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Full Length Research Paper

Evaluation of hypolipidemic activity of different extracts of *Chomelia asiatica* (Linn) in rat fed with atherogenic diet

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In the present investigation, the hypolipidemic activity of different extracts of aerial parts of *Chomelia asiatica* (Linn) is shown. The evaluation dose of different extracts (petroleum ether, ethyl acetate and methanol) of *C. asiatica* was fixed at 200 mg/kg/day. Hypolipidemic activity was screened by inducing hyperlipidemia with the help of atherogenic diet (AD) in Wistar albino rats and plasma levels of different biochemical parameters such as total cholesterol, triglycerides, very low density lipoproteins (VLDL), low density lipoproteins (LDL), and high density lipoproteins (HDL) cholesterol, were determined. Thirty six male Wistar rats were divided into six groups, comprising six rats each. The rats in group 1 were treated with Standard chow diet, group 2 rats were treated atherogenic diet, group 3 rats were treated with AD + Pet.ether extracts of *C. asiatica* (200 mg/kg B.wt), group 4 rats were given AD + ethyl acetate extracts of *C. asiatica* (200 mg/kg B.wt), group 5 rats were given AD + methanol extracts of *C. asiatica* (200 mg/kg B.wt), group 6 AD + standard drug atorvastatin (1.2 mg/kg B.wt). At the end of 9 weeks, all rats were sacrificed by cervical dislocation after overnight fasting. The ethyl acetate extracts administrated rats were significantly ($p<0.001$) reduced in body weight, plasma and tissue total cholesterol, TG, phospholipids, plasma Low density lipoprotein and very low density lipoprotein; along with an increase in plasma high density lipoprotein when compared to that of AD treated groups of rats. Taking into account the outcomes, it can be concluded that the ethyl acetate extract of *C. asiatica* is a significant hypolipidemic agent, having preventive and curative activity against hyperlipidemia.

Key words: *Chomelia asiatica, atherogenic diet*, rats, hypolipidemia.

INTRODUCTION

Coronary heart disease (CHD) is the main cause of death in Western countries and Asia. Among CHDs, ischemic heart disease (IHD) leads to increase in mortality rate. The number of heart patients suffering from IHD worldwide is gradually increasing. About 41% of the deaths in the United States are due to heart diseases

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(Dallas, 2001). Extensive epidemiological studies reported that increased blood cholesterol level is a major cause of coronary heart diseases (Gambhir et al., 2001). Studies have also demonstrated that the relationship between plasma cholesterol levels and the development of IHD hypercholesterolemia is generally associated with an increase in plasma concentration of low density lipoprotein and very low density lipoprotein. The lowering of elevated levels of LDL cholesterol can slow the progression of atherosclerotic lesions.

The current hostility to hyperlipidemic drugs like statins and manufactured cancer prevention agents like probucol are broadly used to treat hyperlipidemic patients. Shockingly, these medications are not free of reactions. To give novel medications to hyperlipidemia, it has been centered on the common items that do not have very many reactions. The world ethnobotanical data reported different home grown drugs from the herbs that are utilized for normalling atherosclerosis and the complexities in patients. Around 80% of the third world populaces are totally reliant on conventional medications. Medicinal plants contain large number of pharmacological active phytoconstituents that might serve as lead for the development of activity, and they are safe and cheap novel drugs. A number of medicinal plants have shown their beneficial activity on the cardiovascular disease (CVD) by virtue of their hypolipidemic, antianginal, antioxidant, and cardioprotective activities (Wang and Ng, 1999; Dwivedi, 2004). Hence, the objective of the present investigation is to ascertain the hypolipidemic activities of different extracts of aerial parts of *C. asiatica* in experimental animals.

MATERIALS AND METHODS

Chemicals and reagents

All the chemicals and reagents were purchased from Sigma, SD fine chemicals, and Fisher. The Fisher chemicals were of analytical grade.

