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Probiotics: Alternative to Antibiotics in Poultry Production

Saba Rashid[*1], Abdullah F Alsayeqh[2*], Tayyaba Akhtar[3], Rao Zahid Abbas[4] and Rehan Ashraf[1]

[1]Faculty of Veterinary Science, University of Agriculture, Faisalabad-38040-Pakistan
[2]Veterinary Medicine, College of Agriculture and Veterinary Medicine, Qassim University, Buraidah, 6622 Postal code 51452, Saudi Arabia
[3]KBCMA College of Veterinary and Animal Sciences, Narowal, Sub-Campus UVAS-Lahore, Pakistan
[4]Department of Parasitology, University of Agriculture, Faisalabad-38040-Pakistan
***Corresponding author:** sabarashid440@gmail.com; a.alsayeqh@qu.edu.sa; dr.abdulah@hotmail.com

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ABSTRACT

Poultry production is facing severe losses due to the development of resistance against most of the available antimicrobials in treating various diseases. Moreover, social stigma against the use of antibiotics is also there. As, the welfare of animals, the environment, food safety and hygiene are also important factors. Something is needed that would meet all these stigmas and still be able to provide the best growth, immunity against diseases, peak production, disease treatment and reduce economic pressure. In the recent era, the use of biological products to replace synthetic products is highly recommended i.e., probiotics. Probiotics provide all the necessary activity needed to enhance the production and performance of poultry. Moreover, probiotics meet all the food safety and eco-friendly parameters. Probiotics enhance the gut flora, improve immunity, increase the activity of digestive enzymes by decreasing the production of ammonia, bind with enterotoxins & neutralizing them and as a result improve feed intake which directly affects the performance and production of the poultry. The purpose of this article is to review the performance of probiotics as a better alternative to antibiotics in the production of poultry.

Keywords: Probiotics, Alternatives, Antibiotics, Poultry, Growth.

INTRODUCTION

Antibiotic resistance has been exacerbated by the excessive use of antibiotics for medicinal purposes and as growth promoters in poultry production over the last 100 years. Moreover, antibiotic overuse in animal feed has consequences like the antibiotic residues (Stanton 2013). Chicken is the most common type of poultry which contributes one-third of meat production worldwide comprising over 50 billion animals reared annually for human food; source for both meat and eggs. However, overuse of antibiotics in these food animals causes the direct selection of antibiotic resistant microbes and thus the food animal system turns into the reservoir of antibiotic resistant genes (Gao et al. 2017). Antibiotic alternatives have been sought in chicken farming for a long time and have become increasingly important in recent years (Yang et al. 2009). This gap can be covered by the use of some agents termed as "probiotics" which could be utilized instead of in-feed antibiotics in poultry production because probiotics can be more beneficial in improving immune responses; ultimately resulting in better growth performance, healthier intestinal microflora, bone health, meat quality and eggshell quality in poultry (Zulkifli et al. 2000; Dalloul et al. 2003).

Ilya Metchnikoff coined the term "probiotics" after seeing that human populations in rural Bulgaria had a greater life expectancy than the national average, which he linked to drinking significant amounts of fermented milk products. The word "probiotic" came from a phenomenon discovered amongst co cultured organisms in which some microbes produce growth promoting chemicals which consequently enhance the growth of the host (Jeni et al. 2021). Probiotics are microbes that can help chickens fight pathogens in their gastrointestinal tracts, as well as increase their overall health and disease prevention. Probiotics are useful because of their inexpensive production costs and wide range of applications in a variety of host species (Gaggìa et al. 2010). Through bile salt hydrolase activity, probiotics establish cross-feeding among various bacterial strains in the gut environment and also lower blood cholesterol levels. The purpose of this review paper is to emphasize the benefits of probiotics as a viable alternative to antibiotics in poultry (Nurmi et al. 1992). Pathogen

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proliferation in the gut is inhibited by the addition of a single or multiple non-pathogenic bacteria, or yeast. Probiotics lower the risk of severe necrotic enteritis by boosting human defenses and balancing intestinal flora. These probiotics produce antibiotic compounds that stop the development of pathogenic microorganisms (Vieira et al. 2013). Use of probiotics in poultry is based on the understanding that gut flora plays a role in resistance to enteric pathogens, particularly *Escherichia coli*. Different studies have been conducted to evaluate the effects of giving a Lactobacillus-based probiotic to the intestinal intraepithelial lymphocyte subpopulations (Dalloul et al. 2003).

