Chapter 05

Dietary Probiotic and Prebiotic Supplementation: their Effects on Broiler Chicken Performance

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ABSTRACT

Increasing the demand on poultry meat necessitate the improvement in production. Broilers that were not given any medicine performed poorly. Dietary measures may be used to control the height of the intestinal villus, which is linked to the ability to digest and absorb nutrients. Various feed additives, including oligosaccharides, enzymes, and antibiotics, are used in poultry feed to promote growth through possibly improving feed intake. While extended usage of antibiotics has resulted in the emergence of resistant bacteria, they also cause an accumulation of antibiotic residue in poultry feed. Prebiotic substrates, probiotic bacteria, or symbiotic prebiotic-probiotic combinations can be used as a substitute to sub-therapeutic antibiotics. Probiotics are living microorganisms that are used in the diet as feed additives or supplements. Also known as a direct-fed microorganism. Probiotic supplementation in the diet can improve host health and performance by enhancing gut health and nutrient utilization. While Prebiotics are defined as 'a non-digestible feed element that benefits the host by increasing the quantities of health-promoting bacteria in the intestinal tract. When the prebiotic enters the colon, it is selectively fermented by members of the indigenous microbiota. Subtherapeutic antibiotics are commonly used to prevent illness and promote body weight growth. The antibiotics subtherapeutic uses have a negative reputation among some customers, because there is emerging evidence that antibiotic resistance genes can be passed from animals to people.

KEYWORDS
Prebiotic, Probiotic, Broiler, Gastrointestinal tract

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INTRODUCTION

Over the last few years, the poultry business has improved its standing within the agri-food sector (Krysiak et al., 2021). Broiler chickens face a variety of stressors due to the high demands of production; these stressors negatively impact the overall health and productivity of the birds. In these situations, using synthetic antimicrobials and antibiotics is normal practice to lessen stress while simultaneously promoting development and feed efficiency (Dhama and Singh, 2010). Since chicken feed makes up over 70% of the overall production costs, the long-term profitability of the business depends on its assessment. Therefore, it's essential to increase feed efficiency while minimizing costs (Agawane and Lonkar, 2004).

Antibiotics have been used for more than 50 years to improve animal health, growth, and efficiency. However, as early as the 1950s, researchers found concern over the development of resistance bacteria for the tetracycline used in broilers. These results paved the way for agricultural regulators to apply more stringent guidelines on the use of antibiotics in chicken feed (Abd El-Hack et al., 2020). Antibiotic growth promoters (AGPs) are being used less or not at all in poultry production. As a result, the poultry industry has experienced a number of challenges, including poor performance and general health problems (Hafez and Shehata, 2021). Oxidative stress, diarrhea, and enteritis are examples of production-related illnesses (Lin et al., 2006; Lauridsen, 2019). Poultry farms often face the difficulty of inflammation, which is linked to innate immunological responses and can result in substantial financial losses (Shah et al., 2020).

Applying feed additives without antibiotics has similar benefits. Like enhancing broiler development and feed consumption (Mountzouris et al., 2007), since the health of consumers is at risk when in-feed AGPs are used in chicken diets (Abudabos et al., 2015). A growing number of probiotics, prebiotics, and phytogenic compounds are among the substitute supplements for antibiotics that have been created, examined, and applied to the production of chickens (Gernat et al., 2021).

Probiotics are live bacteria that are added to animal feed as supplements or additives and have the ability to improve the host's health, mostly through the gastrointestinal system (Abd El-Hack et al., 2020) by enhancing the native microflora's characteristics or the microbial equilibrium (Wang et al., 2018). Prebiotics are indigestible feed additives that preferentially encourage the development and activity of useful bacteria in the intestine, hence providing a favorable effect on the host. The primary prebiotics include mannose, galactose, fructose, and glucose (Hume, 2011). Probiotics are thriving in an excellent environment created by prebiotics (Sekhon and Jairath, 2010). Synbiotics comprise a mixture of probiotics and prebiotics (Yang et al., 2009).

