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Protective effect of lemongrass oil against dexamethasone induced hyperlipidemia in rats: possible role of decreased lecithin cholesterol acetyl transferase activity

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ABSTRACT

Objective: To evaluate the anti-hyperlipidemic activity of lemongrass oil against in dexamethasone induced hyperlipidemia in rats. **Methods:** Administration of dexamethasone was given at 10 mg/kg, sc. to the adult rats for 8 d induces hyperlipidemia characterized by marked increase in serum cholesterol and triglyceride levels along with increase in atherogenic index. **Results:** Lemongrass oil (100 and 200 mg/kg, po.) treatment has showed significant inhibition against dexamethasone hyperlipidemia by maintaining the serum levels of cholesterol, triglycerides and atherogenic index near to the normal levels and the antihyperlipidemic effect of the lemongross oil was comparable with atorvastatin 10 mg/kg, po. The possible mechanism may be associated with decrease in lecithin cholesterol acetyl transferase (LCAT) activity. **Conclusions:** These results suggested that Lemon gross oil possess significant anti-hyperlipidemic activity.

1. Introduction

Hyperlipidemia contributes significantly in the manifestation and development of atherosclerosis and coronary heart diseases (CHD). Atherosclerosis is a common condition in both developed and developing countries and is now recognised to be an inflammatory condition leading to the development of ischemic heart diseases, cerebrovascular diseases and peripheral vascular diseases. Ischemic heart disease is a major risk factor in the pathogenesis of preoperative adverse cardiovascular events which lead to significant morbidity and mortality within the high risk surgical patient population[1]. The risk of CHD can be reduced by drugs which can lower the lipids and cholesterol levels. Modern interest in natural products has inspired the search for new effective cholesterol lowering agents from these sources.

Many medicinal plants like *Paeonia lactiflora* (*P. lactiflora*)[2], *Pleurospermum kamtschaticum* (*P. kamtschaticum*)[3], *Ananas comosus* (*A. comosus*)[4] have been reported to reduce the lipids and cholesterol levels in body. Lemongrass oil is obtained from the leaves of plant *Cymbopogon citratus* (*C. citratus*), family Poaceae and has been reported to have analgesic[5] antimutagenic[6], antifungal[7] and antimicrobial activity[8]. Lemongrass oil, an essential oil rich in geraniol and citral, has also been reported to reduce cholesterol modestly in hypercholesterolemic subjects[9]. However the literature does not show any other study for the antihyperlipidemic activity of lemongrass oil in experimental animals.

Hence the present study was undertaken to investigate the steam distilled crude extract of leaves of lemongrass (lemongrass oil) for anti-hyperlipidemic activity against dexamethasone induced hyperlipidemia in rats[10].

2. Materials and methods

2.1. Drugs

Lemongrass oil (Himalaya Drug Company, Bangalore),

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atorvastatin (Biocon, Bangalore), dexamethasone sodium phosphate (Strides Arco Labs, Bangalore), biochemical kits (Enzokits, Ranbaxy, India), the solvents and other chemical used for the study were of analytical grade and purchased from local firms.

2.2. Animals

The inbred Adult male Wistar albino rats (150-200 g) were acclimatized for seven days under standard husbandry conditions, *i.e.*; room temperature of (25 ± 1)℃; relative humidity 45%-55% and a 12:12 h light/ dark cycle. The animals had free access to standard rat pellet (Amrut feeds, Bombay), with water supplied *ad libitum* under strict hygienic conditions.

The experimental protocol was approved by the Institutional Animal Ethical Committee (IAEC) of Al-Ameen College of Pharmacy, Bangalore (Karnataka) prior to the experiments and all the experiments were conducted in strict compliance according to ethical principles and guidelines provided by Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).

2.3. Experimental protocol

Adult male Wistar albino rats (150-200 g) were divided into 5 groups, each group consists of six animals. The first group of rats fed with normal laboratory diet alone served as normal control. The second group of rats were administered with dexamethasone (10 mg/kg, sc.) for 8 consecutive days served as pathogenic control. The third, fourth and fifth group of rats received dexamethasone (10 mg/kg, sc.) and simultaneously treated orally with 10 mg/kg atorvastatin, 100 mg/kg lemongrass oil and 200 mg/kg lemongrass oil respectively for 8 consecutive days; the atorvastatin treated group was served as a standard. At the end of experimental period, all the animals were fasted overnight, blood samples were taken through retro-orbital plexus using heparinised capillary tubes under light ether anaesthesia. The blood was allowed to clot for 30 min at room temperature and centrifuged at 5 000 rpm, the upper layer of serum was collected in clean centrifuge tubes, which is taken for the biochemical analysis.

