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The cholesterol lowering property of coriander seeds (*Coriandrum sativum*): Mechanism of action

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Abstract: *Coriandrum sativum (Coriander) has been documented as a traditional treatment for cholesterol and diabetes patients. In the present study, coriander seeds incorporated into diet and the effect of the administration of coriander seeds on the metabolism of lipids was studied in rats, fed with high fat diet and added cholesterol. The seeds had a significant hypolipidemic action. In the experimental group of rats (tissue) the level of total cholesterol and triglycerides increased significantly. There was significant increase in β-hydroxy, β-methyl glutaryl CoA reductase and plasma lecithin cholesterol acyl transferase activity were noted in the experimental group. The level of low density lipoprotein (LDL) + very low density lipoprotein (VLDL) cholesterol decreased while that of high density lipoprotein (HDL) cholesterol increased in the experimental group compared to the control group. The increased activity of plasma LCAT, enhanced degradation of cholesterol to fecal bile acids and neutral sterols appeared to account for its hypocholesterolemic effect.*

Key words: *Coriander, Spices, Lipid metabolism*
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Introduction

Before the discovery of insulin in the early 1920s and the later development of oral hypoglycaemic agents, the major form of treatment of diabetes mellitus involved starvation, dietary manipulation and the use of plant therapies (Bailey and Day, 1989).

Coriandrum sativum (coriander) has been reported to have a number of possible medicinal attributes including antispasmodic, carminative and stomachic properties (Alison and Peter, 1999). Additionally, coriander has been advocated as an anti-diabetic remedy. Acute clinical studies in human volunteers have shown that crushed garlic buds or the essential oil of garlic can prevent alimentary hyperlipidemia (Karmanna and Chandrasekhara, 1992). Soyabeen, ginger and spices like capsaicin decreased low density and very low density lipoproteins and enhanced high density lipoprotein cholesterol in the serum (Gujaral *et al.,* 1978; Sambaiah and Satyanarayanan, 1982; Lydie and Villaume, 2001; Pavana *et al.,* 2007). The enhancement in HDL cholesterol and lowered LDL + VLDL cholesterol in serum could be beneficial in many heart diseases. Curcumin increased fecal excretion of bile acids both in normal and hypocholesterolemic rats (Subbarao *et al.,* 1970). This indicates that this spice stimulates the bile forming function of the liver and also the conversion of cholesterol to bile salts. But very little information is available on the effect of administration of coriander seeds on different aspects of lipid metabolism in experimental animals. In view of the important implications, the objective of this study was to determine the effect of the coriander seeds on the metabolism of lipids using rats as experimental animals.

Materials and Methods

Diets: As outlined in Table 1, the control diet contained M/s. Hindustan lever rodent chow, coconut oil (15%) and cholesterol (2%) (high fat diet). Diet for the experimental group was made as a control diet but coriander seeds were included at the rate of 10%.

Dried coriander seeds were obtained from the market at Erode. Seeds were homogenized to a fine powder and stored at room temperature (20 ± 2°C) in opaque screw – top jars. Powdered coriander was used for incorporation into test animal diet.

Animals: Female albino rats (Sprague - Dawley strain) weighing an average of 65-70 g were randomly assigned to the control and experimental groups of six animals each. Animals were housed in polypropylene rat cages. Animals were housed in groups of 6 rats. Cages were in a controlled environment with 12 hr of light and 12 hr of dark each day. Animals were handled using the laboratory animals welfare guidelines (Hume, 1972).

Experiment: Diet food and ordinary tap water were given on an *ad libitum* basis. Diet was maintained for 75 days. Food intake and body weight records were noted weekly. Feces were collected quantitatively in the last two days of the study. At the end of the experimental period, animals were put on fast or made to fast overnight. Blood was drawn by capillary pipette from the orbital sinus. Following the blood draw, animals were sacrificed by decapitation. Heart and liver tissues were removed, blotted dry, weighed and frozen until biochemical analysis.

