



Herbal Feed Additive in Poultry Diet: Reviewing Potential in Improving Egg and Meat Productivity

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Abstract

Plant based feed additives (phytogenic compounds) use in poultry diet for natural, less toxic and residual free egg and meat production compared to that of the antibiotic and inorganic chemical based feed additives. Phytogenic compound majorly involve herbal extract, oils, oleoresin from the herbs and spices commonly like oregano, garlic, pepper, fenugreek, cumin, aloe vera, cinnamon, lemon, anise, nutmeg, ginger etc. These herbal additives contain certain bioactive molecule like allicin, capsaicin, allyl thiocyanate, piperine, thymol, which impart them properties like antimicrobial, antifungal, antiviral, anti-oxidative and potent antiparasitic that overall provide better growth microenvironment within body of bird. Numerous studies have demonstrated the benefits of using phytogenic compounds in poultry diets, including enhanced digestion, increased growth performance, decreased disease prevalence, greater reproductive efficiency, reduced morbidity and greenhouse gas emission. Therefore to improve the overall performance of poultry and safeguard the human health these herbal additives are safe alternatives to chemical additives with no side effects, no residual effect, cost effective and eco-friendly.

Keywords: Phytogenic Compound; FCR; Antioxidant; Weight Gain; Broiler

Abbreviation

FCR: Feed Conversion Ratio; EO: Essential Oil; ADG: Average Daily Gain; FA: Fatty Acid

Highlights

- This article provides valuable information on herbal alternatives of antibiotic feed additives.
- It give sneak into various medicinal and therapeutic properties of these herbal additives.
- It help to understand the effect of additives in different doses % basis and different physical forms.
- This review focuses on analyzing the egg and meat productivity improvement by use of these additive.

Introduction

Poultry being one of the most commercialized industry with fast growing varieties and breeds reared on various drugs and

pharmaceutical chemicals to produce more biomass in short span of time to maximize the profit margin. This trend has now incorporated a large residual of these drugs in human bodies triggering other genetic and lifestyle diseases. Commercial utilization of chemical drug as additive to attain faster growth, excellent weight gain and other commercial appealing parameter has created a havoc among the health conscious consumers. This made a way for shifting from chemical additives to herbal feed additives in poultry diet.

Feed additives are nutrient and non-nutrient compounds groups which are incorporated in diet to improve the efficiency, utilization, acceptability, digestibility of feed and to reduce the high cost of feed. This paves the path for use of herbal ingredients as feed additives to attain maximum meat and egg productivity. Herbs are flowering plant with soft non woody stem which are valued for their medicinal and therapeutic properties along with their great flavor, aroma and metabolic effect.

In recent time’s consumer awareness and world health organization (WHO) efforts have prohibited use of antibiotics as growth modulators [34] due to increased antibiotics resistance bacteria, accumulation of antibiotic residue in egg and meat product and potent threat of resistance transfer from animal to human [32] which accelerated the search for alternative of antibiotics, which bought back the age old concept of using plants extracts (especially herbs, spices, and their derivatives) in the scenario and since they are used for ages, for their aroma and medicinal properties they build the trust really soon in the consumer minds and gained popularity under the sense of being organic, pure and naturally safe.

Various experimental studies have suggested that these herbs have mindful effects on gut micro flora enhancing efficient feed utilization, good production and appealing flavor in egg and meat. These herbs has certain bioactive molecule in their plant extracts

(like allicin, allyl isothionate, cinnamaldehyde, eugenol, carvacrol) having similar action as of chemical compounds.

Mechanism of action

Herbs definitive mechanism of action is not fully known as there use and method of application varies widely with respect to their origin, processing and potency and major active compound present in them. These phytogetic compounds are incorporated in forms of powder, essential oil and extracts depending on the part of plant used viz. leaves, flower, root, bark, or their extracts in solvent. This feed additive usually attributes to be growth promoter, antimicrobial, anti-inflammatory, immunostimulant, sexual stimulant, and egg production promoter and enhances digestive capacity through stimulation of saliva secretion, liver, pancreas and intestinal enzymatic activities, morpho-histology, metabolism by inhibiting potential pathogenic activities.

