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Antihyperlipidemic activity of methanolic extract of *Abroma augusta*

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Abstract

Hyperlipidemia is a major cause of cardiovascular diseases. Approximately 10% of the global population is affected by dyslipidemia. At present, hyperlipidemia is most commonly treated with lipid-lowering drugs, some of which are associated with serious adverse side effects. Many medicinal plants have been found to be useful to successfully manage hyperlipidemia. The present study was undertaken to study Antihyperlipidemic effect of methanol extract of *Abroma augusta* leaves. The powdered crude leaves were extracted in a soxhlet apparatus with methanol. Extract was dried at 40°C under pressure and stored at 4°C until use. Phytochemical screening of extract was done by standard methods. Methanol extract of *Abroma augusta* was studied for acute oral toxicity according OECD guidelines No. 423 on Wistar rats. High cholesterol diet induced hyperlipidemia model was used to study antihypercholestremic effect. After 7 days samples from animals were collected. Serum samples were analyzed spectrophotometrically for cholesterol, triglyceride and HDL-C. Treatment with methanolic extract of *Abroma augusta* showed a marked reduction in TC, TG and LDL-c levels ($p<0.05$). There was a marked reduction in TC: HDL-c ratio, and in the atherogenic index after the treatment of rats with 400mg/kg dose of methanol extract of *Abroma augusta*. The findings of current study proved that the methanol extract of *Abroma augusta* effectively treated hyperlipidemia in murine model may be due to presence of flavonoids, polyphenols, alkaloids found in extract. However isolation and characterization of active constituent responsible for this activity is necessary.

Key-Words: Phytochemical screening, Methanolic extract and *Abroma augusta*

Introduction

Hyperlipidemia is a major cause of cardiovascular disease including atherosclerosis and atherosclerosis-associated conditions, such as coronary heart disease (CHD), ischemic cerebro-vascular disease and peripheral vascular disease. [1] Hyperlipidemia is the presence of high levels of cholesterol in the blood. [2] It is not a disease but a metabolic derangement of lipid metabolism rank as the most firmly established and best understood risk factor for atherosclerosis and cardiovascular complications.[3] Approximately 10% of the global population is affected by dyslipidemia .[4, 5] Cholesterol is the essential for human body but some types of cholesterol has very adverse effect on human body and leads to heart attack and death. [6, 7] Dyslipidemia is one of the most common complications of Diabetes Mellitus.[8] The treatment of hyperlipidemia depends on the patients cholesterol profile. Many antihyperlipidemic agents like statin, fibrates, niacin, bile acids, ezitimibe etc reduce cholesterol level with different condition.[9, 10]

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The statin corrects the altered blood lipid profile by inhibiting the bio-synthesis of cholesterol and the fibrates acts by enhancing the clearance of triglyceride rich lipo proteins.[11]

At present, hyperlipidemia is most commonly treated with lipid-lowering drugs, some of which are associated with serious adverse side effects. [12] Importance of natural products in modern medicine is increased recently. [13, 14] The search for new agents capable of reducing serum lipid levels has therefore become an important research focus. Plant products are generally considered to be less toxic and less prone to side effects than drugs manufactured by chemical synthesis. [15]

In the past two decades, herbal hypolipidemics have gained importance to fill the lacunae created by the allopathic drugs. Many medicinal plants have been found to be useful to successfully manage hyperlipidemia; these include *Dracocephalum kotschyi*, [16] *Allium porrum*, [17] *Eclipta prostrate*, [15] *Scoparia dulcis*, [18] *Trigonella foenum-graecum* [19, 20] and red yeast rice. [21]

Abroma augusta, or Devil's Cotton, is an evergreen tree native from Asia to Australia. *Abroma augusta* is

known to show antidiabetic, antihyperglycemic and antifertility potential. [22-24] Root of the plant is used as abortifacient and anti-fertility agent. Leaves are known for treatment of uterine disorders, rheumatic pain of joints, and headache with sinusitis.[25] Ariel parts are used as demulcent and in treatment of gonorrhea.[26] The root-bark is used as uterine tonic. [27] The plant finds multirole use in modern and traditional medicine; however there is dearth of knowledge regarding antihyperlipidemic potential of *Abroma Augusta*. Hence, the present study was undertaken to study antihyperlipidemic effect of methanol extract of leaves of *Abroma Augusta*.

Material and Methods

Plant material

The leaves of *Abroma augusta* (Ulatkambal) were collected in the month of January from Jawaharlal Nehru Krishi Vishwavidyalaya Jabalpur (M.P.). The plant was identify and authenticated by Dr. A.B. Tiwari, Sr. Scientist, Department of Crop & Herbal Physiology, Jawaharlal Nehru Krishi Vishwavidyalaya Jabalpur (M.P.). Leaves of *Abroma augusta* were dried in shade, coarsely powdered and used for the preparation of extracts. The powdered crude drug was extracted in a soxhlet apparatus with methanol. Finally extract was dried at 40°C under pressure and stored at 4°C until use. Phytochemical screening of extract was done by standard methods. [28]

Drugs and Chemicals

Cholesterol, sodium cholate was purchased from CDH, India. Coconut oil (Parachut, India), Atrovastatin (Microlabs, India) was used in the study. All other reagent used in this study was of analytical grade.

