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# Antihyperlipidemic effect of some medicinal plants used in Bangladeshi traditional medicine: A review

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**Abstract**
Hyperlipidemia is major risk factor for the atherosclerosis. Other complications are coronary heart disease, ischemic cerebro vascular disease, hypertension, obesity and diabetes mellitus. Although many efficacious lipid-lowering synthetic drugs exist, none is effective for all lipoprotein disorders, and all such agents are associated with some adverse effects. Now day's synthetic drugs have been associated with number of side effects but herbal medicines have lipid lowering activities without any side effects. Some traditionally herbs like *Allium sativum, Terminalia arjuna, Cassia angustifolia, Cinnamomum tamala, Gymnema sylvestre, Hibiscus cannabinus, Mimosa pudica, Moringa oleifera, Sida cordifolia, Hemidesmus indicu, Terminalia pallid,* etc. are used as antihyperlipidemic drug as per Unani and Ayurvedic literature. The article is undertaken to investigate the herbal plants for Antihyperlipidemic activity and models use in this investigation. This review is given on the antihyperlipidemic activity of the most familiar medicinal plants of medicine. This matter may be helpful for the researchers, academician and preclinical about the potential herbs having antihyperlipidemic activity.

**Keywords:** hypolipidemic agents, hypolipidemic medicinal plants

## Introduction
Hyperlipidemia is define in a simple way by increase serum total count (TC), triglycerides (TG), VLDL, LDL and IDL which are responsible for various complications like: heart attack, premature coronary artery disease, stroke, atherosclerosis, myocardial infarction and pancreatitis [1]. Cardiovascular diseases contributed to approximately a third of entire global deaths, It is expected that it will become the leading cause of death and disability worldwide [2]. Hyperlipidemia is a major cause of atherosclerosis and atherosclerosis - Associated conditions such as coronary heart diseases (CHD), ischemic cerebrovascular disease, and peripheral vascular diseases [3]. Atherosclerosis referred to as a "silent killer" is one of the leading causes of death in the developed countries and is on the rise in developing countries like India [4]. The American Heart Association has identified the primary risk factor associated with atherosclerosis as elevated levels of cholesterol and triglycerides in the blood. Therefore, therapists consider the treatment of hyperlipidemia to be one of the major approaches toward decelerating the atherogenic process [5]. Allopathic hypolipidemic drugs are available at large in the market, but the side effects and contraindications of these drugs [6].
Medicinal plants play a key role in the human health care. About 80% of the world population relies on the use of traditional medicine which is predominantly based on plant materials [7]. Plants and plant derived product are part of health care since time immemorial. In treatment of various ailments including cardiovascular diseases, herbal drugs play an important role. Effective therapeutic agents with a low incidence of side-effects are in need by physicians and patients and plants potentially constitute such a group. A variety of plants have been studied which support cardiovascular functions and are used to treat diseases of the heart, but still there is a need to explore more cardio protective plants. Studies on ethno-medicinal plants are of great advantage for producing herbal drugs. The local people possess good knowledge of herbal medicines regarding its preparation and use. Hence it is important to study and record their use of medicinal plants.

## Allium sativum
The present study is designed to evaluate the effect of garlic extract on lipid profiles in Triton X-100 induced hyperlipidemia in male wistar rats. Three fractional extracts of Allium sativum (AS) ($AS_1$, $AS_2$ and $AS_3$) were obtained by column chromatography from methanolic extract of garlic. All three garlic extract significantly increased ($p < 0.0001$) plasma HDL-Cholesterol and decreased plasma TC, LDL-Cholesterol and TG levels as compared with hyperlipidemic control. Among three fractions, $AS_3$ has more significantly reduced the plasma lipid levels than others $AS_1$and $AS_2$ [8].
Garlic has been used as a dietary agent through-out the world. Different culture used different varieties of garlic depending upon their ecological productivity. In India Allium sativum species of garlic is very commonly used, while another species of garlic named Allium tuberosum is used in South-east Asia, China and North-east part of India. Both the species are important constituent of customary diet in Indian and Chinese food. The main aim of this study is to compare the potency of these two species for their antihyperlipidemic effect and curative potential against atherosclerosis. Forty-

