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Preclinical Antihyperlipidemic Effect of Herbalism against Lipid Elevating Agents: A Review

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Abnormal increase in the level of more than any one of the lipoproteins such as triglycerides, cholesterol, LDL or VLDL in the bloodstream can be defined as hyperlipidemia. It is the greatest world is often overused so, use "the most significant" instead of the greatestrisk factor of coronary heart attack and stroke. This review emphasizes on some herbal medicinal plants with their extracts, including *Glycyrrhiza glabra,Legenaria siceraria,Medicago sativa,Curcuma longa,Curatella americana, Glycine max, Hibisus rosa-sinesis, Hibisus sabdariffa, Cinnamomum tamala, Withania somnifera, Cassia auriculata, Cynaras scolymus, Eugenia jambolana, Adenanthera pavonia, Garcinia cambogia, Terminalia chebula, Ixora coccinea, Carica papaya, Lycimum barbarum, Bauhinia purpurea, Syzygium alternifolium, Vitex negundo, Piper longa, Moringa oleifera, Zingiber officinale, Trigonella foenum graecum, Carum carvi, Gloriosasuperba, Ficus infectoria, Ficus glomerata* for anti-hyperlipidemic potential. Decrease in the levels of these lipoproteins like, triglycerides (TG), Total cholesterol (TC), Very low density lipoprotein (VLDL) and low-density lipoprotein (LDL)includes some mechanisms actions of these medicinal plants observed in triton-x, cholesterol, high fat diet, Poloxamer-407, Dexamethasone and alloxan-induced in-vivo and in-vitro models. Accordingly, this review provides numerous evidenceswhichindicatethat these medicinal plants can be usedfor treating and preventinghyperlipidemia and related complications.

Keyboard: Hyperlipidemia, Cholesterol, Triglyceride, Lipids, and Herbal medicinal plants.

Hyperlipidemia is a chaos of lipid metabolism produced bytherise of plasma concentration of the different lipid and lipoprotein portions, which are the source of heart disease. It characterizedas the elevation of serum TC, TG, VLDL, LDL and HDL, which are responsible for various complications likeheart attack, coronary artery syndrome, stroke, atherosclerosis, myocardial infarction and pancreatitis. Hyperlipidemia can be either primary or secondary type; the primary syndrome might be treated by hypolipidemic drugs, however, secondary induced by diabetes, hypothyroidism or renal lipid nephrosis which treated by treating the natural disease respectably than hyperlipidemia.[1] Genetic disorder and way of life diet wealthy in calories, fat, and cholesterol assume a vitalrole to cause dyslipidemia around the world.[2] The primary factor responsible for hyperlipidemia includes sedentary lifestyle and changing habits in which the most vulnerable

factor includes poor diet, for example,lipoprotein intake of more than 40 percent of total calories, intake of saturated fat more than 10 per cent of total calories; and ingestion of cholesterol more than 300 milligrams per day.[3] For enormous hyperlipidemia number of manufactured medications available, not a bit is useful for all lipoprotein disorder, and every drug connected with various side effects. So, presently a day different materials are search from natural sources with the severity of less toxic, less expensive, and provide better safety and efficacy on a long agepractice. Characteristic items from plants are a rich wellspring of medication utilized for quite a long time to treat different disease.[4]

Hyperlipidemia, a clinical state can be defined as increase in either all lipoproteins or any one of them in the blood.[5] The lipid metabolism is synchronized in many various ways. Enzymes are the most significant regulators of lipid metabolism, for example, 3-Hydroxy-3-methylglutaryl coenzyme which is a reductase enzyme responsible for the biosynthesis of cholesterol.[6]

However, increase in thelow-density lipoprotein cholesterol (LDL-C) is the major lipid responsible for causing atherosclerosis. Dyslipidemia occurs due to significant abnormal amount of total cholesterol (TC), triglycerides (TG), or low levels of high-density lipoprotein (HDL).Hyperlipidemia is a medical just as social issue, particularly connected with diabetes mellitus results in increased mortality rate and morbidity. The major factors leading to hyperlipidemia includes atherosclerosis,which however results incerebrovascular and ischemic coronary heart disease.[7]

Various allopathic hypolipidemic drugs like statins are obtaining in the market, but they cause various adverse effects like hyperuricemia, looseness of the bowels, myositis, hepatotoxicity, and so on. As they are for the most enzyme inhibitors, so they may inhibitother grave enzymes in the body. Additionally, statins are intake on a long-term basis, so it causes chronic toxic effects over a lifetime use.[8]

Individuals Drugs

Glycyrrhiza glabra

Glycyrrhiza glabra belongs to family *Fabaceae*. The main chemical constituents includes saponins, glycyrrhizin, triterpene and glycyrrhetic acid. It is used as ananti-inflammatory, mild laxative, antiarthritic, antiviral, antiulcer,, antibiotic, memory stimulant, antitussive, aphrodisiac, antineoplastic, anticholinergic, antidiuretic, antimycotic, estrogenic, antioxidant, anticaries agent, hypolipidemic agent.[9]

