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Review on probiotics and prebiotics' in healthcare poultry's prevention of intestinal bacterial infection

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Abstract
The most affordable source of animal protein is poultry, which helps fulfill the world's increasing demand for animal food products. With the increase in global population, likewise, trading and consuming poultry products do. Antibiotic resistance develops as a result of antibiotic additives to feed used as growth promoters in chicken production, and their residual effects on animal-derived food provide a number of health risks to consumers. These issues are solved by adding probiotics and prebiotics to their feeds. Therefore, the applications of probiotics to poultry feed aim to give the chicken the benefits of beneficial microbes while also replacing those that are absent from the gastrointestinal tract. The prebiotics amplify probiotic growth and activity in poultry GIT. Prebiotics supply carbon and energy for native bacteria, which the colon already contains, the energy and carbon they need to flourish in the digestive tract. Probiotics have been linked to numerous health benefits, including enhanced immune function, altered gut flora, and improved mineral absorption. Certain proteins, peptides, and lipids, as well as indigestible carbohydrates, are the prebiotic ingredients included in poultry feed. Probiotics inhibit infections through a variety of mechanisms, including competitive exclusion and host immune system modification. Prebiotics are indigestible feed elements that alter the metabolism and makeup of the gut microbiota in a way that is advantageous to the host.

Keywords: Feed additives, probiotics, microflora, poultry

1. Introduction
There is an increasing demand for food originating from plants and animals in tandem with the ongoing growth of the human population. As a result, food production is now more affordable and complies with strict guidelines for environmental and human health safety. The least expensive source of animal protein is poultry, which helps to meet the world's expanding need for animal food items [18]. Poultry products are becoming more and more popular, which is improving feed conversion and yielding higher meat yields, positioning them as the second most popular source of meat after pork [17].

Poultry's nutritional and overall healths are related to gut health, which encompasses the immune system, the stability of the gut microbes, and the macro and microstructural veracity of the gut. Disease resistance, immunological response, and nutrient digestion, absorption, and metabolism are all impacted by gastrointestinal tract health [73]. Due to the significant financial losses resulting from reduced weight gain, higher mortality rates, a lower food conversion rate, higher medication costs, and a higher chance of poultry products being contaminated for social feeding, enteric diseases are some of the main issues facing chick productivity [68].

The types of feed additives that are employed have an impact on animal health and raise the output of premium fish, meat, eggs, and dairy products. Most animal intestinal infections are zoonosis. Animal production is inextricably linked to consumer nutrition and health. In the past, since the 1940s, antimicrobials have been widely used in the animal production industry as growth promoters. Other pharmaceuticals have also been widely used, mostly to alter the gut flora and increase animal growth and productivity [76]. They function as growth boosters and help strengthen the birds' immunological competence, the body's capacity to mount a defense against infectious diseases, after being exposed to an antigen. According to a certain hypothesis, it has the effect of causing dynamic biological contact with the intestinal bacteria. Antibiotics were permitted to be added to animals feed without a veterinarian's prescription in 1951 by the United States in order to avoid sickness generally and, in certain situations, to increase efficiency.

Every European nation established national legislation concerning antibiotics' usage in animal feed in the 1950s and 1960s. For almost 60 years, dietary antibiotics have been used to treat infectious diseases and enhance growth and feed efficiency [22].

The broader antibiotics being added to feed ultimately result in the appearance of germs unwilling to succumb to anti-infective medications that pose a risk if they are transmitted to humans. The use of antibiotics in food animals is therefore considered a public health concern by the World Health Organization [71] and the European Union [16]. In 2006, all in-feed antibiotics were prohibited from being used as growth enhancers by the European Union [11]. USA government organizations, stated in testimony provided in 2009 that the application of antibiotics to the purpose of promoting development had been discontinued [19].

Poultry diets that no longer contain antibiotics that are utilized as antimicrobial growth promoters have resulted in a number of issues, including subclinical necrotic enteritis and bacteriosis being more common and growth performance being negatively impacted [31]. As a result, probiotics and prebiotics, which, as potent dietary supplements said to enhance growth and positively impact the immune system, have essentially supplanted the use of antibiotics in medical practice. Despite being safe and successful, neither the standard of care nor feed ingredients may use this treatment [33]. Probiotics and prebiotics are listed among other ingredients in the September 22, 2003, European Parliament and Council Regulation (EC) No. 1831/2003 regulating additives used in animal feeding.

