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Advancing Poultry Nutrition With Sustainable Alternatives To Combat Antimicrobial Resistance

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Abstract:

The poultry industry is experiencing rapid growth, especially in developing countries. The use of antibiotics as growth promoters in poultry has been shown to significantly enhance feed conversion efficiency and growth performance. However, the overuse of antibiotics in poultry production can contribute to antimicrobial resistance. For food safety reasons, many developed countries have prohibited the use of antibiotics in all animal feeds. Phytogenic or plant derived feed additives, essential oils, herbs and spices, probiotics and prebiotics, enzymes, organic acids, yeast derivatives, algae and insects play a major role in poultry nutrition as an alternative to antibiotic growth promoters.

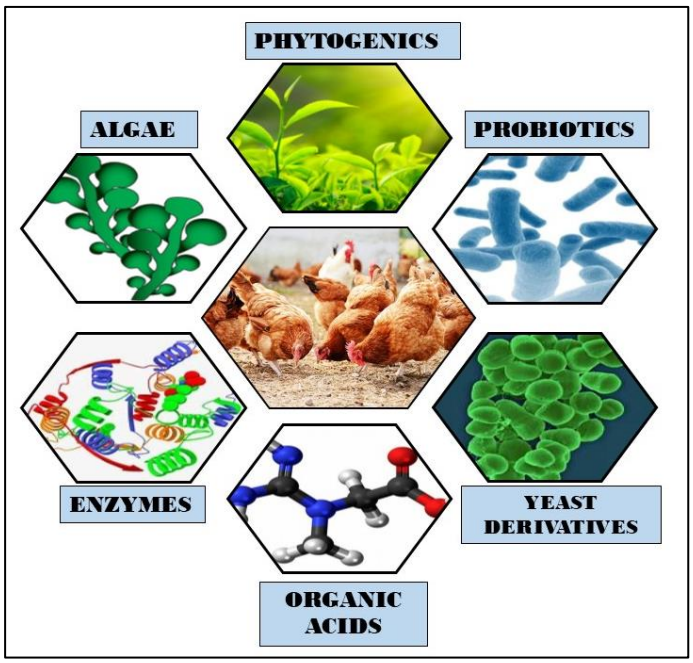
Keywords: Growth Promoters, Antimicrobial Resistance, Poultry Nutrition, Plant Based Feed Additives

Introduction:

The global poultry industry is a cornerstone of food security, providing a significant source of protein. However, the industry's reliance on antibiotic growth promoters (AGPs) has raised concerns about antimicrobial resistance, environmental impact, and consumer health (Van Boeckel *et al*., 2017). This review explores innovative approaches in poultry nutrition that promise to enhance growth, health, and productivity without the drawbacks associated with antibiotics.

The Downside of Antibiotic Growth Promoters:

For many years, AGPs have been utilized to increase the growth rates and feed efficiency in poultry species. However, their widespread use has contributed to the emergence of antibiotic-resistant bacteria, posing a significant threat to public health. Furthermore, the residues of antibiotics in poultry products have sparked consumer concerns and regulatory actions worldwide. Thus, the industry is moving towards finding sustainable and effective alternatives to AGPs (European Medicines Agency, 2017).



(Various alternatives to antibiotic growth promoters to combat antimicrobial resistance)

Phytogenics: Nature's Answer:

Phytogenics, or plant-based feed additives, are gaining traction as a promising alternative to AGPs. These include essential oils, herbs, and spices known for their antimicrobial and antioxidant properties. Research has demonstrated that phytogenics can improve gut health, enhance immune function, and promote growth in poultry (Windisch *et al*.,2008).

- **Essential Oils:** Essential oils such as oregano, thyme, and cinnamon have shown significant potential. Their antibacterial activity targets several harmful bacteria such as Salmonella and E. coli, thereby mitigating the microbial burden in the gut and enhancing the absorption of nutrients. (Burt, 2004).
- **Herbs and Spices:** Herbs like garlic and ginger have been traditionally used for their medicinal properties. In poultry nutrition, these herbs have demonstrated growth-promoting effects comparable to AGPs. Garlic, for instance, has been found to enhance feed efficiency and weight gain, while ginger improves digestive enzyme activity and nutrient absorption (Hashemi, 2011).

Probiotics and Prebiotics: Harnessing Beneficial Microbes:

Probiotics and prebiotics offer another viable alternative to AGPs by promoting a healthy gut microbiota. Probiotics are live microorganisms that confer health benefits, while prebiotics are non-digestible fibers that stimulate the growth of beneficial bacteria.

- **Probiotics:** Lactobacillus, Bifidobacterium, and Bacillus species are commonly used probiotics in poultry. These advantageous microorganisms outcompete harmful bacteria, improve immunological responses, and maintain the integrity of the gut. Studies have shown that probiotics can improve growth performance, feed conversion ratio, and reduce the incidence of

gastrointestinal diseases (Simon, 2010).

- **Prebiotics:** Prebiotics such as inulin, fructooligosaccharides (FOS), and mannanoligosaccharides (MOS) serve as food for beneficial bacteria, promoting their growth and activity. They help in reducing pathogenic bacteria by competitive exclusion and enhancing the production of short-chain fatty acids, which improve gut health and nutrient absorption (Patterson, 2003).

