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Research Article

ANTIOXIDANT AND LIPID LOWERING EFFECTS OF *CORIANDRUM SATIVUM* IN CHOLESTEROL FED RABBITS

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ABSTRACT

In present study hypolipidemic and antioxidant action of *Coriandrum sativum* were investigated in cholesterol-fed rabbits. Cholesterol feeding (500 mg/ kg.b.wt/day) for 120 days caused a significant increase in serum total cholesterol, phospholipid, triglyceride, LDL-cholesterol and VLDL-cholesterol levels whereas HDL ratio was decreased significantly when compared with control group. The changes in the antioxidant parameters were accompanied by an increase in hepatic lipid peroxidation and reduction in glutathione (GSH) and catalase activity. The level of lipid peroxidation was reduced whereas GSH content and catalase activity were elevated after the treatment with 70% methanolic extract of *C. sativum* at the dose level of 500 mg/kg.b.wt/day. Reduced serum lipid profile and elevated HDL ratio was observed after administration of *C. sativum*. *C. sativum* extract feeding increased the faecal excretion of cholesterol and phospholipids. Histology studies showed less cholesterol deposits in the aorta of high cholesterol diet animals given *C. sativum* compared to the high cholesterol diet animals not given *C. sativum* supplement. Our study exhibited that *C. sativum* is a potent hypolipidaemic agent and provide protection against oxidative stress. In addition, *C. sativum* also reduced cholesterol deposition in the aorta of high cholesterol diet animals.

Keywords: *Coriandrum sativum*, Antioxidant, Cholesterol, Lipid peroxidation, HDL ratio.

INTRODUCTION

Elevated serum lipids have been shown to be a major risk factor for the development of coronary heart disease and atherosclerosis[1,2,3]. Oxidative stress results from an imbalance between the generation of reactive oxygen species and endogenous antioxidant systems[4]. The oxidative modification of Low-density lipoprotein (LDL) plays a pivotal role in the progression of atherosclerosis[5,6,7]. The importance of herbal hypolipidaemic has increased to fill the lacunae created by allopathic medicines. Spices offer a cheap but rich source of a number of micronutrients and other phytochemicals having antioxidant properties which help to prevent the progression of atherosclerosis[8,9]. Botanical dietary supplements (herbs) can ameliorate this process and prevent cardiovascular disease at many steps in the process[10]. *Coriandrum sativum* is widely distributed and mainly cultivated for the seeds. Previous studies claims that flavonoids can be able to reduce the hyperlipidemia. Coriander's flavonoids include quercetin, kaempferol, apigenin and acacetin and the phenolic acids identified are vanillic acid, ferulic acid (cis and trans form), p-coumaric acid and caffeic[11,12]. Coriander has been used extensively in folk medicine for its antimicrobial, antianxiety, analgesic, anticonvulsant, carminative, antifertility, antiasthamatic and insulin like activity[13]. The present study is undertaken to screen this commonly used spice coriander principally, for its ability to decrease lipid levels and oxidative stress in rabbits, fed high fat diet.

MATERIALS AND METHODS

Collection and Authentication of Plant Material

Coriandrum sativum belongs to family Umbelliferae and commonly known as "Dhania". The Plant was acquired from local market of Jaipur, Rajasthan state, India and authenticated by the authority of Department of Botany, University of Rajasthan, Jaipur. A voucher specimen number (no.) (RUBL20879) was submitted at Institute's herbarium department for future reference.

Extraction of Plant Material

Coriander seeds were powdered and extracted with 70% methanol for 24 to 36 hours by soxhlet extraction method. Then methanol was separated under reduced pressure to obtain solid mass.

Animal Model

New Zealand white male rabbits (weights 1.50-2.0 kg.) maintained on a control pellet diet and water *ad libitum* were used for the study.

Experimental Design

The rabbits were divided into the following groups-

Group 1 (G1): Control- Placebo treated for 120 days.

Group 2 (G2): Cholesterol feeding for 120 days (atherogenic diet + 500 mg chol./kg.b.wt./rabbit/day in 5ml coconut oil).

Group 3 (G3): Cholesterol feeding for 60 days (atherogenic diet + 500 mg chol./kg.b.wt./rabbit/day in 5ml coconut oil) then treated with 70% methanolic extract of *C. sativum* (500mg/kg.b.wt/day) for next 60 days i.e. from day 61-120.

Group 4 (G4): Cholesterol feeding (atherogenic diet + 500 mg chol./kg.b.wt./rabbit/day in 5ml. coconut oil) + 70% methanolic extract of *C. sativum* (500mg/kg.b.wt/day) from day 1-120 (Concurrent treatment).