Enhanced growth capacity as well as the establishment and preservation of a thriving gut microbiota are facilitated by dietary probiotics and prebiotics, which may also boost immune response and colonization resistance against infections [48].

1.1 Probiotics and Prebiotics in poultry

Etymologically speaking, the word "probiotic" seems to be a combination of the Greek adjective "biotic" which comes from the noun "bios" which means "life" and the Latin preposition "pro" which means "for" or "in support of." The phrase has undergone several interpretations over time. It was employed in 1965 by Lilly and Stillwell to characterize compounds released by one microbe that aided in the growth of another [38].

When given in sufficient quantities, probiotics single or mixed cultures of living microbes improve the health of the host. The most prevalent probiotic strains identified from the guts of healthy poultry are lactic acid bacteria (LAB), enterococcus, bacillus, and bifidobacteria [54].

Prebiotics remain unreadable food components that encourage the development and action of valuable gut microbes. Prebiotics are primarily carbohydrates, including oligosaccharides and non-carbohydrates. In the colon, prebiotics are fermented specifically by advantageous microbes. Probiotic development and activity are efficiently stimulated by prebiotic preparations. There is a reciprocal relationship between prebiotics and probiotics. The primary benefit of synergism is that a probiotic by itself cannot thrive in the digestive tract without food sources. According to some research, symbiotic, a blend of prebiotics and probiotics, are the ideal choice because of their advantageous and successful effects [36]. A prebiotic made from Aspergillus oryzae and a probiotic made from Lactobacillus were each tested alone and together to see how they affected broiler performance and litter quality. The symbiotic interaction enhances feed conversion effectiveness and body weight gain [12].

Growth performance is enhanced by the dietary probiotics found in broiler chicken feed [46]. In comparison to the control group, the feed conversion ratio rose when broiler chicks were given a probiotic mixture including Bacillus licheniformis and Bacillus subtilis spores. Furthermore, broiler feed containing *Bacillus coagulans* increases feed conversion ratio, survival rate, and final and daily weight growth in relation to the control group [31, 76]. *Bacillus coagulans* is known to modify the gastrointestinal tract's microbial flora by decreasing the number of harmful microbes and increasing the number of useful obligate microorganisms [50], secreting the enzymes a-amylase, protease, xylanase, and lipase, producing amino acids and vitamins, and reducing inflammation in the gut [76, 21].

Contrary to what was previously said, some research indicates that using probiotics and prebiotics in chicken production may not always yield favorable results. *Salmonella enterica* serovar *Enteritidis* infected broilers and laying hens are split into groups and fed probiotics, prebiotics, synbiotics, and control. Probiotics and synbiotics administered to broiler and laying hens did not affect the incidence of *Salmonella enteritidis* infection; however, prebiotics lessened the degree of intestinal inflammation and improved feed conversion [49].

According to certain research in the literature, prebiotics and probiotics have not useful in poultry production. The groups that were probiotic/prebiotic challenged, probiotic/prebiotic non-challenged, probiotic/prebiotic challenged, and probiotic/prebiotic non-treated comprise a one-day-old commercial broiler chick. In this study, *Eimeria tenella*-infected broiler chicks are used to assess the preventive effects of prebiotic Immunolin and commercial probiotic Lacto G on lesion scores, immune markers, and performance. Supplementing with probiotics and prebiotics lowers lesion scores and, to some extent, lessens the detrimental consequences of coccidiosis, although neither body weight nor feed conversion ratio are improved [3].

Prebiotic additions to feed result in lower treatment costs, lower mortality and morbidity, and increased production [25]. Probiotics and prebiotics can be introduced into the avian digestive system in a variety of ways. Typically, inovo injection, spraying, and feed or water supplementation occur during the initial hours or days after hatching [7].

Probiotic treatments for poultry or chicken are intended to accomplish two primary goals to replenish the beneficial microorganisms that are absent from the intestine and to supply the beneficial organisms to the chicken. Based on where they work, probiotic preparations can be divided into two main categories: Those whose effects are mostly targeted at the crop and the anterior portions of the alimentary canal, and those whose main goal is to be effective in the caeca. But in the gut, both kinds of preparation are likely helpful to some degree [48].

