A review on lipid lowering activities of Ayurvedic and other herbs

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Abstract
There is a great awareness regarding association between CAD (Coronary Artery Diseases) and mortality, CAD and Obesity, and CAD and Hyperlipidaemia. Thus, there is a need of knowing more about agents working on hyperlipidaemia. Apart from such agents of synthetic origin, there is an increasing search for the lipid lowering agents from natural origin. In this paper an attempt has been made to give an overview of certain commonly used Ayurvedic herbs along with some other herbs which have been studied for their lipid lowering activity.

Keywords: Coronary Artery Diseases, CAD, Mortality, Obesity, Lipid lowering drugs, Ayurvedic drugs, Medicinal Plants.

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Introduction
The imbalance in high energy input and low energy expenditure due to lack of physical exercise is the main cause of obesity. Daily and seasonal health regimens and other modalities such as detailed instructions on a proper balanced diet and appropriate levels of exercise as per the constitution (prakriti) of the person have been laid out clearly in the Ayurvedic texts. It is interesting to note that the world is now again focusing on a healthy lifestyle as a key to avoid risk factors like obesity. Obesity also increases risk for CAD (Coronary Artery Diseases) indirectly through its association with insulin resistance, hyperlipidaemia and hypertension. An increased accumulation of fat in the intra-abdominal cavity, termed visceral adiposity, is highly correlated with an adverse coronary risk profile. However, there is a growing awareness regarding the increasing episodes of CAD. An overabundance of LDL (Low density lipoprotein) cholesterol causes atherosclerosis, a narrowing of coronary arteries due to plaque build up on artery walls and blood clots may develop on plaque surfaces, further blocking the blood supply to the myocardium (heart muscle) and resulting in myocardial infarction (heart attack). Angina (chest pain) or dyspnea (shortness of breath) may be present. Myocardial infarction can be a serious result of CAD, occurring when a blocked coronary artery causes death to a portion of the myocardium. Cardiac arrest may also result from CAD; 90% of sudden deaths occur in patients with two or more major arteries narrowed by atherosclerosis.

LDL cholesterol levels can be reduced by limiting consumption of saturated fats (whole-fat dairy products, cheese and red meats), increasing physical activity and weight reduction. Increased consumption of monounsaturated fats (olive oil, nuts and fish fats) has been shown to reduce LDL cholesterol and increase HDL (High density lipoprotein) cholesterol thus lowering CAD risk. Drug therapy for cholesterol reduction includes statins, bile acid resins, nicotinic acid and fibrates.

The quest for finding the new safe and effective drug for dyslipidaemia is going to be a continuous process amongst the scientific fraternity. Herbs have been used as food and for medicinal purposes for centuries. Research interest has focused on various herbs that possess hypolipidaemic, antiplatelet, antitumor, or immune-stimulating properties that may be useful adjuncts in helping reduce the risk of cardiovascular disease and cancer. Apart from the synthetic modern drugs like clofibrates, statins, there are efforts to find out herbal drugs possessing lipid lowering activities.

A plant-based diet that is rich in fruit, vegetables, and legumes and low in saturated fat, along with regular aerobic exercise program, is an effective prescription for anyone with elevated risk of cardiovascular disease. In addition, there are a few herbs available that provide some help for persons with either hyperlipidaemia, an abnormal tendency to form blood clots, impaired blood flow, or other cardiovascular problems.
Some pharmacological and clinical studies reported on Ayurvedic and other herbs are described below:

1. **Ajamoda**
   
   Tsi et al\(^8\) studied the antihyperlipidaemic property of aqueous extract of celery, *Apium graveolans* Linn. (*Badi Ajmod*) in rats. A significant reduction was reported by them in the serum total cholesterol (TC), low density lipoprotein cholesterol (LDL-C) and triglyceride (TG) concentrations in rats. However, the concentration of hepatic TG was significantly higher in the celery-treated group than in the control group. Hepatic triacylglycerol lipase activity was found to be significantly lower in the celery-treated rats while the reverse was observed for the hepatic microsomal P450 content. Analysis of an ethereal extract of the aqueous extract of celery by TLC with two different solvent systems showed that the extract did not contain 3-n-butylphthalide, a unique compound in celery that has previously been reported to have lipid-lowering action. Their study indicates that other active principle(s) could be responsible for the observed effects of aqueous celery extract on serum and hepatic lipid levels\(^8\).