Animals

Healthy adult male Wistar albino rats between 6 and 8 months of age and weighing about 150-250 g were used for the study. The animals were housed in polypropylene cages, maintained under standard conditions (12 h light: 12 h dark cycle; 25 ± 30 C; 35–60% humidity). All the experimental protocols were approved by Institutional Animal Ethics Committee.

Acute Toxicity Studies

Methanol extract of *Abroma augusta* was studied for acute oral toxicity as per revised OECD guidelines No. 423. [29] The extract was devoid of any toxicity in rats when given in doses up to 2000 mg/kg by oral route. Hence 200 and 400 mg/kg doses of extract were used for the study.

Antihyperlipidemic activity [30]

High cholesterol diet induced hyperlipidemia

Induction of hyperlipidemia

High cholesterol diet was prepared by mixing cholesterol (2%), sodium cholate (1%) and coconut oil (2%). The diet was administered for seven days.

Dose Preparation and Administration of Extracts

The extract of *Abroma augusta* was dissolved in distilled water and a dose of 200 mg/kg and 400 mg/kg was given to the animals once in a day orally along with the high cholesterol diet orally. Treatment was given daily for seven days.

Animal Grouping

The experimental animals were divided into five groups, six animals in each group

Group 1: Normal Control

Group 2: Hyperlipidemic Control

Group 3: Atrovastatin 10 mg/kg + High cholesterol diet.

Group 4: Methanolic Extract (200 mg/kg, orally) + High cholesterol diet.

Group 5: Methanolic Extract (400 mg/kg, orally) + High cholesterol diet

Blood sample collection and analysis

On the 8th day, blood was collected by retro-orbital sinus puncture, under mild ether anesthesia after 8 hr fasting and allowed to clot for 30 minutes at room temperature. Blood samples were centrifuged at 3000 rpm for 20 minutes. Serum was separated and stored at -20°C until use.

Serum samples were analyzed spectrophotometrically for Cholesterol, triglyceride and HDL-C was estimated using diagnostic kits which were procured from Lab-Care Diagnostics (India) Pvt. Ltd.- Mumbai (India). VLDL, LDL, HDL-ratio and atherogenic index were calculated by using the formula of Friedewald and colleagues. [31]

Statistical Analysis

Experimental results were mean±SEM of 6 animals. Statistical differences between the means of the various groups were evaluated using one-way analysis of variance (ANOVA) followed by Dunnett's test. Data were considered statistically significant only when p value < 0.05, $p < 0.01$.

Results and Discussion

There was significant increase in the levels of serum TC, TG, LDL-c and VLDL-c in high fat diet induced hyperchloestremia group of animals. Treatment with methanolic extract of *Abroma augusta* showed a marked reduction in TC, TG and LDL-c levels ($p<0.05$). But there was a significant rise in HDL-c levels in group IV and group V. Atrovastatin also produced significant reduction in serum TC, TG, LDL-c levels and a rise in HDL-c levels. There was a marked reduction in TC: HDL-c ratio, and in the atherogenic index after the treatment of rats with

400mg/kg dose of methanol extract of *Abroma augusta* as given in the Table No.1 & Figures 1-12.

Development of atherosclerotic disease is a complicated process involving accumulation of lipid-containing particles in the walls of coronary arteries & other major arteries within the body. Lowering high cholesterol levels significantly reduce the risk of heart attacks, strokes, and death. Normally hepatocytes initiate synthesis of triglycerides and cholesterol during states of increased free fatty acid flux to the liver but due to anti-hyperlipidemic drug, there may be inability of hepatocytes to increase cholesterol synthesis and decrease hepatocytes cholesterol concentration by increase in the catabolic conversion of cholesterol to bile acids in liver. High cholesterol diet increased serum cholesterol and LDL-C level significantly.[32, 33] A rise in LDL may cause deposition of cholesterol in arteries and aorta and hence it is a direct risk factor for coronary heart disease.[34] Studies show that both LDL and VLDL have a positive role in atherogenesis. [35]

Plant based pharmaceuticals are of of the important gift provided by nature to mankind. Plants serve to be an excellent source of lead molecules for discovery of new drugs. A number of phytoconstitutets like alkaloids, glycosides, tannins, phenolics etc. are known to demonstrate antihypercholestremic potential.[35-41] A number of plants have shown protective effect on hypercholestremia. *T. chebula* and its combination with gaumutra significantly decreases the cholesterol, triglyceride, VLDL-C, LDL-C, atherogenic index and a significantly increase in HDL-C in serum.[42] *Bauhinia purpurea* extracts significantly reduced atherogenic index, TC: HDL-c and LDL: HDL-c ratios .The antihyperlipidemic activity may be due to the presence of polyphenolic compounds flavonoids, tannins and proanthocyanidines. [43]

Abroma augusta was found to be a rich source of flavonoids, tannins, alkaloids. Extract at a dose of 400 mg/kg b.w., significantly reduced the elevated serum cholesterol, LDL, artherogenic index and significantly increased the HDL-C. The *Abroma augusta* extract had significant effect on triglyceride and on VLDL. The finding of current study proves that the methanol extract of *Abroma augusta* effectively treated hyperlipidemia in murine model. This activity may be due to presence of flavonoids, polyphenols, alkaloids found in extract. However isolation and characterization of active constituent responsible for this activity is necessary.