The results concluded that the level of TG, TC, and LDL-C in serum ($P<0.05$) was prominently elevated in HFD animals when compared with the control group. However, the ethanolic root extract of *Glycyrrhiza glabra*at a dose of 400mg/kg when administered to animals showed a prominent increase in the plasma HDL-C in animals treated with *Glycyrrhiza glabra extract* when compared to HFD rats. In this study, the high-fat diet used contains saturated fatty acids which elevates the effect of HMG-CoA reductase enzyme due to increased availability of acetyl CoA thereby resulting in increased cholesterogenesis rate.[10]

Lagenaria siceraria

Lagenaria siceraria belongs to family *Cucurbitaceae*. It is used for treating different conditions, like jaundice, congestive heart failure (CCF),ulcer, piles, diabetes, insanity,colitis, skin disease, and hypertension. The pulp of the fruits is used both as laxative and emetic. It is also used for its cooling effect, antibilious, as diuretic and pectoral properties. The driedpulp can also be used for treatinginsomnia and rheumatism.[11]

The results demonstrate that *Lagenaria siceraria* obtains the prominent antihyperlipidemic potential, which may be because of secondary metabolites as saponins, phenolic compounds, and flavonoids present in the extract of leaf. Flavonoids present in the extract may increase Lecithin Acyl Transferase (LCAT) effects. LCAT is responsible for the regulation of blood lipids. LCAT is the principal enzyme responsible for the incorporation of cholesterol into HDLc. This may result an elevation in HDLc and transferring it back into LDLc and VLDLc. Afterwards,these are taken back in hepatocytes. It demonstrates that there is an inverse relationship between incidence of Coronary Artery Disease (CAD) and HDL-C levels. Saponins are also anti-hyperlipidemic. They exert their antihyperlipidemic effect through various mechanisms. Saponins reduce the intestinal absorption of cholesterol by binding with it and thus elevating its faecal elimination.[12]

Medicago sativa

Medicago sativa, also known as alfalfa, which belongs to family *Fabaceae*. *M. sativa* is utilized as a food additive in the United States, North Africa, Russia and China due to their high vitamin content. It outcomes secondary metabolites, such as naphthoquinones, alkaloids, coumarins, isoflavones and saponins, that have nematocidal, cytotoxic and antimicrobial activity.[13]

The methanolic extract, chloroform, ethyl acetate, petroleum ether, and butanol fractions of sprouts of *M. sativa*, demonstrate a prominent treatment-duration related reduce in the TG, TC, LDL and VLDL levels compared to the untreated diabetic rats in a level alike to those of reference hypolipidemic drug rouvastatin. The high content of omega - 3 fatty acids (2.1%) and phytosterols (28.3%) in oil ether portion might be the reason for the hypolipidemic activity of petroleum ether part,and the total extract of M. sativa grows; as detailed previously, stigmasterol decreases plasma cholesterol levels and stop hepatic synthesis and intestinal absorption in the rats â-sitosterol has a reducing activity on hypercholesterolemia and omega - 3 fatty acids have a diminishing effect on raised cholesterolemia in NIDDM patients. The investigation findings revealed that the methanolic extract of M. sativa grows applied antihyperlipidemic and improved antihyperglycemic activity in STZ diabetic hyperlipidemic rats.[14]

Curcuma longa

Curcuma longa belongs to family *Zingiberaceae*. It commonly namedas turmeric. It is the most common condiment usedall over the world. In curry powder it is the main ingredient and is therefore known as "Indian Golden spice" when used in Asian cuisines. *C. longa* is herbaceous perennial plant. There are many medicinal properties of turmeric include anti-inflammatory, antifungal, antifertility, antiprotozoal, antimutagenic, anti-carcinogenic, anticoagulant, anti-hepatotoxic, antiviral, anti-fibrotic, anti-venom, antiulcer, anti-diabetic, and hypolipidemic properties.

A study on diabetic hyperlipidemic rats demonstrated that the serum TG level declined at the end of 4 weeks in Group IV and Group V rats administered with 300 mg/kg and 500 mg/kg body weight dose respectively. Serum TG level in Group IV was 109.0 ± 7.98, and in Group V was 94.33 ± 5.15 in examination with Group II rodents (diabetic hyperlipidemic control gathering) 136.33 ± 3.32. Mean estimation of serum HDL in Group I was 57.60 ± 5.67, Group II was 33.75 ± 2.25, Group III was 35.00 ± 2.23, and Group IV was 35.67.78 ± 2.41. The studied was noted that curcumin administration did not have any prominent activity on the mean value of serum HDL ($P > 0.05$). The study on diabetic hyperlipidemic rats was conducted and a notable increase in serum HDL levels in diabetic hyperlipidemic rats was observed, who received turmeric at a dose of 300 mg/kg and 500 mg/kg respectively, for four weeks. Activity of ethanolic extract of turmeric in a dose of 300 mg/kg/day and 500 mg/kg/day decreased serum TC and serum TG. There was no prominent rise in serum HDL-C levels in Groups III, IV, V, and VI.[15]

Curatella americana

Curatella americana L. belongs to family *Dilleniaceae*. It's popularly called in Brazil as "lixeira". In folk medicine, it is used as an astringent and antiseptic. It is also used for treat ingulcers, cold and coughs diabetes, hypertension and healing wounds.

The hypolipidemic activity demonstratesa noticeable elevation in the levels of triglycerides and total cholesterol. Other chemical constituents like, saponins also possess the potential to reduce the level of cholesterol in serum. However, it was observed that *C. americana* extract resulted in decreasing both the serum cholesterol and triglycerides level contributing towards management of hyperlipidemia. The extract also reduced the oxidative stress owing to the free radical scavenging activity thereby protecting against lipid peroxidation[16].

