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Turmeric powder as feed additive in laying hen A-review

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Abstract
The growing concerns of consumers on the use of antibiotic as a growth promoter in livestock feed have fuelled the interest in alternative products. The future of these phytogenic feed additives depend on the characteristics of herbs, the knowledge on their major and minor constituents, the in-depth knowledge on their mode of action and their value based on the safety to animal and their products. *Curcumin* stimulates bile production which will be required in emulsification of lipid. Supplementation of turmeric powder is expected to improve liver metabolism and maximize vitellogenin synthesis. Vitellogenin is transported through the circulation to the developing follicles and deposited on the yolk. Turmeric powder can also improve liver function. Besides these properties they are also reported to stimulate feed intake and endogenous secretion and enhance production. Digestibility of crude protein, crude fat, ash and the biological value of protein increased with increasing level of dietary turmeric. Turmeric had positive effect on lowering blood triglycerides, total cholesterol and LDL-cholesterol. Turmeric also improved HDL-cholesterol and might be used as an ingredient in laying hens diet for manipulating egg composition. The decrease of total lipid and cholesterol may be due to the effect of essential oil compounds present in the turmeric on lipid metabolism. Phenolic compounds administration like *Curcumin* may reduce gut inflammation, improve digestibility of nutrients and metabolism.

Keywords: *Curcumin*, HDL, LDL, phytogenic

Introduction
Poultry farming has undergone a paradigm shift in structure and operation, transforming itself from a mere backyard activity into a major commercial venture. Antibiotics have been used as antimicrobial growth promoters in animal to improve food safety. However, in order to avoid the possible risk of developing resistant pathogens, as well as to meet the public pressure of antibiotic-free animal products, the use of antibiotic in poultry diet was totally banned in European Community. Various alternatives of green additives have been studied in order to maximize the growth performance of poultry in the diets without antibiotics. Compared with synthetic antibiotics or inorganic chemicals, these plant-derived products have proved to be less toxic, residue free and are thought to be ideal feed additives in food animal production [1]. Curcumin was effective in reducing both liver and serum cholesterol level [2, 3]. reported that the addition of 0.50 or 1.0% turmeric increased egg weight, egg mass, egg production significantly ($P<0.05$) [4]. Reported that 2 g/kg of turmeric powder decreased the feed conversion ratio (FCR), increased ($P<0.05$) yolk color decreased ($P<0.05$) serum triglycerides, total and LDL-cholesterol [5]. Reported that supplementation of turmeric at 5 g/kg in layer diets increased egg production, weight and mass, while supplementation of 10g/kg increased the yolk index [6]. found that groups fed diets with turmeric powder had significantly higher egg production, egg weight and egg mass.
The literature available on use of turmeric powder as feed additive in the ration of laying hens is scanty. However, an effort has been made to review the available literature has and is presented under the following heads

Feed intake
Feed intake in the birds fed diets containing 0.50 or 1.0% turmeric powder did not differ significantly, but the feed intake in the birds increased numerically as compared to the basal diet [3]. Feed intake was not changed by the dietary treatments, suggesting that addition of turmeric powder did not affect palatability [6, 7] reported that turmeric powder supplementation up to 2% did not affect feed intake, but increasing supplementation to 4% resulted in a significant lower feed intake [8]. Reported that the inclusion of turmeric mixture at levels of 0.75% and 1% in the diets improved feed intake [9]. Found that feeding turmeric (444 ppm) in the basal diet significantly decreased feed intake in birds [10].

found that birds fed with turmeric at the level of 0.50% exhibited significantly decreased feed intake as compared to control group [11]. Reported that the birds fed diets containing turmeric powder at levels of 1% showed significant decrease in the feed intake. However, birds fed diet containing turmeric powder at level of 3% did not differ significantly [12]. Found that inclusion of turmeric root at level of 2 % in the diet did not affect (P<0.05) feed intake significantly in the birds when compared to the basal diet [13]. Reported that given turmeric powder showed no significant difference (P>0.05) on feed intake [4]. found that supplementation of turmeric powder had a slightly effect on feed intake during the weeks 1 to 3, however, in week 4, the significant effect (P<0.05) was observed. Overall, hens fed diets containing 1.5 and 2 g/kg of turmeric powder had lower feed intake that the other groups. [14] Reported that diet containing turmeric powder at 5 or 10 g/kg showed no significant increase in the feed consumption. [15] reported that dietary supplementation of turmeric powder at 2 and 4 % had no significant difference on feed intake in laying hens as compared to control group [16]. reported that birds fed diet having turmeric powder at 1% level showed significant decrease in the feed intake. But birds fed diet containing turmeric powder at level of 3% did not differ significantly [17]. found that there is no significant difference in feed consumption between treatment groups. The overall feed intake was numerically high in birds fed with turmeric compared to other treatment groups.

