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Therapeutic Uses of Medicinal Plant for the Treatment of Hyperlipidemia-A Review

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Abstract
Hyperlipidaemia is defined as an abnormal rise of lipid levels which is one of the main causes behind coronary heart disease. Elevated quantities of lipids such cholesterol and triglycerides along with a decline in high density lipoproteins. Many drugs used now adays to reduces cholesterol and triglycerides like statins and fibrates are associated with adverse effects compared to herbal plants medication. Epidemiologist has been observed that effective of plant products in lowering of lipid level can be achieved by the consumption of the medicinal plants. This present paper is an attempt to list the plants with hyperlipidaemic properties and other beneficial properties reported in scientific literature. This review will be helpful for the future researchers and useful for preclinical trials. The therapeutic effect of these plants is very diverse on the biological system of human body in controlling the lipid levels and in promotion of the conversion of triglycerides and cholesterols into other useful resources to the body.

Keywords
Hyperlipidaemia, high cholesterol, plasma lipids, medicinal plants, therapeutic uses.

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INTRODUCTION:
One of the main risk factors for cardiovascular diseases (CVDS) is hyperlipidaemia. By 2030, it is anticipated that cardiovascular diseases would account for most deaths and disabilities worldwide, accounting for one third of all. Higher levels of plasma lipids, such as triglycerides, cholesterol esters, and phospholipids like very low-density lipoproteins and decreases in high density lipoproteins levels are the signs of hyperlipidaemia. The major cause of atherosclerosis [thinking and hardening of the arteries caused by a buildup of plaque in the inner lining of an artery] which is closely related to ischemic heart disease [IHD] is hypercholesterolemia. The high death rate is strongly correlated with IHD more than four are a result of much more increased plasma cholesterol levels million fatalities each year. This buildup is called plaque pod.

Low-density lipoproteins may undergo oxidative modifications because of hyperlipidaemia, which is related to increase the oxidative stress and oxygen free radical production. These oxidative modifications play a significant role in the development of atherosclerosis and other cardiovascular diseases.

CHOLESTROL:
Cholesterol is a sterol with the higher molecular weight. The cell membranes contain important amounts of cholesterol. Inside the cell, organelle membranes more than 20 enzyme-catalysed reactions make up the process of cholesterol biosynthesis which produces cholesterol mostly in the liver and intestine. 3-Hydroxy-3-methyl glutaryl-CoA [HMG COA] reductase Catalyse the rate limiting Process in Cholesterol manufacture, and stain medications have been designed to pharmacologically target this enzymatic step- The body uses cholesterol as a building block for healing This is why the damaged sections of the arteries (as in atherosclerosis) include cholesterol in addition to

a number of other substances(including calcium and collagen) Lipoproteins like LDL and .HDL act as transporters for cholesterol in the blood.
Low density lipoproteins carriers' cholesterol from the lives to the cells, tissues, and glands where it performs its many vital bodily tasks High density lipoproteins carriers are used for cholesterol transport.

Low-Density Lipoproteins [LDL]:
Lipoproteins keeps a lot of cholesterol in it. Since these tissues have ILDL receptors, the protein layer makes it possible for the tissues to utilise the cholesterol - low-density lipoproteins are depleted of cholesterol in tissues including the inner layer of the artery wall and the liver. LDL is regarded as bad cholesterol because free radicals which are highly reactive and oxidative substances found in the body can oxidise it and cause atherosclerosis plaque to form in the arteries.

High-Density Lipoprotein (HDL):
High density lipoproteins have a different Form of lipoprotein that the liver also makes high-density lipoprotein stores extra Cholesterol that cells unable to process it can use. An enzyme called lecithin cholesterol acyltransferase (LAT) oversees transferring extra Cholesterol reverse to the HDL molecules. HDL cholesterol absorbs extra cholesterol from to the liver, arteries, and to other organs. There is proof that the LCAT and HDL cholesterol Can eliminate even a small amount of oxidised LDL As a result, HDIL is regarded as beneficial Cholesterol. The body's HDL circulates and assembles to the mature cholesterol that is released from tissues returns to the liver- It is recognised by its lipoprotein there.