Blood, aorta and Faecal Collection

At the end of the experiment all the rabbits were sacrificed and blood was collected through cardiac puncture. Serum was separated by centrifugation and stored at -20^{0}C until analysis. The heart together with the aorta (2–3 cm length) was excised from each animal. The aorta was cut at the origin and removed from the heart. A 2 mm section of the aorta of each animal was soaked in a 10 % (v/v) formocalcium solution for H & E staining. The aorta sections were processed for normal histological section. The tissue samples were ultra sectioned (5–6 µm thickness), stained with haematoxylin and eosin (H&E) and examined under a light microscope for observation of structural abnormality. During last week of experiments total faecal matter of control, hyperlipidaemic and the treated rabbits was collected daily and assayed for total cholesterol[14] and phospholipids[15].

Parameters Studied

Following biochemical parameters have been estimated in serum and liver i.e. Total cholesterol[14], High Density Lipoprotein-cholesterol (HDL cholesterol)[16], Low Density Lipoprotein-cholesterol (LDL cholesterol) and Very Low Density Lipoprotein-cholesterol (VLDL cholesterol)[17], Triglyceride (TG)[18], Phospholipids[15], Lipid Peroxidation (LPO)[19], Catalase[20], and Glutathione (GSH)[21].

Statistical Analysis

Data were represented as Mean±SEM. The differences were compared for statistical significance by "t- test" by using SPSS

software (16.0 version) and they were considered non significant at P ≤ 0.05, significant at P ≤ 0.01 and highly significant at P ≤ 0.001.

RESULTS AND DISCUSSION

The traditional Indian system of medicine holds promise for many hypocholesterolaemic and antiatherosclerotic drugs. Spices are reported to possess hypolipidaemic activity[22]. The interest in this search was to find out the effects of *C. sativum* on atherosclerosis as well as boost up the health value of human beings. They are quick and easy way to get a concentrated source of antioxidants and other plant factors.

Dietary cholesterol and an atherogenic diet induced significant increase (P≤ 0.001) in the total serum cholesterol, triglyceride, phospholipid, Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) levels whereas High-Density Lipoprotein (HDL) cholesterol / total cholesterol ratio was decreased significantly as compared to control group[23] (Table 1).

Cholesterol feeding to rabbits for 120 days caused a significant reduction (P≤ 0.001) in the activity of catalase and GSH contents whereas an increase in TBARS (measurement of lipid peroxidation) activity of liver was observed (Figure 1-3).

Table1: Effects of *C. Sativum* on serum lipid profile and faecal biochemistry in rabbits

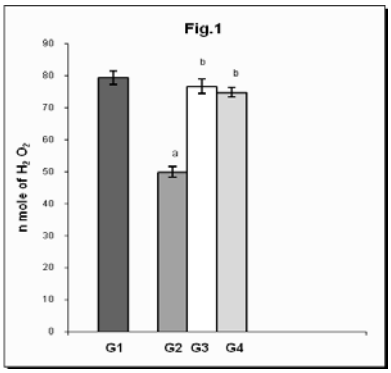
Identification	Group	Triglyceride	LDL Cholesterol	VLDL Cholesterol	HDL Ratio	Total Chlesterol		Total phospholipid	
			mg/dl			Serum mg/dl	Excreta mg/gm	Serum mg/dl	Excreta mg/gm
Control (Placebo treated) from day 1-120	G1	76.21 ± 7.57	58.52 ± 3.83	14.46 ± 1.56	51.94	128.00 ± 8.90	59.39 ± 2.15	121.62 ± 8.99	24.24 ± 1.04
Atherodiet + Cholesterol feeding* from day 1-120	G2	731.15[a] ± 30.63	750.45[a] ± 16.65	96.93[a] ± 7.59	15.42	1206.00[a] ± 45.55	102.42[a] ± 2.00	641.30[a] ± 22.05	39.07[a] ± 2.01
Atherodiet + Cholesterol feeding* from day 1-60 + *C. sativum*** from day 61-120	G3	112.50[b] ± 9.32	76.88[b] ± 13.31	27.26[b] ± 3.43	57.01	192.37[b] ± 5.32	156.34[b] ± 10.00	210.43[b] ± 14.86	57.37[b] ± 3.12
Atherodiet + Cholesterol feeding* + *C. sativum*** from day1-120 (concurrent feeding)	G4	208.83[b] ± 12.78	98.89[b] ±11.92	39.96[b] ± 3.73	79.48	208.10[b] ± 10.24	150.69[b] ± 10.12	289.10[b] ± 17.83	54.14[b] ± 2.00