Feed conversion ratio

Feed conversion ratio in the layers fed turmeric at 0.50 or 1% was improved, but the body weight gain and feed intake was numerically increased when compared to hens fed basal diet [3]. Feed efficiency was not affected by dietary supplementation of different levels of turmeric powder [11, 18]. reported that hens fed 1 % turmeric powder had lower feed consumption which resulted in reduction of egg production and egg mass compared with control diet. The lower egg production and egg mass might be related to the lower feed consumed by laying hens fed 1% turmeric powder [9]. Reported that FCR, body weight gain and average daily feed intake were not affected by 0.50% turmeric powder [12]. found that inclusion of turmeric root at level of 2 % in the diet did not affect feed conversion ratio significantly in the birds when compared to the basal diet. Hens fed 1% turmeric powder had lower feed consumption which resulted in reduction in egg production and egg mass as compared with the control diet. The lower egg production and egg mass might be related to the lower feed consumed by laying hens fed 1% turmeric powder [16]. FCR per dozen eggs differ significantly after 45 weeks of age in all treatment groups, but there was no significant difference in overall mean FCR during the experimental period [17]. Feed conversion ratio was affected by turmeric powder supplementation after just 2 weeks post starting the experiment. Diet containing 2 g/kg turmeric powder showed the lowest FCR in weeks 2, 3, 4 [4, 15]. reported that the dietary supplementation of turmeric powder at 4 % significantly (P<0.05) increased the feed conversion ratio in laying hens as compared to hens fed turmeric powder at 2% level and control group.

Nutrient digestibility

Addition of turmeric at level of 0.50 or 1% to hen's diet numerically increased all nutrient digestibility coefficients [3, 19]. Reported that energy metabolizability and net protein utilization were increased (P<0.05) by virginiamycin, mannon-oligosaccharides and turmeric at the level of 1 g/kg feed. Higher levels (2 and 3 g/kg) of turmeric did not have any effect on feed intake or weight gain but reduced the net protein utilization and energy metabolizability [20]. reported that dietary supplementation of 200 mg/kg *curcumin* significantly improved apparent utilization of fat (ether extract) as compared to control group. The apparent utilization of metabolizable energy was significantly higher in birds fed turmeric at 150 mg/kg level (by 4.71%), as compared to control group; however apparent utilization of crude protein and dry matter were comparatively better in *curcumin* supplemented birds, but the differences were non-significant [21]. reported that higher fat mobilization might be due to stimulated T_4 hormone [22]. found that nutrient digestibility of dry matter and energy did not differ significantly among the groups. Digestibility of crude protein, crude fat, ash and the biological value of protein increased with increasing level of dietary turmeric, and were higher in the 0.10% and 0.20% groups than in control group. Digestibility of crude fibre was also higher in 0.10 % and 0.20% groups.

Biochemical parameters

Turmeric at 1% level decreased total lipid, cholesterol, LDL-cholesterol and HDL-cholesterol non-significantly. The decrease of total lipid and cholesterol may be due to the effect of essential oil compounds present in the turmeric on lipid metabolism [3, 23]. Reported that turmeric (0.05, 0.10 and 0.15%) had positive effect on lowering blood triglycerides, total cholesterol and LDL-cholesterol. Turmeric also improved HDL-cholesterol and might be used as an ingredient in laying hens diet for manipulating egg composition. Adding enzyme along with turmeric significantly decreased blood triglyceride, total and LDL-cholesterol (P<0.05).

