Effects of Garlic extract nutrition on the Performance and Immunity of Broilers

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Abstract: In new poultry production prebiotics medication are widely used due to their positive impact on poultry performance, one of this prebiotics that found to have many beneficial effects is Garlic extract. Garlic by products has outstanding beneficial effects among all medicinal plant, as it show antibacterial, antiviral, antifungal and antiprotozoal properties. Moreover, it boosts the immune system, improves the body weight gain, heighten the digestibility of ingredients, decrease the bad cholesterol, and also augment the meat quality parameters. The present review was carried out to evaluate the effect of supplementation of garlic, ginger and their combination in the diets of broiler chickens and assessment in terms of feed intake, growth performance and economics of feeding. Garlic (Allium sativum) is well known for its antimicrobial activity and the poultry farmers in Namakkal (Tamilnadu) use it in feed to combat infections. However there are limited reports on the efficacy of garlic against poultry pathogens.
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Introduction

Poultry nutrition found to present about 80% of total cost of production [1]. Feed additives are a group of nutrient and non-nutrient compounds which helps in improving the efficiency of feed utilization and thus reducing the high cost of feed. In the past, antibiotics were the most routinely used feed additives. However, nowadays use of antibiotics is not only limited but their use in livestock and poultry industry also have been banned in many countries due to the reasons like alteration of natural gut microbiota together with rise of drug resistance in bacteria that results I hazard human health. As a result, to replace them without adversely affecting the performance of birds, natural growth promoters such as prebiotics, probiotics, synbiotics, enzymes, plant extracts, etc., are used nowadays in poultry nutrition [2].

Garlic, a member of the Allium family (Liliaceae), has been used traditionally for ages to treat a wide array of diseases, namely, respiratory infections, ulcers, diarrhoea and skin infections [2] reported garlic as a plant with antibiotic, anticancer, antioxidant, immunomodulatory, anti-inflammatory, hypoglycaemic and cardiovascular- protecting effect. Garlic extract and/or garlic components were able to prevent chemically induced tumours or acute toxic effects of chemicals. The chemo-preventive potential of garlic has been attributed to the presence of several bioactive organosulfur compounds. These compounds might act as antioxidants [2]. The antioxidative stress properties of garlic might result from the contributions of its sulfur component in different steps and not necessarily from the contribution of only one of them [4]. Garlic also has been shown to have strong antimicrobial action [5], moreover Allicin and its derivatives have been shown to be a larvicidal and bacteriostatic, active against both Gram positive or Gram negative organisms as well as fungi such as *Candida albicans* and viruses including influenza viruses [5].

Recently it was found that garlic extracts contains wide range of useful active ingredients that when extracted in right way will results in many useful properties include improving immune response together with reduced-expanding range of pathogenic micro-organisms in the digestive tract, which resulted in the rapid growth of poultry, efficient digestion, increased immunity and health of poultry (6), This will help in limitations of antibiotic uses as it was found that use of antibiotics as growth promoters faces serious objections. There is justified concern about the adverse consequences that may result in their application, including the development of resistant microbes and their potential adverse effects on human health [7].

Review

The poultry gastrointestinal tract

The gastrointestinal tract of chickens is complex due to the bird's large energy requirements [4]. The chicken GIT includes the crop, gizzard, duodenum, ileum, and cecum, which are microbiologically abundant with over 900 documented bacterial species [5]. Included in the upper segment of the GIT, is the crop, which is used for fermentation, hydrolysis of starch to sugar, food storage, and as an acid barrier

with a pH of ~4.5. The gizzard grinds food particles in a highly acidic environment (pH 2.6) [8]. While the mean retention time throughout the GIT is ~6 h, feed can remain in the crop and gizzard for as little as 8 and 50 min, respectively [9]. The crop contains numerous anaerobic bacteria attached to the epithelium, including *Lactobacillus*, and they produce SCFA's and lactic acid [10]. The continuous layer of *Lactobacillus*, enterococci, coliforms, and yeast promote digestion of most carbohydrates, with the remainder digested in the ceca after passage through the lower GIT [9].

Prebiotic studies have focused largely on oligosaccharides such as manna oligosaccharides (MOS), galactooligosaccharides (GOS), fructooligosaccharides (FOS) including inulin and garlic extract [11]. Oligosaccharides are polymer chains with 3 to 10 of simple sugars Oligosaccharides and fiber have been combined and amended with feed products to create commercially viable sources of prebiotics in the poultry industry with a range of positive impacts on poultry performance, while supplementation of garlic extract improves the performance of broilers when added at the rate of 1% of broiler ration and can be a viable alternative to antibiotic growth promoter in the feeding of broiler chicken.

