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## Herbal supplements in poultry feed: A review of their potential benefits and applications

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### Abstract

Poultry production is a vital component of the global agricultural industry, and maintaining optimal health and productivity of poultry is of utmost importance. In recent years, there has been an increasing interest in incorporating herbal supplements into poultry feed as a natural alternative to promote growth, improve immune function, enhance gut health, and reduce the reliance on antibiotics. This review paper aims to provide an overview of the potential benefits and applications of herbal supplements in poultry feed. It discusses the commonly used herbal ingredients, their mechanisms of action, effects on poultry performance, and prospects for research and commercial utilization.

**Keywords:** Herbal supplements, poultry feed, gut health, antimicrobial, poultry nutrition, poultry health

### Introduction

In India, poultry production is a vital and rapidly growing sector, providing a significant source of animal protein to meet the nutritional needs of a growing population. The production of healthy and high-performing poultry is essential for the sustainability and profitability of this industry <sup>[1]</sup>. To achieve optimal growth, performance, and overall well-being of poultry, proper nutrition plays a crucial role. In recent years, there has been an increasing interest in finding natural and sustainable alternatives to conventional additives, such as antibiotics and synthetic growth promoters, in poultry feed <sup>[2]</sup>. This shift is driven by concerns over the development of antibiotic resistance, consumer preferences for safe and residue-free food, and the need for environmentally friendly production practices <sup>[3]</sup>. Consequently, there has been a growing focus on the use of herbal supplements in poultry feed.

Herbal supplements are derived from various plant sources and are rich in bioactive compounds with potential health-promoting properties <sup>[4]</sup>. These supplements offer a natural approach to supporting poultry health, improving immune function, enhancing gut health, and promoting growth and productivity. Herbal ingredients, such as garlic, turmeric, oregano, and others, have been extensively studied for their potential benefits in poultry nutrition <sup>[5]</sup>.

This review paper aims to provide a comprehensive overview of the potential benefits and applications of herbal supplements in poultry feed <sup>[4]</sup>. It will explore the commonly used herbal ingredients, their mechanisms of action, and their effects on poultry performance, immune response, gut health, and meat quality. Additionally, the paper will discuss synergistic combinations with other feed additives and the challenges and opportunities associated with the incorporation of herbal supplements into commercial poultry production <sup>[6]</sup>.

### Importance of poultry nutrition and health

Poultry nutrition and health are of paramount importance in the poultry industry for several reasons. Proper nutrition is crucial for achieving optimal growth and performance in poultry <sup>[7, 8]</sup>. A well-balanced diet that meets the specific nutrient requirements of poultry promotes efficient feed conversion, higher weight gain, improved feed efficiency, and enhanced production parameters such as egg production and meat yield <sup>[8]</sup>. Good nutrition plays a vital role in supporting a robust immune system in poultry. Essential nutrients, including vitamins, minerals, amino acids, and antioxidants, contribute to the development and functioning of the immune system. Nutritional deficiencies can lead to reduced egg production, poor hatchability, and abnormalities in chicks <sup>[9]</sup>.

Providing a nutritionally balanced diet with adequate levels of essential nutrients supports reproductive health and contributes to the sustainability of the poultry industry. Poultry nutrition directly influences bone strength and skeletal integrity. Calcium, phosphorus, and vitamin D are crucial for bone development and maintenance. Proper levels of these nutrients in the diet help prevent skeletal disorders <sup>[10]</sup>. Feathers are essential for insulation, protection, and display, and their quality directly affects the well-being of birds. A diet rich in essential amino acids, fatty acids, and vitamins contributes to healthy feather development and maintains skin health, reducing the risk of dermatological issues. Balanced diets with precise nutrient ratios minimize nutrient excretion and reduce the environmental burden associated with poultry waste. Efficient nutrient utilization decreases the release of excess nutrients into the environment, mitigating potential negative effects on water and soil quality <sup>[11, 12]</sup>. A well-balanced diet, coupled with proper hygiene and biosecurity measures, helps produce safe and wholesome poultry meat and eggs for consumers <sup>[12]</sup>.

### Rise in interest for herbal supplements in poultry feed

In recent years, the interest in herbal supplements for poultry feed has surged due to concerns over antibiotic resistance, consumer demand for natural products, regulatory restrictions, and bans on synthetic additives. Scientific research has provided evidence of the potential benefits of herbal supplements for poultry health, growth performance, immune function, and gut health <sup>[13, 15]</sup>. Additionally, herbal supplements offer an environmentally friendly approach and a holistic solution to poultry health. This growing interest reflects the industry's shift towards sustainable and natural practices, and herbal supplements have the potential to replace conventional additives effectively <sup>[13]</sup>.