Probiotics and prebiotics decrease the load of pathogens by boosting the host's mucosal immunity and establishing resistance to bacterial colonization (Sugiharto et al., 2017; Azad et al., 2020). Numerous investigations have demonstrated that probiotics, and prebiotics together have combined benefits on immune function, beneficial native bacterial development, and directed probiotic strains in the colon (Mookiah et al., 2014).

Better regulation of intestinal pathogens can be achieved by maintaining a healthy digestive tract through a balanced microbial population (Konstantinov et al., 2006).

Probiotics have demonstrated numerous advantageous attributes, including the capacity to enhance immunity, intestinal architecture, and gut barrier performance in broiler chickens. These elements may enhance absorption and digestion, which in turn may enhance performance under heat stress (Larsson et al., 2012). The demonstrated advantages include elevated peripheral immunoglobin synthesis and enhanced IgA secretion (Villena et al., 2008). The digestive tract is the largest producer of immunity; its activated mucosal B cells create a significant amount of IgA, acting as the body's first line of defense against pathogens (Lycke and Bemark, 2017).

Probiotics benefit chickens of all ages and classes in terms of immunity, health, and growth. They enhance maturation and intestinal integrity, boost immunity, reduce inflammation, improve feed consumption and digestion by lowering the activity of bacterial enzymes and raising the activity of digestive enzymes, decrease ammonia production and neutralize enterotoxins (Rehman et al., 2020). Probiotics and prebiotics have been shown to have growth-promoting properties, which suggests that they can alter the gut ecosystem by boosting the quantity of lactic acid bacteria, Bifidobacteria, and other anaerobic bacteria and lowering the quantity of enteric Bacilli and other aerobic bacteria (Schrezenmeir and de Vrese, 2001). Li et al. (2008) demonstrated that synbiotic (pre- and probiotic) combinations are frequently more beneficial than single supplements. Food digestion, intestinal health, and broiler performance are all improved by symbiotics (Patterson and Burkholder, 2003).

Intestinal Microbiota

The gastrointestinal system of birds is home to a vibrant and diverse community of microorganisms that coexist symbiotically with their hosts. Nutrition, immunity, and metabolism of the host depend on this mutualistic interaction. To support host homeostasis, the intricate ecosystem functions as a virtual organ system (Al-Khalaifa et al., 2019).

Under normal circumstances, intestinal health is largely determined by the symbiotic interaction that exists between the host's gut microbiota and itself. However, an unbalanced host-microbe connection known as "dysbiosis" can result from a disruption in the gut microbiota (Zoetendal et al., 2008). The gut microbiota can be disrupted by a number of factors, including heavy metals, toxic compounds, bacterial toxins, herbicides, and antibiotics. These effects could result in widespread infection, regional inflammation, or even intoxication (Ackermann et al., 2015).

The intestinal tract's permeability regulates not only the movement of non-digested materials but also the intake of nutrients and undesirable external substances like bacteria and xenobiotics. For this reason, the pathophysiology of many intestinal illnesses depends critically on gut health. The gut flora, digesting secretions, physical barriers (mucin, intestinal epithelial cells lining and tight junctions), and chemicals like cytokines regulate the permeability of the intestine (BisBischoff et al., 2014).

The disorder known as "leaky gut," or decreased intestinal barrier function, is characterized by damage to the small intestine's lining, which allows toxins and other luminal materials, such as bacteria, to penetrate between epithelial cells. Following these disorders, the intestines may become inflamed or damaged, resulting in elevated blood levels of endotoxins produced by bacteria. As a result of this inflammatory process' heavy nutritional consumption, metabolic responses particularly immunometabolic and endocrine responses are negatively impacted. Animal performances consequently suffer greatly (Abuajamieh et al., 2016).

Dysbiosis, or the modification of the composition of the gut microbiome, is caused by a number of things, including antibiotics, illnesses, stress, and food. Currently, a variety of techniques are used to alter the gut microbiome, including dietary modifications, the use of antibiotics and antimicrobials, probiotics, prebiotics, postbiotics, and synbiotic (Takáčová et al., 2022).