In comparison to control groups, prebiotic aspergillus meal lowers *Salmonella* spp. levels and enhances poultry meat's general food safety [12]. Compared to the group under control, the laying hens and broilers administered inulin prebiotics had a decrease in intestinal inflammation and *Salmonella enteritidis* infection, as well as an increase in feed conversion. A broiler chicken diet enriched with fructooligosaccharides considerably reduces the population of harmful bacteria while significantly increasing the population of useful bacteria in the cecum and small intestine. In the iliac, colon and jejunum, FOS promotes the formation of intestinal crypts and villi while reducing the consequences of caecal epithelial necrosis [49].

In comparison to the control group, probiotic supplementation in ovo enhances performance and provides immunity against illness [56]. The immune system was not negatively impacted by prebiotics in ovo. Because the spleen forms germinal centers, its synbiotics promote growth of B cells in secondary lymphatic organs; these effects are more pronounced when synbiotics are administered than when prebiotics are [42]. The primary mucin protein produced by goblet cells in the small intestine, MUC2, was the subject of their study. Young turkeys were also given commercial probiotics and mannan oligosaccharide prebiotics as supplements. After being supplemented with probiotics and prebiotics, the mixture increases the height and area of the villus. The immunological response in poultry is modulated by dietary probiotics and prebiotics. This includes immunostimulation, anti-inflammatory responses, pathogen exclusion and death with in gastrointestinal system, and a reduction in the amount of microorganisms on processed broiler carcasses. The intestinal microenvironment is more positively impacted by the symbiotic combination of the commercial probiotic mixture and mannan oligosaccharide prebiotic treatment [53].

2.1 Prebiotics and Probiotics used in Poultry

2.1.1 Probiotics used in Poultry

Allochthonous probiotics are microorganisms that are utilized as probiotics but are often absent from animals' gastrointestinal tracts (GITs); autochthonous probiotics are microbes that are generally present in the GIT as native inhabitants. The following qualities of a perfect probiotic are present in it. It benefits the host, being harmless and non-pathogenic, existing as live cells, being stable throughout processing and storage, and having a high tolerance to bile and gastric acid, and palatable food ingredient that can be processed on a large scale. Additionally, it has the capacity to form inhibitory chemicals, modify the immune response, and cling to mucous or epithelium, remain persistent in the gastrointestinal system, and change microbial activity [32, 26].

Probiotics can be made from a variety of microorganisms, the majority of which are bacteria. The two most often employed microorganisms to treat when making probiotics are lactobacilli and streptococci [28]. Probiotic products might have single strains, multi-strain compositions, or species compositions in their microbial makeup. Multispecies probiotics include Lactobacillus species, *Bifidobacterium thermophilum*, *Lactobacillus reuteri*, *Enterococcus faecium*, and *Pediococcus acidilactici* in PoultryStar ME [24], Lactobacillus species, *Bifidobacterium thermophilum*, and *Enterococcus faecium* in PrimaLac [55], and various species of bacteria in Microguard [59]. Anta Pro EF (*Enterococcus faecium*) is one type of single-species probiotic [2].

Table 1: Bacteria used for the production of probiotics in poultry

Bacterial gene	Bacterial spp.	Sources
Lactobacillus (Non-spore forming)	*L. bulgaricus* *L. acidophilus* *L. helveticus* *L. casei* *L. faecalis* *L. Plantarum* *L. salivarius* *L. lactis* *L. reuteri*	[45] [35]
Bifidobacterium Species (Non-spore forming)	*B. thermophilum*	[55]
Bacillus (spore-forming)	*B. subtilis* *B. amyloliquefaciens*	[1] [5]
Enterococcus Spp.	*E. faecalis* *E. faecium*	[46]
Streptococcus Spp.	*S. thermophilus,*	[35]

2.1.2 Prebiotics used in Poultry

Prebiotics appear in a variety of varieties. Prebiotics such as indigestible carbohydrates, oligosaccharides, polysaccharides and specific proteins, peptides, and lipids are used in the production of poultry. Additionally, maltooligosaccharides, glucooligosaccharides and stachyose are utilized. Legumes (beans, peas, broad beans, and lupins), as well as the components of yeast cells (Saccharomyces cervisiae), and mannan oligosaccharides, are additional natural sources of prebiotics [63].

Prebiotics are mostly made up of oligosaccharide carbohydrates, which make up the bulk of their carbohydrate groups. Inulin, fructooligosaccharides, mannanoligosaccharides, galactooligosaccharides, soyaoligosaccharides, xylooligosaccharides, pyrodextrins, isomaltooligosaccharides, and lactulose are among the oligosaccharides prebiotics [31, 6].