### Commonly used herbal ingredients

Nowadays, herbal ingredients have gained popularity for their potential benefits in poultry nutrition <sup>[16]</sup>. These ingredients, derived from various plant sources, possess bioactive compounds that can promote poultry health and performance. The following are some of the commonly used herbal ingredients in poultry feed (Table 1).

**Table 1:** Effect of commonly used herbs on the performance of Poultry

Herb	Function	Effect	level
Garlic ( <i>Allium sativum</i> )	Garlic is known for its antimicrobial and immune-enhancing properties. It contains allicin, a compound with broad-spectrum antimicrobial activity against bacteria, fungi, and parasites.	Garlic supplementation in poultry feed has been associated with improved immune function, reduced pathogen load, and enhanced growth performance.	Blend of 0.1% aq. extract of thyme, garlic coneflower. Rahimi <i>et al.</i> , 2011 <sup>[28]</sup>
Turmeric ( <i>Curcuma longa</i> )	Turmeric contains curcumin, a potent antioxidant and anti-inflammatory compound. Curcumin has been studied for its antimicrobial, immunomodulatory, and digestive health benefits.	Adding turmeric to poultry feed has shown positive effects on growth performance, antioxidant status, gut health, and immune response in poultry.	2.5 g per kg feed Naderi <i>et al.</i> (2014) <sup>[27]</sup>
Amla powder	Significantly higher values of Hb%, lowest serum cholesterol value was reported in broilers.	Heterophils count was also significantly reduced in amla supplemented group as compared to control group.	0.25, 0.50, 0.75 and 1% of diet. Dalal, <i>et al.</i> 2018b <sup>[10]</sup>
Cinnamon ( <i>Cinnamomum verum</i> )	Cinnamon contains cinnamaldehyde, which possesses antimicrobial, antioxidant, and anti-inflammatory effects	Incorporating cinnamon into poultry feed has shown potential benefits, including improved growth performance, feed efficiency, immune response, and gut health.	100 ppm and 200 ppm essential oil derived from cinnamon. Al Kassie, <i>et al.</i> (2009) <sup>[11]</sup>
Rosemary	Improved antioxidant capacity of products Specific applications relating to poultry keeping include liver protection	Adding showed some benefit to chickens suffering from liver damage as a result of aflatoxicosis, due to ingestion of toxic moulds, common in poor quality poultry feed.	Rosemary to chickens' feed at 500 ppm. Lopez-Bote <i>et al.</i> 1998 <sup>[24]</sup>
Neem ( <i>Azadirachta indica</i> )	Neem is known for its various bioactive compounds, including nimbin, nimbidin, and azadirachtin, which exhibit antimicrobial, antiparasitic, and immunomodulatory effects.	Neem supplementation in poultry feed has shown potential benefits in improving growth performance, intestinal health, and immune response. Significantly improved the body weight gain and FCR in broilers.	@ 1-2 g/kg in the ration Al Amin <i>et al.</i> (2006) <sup>[2]</sup>
Olive leaf powder	Effect on Layers performance	Had no effect on feed intake, egg weight, egg yield and feed conversion ratio ( $p > 0.05$ ) while increased final body weight of hens ( $p < 0.05$ ).	0, 1%, 2%, or 3% Cayan and Erener (2015) <sup>[7]</sup>
Aloe Vera (Aloe <i>barbadensis</i> ) Powder	Aloe vera contains polysaccharides, vitamins, and minerals that contribute to its immune-modulating and antioxidant effects	Supplemented broilers had smaller faecal oocyst shedding count compared to infected group fed with the standard diet	0.5%, 0.75% and 1% AV gel in drinking water. Yim <i>et al.</i> (2011) <sup>[30]</sup>
Shatavari powder	Gain in body weight	Significantly improved ( $p < 0.05$ ) body weight, weekly gain in body weight and feed conversion ratio of broilers.	Shatavari root powder (SRP) @ 0.5, 1 and 1.5% of diet Rekhate <i>et al.</i> (2004) <sup>[29]</sup>

It is important to note that the efficacy and optimal dosage of these herbal ingredients may vary depending on factors such as poultry species, age, and specific health conditions. Additionally, herbal supplements are often used in combination to achieve synergistic effects. Further research is ongoing to explore the mechanisms of action and potential applications of these herbal ingredients in poultry nutrition

### Mechanisms of Action

Herbal supplements in poultry feed exert their effects through various mechanisms of action, contributing to improved growth, immune function, gut health, and overall well-being of poultry. The following are some key mechanisms through which herbal ingredients act in poultry (Table. 2).