What are Probiotics?

Probiotics are live bacteria or yeast that assist in the maintenance of the digestive system by supplementing the microflora. Probiotics are defined as "live microorganisms those, when supplied in suitable proportions, impart a health benefit on the host" by the World Health Organization (WHO) and the joint Food and Agriculture Organization of the United Nations (FAO) working group. Probiotics, on the other hand, are "mono- or mixed cultures of live microorganisms that have a favorable effect on the host by enhancing the qualities of the native microbiota" (Fuller 1989).

Probiotic is a "live microbial feed ingredient that benefits the host animal by enhancing its intestinal equilibrium." Probiotics are also known as DFMs (direct-fed microbials) as they can be consumed as live microbial feed. When added to feed, probiotics, which are a living culture of one or more bacteria, work as growth boosters (Hertrampf 1979). Probiotics are live bacterial cell preparations or foods that include living bacterial cultures or bacterial cell components that have a positive impact on the animal health (Delley et al. 1990; Ehrmann et al. 1992; Charteris et al. 1997).

Probiotics have been utilized as an alternative to standard hatching methods to assist newly born chickens in colonizing normal microflora. Animals' gastrointestinal tracts typically have two forms of microflora colonizing them: helpful and harmful. Gut surfaces are colonized by helpful microorganisms in a symbiotic connection with the host, and potentially pathogenic microbes are present as well. Beneficial organisms, which are crucial to normal physiological processes including food uptake, prevail under normal physiological settings. Probiotics also increase the development rate and feed conversion efficiency of developing chickens and protect carcasses from intestinal pathogen contamination during processing (Hose and Sozzi 1991; Juven and Stern 1991). Parker (1974) originally used the term "probiotic" to refer to bacteria that support gut microbial equilibrium. Probiotic usage has been found to have positive benefits on broiler productivity measures (Katoch et al. 1994; Rincon et al. 2000).

Prophylactic use of Probiotics

Usually, probiotics are added to feed to balance gut bacteria and improve animal health (Fig. 1). Pathogen proliferation in the gut is inhibited by the addition of a single or multiple non-pathogenic bacteria, or yeast. It enhances birds' overall performance while also reducing the prevalence of intestinal illnesses (Chaucheyras-Durand and Durand 2009). Probiotics lower the risk of Severe Necrotic Enteritis boosting human defenses, balancing intestinal flora, and accelerating metabolism. Additionally, these probiotics produce antibiotic compounds that stop the development of pathogenic microorganisms (Pan and Yu 2014). The neutralization of enterotoxins, inhibition of growth of pathogenic bacteria, competitive exclusion, increased digestive enzyme activity, modification of host immune system and alteration of gut microflora are just a few of the potential probiotics' modes of action (Sokale et al. 2019). There have been numerous suggested modes of action for probiotic bacteria and yeast. These include bacteriocin, H2S, and organic acid synthesis; nutritional competition; anti-inflammatory characteristics; and the prevention of pathogen attachment to the epithelium. Additionally, these probiotics affect bacterial virulence factors, immune system regulation, and disruption of bacterially generated signaling pathways (Vieira et al. 2013; Qiu et al. 2021).

Benefits of Using Probiotics in Poultry Production

Probiotics keep the bacterial population in check in a bird's intestine, which is crucial for the animal's growth, production, and efficient feed conversion as well as for the stimulation of its immune system to fight diseases. Effective probiotics have been shown to hasten the formation of normal microbiota in chicks and poults (Geeta et al. 2021).

Food Safety

Ingesting chicken meat has resulted in an increase in food-borne diseases. *Salmonella* causes 10% of all consumer illnesses each year, and 25% of all worldwide diarrheal infections. Salmonella resistant serotypes are a major public health problem and a food safety issue (WHO 2006). Probiotics, which contain live beneficial bacteria, may be able to alleviate, if not completely remove, this issue. Probiotics not only show promise for healthier consumers, but they also help broilers perform better and have stronger immune systems (Oh et al. 2017; Li et al. 2019). Probiotics, such as live yeast and bacteria, have been shown in studies to improve broiler resistance to *Escherichia coli*, *Clostridium perfringens* and *Salmonella* infections (Oluwafemi et al. 2020).