The activity of intestinal epithelial cells can be modulated by commensals and probiotics in a number of ways, including indirect effects on microbial biofilms (Vastano et al., 2016), and direct effects on the synthesis of mucin and tight junctions, which improve barrier function of intestinal epithelial cells (IECs) (Zyrek et al., 2007), raising the synthesis of heat shock protein and antimicrobial peptides (AMPs) (Liu, 2017), and interference with pathogenesis and pro-inflammatory and immunoregulatory cytokine modulation (Chen et al., 2006).

The majority of the microbial communities in chickens were composed of Bacteroidetes and Firmicutes, which are known to be important for energy production and metabolism (Yan et al., 2017; Pandit et al., 2018).

Based on studies carried out primarily in the last ten years, several roles are being assigned to the gut microbiota, for example (i) preservation of the barrier epithelium, (ii) suppression of intestinal surface pathogen adhesion, (iii) immune system regulation and appropriate maturation, (iv) degradation of carbon sources that would otherwise be indigestible, like plant polysaccharides, and (v) creation of several metabolites, including short-chain fatty acids (SCFAs) and vitamins (S´anchez et al., 2017).

Probiotics are made up of both bacterial and yeast cultures, which encourage the growth of microorganisms that can improve feed efficiency and change the gastrointestinal environment to a healthy state (Abudabos et al., 2015). The pathogenic bacteria that use toxins to degrade the intestinal wall were inhibited by the use of probiotics and prebiotics (Hassan et al., 2012).

Antibiotic Growth Promoters

The use of antibiotic growth promoters (AGPs) and synthetic growth promoters (SGPs) peaked many years ago (Broom, 2017). For several decades, the poultry industry has routinely used subtherapeutic dosages of antibiotics as antibiotic growth promoters (AGP) to increase feed efficiency (FE) in broiler chickens additionally lower illness incidence (Paul et al., 2022). Their range of activity encompassed antibacterial mechanisms, mostly aimed at Gram-positive bacteria (Broom, 2017).

The diversity of gut bacteria has been demonstrated to be altered by AGPs., such as beneficial lactic acid bacteria (LABs) (Neumann and Suen, 2015; Fasina et al., 2016). The modification of the animal immune system is another area where the AGP's methods of action extend; however, depending on the substance used, these responses differ, and for example, avilamycin influences the inhibition of bacterial protein synthesis, which results in a reduced release of proinflammatory compounds (Kabploy et al., 2016).

Furthermore, the quantity of amino acids, nucleosides, vitamins, or fatty acids metabolized is affected by the use of these feed additives; surprisingly, studies have indicated an increase in these levels. On the other hand, the information about the rise in polyunsaturated fatty acids (PUFA) is the most startling (Gadde et al., 2018). The usage of AGPs is involved in the development of poultry, and their gradual discontinuation can lower finishing weights. When combined with the detrimental effects of heat stress (HS), this can significantly reduce productivity (Lin et al., 2007).

Due to proven residues in soil, water, and animal products, as well as adverse effects on allergies and antibiotic resistance, AGPs have been discontinued (Ronquillo and Hernandez, 2017). The European Union outlawed using antibiotics as growth enhancers in 2006 (Castanon, 2007). Subsequently, the FDA requested in 2009 that medically significant AGPs be removed voluntarily from animal feed in the US (Thanner et al., 2016). The less effective usage of antibiotics has been replaced by more effective dietary supplements, such as probiotics and/or prebiotics. It is said that these substitute elements will strengthen immunity to all pathogenic agents and improve growth (Al-Khalaifah, 2018).

Since antibiotics reduce the number of beneficial bacteria in the intestine, such as *Lactobacillus* and *Bifidobacteria*, they produce reduced villi height when taken in supplements (Oliveira et al., 2008). In addition to eliminating pathogenic bacteria, antibiotics for treatment purposes change the overall microbiota of the host population. Leading to bacterial dysbiosis as well as future infections that are difficult to treat. Although taking probiotics with antibiotics not only stops diarrhea but also maintains the proper balance of gut bacteria without compromising the effectiveness of the medicine (Yousaf et al., 2022). It is anticipated that the antibiotic growth promoters would be taken out in the not too distant future due to the potential for major health effects from drug-resistant bacterial strains and antibiotic residues in chicken products (Yousaf et al., 2022).

