

Response Garlic Supplementation on Commercial Broiler Performance-A Review

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Abstract

Herbs are plant based products used in various traditional medicines since the time immemorial. Plants and plant derived products being natural, non-toxic, residue free and their easy availability make them first choice as alternate to antibiotic growth promoters. They have multiple effects on animal including appetite stimulator, enhance digestive secretion, immuno-stimulant, bactericidal, antiviral, antioxidants and are termed as phytochemicals. Among the herbs, garlic (*Allium sativum*) has been called the wonder drug of the herbal world due to its multi functional benefits. Garlic possesses at least 33 sulphur containing compounds, several enzymes, amino acid and minerals. Studies have shown that garlic possess antibacterial, antifungal, antiparasitic, antiviral and antioxidant properties. Garlic powder supplementation in basal diet of broiler chicken significantly increased the body weight gain and feed conversion ratio. It may have the potential to be an alternative to antibiotic growth promoter for broiler chicken.

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1. Introduction

Use of antibiotic growth promoters (AGPs) have been widely prevalent in the poultry industry owing to various well quoted benefits. However, their consistent use at sub-therapeutic level can result in the development of drug resistant bacteria (Alexander *et al.*, 2008), which poses a serious threat to life of human being. Realising the sensitivity of the issue, countries like European Union had banned the use of antibiotic as AGPs in animal production. Herbs are other plant based products are used in various traditional medicines since the time immemorial. Plants and plant derived products being natural, non toxic, residue free and their easy availability make them first choice as alternate to AGPs. They have multiple effects on animal including appetite stimulator, enhance digestive secretion, immuno-stimulant, bactericidal, antiviral, antioxidants and are termed as phytochemicals (Hashemi and Davoodi, 2011)

Garlic (*Allium sativum*) has been called the wonder drug of the herbal world due to its multi functional benefits. Garlic possesses at least 33 sulphur containing compounds, several enzymes, amino acid and minerals (Newall *et al.*, 1996). The major active ingredients in garlic are allicin, ajoene, dialkyl polysulphides, s-allylcysteine etc which may be responsible for the various properties of garlic

(Canogullari *et al.*, 2010). In vitro studies have shown that garlic possess antibacterial, antifungal, antiparasitic, antiviral (Ankri and Mirelman, 1999) and antioxidant (Prasad *et al.*, 2009) properties. Suriya *et al.* (2012) suggested that inclusion of 0.5% garlic may have the potential to be an alternative to antibiotic growth promoter for broiler chicken.

2. Effect of Garlic on Growth Performance

Supplementation of raw and boiled garlic powder at 500 and 5000 mg/kg diet did not significantly ($P>0.05$) influence the final live weight, feed intake, weight gain and FCR of the broiler chickens (Onibi *et al.*, 2009). Similarly Issa and Omar (2012) did not found any significant effects of 0.2 and 0.4% garlic powder supplementation on weight gain, feed intake and FCR. Ashayerizadeh *et al.* (2009) conducted a experiment for studying the comparative effect of garlic powder, black cumin seeds powder and wild mint powder at 1 kg/tonn on performance of broilers and reported the non significant ($P>0.05$) effect on feed consumption and comparable ($P<0.05$) body weight gain and FCR in garlic supplemented group as compared to control.

Raeesi *et al.* (2010) supplemented the garlic powder at 0.5, 1 and 3 % during starter phase only, finisher phase only and for the whole experiment

period of 6 weeks duration and revealed the non-significant effect of garlic supplementation during starter phase on the weight gain and FCR as compared to control. However comparable ($P < 0.05$) weight gain was observed during finisher and whole period supplementation, but inclusion of garlic powder at 1 and 3% improved the FCR during finisher and whole period as compared to control. Garlic powder supplementation in basal diet at 250 ppm (Kumar *et al.*, 2010) 1 g/kg (Mansoub, 2011) and 0.5% (Suriya *et al.*, 2012) significantly increased the body weight gain and FCR of broilers chickens.

Saeid *et al.* (2013) investigated the effect of garlic powder, black seed and combination of both at 0.5% level and observed the significant ($P < 0.05$) improvement in final weight and weight gain in all the supplemented treatments as compared to control with a marginal improvement in FCR. Recently, Elagib *et al.* (2013) while investigating the effects of incorporating garlic powder at 3 and 5 % on growth performance revealed that 3% inclusion level of garlic significantly ($P < 0.05$) increased feed intake, body weight gain, final body weight and FCR.

Ramakrishna *et al.* (2003) revealed that the positive influence of garlic supplementation might be due to enhancement of pancreatic enzymes activity which provides an environment for better absorption of nutrients. Khan *et al.* (2008) suggested that the difference in results determined by different authors may be due to the use of different products of garlic. Mansoub and Mohammad (2011) also found the higher body weight and best FCR in 1 gm/kg garlic supplemented group over the control.

