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Review article

TURMERIC AS AN ANTIBIOTIC ALTERNATIVE IN COMMERCIAL BROILER DIETS

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Abstract: Antibiotic are called antimicrobial growth promoters used in poultry feed. It has been proven that supplementation of antibiotics in the diets reduces morbidity and mortality. Turmeric also improved the feed efficiency and overall growth performance in chickens. However the routine use of this antimicrobial growth promoteris being curtailed in view of threat to public health occurring through microbial resistance to antibiotics. Antibiotics are banned by the European Union during 2006 due to the consequences of antimicrobial resistance. As a need of these antibiotics in poultry industry, the industry is in the stage to find new alternative for the antibiotics. One comparable alternative is natural sources of herbs and medicinal plants known as phytobiotics. For last twenty years this alternative have been increasingly claimed to increase the gut health and stimulate digestive system and enhances the performance and health status. In this review responses of poultry diets supplemented with turmeric on growth performance, blood parameter and carcass character were briefly discussed.

Keywords: Broiler, Turmeric, Alternative, antibiotic, Poultry Production

INTRODUCTION

Antibiotics have been used as antimicrobial growth promoters in animal feeds worldwide for many years to improve food safety by increasing animal health and improving certain exogenous pathogens. In poultry industry, antibiotics are used as antimicrobial growth promoter to enhance production. In 2006, European Union banned use of antibiotics as feed additives because of its residual effects in animal tissues and subsequently leading to antimicrobial resistance in human beings (Griggs and Jacob, 2005). Alternatives available to replace antibiotics are called phytogenic feed additives which include prebiotics, probiotics, enzymes, organic acids and essential oils. Phytogenic feed additives are derived from plants that have antimicrobial properties. Their influence on fat metabolism leads to hypocholesterolaemic activities (Saravanan and Ignacimuthu, 2015), antioxidant activities (Menon and Sudheer, 2007) and ability to stimulate the digestion (Hernandez *et al*., 2004).

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Reactive oxygen metabolites (ROM) have been implicated in several degenerative diseases, and are controlled by antioxidants such as Catalase (CAT), Superoxide dismutase (SOD) and Glutathione peroxidase (GPx). The bioactive compounds present in spices are known to have antioxidative defence mechanism through the induction of antioxidant enzyme activities (Hsu and Liu, 2004). Phytogenic products have been used as food spices and traditional remedies for many centuries, but their application in feed industry is almost new. Phytogenic products have received more attention to be used as feed additives after the ban of antibiotics in animal feed industry. These alternatives have been increasingly claimed to increase enteric health, stimulate digestive system and enhance growth performance. Phytogenic feed additives are natural products originated from different parts of the plants, mostly in the form of powder or extracts are the major part in plant derived phytogenic product. Various alternatives of green additives have been studied in order to maximize the growth performance and quality of poultry in the diets without antibiotics. Turmeric is native of Western India and cultivated all over the world in which Indian contribution is 78% followed subsequently by China (8%), Myanmar (4%), Nigeria (3%), Bangladesh (3%) and other countries (4%). In India the production of turmeric during the year 2011-12 was 1246 million tonnes, mainly in states of Andhra Pradesh, Maharashtra, Orissa, Tamil Nadu, West Bengal, Karnataka and Kerala (Anantkawlas, 2014). Researchers found that supplementation of turmeric powder and its extract has beneficial effects on the performance of birds and animals.Turmeric (Curcuma longa Linn. or C. domestica Val.) is a rhizomatous herbaceous perennial herb ofginger family that is widely used and cultivated in the tropical and sub-tropical regions of the world, such as in Pakistan, China, Indonesia, India, Malaysia, Jamaica, and Peru (Govindarajan and Stahl, 1980). Linnaeus described turmeric as Curcuma longa and its taxonomic position is as follows:

Class	:	Liliopsida
Subclass	:	Commelinids
Order	:	Zingiberales
Family	:	Zingiberaceae
Genus	:	Curcuma
Species	:	Curcuma longa

(Chattopadhyay *et al*. 2004)

Curcuma longa is the domesticated species of turmeric, while the wild one is called C. aromatic. It belongs to the family Zingiberaceae that consists of hundreds species of plants, along with other noteworthy members like curcuma, ginger, white turmeric, black-turmeric, wild-turmeric, mango-ginger, cardamom, siam-tulip (hidden-ginger), zedoary, and galangal. This medicinal plant possesses rhizomes and underground root-like stems (Araujo and Leon, 2001) that had been originally used as a food additive in curries to improve the storage condition, appearance, flavour, palatability, and preservation of food (Jayaprakasha *et al*. 2001).