Glycine max

Glycine max belonging to family *fabaceae*. Commonly, it is also known as soybean. It related to a modulation of the immune system, anti-oxidation, inhibition of carcinogenesis, and its capacity to bring down the cholesterol level. There are different soybean cultivars, yet black soybean demonstrated to be better than different varietiesbe cause of its higher capability to act as an antioxidant. The most significant therapeutic properties of black soybean include its capacity to acts as a detoxificant, anti-inflammatory, and wellspring of the progress of the blood plasma profile.[17]

The levels of LDL, VLDL, TG and TC highly prominently increased in the treated group (HCD alone) when compared with control groups (pÂ0.001 or pÂ0.01). The level of HDL was essentially diminished in the efficacy group in comparing with standard control (pÂ0.01). However, the administration of MEGM high dose at 400 mg/kgand MEGM low dose at 200 mg/kg respectively in two groups already treated with HCD showed prominent increase the reduced levels of HDL (pÂ0.001 and pÂ0.05; separately) when compared with the control group.[18]

Hibiscus rosasinensis

Hibiscus rosasinensis belongs to family *Malvaceae.* Usually, it is cultivated as an ornamental garden shrub in the native regions. Also it is used as an antispermatogenic, androgenic, antiviral activities, antipyretic, antispasmodic, anti-inflammatory, anti-diarrhetic, anti-phologistic activity, antitumor and anticonvulsant activities. Furthermore, it assists in inducing abortion and providing treatment for headache.

The level of serum cholesterol and lipoprotein were markedly increased while the level of HDL reduced in the atherogenic diet and triton treated animals. Flowers ethanolic extract portion (500 mg/kg body weight) prominent decreased this level and increased HDL level when compared with the control group. The results revealed maybe due to enhanced activity of Cholesterol acetyltransferase: lecithin, which combines with free LDL and cholesterol into HDL and transferred back to intermediate-density lipoprotein and VLDL. The decreased level of triglyceride might be due to prevention of fatty acids lipolysis because of which they do not get converted to triglyceride.[19]

Hibiscus sabdariffa

*Hibiscus sabdariffa*is belongs to family *Malvaceae.* It commonly named as Roselle. It is one of the most common medicinal plant known all over the world, and can be found in every country of the world such as Thailand, Indonesia, India, Philippines, Vietnam, Mexico, Malaysia, Egypt, Sudan, and Saudi Arabia. It used in the mild laxative activity, capability to elevation urination and cracks treatment in the feet, anti-helmentic, sedative properties, bilious, sores and wounds. It used for healing wounds, relief of sour throat,as a soothing cough remedy, antipyretic antimicrobial, diuretic and emollient.[20]

It assessed that the calyces and leaves of *Hibiscus sabdariffa* decrease total cholesterol and raise HDL level. It examined the anti-hyperlipidemia effect of *Hibiscus Sabdariffa* in decreasing the serum concentration of TC, TGs and LDL-Cholesterol. The study demonstrates a prominentraise in HDL-C($p < 0.05$) since HDL-C is a protective factorin coronary heart disease. It concludedserum Triglycerides and LDL level, the present finding agrees with study showed that serum TGs and level of LDL reduce prominent after rats were administered with 1000 mg/kg and 500 mg/kg dose of Roselle extract (dried calyces). It studied that 5% and 10% ethanolic extract of *Hibiscus Sabdariffa* L. flowers when administered to cholesterol-rich basal diet resulted in effective decrease of serumlipids level.[21]

Cinnamomum tamala

Cinnamomum tamala belongs to Family *Lauraceae*. It commonly calledas Tejapatra, Tejpat leaves. It used as carminative, stimulant, diuretic, diaphoretic, deobstruent, lactagogue, cough, flatulence and dyspepsia. It is beneficial in the inflammation, sore eyes; stops salivation, anthelmintic, and diuretic. Besides, it used as a tonic to the brain.

CTLE treatment decreased theliver serum enzyme levels prominently ($P < 0.001$) in treated animals indicating the liver protective activity of CTLE. However, no glimpse of side effects of extract were seen in the albino rats when adminstered orally with CTLE at the doses of 200 mg/kg/ day and 400 mg/kg/day. It was concluded that the CTLE leaves possess anti-hyperlipidemic,anti-atherosclerotic and cardioprotectiveactivity.[22]

Withania somnifera

Withania somnifera belongs to family Solanaceae. Various vernacular names of *Withania somnifera* includeIndian ginseng,Winter cherry, and Ashwagandha. In the Ayurvedic and indigenous medical system it has been a significant herb. It used in patients with nervous fatigue, a sleeping disorder, debility due to stress, and immune stimulant in patients with less white platelet checks).