Turmeric powder significantly (P<0.05) affected the serum triglycerides. Birds not given turmeric powder had highest serum triglyceride profile (77.23 mg/dl), whereas birds fed 108 g/head/day of turmeric powder had a relatively lower serum triglyceride is at least 49.93 mg/dl [13, 6]. Found that serum total cholesterol concentration and HDL-cholesterol did not differ significantly with the dietary treatment of birds with turmeric at different levels. Supplementation of *curcumin* significantly increased HDL-cholesterol plasma lipoprotein [24]. Supplementation of 500 mg of *curcumin* per day for seven days significantly lowered lipid peroxidase, increased HDL-cholesterol, lowered total serum cholesterol [25]. Curcumin lowered blood cholesterol concentrations through expression induction of CYP7A1 [26]. Curcumin lowered LDL-cholesterol and Apo B. Apo B form complex lipoproteins with LDL-cholesterol. Lipoproteins were synthesized and released from the liver. Low levels of Apo B showed lower levels of LDL-cholesterol [24, 27]. stated that the birds fed with turmeric powder @ 4.5 and 6.0 g/kg of feed showed the maximum percentage reduction in blood glucose (6.75%) in groups T_3 and T_4 on day 56 of the experiment as compared to birds T_1, T_2 (1.5, 3 g/kg turmeric powder) and control groups.

[16] reported that adding turmeric powder at 3% level reduced AST and ALT concentrations which are consistent with previous studies [28, 18] and demonstrate profound antioxidant, and hepatoprotective actions of ginger and turmeric powders [29, 30]. Adding turmeric powder to older laying hen diets affected their serum triglyceride, total cholesterol, HDL and LDL-cholesterol. The birds in control group had the highest (P<0.05) triglyceride, total cholesterol, and LDL-cholesterol

(3170, 323.5 and 251.9 mg/dl, respectively) and the lowest (P<0.05) HDL-cholesterol (23.3 mg /dl). But there was no significant difference between the levels of 0.50, 1, 1.5 and 2 g/kg of turmeric powder for serum metabolites [4].

Egg production

The addition of 0.50 or 1 % turmeric significantly increased the egg production. However, these levels numerically increased the body weight gain and feed intake as compared to hens fed basal diet [3, 17]. Found that dietary supplementation of turmeric at 1.0 g/kg did not influence hen house egg production as well as hen day egg production [16]. Reported that feeding of turmeric at 10.0 or 30.0 g/kg did not influence egg production of single comb white leghorn laying hens [31]. Recorded increased egg production in laying hens fed with herb-derived mineral toxin binder production containing *Curcuma longa* [18]. reported no significant difference in egg production. Hens fed 1 % turmeric powder had lower feed consumption which resulted in reduction of egg production and egg mass compared with the control diet. The lower egg production and egg mass might be related to the lower feed consumed by laying hens fed 1% TRP. Egg production percentage was significantly affected by the treatments (P<0.05), with layers fed 1% turmeric root showed higher egg production as compared to the control birds, which were not fed this natural pigment [12]. Found that inclusion of turmeric root at level of 2 % in the diet did not affect (P<0.05) egg production significantly in the birds when compared to the basal diet [32]. Did not find any significant differences in egg production when lower levels of annatto extract and turmeric were added to layer diets [33, 34]. reported that supplementation of turmeric powder, regardless of period of administration, increased the total number of egg production until 9 months of age (P<0.05). Supplementation of turmeric powder in birds fed high protein ration did not improve total number of egg production (P>0.05). Birds fed high carbohydrate ration and supplemented with turmeric powder for 30 days prior to sexual maturity had 20% higher egg production as compared to control. However, a longer period of turmeric powder supplementation did not increase total number of egg production significantly.

Egg production was the highest in the layers fed diet with 0.5 % turmeric powder and the lowest in the layers fed the control diet [6]. Turmeric powder supplementation up to 4 % in the ration of laying hen showed a significant effect to improve egg production; the improved egg production performance was apparently maintained by turmeric supplementation along the 3 periods of experiment [7, 14]. Reported that diet containing turmeric powder at 5 g/kg showed significant increase (P<0.05) in the egg production but at 1% level the egg production was not affected significantly [15]. Reported that the dietary supplementation of turmeric powder at 2 and 4 % had no significant difference on egg production in laying hens as compared to control group.

Conclusion

The search for alternatives to antibiotics is gaining grounds in recent years. Phytogenic compounds represent one of the most promising alternatives to antibiotics because they consist of a large variety of active ingredients. However, their application in food animal production has been limited, largely owing to their inconsistent efficacy and lack of full understanding. Differences between or within Phytogenic Feed additive (PFA)depend significantly on several variables, which makes it necessary to define the exact composition of the supplements which have been added to diets. In addition, minor components present are critical to the activity of PFA and may have a synergistic influence. Sometimes the minor components may counteract the exerted effects. Therefore, in the future, the detailed study on the constituents of PFA including EOs is needed so as to evaluate their different biological effects, their safety with regards to animal health and the quality of animal products. To make the best use of phytogenic substances for economically effective and sustainable animal production, a better understanding of the effects of phytogenic compounds and their mode of action is a must.