2. **Adraka**
   
   The lipid lowering and antioxidant potential of ethanolic extract of adraka or ginger, *Zingiber officinale* Rosc. was evaluated in streptozotocin (STZ)-induced diabetes in rats by Bhandari et al\(^9\). Ethanolic extract of ginger (200 mg/kg) fed orally for 20 days produced significant antihyperglycaemic effect \((P < 0.01)\) in diabetic rats. Further, the extract treatment also lowered serum total cholesterol, triglycerides and increased the HDL-cholesterol levels when compared with pathogenic diabetic rats \((P < 0.01)\). STZ-treatment also induced a statistically significant increase in liver and pancreas lipid peroxide levels \((P < 0.01)\) as compared to normal healthy control rats. Ginger extract treatment lowered the liver and pancreas thiobarbituric acid reactive substances (TBARS) values \((P < 0.01)\) as compared to pathogenic diabetic rats. The results of test drug were comparable to Gliclazide \((25 \text{ mg/kg, orally})\), a standard antihyperglycaemic agent. The results indicate that ethanolic extract of ginger can protect the tissues from lipid peroxidation. The extract also exhibit significant lipid lowering activity in diabetic rats. This was the first pilot study to assess the potential of *Z. officinale* in diabetic dyslipidaemia\(^9\).

3. **Apamarga**
   
   The alcoholic extract of *Achyranthes aspera* Linn., at 100 mg/kg dose lowered serum cholesterol (TC), phospholipid (PL), triglyceride (TG) and total lipids (TL) levels by 60, 51, 33 and 53\%, respectively in triton induced hyperlipidaemic rats. The chronic administration of this drug at the same doses to normal rats for 30 days, lowered serum TC, PL, TG and TL by 56, 62, 68 and 67\%, respectively in triton induced hyperlipidaemic rats. The chronic administration of this drug at the same doses to normal rats for 30 days, lowered serum TC, PL, TG and TL by 56, 62, 68 and 67\%, respectively in triton induced hyperlipidaemic rats. The chronic administration of this drug at the same doses to normal rats for 30 days, lowered serum TC, PL, TG and TL by 56, 62, 68 and 67\%, respectively in triton induced hyperlipidaemic rats. The chronic administration of this drug at the same doses to normal rats for 30 days, lowered serum TC, PL, TG and TL by 56, 62, 68 and 67\%, respectively in triton induced hyperlipidaemic rats. The possible mechanism of action of cholesterol lowering activity of *A. aspera* may be due to rapid excretion of bile acids causing low absorption of cholesterol\(^10\).

4. **Arjuna**

   To evaluate the antioxidant and hypocholesterolaemic effects of *Terminalia arjuna* (Roxb.) Wight & Arn. tree bark (a popular cardiotonic substance in Indian pharmacopoeia) and to compare it with a known antioxidant, vitamin E, researchers performed a randomized controlled trial with one hundred and five successive patients with coronary heart disease (CHD) presenting to their centre were recruited and using a Latin-square design divided into 3 groups of 35 each. The groups were matched for age, lifestyle and dietary variables, clinical diagnosis and drug treatment status. None of the patients was on lipid-lowering drugs. Supplemental vitamins were stopped for one month before study began and American Heart Association Step II dietary advice was given to all. At baseline, total cholesterol, triglycerides, HDL- and
LDL-cholesterol and lipid peroxide estimated as TBARS were determined. Group I received placebo capsules; Group II vitamin E capsules, 400 units/day; and Group III received finely pulverized _T. arjuna_ tree bark-powder (500 mg) in capsules daily. Lipids and lipid peroxide levels were determined at 30 days follow-up. Response rate in various groups varied from 86 to 91%. No significant changes in total, HDL, LDL-cholesterol and triglycerides levels were seen in Groups I and II (paired t-test _P_ > 0.05). In Group III there was a significant decrease in total cholesterol (–9.7 +/- 12.7%), and LDL-cholesterol (–15.8 +/- 25.6%) (paired t-test _P_ < 0.01). Lipid peroxide levels decreased significantly in both the treatment groups (_P_ < 0.01). This decrease was more in vitamin E group (–36.4 +/- 17.7%) as compared to the _T. arjuna_ group (–29.3 +/- 18.9%). Thus, one may conclude that, _T. arjuna_ tree bark powder has significant antioxidant action that is comparable to vitamin E. In addition, it also has a significant hypocholesterolaemic effect.