Competitive Exclusion

Bacteria are inherently competitive; hence, they make an effort to eradicate dangerous germs that could harm the intestinal system. This is frequently termed as bacterial interference/antagonism, or competitive exclusion (CE) (Arsène et al. 2021). The concept (Riley et al. 1992), which eventually evolved into the CE concept, described the creation of pathogen-resistant bacteria in young chickens through the introduction of intestinal microorganisms. Pathogens that dominate adhesion sites or mucosal surfaces lead to intestinal infections by upsetting the microbiota balance in the intestines. Pathogens that predominate adhesion sites or mucosal surfaces cause intestinal infection thus disturbing the equilibrium of microflora. Positively, probiotics are more capable to adhere to the mucosal surfaces or intestinal epithelium hence their stay in GI tract increases. Pathogens will be pushed out of the

Table 1: Summary of difference between prebiotics and probiotics (Reuben et al. 2021)

Sr No.	Probiotics	Prebiotics
1.	Probiotics are unique in that they include living organisms, often certain bacterial strains that directly increase the number of beneficial microorganisms in your gut.	Specialized plant fibers are known as prebiotics. They function as fertilizers, encouraging the development of beneficial microorganisms in the stomach.
2.	Probiotics can be taken orally, much as prebiotics. Yogurt is arguably the most popular probiotic food.	Many fruits and vegetables, especially those with complex carbohydrates like fiber and resistant starch, are rich in prebiotics.
3.	Similar to prebiotic supplement firms, probiotic supplement manufacturers target specific ailments like irritable bowel syndrome with their products.	Companies that sell dietary supplements say that their contents promote the growth of particular types of bacteria, and target their products to ailments like weight management and bone health.
4.	Live organisms are also present in probiotic pills. A specific strain of microbe or combination of microorganisms may be present in a single dosage.	More prebiotics often include a complex carbohydrate like fiber.
5.	By fermenting milk with various microorganisms, which remain in the finished product, yogurt is created. Probiotics are also present in other foods that have undergone bacterial fermentation, including kimchi, kombucha, and sauerkraut.	These carbohydrates travel through the digestive system as food for bacteria and other germs since they cannot be digested by the body.

Table 2: Summary of Beneficial Probiotics used in poultry (Jha et al. 2020)

Strains	Benefits	Characteristics
Bacillus amyloliquefaciens	Enhances growth performance and gut health	Root-colonizing bacteria used to fight plant pathogens in hydroponics aquaculture and agriculture
Bacillus licheniformis	Growth enhancer and prevention of necrotic enteritis	Common bacteria in soil
Bifidobacterium animalis	Supports the immune system gut health and physiology	Common bacteria of the large intestine of mammals
Lactobacillus bifermentans	Enhances the digestive health and promotes growth	Found in GIT of animals and humans
Bacillus coagulans	Growth enhancer and improves gut histomorphology	Characteristics of both Bacillus and Lactobacillus genera
Lactobacillus sanfranciscensis	Growth enhancer	Heterofermentative bacteria
Bifidobacterium bifidum	Maintains immune system and healthy gut	One of the most common bacteria used as probiotics is found in mammal's bodies
Lactobacillus acidophilus	Enhances the gut health and promotes growth	Found in the mouth and GIT of animals and humans
Bacillus subtilis	Enhance laying and helps to improve the gut health and immune system	Bacteria of the GIT of humans and ruminants
Lactobacillus salivarius	Enhances histomorphology of the gut and improves the performance of layers	Found in the GIT of animals and humans
Lactobacillus reuteri	Enhances histomorphology and health of the gut, growth and supports the immune system	Inhabits the gut of birds and mammals naturally
Propionibacterium acidipropionici	Helps in the development of the gut mucosa	Found in the environment and dairy products.
Lactobacillus bulgaricus	Improves functioning of the immune system and growth	Found in naturally fermented products and GIT of mammals
Pediococcus acidilactici	Improves gut microbiota and laying performance	Found in fermented meat, vegetables, and dairy products
Lactobacillus fermentum	Enhances histomorphology and health of gut, growth and supports the immune system	Found in plant material and fermenting animals
Streptococcus faecium	Boosts immune functioning	Inhabits the GIT of humans and mammals naturally
Saccharomyces cerevisiae	Improves growth and laying performance	A yeast species; found on ripe fruits like grapes