Prebiotics and probiotics may be used in poultry diets as an alternative to AGPs. Prebiotics are oligosaccharides that has the ability to specifically stimulate particular gut bacterial species, perhaps improving the host's health but they are not digested by animal enzymes. Prebiotics are supposed to specifically promote the beneficial bacteria that are already present in the gut, whilst probiotics are designed to introduce helpful bacteria to the gut (Yang et al., 2009).

The Concept of Prebiotic and Probiotics

The Greek term "pro bios," which means "for life," led to the creation of the term "probiotics," which describes bacteria that are good for the body (Bansal et al., 2011). The name "probiotic" was not defined until recently, despite the fact that the concept of probiotics seems ancient. The term "probiotic" was first used in a 1965 in a science paper by Lilly and Stillwell, who described probiotics as "growth promoting factors produced by microorganisms." Probiotics are described by Parker as "organisms and substances which contribute to intestinal microbial balance". A decade later, the term "live microbial feed supplements which improve the intestinal microbial balance of the host animal" was added to the definition. Additional definitions were put up, such as "microbial cell preparations or components of microbial cells that have a beneficial effect on the health and well-being of the host," to describe both dead bacteria and bacterial components (S´anchez et al., 2017). The current definition of a probiotic by FAO/WHO is that it cannot be used with dead or mostly dead bacterial cells; instead, it must include live, viable bacteria. The International Scientific Association for Probiotics and Prebiotics (ISAPP) is one of the organizations that have accepted this description (Hill et al., 2014).

According to the Food and Drug Administration (FDA), probiotics are classified as Generally Recognized as Safe (GRAS) substances, both side effects and aftereffects are absent. By regulating the gut's microbial environment, preventing pathogenic gut bacteria, and reducing digestive disturbances, probiotics enhance live weight gain, improve feed conversion ratio, reduce mortality, and in layers increasing feed conversion ratio and egg production (Bansal et al., 2011).

Since the AGP was outlawed, probiotics have been used more frequently to treat bacterial illnesses. This can be attributed in great part to prior understanding of bacterial contact, wherein microbes compete with one another for survival mechanisms and substrates (Hernandez-Patlan et al., 2020). A probiotic need to possess the following qualities: It is appropriate for bacteria to be a part of the gut microbiota, be able to readily cling to the gut epithelium and resist acidic environments (Kabir, 2009) as well as preserve the intestinal microbiota at the proper physiological level (Krysiak et al., 2021). Probiotics are typically made from a variety of microorganisms, including yeasts like *Candida* spp., and bacteria like *Bifidobacterium* spp., *Lactococcus* spp., *Lactobacillus* spp., *Bacillus* spp., and *Streptococcus* spp. (Park et al., 2016).

Prebiotics are polysaccharides and oligosaccharides that the animal cannot properly digest them, but can be easily digested by helpful of anaerobic colonic bacteria (Zhang et al., 2003). They alter the environment inside the gut by lowering the pH, providing digestive enzymes, and boosting gastrointestinal enzyme activity (Kabir, 2009). Compared to probiotics, prebiotics have the advantage of that they activate bacteria that normally reside in the animal's digestive system, and have so evolved to thrive in such environment (Snel et al., 2002). Mannan oligosaccharides, produced from the cell wall of yeast, are common type of prebiotics, which are elements of the yeast cell walls' outer layer, and mannose, glucans, proteins, and phosphate radicals are among their constituents (Klis et al., 2002).

Prebiotics might take the place of AGPs as non-microbial performance enhancing feed proponents. Although the goal of probiotics is to bring beneficial bacteria into the intestine. Prebiotics might function by specifically triggering the beneficial microorganisms already present. Furthermore, prebiotics support the endogenous microbiota by providing energy, metabolic substrates, and essential micronutrients to the host (Murshed et al., 2024). Prebiotics typically offer a fermentation substrate, increasing the survivability of probiotic organisms. Prebiotic and probiotic preparations work better together than they do separately most of the time (Mookiah et al., 2014).

