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Antibiotic Growth Promoters and their Alternatives

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Introduction

Growth promoters are chemical and biological agents added to livestock feed to enhance the growth of the animals. Mechanism of action differs through several means, such as:Improved appetite, increased feed conversion rate, Immune system stimulation, Enhanced vigor, Management of intestinal microflora

Growth promoters can be divided into four categories:

Those that promote both growth and feed consumption. Those that promote growth without affecting feed intake. Those that have no effect on growth but reduce feed consumption (often known as the feed consumption ratio; fcr = kg of feed consumed per kilogram of body weight). Those that boost growth while reducing feed consumption.

Antibiotic Growth Promoters

Antibiotics have been administered to livestock for more than fifty years. Antibiotics are substances that kill or inhibit bacterial growth. They inhibit bacterial growth if applied at the correct concentrations and the organism is not resistant. As their name suggests, "antibiotic growth promoters" are antibiotics that are routinely employed at low levels in feed to improve growth and feed conversion. This supplementation should not be confused with the therapeutic (curative) use of antibiotics, in which high doses are administered to treat a particular condition. The majority of AGPs target gram-positive organisms, which are associated with poorer health in birds. Antibiotic growth promoters (AGPs) change the microbiota of the digestive tract (bacterial population). Antibiotics inhibit the growth of

harmful microorganisms in the gastrointestinal tract by altering microbial metabolism (Muurinen et al., 2021). It is high time to act in response to antibiotic resistance. Studies have shown that new young one at early age are getting infected and acquiring antimicrobial resistance bacteria (Tumlam et al., 2022). First of its kind studies reported that there is significant evidence of antimicrobial residue in bovine milk and resistant bacteria in bovine (Patel et al., 2019; Patel et al., 2020).

Mechanism of Action of an Antibiotic

Mainly it is Bactericidal which kills bacteria's through multiple actions like, altering bacterial cell wall (Penicillines, Cephalosporines), Target cell membrane (polymixins), Target key bacterial enzymes (quinolones, sulfonamides).

Other major mechanism is by inhibiting further growth of bacteria's *i.e.* Bacteriostatic which make its impact by targeting the production of proteins (Tetracycline, Macrolides, Aminoglycosides, and Amphenicol), these antibiotics inhibit competitively unfavorable microorganisms that absorb nutrients and generate unwanted or poisonous chemicals.

Concerns about antibiotic growth promoters

Antibiotic resistance is caused by the incorrect and prolonged use of antibiotics as feed additives and in chicken diets. Two-thirds of Indian chicken producers utilize antibiotic growth boosters to increase their animals' profitability exponentially. The Center for Science and the Environment undertook a research to examine the use of antibiotics inappropriately in chicken. The incorrect dumping of poultry feces in the field constituted a significant risk of infection to people. 100% of *E. coli*, 92% of *Klebsiella pneumoniae*, and 78% of *Staphylococcus lentus* were found to be multidrug resistant, according to the study.

The Pollution Monitoring Laboratory (PML) at the Centre for Science and Environment analyzed chicken samples from Delhi, NCR for the presence of antibiotics. Seventy raw samples were evaluated in total. The testing was performed in two phases. Muscle, liver, and kidney were examined for the presence of six antibiotics often administered to poultry: oxytetracycline, chlortetracycline, and doxycycline (from the class tetracyclines); enrofloxacin and ciprofloxacin (from the class fluoroquinolones); and neomycin, an aminoglycoside. 50 samples were examined during September and October 2013, while the remaining 20 samples were examined between May and June 2014. Five of the six antibiotics were detected in all three samples of chicken tissue. They ranged from 3.37 to 131.75 g/kg. Of the forty percent of samples confirmed to contain antibiotic residues, 22.9% contained residues of a single antibiotic, while 17.1% included residues of more than one antibiotic.

Alternative growth promoters to antibiotics

Several antibiotic growth promoters have been outlawed as a result of antibiotic resistance produced by irresponsible use of antibiotics. Due to higher feed costs and restrictions on the use of antimicrobials in feeds, the poultry industry in this region has a significant obstacle in maintaining the production performance of birds. Thus, we must investigate other means of protecting and enhancing the health of farm animals. It is well evident that there are many alternatives for use in broilers, ruminants and swine production (Dai et al., 2021; Thacker, 2013; Patel *et al*., 2018).