The study investigated the antihyperlipidemic activity of extract of *Withania somnifera* in Triton X-100 induced in hyperlipidemic rats. Administration of triton-X-100

(100mg/kg) to rats resulted in increase in the level of total triglycerides, total cholesterol, LDL, and VLDL while decreases the level of HDL. Treatment with plant extract at doses 200, 400 mg/kg day, (p.o) was potential to prominently($p<0.05$) reduce the VLDL, LDL, TG and TC levels. The plant extract also resulted in prominent ($p<0.05$) elevation in the levels of HDL. It concluded that extract of *Withania somnifera* is potential to effectively suppress the hyperlipidemia in rats. Therefore, 400mg/kg extract is more effective than 200mg/kg extract.[23]

Cassia auriculata

Cassia auriculata L. belongs to family *Cesalpinaceae.* It is commonly known as Tanner's Cassia. In Ayurvedic medicine it is widely used as 'Avarai Panchaga Choornam'. It is considered to be as the main constituent of Kalpa herbal tea, and is also proved to possess anti-diabetic activity. It used in the treatment of leprosy, asthma, skin disease, tumours, renal injury, antipyretic and antiulcer.

The results revealed that Et-CAF receivesananti-hyperlipidemia effect and may help in maintaining cholesterolhomeostasis. Elevated level of HDL, reduces TC plasma level, and inhibits development of atherosclerosis. The reduced concentration of LDL might also contribute to the reduction of TC in hyperlipidemic rat administered with extract of Et-CAF. It was concluded that Et-CAF possesses antioxidant activity contributing towards the antihyperlipidemic, and anti-diabetic activity. This might however also contribute towards theanti-atherosclerotic and cardio protective role. Et-CAF decreased lipids level and improved the antioxidant activity comparing with lovastatin, which has recorded to have adverse effects, whereas Et-CAF is not harmful.[24]

Cynara scolymus

Cynara scolymus L. belongs to family *Asteraceae.* It is popularly known artichoke. It is a perennial plant of Mediterranean origin. Caffeoylquinic acid derivatives and flavonoids are the main chemical constituents present in the plant. It is traditionally used in the treatment of digestive and urinary tract diseases.

The results demonstrate that diet rich in cholesterol resulted in an elevation in serum levels of TC and LDL-C that can be alleviated by CS at dose ranging from 150 to 600 mg/kg. The increased polyphenols and flavonoids values showed the possible effect of hypolipidemic activity in CS.

The results revealed that the effect of aqueous *C.scolymus* extracts in cholesterol administered rats correlated with lowering of LDL levels and also preventing number of pro-inflammatory cytokines. There were no differences in action of ALT enzyme of serum between the different groups. The outcomes that antiatherogenic and hypolipidemic movement can be connected with proximity of polar substances found in aqueous C. scolymus activity.[25]

Eugenia jambolana

Eugenia jambolana belongs to family *Myrtaceae*. It is commonly named Jamun. It is a large tree found in forests throughout most of Thailand, India, and Philippines. It isa well-known traditional medicinal plant, has various biological effects and pharmacological actions, including decreasing blood glucose and serum lipids levels. It used to treat various diseases, like diabetes mellitus.

The results demonstrate LH II prominent reversed the reduction in hepatic and skeletal muscle glycogen content seen in diabetic controls, possibly due to reducing glycogen phosphorylate and raised glycogen synthase activities. Elevated total lipids of liver and kidney in alloxan-induced diabetic rabbits may indicate a high synthesis of lipid and storage capacity, which may have caused araised in serum TGs and phospholipids. It is concluded that insulin deficiency causes a variety of disorders in metabolic and regulatory mechanisms that are responsible for lipid accumulation. The elevated level of total lipids in diabetic rabbits was because if impaired insulin secretion, which result in high mobilization off at from the adipose tissue to the plasma.[26]

Adenanthera pavonina

Adenanthera pavonina Linn. belongs to family *Leguminoceae*. It is commonly called as Bead tree, Red wood and Kanchan Daana, is utilized for many remedies traditionally. It used an astringent, gout, rheumatism, antiemetic, anthelmintic, colonorrhea, ulcers, febrifuge and hemorrhages.

The petroleum ether part, n-butanol part, diethyl ether part and ethyl acetate fraction of ethanolic extracts of *Adenanthera pavonina* Linn

prevented huge valuable rise in cholesterol at 400 mg/kg dose levels, individually when compared with the untreated control group. The ethanolic extract fractions of *Adenanthera pavonina Linn*reduce the triglycerides levels in comparison to that vehicle control rats. The treatment with Atorvastatin resulted in a slightly better activity than *Adenantherapavonina* Linn. These outcomes concluded that the numerous portions of ethanolic extract of Adenanthera pavonina Linnmight interlope with cholesterol biosynthesis as triton quickens the hepatic synthesis of cholesterol. A significant decrease of cholesterol and triglyceride by ethyl acetic acid derivation portion and n-butanol portion of ethanolic bark extract of Adenanthera pavonina Linn.[27]

Garcinia cambogia

Garcinia cambogia belongs to family *Guttiferae.* It isalso called Malabar tamarind. It is native to South East Asia. The fruit tastes sweet and sour. In Indian medicine it is used for the treatment of diarrhea, dysentery, ulcers, haemorrhoids, and certain types of cancer.

The study evaluated that superfluous intake of diet rich infat resulted in development of obesity-associated complications such asoxidative stress and dyslipidemia. The many chemical constituents present in the GE extract for the observed antioxidant and hypolipidemic activity. It concluded that *G. cambogia* fruit can be given as dietary supplement which might diminish the complications caused due to diet intake.[28]

Terminalia chebula

Terminalia chebula belongs to family *Combretaceae*. It is evergreen flowering tree indigenous to variousAfrican and Asian countries. It is used as an anti-inflammatory, hepatoprotectant,antioxidant, cardio tonic and anti-cancer agent.