**Table. 2:** Key mechanisms through which herbal ingredients act in poultry

Mechanisms of Action	Effect	References
Antimicrobial and Antiparasitic Effects	Many herbal supplements possess natural antimicrobial and antiparasitic properties. Compounds such as allicin in garlic, carvacrol and thymol in oregano, and cinnamaldehyde in cinnamon exhibit broad-spectrum antimicrobial activity. These substances can help reduce the colonization and growth of harmful bacteria, fungi, and parasites in the gastrointestinal tract, thereby promoting a healthier gut environment and reducing the risk of infections.	[16, 17]
Immune Modulation	Herbal ingredients often contain bioactive compounds that have immunomodulatory properties. For example, curcumin in turmeric and polysaccharides in echinacea can modulate the immune system, enhancing the production and activity of immune cells, such as lymphocytes and macrophages. This immune modulation can improve the overall immune response, enhance disease resistance, and promote better health in poultry.	[12, 15]
Gut Health Improvement	Herbal supplements play a vital role in maintaining gut health and function. Many herbs contain compounds that have prebiotic effects, promoting the growth and activity of beneficial gut bacteria. This helps to maintain a balanced gut microbiota, improve nutrient digestion and absorption, and enhance the overall gut health of poultry. Additionally, certain herbal ingredients, such as aloe vera, can help reduce gut inflammation and enhance intestinal barrier integrity.	[18]
Antioxidant and Anti-inflammatory Properties	Several herbal supplements possess antioxidant and anti-inflammatory properties. Compounds like gingerol in ginger, curcumin in turmeric, and polyphenols in oregano and cinnamon can scavenge free radicals, reduce oxidative stress, and suppress inflammatory responses. These effects contribute to the overall well-being of poultry by protecting cells from damage, reducing inflammation in the body, and supporting optimal physiological functions.	[19]
Performance Enhancement	Herbal supplements can have direct or indirect effects on growth performance in poultry. By promoting gut health, improving nutrient absorption, and enhancing metabolic processes, herbal ingredients contribute to better growth rates, improved feed efficiency, and enhanced weight gain in poultry.	[19, 20]

### Synergistic Combinations and Formulations

Synergistic combinations and formulations of herbal supplements in poultry feed have gained attention as they can enhance the overall effectiveness and benefits of these natural additives [17]. By combining multiple herbal ingredients with complementary properties, synergistic effects can be achieved, leading to improved poultry health and performance [20].

#### The following are key considerations regarding synergistic combinations and formulations of herbal supplements:

- Enhanced Efficacy:** Different herbal ingredients may possess distinct bioactive compounds and mechanisms of action. When combined, these ingredients can act synergistically, amplifying their individual effects and producing a more potent response. For example, combining garlic with oregano and cinnamon can enhance antimicrobial properties, resulting in better control of pathogenic bacteria and parasites in the gut [21, 22].
- Multiple Targeted Effects:** Synergistic combinations allow for a broader range of targeted effects on poultry physiology. Herbal ingredients with different mechanisms of action can collectively impact multiple aspects of poultry health, such as growth promotion, immune modulation, gut health improvement, and antioxidant activity. This comprehensive approach helps to address multiple challenges and optimize overall performance [22].
- Gut Microbiota Modulation:** Synergistic combinations can positively influence the composition and activity of the gut microbiota. Different herbal ingredients may promote the growth of specific beneficial bacteria, suppress harmful microorganisms, and enhance the overall balance of the gut microbiome [23]. This modulation of the gut microbiota contributes to improved nutrient digestion, immune function, and overall gut health in poultry.
- Formulation Considerations:** The formulation of herbal supplements is critical for ensuring stability, uniform distribution, and ease of application in poultry feed. Formulations may include dry powders, liquid extracts,

or encapsulated forms of herbal ingredients [11]. Proper formulation techniques help maintain the potency and bioavailability of the active compounds, ensuring consistent efficacy throughout the feed.