References

1. Wang R, Li D, Bourne S. Can 2000 years of herbal medicine history help us solve problems in the year 2000. In Alltechs annual symposium. 1998; (14):168-184.
2. Rao DS, Sekhara NC, Satyanarayana MN, Srinivasan M. Effect of *curcumin* on serum and liver cholesterol levels in the rat. The Journal of nutrition. 1970; 100(11):1307-15.
3. Radwan Nadia L, Hassan RA, Qota EM, Fayek HM. Effect of natural antioxidant on oxidative stability of eggs and productive and reproductive performance of laying hens. International Journal of Poultry Science. 2008; 7(2):134-50.
4. Riasi A, Kermanshahi H, Mahdavi AH. Production performance, egg quality and some serum metabolites of older commercial laying hens fed different levels of turmeric rhizome (*Curcuma longa*) powder. Journal of Medicinal Plants Research. 2012; 6(11):2141-5.
5. Dono ND. Nutritional strategies to improve enteric health and growth performance of poultry in the post antibiotic era (Doctoral dissertation, University of Glasgow).
6. Park SS, Kim JM, Kim EJ, Kim HS, An BK, Kang CW. Effects of dietary turmeric powder on laying performance and egg qualities in laying hens. Korean Journal of Poultry Science. 2012; 39(1):27-32.
7. Rahardja DP, Hakim MR, Lestari VS. Egg Production Performance of Old Laying Hen Fed Dietary Turmeric Powder. World Academy of Science, Engineering and Technology, International Journal of Animal and Veterinary Sciences. 2015; 2(7).
8. AL-Kassie GA, Mohseen AM, Abd-AL-Jaleel RA. Modification of productive performance and physiological aspects of broilers on the addition of a mixture of cumin and turmeric to the diet. Res. Opinions in Animal and Veterinary Science, 2011.
9. Gowda NK, Ledoux DR, Rottinghaus GE, Bermudez AJ, Chen YC. Antioxidant efficacy of curcuminoids from turmeric (*Curcuma longa* L.*)* powder in broiler chickens fed diets containing aflatoxin B 1. British Journal of Nutrition. 2009; 102(11):1629-34.
10. Durrani FR, Ismail M, Sultan A, Suhail SM, Chand N, Durrani Z. Effect of different levels of feed added turmeric (*Curcuma longa*) on the performance of broiler chicks. Journal of Agricultural and Biological Science. 2006; 1(2):9-11.
11. Moeini MM, Malekizadeh M, Ghazi S. The effects of different levels of ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) rhizomes powder on productive performance characteristics of laying hens. Journal of Agricultural Science Technology. 2011; 14(1):127-134.