The *T. chebula*methanolic extract of bark demonstrated dose-dependent anti-hyperlipidemic activity against high-fat diet-induced hyperlipidemia in rats. Extract administration at 600 mg/kg dose produced effective anti-hyperlipidemic activityin high-cholesterol diet-induced hyperlipidemic rats. There was a noticeable decrease in level of blood glucose.[29]

Ixora coccinea

Ixora coccinea belongs to family *Rubiaceae*. It is native to Southern India and Srilanka. It is planted in tropical and subtropical climates.4-5. It is used in the treatment of inflammation, diarrhoea, asthma, ulcer, , skin diseases, colic, flatulence, antiseptic, anti-nociceptive, wounds, ulcers, indigestion, cancer, leucorrhoea, dysentery, dysmenorrhoea, haemoptysis and hypertension.

In a study, there was noteable increase in Malondialdehyde level in the rats administered with triton and cafeteria diet as compared to the standard control. The treatment with hydro alcoholic extracts of *Ixora coccinea* leaves (400 mg/kg) prominent decreased Malondialdehyde levels in the liver, heart. However, *Ixora coccinea* leaves extract dose of 200 mg/kg treated rats are not demonstrate prominent result. It concluded that, hydroalcoholic extract of *Ixora coccinea* leaves has the noticeable hypolipidemic action on both Triton and Cafeteria diet induced hyperlipidemic rats.[30]

Carica papaya

Carica papaya belongs to family *Caricaceae.* It is one of the most nutritional fruits consumed and grown in Africa. It utilized as a tonic for the heart, analgesic. It has antioxidant properties and treatment for stomach ache.

The results demonstrated *C. papaya* extract was administered at a dose of 200 mg/kg and 300 mg/kg body weight respectively. It displays a prominent reduce in all lipid parameters ($p < 0.05$) with a noticeable increase in level of HDL ($p < 0.05$) when compared with thetoxic group. Simvastatin when administered at 1.8 mg/kg dose simultaneously with high fat diet showing a prominentreduce ($p < 0.05$) in all parameters of lipid profile while there was a prominent ($p < 0.05$) raise in level of HDL.[31]

Lycium barbarum

Lycium barbarumL. belongs to family *Solanaceae.* It commonly namedas wolf berries or Goji berries. It has a long tradition as food and medicinal plants in China and many other Asian countries. It used as anti-ageing, blood sugar, immuno-modulating, anti-cancer and anti-fatigue.

The *L. barbarum* extract-treated group demonstrates a noticeable reduction in the TG levels for both the doses employed. Significantly diminsh in VLDL-C was observed at higher dose 20 mg/kg when compared with the disease control. A noticeablerisein HDL-C observed for the lower dose. There was a dose-dependent reduce in TC and LDL-C levels; it was not statistically prominent.