Synbiotics are a combination of prebiotics and probiotics. Which consist of substrates and advantageous microbes, it might have complementary effects on animal digestive systems. Through improving the viability and intestinal implantation of food supplements containing live microorganisms, synbiotics have a positive effect on the host. These outcomes are caused by either selectively encouraging the development of one or few health-promoting microorganisms, which enhances the host's well-being, or both (Gibson and Roberfroid, 1995).

Diarrhea and a lack of appetite are among the symptoms that could arise from bacteria proliferating in the host's digestive tract. There will be a reduction in the effectiveness and immune capacity of chicken production because of the elimination of the natural microbiome causing significant financial losses for poultry producers. To preserve the health and balance of the poultry's microbiota, regular and timely addition of a probiotic supplement to the meal is advised (Bar-Shira and Friedman, 2006).

Increased daily increments, better feed conversion ratio (FCR), and enhanced laying and egg quality are among the nutritional benefits shown in flocks given probiotics. The quality of meat has also improved. This shows that using probiotics can help producers achieve better production results. Bird immunity is enhanced in addition to these production benefits by enabling the organism to more effectively defend itself against infections and stress (Krysiak et al., 2021).

The selection of prebiotics and probiotics, methods of preparation, dose administration, food composition, bird age, and hygienic conditions can all be factors in the variations in growth performance. (Mountzouris et al., 2007). Conversely, the observed improvement in body weight gain (BWG), and feed conversion ratio (FCR) may be associated with a reduced microbial population within the broiler's gastrointestinal tract (Thongsong et al., 2008).

Immunomodulatory Potential of Probiotics

The statement "immunity comes from the intestines" has become more important in the poultry industry since zoonoses and bacterial illnesses have been demonstrated to be effectively combated by probiotics (Krysiak et al., 2021). The establishment of passive and active resistance to avian intestinal illnesses are facilitated by the immune system, gut microbiota, and epithelial cells. There is little information available regarding how the bacteria in an avian's stomach differentiate between "bad" and "good" bacteria and regulate the immune system (Bomba et al., 2002).

Because different cell types, including bacteria in the gut lumen, epithelium, or lamina propria, and members of the innate and adaptive immune systems, are constantly interacting, intestinal enterocytes monitoring the epithelial surface area for potential pathogens in the gut. The precise intestinal lay out and the inter-digitation of immune cells across epithelial tissue enable the balance between hyper- reaction and non-reaction. Partly due to the fact that the gut has the highest density of lymphocytes than any other organ, moreover, because its surface area and size in relation to both autochthonous and allochthonous probiotics are significant variables. The intestinal epithelium's enterocytes serve as a barrier to keep pathogens from obtaining nourishment and help the immune system identify potential infections in the lumen. Consequently, the greatest immunological organ is occasionally applied to the gut (Bouzaine et al., 2005).

Raising cell-mediated immunity could potentially help fight viral infections and potentially alleviate some of the symptoms of infection-associated diseases for example chicken infectious anemia, infectious bursal disease, Marek's disease, reoviral infections, mycotoxins, and other immune-suppressive conditions. Because of the immunomodulatory effects of their metabolites, chicks are shielded from a wide range of infectious diseases. Probiotic-treated chicks may have greater antibody levels against viral diseases including ND and IBD, which are prevalent in the industry (Boirivant and Strober, 2007).

Probiotics have positive effects on the immune system, such as enhanced natural killer (NK) cell, macrophage, and lymphocyte function, increased production of immunoglobulins (IgG, IgM, and IgA), as well as enhanced oxidative burst in heterophils. The use of probiotics, which aid in immune system regulation and stomach stabilization, may support the maintenance of a balanced level of pro- and anti-inflammatory cytokines. Based on these findings, probiotics have been shown to have the ability to raise the quantity of lamina propria lymphocytes (LPL) and intestinal epithelial lymphocytes (IEL) in the small intestine, as well as preventing the growth of harmful bacteria (Dhama and Singh, 2010).