Plant materials (study species)

Chomelia asiatica (Linn) belongs to the Rubiaceae family, commonly known as *Tharani in tami*: *Kuppipoovu, Tharana* in Makayalam. *Chomelia Gaertn* has about 370 species distributed in tropical and subtropical Africa, Asia, Madagascar, and the Pacific Islands. *C. asiatica* (Linn) is a common species found in India, Srilanka, and China. The leaves or powder extracts of *C. asiatica* are used as antimicrobial activities (Jayasinghe et al., 2002). It accounts for pain relieving and mitigating activities (Amutha et al., 2012). The parts of *Tarenna asiatica* (Rubiaceae) plants are customarily used to advance suppuration (Anonymous, 1976), as anthelmintic (Ramarao and Henry, 1996) and antiulcer operator (Rao et al., 2006). Its phytochemical constituents are accounted to be antiseptic (Vinothkumar et al., 2011), injury healing (Anjanadevi and Menaga, 2013) and antioxidant (Ramabharathi et al., 2014). Moreover, the extract of shoots, leaves and fruits are purportedly dynamic against *Mycobacter phlei* (Rajakaruna et al., 2002).

Collection and identification of plant materials

The aerial parts of *C. asiatica* (Linn) were gathered from Shencottai, Tirunelveli District, Tamil Nadu, and India. Taxonomic identification (Plant deposition no is Au/CA/810) was made from Botanical Survey of Medical Plants Unit Siddha, Government of India. Palayamkottai, Tirunelveli. The aerial parts of *C.asiatica* (Linn), were dried under shade, separated, and pulverized by a mechanical processor, through a 40 mesh sieve.

Preparation of different extracts

The above powered materials were successively extracted with Petroleum ether (40 to 60°C), using hot continuous percolation method in Soxhlet apparatus (Harborne, 1984) for 24 h. The marc was subjected to ethyl acetate (76 to 78°C) for 24 h and then marc was subjected to methanol for 24 h. The extracts were concentrated, using a rotary evaporator and subjected to freeze drying in a lyophilizer, until a dry powder was obtained. The percentage yields of pet.ether extract was 2.7%, ethyl acetate extract was 7.4 and 8.2% methanol extract was obtained.

Animals and treatment

Male Wistar rats of 16 to 19 weeks age, weighing 150 to 175 g were procured from the Central Animal House, Nizam Institute of Pharmacy and Research Centre, near Ramoji Film City, Deshmukhi, Hyderabad, Telugana, India. The rats were kept in cages, 2 per cage, with 12:12 h light and dark cycle at 25±2°C. The rats were maintained on their respective diets and water *ad libitum.* Animal Ethical Committee's clearance (Approval number is NIPRC/IAEC/Ph.D/2015/01) was obtained for the study.

Experimental design

The rats were divided into the following 6 groups, 6 rats each:

Group I: Standard chow pellet; Group II: Atherogenic diet (AD); Group III: AD plus treated with pet.ether extract of *C. asiatica* (200 mg/kg B.wt); Group IV: AD plus treated with Ethyl acetate (EA) extract of *C. asiatica* (200 mg/kg B.wt); Group V: AD plus treated with methanolic extract of *C.asiatica* (200 mg/kg B.wt); and Group VI: AD plus treated with Standard drug atorvastatin (1.2 mg/kg B.wt)

Animal diet

The compositions of the two diets were as follows (Kottai Muthu et al., 2005).

Normal diet

Wheat flour, 22.5%; simmered bengal gram powder, 60%; skimmed milk powder, 5%; casein, 4%; refined oil, 4%; salt blend with starch, 4%; and vitamin and choline blend, 0.5%.

High fat diet

Normal diet with coconut oil, 9%; cholesterol, 0.4%.