Herbal plants which are used in anti-hyperlipidemic activity:-

S. No	Botanical Name / Family	Common Name	Extract Dose	Standard Dose	Model	Parameter	Animals
1.	Glycyrrhiza glabra (Fabaceae)	Liquorice	Ethanol200& 400 mg/kg,b.w	Simvastatin 10mg/kg,b.w	HFD	Serum:TC,TG,LDL-C'!HDL-C	Albino wistar (n=30)
2.	Lagenaria siceraria (Cucurbitaceae)	Lauki	Aqueous200& 400 mg/kg,p.o	Atorvastatin 10mg/kg,p.o.	HCD	Serum:"!TC,TG,LDLC, VLDC'!HDLC	Albino wistar (n=30)
3.	Medicago sativa (Fabaceae)	Alfalfa	Methanolic 500mg/kg,i.p.	Rouvastatin 10mg/kg,i.p.	STZ	Serum:"!TG,TG,LDL, VLDL'!HDL	Albino wistar (n=72)
4.	Curcuma longa (Zingiberaceae)	Turmeric	Alcoholic 300,500 mg/kg,p.o.	Atorvastatin 40mg/kg,p.o.	STZ	Lipid:"!TC,TG, LDL'!HDL	Albino wistar (n=36)
5.	Curatella americana (Dilleniaceae)	Sand paper	Hydroalcholic 200mg/kg,b.w	Simvastatin 30mg/kg,b.w	HFD	Serum:"!TC,TG	Albino wistar (n=28)
6.	Glycine max (Fabaceae)	Soyabean	Methanolic 200&400mg/kg,p.o.	Atorvastatin 20mg/kg,p.o.	HFD	Serum:"!TC"!TG"! LDL-C,'!HDL-C	Albino wistar (n=20)
7.	Hibiscus rosa-sinesis (Malvaceae)	China rose	Ethanolic 500mg/kg,p.o.	Simvastatin 10mg/kg,p.o.	Triton WR-1339	Serum:"!TG,TG, LDL, VLDL'!HDL	Albino wistar (n=42)
8.	Hibiscus sabdariffa (Malvaceae)	Roselle	Ethanolic 500&1000mg/kg,p.o.	Atorvastatin 20mg/kg,p.o	HFD	Serum:"!TC,TG, VDL'!HDL	Albino wistar (n=32)
9.	Cinnamomum tamala (Lauraceae)	Tejpatra	Aqueous 200&400mg/kg,p.o	Atorvastatin 10mg/kg,p.o.	HFD Triton X	Serum:"!TC,TG, LDL-C'!HDL-C	Albino wistar (n=30)
10.	Withania somnifera (Solanaceae)	Ashwagandha	Ethanolic 200&400 mg/kg,p.o	Atorvastatin 10mg/kg,p.o.	Triton X	Serum:"!TG,TG, LDL,VLDL'!HDL	Albino wistar (n=30)
11.	Cassia auriculata (Cesalpinaceae)	Senna	Ethanolic 150,300& 450 mg/kg,i.p	Lovastatin 10mg/kg,i.p	Triton WR-1339	Serum:"!TG,TG, LDL,VLDL'!HDL	Albino wistar (n=36)
12.	Cynaras scolymus (Asteraceae)	Artichoke	Aqueous 150,300& 600mg/kg,p.o	Simvastatin 4mg/kg,p.o.	Cholestrol fed	Serum:"!TC.LDL-C	Albino wistar (n=30)
13.	Eugenia jambolana (Myrtaceae)	Jamun	Alcoholic 1.5g/100g,p.o	Glibenclamide 10mg/kg,p.o	Alloxan	Serum:'!TC,TG "!HDL	Albino wistar (n=25)
14.	Adenanthera pavonia (Leguminoceae)	Bead tree	Ethanolic 200 & 400mg/kg,i.p	Atorvastatin 1mg/kg,i.p	Triton WR 1339HFD	Serum:'!TC, LDL-C	Albino wistar (n=36)
15.	Garcinia cambogia Guttiferae	Malabar	Ethanolic 400mg/kg,i.p	3.2kcal/g	HFD	Serum:'!TC, Non-HDL-C"!HDL-C	Albino wistar (n=40)
16.	Terminalia chebula (Combretaceae)	Chebulic myrobalan	Mehanolic 200, 400&600mg/kg,p.o	Atorvastatin 10mg/kg,p.o	HFD	Seum:"!TC,TG'!HDL	Albino wistar (n=36)
17.	Ixora coccinea (Rubiaceae)	Jungle flame	Hydroalcoholic 200 & 400mg/kg,p.o	Atorvastatin 10mg/kg,p.o	Triton X-100	Seum:"!TC,TG'!HDL	Albino wistar (n=30)

19.	Lycium barbarum (Solanaceae)	Goji berry	Hydro alcoholic 250&500mg/kg,p.o	Atorvastatin 10mg/kg,p.o	HFD	Serum:“!TC,TG,LDL-C, VDL-C‘!HDL	Albino wistar (n=30)
20.	Bauhinia purpurea (Fabaceae)	Purple camel foot	Ethanolic 300mg/kg,p.o	Atorvastatin 10mg/kg,p.o	CHFD	Serum:“!TC,TG, LDL, VLDL‘!HDL	Albino wistar (n=30)
21.	Syzygium alternifolium (Myrtaceae)	Mogi	Methanolic 100 & 200mg/kg,p.o	Atorvastatin 10mg/kg,p.o	HFD Dexamethasone	Serum:“!TC,TG,LDL, VLDL‘!HDL	Albino wistar (n=30)
22.	Vitex negundo (Verbenaceae)	Horseshoe vitex	Ethanolic 200mg/kg,p.o	Lovastatin 7.2mg/kg,p.o	HFD	Serum:“!TC,TG,LDL, VLDL‘!HDL	Albino wistar (n=20)
23.	Piper longum (Piperaceae)	Pipli	Aqueous 500mg/kg,p.o	Simvastatin 1mg/kg,p.o	Triton WR-1339HFD	Seum:“!TC,TG‘!HDL	Albino wistar (n=20)
24.	Moringa oleifera (Moringaceae)	Drumstick	Methanolic 200 & 400mg/kg,p.o	Simvastatin 3mg/kg,p.o	HFD	Serum:“!TC,TG, LDL‘!HDL	Albino wistar (n=50)
25.	Zingiber officinale (Zingiberaceae)	Ginger	Methanolic 500mg/kg,p.o	Atorvastatin 10mg/kg,p.o	Alloxan Propylthiouracil	Serum:“!TC,LDL ‘!HDL	Albino wistar (n=40)
26.	Trigonella foenum graecum(Fabaceae)	Fenugreek	Ethanolic 400mg/kg,p.o	Atorvastatin 400mg/kg,p.o	HFD	Serum:“!TC,TG, LDL-C‘!HDL-C	Albino wistar (n=24)
27.	Carum carvi (Apiaceae)	Caraway	Methanolic 50 & 100mg/kg,p.o	Gemfibrozil 100mg/kg,p.o	Cholestrol Triton WR 1339	Serum:“!TC,TG, LDL‘!HDL	Albino wistar (n=30)
28.	Gloriosasuperba (Liliaceae)	Flame lily	Methanolic 200 & 400mg/kg,i.p	Atorvastatin 10mg/kg,p.o	Poloxamer-407 Cholestrol& Cholic acid suspension	Serum:“!TG,LDL‘!HDL	Albino wistar (n=30)
29.	Ficus infectoria (Moraceae)	White fig	Methanolic 200&400mg/kg,p.o	Fenofibrate 20mg/kg,p.o	Fructose	Serum:‘!TC,TG,LDL, VLDL“!HDL	Albino wistar (n=30)
30.	Ficus glomerata (Moraceae)	Gular	Hydroethanolic 100&200mg/kg,p.o	Gemfibrozil 100mg/kg,p.o	Triton-WR 1339	Serum:‘!TC,TG“!HDL	Albino wistar (n=20)