Table 1: Effect of *Abroma augusta* extract on various parameters in High cholesterol diet rats

Parameters	Normal	Hyperlipidemic control	Standard (Atorvastatin)	Extract 200mg/kg	Extract 400mg/kg
Cholesterol (mg/dl)	114.16 ±3.86	254.83±2.22	163.83±2.92**	215.16±3.18** ψ ψ	184.66±2.73** ψ ψ
Triglyceride (mg/dl)	101.33±2.58	186.83±2.63	134.66±3.07**	173.83±3.25* ψ	145.66±3.50**
HDL-C (mg/dl)	56.33±2.73	36±2.60	75.16±2.31**	64.5±2.16** ψ	71.16±3.18**
LDL (mg/dl)	53.66±1.96	166.33±1.63	75.66±2.80**	108.83±2.63** ψ ψ	94.5±2.34** ψ ψ
VLDL (mg/dl)	24.83±1.94	75±3.74	34.33±2.58**	55.33±2.33** ψ ψ	44.5±3.08**
Atherogenic Index	0.257±0.008	0.715±0.002	0.253±0.008**	0.430±0.027** ψ ψ	0.311±0.0028** ψ
Cardiac risk ratio TC:HDL-C	2.04±0.026	7.05±0.023	2.16±0.018**	3.33±0.095** ψ ψ	2.57±0.023** ψ ψ

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test.
*Significantly compared to Hyperlipidemic control group (p<0.05). **Significantly compared to Hyperlipidemic control group (p< 0.01).
ψ Significantly compared to Standard group (p<0.05). ψψ Significantly compared to Standard group (p< 0.01).

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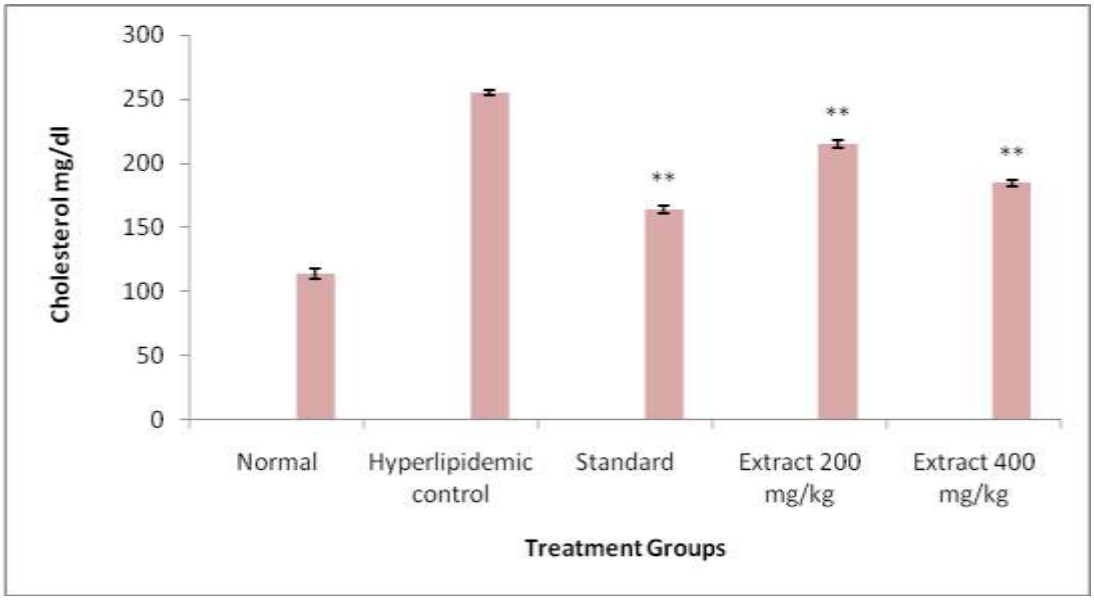

Fig. 1: Effect of *Abroma augusta* extract on cholesterol in High cholesterol diet rats.
Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. *Significantly compared to Hyperlipidemic control group (p<0.05). **Significantly compared to Hyperlipidemic control group (p< 0.01).