Plant	Used parts	Major active component	Function
Aromatic spices			
Nutmeg	Seed	Sabinene	Digestion stimulant, antidiarrhoeic
Cinnamon	Bark	Cimetaldehyde	Digestion stimulant, Appetite and antiseptic
Cloves	Cloves	Eugenol	Digestion stimulant, Appetite and antiseptic
Cardamom	Seed	Cineol	Digestion stimulant
Coriander	Leaves, Seed	Linalol	Digestive, carminative, galactagogue
Cumin	Seed	Cuminaldehyde	Digestion stimulant, galactagogue
Anise	Fruit	Anethol	Digestion stimulant, galactagogue
Celery	Fruit, Leaves	Phtalides	Digestion stimulant, Appetite
Parsley	Leaves	Apiol	Digestion stimulant, Appetite and antiseptic
Fenugreek	Seed	Trigonelline	Appetite stimulant
Pungent spices			
Capsicum	Fruit	Capsaicin	Digestion stimulant
Pepper	Fruit	Piperine	Digestion stimulant
Horradish	Root	Allyl izotiocianat	Appetite stimulant
Mustard	Seed	Allyl izotiocianat	Digestion stimulant
Ginger	Rhizome	Zingerone	Gastric stimulant
Garlic	Bulb	Allicin	Digestion stimulant
Herbs			
Rosemary	Leaves	Cineol	Digestion stimulant, Antioxidant and antiseptic
Thyme	Whole plant	Thymol	Digestion stimulant, Antioxidant and antiseptic
Sage	Leaves	Cineol	Digestion stimulant, Carminative and antiseptic
Laurel	Leaves	Cineol	Digestion stimulant, Appetite and antiseptic
Mint	Leaves	Menthol	Digestion stimulant, Appetite and antiseptic

Table 1
Source: [18].

- **Antimicrobial effects:** Supplementation of herbal and medicinal plants like turmeric, thyme, clove, cinnamon, sage, oregano, rosemary etc. in poultry diet exhibit antimicrobial tendency. Use of essential oil of oregano containing 60% carvacrol and 10% thymol demonstrated effective protection against some *salmonella* strain [20] while oregano combined with thyme is effective against *E.coli*. at dose rate of 0.6 ml/l [4,8] in their study reported use of *aloe vera* tends to improve intestinal micro flora, *lactobacillus* count and reduce pathogenic load while their phenolic extract exhibit high antibody titer.
- **Antioxidative effect:** [24] reported antioxidant compound in black pepper and red pepper and chilli contributing to the protection of dietary lipid from oxidation in egg and meat products [6]. Study reported significant decrease in lipid peroxidation while storage of fresh and cooked meat of turkey fed on 200 mg extract of oregano per kg of feed [13], demonstrated Labiate phenolic compound activity in enhancing the stability of broiler meat mass from lipid peroxidation spoilage on storage. Presence of thymol, carvacrol, monoterpenes in these herbs not only influence the oxidative status in body but also prevent the pathogenic susceptibility in birds as the reducing tendency destroy the cell structure of pathogen and also scavenge the free radical produced in body during metabolism.
- **Growth promoting effect:** Certain phytochemical additives have growth promoting effect with increased feed intake, improving gut health and enhancing dietary palatability due to stimulatory effect of flavor and odour from oily extracts [15], explained growth promoting effects of essential oils, ether extract of these additives as they reduce coccidial load and prevent damage to intestinal wall which probably increase feed intake due to higher palatability, acceptability and better absorbability [11]
- **Effect on FCR:** FCR is directly related with feed intake and body weight gain. More accurately, it represents animal's efficiency to convert feed mass into body mass over a specific time period. Fenugreek, garlic and thyme are reported to demonstrate significant higher FCR in broiler chicken over the control group [19,22] Several studies were conducted by comparing the FCR changes. (Ertas *et al.*, 2005) reported significant increase in FCR by 12% to control group and 8% in antibiotic additive when 200 mg/kg of mixture containing EO (essential oil) from oregano, clove, and anise were fed.
- **Effect on Intestinal Health:** Intestinal optimal health is a prerequisite for the efficient nutrient utilization pertaining to the fattening, weight gain, egg production, and reproductive performance. Optimal functioning of intestinal villi is necessary for higher production performance of birds [17] Reported positive effect on the activity of trypsin, amylase, and lipase and stabilizes the gut microbes by the use of essential oils of these additives [28], explained these improvements as results of increased villi and crypts size in jejunum and colon.
- **Immuno Stimulant Effect:** Immunity of any animal depends on its defense and antibody titer mechanism efficiency which involves certain cells like macrophages, lymphocytes, NK cells which help to carry out defensive plan in body. These herbal additives are rich in vitamin C, flavonoids, carotenoids which are crucial for efficacy of these cells [10], noticed increase in feed intake at 3 weeks when EO of clove, oregano, and anise is fed at 200 mg/kg and 400 mg/kg in broilers diet. While [33] noticed increased feed intake at 18mg/kg of EO of oregano, cinnamon, eucalyptus and thyme.
- **Effect On Reducing Feed Cost:** Adding herbs in place of commercial chemical additive has reduced feed cost effectively in birds as they produce high carbohydrate, lipid and protein digestibility and efficient mineral usability by birds with reduced feed cost and wider availability and vast variety of option available depending on need and choice reducing economic burden and improving production and profit percent [3].