Table - 1: Composition of the diet

Control diet (high fat diet)	Experimental diet	Composition of rodent chow
Rodent chow 83%	Rodent chow 73%	Crude protein 23%
Coconut oil 15%	Coconut oil 15%	Ether extract (fat) 5%
Cholesterol 2%	Cholesterol 2%	Crude fiber 5%
	Coriander 10%	Ash 10%
		Calcium 2%
		Phosphorus 1%
		Nitrogen free extract 54%

Table - 2: Diet intake and body weight gain of animals diet-fed. with and without coriander

Groups	Average weight per group	
	Initial (g)	Final (g)
Control	63	148
Coriander	60	144

Biochemical assays: The serum and tissues were extracted according to the procedure described by Zlatkis *et al.,* 1953. Total cholesterol was estimated by the method of (Abell and Lovy, 1952). Triglycerides were estimated as described by Abraham and Kurup (1988). The bile acids were extracted from the liver according to the procedure of Okishio *et al.* (1967). Fecal sterols and bile acids were extracted by the procedures of Grundy *et al.* (1965). Total bile acids (Robert, 1969) neutral sterols (Ghanbari and Leelamma, 1975) and serum lipoproteins (Warnick and Albers, 1978) were also estimated. β–hydroxy, β–methyl glutaryl CoA reductase (HMG CoA EC 1.1.1.34) activity was assayed using the method described by Rao and Ramakrishnan, 1975). The ratio of HMG CoA to mevalonate was taken as an index of enzyme activity which catalyzes the conversion of HMG to mevalonate. The lower the ratio, of HMGCoA to mevalonate showed the higher the enzyme activity. The activity of plasma lecithin cholesterol acyl transferase (LCAT) (EC 2.3.1.43) was estimated as described by Annie and Kurup (1986). The extent of increase in the ester cholesterol / unesterified cholesterol ratio was taken as a measure of LCAT activity. Protein was estimated in the enzyme extract by the method of Lowry *et al.* (1951).

Statistical analysis: Statistical evaluation of the analytical data was undertaken by students through a t-test (Bennet and Franklin, 1967). Significance was accepted at the $p \leq 0.05$.

Results and Discussion

A significant decrease in cholesterol and triglyceride level was observed in animals fed with coriander seed in their diets (Table 3). The activity of HMG CoA reductase increased in this group compared to the control group (Table 4). The level of hepatic bile acids and neutral sterols, fecal output of total bile acids and neutral sterols were found to be enhanced in the experimental animals compared to the control group. The concentration of LDL + VLDL cholesterol decreased while that of HDL cholesterol and activity of plasma LCAT was increased in the experimental group.

The results indicate that the administration of coriander seeds had a profound influence on the metabolism of lipids in animals fed on cholesterol containing diet. A significant decrease in cholesterol and triglyceride levels was observed in animals fed on coriander seeds. Similar inhibition in the rise of serum cholesterol, triglyceride and lipoproteins when fed on garlic and onion has been reported (Bennet and Franklin, 1967; Alison and Peter, 1999). The inhibition in the enzyme activity may be due to that this is the key enzyme in the pathway of cholesterol biosynthesis in liver is HMG CoA reductase, a microsomal enzyme. In animals administered with coriander powder, the activity of this enzyme significantly increased, when compared to the control group.

Significant increase in the concentration of hepatic and fecal bile acids and neutral sterols may indicate increased hepatic degradation of cholesterol. The fact that liver cholesterol was significantly reduced in rats fed on spice was most likely seen because the rate of its degradation to bile acids was more than its rate of synthesis (Sharma *et al.,* 1990). There was an increase fecal excretion of bile acids and neutral sterols in the experimental animals.

The present study was confirmed with the work of *Momordica charantia* (Cucurbitacae) fresh fruit juice by oral administration lowered the blood sugar level in normal and alloxan diabetic rabbils. Further the present study was supported by Rao and Rao (2001) who reported that the aqueous extract of *Syzygium alternifolium* at a dosage of 0.75 g/kg body weight (b.wt.) is showing maximum blood glucose lowering effect in both normal and alloxan diabetic rats.

Similar study was reported by Prince *et al.* (1998), Sharma and Raghuram (1991) by the effect of cumini and fenugreek seeds on the lipid peroxidation in alloxan diabetic rats respectively.