EFFECT OF TURMERIC ON GROWTH PERFORMANCE OF BROILERS

Sethy *et al*. (2016) reported that addition of *Curcuma longa* powder at 0.5% and 1% caused significant ($P<0.05$) increased in body weight gain. On the other study, Rajput *et al*. (2013) showed that supplementation on 0.2o g/kg pure curcumin - phytochemicals derived from turmeric increased the body weight gain and reduced the FCR of broiler chickens. Al-Sultan. 2003 and Kumari *et al*. 2007 found that the inclusion of 0.5 or 1% turmeric powder significantly increased body weight gain and feed conversion ratio compared to control ($p<0.05$). Similarly, Al-Jaleel (2012) reported that a lower level of turmeric powder at the level of 0.5g/ kg significantly increased the body weight gain and FCR compared with control. Akbarian *et al*. (2012) reported that addition of turmeric rhizome powder at 0 and 0.5g/ kg in broiler did not affect the body weight gain. Similarly, Namagirilakshmi (2010) and Emadi and Kermanshahi (2006) who found that broiler chickens fed turmeric 2.5, 5.0, 7.5 and 10g/kg did not significantly gain weight compare to control. Nouarian *et al*. (2011) reported that supplementation of turmeric powder at different level had no significant effect on daily feed intake and body weight gain of chickens at different periods. Gowda *et al*. (2009) reported that feeding broiler chickens with diets containing 74 ppm curcuminoids from turmeric meal ameliorated the growth-depression effect of aflatoxin B1. Wang *et al*. (2015) reported that supplementation of Turmeric Rhizome powder had no significant effect ($P>0.05$) on the body weight of birds between 0-8 weeks of age and after that the week of 9 to 12, the average daily gain (ADG) was significantly ($P<0.05$) improved in the T100 and T200 groups, as compared to control. Al-Kassie *et al*. (2011) reported that supplementation of turmeric and cumin mixture in the diets at the rate of 5.0 g/kg resulted in a greater body weight gain and lower feed conversion ratio in 42-d old Arbor Acres broiler chickens. Durrani *et al*. (2006) found that broilers fed Turmeric at the level of 0.5% exhibited significantly improved weight gain and FCR, while feed intake decreased significantly in this

group compared to control. Hady *et al*. (2016) showed a significant (P<0.05) positive effect of the coriander and turmeric phytogenic feed additives on body weight development established by the end of the starting period (21d) up to the finishing period as compared to control except for the mix- group which sustained the lowest body weight throughout the experimental period. Naderi *et al*. (2014). Dietary inclusion of turmeric powder, cinnamon powder, or avilamycin at the level used in this experiment had no significant effect on body weight gain during grower (22 to 42 d) or entire (0 to 42 d) periods of the experiment. Fallah and Mirzaei (2016) reported that diet supplementation with different levels of turmeric and thyme powders increased chicks body weight in comparison to control chicks at 42 days of age (P>0.05). Arslan *et al*. (2017) reported that turmeric supplementation at higher dose (1.0 and 1.5%) improved body weight gains and showed best FCR results. Mehala and Moorthy (2008a) revealed that there was no significant difference in body weight and body weight gain between *Curcuma longa* group and *Aloe vera* fed group first week to end of the experiment period except at first week (P < 0.01). Barad *et al*. 2016 found that highest total body weight of experimental birds was observed in Coriander seeds supplemented group followed by Black Pepper, Turmeric Powder and control group. Chaudhary et al. 2015 showed that supplementation of herbal mixture (*Curcuma longa*, *Emblicaofficinalis* and *Nigella sativa* powder) at 1% level in broilers diet resulted in better weight gain, feed conversion ratio. Montal *et al*. 2015 showed that supplementation of turmeric powder at a level of 0.5% had significant influence on body weight gain. Yaghobfar *et al*. (2011) stated that there was no significant effect of feeding turmeric powder on FCR at the level of 0.4 and 0.8%. Doley *et al*. (2009) found that supplement of garlic and turmeric powder at 0.25% on the broilers live weight gain and feed intakes were not influenced significantly. Hosseini-Vashan *et al*. (2012) reported that turmeric rhizome powder did not affect feed intake, body weight, feed conversion ratio (FCR), production index, and protein and energy efficiency ratio of broilers.

