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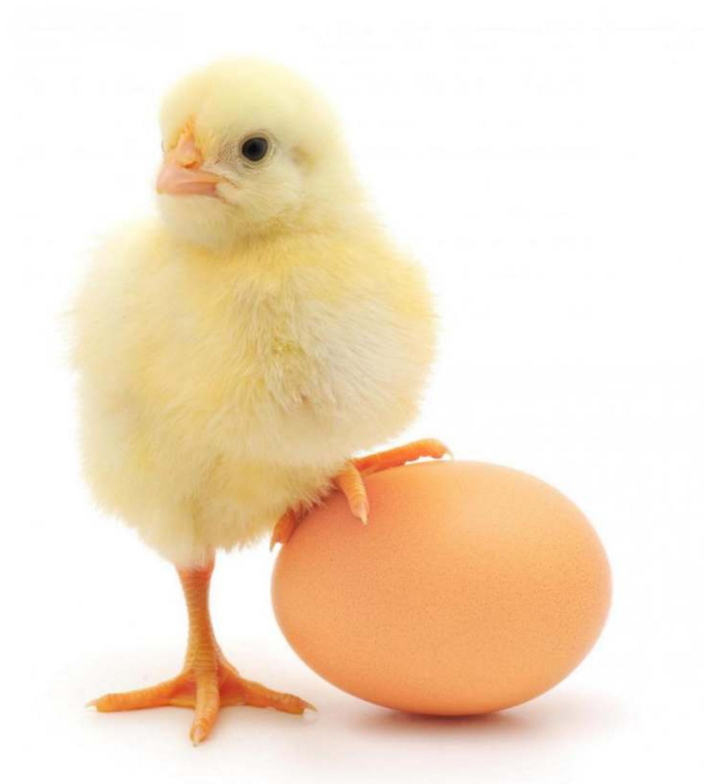

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Effect of Turmeric Rhizome Powder (*Curcuma longa*) and Soluble NSP Degrading Enzyme on Some Blood Parameters of Laying Hens

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Abstract: In order to study the effect of turmeric rhizome powder (TU) and enzyme in some blood parameters of laying hens, an *in vivo* study was conducted. In a 5 * 2 completely randomized block design with factorial arrangement, 5 levels of TU (0.0, 0.05, 0.10, 0.15, and 0.20 %) and 2 levels of enzyme (0.0, and 0.05%) with 4 blocks (replicate) , 480, 100-week old laying hens for 4 weeks fed wheat-soybean meal based diets. Some serum blood parameters of laying hens including hematocrit value, triglyceride, total cholesterol, HDL and LDL-cholesterol were recorded at 104 weeks of age. Increasing dietary levels of TU with or without a dietary enzyme significantly decreased serum triglyceride, total cholesterol and LDL-cholesterol (P<0.05). TU without enzyme significantly increased HDL-cholesterol. It was concluded that dietary supplementation of TU improves some of good indices of serum blood components in laying hens and might be used as an ingredient in laying hen diets for manipulating egg composition.

Key words: Turmeric rhizome, enzyme, blood components, laying hens

Introduction

The rhizome of *Curcuma Longa* L. (family: Zingiberaceae) named turmeric is a perennial herb widely cultivated in tropical regions of Asia and Central America. Turmeric has been used as a coloring and flavouring agent and spice in many foods. Spices are the natural food additives contribute immensely to the taste and flavour of our foods. In several Asian countries, it has been used as a traditional remedy and for the treatment of many diseases. Turmeric has been subjected to chemical analysis which yielded essential oils (2.4-4%) and fatty oils (1.7-3.3%). Apart from curcumin, some other curcuminoids, fats, minerals, fibers, vitamins, proteins and carbohydrates, with total ash content of 4.7-8.2% (Srimal, 1997; Bakhru, 1997). In spite of the fact that spices have been extensively consumed for centuries, occasional doubts have been expressed regarding the safety of some of them. Fortunately the safety of turmeric and its yellow coloring agent, curcumin, are approved by many organizations and researchers (FDA, Hallagan *et al*., 1995); the joint FAO/WHO Expert Committee on Food Additives, JECFA, (WHO, 1987); Department of Biochemistry and Nutrition of Central Food Technological Research Institute of India, CFTRI (Srinvasan, 2005); and Groten *et al*., (2000). Apart from its daily use in the kitchens as a condiment and spices, turmeric rhizome and its constituents have been effectively used in the indigenous systems of medicine in Asia and also in other countries during the past three decades (Srinvasan, 2004). Curcumin (diferuloly methane), which gives yellow color to turmeric rhizomes, is one of the most active ingredients responsible for the biological activity. Turmeric has been used in coughs, fever, jaundice, liver and urinary diseases, wounds, inflammatory troubles of the joints, itching, eczema, parasitic skin diseases and cold (Kapoor, 1990), the rhizome has also been recommended for anaemia, measles, sprains, boils, scabies, sore eyes (Bakhru, 1997), smallpox, chicken pox, insect bites, as a food purifier and anthelmintic (Nadkari, 1976).