Values ± 6 determinations a – P ≤ 0.001 Highly Significant Group 2 compared with group 1

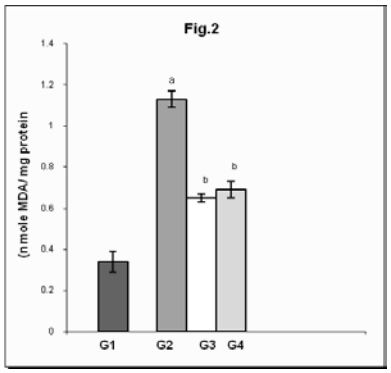
*Cholesterol feeding –500mg/ kg.b.wt in 5 ml coconut oil / day b – P ≤ 0.001 Highly Significant Group 3, 4 compared with group 2

***C. sativum* –500mg/ kg.b.wt. / day c – P ≤ 0.01 Significant

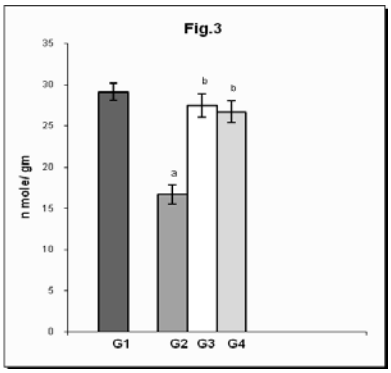
ns – Non Significant



Catalase activity



Lipid per oxidation activity



Glutathione activity

Fig. 1-3: It Shows enzyme activity of *C. sativum* treated rabbits in liver

Each column represents Mean ± SEM, n=6 (a-P≤0.001 Highly Significant; b-P≤0.001 Highly Significant & c-P≤0.01 Significant)

The histopathological changes in the ascending aorta were also observed in high cholesterol animal diet group, *C. sativum* treatment group and high cholesterol animal diet accompanied with *C. sativum* extract group when compared with control (Figure 4-7).

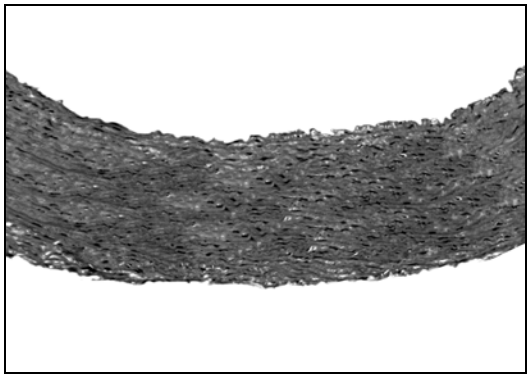


Fig. 4: Ascending Aorta of control rabbit

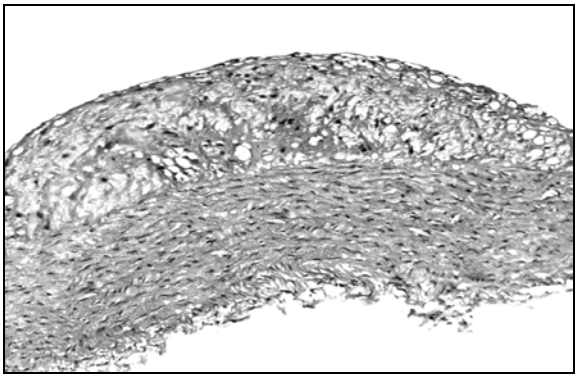


Fig. 5: Ascending Aorta of Atherodiet fed Rabbit for 120 days

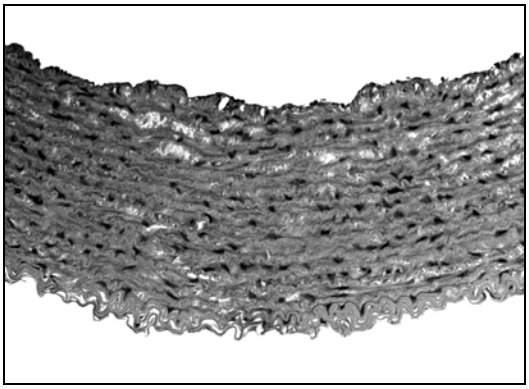


Fig. 6: Ascending Aorta of an animal on a high cholesterol diet (1-60 days) +*C. sativum* (500 mg/kg. (500 mg/kg. b.wt. /day) (61-120 days)