Assessment of hypolipidemic activities

Rats of III, IV and V groups were orally fed with the different

Table 1. Average body weight gain in normal and treated rats**.**

Treatment groups	Before treatment weight (g)	After treatment weight (g)	Average Body weight gain (g)
I	147.63±0.87^{bNS}	193.83±0.88^{b}*	46.20±0.38 ^{b}*
II	148.21±1.13^{aNS}	285.24±1.34^{a}**	137.03±1.19^{a}**
III	152.96 ± 0.33$^{aNS, bNS}$	265.35± 0.71$^{aNS, b*}$	112.39 ± 0.39$^{aNS, b}$*
IV	152.30±0.92$^{aNS, bNS}$	223.37±0.66$^{aNS, b**}$	70.65±0.22$^{aNS, b}$*
V	150.65±0.46^{aNS,bNS}	255.26±0.09$^{aNS, b*}$	104.61 ± 0.36 $^{aNS, b}$*
VI	162.68±0.88$^{aNS, bNS}$	222.01±0.43$^{aNS, b**}$	59.33±0.52$^{aNS, b}$**

Values are mean ± SE of 6 rats; *P* values: *<0.001, **<0.05; NS: Non-significant; a → group I compared with groups II, III, IV, V, VI. b → group II compared with groups III, IV, V, VI. Group I: standard chow pellet. (Normal); Group II: atherogenic diet. III Group: AD + Pet.ether extracts of *C. asiatica* (200 mg/kg B.wt); Groups IV: AD + Ethyl acetate extracts of *C. asiatica* (200 mg/kg B.wt); Group V: AD + Methanol extracts of *C. asiatica* (200 mg/kg B.wt); Group VI: AD + standard drug atorvastatin (1.2 mg/kg B.wt).

extracts of *C. asiatica* (200 mg/kg/day) and rats of VI group were fed with standard drug atorvastatin. Both the extracts and atorvastatin were suspended by 2% tween 80 (Waynforth, 1980) separately and nourished to the respective rats, using oral intubation. Toward the end of sixty three days, every one of the creatures was sacrificed by cervical dislocation after overnight fasting. The liver, heart and aorta were cleared of sticking fat, weighed precisely and utilized for the preparation of homogenate. Animals were given enough care as per the Animal Ethical Committee's recommendations.

Biochemical estimation

Plasma samples were analyzed for TC, HDL-cholesterol and TG were estimated using Boehringer Mannheim kits by Erba Smart Lab analyzer USA. Low density lipoprotein and very low density lipoprotein were calculated, using Friedewald et al. (1972) method. Ester cholesterol and free cholesterol (Sperry and Webber, 1950) were analyzed, using digitonin. Parts of the tissues from liver, heart and aorta were marked, weighed, and homogenized with methanol (3 volumes). The lipid extracts were obtained using Folch et al. (1957) method. Extracts were used for the estimation of ester cholesterol and free cholesterol, triglycerides (Foster and Dunn, 1973) and phospholipids (Zilversmit and Davis, 1950). Plasma total cholesterol: High density lipoprotein cholesterol ratio. Low Density Lipoprotein cholesterol: High density lipoprotein ratio was also utilized to access the atherogenic risk.

Statistical analysis

The results were expressed as mean ± SE of 6 rats in each group. The statistical significance between the groups was analyzed, using one way analysis of variance (ANOVA); followed by Dunnet's multiple comparison tests. The significance level was fixed at $p < 0.05$.

RESULTS

The body weight changes in normal and treated rats were appeared in Table 1. The body weight of AD treated rats (Group II) were increased significantly ($p<0.001$) in comparison with normal rats (group I). The average body weight gain was reduced significantly by the administration of EA extracts of *C. asiatica* at the dose of 200 mg/kg body weight, as well as atorvastatin 1.2 mg/kg in comparison with AD rats (Group II).