three guinea pigs were fed cholesterol (0.5 g per kg. body weight) for an initial period of 4 weeks. Cholesterol was then discontinued and they were divided into three groups. Group-I (n=7) was fed stock diet while group-II (n=18) was given 2 gm. per kg body weight of Allium sativum daily for 4 weeks. Group-III (n=18) was supplemented by Allium tuberosum species of garlic (2 gm/kg body weight) daily for 4 weeks period. Fasting blood samples were collected at onset of study, at 4 weeks duration and finally at the end of study (8 weeks period), for estimation of serum cholesterol, serum triglycerides, LDL-C. HDL-C, VLDL-C and atherogenic index. At 8 weeks duration all the animals were sacrificed for grading of atherosclerotic lesions. In present study both species of garlic (A. sativum, A. tuberosum) showed significant hypolipidemic activity as they reduced serum cholesterol, triglyceride, LDL-C and atherogenic index in hyperlipidemic guineapigs ($p<0.01$). The significant rise in HDL-C level was not observed. On comparison between Alliums sativum & Alliums tuberosum it was found that Allium tuberosum very significantly reduced serum cholesterol and serum triglycerides, LDL-C and atherogenic index ($p<0.05$). Allium tuberosum species of garlic was found more potent ($p<.05$) than Allium sativum in reducing severity of atherosclerosis. It can be concluded that Allium tuberosum species of garlic is a more potent hypolipidemic and antiatherosclerotic agent as compared to Allium sativum [9].

Garlic (Allium sativum) is naturally occurring sulphur containing dietary agent belongs to family Liliaceace. Members of this family like garlic and onions are found to have beneficial effect on atherosclerosis and ischemic heart diseases in experimental animals and humans. The objective of this study was to find out the effect of Allium sativum on experimentally induced hyperlipidemia in guinea pigs. Twenty-five guinea pigs were fed cholesterol (0.5 g/Kg body weight/day) for an initial period of 4 weeks. Cholesterol was then discontinued and the animals were divided into 3 groups. Group-I (control, n=7) was now fed normal diet with 1 ml normal saline. Group-II (n=9) was given 1 ml of aqueous extract with normal diet, and Group-III (n=9) was fed normal diet with 1 ml of alcoholic extract of garlic daily for 4 weeks. The garlic contents of both extracts were 2 g/ml. Fasting blood samples were collected at the end of 4 weeks after induced hyperlipidemia and finally at the end of the study (i.e., 8 weeks) for estimation of total serum cholesterol, serum triglyceride, HDLc, LDLc, VLDLc and atherogenic index was calculated in all 3 groups. The aqueous and alcoholic extracts of garlic showed a significant hypolipidemic activity as they reduced significantly serum cholesterol, serum triglyceride, LDLc, VLDLc and atheriogenic index in hyperlipidemic guinea pigs ($p<0.001$) as compared to control group. The significant rise in HDLc was observed in group II but not in group I and III animals. On comparison between the two extracts, aqueous extract of garlic was found to be more potent hypolipidemic agent than to the alcoholic extract. Both extracts have hypolipidemic activity but aqueous extract of Allium sativum is more potent than alcoholic extract [10].

**Allium cepa**

Hypolipidemic and antioxidant potency of a dehydrated onion product was evaluated in experimental rats maintained for 6 weeks at 5 and 10% dietary levels. Serum cholesterol especially low-density lipoprotein was significantly reduced by dietary dehydrated onion in hypercholesterolemic rats. This was associated with an increase in high density lipoprotein cholesterol. Blood triglyceride concentration in hypercholesterolemia rats was lower in onion supplemented diet group. Glutathione, ascorbic acid and α-tocopherol in the blood of hypercholesterolemic rats were higher in onion treatment, while lipid peroxides were lower. Hepatic α-tocopherol concentration was higher in rats maintained on onion diets, while lipid peroxides were reduced. Thus, this study has proved significant cholesterol lowering and antioxidant effect of dehydrated onion product [11].