gut by an increased probiotic bacterial population due to competition. As a result, the bird consumes more nutrients. Frequently, competitive exclusion is supposed to occur in the caeca or intestines of the bird. The oral delivery of spores, primarily from the genus *Bacillus*, which can help the body to defend against infectious diseases, is an example of CE (Abdel-Hack et al. 2020).

Nutrient Utilization

Nutrients and energy are used by live microorganisms to thrive and proliferate within the host. According to the researchers, the probiotic microbes introduced to the meal had a greater demand for nutrients, resulting in worse nutritional digestibility (Bean-Hodgins and Kiarie 2021).

Gut Microbiota Improvement

The maintenance of healthy gut microflora is crucial to animal`s health. Probiotics can play a role by displacing harmful microorganisms, in order to improve the microbial ecology of a bird's intestinal tract. The stomach is sterile in newly hatched chicks in particular, and it begins to pick up microorganisms from the surroundings. Chicks may become ill at this time because pathogenic microorganisms may multiply more quickly than helpful bacteria. But as the days pass after hatch, the microflora stabilizes and strikes a balance between the favorable and destructive. External factors like viral pressure or internal causes like stress may influence the equilibrium between these two, hence, supplementation of probiotics may be useful (Alayande et

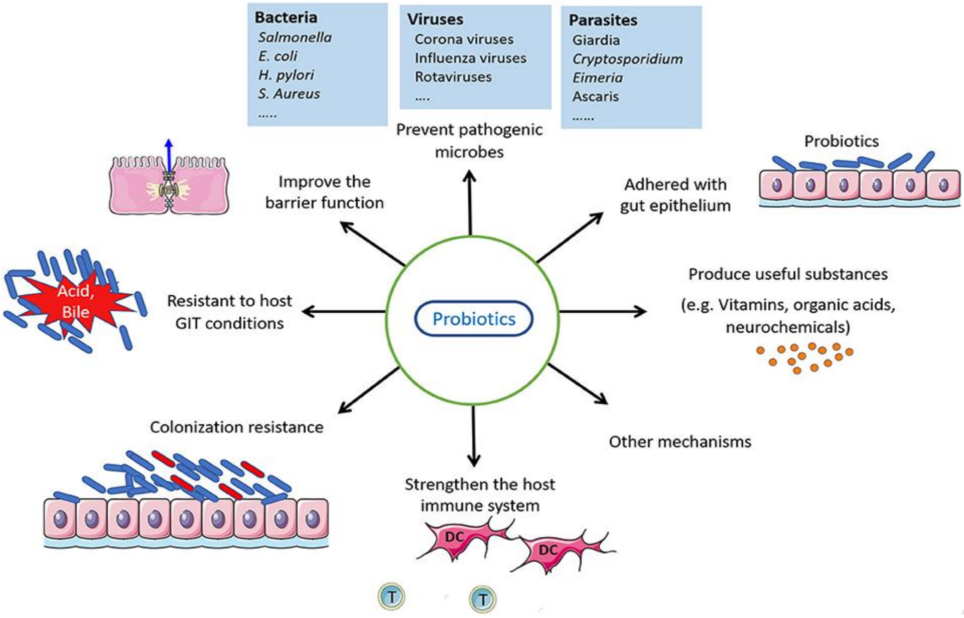

Fig. 1: Prophylactic use of probiotics. Probiotics work by dealing with the gut flora as it is resistant to host gastrointestinal conditions, it produces several vitamins and other chemicals to boost the immune system. Probiotics are highly active against certain bacteria, viruses and parasites (Raheem et al. 2021).

al. 2020). Probiotics' ability to successfully colonize a host depends on several factors, including the host's health, nutritional status, age, stress level, heredity, interaction with the probiotics, and the persistence and stability of the microbial strain used (Mason et al. 2005). The colon and caecum have been found to have the highest levels of bacteria, 10^{10} to 10^{13} CFU/mL (Heczko et al. 2000).