The activities of different extracts of *C. asiatica* on plasma lipid parameters were summarized in Table 2. The lipid parameters levels were significantly ($p<0.001$) increased in the rats fed with AD in comparison with the normal rats (Group I). The treatment of ethyl acetate extracts of *C. asiatica* of rat fed with AD significant ($p<0.001$) reduction in the level of plasma total cholesterol, free cholesterol, ester cholesterol, TG, phospholipids and free fatty acids as compared to AD rats (Group II). The treatment of ethyl acetate extracts of *C. asiatica treated* rats with AD showed that the plasma lipid parameters were restored to normalcy as well as standard drug treated rats. Promising results in reduced atherogenic index by ethyl acetate extracts of *C. asiatica* was found in Table 2. The AI is utilized as a marker to assess the susceptility of atherogenesis. The ethyl acetate extracts of *C. asiatica* showed an improvement of the cardio vascular risk level by decrease of AI in the treated group by more than 61% ($p < 0.01$), as comparison to AD rats (Group II).

As shown in Table 3, the plasma HDL-cholesterol levels were reduced in AD rats (Group II) as compared to normal rats. After treatment with ethyl acetate (EA), extracts of *C. asiatica* significantly increase the high density lipoprotein cholesterol concentration in rats fed with AD as compared to AD rats. Rats fed with AD (Group II) had elevated levels of plasma low density lipoprotein and very low density lipoprotein cholesterol, when compared with the normal rats (Group I). The treatment of EA extracts of *C. asiatica* significantly reduces the levels of low density lipoprotein and very low density lipoprotein cholesterol in plasma, when compared to AD rats (Group II). The ratios of TC: high density lipoprotein cholesterol and low density lipoprotein: high density lipoprotein-cholesterol are presented in Table 3. AD rats caused significant ($P<0.001$) increase in the ratios of TC: high density lipoprotein cholesterol and low density lipoprotein: high density lipoprotein cholesterol. Treatment of EA extracts of *C. asiatica* along with AD was found to significantly reduce the ratios of high density lipoprotein cholesterol. TC and low density

Table 2. Activity of different extracts of *C. asiatica on* plasma lipid parameters in normal and treated rats.

Group	Total cholesterol (mg/dl)	Free cholesterol (mg/dl)	Ester cholesterol (mg/dl)	Free fatty acid mg/dl)	Phospholipid (mg/dl)	Triglyceride (mg/dl)	AI
I	114.79± 0.35^{b}*	26.05±0.07^{b}*	88.73±0.39^{b}*	42.01±0.11^{b}*	104.87±0.17^{b}**	85.79±0.15^{b}*	1.91.05±0.01^{b}*
II	179.68±0.49^{a}*	45.31±0.23^{a}*	134.36±0.63^{a}*	59.96±0.36^{a}*	149.99±0.24^{a}**	170.39±0.44^{a}*	4.48±0.03^{a}*
III	163.83±0.44^{a}**,^{b}**	41.71±0.30^{a}*,^{b}*	122.18±0.21^{a}**,^{b}*	54.68±0.27^{a}*,^{b}**	143.01±0.17^{a}*,^{b}**	153.89±0.16^{a}*,^{b}**	3.81±0.01^{a}**,^{b}**
IV	99.85±0.15 ^{a}**,^{b}*	23.24±0.34^{a}*,^{b}*	76.61±0.32^{a}*,^{b}*	39.76±0.19^{a}*,^{b}**	108.35±0.29^{a}*,^{b}*	78.74±0.21^{a}*,^{b}*	1.75±0.01^{a}*,^{b}*
V	123.29±0.45^{a}*,^{b}*	36.78±.0.23^{a}*,^{b}*	86.52±0.50^{a}*,^{b}*	48.34±0.34^{a}*,^{b}**	133.61±0.32^{a}*,^{b}**	119.93±0.41^{a}*,^{b}**	2.78±0.01^{a}*,^{b}*
VI	97.57±0.29 ^{a}*,^{b}*	21.34±0.33^{a}*,^{b}*	76.23±0.15^{a}*,^{b}*	38.49±0.16^{a}*,^{b}*	100.42±0.20^{a}*,^{b}*	70.46±0.30^{a}*,^{b}*	1.72±0.01^{a}*,^{b}*

Values are expressed as mean ± SE (n=6 rats), *P* values: * < 0.001, ** < 0.05.