Prebiotics called fructans include inulin, fructo-oligosaccharide (also known as oligofructose), and fructans can selectively stimulate lactic acid bacteria. However, fructans can also directly or indirectly promote other bacterial species (table 1) [61]. The most commonly used fructooligosaccharides are those found in beet leaves, wheat, barley, and chicory. Galacto-oligosaccharides can significantly stimulate Bifidobacteria and Lactobacilli [41]. Resistant starch is one kind of starch that cannot be broken down in the upper gastrointestinal system, which also includes glucose-derived oligosaccharides. It was recommended that resistant starch be categorized as a prebiotic since it can improve health by generating a high concentration of butyrate. Pectin is a type of polysaccharide that is the source of some oligosaccharides. Pectic oligosaccharides are the kind of oligosaccharides that constitute this [74].

Certain substances, such flavanols generated from cocoa, are not considered carbohydrates and are referred to as non-carbohydrate oligosaccharides. Lactic acid bacteria have been demonstrated to be activated by flavanols in both in vitro and *in vivo* experiments [70]. Prebiotics known as beta-glucans are specific polysaccharides that are also obtained from the cell walls of some yeast, bacterial, and fungal strains. A study conducted on broiler chickens revealed that the most commonly utilized prebiotics include fructooligosaccharide products, oligofructose, inulin, gluco-oligosaccharides, stachyose, maltooligosaccharides, and oligochitosan [29].

2.2 Prebiotics and Probiotics' Mechanisms of Action

2.2.1 Probiotics' Mechanism of Action

With more than 600 distinct bacterial species belonging to more than 100 bacterial genera, the chicken GIT is home to an extremely complex microbiota [69]. Gastrointestinal pathogens can be avoided and managed with the aid of probiotics. The two portions of the digestive system, the crop and the cecum blind, has significant effect in preserving and forming the microbial system. Through the use of bacterial enzymes, lactic acid bacteria in crops reduce pH, create short-chain fatty acids, and predigest feed. Bacteria therefore guard the digestive system from potential pathogen invasion and stop them from multiplying. The process of microbial fermentation occurs in the stomach. Probiotics have been linked to numerous health benefits, including enhanced immunological function, altered gut microbiota, lowered inflammatory responses, lower blood cholesterol, decreased excretion of ammonia and urea, and enhanced mineral adsorption [20].

The primary determinants of the overall effects of probiotics include strain origin, application levels, and probiotic species. Probiotics have the potential to inhibit pathogens through two main mechanisms: The first is exclusion from competition, which involves the production of compounds that inhibit pathogen adhesion, nutrient competition, and lower bioavailability of toxin; the second involves modulating immune of the host [46].

2.2.1.1 Competitive Exclusion (Niche Filling)

Other terms for competitive exclusion are bacterial antagonistic behavior and bacterial interference. This antagonistic connection between advantageous microbes and possibly hazardous germs stimulates the immune system of the host. When it comes to food and mucosal settling, these bacteria compete. Bacteriocins, such as lactocin, helveticin, curvacin, nisin, or bifidocin, are produced as a result of this competition. Bacteriocins are toxic to a range of intestinal pathogens, both Gram-positive and Gram-negative [9].

2.2.1.2 Production of Inhibitory Compounds

In the gastrointestinal tract, probiotic bacteria (Table 1) create chemical components that hinder the growth of pathogenic organisms and put them in competition with them for nutrients and a location in the intestinal epithelium. These include hydrogen peroxide, short-chain organic acids, and bacteriocins. High levels of antibacterial activity are exhibited by bacteriocins against *Salmonella*, Clostridium perfringes, Staphylococcus aureus, and Escherichia coli. Lactic acid bacteria create nisin bacteriocin. By preventing the production of bacterial cell walls and causing holes to appear on the surface of the bacteria, nisin prevents the proliferation of harmful microbes. In order to do this, the bacteriocin attaches itself to lipid II, a precursor of the cell wall, to create an intricate that can puncture cell membrane of the bacterial and results the bacterium to die [27].

Numerous probiotic bacteria (table 1), particularly those that produce lactic acid and acetic acid, can inhibit harmful microorganisms. When broiler chickens' GIT microbes absorb SCFAs, the pH in the intestinal lumen's microenvironments is lowered to a level that some bacteria can no longer survive [15]. Other antimicrobial may prevent pathogenic microorganisms from growing in the gastrointestinal tract. The bacterial strain Bacillus subtilis PB6, which was isolated from the hens' gastrointestinal tract, produces a heat-stable anti-clostridial factor that inhibits in vitro the growth of different harmful bacteria [5].