It concluded the hypolipidemic activity of *L. barbarum* in a high-fat diet-induced model of hyperlipidemia.[32]

Bauhinia purpurea

Bauhinia purpurea belongs to family *Fabaceae*. It is commonly known as Purple camel's foot and Hong Kong Orchid Tree. It is a species of flowering plant native to south eastern Asia and South China. It is used as anti-malarial, anti-mycobacterial, anti-funga, cytotoxic, anti-oxidant, hepatoprotective, and anti-nociceptive, anti-inflammatory, anti-pyretic,nephro protective and hypoglycaemic.

The treatment with ethanolic extract of leaves (300mg/kg/day) and unripe pods (300mg/kg/day) demonstrate elevation in body weight to 7.4% and 2.0%, respectively, when compared with thetoxic group (13.11%). The results revealed that theability of *B. purpurea* extracts against obesity. The effects of the extracts can be due to direct inhibition of absorption of cholesterol or due to elevated biliary excretion of bile acids and /or sterol and the blockage of movement of cholesterol from the liver to the blood; as cholic acid was one of the ingredients of cholesterol high fat-diet.[33]

Syzygium alternifolium

Syzygium alternifolium belonging to family *Myrtaceae*is known commonly as mogi/movi. It is an aromatic tree, distributed in Assam and Andhra Pradesh. The parts of the plant were used in traditional medicine for treating many diseases that is dysentery, diabetes and used to treat gastric ulcers.

It demonstrates a statistically prominent action at100 mg/kg and 200 mg/kg dose when administered orally. The plasma cholesterol was decreases remarkably on treating the HFD rats with methanol extract of *S. alternifolium.* The lipid-lowering activity may be because of the presence of plant sterol. The plasma lipoproteins are the major sources of fatty acid to synthesis triacylglycerol. It results assessed that MESA obtains prominent anti-hyperlipidemic activity.[34]

Vitex negundo

Vitex negundo belongs to family *Verbenanceae*. It is an aromatic shrub, seen in Wasteland up to 2000 meters in the Himalayas.

The results revealed that *Vitex negundo* aqueous extract significantly and dose-dependently decreased the level of LDL and total cholesterol level when compared with the control group. However, the treatment groups resulted inslight increase in the level of HDL. The extract treated group showed prominent effect in triglyceride level when compared with the standard group.

It concluded that *Vitex negundo* leaf possessesplasma lipid-lowering effects, (which might help inhibit or slow the progression of atheroma related diseases)[35].

Piper longum

Piper longum belongs to family *Piperaceae*. In Indian kitchen, the *Piper longum* is black, hot, and used as spices beside its medicinal purpose, where it's soothing and relieves muscular pains and inflammation.

Hyperlipidemia was induced in the animals by administering triton WR-1339 through intraperitonial route. Extract of guggulipid and *Piper longum* along with aqueous gum acacia (1% w/v) suspension were macerated and were administered orally at 500 and 200 mg/kg, b.w. doses respectively. It was investigated that HFD rich in cholesterol when administered to rats induced hyperlipidemia which when demonstrated that extract of *Piper longum* could excite hepatic LPL and PHLA action, both the components play a vital role in the catabolism of lipid and their functions in the body[36]

Moringa oleifera

Moringa oleifera Lam is specie of family *Moringaceae*. Commonly it is knownas Drumstick. It is used as antimicrobial activity, anti-diabetic, hepato protective, cardiac stimulation and hypocholesterolemic activity.

The result showed that high fat diet induced repeatedly for 21 days caused a significant increase in lipid levels characterised by increased triglycerides, triglycerides, VLDL, LDL (5ØCÜ< 0.001), and decreased HDL levels (5ØCÜ< 0.001) when compared with the normal and control group. However, an increased LDL level indicates hypercholesterolemia and treatment with MEMOL for 3weeks resulted in decreased hyperlipidemia activity induced by high-fat diet prominent (5ØCÜ< 0.001) drug. MEMOL treated animals with extract dose of 200mg/kg and 400mg/kg resulted in prominent decrease in the atherogenic index. It concluded that *M. oleifera* methanolic extract can be usedin weight management, which supports its traditional claim.[37]

Zingiber officinal

Zingiber officinal belongs to family *Zingiberaceae*. Commonly it is known as ginger. It is a perennial herb. It used for gastrointestinal disorders and anti-inflammatory effect.

The result revealed that decreased levels of low-density lipoprote in (LDL), and total cholesterol (TC) in therat serum were administered with ginger extracts when compared with the control groups. The extracts were also effective indecreasing LDL levels to same levels as that of standard group which was also comparable to the effect of atorvastatin 10 mg/day. It was concluded that reduced triglyceride, and increased high-density lipoprotein level was observed in ginger-treated groups.[38]

Trigonella foenum-graecum

Trigonella foenum-graecum Linn. is specie of family *Fabaceae.* It is known commonly as Fenugreek. It is cultivated as a leafy vegetable, condiment and as medicinal plant. It used as anti-diabetic, anti-microbial, hypocholesterolaemic lactation stimulant, anti-fertility, antioxidant, anticancer, anti-parasitic and hair growth promotion activity. It used for reducing the body weight in folklore.