Natural Growth Promoters (NGPs) such as phytobiotics, probiotics, prebiotics, symbiotics, organic acids, clay minerals, exogenous enzymes, and nucleotides have boosted the motivation to revisit the search for novel, beneficial additives that can improve the gut health and productivity of birds and ruminants (Gadde et al., 2017;Patel K. P. *et al*., 2020).

Natural Growth Stimulants

A good alternative to AGP should be able to reduce the incidence and severity of subclinical intestinal infections in broilers by reducing microbial utilization of nutrients and enhancing absorption due to intestinal wall weakening. The optimal outcomes can be reached by combining these feed ingredients with favorable environmental conditions.

Organic acids

For a very long time, it has been common knowledge that organic acids or their salts can be used effectively as feed supplements. Organic acids are not antibiotics, but when utilized effectively in conjunction with dietary, managerial, and biosecurity measures, they can be an effective tool for maintaining the health of poultry's gastrointestinal tract. Organic acids suppress intestinal bacteria, hence reducing bacterial competition with the host for available nutrients and decreasing the concentration of harmful bacterial metabolites. Raise the height of the villus in the small intestine.

Organic acids decrease the pH of feed, so acting as preservatives and preventing microbiological or microbial contamination. Feed additives include organic acids such as lactic acid, acetic acid, tannic acid, fumaric acid, propionic acid, caprylic acid, etc. Sodium butyrate has shown the ability to suppress pathogenic microorganisms, increase the digestibility of diets, and enhance animal performance (Griggs and Jacob, 2005).

Probiotics

Probiotics are described as direct-fed mono or mixed cultures of living microorganisms that, when supplied in sufficient quantities, confer a health benefit to the host by enhancing the qualities of the native microflora. Improves the intestinal microbial balance of the host. Pathogen-resistant immunity generated by colonization. Enhancing immunological responses. Effective probiotics encourage beneficial microorganisms in the gastrointestinal

system and decrease pathogens through competitive exclusion. These probiotic organism also possess significant role in development of several Fibrolytic enzymes which aids in effective digestion of tough to digest fibrous materials in feeds given to animals (Patel K. P. *et al*., 2020).

They primarily function in three ways:

1) Competitive exclusion: by populating the gut in vast numbers, probiotic bacteria compete for areas to adhere to intestinal mucous membranes, thereby excluding pathogens and preventing them from causing infection.

2)Stimulation for the immune system: while the immune system is activated by exposure to probiotic bacteria, any hostile microorganisms are also detected by heightened surveillance by leukocytes, resulting in the elimination of potential infections.

3) Affecting intestinal metabolic activities, such as the increased generation of vitamin B12, bacteriocins, organic acids, and other substances with antibacterial activity against pathogen germs.

There are numerous types of microorganisms used in probiotic preparations, including *Lactobacillus bulgaricus, Lactobacillus acidophilus, Lactobacillus casei, Lactobacillus lactis, Lactobacillus salivarius, Lactobacillus plantarum, Streptococcus thermophilus, Enterococcus faecium, Enterococcus faecalis, and Bifidobacterium.*

Prebiotics

Nondigestible food or feed substances that boost host health by selectively encouraging the growth and/or activity of one or a limited number of bacterial species already established in the digestive system. Competitive exclusion of harmful bacteria such as E. coli and salmonella from young animals. Prebiotics can serve as particular sources of nutrients for beneficial microbes, such as fructo-oligosaccharides for Bifidobacterium spp. Prebiotics may provide energy for the growth of endogenous beneficial bacteria, such as bifidobacteria and lactobacilli, in the gut, so enhancing the microbial balance of the host. The increased generation of short chain fatty acids, which results in an increase in intestinal acidity, may also contribute to the suppression of pathogens in the chicken intestine.Increase the chicken's immunological response, leading in fast intestinal pathogen. Ex.

oligosaccharides (2–20 monosaccharides) (2–20 monosaccharides), galactooligosaccharides (GOS) (legume seeds), fructooligosaccharides (FOS) (cereal grains), Mannanoligosaccharides (MOS) (yeast cell walls)

Symbiotics

Both probiotics and prebiotics are present.Because its specialized substrate is available for fermentation, this combination could boost the survival and permanence of the health-promoting organism in the gastrointestinal tracts of birds.The development of symbiotic goods anticipates the functional benefits of symbiotics, such as resistance to

gastrointestinal bacterial infection, antibacterial action, and strengthening of the immune system.