2.2.1.3 Prevention of the Pathogen Adhesion

Neonatal birds raised in a natural environment developed a microbial colony in their gut that originated from their adult mother. The intestinal pathogens are warded off by these microbes. Animals are now more vulnerable to intestinal pathogen threats since there is less chance of natural colonization of the GIT due to the industrialization of animal husbandry. Probiotics colonize adult animals or imitate the natural colonization process in newborns to stop harmful organisms from settling on the mucosa of the intestine. Some strains of Bifidobacterium and Lactobacillus have proteins on the surface layer that are hydrophobic and aid bacteria stick to the surface of animal cells without any particular pattern. *Salmonella*, Escherichia coli O157:H7 and other harmful microbes are prevented from adhering by the probiotics to the intestinal epithelium bacteria's (Table 1) adhesion, which covers the receptor binding sites [34].

Probiotics have the ability to alter the dynamics of the bacterial community in the digestive system by tipping the balance between useful and detrimental bacteria, eventually resulting in a more favorable microbial population [47]. Animal performance is frequently linked to healthy bacteria populations in the gastrointestinal tract (GIT), which may indicate better immunity and more effective digesting. The competitive omission of harmful bacteria is due to the probiotics' attachment to the intestinal epithelium and subsequent decrease in harmful bacteria [30]. Probiotics most frequently alter the GIT microflora by increasing the populations of probiotic bacteria (table 1), whereas coliform populations, especially those of Escherichia coli [45, 75] and Clostridium spp. decline [10].

In pathogenic microbes, probiotics also change the expression of some genes. Through the release of chemical signals known as autoinducers, which alter bacterial activity, bacteria are able to interact with one another across cells. Quorum sensing is the name of the communication mechanism that bacteria utilize to communicate with their host. Probiotics may have an impact on pathogenic bacteria's ability to sense quorum, which could change how harmful they are. This interferes with quorum sensing and ultimately stops microbes from colonizing the digestive system [44].

2.2.1.4 Modulation of the host immune systems

The second way that probiotics work is by boosting the immune system's effectiveness. Microorganisms from the environment start to invade a newborn's sterile digestive tract before its organism has a chance to build antibodies. As a result, probiotic use boosts immunity since it permits the development of a natural barrier against possible pathogens. Probiotic immunological system activation via enhanced γ-interferon synthesis, increased macrophage and lymphocyte activities, as well as a rise in the production of immunoglobulins [72].

The host is shielded from various antigens in the GIT lumen that are impacted by probiotics by the GIT component of the immune system. Probiotics impact both innate and adaptive immunity. Through colonization resistance mechanisms, the creation of a normal microflora is a crucial aspect of intestinal health that affects both the healthy growth of the stomach and the full maturity of the mucus immunity [51]. The primary mediator of communication between the microbiota and the immune system is the interaction of microbes with pattern recognition receptors expressed by intestinal epithelium and various local antigen-presenting cells, which results in the activation or modulation of both innate and adaptive immune responses [66]. As soon as the microorganisms hatch, the gut's immune system interacts with the commensal microflora to produce a mild degree of inflammation that is characterized by an increase in the expression of cytokines and chemokines as well as other immune-associated proteins [13].

The gastrointestinal mucosa's epithelial cells create a barrier that is selectively permeable and divides the intestinal lumen, which is home to hazardous things including microbes, foreign antigens, and poisonous materials, from the body's internal environment and helpful nutrients. The initial line of protection against the microorganisms in the GIT is this barrier. It combines morphological components, immunological secretions including mucus and immunoglobulins and the epithelial junction adhesion complex to perform a joint defense role [57].

Preserving the intestinal barrier's integrity greatly depends on the timing of probiotic administration. The best time to introduce probiotics is before the pathogens enter the gastrointestinal tract and begin to naturally multiply [52]. Probiotics can either stimulate or depress the immune system. Depending on the clinical situation, the host's immune response should be inhibited in some circumstances, such as allergies and autoimmune illnesses, and increased in others, such as during infections and immunological deficiencies. Depending on the cytokine, probiotics may have a distinct effect on the expression of cell-signaling proteins or anti-inflammatory cytokines [39].