In order to maintain a healthy gut microflora, probiotics boost the immune system and prevent infections by competing for resources. The supplementation of probiotics results in better gut microflora and increases gut barrier function, consequently, more development is seen. There is a competition between non-pathogenic and pathogenic bacteria in the gut for nutrition, making it difficult for pathogenic bacteria to establish or occupy and secrete digestive enzymes (like amylase), which help in better nutrient absorption and enhance animal growth performance consequently (Jadhav et al. 2015). In terms of how they act, probiotics vary from antibiotics in birds. Both, on the other hand, may help with growth. Improvements in body weight gain are typically connected to an increase in average daily feed intake (ADFI) and an improved feed conversion ratio (FCR) (Alagawany et al. 2018). The duration, dose, and strain choice of the probiotic therapy have an impact on ADFI, BWG, and FCR outcomes (Jha et al. 2020). When supplemented, various probiotic species may work differently and yield a variety of results. Short-chain fatty acid (SCFA) generation and immune regulation are both enhanced by the changes in microbial populations brought about by probiotics (Anwar and Rahman 2016). The microbial fermentation of carbohydrates in the gut produces SCFA which acts on leukocytes and endothelial cells by the activation of G-protein-coupled receptors and inhibition of histone deacetylase. They also promote IgA synthesis in B-immune cells, inhibit the NF-B transcription factor and reduce chemokine and cytokine production although SCFAs bind to a number of receptors (Flores et al. 2016). There are many factors which could contribute to improvement in feed efficiency such as reduced viscosity of the digesta, enzymatic lysis of nonnutritive substances, less number of pathogens in the gut and the creation of a hospitable habitat for the beneficial gut microorganisms (Momtazan et al. 2011).

Laying Performance

Egg quality often includes a number of factors, including albumen and yolk quality, shell weight, and albumen. The genetic makeup of egg quality differs among strains of laying chickens. The age of the laying hens, the type of feed utilized, and the housing arrangement, how the hens are kept, all have an impact on the egg quality (Alagawany et al. 2018).

Eimeria Species Treatment

The use of probiotics in poultry is based on the understanding that gut flora plays a role in resistance to enteric pathogens, particularly *E. coli*. Different studies have been conducted in order to check the effects of giving a *Lactobacillus*-based probiotic to the intestinal intraepithelial lymphocyte (IEL) subpopulations, as well as any improvement in immunity against coccidiosis. Larger numbers of IEL are seen expressing the surface markers CD3, CD4, CD8 and TCR in the birds which are given infeed probiotic diet as compared to those which are given probiotic deficient feed. There were nearly the same numbers of TCR-expressing IEL in both groups (Pirgozliev et al. 2019). The local immune system may have been triggered nonspecifically by specific probiotic bacterial antigens, which could explain significant increase in IEL. IEL plays a remarkable role during enteric infections, especially by the involvement of T cells and importance in immune responses to coccidiosis. The stimulation of mucosal immunity by the probiotic bacteria prior to coccidia infection may aid in the prevention of the pathogen. Dietary probiotic plays an immunoregulatory effect on the local immune system in broiler chickens (e.g. increased IEL) and improves resistance to EA (e.g. reduced oocyst shedding). The beneficial effects of Lactobacillus-based probiotics, as well as their protective role in the local immune system of broiler chickens, can be investigated further (Dalloul et al. 2003).