**Cassia angustifolia**

Anti-hyperlipidemic activity was evaluated using Triton X 100-induced Hyperlipidemia in rats as an experimental model. Plasma triglycerides, Total cholesterol, HDL, LDL and VLDL were determined to assess the hypolipidemic activity. It was found that the EECA 400 mg/kg dose showed significant hypolipidemic effect ($P<0.01$) where as 300 mg/kg also significant in the entire parameter used for evaluation of hypolipidemic effect ($P<0.05$). Ethanolic extracts of Cassia angustifolia showed that hypolipidemic effect and this study provide scientific proof for their traditional claims. However further study is needed in order to understand the precise mechanism [12].

**Cinnamomum tamala**

Cinnamomum tamala belongs to family of Lauraceous. The hypolipidemic effect of Cinnamomum leaves extracts in high cholesterol diet induced hyperlipidemia. Aqueous and ethanolic extracts of leaves of Cinnamomum tamala were administered in doses of 400mg/kg /day p.o. each for 10 days. Simultaneous administration of Cinnamomum leaves extracts significantly prevent the rise in serum levels of total cholesterol, triglyceride, LDL-C,VLDL-C and Atherogenic index whereas significant increases in the level of HDL-C [13].

The leaf part of Cinnamomum tamala is used for bronchial asthma, cough, aphthous ulcers and oligospermia. It has aromatic, carminative, digestive and lipid lowering actions. The study was done on anti-hyperlipidemic activity of aqueous and ethanolic extracts of leaves of Cinnamomum tamala in cholesterol high fat diet induced hyperlipidemic rat models. The treatment of hyperlipidemic rat with aqueous and ethanol extract of leaves of Cinnamomum tamala in doses of 400mg/kg /day p.o. each for 10 days with cholesterol diet shows significantly decrease in serum levels of total cholesterol, triglyceride, LDLC, VLDL-C and atherogenic index whereas significant increases in the level of HDL-C [14].

**Gymnema sylvestre**

Gymnema sylvestre belongs to the family of Asclepiadaceae. Hyperlipidemia was induced in rats by giving high cholesterol diet (2% cholesterol, 1% sodium cholate and 2% coconut oil) for seven days in standard rat chow diet. The hydroalcoholic extract of G. sylvestre leaves (200 mg kg-1 b.wt.) was orally administered once a day to rats fed with a high cholesterol diet for seven days. High cholesterol fed diet rats exhibited significant increase in total serum cholesterol, triglycerides,

low density lipoproteins, very low density lipoprotein and significant decrease in high density lipoproteins. Treatment with hydroalcoholic extract of Gymnema sylvestre leaves significantly decreased total serum cholesterol, triglycerides, low density lipoproteins, very low density lipoprotein and increased the high density lipoproteins in hyperlipidemic rats and was comparable with that of standard atorvastatin. Hence significant antihyperlipidemic activity of hydroalcholic extract of Gymnema sylvestre leaves [15].

The leaf part of Gymnema sylvestre is used for treating diabetes mellitus, obesity and insect bites. The study was done on antihyperlipidemic activity of leaf extract in cholesterol high fat diet (CHFD) induced hyperlipidemic rat models. The treatment of hyperlipidemic rat with leaf extract at 25-100 mg/kg dose along with cholesterol diet shown significantly decrease in serum triglyceride (TG), total cholesterol (TC), very low-density lipoprotein (VLDL) and low-density lipoprotein (LDL) [16].

**Hibiscus cannabinus**

The activity was assessed by estimation of serum lipid profile viz. total cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL-C), very low-density lipoprotein cholesterol (VLDL-C), high density lipoprotein cholesterol (HDL-C), stress (TBARS) and liver histopathological studies of control and drug-treated animals. The extract exhibited a strong dose dependent antihyperlipidemic activity and at dose level 400mg/kg p.o. the extract showed a significant decrease in the levels of serum TC, TG, LDLC, VLDL-C and TBARS. The extract markedly prevented the liver microvesicular steatosis in hyperlipidemic rats. The study demonstrated that the extract exhibits a potent lipid lowering activity in diet induced hyperlipidemia which account for some of the medical claims attributed to this plant [17].