5. _Bhumiamalki_

The lipid lowering activity (LLA) of _Phyllanthus niruri_ Hook. f. has been studied by Khanna and others in triton and cholesterol fed hyperlipemic rats. Serum lipids were lowered by _P. niruri_ extract orally fed (250 mg/kg b.w.) to the triton WR-1339 induced hyperlipemic rats. Chronic feeding of this drug (100 mg/kg b.w.) in animals simultaneously fed with cholesterol (25 mg/kg b.w.) for 30 days caused lowering in the lipids and apoprotein levels of VLDL and LDL in experimental animals. The LLA of this drug is mediated through inhibition of hepatic cholesterol biosynthesis, increased faecal bile acids excretion and enhanced plasma lecithin: cholesterol acyltransferase activity.

6. _Banana_

The pulp of banana fruit (_Musa sapientum_ Linn. var. _cavendishii_ Lamb.) was examined by Horigome and others for its cholesterol-lowering effect with male rats fed on a diet containing lard (50 g/kg) and cholesterol (5 g/kg). Freeze-dried banana pulp showed a marked cholesterol-lowering effect when incorporated into a diet at the level of 300 or 500 g/kg, while the banana pulp dried in a hot-air current (65°C) did not. Starch and tannin prepared from banana pulp were not responsible for the cholesterol-lowering effect. The results also suggest that banana lipids did not affect the concentration of serum cholesterol. Feeding of dopamine, n-epinephrine and serotonin tended to raise the concentration of serum cholesterol. Thus, all the substances tested which were thought to be susceptible to influence by hot-air drying were unlikely to be responsible for the hypocholesterolaemic effect. However, both soluble and insoluble fibres fractionated from banana pulp had a cholesterol-lowering effect, with the exception of cellulose. It was assumed that a browning reaction undergone during hot-air drying might be related to the disappearance of the hypocholesterolaemic effect of banana pulp dried in a hot-air current. The results obtained support the conclusion that soluble and insoluble components of dietary fibre participate in the hypocholesterolaemic effect of banana pulp.

7. _Coconut oil_

A study was conducted by Nevin and Rajmohan to investigate the effect of consumption of virgin coconut oil (VCO) on various lipid parameters in comparison with copra oil (CO). In addition, the preventive effect of polyphenol fraction (PF) from test oils on copper induced oxidation of LDL and carbonyl formation was also studied. After 45 days of oil feeding to Sprague-Dawley rats, several lipid parameters and lipoprotein levels were determined. PF was isolated from the oils and its effect on in vitro LDL oxidation was assessed. Thus, it was found that VCO obtained by wet process has a beneficial effect in lowering lipid components compared to CO. It reduced total cholesterol, triglycerides, phospholipids, LDL and VLDL cholesterol levels and increased HDL cholesterol in serum and tissues. The PF of virgin coconut oil was also found to be capable of preventing in vitro LDL oxidation with reduced carbonyl formation. The results demonstrated the potential beneficiary effect of virgin coconut oil in lowering lipid levels in serum and tissues and LDL oxidation by physiological oxidants. This property of VCO may be attributed to the biologically active polyphenol components present in the oil.