Cholesterol Esters:
Esters of cholesterol are used to Camry Cholesterol throughout the body additionally, extra cholesterol is retained inside of cells as cholesterol esters. The breakdown of these accumulated cholesterol esters under the direction of the enzyme cholesterol esterase. fatty acids. produces bioavailable cholesterol and fatty acids. Long chain and unsaturated fatty acid esters are hydrolysed by cholesterol esterase more quickly than the short chain saturated fatty acids. Additionally, cholesterol esterase helps transport Free cholesterol into the enterocyte and p contributes to the integration of cholesterol into mixed micelles.

Triglycerides:
Triglycerides make up most of the fat in our food. The primary form of fat that is carried by our bodies are triglycerides. Following a meal, your body breaks down the dietary fats into triglycerides, which are then released into the bloodstream. Triglycerides go throughout our bodies in the blood to either provide energy or be stored as fat. Triglycerides are also made by our liver, some of which are converted into cholesterol. Any source of extra calories can be converted by our liver to triglycerides. However, our body produces many triglycerides it causes it may cause hyperlipidaemia, which is a medical term for having more bad fat in the blood stream.

Phospholipids:
All plants and animals cell membranes contain phospholipids (PLs), which are amphiphilic lipids organized in lipid bilayers. Glycerol-phospholipids (GPLs), the primary component of cell membranes, are composed of fatty acids esterified backbone and a phosphate group and a hydrophilic residue (such as choline, that produces phosphatidylcholine on lecithin).

Dyslipidaemia:
The Levels of serum in cholesterol, triglycerides LDL-C & HDL-C are above normal, the lipid metabolism is disrupted, which is referred to dyslipidemia.one of the most potent and thoroughly researched risk factors of atherosclerosis is Corona y heart disease (CHO), is the presence of lipids and lipoprotein lipids in the serum.

Blocking absorption of Dietary cholesterol:
Animals that have high sources of fat Content provides dietary cholesterol. A healthy adult contains only 30% of the cholesterol intake. Foods produced from animal sources that are high in fat content provide dietary cholesterol. A healthy adult only requires about 30% of the daily recommended cholesterol intake. Getting more dietary cholesterol than this can result in higher cholesterol levels and significant health hazards. The small intestine's lumen serves as the site of dietary cholesterol absorption. A biliary micelle is created by the liver's production of bile salts from cholesterol and phospholipids, which is then carried into the lumen by bile.

USES OF MEDICINAL PLANTS FOR THE TREATMENT OF HYPERLIPIDEMIA:
1) Botanical Name: *BOERHAVIA ELEGANS*
Family: NYCTAGINACEAE FAMILY
Plant extract: Leaves, Roots
Uses: The Ethanolic extract of roots of boerhavia elegans shows the antihyperlipidemic activity by reducing the total cholesterol, triglycerides levels,

very low-density lipoproteins and low-density lipoproteins with an increase in high density lipoproteins which has a protective effect for heart. The various ayurvedic formulations of Boerhavia elegans are used for nephrological disorders, gynaecological disorders, antidiabetic, and asthma. Boerhavia elegans also shows the antioxidant activity, antimalarial activity of boerhavia elegans was founded by Ramazani,et,al in 2010**.**

2) Botanical Name: *ALLIUM SATIVUM*
Family: AMARYLLIDACEAE FAMILY
Plant extract: Garlic naphtha, Allicin
Uses: Allium sativum Linn, Commons know as garlic. It is a perennial plant. Many herbal products are sold on the market by this plant. It is also on old - fashioned treatment for the aliments affecting human health.

Additionally, it is a food additive. Garlic has active components that include an enzyme that creates chemicals that contain sulphur. Alliin (such as allicin) has important biological impacts on the immune system. The crushed raw garlic can decrease the levels of total cholesterol (TC), triglycerides (TG), and low-density lipoproteins (LDL). Allium sativum also has other medicinal uses like sinus congestion, rheumatoid arthritis, bronchitis, anti-inflammatory, antioxidant, and hypertension as well as maintaining healthy liver function.