**Mimosa pudica**

The hypolipidemic activity of Mimosa pudica extract was studied on high fat diet induced models of hyperlipidemia in rats. Hyperlipidemia in experimental rats was evidenced by an enhancement in the levels of cholesterols, triglycerides, LDL and VLDL. Ethanol extract showed significant hypolipidemic effect by lowering the serum levels of biochemical parameters such as significant reduction in the level of serum Cholesterol, TG, LDL, VLDL and increase in HDL level which was similar to the standard drug Lovastatin [18].

**Moringa oeifera**

The effect of aqueous leaf extract of Moringa oleifera on plasma glucose level, total cholesterol level, triglycerides (TG), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) in male albino rats. Diabetes was induced by 100 mg/kg of alloxan monohydrate. The control and the diabetic groups received distilled water while the diabetic treated group was administered 400 mg/kg body weight of aqueous leaf extract of M. oleifera for 28 days. At the end of the experiment, plasma glucose level, cholesterol, Triglycerides (TG), High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL) were determined in all the experimental animals after 12 hours fast. The result showed significant increases in plasma cholesterol, TG and LDL level of the diabetic control group when compared with the normal control group while there were no significant differences in the M. oleifera -treated diabetic group and the normal control group. The HDL however was not different in all the three groups. Oral administration of aqueous leaf extract of M. oleifera may reduce the plasma lipid imbalances associated with diabetes mellitus [19].

**Sida cordifolia**

The study was to evaluate antioxidant and antihyperlipidemic activity of an aqueous extract of root of Sida cordifolia Linn. (SCAE) against Triton WR-1339 and High fat diet (HFD) induced hyperlipidemia in experimental animal. Effect of simultaneous administration of SCAE in different doses (200 & 400 mg/kg) by oral route was estimated in Triton WR-1339 and HFD induced hyperlipidemic animals by estimating serum lipid levels of cholesterol (TC), Triglycerides (TG), Low density lipoproteins (LDL), High density lipoprotein (HDL) and Very low density lipoprotein (VLDL) and atherogenic index. Whereas antioxidant activity was carried out by estimating serum levels oxidative marker Superoxide dismutase (SOD) and Catalase (CAT). It was revealed that the aqueous extract of Sida cordifolia possesses significant hyperlipidemic activity in acute as well as chronic hyperlipidemic models in the company of promising antioxidant activity. So, it was concluded that aqueous extract of Sida cordifolia possesses potential antioxidant and antihyperlipidemic activity in experimental animals [20].

**Cissus Quadrangularis**

It belongs to family Vitaceae. The Stem part of Cissus quandrangularis is used for epistaxis, anorexia, fracture of bones, worm infestations, bleeding piles, eczema, gastric ulcers, anaemia and to regulate menstruation. It is a rich source of calcium, phosphorus and magnesium.9The study was a randomized and double blind design involving 123 overweight and obese persons (47.2% male; 52.8% female; ages 19-50). All participants received two daily doses of the formulation and remained on a normal or calorie-controlled diet for 8 weeks. At the end of the trial period, significant net reductions in weight as well as in fasting blood sugar level, TC, LDL and TG [21].

**Terminalia Arjuna**

The bark part of Terminalia arjuna is used for diabetes, heart diseases, leucorrhoea and lowering of cholesterol. The study was done on anti-hyperlipidemic activity of the 50% ethanol extract of bark of T. arjuna in cholesterol high fat diet induced hyperlipidemic rat models. The treatment of hyperlipidemic rat with the 50% v/v ethanol bark extract at the dose of 40mg/kg body weight along with cholesterol diet shown significantly decrease in serum total cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) levels while HDL cholesterol increased in experimental group [22].

**Spirulina platensis**

Hyperlipidemia is the greatest risk factor of coronary heart disease. The present study was designed to investigate the antihyperlipidemic activity of Spirulina platensis in Triton X-

100 induced Hyperlipidemic rats. Spirulina platensis was administered at a dose of 0.5gm/day, (p.o) to Triton induced Hyperlipidemic rats. Fenofibrate is used as reference standard. The statistical analyses were carried out using one way ANOVA followed by Dunnet's multiple comparison tests. S.platensis show a significant decrease in the levels of serum cholesterol, phospholipids, triglycerides, LDL, VLDL and significant increase in the level of serum HDL at the dose of 0.5gm/day (p.o) against Triton induced hyperlipidemic rats. Therefore it effectively suppressed the Triton induced hyperlipidemia in rats, suggesting the potential protective role in Coronary heart disease [23].