8. _Flaxseed_

Flour derived from flaxseed or linseed (_Linum usitatissimum_ Linn.) is popular for use in bread and bakery products; it provides a nutty flavour and also increases the nutritional and health benefits of the final product. Flaxseed...
consumption may lower both total- and LDL-cholesterol concentrations because of its low-saturated fat content, high polyunsaturated fat and phytosterol content, and mucilage content\textsuperscript{15, 16}. When 15 patients with elevated blood cholesterol concentrations \([ > 6.2 \text{ mmol/L (240 mg/dL)}]\) consumed 15 g ground flaxseed and 3 slices of flaxseed-containing bread daily for 3 months, their total- and LDL-cholesterol concentrations decreased by 10\% and platelet aggregation decreased substantially, while their HDL-cholesterol and triacylglycerol concentrations did not change significantly\textsuperscript{17}.

9. Ginko

It has been found in one of the animal studies that Maidenhair tree, \textit{Ginkgo biloba} Linn. extract (EGB761) inhibits beta amyloid production by lowering the free cholesterol\textsuperscript{18}.

10. Garlic

Various studies conducted on garlic are:

\textit{a) Effect of short-term usage of garlic extract}

Garlic (\textit{Allium sativum} Linn.) is one of the most commonly used herbal remedies and is considered to have hypocholesterolaemic as well as other cardioprotective properties. Its effect on psychopathologic parameters has never been reported. Peleg and others conducted studies to evaluate the effect of garlic on lipid parameters and depression, impulsivity, hostility and temperament in patients with primary type 2 hyperlipidaemia. In a 16 weeks prospective double-blind placebo-controlled study, 33 patients with primary hypercholesterolaemia and no evidence of cardiovascular disease were randomly assigned to receive either garlic or placebo. Garlic in the form of alliin 22.4 mg/day was given to 13 patients and placebo to 20 patients. Both groups received individual dietary counseling. The changes in lipid profile and the various psychopathologic parameters were determined at the beginning and end of the trial. The differences in lipid parameters were evaluated by Student's t-test. The psychological data were analyzed by one-way analysis of variance (ANOVA) with repeated measures and Neuman-Keuls test. The result concluded that no significant changes were observed in levels of total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides, or in the psychopathologic parameters evaluated. So, it can be concluded that short-term garlic therapy in adults with mild to moderate hypercholesterolaemia does not affect either lipid levels or various psychopathologic parameters\textsuperscript{19}.

\textit{b) Effect of long-term dietary supplementation of fresh garlic}

Epidemiologic studies have suggested that fresh garlic has lipid-lowering activity. Long-term dietary supplementation of fresh garlic may exert a lipid-lowering effect partly through reducing intestinal MTP gene expression, thus suppressing the assembly and secretion of chylomicrons from intestine to the blood circulation\textsuperscript{20}.

\textit{c) Hypocholesterolaemic effect of enteric-coated garlic supplement}

A double-blind randomized, placebo-controlled intervention study was conducted in 46 hypercholesterolaemic subjects who had failed or were not compliant with drug therapy. Each subject was given dietary counseling to lower fat intake and enteric-coated Australian garlic powder tablets with 9.6 mg allicin-releasing potential or matching placebo tablets. The study demonstrates that enteric-coated garlic powder supplements with 9.6 mg allicin-releasing potential may have value in mild to moderate hypercholesterolaemic patients when combined with a low fat diet. Taken with other evidence, the efficacy of garlic for lipoprotein metabolism might require allicin bioavailability to be enhanced through the use of, for example, an enteric-coated dose form. If this is the case, the possibility remains that greater hypocholesterolaemic efficacy may be evident at a higher allicin dose. Also noteworthy in this study was a small reduction in energy intake with garlic compared with placebo, attributable to reduction in fat, carbohydrate and alcohol intakes. This may also have contributed to the effects on blood lipids. This study suggests that garlic supplementation has a cholesterol-lowering effect, which may be mediated by direct action of a biologically active compound or compounds and in part through the effect on food and nutrient intake\textsuperscript{21}.
**d) Suppression of LDL oxidation by garlic**

Short-term supplementation of garlic in human subjects has demonstrated an increased resistance of LDL to oxidation. These data suggest that suppressed LDL oxidation may be one of the powerful mechanisms accounting for the antiatherosclerotic properties of garlic.