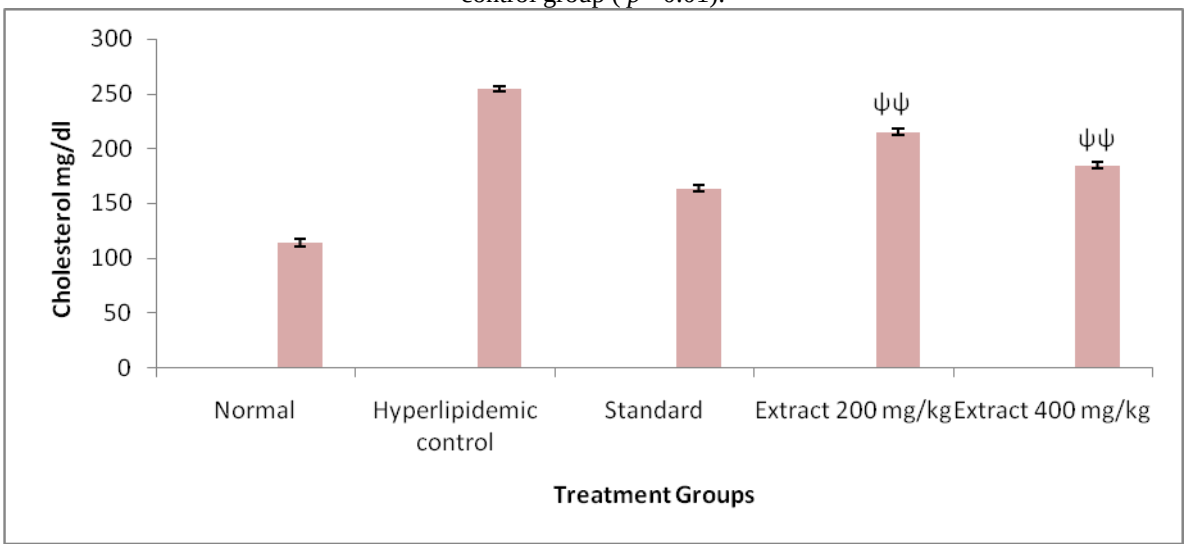

Fig. 2: Effect of *Abroma augusta* extract on cholesterol in High cholesterol diet rats.
Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. ψ Significantly compared to Standard group (p<0.05). ψψ Significantly compared to Standard group (p< 0.01).

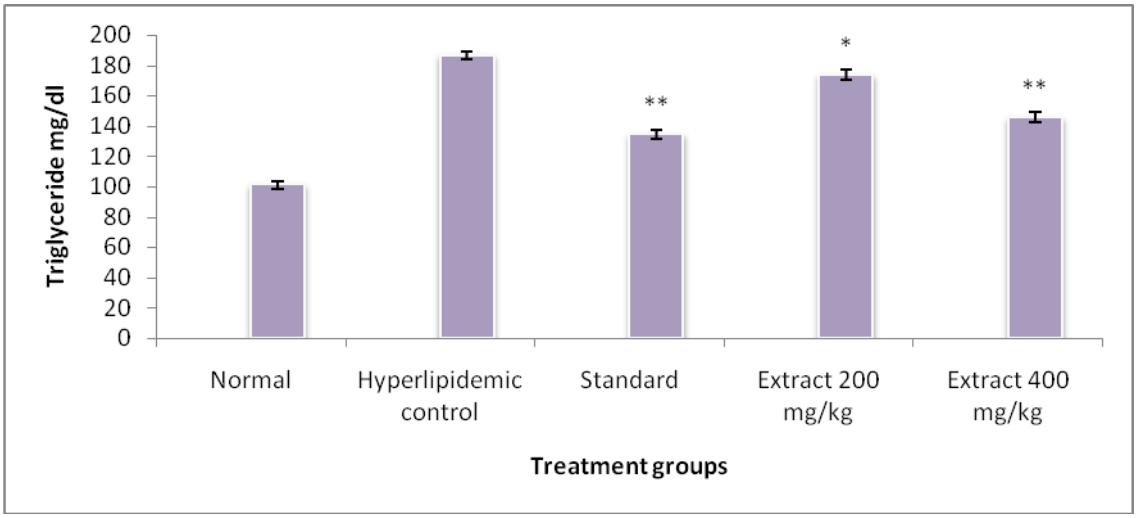

Fig. 3 Effect of *Abroma augusta* extract on Triglyceride in High cholesterol diet rats.

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. *Significantly compared to Hyperlipidemic control group (p<0.05). **Significantly compared to Hyperlipidemic control group (p< 0.01).

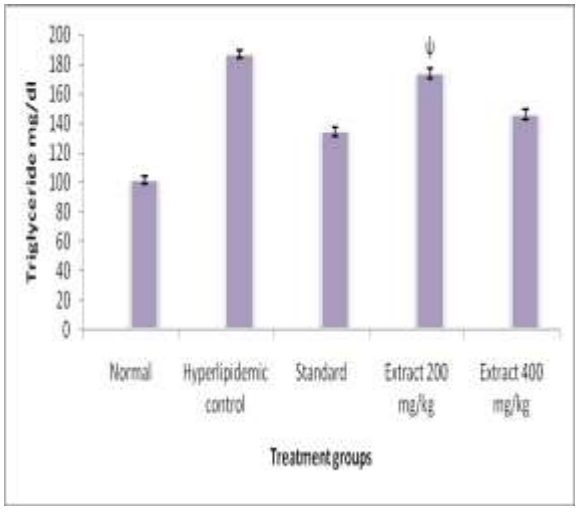

Fig. 4: Effect of *Abroma augusta* extract on Triglyceride in High cholesterol diet rats.

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. ψ Significantly compared to Standard group (p<0.05). ψψ Significantly compared to Standard group (p< 0.01).