3) Botanical Name: *FENU GREEK*
Family: FABACEAE FAMILY
Plant extract: Seeds, Leaves
Uses: Fenu Greek (Trigonella foenum - graceum) is a nutritional supplement and herbal treatment. fenu greek seeds are very useful in treating hypercholesterolemia by up - regulating the low density lipoprotein receptor (LDLR) it can be used in hyperlipidaemia condition and prevents atherosclerosis. Fenu greek is frequently used by people to treat menstrual cramps, and sexual dysfunction. Chemical components such as flavonoids, alkaloids, coumarins, saponins and vitamins are found in fenu greek which are used to reduce inflammation, and acts as antioxidant, antidiabetic, and anti-hypertensive.

4) Botanical Name: *COPTIDIS RHIZOMA (HUANGLIAN-IN CHINA) IS A RHIZOME*
Family: RANUNCULACEAE FAMILY
Plant extract: Ethanol 59%, Berbine, c.rhizome extract.
Uses: Coptidis rhizoma has anti-atherosclerotic property. Coptidis rhizoma alkaloids with the dose of 46.7 mg/kg/ day shows the decrease of serum total cholesterol and increased high density lipoproteins. So the Rhizoma coptidis produces a lipid - reducing action that is reduced by lowering cholesterol levels. The primary bioactive components in Rhizoma coptidis berberine have a strong hypolipidemic activity. The rhizome of the coptidis plant is frequently used in traditional medicine. It has been used to treat cardiovascular disease, which affects lipid metabolism and includes issues including obesity, diabetes. It also has antibacterial, spasmolytic, immunomodulatory, and anti-athymic activity and used to treat respiratory infections including tuberculosis, whopping cough and pulmonary candidiasis caused by pneumonia.

5) Botanical Name: *HIBISCUS CANNABINUS*
Family: MALVACEAE FAMILY
Plant extract: Flowers, Leaves, Seeds.
Uses: Kenaf oil contains high amount of monounsaturated and polyunsaturated fatty acids (PUFAs) which shows the cholesterol lowering effect. Hence it is useful in hypocholesterolaemia. It is an annual herbaceous tropical plant has high potential for both fibre and strength. The juice of these flowers is used in biliousness with acidity and the seeds are aphrodisiac. They are used in hypertension and improve metabolic syndrome. The flowers, leaves and seeds are consumable. So, they are used in throat infections, used in the form of tea to control common cold and lowering the blood pressure.

6) Botanical Name: *CINNAMOMUM TAMALA*
Family: LAURACEAE FAMILY
Plant extract: Cinnamon oil, Leaves
Uses: Cinnamomum tamala leaves extract shows the antihyperlipidemic effects. The Ethanolic extract of the cinnamomum tamala in the doses of 400/mg/kg/day shows the significance reduction in serum levels of total cholesterol and decrease in triglyceride levels and also it shows the increase in HDL-C levels. cinnamomum tamala is an herbaceous plant used in the ayurvedic studies called as cinnamon tamala. It is also referred as Indian cassia called as tejpat or tejpatta. It leaves smell like cloves .The primary chemical components of cinnamomum tamala include cinnamaldehyde, linalool and eucalyptol. Ayurvedic religious and historic medical writings all mentioned it's advantages. This plant is used to treat foul Indian breath as well as oral hygiene issues, dark spots on the face and tuberculosis.

7) Botanical Name: *TERMINALIA PALLIDA*
Family: COMBRETACEAE FAMILY
Plant extract: Flowers, Fruits.
Uses: Terminalia pallida fruit ethanolic extract shows the reduction of low-density lipoprotein levels and increased High density lipoprotein cholesterol levels (HDL-C) and it shows both anti atherogenic and anti-hyperlipidaemic activity. The methane extract of Terminalia pallida shows greater effectiveness

against gram negative bacteria. It contains the active components like Triterpenes, flavonoids, alkaloids, tannins and polyphenols are used to treat peptic ulcers, purgative, swellings and anti-inflammatory. Terminalia pallida stem bark is used as anti-diuretic and leaf is used to treat skin infections, skin cracks and skin tanning, and it is also used to treat venerable diseases.