Recently Singh *et al.* (2015) evaluated the effect the whole bulb garlic powder at 1.0, 1.5 and 2.0 percent as phyto-genic growth promoters on commercial broiler performance and revealed that inclusion of GP at 1.5% level during both starter and finisher stage improved the body weight which is comparable with antibiotic fed group but feed conversion ratio was better at 1.5% garlic supplementation during overall growth period. Phyto-genic's antibacterial, antioxidant, anti-stress, gut microflora manipulation, immune enhancement and digestive enzymes stimulation were the major mechanism behind the positive effects exerted by them on the growth and health performance of animals (Durrani *et al.*, 2007; Hashemi and Davoodi, 2011).

3. Effect of Garlic on Haematological Parameter

Increase in total white blood cells and heterophils and slight decrease in haemoglobin concentration in garlic treated birds as compare to control (Ademola *et al.*, 2009). Parsad *et al.* (2009) studied the effect of 1.5 and 3.0% garlic on the

haematological parameters in chicken and revealed the insignificant lower value of haemoglobin and total erythrocyte count and slight rise in lymphocyte and heterophils count in garlic treated groups. However, Onyimonyi *et al.* (2012) reported the non significant ($P < 0.05$) effect of 0.25, 0.50 and 0.75% garlic powder supplementation on haematological and serum chemistry of the birds.

Elagib *et al.* (2013) reported the non significant ($P > 0.05$) effect of 3 and 5% garlic powder inclusion on the PCV, RBC's and TWBCs including neutrophil, eosinophil, monocytes and lymphocytes, however significant ($P < 0.05$) lower haemoglobin level was observed in garlic supplemented groups as compared to control. These effects may be due to the presence of some haemolytic bioactive constituents and/or their metabolites in garlic (Ademola *et al.*, 2009).

4. Garlic's anti-Cholesteremic Effect

Supplementation of oven dried garlic powder at 2, 6 and 8% level reduced the serum cholesterol concentration on average over 6 week by 19.52, 33.72 and 46.74% respectively as compared with control diet (Khan *et al.*, 2007). Rahimi *et al.* (2011) reported the reduction in total cholesterol, triglyceride and LDL cholesterol but increased HDL level with the supplementation of 0.1% garlic powder in broiler diet. Issa and Omar (2012) reported that supplementation of garlic powder at the rate of 0.2 and 0.4% significantly reduced the cholesterol, triglycerides, low density lipoprotein and increased the high density lipoprotein level in Cobb broiler blood as compared to control birds.

The possible mechanism of hypocholesterolaemic and hypolipidemic action of garlic products is through depressing the lipogenic and cholesterogenic activities of liver enzymes such as malic enzyme, fatty acid synthase, Glucose-6-phosphatase dehydrogenase and 3-hydroxy-3-methylglutaryl-CoA reductase (Qureshi *et al.*, 1983; Mahmoud *et al.*, 2010). Onyimonyi *et al.* (2012) result showed that supplementation of 0.75% garlic in broiler diet for eight week significantly ($P < 0.05$) lowered the cholesterol level as compared to 0, 0.25 and 0.50% garlic supplemented treatments.

5. Effect of Garlic on Carcass Parameters

Supplementation of garlic powder at 0.1% (Sarica *et al.*, 2005), 0.2 and 0.4% (Issa and Omar, 2012) did not have significant ($P < 0.05$) effect of on the carcass and organs characteristics. Similarly, Onibi *et al.* (2009) reported the non significant effect of 500 and 5000 mg/kg diet of raw and boiled garlic powder on the carcass and organ characteristics. Ashayerizadeh *et al.* (2009) revealed that inclusion of garlic at the rate of 1

kg/ton in Ross 308 broiler results in significantly higher carcass percentage as compare to control. Similarly they observed the lowest abdominal fat in garlic treatment group.

Elagib *et al.* (2013) observed the non significant ($P < 0.05$) effect of 3 and 5% garlic supplementation on dressing percentage, however birds fed on diet containing 3% garlic powder level attained the highest dressed weight and lowest was found in 5% garlic included group. Singh *et al.* (2015) observed no effect of whole bulb garlic powder supplementation at 1.0, 1.5 and 2.0% level on the carcass characteristic except the heart weight, which was highest in 1% GP inclusion group. However, Raeesi *et al.* (2010) reported the significant ($P < 0.001$) higher carcass and breast yield lower abdominal fat, decreased heart, pancreas, gizzard, bursa and spleen weight in 0.5, 1 and 3% garlic supplemented groups as compared to control. They further revealed that supplementation of garlic powder in finisher diet resulted in higher ($P < 0.001$) carcass yield. Bone (1979) suggested that abnormalities in the weight of the internal organs like liver, kidney, gizzard etc arise because of increased metabolic rate of the organs in attempt to reduce the toxic elements or anti-nutritional factors to non toxic metabolites.

6. Effect of Garlic's on Gut Health

Xu *et al.* (2003) revealed that higher the length of villus, more will be the surface area and consequently, absorption of nutrients. Deeper crypt indicate fast tissue turnover to permit renewal of the villus as needed in response to normal sloughing or inflammation from pathogens or their toxins (Yason *et al.*, 1987). Reduced villus height/crypt depth ratio can also indicate presence of toxin, reduced absorption of nutrients, increased secretion in gastrointestinal tract, diarrhoea, reduced disease resistance and lower overall performance.