Administration of the spice brought about a significant alteration in the serum lipoprotein. It has been reported that ingestion of 100 g of debittered fenugreek powder significantly reduced serum total cholesterol. Cholesterol in LDL and VLDL fractions and triglyceride level (Srinivasan and Sambaiah, 1991). Similarly in the present

Table - 3: Levels of cholesterol and triglycerides in serum (mg/100 ml), liver and heart (mg/100 ml), of animals fed on coriander seeds in a high fat diet

Group	Cholesterol			Triglyceride		
	Serum	Liver	Heart	Serum	Liver	Heart
Control	157.30± 4.65	1749.20± 50.8	275.60± 8.17	12.40± 0.43	785.50± 23.14	68.80 ± 2.10
Coriander	85.10 ± 2.60	1048.30 ± 30.50	88.43 ± 2.62	7.28± 0.214	328.12± 9.56	24.93± 0.69

Table - 4: Levels of hepatic and fecal bile acids and neutral sterols, cholesterol in serum lipoprotein fractions, activity of hepatic HMG CoA reductase and plasma LCAT of animals fed on coriander seeds in a high fat fed diet

Parameters analyzed	Control group	Coriander fed
Hepatic bile acids (mg/100 g)	42 ± 1.14	67 ± 1.6
Hepatic neutral sterols (mg/100 g)	90± 2.12	112 ± 2.6
Fecal bile acids (mg/rat/day)	26.4 ± 0.68	57.51 ± 1.3
Fecal neutral sterols (mg/rat/day)	8.25 ± 1.86	105.3 ± 2.34
HDL cholesterol (mg/100 ml)	30.7 ± 0.92	42.8 ± 1.38
LDL+VLDL cholesterol (mg/100 ml)	122.4 ± 3.22	44.7 ± 1.30
Hmg CoA reductase (ratio of HMG CoA mevalonate)	3.5 ± 0.092	2.04 ± 0.04
Plasma LCAT	125.6 ± 3.52	285.14 ± 8.38

study, administration of coriander seeds also reduced the LDL + VLDL cholesterol. Thus, the decrease in serum cholesterol brought about by administration of spice was manifested in the LDL + VLDL fractions. Thus the circulating LDL + VLDL in rats fed on coriander had lower cholesterol content. The newly synthesized cholesterol in the liver may be used for VLDL secretion and synthesis of bile acids. One possibility is that more of the newly synthesized cholesterol is channeled for the synthesis of bile acids which is supported by the observation that bile acids were significantly increased in the liver of the animals administered with coriander seed's powder.

High density lipoproteins (HDL) and plasma LCAT are believed to be involved in the transport of cholesterol from extra hepatic tissues to the liver for its excretion. The higher levels of cholesterol associated with HDL and the increase in the activity of plasma LCAT on administration of coriander may result in a higher amount of cholesterol being removed from extra hepatic tissues which may contribute to the hypercholesterolemia observed in these animals. Hence the lowering in cholesterol levels of serum and tissues by the administration of this spice would seem to be mediated through its increased rate of degradation to bile acids and neutral sertols. As with other spices like turmeric, mangoginger, ginger, garlic, Jambu seed and fenugreek, inclusion of coriander seeds in the diet show significant hypolipidemic effects Lydie and Villaume, (2001), Sankarikutty *et al*. (1982), further studied in relation to lipid metabolism, and the effect of this spice as an atherogenic diet on animals are in progress.

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References

Abell, L.L. and B.B. Lovy: A simplified method for the estimation of total cholesterol in serum and demonstration of its specificity. *J. Biol. Chem.*, **195**, 357 (1952).

Abraham, A. and P.A. Kurup: Mechanism of hypercholesterolerolemia produced by biotin deficiency. *J. Bio. Sci.*, **12**, 187-189 (1988).

Alison, M. Gray and Peter R. Flatt: Insulin releasing and insulin activity of the traditional anti diabetic plant *Coriandrum sativum*. *Brit. J. Nut.*, **81**, 203-209 (1999).

Annie A. and P.A. Kurup: Dietary carbohydrates and regulation of the activity of HMGCoA reductase and cholesterol metabolism. *Ind. J. Biochem. Biophys.*, **23**, 28-31 (1986).

Bailey, C.J. and C. Day: Traditional treatments for diabetes from Asia and the West Indias. *Proc. Diabetes*, **3**, 190-192 (1989).

Bennet C.A. and N.I. Franklin: Statistical Analysis in Chemistry and the Chemical Industry. New York. John Wiley and Sons (1967).

Ghanbari Sissan, M.A. and S. Leelamma: Influence of components of oral contraceptive on lipid metabolism. *Ind. J. Exp. Biol.*, **34**, 131-134 (1975).