**Hemidesmus indicus**

Dietary changes play major risk roles in oxidative stress and cardiovascular disease and modulate normal metabolic function. The present study was designed to investigate the ameliorative potential of different extracts of Hemidesmus indicus to experimental high-fat diet in wistar rats, and their possible mechanism of action. Male wistar rats were divided into 6 groups (n=6/group) and fed with a standard diet (control), high-fat diet (HFD), high-fat diet supplemented with different extracts and positive control for 9 weeks. High-fat diet induced changes in average body weight and oxidative stress and elevated levels of plasma lipid profile in rats. Oral administration of methanolic extract of H. indicus (200 mg/kg) offered a significant dose-dependent protection against HFD-induced oxidative stress, as reflected in the levels of catalase ($p<0.001$ in the aorta, heart and liver), superoxide dismutase ($p<0.001$ in the aorta, heart and liver), and glutathione peroxidase ($p<0.001$ in the aorta, heart and liver). Hyperlipidemia condition assessed in terms of body weight, total cholesterol, free cholesterol, ester cholesterol, phospholipids, triglycerides, and atherogenic index and the results showed significant differences between HFD and non-HFD fed rats ($p<0.001$). High-fat diet treated rats showed changes in hepatic tissue architecture such as micro and macrovascular steatosis, increased fatty infiltration, and inflammation. The present study revealed that the methanolic extract of H. indicus protects against oxidative stress, hyperlipidemia and liver damage [24].

**Terminalia pallida**

Hyperlipidemia contributes significantly in the manifestation and development of atherosclerosis and coronary heart disease (CHD). Although synthetic lipid-lowering drugs are useful in treating hyperlipidemia, there are number of adverse effects. So the current interest has stimulated the search for new lipid-lowering agents with minimal side effects from natural sources. The present study was designed to investigate the antihyperlipidemic and antiatherogenic potentiality of ethanolic extract of *Terminalia pallida* fruits in high fat diet-induced hyperlipidemic rats. *T. pallida* fruits ethanolic extract (TPEt) was prepared using Soxhlet apparatus. Sprague-Dawley male rats were made hyperlipidemic by giving high fat diet, supplied by NIN (National Institute of Nutrition), Hyderabad, India. TPEt was administered in a dose of 100 mg/kg.b.w./day for 30 days in high fat diet-induced hyperlipidemic rats. The body weights, plasma lipid, and lipoprotein levels were measured before and after the treatment. TPEt showed significant antihyperlipidemic and antiatherogenic activities as evidenced by significant decrease in plasma total cholesterol, triglycerides, low-density lipoprotein cholesterol, and very low-density lipoprotein cholesterol levels coupled together with elevation of high-density lipoprotein cholesterol levels and diminution of atherogenic index in high fat diet-induced hyperlipidemic rats. There was a significantly reduced body weight gain in TPEt-treated hyperlipidemic rats than in the control group. The present study demonstrates that TPEt possesses significant antihyperlipidemic and antiatherogenic properties, thus suggesting its beneficial effect in the treatment of cardiovascular diseases [25].

**Conclusions**

Hyperlipidemia is a condition in which there is abnormal high levels of lipids, elevated serum levels of one or more of total cholesterol, low-density lipoprotein cholesterol, triglycerides, or both total cholesterol and total triglycerides (combined Hyperlipidemia), very low density lipoprotein [26]. Hyperlipidemia is a lifestyle disorder which seriously affects the human health [27]. It leads to various cardiovascular disorders like angina pectoris, myocardial infarction, hypertension, atherosclerosis, congestive heart failure [28]. This article gives an overview of some medicinal plants which have significant anti-hyperlipidemic property and may be useful as anticipatory agents in some ailments like cardiac disorders and hyperglycaemia. By this review, it can be concluded that there are so many plants which possess potent anti-hyperlipidemic property and many more are still to be explored.

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