12. Laganá C, Pizzolante CC, Saldanha ES, de Moraes JE. Turmeric root and annato seed in second-cycle layer diets: performance and egg quality. Revista Brasileira de Ciência Avícola. 2011; 13(3):171-6.
13. Putra SH, Saraswati TR, Isdadiyanto S. Profile triglycerides Japanese Quail (*Coturnix coturnix* Japonica) after giving turmeric (*Curcuma longa*) powder. International Journal of Science and Engeering. 2015; 8(1):65-68.
14. Bozkurt M, Hippenstiel F, Abdel-Wareth AA, Kehraus S, Küçükyilmaz K, Südekum KH. Effects of selected herbs and essential oils on performance, egg quality and some metabolic activities in laying hens–A review. European Poultry Science. 2014; 78:1612-9199.
15. Hassan SM. Effects of Adding Different Dietary Levels of Turmeric (*Curcuma longa* Linn) Powder on Productive Performance and Egg Quality of Laying Hens. International Journal of Poultry Science. 2016; 15(4):156-60.
16. Malekizadeh M, Moeini MM, Ghazi S. The effects of different levels of ginger (*Zingiber officinale Rosc*) and turmeric (*Curcuma longa* Linn) rhizomes powder on some blood metabolites and production performance characteristics of laying hens. Journal of Agricultural Science and Technology. 2011; 14(1):127-34.
17. Moorthy M, Saravanan S, Mehala C, Ravi S, Ravikumar M, Viswanathan K *et al*. Performance of single comb white leghorn layers fed with Aloe vera, *Curcuma longa* (Turmeric) and probiotic. International Journal Poultry Science. 2009; 8(8):775-8.
18. Emadi M, Kermanshahi H, Maroufyan E. Effect of varying levels of turmeric rhizome powder on some blood parameters of broiler chickens fed corn-soybean meal based diets. International Journal Poultry Science. 2007; 6(5):345-8.
19. Samarasinghe K, Wenk C, Silva KF, Gunasekera JM. Turmeric (*Curcuma longa*) root powder and mannanoligosaccharides as alternatives to antibiotics in broiler chicken diets. Asian Australasian Journal of Animal Sciences. 2003; 16(10):1495-500.
20. Rajput N, Muhammad N, Yan R, Zhong X, Wang T. Effect of dietary supplementation of curcumin on growth performance, intestinal morphology and nutrients utilization of broiler chicks. The Journal of Poultry Science. 2013; 50(1):44-52.
21. De Beer M, McMurtry JP, Brocht DM, Coon CN. An examination of the role of feeding regimens in regulating metabolism during the broiler breeder grower period. 2. Plasma hormones and metabolites. Poultry science. 2008; 87(2):264-75.
22. Maneewan C, Yamauchi KE, Mekbungwan A, Maneewan B, Siri S. Effect of turmeric (*Curcuma longa Linnaeus*) on growth performance, nutrient digestibility, hematological values, and intestinal histology in nursery pigs. Journal of Swine Health and Production. 2012; 20(5):231-40.
23. Kermanshahi H, Riasi A. Effect of turmeric rhizome powder (*Curcuma longa*) and soluble NSP degrading enzyme on some blood parameters of laying hens. International Journal Poultry Science. 2006; 5:494-8.
24. Shin SK, Ha TY, McGregor RA, Choi MS. Long-term *curcumin* administration protects against atherosclerosis via hepatic regulation of lipoprotein cholesterol metabolism. Molecular nutrition & food research. 2011; 55(12):1829-40.
25. Soni KB, Kuttan R. Effect of oral *curcumin* administration on serum peroxides and cholesterol levels in human volunteers. Indian journal of physiology and pharmacology. 1992; (36):273.
26. Kim M, Kim Y. Hypocholesterolemic effects of *curcumin* via up-regulation of cholesterol 7a-hydroxylase in rats fed a high fat diet. Nutrition Research and Practice. 2010; 4(3):191-5.
27. Chauhan SS, Jain N, Quadri MA, Gelaut BS, Chaurasia R, Shakkarpude J. Effect of turmeric (*Curcuma longa*) on blood glucose in Jabalpur color layer birds. Environment and Ecology. 2014; 32(2):408-9.
28. Dias MC, Spinardi-Barbisan AL, Rodrigues MA, De Camargo JL, Teran E, Barbisan LF. Lack of chemopreventive effects of ginger on colon carcinogenesis induced by 1, 2-dimethylhydrazine in rats. Food and chemical Toxicology. 2006; 44(6):877-84.
29. Manju V, Nalini N. Chemopreventive efficacy of ginger, a naturally occurring anticarcinogen during the initiation, post-initiation stages of 1, 2 dimethylhydrazine-induced colon cancer. Clinica Chimica Acta. 2005; 358(1-2):60-7.
30. Shukla Y, Singh M. Cancer preventive properties of ginger: a brief review. Food and chemical toxicology. 2007; 45(5):683-90.
31. Sawale GK, Gosh RC, Ravikanth K, Maini S, Rekhe DS. Experimental mycotoxicosis in layer induced by ochratoxin A and its amelioration with herbomineral toxin binder Toxiroak. International Journal of Poultry Science. 2009; 8(8):798-803.
32. Curvelo ER, Geraldo A, Silva LM, Santos TA, Vieira-Filho *et al*. Levels of inclusion of *curucumin* extract and turmeric in diets for semidried hens and their effects on performance and egg yolk coloration. Proceedings of the II IFMG Science Technology Week, 2009.
33. Saraswati TR, Manalu W, Ekastuti DR, Kusumorini N. Increased egg production of Japanese quail (*Cortunix japonica*) by improving liver function through turmeric powder supplementation. International Journal of Poultry Science. 2013; 12(10):601.
34. Saraswati TR, Manalu W, Ekastuti DR, Kusumorini N. The role of turmeric powder in lipid metabolism and its effect on quality of the first quail's egg. Journal of the Indonesian Tropical Animal Agriculture. 2013; 38(2):123-30.