Grundy, S.M., E.H. Ahrens and T.A. Miettinen: Quantitative isolation and gas-liquid chromatographic analysis of total dietary and neutral sterols. *J. Lipid Res.*, **6**, 11-16 (1965).

Gujaral, S., N. Bhumra and M. Swaroop: Effect of ginger oleoresin on serum and hepatic cholesterol, levels in cholesterol fed rats. *Nutr. Rep. Int.*, **17**, 183-187 (1978).

Hume, C.W.: The UFAW Handbook on the Care and Management of Laboratory Animals. Edinburgh / London: Churchill Livingstone (1972).

Karmanna, V.S. and N. Chandrasekhara: Effect of garlic on serum lipoproteins and lipoprotein cholesterol levels in albino rats rendered hypercholesteremic by feeding cholesterol. *Lipids*, **17**, 483-488. (1992).

Lowry, O.M., N.J. Rosebrough, A.L. Farr and R.J. Randal: Protein measurement with the Folin phenol reagent. *J. Biol. Chem.*, **193**, 265-275 (1951).

Lydie, Guermani Nicolle and Christian Villaume: The cholesterol – Lowering property of soya beans fed to rats is related to the fasting duration. *Plant foods for human nutrient*, **56**, 239-249 (2001).

Okishio, T. Nair and P.P. Gordon: The mere quantitative separation of cellular bile acids by gas-liquid chromatography. *Biochem. J.*, **102**, 654-659 (1967).

Pavana, P., S. Manoharan, G.L. Renju and S. Sethupathy: Antihyperglycemic and antihy-perlipidemic effects of *Tephrosia purpurea* leaf extract in streptozotocin induced diabetic rats. *J. Environ. Biol.,* **28**, 833-837 (2007).

Prince, P.S., V.P. Menon and L. Pari: Hypoglycaemic activity of *Syzigium cumini* seeds: Effect on lipid peroxidation in alloxan dietetic rats. *J. Ethnopharmacol.,* **61**, 1-7 (1998).

Rao, Venugopalan and A. Ramakrishnan: Indirect assessment of hydroxy methyl gultaryl CoA reductase (NAOPH) activity in liver tissue. *Clin. Chem.,* **21**, 1523-1525 (1975).

Rao, B.K. and C.H. Rao: Hypoglycemic and antihyperglycemic activity of *Syzygium alternifolium* (Wt) Warp. Seed extracts in normal and diabetic rats. *Phytomedicine,* **8**, 88-93 (2001).

Robert, H. Palmoer: The enzymatic assay of bile acids and related 3-hydroxy steroids: It application to serum and other biological fluids. *Methods in Enzymol.,* **15**, 280 (1969).

Sambaiah, K. and M.N. Satyanarayanan: Influence of red pepper and capsaicin on body composition and lipogenesis in rats. *J. Bio. Sci.,* **4**, 425-428 (1982).

Sankarikutty, B., M.A. Sumathy Kutty, A.U. Bhat and A.G. Mathew: Studies on extraction of oils and oleoresins from cumin, fennel and fenugreek, *Spices and CocoA Journal II,* **(2)**, 25-30 (1982).

Sharma, R.D. and Raghuram: Hypolipidemic effect of fenugreek seeds: A clinical study. *Phyt. Ther. Res.,* **30**, 145-147 (1991).

Sharma, R.D., R.C. Raghuram and N. Sudhakar Rao: Effect of fenugreek seeds on blood glucose and serum lipids in type I diabetes. *Eur. J. Clin. Nutr.,* **44**, 301-306 (1990).

Srinivasan, K. and K. Sambaiah: The effect of spices on cholesterol 7 alpha – hydroxylase activity and on serum and hepatic cholesterol levels in the rats. *Int. J. Vit. Nutr. Re.*, **61**, 364-369 (1991).

Subbarao, D., N. Chandraskhara, M.N. Satyanarayanan and P. Srinivasan: Effect of curcumin on serum and liver cholesterol fed rats. *J. Nutr.,* **100**, 1307-1309 (1970).

Warnick, G.R. and Albers: A comprehensive evaluation of the heparin – Manganese precipitation procedure for estimating high density lipoprotein cholesterol. *J. Lipid Res.,* **19**, 65 (1978).

Zlatkis, A., B. Zak and A.J. Boyle: A new method for the direct determination of serum cholestrol. *J. Lab. Clin. Med.,* **41**, 486-492 (1953).