8) Botanical Name: *HEMIDESMUS INDICUS*
Family: APOCNACEAE FAMILY
Plant extract: Roots,Fruits.
Uses: The methanolic extract of Hemidesmus indicus is used to treat hyperlipidemic condition. Bopanna and his workers has investigated that the Hemidesmus indicus administrated rats in the doses of 16mg/kg shown the reduced LDL, VLDL levels and increased HDL levels. Hemidesmus indicus is a shrub that is semi- erect or prostrate. It is commonly known as Indian sarsaparilla that has been used in traditional medicine for centuries and is available in powder, decoction, and syrup forms for administration. It is also used as antioxidant, antimicrobial, anti-hepatoprotective, anticarcinogenic and antithrombic.

9) Botanical Name: *MIMOSA PUDICA*
Family: FABACEAE FAMILY
Plant extract: Leaves, Stem, Roots, Seeds.
Uses: Mimosa pudica leaves has the inducing effect of hyperlipidemia. The active phytoconstituents present in the mimosa pudica like alkaloids, flavonoids are responsibile for hypolipidemic effect. Mimosa pudica is a delicate plant also referred to as the "shame plant". The primary characteristic of this plant is its swift mobility. Mimosine a poisonous alkaloid found in mimosa pudica, has antiproliferative and apoptotic properties. This plant has long been utilised for a variety of purposes in ayurveda, siddha and unani medicine to cure a wide range of illnesses. It works as a repellent for both scorpion and snake bites. This plant roots is chewed and the root paste is then put to the place that snake was been bit. The root is also used to treat intestinal worms and dysentery.

10) Botanical Name: *SPIRULINA*
Family: SPIRULINACEAE
Plant extract: Blue green algae, Cyanobacteria, Artthrospiraplatensis.
Uses: Spirulina contains the gamma- linolenic acid (GLC) will prevents the accumulation in the body. The spirulina contains antioxidants, GLC, fatty acids which are helpful to decrease the lipid levels in hyperlipidemic patients. Cyanobacterium filament ous in shape is spirulina plantensis (arthrospiraplatensis). It is utilised in aquaculture, aquarium, and poultry as dietary supplements in industries. It also has Amino acids and fatty acids. It includes functional groups like Phycocyanins and phenolics. Spirulina plantensis major ingredient is Phycocyanins which is used in both reduce the synthesis of inflammatory signalling molecules and free radicals. It has excellent anti-inflammatory and antioxidant capabilities.

11) Botanical Name: *ASPARAGUS RACEMOSUS*
Family: LILIACEAE FAMILY
Plant extract: Roots, Leaves, Flowers
Uses: Asparagus racemosus Commons called as satamuli, satvari is a climbing plant which is used in traditional medicines. It was identified in southern Asia and also includes in Indian subcontinent. The dry powder of Asparagus racemosus shows the lipid lowering activity in hyperlipidemic condition. It also lowers the plasma cholesterol levels. Asparagus racemosus is also used as an antioxidant and anti-bacterial effects. It has several medicinal values to treat various diseases like dyspepsia, stomp ulcers, constipation, stomach ulcers, constipation, stomach spasms, diabetes, dementia, bronchitis, and fluid retention. It also helps to promote fertility in women.

12) Botanical Name: *CARACA PAPAYA*
Family: CARICACEAE FAMILY
Plant Extract: Leaves, Fruit extract
Uses: Caraca papaya leaf contains the components like phenolics, squalene and flavonoids has been investigated by several studies that shows the antihyperlipidemic effect. The aqueous extract of Caraca papaya fruit seeds can lowers the triglycerides and low-density lipoproteins. caraca papaya is a widely grown in tropical and subtropical regions of Hawaii, Australia, and South-east Asia. The leaves extract of these fruits is widely used in the treatment of dengue fever. It has the active components of phenolic, flavonoids, alkaloids have the high amount of ascorbic acid. caraca papaya also shows antidiabetic, anti-inflammatory and antihypertensive properties.

13) Botanical name: *BACCAUREA RAMIFLORA*
Family: EUPHORBIACEAE FAMILY
Plant Extract: Seeds, Fruit, Leaves Stem, Bark extract.
Uses: Baccaurea ramiflora is the evergreen tree of slow growing to 25M.It is identified in Asia from Nepal. The ethanolic extract of Baccaurea ramiflora seeds has the capacity of lower hyperlipidemic activity and lowers the TC, TG, and LDL values. Other than hypolipidemic it also has anticholinergic, antiviral, diuretic, antioxidant cytotoxic activities. It has the traditional uses to treat rheumatoid arthritis, cellulitis, constipation and injuries.