**e) Pleiotropic effect of Garlic**

Garlic as a herbal remedy reduces a multitude of risk factors which play a decisive role in the genesis and progression of arteriosclerosis: decrease in total and LDL-cholesterol, increase in HDL-cholesterol, reduction of serum triglyceride and fibrinogen concentration, lowering of arterial blood pressure and promotion of organ perfusion, and, finally, enhancement in fibrinolysis, inhibition of platelet aggregation, and diminution of plasma viscosity. In a prospective, 4-year clinical trial with primary endpoint ‘arteriosclerotic plaque volume’ it was proven not only a 9 to 18% reduction and 3% regression in plaque volume of the total collective under the influence of standardized garlic powder dragees (900 mg/diet LI 111), but also of some facets of the phytopharmacologic pleiotropy of this herb: decrease in LDL level by 4%, increase in HDL concentration by 8%, and lowering in blood pressure by 7%. The reduction of arterial blood pressure is due to an additional opening of K (Ca) ion channels in the membrane of vascular smooth muscle cells that effects its hyperpolarization. This membrane hyperpolarization closes about 20% of the L-type Ca$^{2+}$ channels, consequence of which is vasodilatation. In human coronary arteries, the increase in vascular diameter by 4% is closely associated with an improvement of coronary perfusion by 18%. These pleiotropic effects of garlic result in a reduction of relative cardiovascular risk for infarction and stroke by more than 50%.

**11. Guggul**

a). The effects of the administration of 50 mg of guggulipid of *Commiphora mukul* (Hook. ex Stocks) Engl. or placebo capsules twice daily for 24 weeks were compared by Singh and others as adjuncts to a fruit- and vegetable-enriched prudent diet in the management of 61 patients with hypercholesterolaemia (31 in the guggulipid group and 30 in the placebo group) in a randomized, double-blind fashion. Guggulipid decreased the total cholesterol level by 11.7%, the LDL-cholesterol by 12.5%, triglycerides by 12.0%, and the total cholesterol/HDL-cholesterol ratio by 11.1% from the post diet levels, whereas the levels were unchanged in the placebo group. The HDL-cholesterol level showed no changes in the two groups. The lipid peroxides, indicating oxidative stress, declined 33.3% in the guggulipid group without any decrease in the placebo group. The compliance of patients was greater than 96%. The combined effect of diet and guggulipid at 36 weeks was as great as the reported lipid-lowering effect of modern drugs. After a washout period of another 12 weeks, changes in blood lipoproteins were reversed in the guggulipid group without such changes in the placebo group. Side effects of guggulipid were headache, mild nausea, eructation, and hiccup in a few patients.

b). Multicentric clinical trials of the efficacy of guggulipid conducted at Bombay, Bangalore, Delhi, Jaipur, Lucknow, Nagpur and Varanasi have been reported by Nityanand and others. Two hundred and five patients completed 12 weeks open trial with guggulipid in a dose of 500 mg tds after 8 weeks diet and placebo therapy. One patient showed gastrointestinal symptoms which did not necessitate withdrawal of the drug. A significant lowering of serum cholesterol (av. 23.6%) and serum triglycerides (av. 22.6%) was observed in 70-80% patients. Double-blind, crossover study was completed in 125 patients with guggulipid therapy and in 108 patients with Clofibrate therapy. Two patients had flu-like syndrome with Clofibrate and opted out from the study. With guggulipid the average fall in serum cholesterol and triglycerides was 11 and 16.8%, respectively and with Clofibrate 10 and 21.6%, respectively. The lipid lowering effect of both drugs became evident 3–4 weeks after starting the drug and had no relationship with age, sex, and concomitant drug intake. Hypercholesterolaemic patients responded better to guggulipid therapy than hypertriglyceridaemic patients who responded better to Clofibrate.
therapy. In mixed hyperlipidaemic patients, response to both drugs was comparable. HDL-cholesterol was increased in 60% cases who responded to guggulipid therapy. Clofibrate had no effect on HDL-cholesterol. A significant decrease in LDL-cholesterol was observed in the responder group to both drugs.