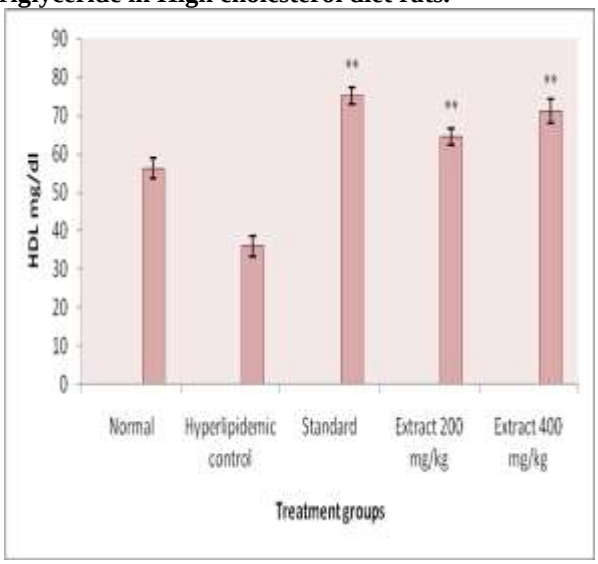

Fig. 5 Effect of *Abroma augusta* extract on HDL-C in High cholesterol diet rats.

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. *Significantly compared to Hyperlipidemic control group (p<0.05). **Significantly compared to Hyperlipidemic control group (p< 0.01).

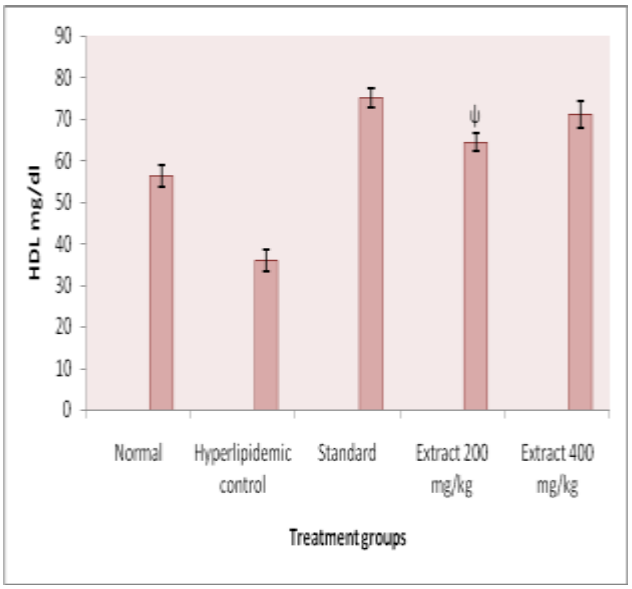

Fig. 6: Effect of *Abroma augusta* extract on HDL-C in High cholesterol diet rats.

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. ψ Significantly compared to Standard group (p<0.05).

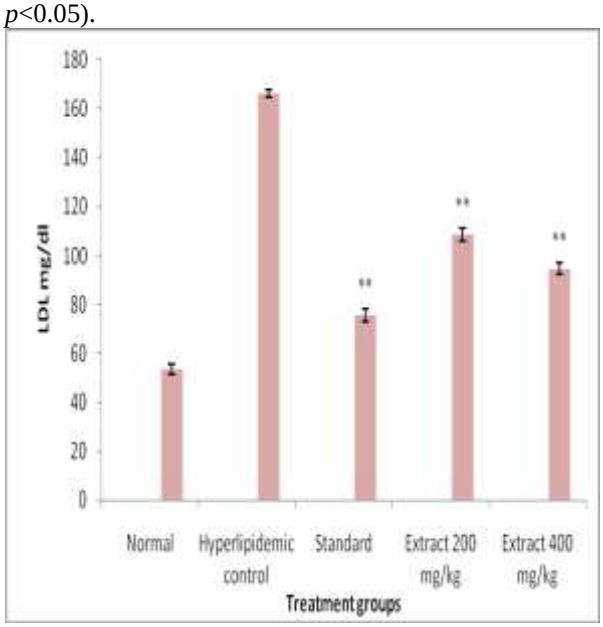

Fig. 7: Effect of *Abroma augusta* extract on LDL in High cholesterol diet rats.

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. *Significantly compared to Hyperlipidemic control group (p<0.05). **Significantly compared to Hyperlipidemic control group (p< 0.01).

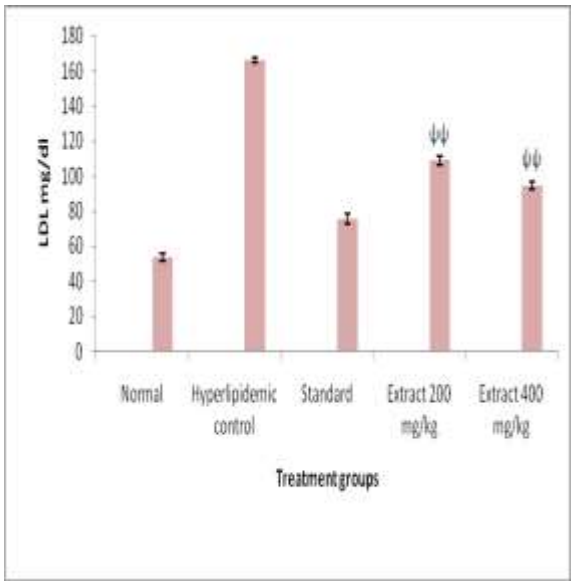

Fig. 8: Effect of *Abroma augusta* extract on LDL in High cholesterol diet rats.