2.2.1.5 NISM of action of prebiotics

Prebiotics enhance the host-microbial balance by supplying the energy needed for the growth of natural beneficial organism like lactobacilli and bifidobacteria in the gut. Prebiotics and probiotics work similarly to support the health of chickens' guts [31]. Because prebiotics encourage native organism evolved to the digestive systems environment, they may be more beneficial than probiotics [4, 6].

Prebiotics strengthen immunity and lower bird mortality by stopping pathogen damage and transmission [14]. Prebiotics have a wide range of mechanisms and activities related to the GIT microbiota of poultry, and it appears that multiple bacteria are engaged in their usage [60]. However, there's proof of additional microbiota-neutral interactions as well. Prebiotics have no known specific mechanism of action for promoting host health or preventing the growth of pathogens. A complicated web of exchanges within the physiology of the host leads to the favorable effect. Intestinal shape, the equilibrium of microbes, inhibitory actions against systemic and intestinal diseases, increased nutrient digestibility, positive metabolic alterations, improved meal quality originating from chicken, animal welfare in overall, and ultimately a reduction in production costs are among the positive effects [26].

2.2.1.6 Intestinal microbial balance

The microbiota in poultry has a major influence on the reliability, efficiency, and condition of the intestines, which in turn is critical for how the immune system evolved the exclusion of pathogens, and the digestion and absorption of nutrients [62]. One of the most extensively studied modes of action when utilizing prebiotics has been the change of the intestinal microbiota, then a synergetic connection amongst the host and its microflora is essential to chicken well-being and output [64]. Prebiotics are now widely recognized to have a favorable effect on the bacteria in the gut of chickens; nevertheless, the precise processes and nature of the interaction will differ based on the prebiotic and the host's species.

Certain microbes, like Lactobacillus and Bifidobacterium species, show positive impacts on intestinal function and are therefore valuable to the host's health out of all the germs that make up the intestinal microbiota in chickens. When prebiotics are added to chicken diets, the number of these beneficial bacteria increases. Prebiotics can be fermented and metabolized by these bacteria, which specifically promotes their growth and activity. Potential effects include lowering intestinal pH and short-chain fatty acid (SCFA) synthesis; improving metabolism through increased vitamin production and digestive enzyme activity; lowering triglyceride, lipids, and odor compound levels; and enhancing immunity, which aids in halting the spread of germs [23].

Prebiotics maintain low concentrations of possible infections in the cecum and small intestine digestion while influencing the advantageous intestinal microbiota of broiler chickens. Within the broiler chickens' small intestine, the addition of fructooligosaccharide as a prebiotic to the baseline diet boosts the viable count of probiotics, whereas Escherichia coli drastically decreased in comparison to the control cluster. When chickens were nourished fructooligosaccharide and mannano oligosaccharide, the populations of Lactobacillus increased, while harmful bacteria in the intestine fell, and the counts of coliform bacteria were also linearly reduced by increasing doses. When inulin is fed to laying hens together with varying dosages of prebiotic, the results show a considerable rise in cecal Bifidobacterium counts in comparison toward the group under control [37].

2.2.1.7 Preventing the colonization of pathogens

In poultry diets, prebiotics decrease pathogen colonization through a variety of mechanisms that take place in the gastrointestinal tract (GIT), varying from those where the prebiotics have an independent effect on bacteria or the host animal and are directly related to the targeted activation of the helpful flora. Prebiotics improve the intestine's absorptive surface and lessen the colonization and migration of infections into internal organs. This increases the release of enzymes for digestion and nutritional absorption, which enhances the breakdown and absorption of nutrients in the diet. Prebiotics' precise method of action to lower pathogenic infections cannot be pinpointed [26].

Prebiotics have been shown to confer pathogen resistance through a number of possible mechanisms, the most prominent of which is directly linked to the beneficial bacteria found in the gastrointestinal tract [60]. That's mostly due to the fact that these bacteria release a number of hydrolases that monogastric animals are unable to produce. Since SCFA are comparatively weak acids and the main luminal anions. Alterations in SCFA may result in a reduction in Enterobacteriaceae in broiler chicken ceca counts [65].

There are further ways that SCFA can help prevent pathogen colonization in the GIT, like goblet cells producing more mucin, which acts as a somatic fence to keep germs out and reduces their establishment. Prebiotics increase the proliferation of helpful bacteria that are present throughout the host animal and may endure in GIT circumstances, which amplifies the competitive exclusion of harmful bacteria by probiotics [43].