EFFECT OF TURMERIC ON SERUM PARAMETERS OF BROILERS

Sethy *et al*. (2016) reported that *Curcuma longa s*upplementation of 0.5% and 1.0% turmeric powder improved Haemoglobin concentration without affecting other blood biochemical parameters of broiler chickens. Qasem *et al*. (2016) concluded that dietary turmeric powder had positive effects on the blood biochemistry parameters of broiler chickens, but that antioxidant activity was not improved. Akbarian *et al*. (2012) showed that addition of 0.5 g Turmeric rhizome powder in diet significantly decreased alanine

aminotransferase (ALT) activity, but did not affect AST LDH, triglycerides, LDL and HDL cholesterol in serum. Emadi *et al*. (2007) reported that 2.5 g/kg turmeric meal supplementation in the diet increased the total cholesterol and HDL-cholesterol, while 5.0 g/kg supplementation increased haemoglobin and reduced LDL-cholesterol, very low-density lipoproteincholesterol (VLDL-cholesterol), and red blood cells of male Ross broiler chickens at 42 days of age. Mehala and Moorthy (2008b) reported that serum glucose, total cholesterol, HDL, LDL, triglycerides level did not differ significantly between treatment groups. Faghani *et al*. (2014) reported that the triglyceride and cholesterol (HDL) level decreased significantly in turmeric extract treated group whereas HDL levels increased when compared to control. Hosseini-Vashan *et al*. (2012) reported that turmeric rhizome powder decreased blood cholesterol and LDL cholesterol and increased HDL cholesterol when turmeric rhizome powder fed before and after heat stress birds. Al-Sultan (2003) reported a significant improvement in both erythrocyte and leukocyte when the diets of broiler chicken was supplemented with 10.0 g/kg turmeric meal, while Sugiharto *et al*. (2011) reported a significant increase in erythrocyte following 600 mg/kg live body weight turmeric meal supplementation in the drinking water of broiler chickens. Other study using (Ross x Ross) male broiler chickens (Gowda *et al*., 2009) showed that dietary inclusion of 222 mg/kg curcuminoids from turmeric ameliorated the adverse effects of aflatoxin B1 on serum chemistry in terms of total protein, albumin and glutamyl transferase activity. In that study, the depression in antioxidant functions caused by aflatoxin B1 was also mitigated by 222 mg/kg curcuminoids inclusion in the diets. Hussein (2013) reported that turmeric powder (7g TP / kg diet) have a positive effect on broiler's performance and lowering effect on blood serum cholesterol, triglycerides, compared with the control group or other dietary treatments. In other studies using broiler chickens, dietary supplementation of turmeric meal reduced ALT (Akbarian *et al*., 2012) and alkaline phosphatase (ALP) activities in the blood serum (Emadi *et al*., 2007), which can be indication of better function of liver. Fallah and Mirzaei (2016) observed that broilers receiving turmeric and thyme powders had lower uric acid, total cholesterol, HDL, LDL and triglyceride concentrations compared to the control groups. Barad (2016) reported that feeding of turmeric and coriander seed had no significant effect on haemato biochemical parameters like Hemoglobin (Hb), Packed cell volume (PCV), Total Erythrocyte Count (TEC), Total Leukocyte Count (TLC) and Alanine Amino Transaminase (ALT) were observed. Aspartate amino transferase (AST) value which was significantly higher in turmeric fed treatment groups as compare to control. Chaudhary *et al*. (2015)

reported that the activity of AST and ALT was similar in all the groups indicating that supplementation of the mixture of these herbs in different combinations did not affect the liver integrity. Arslan *et al*. (2017) reported that turmeric supplementation reduced serum total cholesterol and HDL-cholesterol was increased, while LDL-cholesterol and triglycerides remained unaffected due to turmeric supplementation. Al-Noori *et al*. (2011) indicated that addition of *Curcuma Longa* powder significantly increases were observed in, Hb, PCV, Total Protein and Globulin, as compared with the control.