Probiotics have the ability to decrease inflammation caused by pathogen-infected cells or microflora by blocking signaling pathways including MAP kinase and NF-kappa beta that are responsible for immune response activation. Probiotics also strengthen the immune system by raising the lumen's IgA levels, the quantity of cells that make IgA, IgM, and IgG, and the quantity of T cells in the cecal tonsils (Cavit, 2003). When probiotics are taken orally, the stomach and bloodstream produce more natural antibodies to a greater variety of antigens (Chichlowski et al., 2007).

For poultry farms, inflammation linked to innate immunological responses is a frequent problem that results in large financial losses (Shah et al., 2020). Malondialdehyde (MDA) is the end result of lipid peroxidation, and antioxidant enzymes glutathione peroxidase (GSH-Px), superoxide dismutase (SOD), and catalase (CAT) are involved (Yu et al., 2022).

Probiotics support the immune system and screen for or avoid developing intestinal infections when suffering from viral infections or immunosuppressive circumstances (bacterial, coccidian) to reduce the risk of secondary infections in birds. As many infectious illnesses are transmitted by bacteria, fungi, protozoa, and viruses, a multi-strain probiotic ought to be a regular part of the diet (Hajati and Rezaei, 2010).

How Probiotic and Prebiotics Produce their Positive Effects

It has been demonstrated in multiple scientific investigation that probiotics and direct-fed microbial feed supplements can modify the gut microflora's composition by effectively competing with pathogens through an alternative mechanism (Mountzouris et al., 2007). Two potential defense mechanisms used by probiotic bacteria to keep viruses out of the digestive tract include competitive exclusion and bacterial antagonism such as intestinal villus and colonic crypts, which are favored habitats of enteric pathogens (Yousaf et al., 2022).

A phenomenon known as "competitive exclusion" happens when pathogens and probiotics compete for gut adhesive receptors that are essential to the adhesion and growth of microorganisms. According to this method, probiotics have an impact on how bacteria colonize disorders. Pathogens are unable to establish themselves in the gastrointestinal system due to probiotics quick colonization (the development of a thick layer of microflora) (Yousaf et al., 2022). Additionally, they alter the environment inside the gut by lowering pH, providing digestive enzymes, and boosting gastrointestinal tract enzyme activity (Kabir, 2009).

Preventing the infectious agents from getting the food and energy they need to proliferate in the gut environment is one of the key objectives of probiotics. Bacterial pathogens such as *Salmonella* and *E. coli* cannot thrive in an environment where primary and secondary metabolites such as lactic acid, volatile fatty acid (VFA), and organic acid have changed the pH of the gut. There is evidence that a class of substances called bacteriocins can effectively eradicate or stop harmful bacteria from colonizing an area (Yousaf et al., 2022).

Animal growth and development can be aided by probiotics' ability to create digestive enzymes, preserve intestinal structure, reduce the growth of harmful bacteria, and improve nutrient absorption (Kabir 2009). According to Sakata et al. (2003), probiotic bacteria actually accelerate the breakdown of indigestible carbohydrates, which raises the rates at which volatile fatty acids (VFA), lactic acid, and occasionally succinic acids are produced. The fermentation products produced by the oligosaccharides in the colon may help prevent the growth of harmful bacteria such as *Salmonella* spp., *Campylobacter* spp., or putrefactive bacteria such as *Clostridium perfringens* (Gibson and Wang, 1994).

Probiotics have a significant impact on the oxidative state of the gut because they directly possess antioxidant qualities and stimulate intrinsic organisms that communicate antioxidant defense (Zolotukhin et al., 2018). By lowering the amount of malondialdehyde (MDA) and increasing the amount of glutathione in the colon, probiotics may be able to withstand oxidative stress brought on by LPS (Chorawala et al., 2021). In response to repeated LPS stimulation, the peripheral blood immune organs, such as the thymus and spleen, extensively proliferated, producing inflammation and proinflammatory cytokines (TNF-a) (Zhong et al., 2018).

In addition, pathogenic bacteria with type-1 fimbriae, such *E. coli*, are prevented from adhering to the gut wall by the prebiotic mannanoligo saccharides, which also serve to push them out of the wall (Abdel-Raheem et al., 2012).