14) Botanical name: *EMBLICA OFFICINALIS*
Family: PHYLLANTHACEAC FAMILY

Plant Extract: Fruits, leaves
Uses: The fresh juice of Emblica officinalis (Amla) shows the lipid lowering and anti-atherosclerotic activities. The lowering of serum cholesterol, total cholesterol, phospholipid, and low-density lipoprotein levels has been observed. Emblica officinalis (Indian goose berry) each part of the tree especially the fruit is used as the herbal medicine. The amla contains the active components like ellagitannins-1.2-1.5%, gallic acid-1.5-2.0%, total polyphenols 10-14%. are used for various diseases like to improve kidney, liver and heart health and increase the immune system and promotes the digestive health.

15) Botanical name: *IPOMOEA AQUATICA*
Family: CONVOLVULACEAE FAMILY
Plant extract: Leaves, Flower
Uses: Ethanol extract of Ipomoea aquatica plant shows the significant decrease of serum levels of Total cholesterol (TC) and increase in the High-density lipoprotein cholesterol (HDL) -C. Ipomoea aquatica commonly known as water spinach grown as a semi aquatic tropical plant identified in southern Asia. These ipomoea aquatica is widely used to treat against piles, to treat high BP, and anti-helminthic. It contains the active components like saponins, flavonoids, Cartenoids and glucosides which are used to reduce the total cholesterol levels, free fatty acids and acts as anti hyperlipidemia.

16) Botanical name: *WITHANIA SOMNIFERA*
Family: SOLANACEAE FAMILY
Plant extract: Root extract
Uses: Withania somnifera the aqueous extract of ashwagandha (withania somnifera) root shows the decreasing of cholesterol levels in the hyperlipidemic patients. The active components withaferin A shows the anti-hyperlipidaemic activity. It is commonly known as winter cherry used as both traditional and modern medicines from thousands of years. Many investigations have been done on this plant and found it has antioxidant, anti-inflammatory, Hemopoetic and rejuvenating properties. Visavaidya and Narsimha charya has evaluated that withania somnifera root powder shows hypercholesterolemia properties.

S No	Botanical name	Family	Plant extract	Hyperlipidemic and other therapeutic uses
1.	*BOERHAVIA ELEGANS*	Nyctaginaceae	Leaves, Roots	Hepatitis, diuretic, Antiinflammatory, Anti hyperlipidemic,spasmodic.
2.	*ALLIUM SATIVUM*	Amaryllidaceae	Garlic naphtha, Allicin	Antibacterial Antiprotozoal, Antifungal, Antiviral, Antibacterial.
3.	*FENU GREEK*	Fabaceae	Seeds, Leaves	Antiulcerogenic, Antipyretic immuno modulatory, antitumor.
4.	*COPTIDIS RRHIZOMA (HUANGLIAN-IN- CHINA) IS A RHIZOME*	Ranunculaceae	Ethanol 59%, Berbine, C. rhizome extract	Bacillary dysentery diabetes sore throat hyperlipidemia.
5.	*HIBISCUS CANNABINUS*	Malvaceae	Flowers of Hibiscus,Leaves,Seeds.	Antihelmintic, cytotoxic, Antiulcer,Antibacterial antidiabetic.
6.	*CNNAMOMUM TAMALA*	Lauraceae	Cinnamon oil, Leaves	Antioxidant, Antidiabetic, Antibacterial, Dyslipidemia.
7.	*TERMINALIA PALLIDA*	Combretaceae	Fruits	Diuretic, Antihyper glycemic, Antiulcer.
8.	*HEMIDESMUS INDICUS*	Apocnaceae	Roots	Rheumatoid aethritis, Antileprosy, Urinary tract infection, Skin infection.
9.	*MIMOSA PUDICA*	Fabaceae	Leaves, Steem, Roots, Seeds.	Anticancer, Antidiabetic, Antifertility, Anticonvulsant, Aphrodisiac, Anti-depressant.
10.	*SPIRULINA*	Spirulinaceae	Blue green algae, Cyanobacteria	To manage blood sugar

