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Impact of dietary supplements on immune response on poultry

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ABSTRACT

The use of herbal dietary supplements in poultry nutrition has gained increasing attention as a natural and safe alternative to synthetic growth promoters and antibiotics. This study evaluates the impact of herbal-based dietary supplementation on the immune response of poultry. Various medicinal plants and plant-derived compounds, such as garlic (*Allium sativum*), green tea, turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), Lavender and neem (*Azadirachta indica*), are incorporated into poultry diets at different inclusion levels to assess their immunomodulatory effects. The findings indicate that herbal supplements significantly enhance both humoral and cellular immune responses in poultry. Birds receiving herbal additives showed increased antibody titers against common vaccines, improved lymphoid organ development, and enhanced activity of immune-related enzymes. Additionally, herbal nutrition contributed to improved gut health and microbial balance, which further supports immune function. The antioxidant and anti-inflammatory properties of these phytogenic compounds help reduce oxidative stress and improve disease resistance.

Keywords: Supplements, Diet, Immune response, Poultry

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Introduction

Antibiotics have so far been the most cost-effective way to maintain feed efficiency and health status in monogastrics like poultry [1]. The renewed and deliberate interest in the use of herbs and different plant products is an interesting development in modern poultry production. This is in alignment with the clean production practice in millennial farming [2]. This intensified effort in search for alternatives to synthetic drugs came about as a result of negative effect of synthetic on poultry and consumers health and the rising cost of the use of drugs in poultry production. Several herbs such as black cumin seed, moringa, pawpaw seed, green tea, lavender, garlic, neem, essential oil etc. have been used in poultry such as quail, broiler, turkey, and pullets as alternative to antibiotics and growth promoter. These herbs are used not only as alternative to antibiotics and growth promoter's but also as antiviral, anticocidiosis, ant parasite, and immunomodulatory agents. It can also reveal beneficial, toxic or lethal effect depending on the quantity of usage [3].

Green tea (*Camellia sinensis* L.)

Phytoconstituents

Leaves of green tea (Family – Theaceae) have been used for beverages in China, Japan, and some other countries for thousands of years, even more in the form of black tea than as green tea. This plant contains polyphenol components such as epiphanolatega-late, tannin, caffeine, theophylline, and the bromine [4].

Beneficial and adverse effects in poultry nutrition

In the poultry industry, it is important to pay attention on the growth performances and immune system. This can be achieved via nutritional manipulation by supplementing green tea as feed additives [5]. The effects of a diet that included fish oil [1.5 and 2%weight by weight (w/w)] and green tea powder 1 and1.5% (w/w) as supplements on the immunity of broiler chickens were demonstrated.

Hemorrhagic responses to Flu and Newcastle disease were improved. In another study, the addition of fish pow-der (1–2% w/w) and green tea (1 and 1.5% w/w) a supplements in the diet of broiler chickens improved the carcass weight. Rate of passage of feed through the digestive tract was reduced by increasing digestion, absorption, and efficiency of diet utilization. In addition, researchers determined the effect of diets containing fish oil (1.5 and 2% w/w) and green tea powder (1 and 1.5% w/w) as supplements on gizzard, Ileal, and cecal microflora in broiler chickens.

These diets did not have a significant effect on cecal micro-flora, especially at low levels; but if the combination was used for 42 days, it effectively inhibited the growth of pathogens by increasing non-intestinal bacteria, which improved performance and reduced mortality. Furthermore, researchers examined the effects of dietary supplementation of different levels of green tea powder (1 and 1.5% w/w) and fish oil (1.5 and 2%w/w) on carcass characteristics in broiler chickens. The combination resulted in lower abdominal fat in the carcass, as well as weight loss, because it led to a higher oxidation rate of lipid in the body [6].

Hematological and serum biochemistry parameters are very important measurements when using herbsin livestock. This is meant to access the internal health of livestock in a noninvasive manner. Study revealed the effects of green tea powder (1.5% w/w) on blood parameters, egg quality, carcass quality, and growth performances in Japanese quail fed with or without added cholesterol [7].

Results showed that the addition of green tea powder into the diet of Japanese quail did not reduce blood lipid and cholesterol levels, but led to increase the body weight gain. The effects of dietary supplements including microencapsulated Enterococcus faecalis (1 g/kg of diet) and tea extract (300 and 500 mg/kg of diet) on growth performance, immune system, and biochemical parameters of broiler chickens were investigated [8].

In another study, the supplementation of GTP (1%w/w) reduced the body weight gain of broiler during their early age (days 0–21) but increased the bodyweight gain during the late stage (days 21– 42) of production. The feed conversion ratio was UN altered upon addition of GTP. The leg muscle was proportionally high and abdominal fat was proportionally low in the supplemented group. The lightness value, the shear force, and the calcium content of the supplemented group were reduced in the breast meat. Dietary supplementation of GTP induced Lactobacillus proliferation, inhibited Escherichia coli proliferation in the ileum and cecum. Thus, study suggested that GTP could be used as ideal feed additive for improving meat color and Lactobacillus proliferation for broiler production [9].

Lavender (*Lavandula stoechas* L.)

Phytoconstituents:

Lavender (Family – Lamiaceae) is a perennial plant, revealing bitter taste and a pleasant smell. The essence of this plant contains some compounds such as acetate lanalil, butyric acid, propionic acid, valeric acid, free linalool, and grambol [10].

