus development. In addition, SCFAs exert anti-inflammatory effects and support immune cell signalling within the gut. Collectively, SCFA-mediated mechanisms improve nutrient absorption efficiency and contribute to enhanced feed conversion, a critical performance parameter in poultry production.

Strengthening of Intestinal Barrier Integrity

Synbiotics support the structural and functional integrity of intestinal epithelium through multiple mechanisms, including upregulation of tight junction proteins that reduce intestinal permeability and prevent translocation of pathogens and their toxins. They also promote mucus secretion by goblet cells, forming a protective physical barrier over intestinal surface and increase villus height and villus-to-crypt ratio, thereby enhancing absorptive surface area of gut. Collectively, these effects strengthen the gut barrier, reduce intestinal inflammation and improve overall digestive efficiency.

Immunomodulatory Effects

In addition to modulating the gut microbiota and intestinal structure, synbiotic supplementation influences both innate and adaptive immune responses through regulation of Toll-like receptor expression, cytokine profiles and lymphoid tissue activity. Synbiotics enhance mucosal immunity by increasing secretory IgA production, promote balanced cytokine responses that limit excessive inflammation while strengthening pathogen defence and activate innate immune cells such as macrophages and dendritic cells, leading to more effective early responses to enteric challenges. These immunomodulatory effects improve resilience against disease, particularly during early life stages or under stress conditions, thereby supporting overall flock health.

Mitigation of Stress and Dysbiosis

Environmental stressors such as high stocking density and heat stress can disrupt the intestinal microbial balance and compromise gut health. Synbiotic supplementation helps restore microbial equilibrium under stress conditions and reduces markers of stress-induced intestinal damage while maintaining healthier gut morphology. This enhanced gut resilience supports the maintenance of growth performance and feed efficiency even under suboptimal production conditions.

Effects of Synbiotics on Performance

Body Weight Gain (BWG) and Average Daily Gain (ADG)

Synbiotics contribute to improved growth performance by creating a more stable and functionally efficient gastrointestinal environment. These combined effects support more efficient digestion and nutrient absorption, enabling birds to allocate a greater proportion of dietary energy toward growth. Synbiotic supplementation has been associated with increases in final body weight and BWG ranging from approximately 3–8%, with corresponding improvements in ADG of 2–6% compared with unsupplemented controls, particularly during starter and grower phases when gut development is most critical (Awad *et al.,* 2009; Abd El-Hack *et al.,* 2020).

Feed Conversion Ratio (FCR) and Feed-to-Egg Ratio

Improved feed efficiency is among the most consistently reported benefits of synbiotic supplementation. By enhancing gut morphology, strengthening epithelial barrier function and reducing subclinical intestinal inflammation, synbiotics improve nutrient partitioning and reduce maintenance of energy losses. In broilers, this translates into FCR improvements typically ranging from 2–6%. In laying hens, synbiotics support more efficient conversion of feed into egg mass with reported improvements in feed-to-egg ratio of approximately 3–5% across laying cycle, particularly under heat stress or antibiotic-free feeding regimes (Abdelqader *et al.,* 2013).

Egg Production and Egg Mass

In laying hens, synbiotics contribute to sustained productive performance by supporting gut health during physiologically demanding processes of egg formation. Improved microbial balance and enhanced SCFAs production promote better absorption of minerals, especially calcium and phosphorus supporting shell formation and egg quality, while stable nutrient availability facilitates yolk and albumen synthesis. Synbiotic supplementation has been associated with increased egg production from 69.29% to 77.00% during 20–36 weeks and increased egg mass from 37.68 to 43.06 g/hen/day. Across 20–52 weeks, egg production rose from 78.04% to 82.38% and egg mass from 43.88 to 47.97 g/hen/day versus controls (Tang *et al.,* 2017).

Mortality and Health-Related Performance Outcomes

Synbiotics play a protective role when birds encounter intestinal challenges such as dysbiosis, pathogen exposure or environmental stressors. Their capacity to stabilize gut microbiota, reinforce mucosal immunity and maintain epithelial integrity, reduces susceptibility to enteric damage and systemic stress. In broiler operations, synbiotic supplementation has been linked to reductions in mortality ranging from 10–40%, alongside lower gut lesion scores and decreased incidence of performance losses associated with necrotic enteritis, coccidial challenge or heat stress (Awad *et al.,* 2009; Abd El-Hack *et al.,* 2020). These health-protective effects contribute to improved flock uniformity, greater resilience under intensive production conditions and more predictable production outcomes (Tang *et al.,* 2017).

Carcass Traits

Improvements in nutrient efficiency associated with synbiotic supplementation are frequently reflected in favourable carcass characteristics in broilers by promoting more efficient nutrient partitioning toward lean tissue accretion rather than fat deposition. Synbiotic fed broilers have demonstrated increases in dressing percentage and breast muscle yield ranging from approximately 3–9%, accompanied by a reduction in abdominal fat deposition of 8–20% compared with unsupplemented controls (Mountzouris *et al.,* 2010; Abd El-Hack *et al.,* 2020).

Factors Determining Efficacy of Synbiotics

Efficacy of synbiotics manifested as improvements in gut health, immune modulation, microbial stability and performance, depends on multiple interacting biological, nutritional and management-related factors. Central to synbiotic success is the compatibility between probiotic strains and prebiotic substrates, with true synbiotics providing selective substrates that directly enhance probiotic survival, metabolic activity and functional outcomes, while complementary synbiotics deliver more modest benefits. Dosage and inclusion level are critical as adequate dosing promotes effective colonization and physiological modulation, whereas under or overdosing can limit efficacy or disrupt microbial balance.