12. Haridra and Jatamansi

It has been reported that fifty percent ethanolic extract of Haridra/Turmeric, Curcuma longa Linn. (rhizome) and Jatamansi, Nardostachys jatamansi DC. (whole plant) feeding elevates HDL-cholesterol/total cholesterol ratio. The extracts also caused a significant reduction in the ratio of total cholesterol/phospholipids. Turmeric exhibited better cholesterol and triglyceride lowering activity [Ch = –85%; Tg = –88%] as compared to Jatamansi in triton-induced hyperlipidaemic rats. In view of the protective action of HDL against heart disease and atherogeneity, haridra consumption is recommended.

13. Karela

Effects of three different Japanese cultivars (‘Koimidori’, ‘Powerful-Reishi’ and ‘Hyakunari’) of bitter melon (Momordica charantia Linn.) and those of methanol fraction extract of cv. ‘Koimidori’ on serum and liver triglycerides were studied in rats by Senanayake and others. Feeding of diets containing either bitter melon or various fractions isolated by organic solvents caused no adverse effects on food intake or growth of rats. When the effect of three different varieties of bitter melon was compared, the cv. ‘Koimidori’ was found to be the most effective in lowering hepatic triglyceride levels as compared to the other two cultivars, suggesting a variety-dependent difference in their activity. Furthermore, the active component(s) responsible for the liver triglyceride lowering activity of cv. ‘Koimidori’ was assumed to be concentrated in the methanol fraction, but not in other fractions such as the n-hexane, the acetone or the residual fraction. The triglyceride lowering activity was furthermore confirmed by the dose-dependent reduction of hepatic triglyceride, the lowest level in rats fed 3.0% supplementation was observed. In these experiments, the effects on serum lipids were marginal. The results of these studies clearly show that bitter melon, especially cv. ‘Koimidori’, exhibits a potent liver triglyceride-lowering activity.

14. Lemongrass

It was reported that hypercholesterolaemic subjects who consumed 140 mg/day of lemongrass (Cymbopogon citratus Stapf) oil (rich in geraniol and citral) experienced a drop in cholesterol concentrations over 3 months.

15. Meshashringi

In one of the interesting studies on Meshashringi, Pterocarpus marsupium Roxb. (Indian Kino Tree), it has been observed that serum lipid levels in rats with hyperlipidaemia induced by diet as well as by Triton were determined after oral administration of ethyl acetate extract of heartwood and its flavonoid constituents, marsupsin, pterosupin and liquiritigenin. Administration of ethyl acetate extract for 14 consecutive days produced a significant reduction of serum triglyceride, total cholesterol, and LDL- and VLDL-cholesterol levels without any significant effect on the level of HDL-cholesterol. Liquiritigenin and pterosupin were able to produce a significant fall in serum cholesterol, LDL-cholesterol and atherogenic index; pterosupin being additionally effective in lowering serum triglyceride.

16. Kalonji

Petroleum ether extract of Kalonji, Nigella sativa Linn. (Black cumin) has a slight anorexic effect, and that it contains the hypolipidaemic activity previously obtained with the plant. More significantly, the data demonstrated that in vivo treatment with the petroleum ether extract exerts an insulin-sensitizing action by enhancing the activity of the two
major intracellular signal transduction pathways of the hormone’s receptor.

17. Kala Isabgol

Some hypercholesterolaemic patients have benefited from the use of Black psyllium (Plantago psyllium Linn.), a rich source of soluble fibre (10-12% mucilage). When 5g psyllium was given twice a day for 4 months to subjects with blood cholesterol concentrations >5.7 mmol/L (220 mg/dL), their total- and LDL-cholesterol concentrations dropped to an average of 0.26-0.39 and 0.28-0.34 mmol/L, respectively (10-15 and 11-13 mg/dL, respectively). These changes tended to be greater in subjects consuming high-fat diets.