Beneficial and adverse effects in poultry nutrition

Researchers reported the effects of lavender extract (24 and 48 mg/kg of feed) on growth performance, carcass quality, and antioxidant status of broiler chickens [11]. A total of 405 day-old chicks (Ross-308) were allocated to the three dietary treatments, each with three replicate pens with 45 birds per pen. After the first 21-dayfeeding period, the body weight of chicks fed 24 mg of lavender extract/kg of feed was higher ($p < 0.01$) than 48 mg of lavender extract/kg of feed treatment, but only slightly higher than that of the untreated group. Diets with 24 and 48 mg of lavender extract tended to increase final body weight of birds at 39 days old. No differences were observed for feed intake, feed conversion ratio, and mortality among treatments. Percentage of spleen weight of birds fed 24 mg of lavender extract/kg of feed was lower ($p < 0.05$) than for those who received 48 mg of lavender extract/kg offered. However, it was similar to that of the control group. Birds fed diets supplemented with 24 and48 mg lavender extract/kg of feed had breast meat with higher brightness and higher concentration of superoxide dismutase compared with birds that did not receive lavender extract. Authors concluded that the extract of this plant could be used as a growth promoter in broiler chickens and prevented liver damage due to its antioxidant activity [12].

Flax (*Linum usitatissimum* L.)

Phytoconstituents:

Flax (Family – Linaceae) is unique among the vegetable oil seeds as its essence contains large amounts of oil, with a high percentage of a-linoleic acid. Traditionally, ground flax is used to produce oil for industrial use and as a protein supplement in the feeding of birds. In birds, the characteristics

of meat and fat are directly affected by the source of dietary fat. Omega-3 fatty acids are known to increase in egg and meat of poultry fed with flax supplementation [13].

Beneficial and adverse effects in poultry nutrition

The growth performance (live weight, feed intake, feed conversion ratio, and energy efficiency ratio) carcass characteristics, and meat quality of broilers fed diets with flaxseed (5–15 g/kg of feed) were demonstrated. Among the treatments, birds of 5 and 10 g of flaxseed/kg of feed meal groups had significantly ($p < 0.05$) better feed conversion ratio, protein efficiency ratio, and energy efficiency ratio compared to those of the 15 g of flaxseed/kg of feed meal group. The carcass characteristics data indicated a significant ($p < 0.05$) reduction in the eviscerated weight and breast yield at 15 g of flaxseed/kg of feed meal in the diet as compared to other dietary groups. The alpha-linolenic acid content in both breast and thigh meat was higher with an increasing level of flax-seed meal in the diets without affecting the sensory acceptability of meat. Findings suggested that up to10 g of flaxseed/kg of feed meal may be used in broiler diet to enhance the alpha-linoleic acid content in the broiler meat [14]. In another study, researchers demonstrated the effects of flaxseeds (4 and 7 g/kg of feed) as dietary supplementation on performance (egg weight, egg laying performance, feed intake, and feed utilization) and reproduction (fertilization rate and hatchability rate) of quails Results showed the best performance and the highest fertility of eggs in quails that received 4 g of flaxseeds/kg of diet. On the other hand, the highest rate of hatching was obtained when the diet was supplemented with 7 g of flaxseeds/kg of feed

The effect of diets containing various levels (12 and14 g/kg of diet) of flaxseed on carcass characteristics and fatty acid deposition was investigated in broiler chickens. Flaxseed resulted in increased levels of omega-3 fatty acids in broiler breast and thigh meat.

Alfalfa (*Medicago sativa* L.)

Phytoconstituents

Alfalfa (Family – Fabaceae) is an important ingredient used to feed a variety of animals. It is known as the king of medicinal herbs due to the presence of variety of vitamins, minerals, and proteins. It is an important source of various minerals and vitamins, flavonoids, phenolic acid, xanthophylls, zanotophils, carotenoids, and other nutrients [14].

Beneficial and adverse effects in poultry nutrition

Study investigated the nutritional effects of low-fiber alfalfa (15%w/w of diet) on production characteristics and egg quality in laying hens. There was a positive effect on production characteristics, yolk color, and yolk percentage. Results suggested that the supplementation of low-fiber alfalfa meal in the laying-hens diet can positively influence yolk quality without adversely affecting productive traits (Laudadio et al., 2014). The effect of polysavone, a natural extract from alfalfa on deposition of abdominal fat and immunity of broiler chickens was determined (Dong et al., 2007). Polysavone had no significant ($p > 0.05$) effect on feed intake, bodyweight, or feed: gain ratio in the experimental period, and it decreased the abdominal fat weights at 5 and 6 wk of age. Polysavone improved ($p < 0.05$) the relative thymus and spleen weights at 6 wk of age and the bursa weights at 4 and 5 wk of age compared with the control group. At 4 and 6 wk of age, the proliferation of T and B lymphocytes in the polysavone group was significantly greater ($p < 0.05$) than that of the control group. When birds were of 4 and 5 wk of age, polysavone resulted in a significant increase ($p < 0.05$) in serum anti-Newcastle disease virus hem agglutination inhibition antibody titer. These results showed that polysavone may decrease abdominal fat deposition and enhance immunity without an adverse effect on the performance of broiler chickens. The use of alfalfa ethanol extract (0.1 and 0.15 g/kg of feed) as potent replacement of antibiotics in poultry was studied and determined its effect on the body weight gain and liver enzymes in broiler chickens [15].

Conclusion:

Green tea, flaxseed, lavender, and yarrow are capable of improving poultry production. On the other hand, nettle, lavender, ginger, flax seed, and alfalfa have the potentiality to improve the animal product quality which are beneficial to producer as well as consumers. Considering the prior findings, these medicinal plants can certainly be considered for utilization in poultry nutrition as direct feed supplements in the form of powder, extracts, and seeds.

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