Timing and duration of supplementation strongly influence outcomes, with early-life supplementation producing more persistent microbial imprinting and improved intestinal development and sustained use ensuring long-term stability, particularly during predictable stress periods. Host-related factors including age, genetic background and health status further shape responses with younger and stressed birds typically exhibiting greater benefits. Diet composition and feed interactions determine the fermentative environment, influencing substrate availability and microbial competition while environmental and management conditions such as hygiene, stocking density, heat stress and delivery method modulate probiotic survival and gut colonization. Collectively, optimizing these interconnected factors is essential for achieving consistent and reproducible synbiotic benefits in commercial poultry production.

Conclusion

Synbiotics have emerged as one of the most effective and practical nutritional tools for modern poultry systems, offering a reliable alternative to antibiotic growth promoters while supporting sustainable, high-performance production. By combining targeted probiotics with selectively supportive prebiotics, synbiotics enhance microbial stability, improve nutrient utilization and strengthen gut resilience in genetically fast-growing birds raised under intensive conditions. Their consistent benefits including improved growth performance, feed efficiency, egg production and flock uniformity reflect their ability to stabilize gut during critical periods of development and stress. As poultry production increasingly prioritizes antibiotic-free, health-focused strategies, synbiotics provide a scientifically validated approach that aligns poultry health, economic efficiency and long-term sustainability.

References

Abd El-Hack, M. E., El-Saadony, M. T., Shafi, M. E., Qattan, S. Y., Batiha, G. E., Khafaga, A. F.,Abdel-Moneim A M. and Alagawany, M. **(2020)**. Probiotics in poultry feed: A comprehensive review. *Journal of animal physiology and animal nutrition*, **104:** 1835-1850.

Abdelqader, A., Al-Fataftah, A. R. and Daş, G. **(2013)**. Effects of dietary Bacillus subtilis and inulin supplementation on performance, eggshell quality, intestinal morphology and microflora composition of laying hens in the late phase of production. *Animal Feed Science and Technology,* **179:** 103-111.

Awad, W. A., Ghareeb, K., Abdel-Raheem, S. and Böhm, J. **(2009)**. Effects of dietary inclusion of probiotic and synbiotic on growth performance, organ weights, and intestinal histomorphology of broiler chickens. *Poultry science,* **88:** 49-56.

Mountzouris, K. C., Tsitrsikos, P., Palamidi, I., Arvaniti, A., Mohnl, M., Schatzmayr, G. and Fegeros, K. **(2010)**. Effects of probiotic inclusion levels in broiler nutrition on growth performance, nutrient digestibility, plasma immunoglobulins, and cecal microflora composition. *Poultry science*, **89:** 58-67.

Pourabedin, M. and Zhao, X. **(2015)**. Prebiotics and gut microbiota in chickens. *FEMS microbiology letters*, **362:** fnv122.

Prentza, Z., Castellone, F., Legnardi, M., Antlinger, B., Segura-Wang, M., Kefalas, G., Papaioannou, N., Stylianaki, I., Papatsiros, V.G., Franzo, G. and Cecchinato, M. **(2022)**. Administration of a multi-genus synbiotic to broilers: Effects on gut health, microbial composition and performance. *Animals*, **13:** 113.

Rajput, D. S., Zeng, D., Khalique, A., Rajput, S. S., Wang, H., Zhao, Y. and Ni, X. **(2020)**. Pretreatment with probiotics ameliorate gut health and necrotic enteritis in broiler chickens, a substitute to antibiotics. *Amb Express,* **10:** 220.

Śliżewska, K., Markowiak-Kopeć, P., Żbikowski, A. and Szeleszczuk, P. **(2020)**. The effect of synbiotic preparations on the intestinal microbiota and hermetabolism in broiler chickens. *Scientific reports*, **10:** 4281.

Tang, S. G. H., Sieo, C. C., Ramasamy, K., Saad, W. Z., Wong, H. K. and Ho, Y. W. **(2017)**. Performance, biochemical and haematological responses, and relative organ weights of laying hens fed diets supplemented with prebiotic, probiotic and synbiotic. *BMC veterinary research*, **13:** 248.

Yue, Taojing, Yanan Lu, Wenli Ding, Bowen Xu, Cai Zhang, Lei Li, Fuchun Jian and Shucheng Huang. "The role of probiotics, prebiotics, synbiotics, and postbiotics in livestock and poultry gut health: a review." *Metabolites* 15, no. **7 (2025)**: 478.

Youssef, I. M., Elsherbeni, A. I., Almuraee, A. A., Nass, N. M., Beyari, E. A., Alshammarii, N. M., Abdel-Ghany, A.M., Ahmed, E.S.G., Nasr, S., Youssef, K.M. and Salem, H.M. **(2024)**. Influence of using synbiotics by various routes on Mandarah male chicks: intestinal bacterial counts, gut morphology and histological status. *Poultry Science*, **103:** 103601.

Zhao, Z., Liswaniso, S., Qin, N., Cao, S., Wu, X., Ma, C.,Yan C., Xu R. and Sun, X. **(2024)**. Effects of a novel synbiotics-enzyme complex as a replacement for antibiotics on growth performance, slaughter and meat characteristics, immune organ index, and intestinal morphology of broilers. *Frontiers in Veterinary Science*, **11:** 1468847.

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