Turmeric has been extensively studied for its biological activities including anti-inflammatory and antiarthritic (Chandra and Gupta, 1972), antioxidant (Toda *et al*., 1985), antimicrobial (Lutomski *et al*., 1974), anti-leishmanial (Gomez *et al*., 2002), hepatoprotective (Kiso *et al*., 1983), anticancer (Kuttan *et al*., 1985), vasodilator (Sasaki *et al*., 2003), hypolipidaemic (Dixit *et al*., 1988), antiplatelet (Srivastav *et al*., 1995), hypoglycaemic (Arun and Nalini, 2002), choleretic (Deters *et al*., 1999), immunomudolatory (Antony *et al*., 1999), neuroprotective (Rajakrishnan *et al*., 1999), antidepressant (Yu *et al*., 2002) and effective in Alzheimer's disease (Park and Kim, 2002).

There are several studies on the effects of soluble non-starch polysaccharide (NSP) degrading enzymes on laying hens and broilers indicating their positive effects on fat efficiency particularly when the fats in the diets contained saturated fatty acids and wheat (Bedford *et al*., 1991; Bedford and Partridge, 2001; Van der Klis *et al*., 1995). The interaction of saturated fatty acids in the diet and the presence of NSP in the wheat varieties with NSP degrading enzymes and the lower excretion of fats and fatty acids into the feces of birds with the presence of these enzymes and thus better absorption of these fats and fatty acids and possibly different blood constituents especially lipoproteins might be interesting. Turmeric has been used widely in human and rats as animal models. However its use in Poultry is only limited to one study for evaluating its potential in transferring yellow colour to skin in broilers (Awang *et al.*, 1992). Therefore as a series of experiment, this study was conducted to study levels of turmeric rhizome powder with or without a dietary soluble NSP degrading enzyme in some serum blood parameters in laying hens fed a wheat-soybean meal based diets containing fat blends and to evaluate hypolipidaemic and hypocholesterolemic properties of turmeric rhizome.

Materials and Methods

In a 5 * 2 completely randomized block design with a factorial arrangement, 5 levels of turmeric rhizome powder (TU; 0.0, 0.05, 0.10, 0.15, and 0.20%) and 2 levels of a NSP degrading enzyme (0.0, and 0.05%, Endofeed W from GNC Bioferm Inc., Canada) with 4 blocks (replicates) were tested in 480, 100-week old commercial Hy-line W-36 laying hens at the final stage of egg production for 4 weeks. The enzyme contained at least 1200 U/g arabinoxylanase and 400 U/g beta-glucanase activity. A wheat-soybean based diet with a blend of animal fat (Table 1) was used to meet the requirement of laying hens as recommended by Hy-line W36 manual. Blood parameters including packed cell volume (PCV) or hematocrit value, triglyceride, total cholesterol, LDL-cholesterol and HDL-cholesterol measured at the end of experiment using appropriate commercial laboratory kits (Friedewald *et al.*, 1972; Gordon and Amer, 1977). Data were analyzed based on a general linear model procedure of SAS (SAS, 1997) and treatment means when significant, were compared using Duncan multiple range test.