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. ψ Significantly compared to Standard group (p<0.05). ψψ Significantly compared to Standard group (p< 0.01).

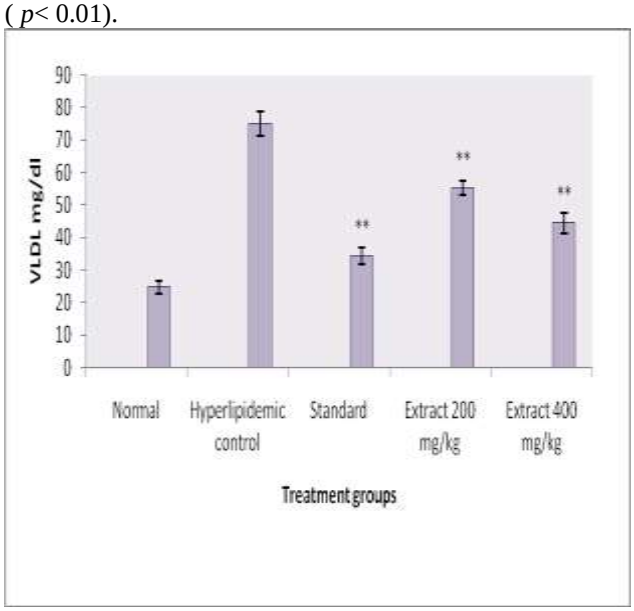

Fig. 9: Effect of *Abroma augusta* extract on VLDL in High cholesterol diet rats.

Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. *Significantly compared to Hyperlipidemic control group (p<0.05). **Significantly compared to Hyperlipidemic control group (p< 0.01).

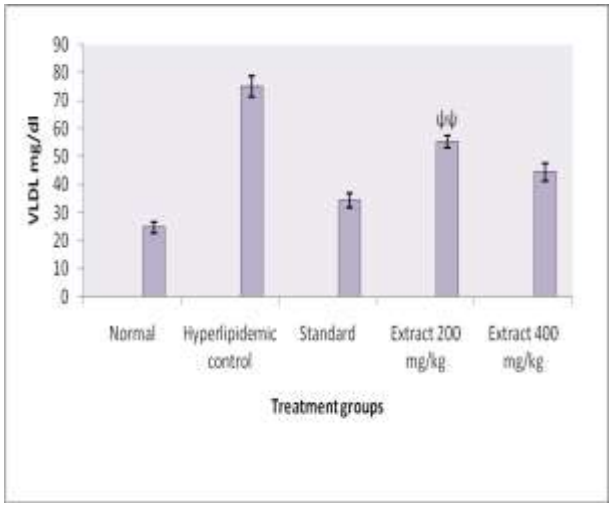

Fig. 10: Effect of *Abroma augusta* extract on VLDL in High cholesterol diet rats.
Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. ψ Significantly compared to Standard group (p<0.05). ψψ Significantly compared to Standard group (p< 0.01).

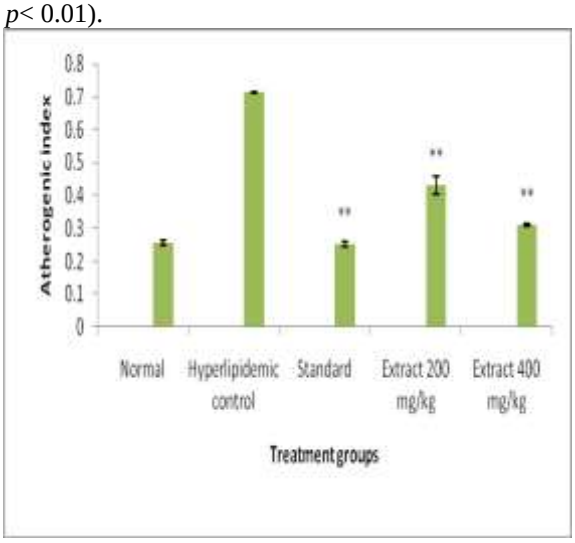

Fig. 11: Effect of *Abroma augusta* extract on Atherogenic Index in High cholesterol diet rats.
Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. *Significantly compared to Hyperlipidemic control group (p<0.05). **Significantly compared to Hyperlipidemic control group (p< 0.01).