				levels anti-bacterial, anti-inflammatory allergic, Rhinitis, Anti-Fungal.
11.	*ASPARAGUS RACEMOSUS*	Liliaceae	Roots, Leaves, Flowers	Dyspepsia, hepatoprotective immune modulatory anti Inflammatory.
12.	*CARACA PAPAYA*	Caricaceae	Leaves, Fruit	Dengue Fever anticancer, improve digestion helps in wound healing.
13.	*BACCAUREA RAMIFLORA*	Euphorbiaceae	Seeds, Fruit, Leaves Stem, Bark	Skin diseases rheumatoid arthritis constipation cellulitis.
14.	*EMBLICA OFFICINALIS*	Phyllanthaceac	Fruits, leaves	Hypertension, parasitic conditions, Neurological conditions, anti-inflammatory
15.	*IPOMOEA AQUATICA*	Convolvulaceae	Leaves, Flower	Fever, Jaundic bronchitis, Liver disease.
16.	*WITHANIA SOMNIFERA*	Solanaceae	Roots	Antitumor, Anti-inflammatory, Antioxidant Immunomodulatory, Hemopoietic.

DISCUSSION

In numerous organs, lipoprotein levels and antioxidant status have both been proven to be impacted by hyperlipidaemia. Hyperlipidaemia may be reduced with lipid-lowering medicinal plants, reducing atherosclerosis and vascular endothelium damage. Most of the time, therapeutic effect as well as other medical plant effects, have been at least partially related to their antioxidant qualities. Free radical generation rises because of hyperlipidaemia, which also causes an increase in oxidative stress and low-density lipoprotein oxidation. Low-density lipoprotein undergoes this transformation into oxidised low-density lipoprotein during which time adhesion molecules are expressed, T cells and macrophages are stimulated to become activated, foam cells are produced in greater quantities, and macrophages are drawn to the sarcoplasmic reticulum. Low-density lipoprotein oxidation is a key factor in the development of atherosclerotic plaques. Lipophilic antioxidants at first protect. Hyperlipidaemia is caused due to the abnormal levels of lipids and increased levels of cholesterol in the body. Hyperlipidaemia is mainly occurring due to the lifestyle like improper diets like highly saturated fatty food items, excessive smoking and alcohol intake. some cases it also occurs due to the hereditary conditions. In other causes hyperlipidaemia may also occurs in pregnancy. Hyperlipidaemia symptoms that are associated with severe chest pain (angina pectoris), stroke, obesity, swelling of body organs and blockage of the blood vessels in heart and brain.

CONCLUSION

Hyperlipidaemia is increasingly recognised in most societies as a medical issue with its associated adverse effects. Additionally, hyperlipidaemia worsens metabolic abnormalities and raises the risk of cardiovascular illnesses, particularly in people with diabetes and high blood pressure. Information now available suggests that substances found in dietary supplements and medicinal plants, such as dietary fibres, vitamins, flavonoids, sterols, and other antioxidants, can be beneficial for the metabolism of lipids. Disorders of lipoprotein metabolism. Harrison's metabolic processes of various tissues. Most of the time, these plants' lipid-lowering abilities have been linked, at least in part, to their antioxidant capacities, and many therapeutic plants have antioxidant capacities. It may be worthwhile to investigate alternative medicinal plants with antioxidant properties for their hypolipidemic effects. At present Hyperlipidaemia is the major cause of worldwide morality. Hyperlipidaemia is the major cause that leads to Atherosclerosis and other heart related problems. The drugs that are used to treat hyperlipidaemia condition are statins which are associated with lots of side effects like increased blood sugar levels, pain in muscles, Tiredness/fatigue, and liver problems. Hence the medicinal plants with active components can be used effectively without any adverse effects. The herbal plants can also be used in the preparations of foods, and we can also include in our daily diet. One of the main reasons of hyperlipidaemia is improper diet conditions. So, the Herbal plants are readily available and cheaper when compared with the modern drugs. In this part of above review we have discussed about the medicinal plants to treat hyperlipidaemia condition.

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