Table 3. Activity of different extracts of *C. asiatica* on plasma lipoprotein in normal and treated rats.

Group	High density lipoprotein (mg/dl)	Low density lipoprotein (mg/dl)	Very low density lipoprotein (mg/dl)	LDL- c/HDL-c ratio	HDL-c/ TC ratio
I	59.94±0.24^{b}*	36.35±0.22^{b}*	17.15±0.04^{b}*	0.60±0.01^{b}*	0.52±0.01^{b}*
II	40.02±0.24^{a}*	101.40±0.16^{a}*	34.07±0.08^{a}*	2.53±0.01^{a}*	0.22±0.01^{a}*
III	42.89±0.18^{a}**,^{b}*	80.55±0.20^{a}*,^{b}*	30.77±0.03^{a}*,^{b}*	1.87±0.01^{a}**,^{b}*	0.26±0.01^{a}*,^{b}*
IV	56.93±0.18^{a}*,^{b}*	30.21±0.24^{a}*,^{b}*	15.75±0.04^{a}*,^{b}*	0.53±0.01^{a}*,^{b}**	0.56±0.01^{a}*,^{b}*
V	44.23±0.15^{a}*,^{b}*	44.73±0.20^{a}*,^{b}*	23.98±0.08^{a}*,^{b}**	1.03±0.01^{a}*,^{b}**	0.35±0.02^{a}*,^{b}*
VI	56.35±0.22^{a}*,^{b}*	30.15±0.21^{a}*,^{b}*	14.06±0.04^{a}*,^{b}*	0.53±0.01^{a}*,^{b}*	0.57±0.05^{a}*,^{b}*

Values are expressed as mean ± SE (n=6 rats), *P* values: * < 0.001, ** < 0.05.

Table 4. Activity of different extracts of *C. asiatica* on tissues ester cholesterol profile in normal and experimental rats.

Group	Ester cholesterol (mg/g tissue)		
	Liver	Heart	Aorta
I	2.00±0.01^{b}*	2.83±0.02^{b}*	2.30±0.06^{b}*
II	3.45±0.02^{a}*	7.19±0.04^{a}*	7.21±0.03^{a}*
III	2.97±0.07^{a}*,^{b}**	5.36±0.03^{a}*,^{b}**	6.67±0.04^{a}*,^{b}*
IV	1.86±0.04^{a}*,^{b}*	2.80±0.04^{a}**,^{b}*	2.79±0.02^{a}*,^{b}**
V	2.70±0.04^{a}*,^{b}*	4.72±0.08^{a}*,^{b}*	5.22±0.04^{a}*,^{b}*
VI	1.84±0.01^{a}*,^{b}*	2.58±0.07^{a}*,^{b}*	2.65±0.04^{a}*,^{b}*

Values are expressed as mean ± SE (n=6 rats), *P* values: * < 0.001, ** < 0.05.

lipoprotein cholesterol: high density lipoprotein cholesterol compared to AD rats.

Activity of free and ester cholesterol in tissue were shown in Tables 4 and 5. The significant (P<0.001) elevated levels of both free and ester cholesterol were observed in tissues of rats fed

Table 5. Activity of different extractss of *C asiatica* on tissues free cholesterol in normal and treated rats.

Group	Free cholesterol (mg/g tissue)		
	Liver	Heart	Aorta
I	0.89±0.01^{b}*	0.79± 0.01 ^{b}*	0.55±0.17^{b}*
II	1.44±0.01^{a}**	1.12±0.02 ^{a}*	2.51±0.02^{a}*
III	1.24±0.02^{a}**,^{b}**	1.01±0.01 ^{a}*,^{b}**	1.87±0.01^{a}*,^{b}**
IV	0.90 ±0.01^{a}*,^{b}*	0.64±0.01 ^{a}*,^{b}*	0.79±0.01^{a}*,^{b}*
V	1.03±0.01^{a}*,^{b}*	0.88±0.01 ^{a}*,^{b}**	1.39±0.02^{a}*,^{b}**
VI	0.84±0.01^{a}*,^{b}*	0.61±0.01 ^{a}*,^{b}*	0.72±0.01^{a}*,^{b}*

Values are expressed as mean ± SE (n=6 rats), *P* values: * < 0.001, ** < 0.05.