Advantages of using Probiotics and Prebiotics

The effects of antibiotics on microorganisms can be reduced with the use of probiotics. Nevertheless, the growth of drug-resistant bacteria and residues in chicken products could be caused by the common usage of subtherapeutic dosages of antibiotics. In addition to eliminating harmful bacteria, antibiotics used to treat illnesses also alter the general microflora of the host, resulting in bacterial dysbiosis and future infections that are challenging to treat. When probiotics are used with antibiotics to prevent diarrhea, the balance of gut microbiota is maintained without compromising the medication's effectiveness (Farnell et al., 2006). Probiotics successfully prevent pathogens from obtaining access to resources by maximizing their utilization of the accessible substrate, which is a result of their higher colonization aids in the gut (Yousaf, et al. 2022).

The health benefits of probiotics have previously been studied at the cellular level, where they were shown to modify gene expression and reduce heat stress (Krysiak et al., 2021). Probiotics have been shown to provide defense against a variety of cellular stressors, including oxidative stress-mediated apoptosis (Tao et al., 2006). Additionally, they improve barrier performance by stopping intestinal paracellular permeability from being destroyed (Llewellyn and Foey, 2017).

Effective probiotic use has been demonstrated to benefit chicks and poults (Bansal et al., 2011). As they improve feed conversion, growth rate, efficiency, nutrient absorption, and microbial balance (Elam et al., 2003). Preventing the growth of harmful microorganisms particularly those that cause digestive problems due to bacterial invasions also lowers the mortality rate of chicks. The performance of layers may also be improved by increased egg production, weight/size, and food uptake ratio (Al khalf et al., 2010). Probiotics have enhanced the flavor and quality of poultry products in addition to improving avian health (Krysiak et al., 2021). They increase the quality of egg yolk cholesterol content, egg albumen quality, egg fertility, and hatchability (Elam et al., 2003). Probiotic supplements also have a major impact on the carcass yield, and live weight gain, and prominent cut up meat parts (Soomro et al., 2019).

Prebiotics are not digested in the small intestine, consequently, increase the likelihood that bacteria will exit the intestine without adhering to the epithelium, which reduces or prevents of unwanted bacteria from colonizing the small intestine (Spring et al., 2000). Improved probiotic survival in the gut requires prebiotics. With the aid of prebiotics, probiotics may thrive in the digestive tract and withstand anaerobic conditions, such as low oxygen, low pH, and low temperature (Hanamanta et al., 2011).

The primary cause of the reduction in meat quality and the shortened shelf life of meat and meat products is the lipid macronutrients' susceptibility to various medications. Prebiotics can alter lipid metabolism and increase the proportion of polyunsaturated fatty acids (PUFAs) in chicken meat, which is beneficial to human health but shortens the meat's shelf life (Maiorano et al., 2017).

Probiotics and prebiotics work together to give the body greater benefits than either alone. Through targeted growth stimulation and/or metabolic activation of certain beneficial bacteria, synbiotics enhance the host's defenses and facilitate the implantation of feed supplements containing living microbes in the channel of digestion, improving the host's overall health. This combination also has the advantage of increasing probiotic bacterial survival since it provides particular substrates for fermentation (Gibson and Roberfroid, 1995).

The potential to reduce rooster semen quality and the variety of production methods that could impact the probiotic's durability are only two of the few disadvantages that outweigh the many benefits (Krysiak et al., 2021).

Supportive Effects of Probiotic and Prebiotics against Disease Conditions

For improving the health of broilers both inactivated and live probiotics are effective (Hajati and Rezaei, 2010). When added to a bird's diet on a regular basis, probiotics can help keep their microbiome balanced and healthy, which can enhance the bird's overall health and productivity. Probiotics are strongly recommended for use in the care of new hatch chicks, during stressful times, and as a broiler chicken substitute for antibiotic growth boosters (Duggan et al., 2002).

Successful probiotic colonization depending on several variables, including dosage and frequency of use, stability of the microbes and their long-term relationships with hosts (Yousaf et al. 2022). Gut microbiota disruption can occur due to a variety of stresses and pathogenic microorganisms found in all poultry raising facilities, potentially leading to an unbalanced microbiome in the gut, and a decrease of the body's defenses (Balevi et al., 2001). Wilson et al. (2005) clarified that the generation of toxic compounds that irritate the gut mucosa is the cause of the growth-suppressive impact of intestinal bacteria, so restricting the absorption of nutrients.