Adibmoradi *et al.* (2006) studied the effect of dietary garlic meal at 0.125, 0.25, 0.5, 1.0 and 2.0% levels on histological structure of small intestine in broiler chickens. Results revealed that villus height increases linearly in duodenum, jejunum and ileum as the incorporation level of garlic increases from 0.125 to 2.0%. However garlic supplementation at higher doses 0.5 to 2.0% increases ($P < 0.05$) the crypt depth, which resulted in lower crypt to villi ratio in duodenum and higher in jejunum and ileum.

Oladele *et al.* (2012) studied the effect of garlic meal (70 % garlic powder + 30 % wheat offals as carrier) at 0.125, 0.25 and 0.5% level on the absorptive surface of the small intestine of broiler and reported the highest ($P < 0.05$) villus length, width and cryptal depth in 0.125% garlic meal supplemented group, resulting in increased absorptive area of the intestine and ultimately

higher body weight gain and lower FCR. Saeid *et al.* (2013) while studying the effect of garlic powder, black seed and premix of both herbs, each at 0.5% level, reported the improved intestinal morphological characteristics like villi length and small crypts in birds receiving 0.5% garlic powder containing diet as compare to control.

7. Effect of Garlic's on Sensory Quality of Meat

Onibi *et al.* (2009) studied the effect of 500 and 5000 mg/kg of raw and boiled garlic powder on the meat quality of shaver starbo broiler chicks and reported that palatability score increased ($P < 0.05$) with increasing level of dietary garlic supplementation. Toghiani *et al.* (2011) studied the effect of cinnamon and garlic at 2 and 4 g/kg level on sensory quality of thigh meat and revealed that supplementation of cinnamon and garlic at both level not induces or impart any flavour in meat while inclusion of 4 g/kg garlic in broiler diet improved ($P > 0.05$) meat sensory evaluation. Puvaca *et al.* (2013) reported the beneficial effect of phytoadditive compounds on meat quality and safety which may be due to presence of antimicrobial and antioxidants properties in these.

Singh *et al.* (2015) reported that supplementation of whole bulb garlic powder at 1.0, 1.5 and 2.0 % supplementation levels lead to significantly ($p < 0.05$) better appearance, colour flavour, tenderness, juiciness and overall acceptability then control and Antibiotic fed groups. Overall acceptability score of meat increases linearly as the inclusion level of garlic increased from 1.0 to 2.0%. Authors further revealed that inclusion of garlic did not impart any strong repulsive odour to chicken meat rather it improved the sensory parameters of meat and the overall acceptability. Improvement in sensory evaluation in this study are in agreement with Toghiani *et al.* (2011), who studied the effect of cinnamon and garlic at 2 and 4 g/kg level on sensory quality of thigh meat and revealed that supplementation of cinnamon and garlic at both level not induces or impart any flavour in meat while inclusion of 4 g/kg garlic in broiler diet improved ($P > 0.05$) meat sensory evaluation. Kim *et al.* (2009) also observed positive influence of garlic supplementation on culinary traits of poultry meat. The positive influence of garlic supplementation on meat can be correlated to the presence of volatile compounds, phenolic content and antioxidant active compounds (Canogullari *et al.*, 2010), in addition to S-containing enzymes, amino acids and minerals (Newall *et al.*, 1996).

8. Effect of Garlic's on Broiler Economics

Hossain *et al.* (2014) reported significantly higher profitability per broiler and benefit cost ratio in 1% garlic and 1 % cinnamon supplemented groups as compare to control group. Singh *et al.* (2015) reported significant ($p<0.05$) lowest feed cost/kg weight gain in 1.5% GP inclusion level followed by 1.0 and 2.0% supplementation level and the highest ($p<0.05$) feed cost/kg weight gain of rupees 50.09 was observed in control group. Inclusion of whole bulb garlic powder at all the three level studied improved the BCR. Best ($p<0.05$) BCR of 1.38 was observed in 1.5 % whole bulb garlic powder containing diet and the lowest ($p<0.05$) BCR was in control group. BCR in antibiotic fed group and 1.0% and 2% whole bulb garlic powder supplemented groups was statistically ($p<0.05$) comparable. Eevuri and Putturu (2013) reviewed the economics of herbal preparation supplementation and reported the positive influence of herbs on lowering the feed cost per unit live weight gain.

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9. Conclusion

Garlic (*Allium sativum*) has multi functional benefits due to possess of sulphur containing compounds, several enzymes, amino acid and minerals. Supplementation of garlic powder in basal diet of broiler chicken significantly increased the body weight gain and feed conversion ratio and may have the potential to be an alternative to antibiotic growth promoter for broiler chicken. Therefore, it can be concluded that garlic has the potential to replace the prevalent antibiotic growth promoters with an added advantages of making consumer oriented product. An attempt is made through this article to sum up the work done on garlic supplementation effect on broilers performance to make the industry and farmers aware about this.

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