Immune Function

A probiotic is a non-pathogenic bacterium that can increase the number of helpful colonies in their host, which is a desirable trait (Smith 2014). This is significant as it establishes a symbiotic or commensal interaction. Commensal connections suggest the coexistence of non-pathogenic bacteria and hosts, however there are not always clear advantages. When two different species coexist, at least one of them benefits without having an adverse impact on the other, this is referred to as a symbiotic connection (Hooper and Gordon 2001). Different strains of probiotics have different effects on chicken broilers' immune systems. In order to support gut integrity and immune function, probiotics are often administered as they aid in the maintenance of equilibrium of microflora (Fig. 2). They may also play a role by producing antimicrobial substances such as SCFA and bacteriocins, which hinder the development and survival of pathogenic bacteria (Rhayat et al. 2017). By controlling the production of mucin, probiotic bacteria also support the integrity of the intestinal barrier. The main protein component protecting the GIT is mucin. Probiotics repair the mucus layer and intestinal integrity via changing mucin monosaccharide concentration, mucus layer thickness, and mucin gene expression (Aliakbarpour et al. 2012). During the projected 45-day production phase, the GIT is crucial to the health and growth of the birds. The performance and nutrition of the host depend on the microbial populations in the gut (Sohail et al. 2015). Live *B. subtilis* microorganisms or probiotics, for example, have been provided to chickens to improve their gastrointestinal tract health, IgA secretion from their duodenum and FCR (Amerah et al. 2013). Probiotic dynamics related with immune responses indicated enhanced antibody production in broilers given *Lactobacillus*-containing probiotics and reared in both thermoneutral and heat stress settings (Kabir et al. 2004). Furthermore, consuming Lactobacillus-based probiotics as dietary supplements has been reported to improve coccidiosis-induced intestinal immunity by modifying the population of intraepithelial lymphocytes that express the surface marker cluster of differentiation 4 (CD4) (Zulkifli et al. 2000; Dalloul et al. 2003). Probiotics' ability to boost Toll-like receptor (TLR) signaling and so excite T cells in the gut immune system may be a factor in their ability to have an enteric immunostimulatory effect. *Saccharomyces cerevisiae* and *Lactobacillus* fermentum probiotics boosted TLR-2 and TLR-4 mRNA expression in the chicken foregut. Furthermore, probiotic *Lactobacillus* and *Bifidobacterium* strains have been demonstrated to increase the levels of immunoglobulin (Ig) A, G, and M in broilers and turkeys, improving productivity and disease resistance (Abdel-Moneim et al. 2020). After the hatching of chicks, their microbiota begins to develop. So, an early exposure to probiotics can benefit the digestive system. Establishing the situations in which probiotics display efficacy and identifying the mechanisms of action are critical for the effective use of probiotics in the future (Jha et al. 2020).

Heat Stress

A condition known as stress is one that affects animals and poultry and is brought on by one or more stressors, which may have internal or external causes. An animal's health and performance are frequently impacted by a stressor because it alters the normal physiological balance or homeostasis. In instances of mild temperature fluctuation, chickens, as homeotherms, will seek to maintain relatively stable body temperatures by controlling heat loss and heat generation in their bodies through behavioral and physiological adaptation. Heat stress, which is defined as an increase in temperature and humidity above the threshold values, makes it harder for birds to regulate their body temperatures through adaptation (Lara and Rostagno 2013). When there was heat stress, probiotics were initially used in chicken production, where the focus was on output capacity. Feed additives including *L. pentosus ITA23* and *L. acidophilus ITA44* had a positive effect on growth and FCR (Panda et al. 2006). The proportion of feed consumption to broiler growths produced was a significant nutritional factor that improved (Song et al. 2014). Additionally, probiotic medication delivery has increased laying in flocks of chickens that are used for egg production (Deng et al. 2012).

Gut Histomorphology

Increased short crypt depth, villus height, greater villus height-crypt depth ratio, and other intestinal morphological factors imply an improvement in the absorption of nutrients by increasing the amount of accessible surface area for absorption. The number of goblet cells, which produce mucin and prevent hazardous germs from sticking to the intestinal epithelium, is another indicator of intestinal health. These cells can be found in the villi and crypts of the intestine (Shroyer and Kocoshis 2011). The effects of several probiotic strains on certain gut histomorphology traits have been investigated. The histological and morphological parameters of broiler intestinal mucosa must be clarified in order to determine strain traits and mechanisms of action. It has been observed that giving probiotics to animals changes the histomorphology of the gut, although the degree of change differs according to the strain. According to a study, a probiotic including *Lacticaseibacillus casei, Enterococcus faecium*, *Bifidobacterium thermophilum*, and *Lacticaseibacillus acidophilus* increased the height and lowered the depth of jejunal villus. Longer villi signify increased nutrition and growth-promoting effectiveness (Jin et al. 2000; Chichlowski et al. 2007). This discovery suggested that *L. reuteri* and *L. salivarius* could help with nutrient absorption and gut architecture (Jha et al. 2020). Selective nutrient absorption is permitted by the intestinal epithelium, but infections are not allowed to enter the bloodstream (Buckley and Turner 2018). *Lactobacillus plantarum* and *Lactobacillus reuteri*, when added to broiler feed, increased barrier integrity and reduced the entry of several opportunistic or harmful microorganisms (Meyer et al. 2020). According to a study, a probiotic blend of *B. licheniformis*, *B. subtilis*, and *L. plantarum* can help broilers whose gut flora, histomorphology, and barrier integrity have been compromised by heat stress. This supplementation changed and enhanced the quantity of Bifidobacterium and Lactobacilli in the small intestine, as well as the height of the jejunal villus. The broilers