The result revealed that extract group demonstrate prominent reduce serum triglyceride, LDL-Cholesterol and total cholesterol and increase HDL cholesterol serum level. It concluded that the fenugreek extract mightuse for anti-hyperlipidemic and anti-obesity activity with efficacy comparable to the newlipid-lowering agent. Hence, it can use as natural and safe remedy for the treatment of hyperlipidemic and cardiovascular complications of diet-induced obesity.[39]

Carum carvi

*Carum carvi L.*belongs to family *Apiaceae*. It commonly known as caraway. It is used as a food flavour, fragrance additive. It is used for the treatment in an antibacterial agent with antispasmodic, carminative, and appetite stimulant properties. *Carum carvi* is also used in eye ailments, gastrointestinal disorders, genitourinary diseases like metritis, dysuria and orchitis.[40]

Concominent administration of the methanolic extract at dose of 100 mg/kg and 50 mg/kg respectively to various groups demonstrated prevention in increase of TC prominent when compared with the animals treated with cholesterol ($p<0.05$).Statistically they were non-prominent to the control group. Extract drug at both the doses reduces prominent ($p<0.01$) the increase of VLDL and TGL when compared with group toxic group. In same test,the drug (100 mg/kg) raises prominent levels of ($p<0.01$) HDL when compared with control and toxic groups. Test drug has prominently reduced the ratio of TC/HDL and AI in the hyperlipidemic rats. Test drug showed more hypolipidemic effect on a higher dose and therefore produce dose-dependent effect.[41]

Gloriosasuperba

Gloriosasuperba belongs to *Liliaceae* family. This drug is a valuable plant found in Africa and tropical Asia. It used an Anthelmintic, anti-inflammatory, Analgesic, Oxytocic, Abortifacient, Mutagenic and Antimicrobial activities.

MEGS treated animals showed prominent ($p<0.0001$) inhibitory effect on serum LDL and TC levels. (Moreover, and regarding the liver, it displayed the prevention of lipid peroxidation and increased catalase). The results revealed increase in plasma cholesterol level after administration of Poloxamer-407 i.p. The effect produced might be due to inhibition of cholesterol 7*a*- hydroxylase, which facilitates cholesterol clearance and up-regulation of 3-hydroxy-3-methylglutaryl coenzyme A (HMG CoA) reductase. Inhibitory effect of this enzyme reduces the rate at which triglycerides breaks down into free fatty acids to produce increase in triglycerides level.[42]

Ficus infectoria

Ficus infectoria (*F. infectoria*) belongs to *Moraceae* Family. It is commonly known as White Fig and locally as Pilkhan. Moreover, they are more commonly foundin Nepal, Bangladesh, Sri Lanka, South-west China, and Pakistan & Indochina. It is used as a gargle in salivation,for washing ulcers, leucorrhoea and also in treating menstrual disorders.

The results demonstrate that *F. infectoria* methanolic extract receives hypoglycemic and antihyperlipidemic activity. 20 days continuous administration of fructose prominently increased the insulin, triglyceride and glucose levels similar to an earlier study. However, administration of *F. infectoria* at the dose of 200 mg/kg and 400mg/kg respectively inhibits the development of hyperglycemia and hyperlipidemia.[43]

Ficus glomerata

Ficus glomerata syn. Ficus racemosa belongs to *Moraceae* family. Commonly it is known as Gular. It used traditionally in a wide variety of ethnomedical remedies. Widely it is distributed in different parts of world like northern Australia, India and other parts of Asia. It used as anti-diarrhoeal, antidiuretic, antitussive, antipyretic, chemo modulatory effect and hypoglycemic activities, antifungal, antimicrobial, antipyretic and anti-diabetic activities.

The study demonstrated the lipid-lowering effect of *Ficus glomerata* hydroethanolic fruit extract in triton induced hyperlipidemic rats. The hypolipidemic activity of extract is compared with gemfibrozil (standard drug) at the dose of 100mg/kg. Both Gemfibrozil and *F. glomerata* caused a prominent reduce in lipids serum levels in triton induced hyperlipidemic rats, and this model has been used successfully for the examination of lipid-lowering activity of natural products in animals.[44]

CONCLUSION

Traditionally, herbal medicines have utilized from decades as a remedy for a few diseases. In this review,thirty herbaceous plants processing anti-hyperlipidemic activity. The anti-hyperlipidemia activity of plants plays a vitalrole in the decrease of CVD; where this is the top disease that causes mortality everywhere throughout the world. Thus we need to focus on thelipid-lowering activity of herbs and should adopt a new approach to the protective role of these medicinal plants which depends on the reduction of LDL, so that we can come out with more concrete solution on these plant lipid-lowering activity for phytomedicine research and medication improvement for such a disease. This review is an overview of the anti-hyperlipidemic activity in traditional medicinal plants asa potential use for the development of new medicines used in the protection against dyslipidemia or atherosclerosis. However, we can safely state that herbal medicines have enormous potential to provide some remarkable drugs.

Conflict of interest

The authors declare no conflict of interest, financial or otherwise.

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