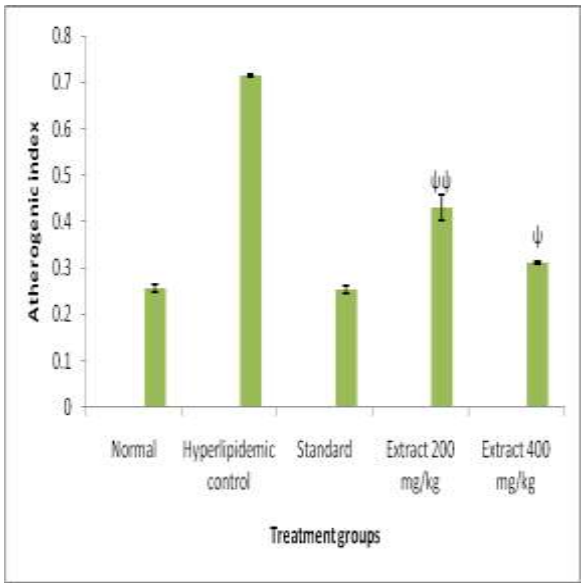

Fig. 12: Effect of *Abroma augusta* extract on Atherogenic Index in High cholesterol diet rats.
Each value is mean ± S.E.M. (n = 6) .Data was analyzed by One-way ANOVA followed by Dunnett's test. ψ Significantly compared to Standard group (p<0.05). ψψ Significantly compared to Standard group (p< 0.01)**.**

References

1. Yang RL, Shi YH, Li et al. Increasing Oxidative Stress with Progressive Hyperlipidemia in Human: Relation between Malondialdehyde and Atherogenic Index. *J Clin Biochem Nutr*. 2008; 43(3):154-8.
2. Durrington P. Dyslipidaemia. *Lancet*. 2003; 362(9385):717-31.
3. Son IS, Kim JH et al. Antioxidative and hypolipidemic effects of diosgenin, a steroidal saponin of yam (Dioscorea spp.), on high-cholesterol fed rats. *Biosci Biotechnol Biochem.* 2007;71(12):3063-71.
4. Adiseshiah M. Effective care of patients with type 2 diabetes and dyslipidemia: a nurse's perspective. *Diabetes Res Clin Pract*. 2005;68 (2):S23-7.
5. Enas EA, Mohan V, Deepa M et al. The metabolic syndrome and dyslipidemia among Asian Indians: a population with high rates of diabetes and premature coronary artery disease. *J Cardiometab Syndr*. 2007; 2(4):267-75.
6. Jones PJ. Dietary cholesterol and the risk of cardiovascular disease in patients: a review of the Harvard Egg Study and other data. *Int J Clin Pract Suppl*. 2009 ;(163):1-8, 28-36.

7. Saher G, Brügger B, Lappe-Siefke C et al. High cholesterol level is essential for myelin membrane growth. *Nat Neurosci*. 2005; 8(4):468-75.
8. Tang WH, Maroo A, Young JB. Ischemic heart disease and congestive heart failure in diabetic patients. *Med Clin North Am*. 2004; 88(4):1037-61, xi-xii.
9. Kinoshita M. Anti-hyperlipidemic agents. *Nihon Rinsho*. 2002; 60(5):968-74.
10. Derosa G, Salvadeo S, Cicero AF. Prospects for the development of novel anti-hyperlipidemic drugs. *Curr Opin Investig Drugs*. 2006; 7(9):826-33.
11. Robert WM, Thomas V. Anti hyperlipidemic agent. In: Brunton LL, Lazo SJ, editors. Goodman and Gillman's the pharmacological basis of therapeutics. 11th ed. New York: Mc Graw-Hill; 2006.
12. Marinangeli CP, Varady KA, Jones PJ. Plant sterols combined with exercise for the treatment of hypercholesterolemia: overview of independent and synergistic mechanisms of action. *J Nutr Biochem*. 2006;17(4):217-24
13. Lata S, Saxena KK, Bhasin V et al. Beneficial effects of Allium sativum, Allium cepa and Commiphora mukul on experimental hyperlipidemia and atherosclerosis--a comparative evaluation. *J Postgrad Med*. 1991; 37(3):132-5.
14. Gupta N, Ganeshpurkar A, Jatav N et al. In vitro prevention of chick pancreatic lipase activity by Abroma augusta extract. *Asian Pac J Trop Biomed*. 2012; 2-S II: S712-S715.
15. Kumari CS, Govindasamy S, Sukumar E. Lipid lowering activity of Eclipta prostrata in experimental hyperlipidemia. *J Ethnopharmacol*. 2006 May 24; 105(3):332-5.
16. Ebrahim Sajjadi S, Movahedian Atar AM, Yektaian A. Antihyperlipidemic effect of hydroalcoholic extract, and polyphenolic fraction from Dracocephalum kotschyi Boiss. *Pharm Acta Helv*. 1998; 73(3):167-70.
17. Movahedian A, Sadeghi H, Ghannadi A et al. Hypolipidemic activity of Allium porrum L. in cholesterol-fed rabbits. *J Med Food*. 2006; 9(1):98-101.
18. Pari L, Latha M. Antihyperlipidemic effect of Scoparia dulcis (sweet broomweed) in streptozotocin diabetic rats. *J Med Food*. 2006; 9(1):102-7.
19. Stark A, Madar Z. The effect of an ethanol extract derived from fenugreek (Trigonella foenum-graecum) on bile acid absorption and cholesterol levels in rats. *Br J Nutr*. 1993; 69(1):277-87.
20. Raju J, Patlolla JM, Swamy MV et al. Diosgenin, a steroid saponin of Trigonella foenum graecum (Fenugreek), inhibits azoxymethane-induced aberrant crypt foci formation in F344 rats and induces apoptosis in HT-29 human colon cancer cells. *Cancer Epidemiol Biomarkers Prev*. 2004; 13(8):1392-8.
21. Thompson Coon JS, Ernst E. Herbs for serum cholesterol reduction: a systematic view. *J Fam Pract*. 2003; 52(6):468-78.
22. Islam T, Rahman A, Islam AU. Effects of Aqueous Extract of Fresh Leaves of Abroma augusta L. on Oral Absorption of Glucose and Metformin Hydrochloride in Experimental Rats. *ISRN Pharm*. 2012; 2012: 472586.
23. Halim EM. Lowering of blood sugar by water extract of Azadirachta indica and Abroma augusta in diabetes rats. *Indian J Exp Biol*. 2003 Jun; 41(6):636-40.
24. Vohora SB, Garg SK, Chaudhury RR. Antifertility screening of plants. 3. Effect of six indigenous plants on early pregnancy in albino rats. *Indian J Med Res*.1969; 57(5):893-9.
25. Prajapati ND, Purohit SS, Sharma AK et al. A hand book of medicinal plant: A complete source book. Ist ed. Jodhpur: Agrobios (India) Publisher; 2003.
26. Nandkarni KM. Indian material medica; Vol. I. Mumbai: Bombay Popular Prakashan; 2002.
27. Chatterjee A ,Pakashi CS. The trestise on Indian medicinal plants. Vol III .New Delhi: International Institute of Science and Communication Publisher.
28. Harborne JB. Phytochemical Method: A guide to modern techniques of plants analysis. New York: Chapman and Hall; 1983.
29. Organization for Economic Cooperation and development (OECD). Guideline 423 for testing chemicals: Paris; 2001;1-14 .
30. Dai FJ, Hsu WH, Huang JJ et al. Effect of pigeon pea (Cajanus cajan L.) on high-fat diet-induced hypercholesterolemia in hamsters. *Food Chem Toxicol*. 2013; 53:384-91.
31. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem*. 1972; 18(6):499-502.