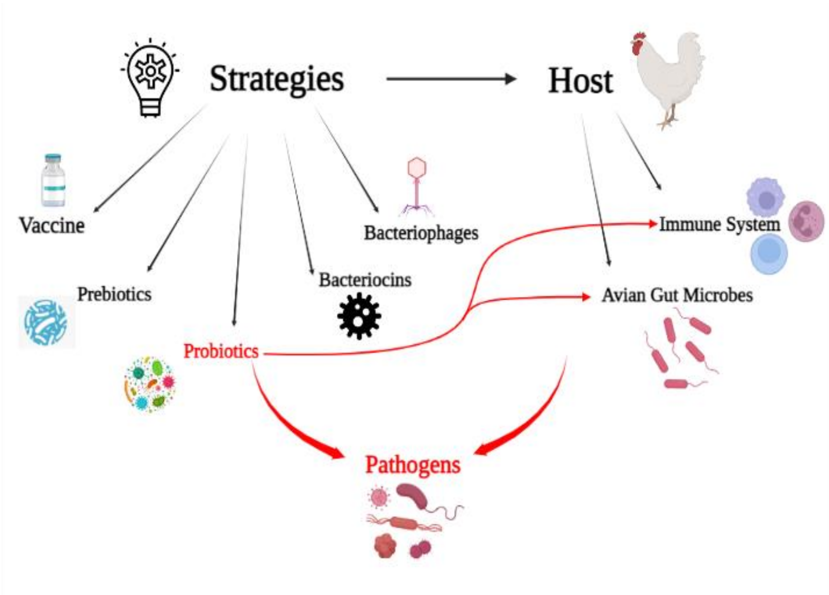

Fig. 2: Probiotics as alternative to vaccine and other bacteriocins.

benefited from a reduced feed to gain ratio and a decreased concentration of tiny intestinal coliforms (Song et al. 2014). Following *Propionibacterium acidipropionici* supplementation, the concentration of SCFA was greater on day 14, and this higher concentration remained through the trial's end. The length of the villus-crypt units, the number of goblet cells, and neutral mucin production all increased, indicating that it contributed to the gut mucosa's enhanced development (Martínez et al. 2016).

Mode of Action of Probiotics

The beneficial benefits of probiotics may be brought about via a direct antagonistic mechanism against specific organisms, which leads to a decrease in their population, by an effect on their metabolism, the generation of essential nutrients, or by the stimulation of immunity (Fig. 3). Numerous studies have hypothesized and discussed the mechanism of action of probiotics (Jin et al. 1997; Ghadban 2002).

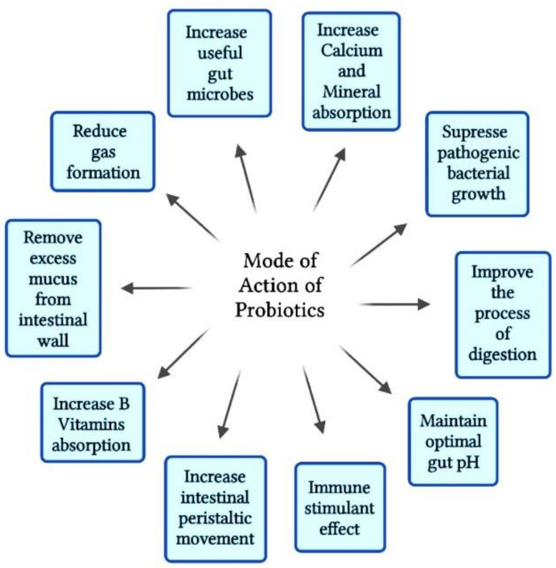

Fig. 3: Mode of action of probiotics.