The serum samples were analyzed for cholesterol, triglycerides, HDL-cholesterol using the respective biochemical kits, while LDL-cholesterol[11] and Atherogenic index[12,13] were calculated using the following formula.

LDL-C= Cholesterol − (Triglyceride/5) − HDL-C

Atherogenic index = (Total cholesterol − HDL-C)/HDL-C

2.4. Statistical analysis

Values are expressed as mean±SEM from 6 animals. Statistical differences in mean were analyzed using one way ANOVA (analysis of variance) followed by Dunnett's test. $P<0.05$ was considered significant.

3. Results

Dexamethasone administration for 8 consecutive days caused acute hyperlipidemia in rats wherein the serum levels of cholesterol, triglycerides and atherogenic index was increased by 167%, 248% and 210% respectively (Table 1). However, there was no significant difference in serum HDL-Cholesterol and LDL-cholesterol levels. In contrast, Atorvastatin (10 mg/kg, po.) treatment showed significant protection against dexamethasone induced elevated serum cholesterol, triglyceride and atherogenic index in statistically significant manner ($P < 0.05$, $P < 0.01$, $P< 0.05$ respectively) and these values are comparable to normal control group. Similarly the group of rats treated with lemongrass oil 100 and 200 mg/kg also showed significant reversal of cholesterol ($P < 0.001$ and $P < 0.01$), triglycerides ($P < 0.01$ and $P < 0.01$) levels and atherogenic index ($P < 0.01$ and $P < 0.05$).

4. Discussion

The animal model of dexamethasone induced hyperlipidemia in rats is been successfully used for evaluating the lipid lowering activity of natural products and chemical entities[10,14,15]. The corticoid treatment is known to cause an increase in the secretion of VLDL by liver and in addition corticoids may also stimulate VLDL formation by the intestine. The low level of liver lipoprotein lipase activity could have been responsible for the high VLDL-Triglyceride level and this also causes imbalance in lipid metabolism

Table 1
Protective effect of lemongross oil on dexamethasone induced hyperlipidemia in rats (n = 6).

Treatment	Cholesterol(mg/dL)	Triglycerides(mg/dL)	HDL-cholesterol(mg/dL)	LDL-cholesterol(mg/dL)	Atherogenic index
Normal control	56.37 ± 3.11	106.70 ± 10.36	21.82 ± 1.27	13.21 ± 3.50	1.620 ± 0.180
Pathogenic control	94.36 ± 8.78**	264.80 ± 35.15**	22.48 ± 3.10	18.92 ± 8.11	3.404 ± 0.447**
Atorvastatin 10 mg/kg	62.02 ± 6.19†	149.30 ± 27.43††	22.61 ± 2.54	9.55 ± 6.90	1.818 ± 0.248†
Lemongrass oil 100 mg/kg	44.06 ± 3.94†††	145.50 ± 21.79††	19.06 ± 3.16	4.10 ± 0.60†	1.541 ± 0.364††
Lemongrass oil 200 mg/kg	57.19 ± 7.06††	113.50 ± 10.45††	22.13 ± 2.42	12.37 ± 8.09	1.713 ± 0.439†

The values are Mean ± SEM, (n = 6). $^{*}P<0.05$, $^{**}P<0.01$, $^{***}P<0.001$ Pathogenic control *vs* normal control. $^{\dagger}P<0.05$, $^{\dagger\dagger}P<0.01$, $^{\dagger\dagger\dagger}P<0.001$ Treatments *vs* pathogenic control.

leading to hyperlipidemia[14]. In present study, treatment with lemongrass oil (100 and 200 mg/kg) has significantly reduced the serum cholesterol, triglycerides levels and atherogenic index when compared to dexamethasone *per se* treated animals, indicating the ability of lemongrass oil to reverse the hyperlipidemia caused by dexamethasone administration.

Furthermore, the dexamethasone treatment is been reported to show an increase in free cholesterol along with the decrease in Lecithin cholesterol acetyl transferase (LCAT) activity in experimental animals, co-treatment with lemongrass oil may be able to reverse the plasma free cholesterol levels and LCAT activity near to normal, as in case of Garcinia cambogia treated rats[10]. The low lipoprotein lipase activity in the liver may be responsible for low degradation of lipoprotein, triglycerides and cholesterol. Hence the hyperlipidemic effect of dexamethasone was found to be reversed by co-treatment with lemongrass oil and further this was also found to be comparable with that of atorvastatin.

In the present study, co-administration of lemongrass oil (100 & 200 mg/kg, po.) has significantly normalized the dexamethasone induced increased in serum cholesterol, triglycerides levels and also decreased the atherogenic index. These findings would support the therapeutic property of lemongrass oil against dexamethasone induced hyperlipidemia and hypercholesterolemia in rats.

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Conflicts of interests

Authors declare that there are no conflicts of interest.

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