Results and Discussion

The effect of TU on blood parameters (Table 2) including triglyceride, total cholesterol, HDL and LDL-cholesterol without enzyme was significantly different ($P<0.05$). The highest triglyceride, cholesterol, and LDL-cholesterol and the lowest HDL-cholesterol were seen in control group (no added TU). TU had a profound positive effect on lowering blood triglyceride, total cholesterol and LDL-cholesterol. TU also improved blood HDL-cholesterol. Hematocrit values were not affected by TU with or without the enzyme. Adding enzyme along with TU significantly decreased blood triglyceride, total and LDL-cholesterol ($P<0.05$). Enzyme itself had no effect on hematocrit value, but its interaction with TU was significant ($P<0.05$). Effect of enzyme and enzyme with TU on triglyceride were not significant. Use of enzyme significantly ($P<0.05$) increased HDL-cholesterol (32.7 vs 29.4 mg/dl). Adding enzyme to TU significantly ($P<0.05$) increased LDL-cholesterol (147.7 vs 117.9 mg/dl).

LDL and HDL-cholesterol is formed when cholesterol and fats get together in circulatory system. With changing the physico-chemical properties of intestinal chyme due to the presence of soluble NSPs in wheat and the known interaction effects of them with saturated fatty acids (Kussaibati *et al.*, 1982) and the effect of NSP degrading enzymes might explain some of these results. Adding enzyme may alleviate the limitations present for the function of bile salts and the emulsifying properties of them in intestinal chyme and therefore it might be a reason for increasing LDL-cholesterol in blood. It is reported that the digestion of big molecules of carbohydrates with pentosanase (arabinoxylanase) can change the viscouse nature of intestinal chyme and therefore improves fat digestibility (Bedford *et al.*, 1991; Van der Klis *et al.*, 1995).

Turmeric extract along with saturated fat and cholesterol in rabbits (Ramirez-Tortosca *et al.*, 1999) significantly decreased the plasma cholesterol level and the susceptibility of the LDL to oxidation. They suggested that curcumin antioxidants are active one step above that of action of vitamin E. It seems that the turmeric extract has a vitamin E- sparing effect, since the levels of this vitamin in the serum of the rabbits receiving extracts were even higher than those found in the animals receiving a diet enriched with vitamin E. Miquel *et al.* (2002) suggested that curcumin and related anti-oxidants may complement the well established anti-atherogenic action of tocopherol (Meydani, 1999). They concluded that curcumin antioxidants might be especially useful as antiatherogenic agents in those processes linked to a marked increase in blood lipid peroxidation such as myocardial infraction (Santos *et al.*, 1989). Witting *et al.* (1999) stated that if arterial LDL lipid oxidation causes atherosclerosis, co-antioxidants may be antiatherosclerotic. Further work by Ramirez-Bosca *et al.* (1997) on healthy men and women which received the above daily doses of curcumin extract during 60 days showed that both men and women with initial levels of HDL- and LDL-peroxides had a 25-50% reduction in these peroxides on the 60th day of treatment. It is also reported that the administration of curcumin to rats, the blood levels of LDL and VLDL cholesterol, triglycerides and phospholipids were decreased (Suresh Babu and Srinivasan, 1997) . These results are in agreement with the result of this study suggesting the use of turmeric rhizome and its extract could be useful in the management of cardiovascular disease in which atherosclerosis is important.

Along with the lowering effect of TU on triglyceride, total cholesterol, LDL-cholesterol and the increasing effect of TU on HDL-cholesterol, these results may bring the idea that use of turmeric rhizome may satisfy egg consumers when they fear from eating egg as they fear from heart

Table 1: Composition of experimental diets

Ingredients	%	Calculated composition	
Wheat	63.55	ME (kcal/kg)	2700
Soybean meal	18.70	Crude protein (%)	15.00
Animal-vegetable fat blend	4.41	Ca (%)	4.00
Oyster shell	11.33	Avail. P (%)	0.30
Dicalcium phosphate	0.90	Na (%)	0.18
Vit . and Min. premix[1]	0.50	Linoleic acid (%)	1.10
Salt	0.31	Arginine (%)	0.84
DL-methionine	0.06	Lysine (%)	0.74
L-Lysine	0.04	Met + Cys (%)	0.54
Fine grit[2]	0.20	Tryptophan (%)	0.20
Total	100.00		