2.2.1.8 Improve Intestinal morphology

Enhanced intestinal morphological makeup is one of prebiotics' health benefits; numerous prebiotics have demonstrated their ability to alter the macroscopic (intestinal length) and microscopic (size, density, and microvilli size, as well as crypt depth) structures of various intestine sections in chicken species. Furthermore, following dietary treatment of prebiotics, the intestinal villi have a greater number of goblet cells. These specialized cells secrete glycoprotein compounds, primarily mucins, which trap harmful microbes and decrease their adhesion to the intestinal mucosa. These morphological modifications result in higher utilization efficiency of nutrients [8].

2.2.1.9 Enhancement of the Immune System

Immune process-related genes and pathways have been activated in relation to the mechanisms and functions of prebiotics' immune-modulatory action [58]. Through the deliberate development of beneficial microbiota, prebiotics in the diets of chickens enhance the resistant system of the chickens. This results to an improve in the productivity of various substances, including bacteriocins and SCFA, which not only hinder the expansion of microbes but also function in the immune system's signaling pathway [40].

Particularly probiotic in the gut microflora of poultry have been shown to have numerous advantages in terms of modulating intestinal expression of genes, T cell-mediated immunity and the development of the gut immune response. These benefits are attributed to their influence on the production of antimicrobial peptides and cytokines by the intestinal epithelium. There have also been reports of enhanced synthesis of immunoglobulin, enhanced phagocytosis and immune cell proliferation, including that of macrophages and monocytes, increased production of reactive oxygen and reactive nitrogen species, and enhanced natural killer cell proliferation [58]. Certain prebiotics stimulate the intestine to produce more secretory IgA, which restricts bacteria's ability to attach to and penetrate the lumen, produces more mucus, and reduces inflammation that can harm epithelial cells [37].

Pathogen associated molecular patterns (PAMPs), which remain harmful compounds formed by germs, can be inhibited by prebiotics. These molecules function as exogenous signals. Receptors that recognize patterns, such NOD-like receptors (NLR) and Toll-like receptors (TLR), presented on the surface of mast cells, dendritic cells, epithelial cells, and macrophages, can recognize these PAMPs. Once recognized, these receptors are activated, releasing cytokines that regulate additional innate immune responses. Direct interfaces prebiotics' influence on immune system performance: Some research has shown shows the *Salmonella* vaccination reacts more favorably to prebiotics. This may be the case due to the fact that prebiotics themselves can serve as nonpathogenic antigens, which immune cell receptors can recognize and which subsequently positively modulates host immunity [67].

3. Conclusion

Antibiotic resistance develops as a result of feed additives used in chicken farm to avoid sickness and increase development, and their lingering effects on animal-derived food cause a number of public health problems. To combat these antibiotic-related issues, probiotics and prebiotics are included as feed additives to poultry feed. In addition to improving performance and preventing and controlling enteric infections in chicken, probiotics and prebiotics offer a viable substitute for the use of antibiotics in this species. Probiotics are used to give chickens the benefits of beneficial organisms and to replenish helpful organisms that are absent from the digestive system. As a carbon and energy source for the natural microorganisms that are present in the colon, prebiotics encourage probiotics. In place of antibiotics, these bioactive compounds are introduced into the avian gastrointestinal tract during the first few hours or days after hatching by feed or water. These bioactive are preventing gastrointestinal bacterial infections and improve productivity.

The following procedures were sent out in light of the advantages that probiotics and prebiotics provide for poultry:

- Probiotics and prebiotics should be used instead of antibiotics to prevent diseases.
- Probiotics and prebiotics should be used to improve production and productivity.
- It is indorsed to utilize prebiotics and probiotics to escape drug resistance and antibiotic residue in poultry-derived foods.

4. List of Abbreviations

- CD: Cluster of Differentiation
- FAO: Food and Agricultural Organization
- FDA: Food and Drug Administration
- GIT: Gastrointestinal Tract
- IFN: Interferon
- Ig: Immunoglobulin
- IL: Interleukin
- NLR: NOD like receptors
- PAMP: Pathogen associated molecular pattern
- SCFA: Short chain fatty acid
- TLR: Toll-like receptors

- TNF: Tumor Necrosis Factor
- WHO: World Health Organization

5. Conflicts of interest

The authors indicate that they are free of conflicts with interest in publishing this work.

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