Table 6. Activity of different extracts of *C. asiatica* on tissues TG level in normal and treated rats.

Group	Triglyceride (mg/g tissue)		
	Liver	Heart	Aorta
I	9.54±0.04^{b}*	11.43±0.08^{b}*	11.56±0.12^{b}*
II	30.50±0.02^{a}*	49.36±0.08^{a}*	23.19±0.10^{a}*
III	28.29 ± 0.09 ^{a}*,^{b}**	46.78±0.26^{a}**, ^{b}**	22.41±0.14^{a}*, ^{b}**
IV	10.42±0.08^{a}*, ^{b}*	19.24± 0.10 ^{a}*, ^{b}*	14.25±0.05^{a}*, ^{b}*
V	26.41±0.08^{a}*, ^{b}*	40.17± 0.10 ^{a}**, ^{b}*	19..37±0.05^{a}*, ^{b}*
VI	11.56±0.08^{a}*,^{b}*	20.26±0.04^{a}*, ^{b}*	13.31 ± 0.05 ^{a}*, ^{b}*

Values are expressed as mean ± SE (n=6 rats), *P* values: * < 0.001, ** < 0.05.

Table 7. Activity of different extracts of *C. asiatica on* tissues phospholipids level in normal and treated rats.

Group	Phospholipids (mg/g tissue)		
	Liver	Heart	Aorta
I	18.46±0.07^{b}*	25.49 ±0.08^{b}*	9.37±0.09^{b}*
II	27.46±0.14^{a}*	37.39±0.13^{a}*	18.26± 0.07^{a}*
III	26.34± 0.10^{a}**,^{b}*	35.29±0.10^{a}**,^{b}**	12.37 ± 0.06^{a}*, ^{b}**
IV	19.36 ± 0.09^{a}*,^{b}*	26.24±0.04 ^{a}*,^{b}*	10.30± 0.04^{a}*, ^{b}*
V	24.67 ± 0.24^{a}*,^{b}**	34.527±0.07 ^{a}*,^{b}**	16.35± 0.04^{a}*, ^{b}*
VI	18.66±0.14^{a}*,^{b}*	27.33±0.12^{a}*,^{b}*	11.48± 0.08^{a}*, ^{b}*

Values are expressed as mean ± SE (n=6 rats), *P* values: * < 0.001, ** < 0.05.

with AD (Group II), when compared to normal rats (Group I). Both tissues were free and ester cholesterol reduction remarkably treats the AD rats with EA extracts of *C. asiatica* (Group IV) compared with other two extracts treatment group.

The activity of different extracts of *C. asiatica* on tissue TG is shown in Table 6. The levels of TG tissue were increased in rats fed with AD (Group II), as compared to normal rats (Group I). Both plasma and tissue TG levels were significantly reduced in rats treated with EA extracts of *C. asiatica,* at the dose of 200 mg/kg and as well as standard drug along with AD, when compared to AD rats (Group II).

Activities of different extracts of *C. asiatica* on tissue phospholipids and free fatty acid are presented in Tables 7 and 8. The levels of tissue phospholipids and free fatty acids were significantly increased in rats fed with AD (Group II), as compared to normal rats (Group I). After the treatment of EA extracts of *C. asiatica* along with AD were shown, significantly (p<0.001) reduced the level of phospholipids and free fatty acids in comparison with AD fed rats (Group II).

DISCUSSION

The male albino rats utilized in the current investigation were reported as ideal hypercholesterolemic models in

Table 8. Activity of different extracts of *C. asiatica* on tissues free fatty acids level in normal and treated rats.