[1]Supplied per kilogram of diet: vitamin A, 10000 IU; vitamin D_3,9790 IU; vitamin E, 121 IU; B_{12}, 20 µg; riboflavin, 4.4 mg; calcium pantothenate, 40 mg; niacin, 22 mg; choline, 840 mg; biotin, 30 µg; thiamin, 4 mg; zinc sulphate, 60 mg; manganese oxide, 60 mg. [2]0.0, 0.05, 0.10, 0.15 and 0.20 % turmeric rhizome powder as treatment replaced with fine grit.

Table 2: Effect of turmeric powder on blood parameters of laying hens

Treatments		Blood parameters (104 weeks)				
Enzyme level (%)	Turmeric level (%)	Hematocrit value	Triglyceride (mg/dl)	Total cholesterol (mg/dl)	HDL-cholesterol (mg/dl)	LDL-cholesterol (mg/dl)
0	0.00	28.5	3170^{a}	323.5^{a}	23.3^{c}	251.9^{a}
0	0.05	29.6	1371^{b}	154.8^{b}	29.9^{ab}	93.9^{b}
0	0.10	29.5	1350^{b}	199.0^{b}	33.0^{a}	79.1^{b}
0	0.15	29.6	1297^{b}	175.3^{b}	33.8^{a}	67.1^{b}
0	0.20	28.6	1145^{b}	161.0^{b}	26.9b^{c}	92.5^{b}
P value		0.234	0.0001	0.0001	0.003	0.0001
Means in each column with different superscripts are significantly different (P<0.05)						
0.05	0.00	30.6	3148^{a}	338.8^{a}	34.2	243.6^{a}
0.05	0.05	29.3	1361^{b}	156.3^{c}	32.0	102.2^{b}
0.05	0.10	28.9	1349^{b}	201.0^{b}	34.4	95.0^{b}
0.05	0.15	29.5	1293^{b}	174.0b^{c}	32.8	89.4^{b}
0.05	0.20	28.9	1289^{b}	158.6^{c}	29.6	108.4^{b}
P value		0.089	0.0001	0.0004	0.732	0.0001

Means in each column with different superscripts are significantly different (P<0.05)

diseases, like arthrosclerosis, coronary heart disease, etc. The ability of TU to increase blood HDL-cholesterol is a profound result that we found in this study but still more research is needed to confirm this positive effect and the possible transfer ability of blood HDL-cholesterol into the egg. Adding enzyme into the diets containing TU although didn't show a significant improvement on HDL-cholesterol but it is comparable to TU itself.

Turmeric rhizome at the used levels decreased LDL-cholesterol and this result might be interesting for scientist. There is a close relationship between some of the components of the diet and egg composition (Farrel, 1999; Sim, 1999; Watkins *et al.*, 1999). So it is worthy to do more research on broilers and layers to produce products possibly fortified with some of the phytochemical compounds present in turmeric rhizome. Under the conditions of this study, it was concluded that use of turmeric rhizome powder as a herbal drug may improve some of the components of the blood and possibly egg and this may lead us to produce enriched eggs that are healthier for human consumption.

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References

Antony, S., R. Kuttan and G. Kutta, 1999. Immunomodulatory activity of curcumin. Immunological Investigations, 28: 291-303.

Arun, N. and N. Nalini, 2002. Efficacy of turmeric on blood sugar and polyol pathway in diabetic albino rats. Plant Foods for Human Nutrition, 57: 41-52.

Awang, I.P.R., U. Chulan and F.B.H. Ahmad, 1992. Curcumin for upgrading skin colour of broilers. Pertanica, 15: 37-38.

Bakhru, H.K., 1997. Herb that heal: Natural remedies for good health. Orient paperwork, New Delhi, pp: 164-166.

Bedford, M.R., H.L. Classen and G.L. Campbell, 1991. The effects of pelleting, salt and pentosanase on the viscosity of intestinal contents and the performance of broiler broilers fed rye. Poult. Sci., 70: 1571-1577.