Effect on egg production

Recent researches have reported potential of these feed additive on laying hens performance through the quality of shell thickness, haugh unit, albumen thickness, yolk composition, egg weight etc. while some studies report no significant changes in these parameters especially except improvement in overall production performance [26]. In layers, use of turmeric powder indicated significant increase in albumen height and egg protein due to stimulation of tubular gland cells in magnum to produce albumen [30]. Another additive fenugreek, an annual legume plant grown in sandy and alluvial soils found to have multiple medicinal properties as anti-diabetic, antifertility, anticancer, antimicrobial, anti-parasitic, hypo-cholesterolaemic effects [1], hypoglycemic, anthelmintic, antibacterial, anti-inflammatory and antipyretic properties (Alamadiani, *et al.*, 2001; Basch, *et al.*, 2003; Khan, *et al.*, 2009). Supplementation of garlic (*Allium sativum*), thyme (*Thimus vulgarus*) and Corn flour (*Echinacea perpurea*) reported to exert beneficial effect on quality and production of eggs in layer [19], concluded thyme @ 0.1 and 0.5% in diet improves egg production and FCR associatively reduces *Ecoli* in faeces.

[23] Studied use of pumpkin (*Cucurbita maxima*) seed in laying hen diet reported to improve healthy FA (Fatty acids) levels while decreasing harmful cholesterol and fatty acids. Pumpkin seed oil is

high in vitamin E and beta carotene which have powerful antioxidant and anticancer properties. Olive oil is a good solvent of vitamin D that help in improve Ca concentration in egg shells.

[25]. Studied effect of black cumin (*Nigella sativa*) seed in layer and reported high egg shell thickness and higher haugh unit and reduced yolk content desirables for the requirement of gym trainee consumers.

Effect on meat production and safety

In broilers diet phytogetic compounds are incorporated majorly to influence their metabolism and FCR to stimulate better weight gain and good carcass yield and quality. Inclusion of rosemary and cinnamon essential oil in broiler feed found to influence the antioxidant, hypocholesteromic properties of meat to a better position than control groups [7]. Inclusion of 1-1.5% of fenugreek (*Trigonella foenumgracum*) in broiler diet has growth promoting effects on FCR, higher weight gain in birds [12] preferably due to trimethylamine (TMA) stimulating appetite and galactomannan recognized as anti-diabetic compound improving weight gain. Study on use of black cumin (*Nigella sativa*) in diet was found to enhance the meat quality by antioxidant property and inhibit lipid peroxidation in meat as cumin seeds are rich in volatile oils, alkaloids ,essential fatty acids [29]. Certain herbal plants like Olive (*Olea europaea*) are used in various forms (leaves, cake, pulp meal and oil) having high PUFA, polyphenols, other phytochemical compounds influencing metabolic activities and promoting faster weight gain in meat producing birds.

[14] conducted their studies on lepidium sativum supplementation in broilers and studied various parameters, thus reported 0.75%-1% inclusion of garden cress in diet is a potential additive which contains tocopherol, carotenoid, oleic acid and linolenic acid which reduces free radicals and increase broiler feed consumption, body weight, blood globulin and improve the economic efficiency. Use of black cumin in broilers promotes anti-oxidative potency essential to prevent the meat quality in longer storage.

[9] in their studies reported using *Alpinia* spp. having active 1-8 cineole in it which influences average daily gain (ADG) and improves FCR in stress conditions as it increase intestinal villi height and crypts depth thereby enhancing absorption.

Tulsi (*Occimum sanctum*) has property to protect tissues against chemical stress, physical restraint and has antioxidant property to counter the metabolic stress in broiler chickens. Use of amla (*Em-*

blica officinalis) and mint (*Mentha longifolia*) in a comparative study shown anti-oxidative effect, in broilers. Use of herbal feed additives in broiler chicken is widely acknowledged for their microbial food safety, quality upon storage of raw and cooked meat, higher carcass stability with delayed oxidation of fat.

Use of (*Azolla pinnata*), an aquatic fern rich in protein (25-38%), minerals (10-15%), vitamins (20-30%) and low fiber (11-13%) content [27]. reported 25-30% *azolla* inclusion in diet for chicken and 40-45% for goose helps to reduce high feed cost by replacing traditional protein and also improves poultry productive performance by inhibiting free radicle activity [2].

Conclusion

In the concept of the production of healthy birds without the use of antibiotics herbs can be relevant in many different ways. They can regulate feed intake and stimulate digestive secretions. An optimized digestion capacity and reduced risk of digestive disorders are the consequence. Several phytochemicals like essential oils or dietary fibre can contribute to a balanced micro flora (eubiosis), an optimal precondition for an effective protection against pathogenic micro-organisms and an intact immune system. Herbs and botanicals contain many different antioxidants with a high potential for the protection of nutrients against oxidation in the digestive tract, in metabolism as well as in the products.

Conflict of Interest

Authors have no conflict of interest.

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