32. Guido S, Joseph T. Effect of Chemically different antagonists on lipid profile in rat.Goodman and Gilman's The Pharmacological Basis of Therapeutics: 10th Ed. USA :McGraw-Hill Publishers; 2001.
33. Khan S, Dwivedi C, Parmar V et al. Methanol extract of dried exudate of Commiphora mukul prevents bone resorption in ovariectomized rats. *Pharm Biol*. 2012 Oct; 50(10):1330-6.
34. Libby P. Molecular bases of the acute coronary syndromes. *Circulation*. 1995 1; 91(11):2844-50.
35. Parthasarathy S, Quinn MT, Schwenke DC et al. Oxidative modification of beta-very low density lipoprotein. Potential role in monocyte recruitment and foam cell formation. *Arteriosclerosis*. 1989; 9(3):398-404.
36. Zheng XK, Wang WW, Zhang L et al. Antihyperlipidaemic and antioxidant effect of the total flavonoids in Selaginella tamariscina (Beauv.) Spring in diabetic mice. *J Pharm Pharmacol*. 2013;65(5):757-66
37. Chan KC, Yang MY, Lin MC et al. Mulberry Leaf Extract Inhibits the Development of Atherosclerosis in Cholesterol-Fed Rabbits and in Cultured Aortic Vascular Smooth Muscle Cells. *J Agric Food Chem*. 2013.
38. Azmi MB, Qureshi SA. Methanolic Root Extract of Rauwolfia serpentina Benth Improves the Glycemic, Antiatherogenic, and Cardioprotective Indices in Alloxan-Induced Diabetic Mice. *Adv Pharmacol Sci*. 2012;37: 642-9
39. Shrime MG, Bauer SR, McDonald AC et al. Flavonoid-rich cocoa consumption affects multiple cardiovascular risk factors in a meta-analysis of short-term studies. *J Nutr*. 2011; 141(11):1982-8.
40. Roza JM, Xian-Liu Z, Guthrie N. Effect of citrus flavonoids and tocotrienols on serum cholesterol levels in hypercholesterolemic subjects. *Altern Ther Health Med*. 2007; 13(6):44-8.
41. Chanet A, Milenkovic D, Deval C et al. Naringin: the major grapefruit flavonoid, specifically affects atherosclerosis development in diet-induced hypercholesterolemia in mice. *J Nutr Biochem*. 2012;23(5):469-77
42. Kumar D, Parcha V, Maithani A et al. Effect and evaluation of antihyperlipidemic activity guided isolated fraction from total methanol extract of Salvadora oleoides (Decne.) in Triton WR-1339 Induced hyperlipidemic rats. *Phcog Mag*. 2012; 8(32): 314-318.
43. Rajani GP, Ashok P. In vitro antioxidant and antihyperlipidemic activities of Bauhinia variegata Linn. *Indian J Pharmacol*. 2009; 41(5):227-32.

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