- Feed Additives and Prebiotic Combinations:** Synergistic combinations of herbal supplements with other feed additives, such as probiotics and prebiotics, can further enhance their effects. Probiotics and prebiotics provide beneficial microorganisms or substrates that selectively stimulate the growth of beneficial gut bacteria [19]. Combining herbal ingredients with these additives can create a symbiotic relationship, optimizing gut health and promoting a more favourable gut environment [24].
- Dosage Optimization:** The synergistic effects of herbal combinations may require dosage adjustments to achieve the desired results. Dosage optimization ensures that the concentrations of each herbal ingredient in the formulation are appropriate to achieve the desired physiological effects without causing any negative impacts [23, 24]. It is important to consider factors such as poultry species, age, health status, and specific performance goals when determining the optimal dosage levels.

Synergistic combinations and formulations of herbal supplements in poultry feed provide an opportunity to harness the benefits of different herbal ingredients and maximize their positive effects on poultry health, performance, and overall well-being. Further research and collaboration between researchers, nutritionists, and feed manufacturers are necessary to explore and optimize these combinations to develop effective and commercially viable products for the poultry industry

### Prospects and Challenges

Addressing these challenges will require collaboration among researchers, industry stakeholders, regulatory bodies, and farmers [24]. By overcoming these obstacles and leveraging the prospects, herbal supplements can become a valuable tool in promoting sustainable, natural, and effective poultry nutrition practices (Table 3).

**Table 3:** Prospects and challenges in herbal poultry supplements

<b>Future prospects</b>	
Further Research and Development	Continued research efforts are needed to deepen our understanding of herbal supplements in poultry nutrition. Future studies should focus on identifying optimal dosages, exploring interactions between different herbal ingredients, investigating their long-term effects, and elucidating specific mechanisms of action <sup>[26]</sup> .
Technological Advancements	Advances in extraction techniques, encapsulation methods, and formulation technologies (nanotechnology) can enhance the stability, bioavailability, and efficacy of herbal supplements. Improved processing methods will allow for the preservation of bioactive compounds and targeted delivery systems, ensuring their maximum benefits in poultry nutrition <sup>[26]</sup> .
Sustainable Sourcing and Production	The demand for herbal supplements in poultry feed necessitates sustainable sourcing and production practices <sup>[27]</sup> . Ensuring responsible cultivation, harvesting, and processing of herbal ingredients will help preserve biodiversity, minimize environmental impact, and support local communities.
Integration with Conventional Strategies	The integration of herbal supplements with conventional management strategies, such as vaccination programs and biosecurity measures, can enhance their efficacy <sup>[26, 27]</sup> . Synergistic approaches that combine herbal supplements with other feed additives, such as probiotics, prebiotics, and enzymes, can optimize the benefits and provide comprehensive solutions for poultry health and performance.
<b>Challenges</b>	
Standardization and Quality Control	Ensuring the consistency and quality of herbal supplements is a significant challenge. Herbal ingredients can vary in their composition and potency, making it challenging to achieve consistent results. Standardization protocols, quality control measures, and certification systems are necessary to ensure the reliability and effectiveness of herbal supplements in poultry feed <sup>[28]</sup> .
Cost-effectiveness and Practical Implementation	The cost-effectiveness of herbal supplements is a critical consideration for their widespread adoption in the poultry industry. Economic feasibility, including the availability and affordability of herbal ingredients, formulation costs, and potential returns on investment, must be carefully evaluated <sup>[29]</sup> .
Regulatory Considerations	Regulations governing the use of herbal supplements in animal feed can vary across regions. Clear guidelines and regulations are necessary to ensure their safe and legal use. It is essential to establish appropriate maximum residue limits and define withdrawal periods to guarantee food safety and compliance with regulatory standards <sup>[30]</sup> .
Limited Scientific Knowledge	More comprehensive studies are needed to fully explore their effects on different poultry species, production systems, and environmental conditions. Lack of standardized methodologies and inconsistent reporting of results can hinder the broader acceptance and integration of herbal supplements into poultry production practices <sup>[29, 30]</sup> .

## Conclusion

Herbal supplements have shown promising potential in improving poultry health, performance, and product quality. The use of natural plant-derived ingredients such as ginger, garlic, turmeric, and others can provide alternatives to conventional additives and help reduce the reliance on antibiotics in poultry production. However, further research is required to fully understand the mechanisms of action, optimize dosage levels, standardize formulations, and address challenges related to commercial implementation. With continued scientific advancements and industry collaboration, herbal supplements have the potential to contribute to sustainable and healthier poultry production systems.

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