18. Soyabean

Convincing evidence shows that soyabean (Glycine max Merrill) protein intake has beneficial effects on lipid changes, but it is unclear which components of soy protein are responsible. Researchers have conducted a meta-analysis to identify and quantify the effects of soy protein containing isoflavones on total cholesterol, LDL-cholesterol, and triacylglycerol. Containing extracted soy isoflavones did not have a significant effect on total cholesterol reduction. Thus, soy protein containing isoflavones significantly reduce serum total cholesterol, LDL-cholesterol, and triacylglycerol and increased HDL-cholesterol, but the changes are related to the level and duration of intake and the sex and initial serum lipid concentrations of the subjects.

19. Tulsi

Administration of fresh leaves of Tulsi, Ocimum sanctum Linn. mixed as 1g and 2g in 100g of diet given for four weeks, brought about significant changes in the lipid profile of normal albino rabbits. This resulted in significant lowering in serum total cholesterol, triglyceride, phospholipids, LDL-cholesterol levels, increase in the HDL-cholesterol and total faecal sterol contents.

20. Vidang

Embelia ribes Burm. f., commonly known as Vidanga, is used in Ayurveda for its anthelmintic activity. Ayurveda describes Vidanga as pungent, causes increase in digestive fire, and cures flatulence and colic. Antihyperglycaemic activity of decoction of E. ribes in glucose-induced hyperglycemic albino rabbits has also been reported in a study. The lipid-lowering and antioxidant potential of Ethanolic extract of E. ribes was investigated in streptozotocin (40 mg/kg, IV, single injection)-induced diabetes in rats by Bhandari and others. Twenty days of orally feeding the extract (200 mg/kg) to diabetic rats resulted in significant (P < 0.01) decrease in blood glucose, serum total cholesterol and triglycerides, and increase in HDL-cholesterol levels when compared to pathogenic diabetic rats. Further, the extract also lowered the liver and pancreas TBARS levels (P < 0.01) when compared to TBARS levels of liver and pancreas of pathogenic diabetic rats. The results of test drug were comparable to Gliclazide (25 mg/kg, orally), a standard antihyperglycaemic agent. The study provides biochemical evidence of potential of E. ribes in diabetic dyslipidaemia.

21. Vrikshamla - Kokam

Flavonoids from Cocos nucifera Linn., Myristica fragrans Houtt., Saraca asoca (Roxb.) De Wilde and Garcinia cambogia Desr. exerted hypolipidaemic activity in rats. Lipid lowering activity was reported maximum in rats administered flavonoids (10 mg/kg b.w./day) from Garcinia cambogia. A dose response study revealed biphasic activity. Higher doses
were less effective in reducing lipid levels in serum and tissues, although devoid of toxic effects\textsuperscript{35}.

**Conclusion**

In Ayurveda, lipids can be equated with Medodhatu. Therefore, any drugs that will be working against Medodhatu or Kapha dosha might act as lipid lowering agents. Also, there is a description of group of drugs such as Medoghna (the one which decreases the Medodhatu), Lekhana (the one which helps in reducing the body mass), Kaphaghna gana (the one which acts against Kapha dosha), which might demonstrate the antilipidemic activity. The commonest amongst them will be the contents of Triphala i.e. three myrobalans, viz. Amalki (Embilica officinalis Gaertn. syn. Phyllanthus emblica Linn.), Haritaki (Terminalia chebula Retz.) and Bibhitaki (Terminalia bellerica Roxb.), and Trimada i.e. Vidang (Embelia ribes), Musta (Cyperus rotundus Linn.), Chitrak (Plumbago zeylanica Linn.) and many more herbs given in a dosage form of Guggulu pills with a base of Guggul\textsuperscript{36}. Thus, we need to focus on our rich heritage of Ayurvedic Medicine and should adopt the newly accepted Golden triangle approach (a research collaboration of Traditional Medicine of India i.e. Ayurveda with Modern Medical Science and Modern Basic Sciences), so that we can come out with more concrete solution on this front of lipid lowering drugs.

**References**


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