Bedford, M.R. and G.G. Partridge, 2001. Enzymes in farm animal nutrition. CABI Publishing, UK.

Chandra, D. and S.S. Gupta, 1972. Anti-inflammatory and anti-arthritic activity of volatile oil of *Curcuma longa* (Haldi). Ind. J. Med. Res., 60: 138-142.

Deters, M., C. Siegers, P. Muhl and W. Hansel, 1999. Choleretic effects of curcuminoids on an acute cyclosporine-induced cholestasis in the rat. Planta Medica, 60: 610-613.

Dixit, V.P., P. Jain and S.C. Joshi, 1988. Hypolipidaemic effects of *Curcuma longa* L and Nardostachys jatamansi DC in triton-induced hyperlipidaemic rats. Ind. J. Physiol. Pharmacol., 32: 299-304.

Farrel, D.J., 1999. Not all omega-3 enriched eggs are the same. *In*: egg nutrition and biotechnology, CABI Publishing, UK.

Friedewald, W.T., R.I. Levy and D.S. Fredrickson, 1972. Estimation of the concentration of LDL cholesterol in plasma, without use of the preparative ultracentrifuge. Clin. Chem., 18: 499-504.

Gomez, D.C., L.V. Alegrio, L.L. Leon and M.E. Lima, 2002. Total synthesis and anti-leishmanial activity of some curcumin analogues. Arzneimittel-Forschung-Drug Research, 52: 695-698.

Gordon, T. and M. Amer, 1977. Cardiovascular disease marker, Am. J. Med., 62: 707-714.

Groten, J.P., W. Butler, V.J. Feron, G. Kozianowski, A.G. Renwick and R. walker, 2000. An analysis of the possibility for health implications of joint actions and interactions between food additives. Regulatory Toxicology and Pharmacology, 31: 77-91.

Hallagan, J.B., D.C. Allen and J. Borzelleca, 1995. The safety and regulatory status of food, drugs and cosmetics, colors additives exempt from certification. Food and Chemical Toxicology, 33: 515-528.

Kapoor, L.D., 1990. Handbook of ayurvedic medical plants. CRC Press, Boca Raton, pp: 149-150.

Kiso, Y., Y. Suzuki, N. Watanabe, Y. Oshima and H. Hikino, 1983. Antihepatotoxic principles of *Curcuma longa* rhizomes. Planta Medica, 49: 185-187.

Kussaibati, R., L. Guillaume and B. Leclerq, 1982. The effects of age, dietary fat and bile salts and feeding rate on apparent and true metabolizable energy values in chickens. Br. Poult. Sci., 23: 292-303.

Kuttan, R., P. Bhanumathy, K. Nirmala and M.C. George, 1985. Potential anticancer activity of turmeric (*Curcuma longa*). Cancer Letters, 29: 197-202.

Lutomski, J., B. Kedzia and W. Debska, 1974. Effect of an alcohol extract and of active ingredients from *Curcuma longa* on bacteria and fungi. Planta Medica, 29: 9-19.

Meydani, M., 1999. Dietary antioxidants modulation of aging and immune-endothelial cell interaction. Mech. Ageing Dev, 11: 123-132.

Miquel, J., A. Bernard, J.M. Sempere, J. Diaz-Alperi and A. Ramirez, 2002. the curcuma antioxidants: pharmacological effects and prospects for future clinical use, A review. Archives of Gerontology and Geriatrics, 34: 37-46.

Nadkari, K.M., 1976. Indian Materia Medica. Popular Prakashan, Bombay, pp: 418-419.

Park, S.Y. and D.S. Kim, 2002. Discovery of natural products from *Curcuma longa* that protect cells from beta-amyloid insult: a drug discovery effort against Alzheimer's disease. J. Natural Prod., 65: 1227-1231.

Rajakrishnan, V., P. Visvanathan, K.N. Rajasekharan and V.P. Menon, 1999. Neuroprotective role of curcumin from *Curcuma longa* on ethanol-induced brain damage. Phytotherapy Res., 13: 571-574.