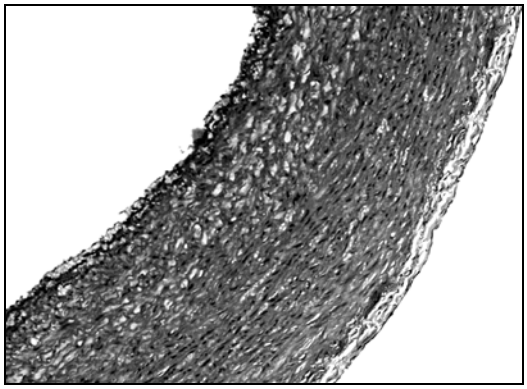


Fig. 7: Ascending Aorta of an animal on a Atherodiet feeding + *C. sativum* b.wt./day) (1-120 days-concurrent feeding)

Our study demonstrated that oral administration of *C. sativum* brought down the total cholesterol, triglyceride, phospholipids, LDL and VLDL- cholesterol levels whereas HDL cholesterol / total cholesterol ratio improved significantly. The decrease in serum cholesterol level is probably due to enhanced removal of LDL from plasma by increasing LDL-receptor activity[24].

The decrease in serum triglyceride has been attributed to stimulation of the degradation of triglycerides through increased expression and activity of lipoprotein lipase (LPL) and to decrease of hepatic synthesis and secretion of triglycerides[25]. The reduction in phospholipids level could possibly be due to a higher level of phospholipase that metabolized the blood phospholipids in hypercholesterolaemic animals[26]. The LDL- cholesterol lowering could result from a reduced LDL- synthesis and/ or an increased LDL metabolism[27]. VLDL cholesterol levels decreased by increasing the fractional catabolic rate of LDL cholesterol and lower the content of cholesterol in the VLDL and LDL particles by increasing the liver LDL receptors activity[28]. Similar results were observed in concurrent group.

Atherodiet fed rabbits showed lower faecal excretion of cholesterol and phospholipids whereas rabbits treated with *C. sativum* extract excreted more faecal cholesterol and phospholipids contents in faeces (Table 1). Plant products may lower cholesterol and phospholipids levels due to interference by plant sterols with absorption of dietary fat and cholesterol as well as increased endogenous cholesterol excretion[29,30].

The *C. sativum* seed contain total phenolic content in the extract which has antioxidant activity[31]. Administration of *C. sativum* reduced the lipid peroxidative markers in the tissue. This indicates that *C. sativum* extract react with peroxyl radicals including the inhibition of lipid peroxidation chain propagation[32]. Our findings showed that administration of *C. sativum* caused a significant increase in catalase and Glutathione (GSH) content of liver in rabbits. These results reveal that *C. sativum* is a protective antioxidant action on living cells suffering from oxidative stress induced by free radicals and hyperlipidaemia.

Ascending aorta of athero diet fed animals showed spaces within the intima tunica and media tunica. These spaces had originally contained fat droplets which were dissolved during the hemotoxylin and eosin (H & E) staining procedure and also showed the presence of atherosclerotic changes including reduction in the vascular calibre to less than half normal diameter by a greatly thickened intima. The intima nearest to the lumen consists of dense fibrous tissue, apart from one area rich in lipid filled macrophages results from atherosclerotic thickness grading. High cholesterol diet fed rabbits exhibited atheromatous plaque as compared to normal control group. The lipids deposited in the atherosclerotic lesions are mostly derived from plasma LDL, which is modified by oxidative processes, resulting in an enhanced uptake by the scavenger receptor of macrophages leading to foam cell formation[33].

In the *C. sativum* extract group plaques were decreased significantly compared to the high-cholesterol diet group and compared to concurrent group[34]. The improvement may be related to the free radical scavenging activity of this extract which inhibit LDL oxidation and can be probably explained by its known properties to stimulate bile fluid secretion as well as biliary cholesterol secretion and enhance excretion of bile acids in feces[35]. The present results are in accordance with those reported by[36,] they reported antioxidant properties of *C. sativum* fruits. The extract also exhibit significant lipid lowering activity in cholesterol fed rats[37].

CONCLUSIONS

In conclusion, our study demonstrated that oral administration of *C. sativum* extract evokes a beneficial effect on the hyperlipidemia and oxidative stress. This implies that consumption of *C. sativum* seed extract could prevent or be helpful in reducing the complications of dyslipidemia associated with oxidative stress. Hypolipidemic effects of *C. sativum* may be due to its ability to combat oxidative stress by quenching free radicals generated in the body as a result of high fat diet.

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