Herbs and Phytogenic Enhancements

Phytogenic supplements boost broiler chickens' consumption and conversion of food, as well as its digestibility and growth.Herbs, oils, botanicals, and spices added to feed additives stimulate digestive fluid output and boost broiler immunity.In addition to enhancing health and nutrient digestibility, they minimize the incidence of digestive diseases.As growth promoters, the majority of biologically active plant components are secondary metabolites, such as terpenoids, phenolics (tannins), glycosides, and alkaloids.Such additions can partially substitute for antibiotics. Complex effects (flavor materials, antibacterial, coccidiostatic, anthelmintic, antiviral (Ghoke*et al.*2018) or anti-inflammatory activity, and particularly antioxidant properties). They are predominantly employed in combinations of various plant extracts and oils.The growth-promoting effects of phytobiotics are likely the result of synergistic interactions between phytobiotics' complex active components.

g Oligosaccharides and polysaccharides, inulin and fructooligosaccharides, and arabinogalactans are carbohydrates found in plants (Lillehoj et al., 2018; Patel *et al*., 2018).Phytogenic chemical and herbal plants have been reported for significantly amelioration of fatty liver disease (Parmar et al., 2022[b]) and anti-viral activities. Furthermore, Parmar et al. (2022)[a] have significantly proved that naturally available top crop can be used as feed for livestock as they have significant source of nutrients, thereby the use of herbal plants can be the useful for the livestock, poultry and in swine husbandry.

Advantages

- Natural component of animal diets.
- Lack of lingering effects
- Non-hazardous and environmentally friendly.
- Minimal drug resistance problem.

Disadvantages

- Complicated composition.
- Geography, soil type, climatic conditions, altitude, and growing season all influence the chemical composition of plants.
- Environmental growth circumstances, time of harvest, and degree of maturity. Manner and duration of plant preservation and storage, and extraction techniques.
- Potential synergistic or antagonistic effects, antinutrients, or microbiological contamination.

Extremely Available Elements

To address the nutritional needs of farm animals, highly accessible trace minerals in the form of chelates or proteinates can replace the inorganic sources now used.Greater bioavailability

of these chelated minerals results in enhanced mineral absorption, improved health status, and enhanced performance.Selenium (Se), when administered as Se-yeast, can have specific impacts on the animal's metabolism and hence improve its health.Organic chromium (Cr) in the form of glucose tolerance factor supports the metabolism of carbohydrates and insulin action.As growth stimulants, chelated versions of zinc, copper, etc. are utilized.

Clay minerals and binders for toxins

Clay minerals are naturally occurring clays made primarily of molecules of silicon, aluminum, and oxygen, and produced by a network of stratified tetrahedral or octahedral layers.Clays added to the diet can bind and immobilize harmful substances such as aflatoxins, heavy metals, and so forth.Due to their binding capabilities, clay minerals have been frequently utilized in poultry diets to increase chicken performance when mycotoxins are assumed to be present in the diet. Ex. Special ATB Toxin Binders. HSCAS and other clays; MOS; organic acids; and activated charcoal make up the composition. Including: 1 pound per ton.

Nucleotides

Nucleotides are required for cellular metabolism and all intracellular biochemical processes, including biosynthetic pathways, energy transfer systems, coenzyme components, and biological regulators.Nucleotides alter the gut microflora's composition.Increase intestinal iron absorption by increasing the conversion of purine nucleotides (AMP, GMP) to iron-absorbing inosine, hypoxanthine, and uric acid.

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