Ramirez-Bosca, A., M.A. Carrion Gutierrez, A. Soler, C. Puerta, A. Diez, E. Quintanilla, A. Bernd and J. Miquel, 1997. Effects of the antioxidant turmeric on lipoprotein peroxides: implications for the prevention of atherosclerosis, Age, 20: 165-168.

Ramirez-Tortosca, M.C., M.D. Mesa, M.C. Aguilera, J.L. Quiles, L. Baro, C.L. Ramirez-Tortosa, J. Martinez-Victoria and A. Gil, 1999. Oral administration of a turmeric extract inhibits LDL in rabbits and has hypocholesterolemic effects in rabbits with experimental atherosclerosis. Atherosclerosis, 147: 371-378.

Santos, M.T., J. Valles and J. Aznar, 1989. Plasma lipid peroxides in patients with vascular disease and in middle-aged normal subjects with a high risk of atherosclerosis. *In*: Miquel, J., A. Quintanilla and H. Weber (Eds.), CRC Handbook of free radicals and antioxidants in biomedicine, vol. 1, CRC Press, Boca Raton, FL, pp: 237-254.

SAS, 1997. User's guide statistics. SAS Institute. Inc. Cary. N.C., U.S.A.

Sasaki, Y., H. Goto, C. Tohda, F. Hantanaka, N. Shibahara, Y. Shimada, K. Terasawa and K. Komatsu, 2003. Effects of curcum drugs on vasomotion in isolated rat aorta. Biological and Pharmaceutical Bulletin, 26: 1135-1143.

Sim, J.S., 1999. Designer egg concept: perfecting egg through diet enrichment with omega-3 PUFA and cholesterol stability. *In*: egg nutrition and biotechnology, CABI Publishing, UK.

Srimal, R.C., 1997. Turmeric: A brief review of medicinal properties. Fitoterapia LXVIII, No. 6, 483-493.

Srinvasan, K., 2004. Spices as nutraceuticals with multi-beneficial health effects: J. Herbs Spices and Medicinal Plants, 11: in press .

Srinvasan, K., 2005. Spices as influencers of body metabolism: an overview of three decades of research. Food Res. Int., 38: 77-86.

Srivastav, K.C., A. Bordia and S.K. Verma, 1995. Curcumin, a major component of food spice turmeric (*curcuma longa*) inhibits aggregation and alters eicosanoid metabolism in human blood platelets. Prostaglandins Leukotriens and Essential Fatty Acids, 52: 223-227.

Suresh Babu, P. and K. Srinivasan, 1997. Hypolipedemic action of curcumin, the active principle of turmeric (*Curcuma longa*) in streptozotocin induced diabetic rats. Molecullar Cell. Biochemistry, 166: 169-175.

Toda, S., T. Miyase, H. Arichi, H. Tanizawa and Y. Takino, 1985. Natural antioxidant. III. Antioxidative components isolated from rhizome of *Curcuma longa* L. Chemical and Pharmaceutical Bulletin, 33: 1725-1728.

Van der Klis, C., W. Scheele and C. Kwakernaak, 1995. Wheat characteristics related to its feeding value and to the response of enzymes. Proceeding of the 10th European Symposium on Poultry Nutrition. Antalya, Turkey.

Witting, P.K., K. Petterson and A.M. Ostlund-Lindqvist, 1999. Inhibition by a coantioxidant of aortic lipoprotein lipid peroxidation and atherosclerosis in apolipoprotein E and low density lipoprotein receptor gene double knockout mice. FASEB J., 13: 667-675.

Watkins, B.A., A.A. Devitt and M.A. Latour, 1999. Biological activities of conjugated linoleic acids and designer eggs. *In*: egg nutrition and biotechnology, CABI Publishing, UK.

WHO, 1987. Principles for the safety assessment of food additives and contaminants in food, environmental health criteria, vol. 70. World Health Organization, Geneva.

Yu, Z.F., L.D. Kong and Y. Chen, 2002. Antidepressant activity of aqueous extracts of *Curcuma longa* in mice. J. Ethno Pharmacol., 83: 161-165.