Reduction in the viable count occurs through the formation of antibacterial chemicals, including organic acids, acidophillin, bacteriocins (Fig. 3), leucocidin and hydrogen peroxide. Through exclusive competition for binding sites, for nutrition, non-pathogenic and pathogenic bacteria typically compete. Nonpathogenic bacteria often have strong competitive abilities, which help them colonize the gut more successfully. Modification of bacterial metabolism by increased activity of the digestive enzymes' galactosidase, amylase, etc. helps in the digestion of different carbohydrates, proteins, and fats and the absorption of nutrients. The ammonia production of harmful bacteria is reduced due to reduce in production of glucuronidase, azoreductase, and nitroreductase enzymes. Immune system stimulation makes birds less susceptible to illness by boosting macrophage activity, boosting immunoglobulin-IgM, IgA, and IgG synthesis, boosting production of cytokines (Ma and Suzuki 2018).

Other mechanisms include increasing the absorptive area of the small intestine by improving the morphology of the intestine (increasing the height of the villus, for example), neutralization of enterotoxins, creating a hostile microecology to disease-causing microbes by lowering the pH of the gut by producing lactic acid, providing enzymes, digestive protein, vitamins, and cofactors and growth factors (short-chain FAs malic acid), proliferation of good and useful bacteria (Dankowiakowska et al. 2013).

Characteristics of Ideal Probiotics

The following qualities make up an excellent probiotic are possibility of having positive effects on the poultry, such as improved growth or disease resistance, not harmful to humans or animals and is not pathogenic, although the minimal effective dose is not completely determined, it should be present as living cells, ideally in high numbers, being able to survive processing and storage, heightened resistance to acid of stomach having low pH and bile, adherence to mucus or epithelium, ability to influence immunological response, persistence in the digestive system, capacity to generate inhibitory chemicals and change microbial activity (Klaenhammer et al. 1999).

Future Prospects

Animal feeding standards have undergone significant modifications because of European Union regulation. Consumer awareness has also prompted chicken breeders to abandon traditional antimicrobial treatments. Concludingly, using probiotics has emerged as an effective technique for combating the expansion of antibiotic-resistant bacteria and pathogenic bacteria. Due to the demand to enhance bird mass gain, the starting point in practice was muscle mass gain. Understanding the incredibly intricate ecology in the intestines was essential for a breakthrough in this form of therapy. Breeders are currently concentrating their efforts on limiting and preventing the spread of harmful bacteria. The business of feed additives has a focus on the future prospect, such as maintaining normal microflora or more accurate strain and dose selection, although this may be a more complex process as the disease's shape varies with animal husbandry settings. Future probiotics research should look at the interactions between different bacterial strains. Interaction-produced metabolites have the potential to be hazardous. This is what *Clostridium perfringens* does, for example, when it affects even the strains of bacteria which are closely related to each other. Bacteria may, however, exist as a symbiotic relationship, with one strain's metabolites having a beneficial impact on another, resulting in a source of nutrition. This is a cross-feeding phenomena that will serve as a useful benchmark for restoring equilibrium to birds' digestive systems. Probiotics should not be used as a stand-in for antibiotics if you want to get the most out of them. The critical relationship between the host, the feed, and the microbes must be considered.

Conclusion

Poultry production is facing severe losses due to resistance of antimicrobials in treating various diseases. Antibiotic resistance has been exacerbated by the widespread use of antimicrobials in poultry production. Antibiotic alternatives have been sought in chicken farming for a long time and have become increasingly important. Probiotics are microbes that can help chickens fight pathogens in their gastrointestinal tracts. Probiotics provide all the necessary activity needed to enhance the production and performance of poultry. They enhance the gut flora, improve immunity, ascending the activity of digestive enzymes and better feed intake. Using probiotics is an effective technique for combating the expansion of pathogenic bacteria. Understanding the intricate ecology in the intestines is essential for a breakthrough in this form of therapy. Probiotics should not be used as a stand-in for antibiotics if you want the most out of them.

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