EFFECT OF TURMERIC ON CARCASS CHARACTERSTICS OF BROILERS

Dietary supplementation with turmeric may have beneficial effects on the carcass traits of broiler chickens as it contains beneficial phytochemicals, like curcumin, ar-turmerone, methyl curcumin, and other active compounds. Supplementation of turmeric meal at 5g/kg of diet increased the breast and thigh weight in broiler chickens (Durrani *et al.,* 2006) when compared to the control group. In contrast, Mehala and Moorthy (2008b), Nouzarian *et al.* (2011) and Al-Jaleel (2012) reported that supplementation of turmeric had no significant impact on carcass parameters. Hussein (2013) reported that supplementation of turmeric powder at the rate of 7g/kg increased the weight of thigh and breast muscle significantly as compared to the control. Turmeric rhizome extract supplementation increased the breast muscle weight of Wenchang broilers (Wang *et al.,* 2015). Broilers fed with turmeric did not alter the relative weight of liver when compared to control group birds (Durrani *et al.,* 2006; Mehala and Moorthy, 2008b; Al-Jaleel, 2012 and Al-Mashhadani, 2015). Nouzarian *et al.* (2011) reported significant dose dependent decrease in relative weight of liver in broiler chicken fed with turmeric powder at 3.3, 6.6 and 10 g/kg level as compared to control. On the contrary, Hussein (2013) stated that supplementation of turmeric powder at the rate of 7g/kg showed a significant increase in the relative weights of liver when compared to control and other treatment groups (0, 5 and 9 g/kg turmeric powder). Hady *et al.* (2016) also observed significant increase in the relative weight of liver when the birds were fed with 0.75% turmeric powder as compared to control group. Dietary supplementation of turmeric powder had no significant effect on relative weight of heart in broilers when compared to control (Nouzarian *et al.* 2011; Al-Jaleel, 2012; Hussein, 2013 and Naderi *et al.,* 2014). However, Emadi and Kermanshahi (2007) reported a significant reduction in relative weight of heart when broilers were fed with 0.50 and 0.75 % turmeric powder respectively when compared to control birds, which indicates as a good factor for prevention of ascites syndrome and sudden death syndrome (SDS). On the contrary, Hady *et al.* (2016) observed

significant increase in the relative weight of heart when the birds were fed with 0.75% turmeric powder as compared to control group. Emadi and Kermanshahi (2006) and Nouzarian *et al.* (2011) observed supplementation of turmeric significantly reduced the relative weight of abdominal fat pad as compared to control. Similarly, supplementation of turmeric powder (Hussein, 2013) and curcumin supplementation (Rajput *et al.,* 2013) significantly decreased the relative weight of abdominal fat in birds as compared to control. On the other study, Wang *et al.* (2015) also reported that dietary supplementation with turmeric rhizome extract at 100, 200 and 300 mg/kg of diet reduced the abdominal fat ratio in broilers. On the contrary, Mehala and Moorthy, (2008b) reported that supplementation of turmeric powder at the rate of 0.10 and 0.20 % levels had no significant effect on abdominal fat weight. Sugiharto *et al.* (2011) also reported that birds fed with different levelsof turmeric extract had no effect on the relative weight of abdominal fat. Similar observations were recorded by Al-Mashhadani (2015) in broilers fed with turmeric powder at 0.2, 0.4 and 0.6 % levels for 42 d period. Al-Sultan (2003) observed higher spleen weight index in broilers fed with 1 % turmeric powder when compared to control and those fed with 0.25 and 0.50 % turmeric powder respectively. Namagirilakshmi (2010) also reported that the weight of spleen and pancreas increased significantly in all the dietary treatments supplemented with turmeric as compared to control. However, no significant effect was observed in the relative weight of spleen in broiler chicken fed with turmeric powder as compared to control (Nouzarian *et al.,* 2011; Al-Mashhadani, 2015 and Qasem *et al.,* 2015).

Conclusion

Turmeric can be used as an antibiotic alternative due to its wide safety margin and its efficacies to promote growth and production in poultry. The enhanced production is due to the maintenance of gut health and stimulation of digestive enzymes thereby improves the nutrient utilization.

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