Group	Free fatty acids (mg/g tissue)		
	Liver	Heart	Aorta
I	10.66±0.15^{b}*	14.28±0.04^{b}*	10.30±0.06^{b}*
II	31.38±0.10^{a}*	49.38±0.06^{a}*	27.53±0.12^{a}*
III	29.21 ± 0.08 ^{a}*,^{b}**	46.24±0.50^{a}**, ^{b}**	25.31±0.07^{a}*, ^{b}**
IV	11.39±0.09^{a}*, ^{b}*	20.87± 0.10 ^{a}*, ^{b}*	14.34±0.08^{a}*, ^{b}*
V	25.29±0.06^{a}*, ^{b}*	37.39± 0.08 ^{a}**, ^{b}*	22.40±0.05^{a}*, ^{b}*
VI	10.34±0.05^{a}*,^{b}*	19.36±0.07^{a}*, ^{b}*	13.51 ± 0.10 ^{a}*, ^{b}*

Values are expressed as mean ± SE (n=6 rats), *P* values: * < 0.001, ** < 0.05.

previous studies (Mary et al., 2003). The plasma lipid parameters in plasma and tissue were increased in rats fed with AD (Group II) (Chandar et al., 1996; Guido and Joseph, 1992). The decrease in the lipid parameters levels in rats fed with ethyl acetate extracts of *C. asiatica* may be attributed to the elevated level of serum HDL, increase in the activity of lipoprotein lipase and plasma LCAT; which are known to be involved in transport of tissue cholesterol to liver for its excretion. Hence the hypolipidemic activity of the extracts seems to be mediated through elevated hepatic clearance of cholesterol, reduced the regulation of lipogenic enzymes like glucose-6-phosphate dehydrogenase and malate dehydrogenase as well as cholesterol biosynthetic enzyme HMG-CoA reductase.

Earlier investigations demonstrated constructive association in LDL cholesterol level in serum and risk of atherosclerosis (Kannel et al., 1971). The elevated levels of Low density lipoprotein and very low density lipoprotein cholesterol are the main risk factor for atherosclerosis (Temme et al., 2002; Parthasarathy et al., 1989). The low level of HDL-C was found in AD rats. It has been demonstrated that an elevated concentration of High density lipoprotein correlates inversely with atherosclerosis (Mayes et al., 1996). The present report demonstrates a significant reduction in plasma low density lipoprotein and very low density lipoprotein level, as a function of treatment of ethyl acetate extracts of *C. asiatica* in experimental animals. The decrease in the serum total cholesterol concentration may be due to increase in HDL cholesterol, which normally facilitates catabolism of excess cholesterol.

The high level of plasma and tissue triglyceride in rats fed with AD. AD rats significant elevated level of plasma TG due to reduction in the activity of lipoprotein lipase (Kavitha and Nalini, 2001). Similarly, there is a high level of plasma and tissue phospholipids also in rats fed with AD; this may be due to the reduced phospolipase effect (Mirhadi et al., 1991; Whereat and Robinowitz, 1975). Treatment of ethyl acetate extracts of *C. asiatica* significantly decreases the level of TG and phospholipids when compared to AD rats. The plant extracts may have prompt lipoprotein lipase activities resulting in reduced plasma TG and might enhance the uptake of TG from plasma by skeletal muscle and adipose tissues (El-Hazmi and Warsy, 2001).

Conclusion

The current investigation demonstrated that AD-induced hyperlipidemic was associated with ethyl acetate extracts of aerial parts of *C. asiatica,* reducing plasma free cholesterol (FC), esterified cholesterol (EC), total cholesterol (TC) triglyceride, low density lipoprotein and increase plasma high density lipoprotein-C. Also, the treatment with the ethyl acetate extracts of aerial parts of *C. asiatica* gives the protection against AD induced damage to the cardiac tissues probably through constructive modulation of the cardiac antioxidant system. The findings hence support the therapeutic use of the ethyl acetate extracts of aerial parts of *C. asiatica* in the management of cardiovascular complications like atherosclerosis.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interest.

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