Main Organosulfur Compounds Purified from Garlic Preparations

Garlic compounds can be divided in several groups or families of compounds. Among these families, we find γ-glutamyl cysteine derivatives, the primary precursor components of the alliin and allyl methyl cysteine (methiin) compound families [6], that produce, by enzymatic action of alliinase (alliinlyase, EC: 4.4.1.4), the diallylthiosulfinate (Allicin) and allyl methyl thiosulfinate (AM) compound families [12], which are precursors of several organosulfur compound families (i.e., the ajoene and dithiin families) [17]. Additionally, garlic preparations contain nonorgansulfured compounds, such as tetrahydro-beta-carbolines [13], fructans, and glucose-linked β-D-fructofuranosyl [21], identified in AGE preparations [15].

Immunomodulation and Anti-Inflammatory Effects of Garlic Compounds

The wide variety of effects that has been reported of garlic preparations and extracts with beneficial and useful properties may be due to their numerous compounds (organosulfur and others) contained in different concentrations, which is being a challenge to separate and identify compounds with potential beneficial properties on the human immune and cardiovascular systems [7]. A comprehensive classification of the different compound derived from garlic, as well as their biological effects reported, is actually in preparation and will be published elsewhere. The presence and potency of garlic compounds vary with respect to mode of garlic preparation and extraction. Additionally, the proportion of these compounds is poorly controlled with the methods used to generate different garlic preparations, the main problem being reproducibility and validation of the real effects observed [14].

Moreover it was found that Fructooligosaccharides (FOS) are fructans that are naturally present in garlic. Chandrashekar et al. isolated fructans present in AGE: high molecular weight (>3.5 kDa; HF) and low molecular weight (<3 kDa; LF), which were assessed in an immunostimulatory mouse model. Both HF and LF displayed mitogenic activity and activation of macrophages including phagocytosis. These activities were comparable with those of known polysaccharide immunomodulators, such as zymosan and mannan [18]. Additionally, similar results have been obtained with immunoproteins QR-1, QR-2, and QR-3, present in garlic and identified as lectins or agglutinins [9] were previously described as ASA II and ASA I [19], and their mitogenic and comitogenic properties were confirmed as comparable with potent mitogeniclectins ConA and PHA. On the other hand, it is well known that fructans selectively stimulate some beneficial bacteria in colon, modulating different immune responses [21].

Recently the effects of alliin in lipopolysaccharide- (LPS-) stimulated 3T3-L1 adipocytes was examined by [22]. Incubation of cells for 24 h with 100 μmol/L alliin prior to LPS (100 ng/mL) stimulation for 1 h prevented an increase in the expression of proinflammatory genes IL-6, MCP-1, and Egr-1 and in the protein levels of IL-6 and MCP-1. Interestingly, the phosphorylation of ERK1/2, which is involved in LPS-induced inflammation in adipocytes, decreased following alliin treatment. Furthermore, gene expression profile by microarray evidences an upregulation of genes involved in immune response and downregulation of genes related with cancer. Indeed SAC, caffeic acid (CA), uracil, diallyltrisulfide (DATS, as known as Allitridin), diallylsulfide (DAS), and other garlicderived compounds can inhibit transcription factor NF-κB, a master regulator, inhibiting the transcription of several cytokine genes involved in proinflammatory responses, such as TNF-α, interleukin-1beta (IL-1β), IL-6, MCP-1, and IL12(p70) [23].

Role of Garlic Compounds in Inflammatory Disorders

Numerous research works have shown the immunomodulatory and immunotherapeutic potentials of AGE as a whole, including free radical-mediated anti-inflammatory, anticancer, and antiangiogenic effects, as well as improving hyperglycemia and

dyslipidemia, cardiovascular diseases, infectious diseases, autoimmune diseases, and allergy, which have been shown in both animal models and cell lines [23 and 24]. It is known that the aqueous garlic extract exerts antioxidant action by scavenging reactive oxygen species (ROS) and enhancing cellular antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidase. In addition, garlic represents an important source of antioxidants due to phytochemicals such as DAS and SAMC [25].

Conclusion

It can be concluded that garlic added into diets for broiler chickens had limited positive effect on broiler production parameters. In regard to most of the parameters, the effect of 1.5% of garlic added into diet was greater than the dose of 3%, which confirmed the conclusions of several authors that it is not necessary to add larger amounts of additives than 3% since the opposite effect can occur primarily through the depression and other negative effects. Garlic exhibited positive effect on carcass yield "ready to roast" and "ready to grill" and share of white meat in carcasses, which was confirmed through statistical significance ($P < 0.05$). The reduction of abdominal fat in carcass of broiler chickens fed garlic in their diets is evident and statistically significant, which is consistent with researches of other authors. The negative effect of garlic was exhibited as increase of liver and heart mass, but this did not results in increase of mortality in chickens which was at the minimum level in all groups of chickens.

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