Enzymes: Enhancing Digestibility:

Supplementing poultry diets with enzymes has emerged as a practical approach to improve nutrient digestibility and feed efficiency. Enzymes such as phytase, protease, and xylanase break down anti-nutritional factors in feed ingredients, making nutrients more available for absorption.

- **Phytase:** Phytase is widely used to break down phytic acid, an anti-nutritional factor in grains that binds essential minerals like phosphorus, calcium, and zinc. By degrading phytic acid, phytase enhances mineral availability and improves bone health, growth performance, and feed efficiency in poultry (Selle, 2007).
- **Protease and Xylanase:** Protease helps in the digestion of proteins, while xylanase breaks down non-starch polysaccharides in feed ingredients. These enzymes reduce gut viscosity, enhance nutrient absorption, and promote growth. The combined use of these enzymes has shown synergistic effects in improving overall feed utilization (Bedford, 2012).

Organic Acids: Modulating Gut Environment:

Organic acids such as citric acid, formic acid, and butyric acid are effective alternatives to AGPs due to their ability to lower gut pH and inhibit pathogenic bacteria. They also enhance nutrient digestibility and promote a healthy gut microbiota.

- **Citric Acid:** Citric acid has been found to improve mineral absorption, particularly calcium and phosphorus, by chelating with them and preventing their precipitation in the gut. This leads to better bone development and growth performance in poultry (Ricke, 2003).
- **Butyric Acid:** Butyric acid, a short-chain fatty acid, is a key energy source for intestinal epithelial cells. It improves intestinal barrier function and encourages the growth of beneficial bacteria to improve gut health. Supplementing poultry diets with butyric acid has been shown to improve feed efficiency, growth rates, and overall health (Leeson, 2001).

Yeast Derivatives: Immune Modulation:

Yeast-derived products such as beta-glucans, mannoproteins, and yeast cell wall extracts have immunomodulatory properties that can enhance poultry health and performance. These compounds stimulate the immune system, improve gut health, and act as prebiotics.

- **Beta-Glucans:** Beta-glucans are polysaccharides found in the cell walls of yeast and fungi. They activate the immune system by stimulating macrophages, neutrophils, and natural killer cells. In

poultry, beta-glucans have been shown to enhance disease resistance, improve vaccine responses, and promote growth (Kogan *et al*., 2007).

- **Mannoproteins and Yeast Cell Wall Extracts:** Mannoproteins and yeast cell wall extracts contain mannanoligosaccharides (MOS) and other bioactive compounds that bind to pathogenic bacteria, preventing their attachment to the gut lining. This reduces the risk of infections and enhances gut health. These yeast derivatives also promote the growth of beneficial bacteria, improving nutrient absorption and overall performance (Spring, 2000).

Algae: The Superfood for Poultry:

Algae, particularly microalgae like Spirulina and Chlorella, are rich in proteins, vitamins, minerals, and bioactive compounds. They have been explored as a sustainable feed additive in poultry nutrition due to their high nutritional value and functional properties.

- **Spirulina:** It is a blue-green microalgae that is high in protein, vitamins, antioxidants, and vital amino acids. It has been found that supplementing poultry diets with spirulina enhances immune system performance, growth performance, and egg production. Because of its antioxidant properties, it can improve general health of the animals by lowering the oxidative stress. (Becker, 2007).
- **Chlorella:** Chlorella, a green microalga, is known for its detoxifying and immune-boosting properties. It is a valuable feed additive for poultry because of high level of chlorophyll, vitamins, and minerals. Studies have demonstrated that Chlorella supplementation can improve growth rates, enhance nutrient absorption, and support immune health (Gouveia *et al*., 2011).

Insects: Sustainable Protein Source:

Insects such as black soldier fly larvae (BSFL) and mealworms are gaining attention as a sustainable and nutritious protein source for poultry. They have high protein, essential amino acids, and fat contents, making them a viable alternative to conventional feed ingredients.

- **Black Soldier Fly Larvae:** They have high protein content and have the ability to convert organic waste into valuable biomass. They are rich in lauric acid, which has antimicrobial qualities that can help lower pathogenic bacteria in the gut. Feeding poultry with BSFL has been shown to improve growth performance, feed efficiency, and gut health (Makkar *et al*., 2014).
- **Mealworms:** Mealworms are another promising insect protein source. They are rich in lipids, protein, and necessary amino acids. Studies have indicated that mealworm inclusion in poultry diets can enhance growth rates, feed conversion ratio, and overall health. Their sustainable production also makes them an environmentally friendly alternative to traditional feed ingredients (Van Huis, 2013).

Conclusion:

The search for sustainable alternatives to antibiotic growth promoters in poultry nutrition is driven by the need to address antimicrobial resistance, consumer health concerns, and environmental impact. Innovative approaches such as phytogenics, probiotics, prebiotics, enzymes, organic acids, yeast derivatives, algae, and insect proteins offer promising solutions. These alternatives not only enhance growth performance and feed efficiency but also promote gut health, immune function, and overall well-being in poultry. The adoption of these sustainable practices will ensure the continued growth and sustainability of the poultry industry, aligning with global efforts to promote safe and responsible animal agriculture.

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