Through the competitive exclusion process, probiotics have been demonstrated to prevent the gastrointestinal tract from becoming colonized with harmful bacteria (Teo andTan, 2006; Abudabos et al., 2013).

The removal of pathogenic microorganisms, especially enteric pathogens, can potentially avert early chick mortality as well as gastro-intestinal abnormalities such scouring, lack of appetite, and incorrect digestion. This could lead to an increase in productivity and a reduction in significant losses for chicken breeders (Duggan et al., 2002). Probiotic therapy significantly improves birds' gut immunity, and is quite successful against parasitic coccidian and bacterial intestinal infections. Supplementing chicken with probiotics has been demonstrated to suppress a number of infections, including *Salmonella enteritidis, E. Coli, Clostridium perfringens, Listeria monocytogenes, Campylobacter jejuni*, and *Candida albicans* (Dhama and Singh, 2010).

A subclinical condition linked to necrotic enteritis may harm the intestinal mucosa, impairing absorption and digesting leading to poor performance (Kaldhusdal et al., 2001). Feighner and Dashkevicz (1987) elucidated that the growth depression resulting from a *C. perfringens* infection was connected to the pathogen's high level of bile salt hydrolase activity. Probiotic supplementation alone or as a part of synbiotics inhibited the growth of *C. perfringens* in the ileum. This elimination may account via competitive exclusion and immune system activation (Abudabos et al., 2015).

Probiotic use might help reduce the production of litter ammonia, which would reduce the danger of keratoconjunctivitis, an eye condition brought on by an overabundance of ammonia in the environment (Yousaf et al., 2022).

Lipopolysaccharide stimulation in addition to readily causing intestinal inflammation, it frequently resulted in severe liver injury (Baranova et al., 2016; Stephens and von der Weid, 2020). Probiotic therapy prevented an increase in LPS induced pro- and anti-inflammatory (IL-1b, TNF-a and IL-6) peripheral cytokines. Decreased the mRNA expression of central cytokines in the hypothalamus, prefrontal cortex, and hippocampus, stopped the alterations in the gut microbiota brought on by LPS (Murray et al., 2019).

Prebiotics have demonstrated potential in suppressing pathogens like *Salmonella* and *E. coli* while promoting the growth of *Bifidobacteria* and *Lactobacilli*. Mannan oligosaccharides (MOS) are frequently utilized prebiotics. They consist of 12.5% protein, 30% mannan, and 30% glucan. Serine, aspartic acid, glutamic acid, and methionine are abundant in the protein (Song and Li, 2001). The inclusion of MOS in the diets of broiler chickens may improve their growth performance (Rosen, 2007). MOS function through modifying the bacteria communities within the gastrointestinal system, which sets them apart from other oligosaccharides. MOS offer a competitive binding site and a ligand with strong bacterial affinity. Therefore, pathogens pass through the intestine without colonizing because they adhere to the MOS rather than the intestinal wall (Benites et al., 2008). Furthermore, MOS raised the level of IgA in the serum (Kim et al., 2009).

Conclusions

The supplemented diet with probiotic and prebiotic can enhance chicken growth performance through changes in intestinal flora. Dietary combination of various compounds can help in body weight gain and modulation of immune system. Using of probiotic and prebiotic as potential alternative of antibiotic is recommended in broiler diet. They have been shown to have beneficial profits both directly in the gastrointestinal tract and indirectly in the immune system immunomodulation of chickens. Applying of probiotic and prebiotic, will help in balancing of gut microbiota encourage growth and boost immunity in the bird population. Even though synbiotic seemed to be superior in improving broiler performance. By using natural means, the occurrence of diseases in poultry can be reduced, strengthening their immune systems and contributing to higher levels of chicken production. Probiotics are a less expensive and more beneficial feed additive or growth stimulant than antibiotics because they have no known adverse consequences.

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