Antihyperlipidemic and thrombolytic potential of medicinal plants: Mechanistic insights and precision medicine perspectives

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2026-07-29

ChinaRxiv

Abstract

Full Text

Antihyperlipidemic and thrombolytic potential of medicinal plants: Mechanistic insights and precision medicine perspectives

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ARTICLE INFO

Keywords:
Antihyperlipidemic
Thrombolytic
Medicinal plants
Cardiovascular disease
Precision medicine

ABSTRACT

Background: Hyperlipidemia and thrombosis are major contributors to cardiovascular morbidity and mortality worldwide. Although synthetic antihyperlipidemic and thrombolytic agents are clinically effective, their long-term use is limited by adverse effects and patient intolerance. Medicinal plants offer a promising alternative due to their multitarget pharmacological actions and favorable safety profiles.

Objective: This review critically evaluates medicinal plants exhibiting antihyperlipidemic and thrombolytic activities, with emphasis on bioactive phytoconstituents, mechanisms of action, and their relevance to precision medicine.

Methods: A comprehensive literature survey was conducted using databases including PubMed, Scopus, and Google Scholar, focusing on experimental and clinical evidence supporting lipid-lowering and clot-dissolving effects of herbal drugs.

Results: Multiple plants such as *Commiphora mukul*, *Hibiscus* species, *Allium sativum*, *Ocimum sanctum*, and *Zingiber officinale* demonstrate significant antihyperlipidemic and thrombolytic activity through mechanisms including inhibition of cholesterol synthesis, antioxidant effects, platelet aggregation inhibition,

and fibrinolysis. Phytochemicals such as flavonoids, polyphenols, saponins, and organosulfur compounds play key roles.

Conclusion: Medicinal plants represent viable candidates for adjunct or alternative therapy in cardiovascular disorders. Integration of phytotherapy with precision medicine approaches may improve therapeutic outcomes while minimizing adverse effects. However, standardized formulations, mechanistic validation, and controlled clinical trials are essential.

Introduction

Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality worldwide, accounting for a substantial proportion of global deaths each year.1 Among the major pathological contributors to CVDs, hyperlipidemia and thrombosis play a central role in the development of atherosclerosis, myocardial infarction, and ischemic stroke.

Lipids are essential biomolecules involved in cellular structure, energy metabolism, and signaling; however, dysregulation of lipid metabolism leads to elevated levels of cholesterol and triglycerides in circulation, a condition known as hyperlipidemia.2,3 Excess low-density lipoprotein cholesterol (LDL-C) undergoes oxidative modification and accumulates within arterial walls, triggering inflammatory cascades and plaque formation that progressively narrow blood vessels.

Recent epidemiological evidence indicates a high global prevalence of dyslipidemia, highlighting its significant contribution to cardiovascular risk across diverse populations.4 In parallel, hyperlipidemia promotes a pro-thrombotic state by enhancing platelet activation, endothelial dysfunction, and coagulation pathway activation, thereby increasing the likelihood of thrombus formation and acute cardiovascular events. Despite the effectiveness of conventional pharmacotherapy, long-term use is often limited by adverse effects, underscoring the need for safer, mechanism-based therapeutic alternatives.

Hyperlipidemia

Types of hyperlipidemia:
On the basis of type of lipid-

Peer review under the responsibility of Editorial Office of Precision Medication.
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https://doi.org/10.1016/j.prmedi.2026.100095

Received 17 January 2026; Accepted 6 May 2026
Available online 18 June 2026

- Hypercholesterolemia (high cholesterol level)
- Hypertriglyceridemia (high triglyceride level)

On the basis of causative factor:

- Primary (genetic/familial)
- Secondary (acquired)5

Hyperlipidemia leads to the deposition of lipids or fats on the inner wall of blood vessels, which further leads to plaque formation, foam-cell formation, atherosclerosis, and thereby narrowing of blood vessels. This causes serious cardiovascular events, namely stroke and heart attack.6

Diagram text:

HYPERLIPIDEMIA
↓
ATHEROSCLEROSIS
↓
Coronary artery diseases Myocardial infraction Ischemic stroke

Different forms of lipids contributing to hyperlipidemia are as follows:

- Triglycerides: high levels of triglycerides contribute to plaque formation and inflammation.
- LDL cholesterol: LDL (low-density lipoprotein) particles can enter artery walls, become oxidized, and lead to the formation of foam cells and atherosclerotic plaques, narrowing blood arteries and reducing blood flow through arteries.
- HDL cholesterol: HDLs (high-density lipoproteins) are protective lipoproteins that lower the level of bad cholesterol and carry excess cholesterol to the liver for metabolism.
- VLDL: VLDL (very-low-density lipoproteins) works by transporting triglycerides from the liver to tissues. Its high level increases the risk of plaque formation.5

Common factors contributing to hyperlipidemia:

- Genetic and lifestyle-related factors: obesity, physical inactivity, smoking, age, family history, diet, etc.
- Medical conditions: various medical conditions can cause hyperlipidemia, including hypothyroidism, liver disease, diabetes, kidney diseases, etc.

- Medication-related factors: some synthetic medications, namely beta-blockers, diuretics, etc., can cause cholesterol imbalance.6

Treatment of hyperlipidemia:

Hyperlipidemia can be treated in two ways, namely self-care (non-pharmacological management) and pharmacological treatment.

Self-care: Lifestyle changes can positively affect the lipid profile if one starts daily exercise, follows a healthy or low-trans-fat diet, reduces smoking and alcohol consumption, and manages stress levels, etc.

Pharmacological treatment: In some cases, self-care is sufficient to manage cholesterol levels within a healthy range, but it does not work in all cases; therefore, medical treatment is required. Different types of medications are available for the treatment of hyperlipidemia.6

Medical treatment of hyperlipidemia

- Statins: prevent the formation of cholesterol in the liver. Examples include atorvastatin, simvastatin, etc.
- Cholesterol absorption inhibitors: prevent absorption of dietary cholesterol. Example: ezetimibe.
- PCSK9 inhibitors: lower LDL levels by inhibiting the liver enzyme PCSK9, which promotes cholesterol formation.
- Nicotinic acid: lowers LDL and triglyceride levels and increases HDL levels.
- Fibrates: decrease the level of VLDL and increase the removal of triglycerides from the body. Example: fenofibrate.

Along with their various advantages, the above drugs have side effects including sore muscles, liver enzyme abnormalities, increased blood glucose levels, reversible memory issues, joint pain, fatigue, cold-like symptoms, etc.7

Thrombosis (an ancient Greek word meaning clotting) is a physiological condition characterized by the formation of clots in blood vessels, narrowing blood vessels and obstructing blood flow through them. On the basis of the blood vessel affected, thrombosis is classified as venous thrombosis and arterial thrombosis. Venous thrombosis is a blockage of veins due to clot formation. Deep vein thrombosis is the most common form of venous thrombosis, characterized by the formation of clots in deep veins (generally in leg veins). Arterial thrombosis is the formation of a thrombus or clot in an artery.8 Acute thrombosis is a major cause of morbidity and death in humans, and platelet aggregation is a crucial component of this condition.9 The global prevalence of thrombosis was 29.03%; the rate of deep vein thrombosis was 20.01%, the rate of pulmonary embolism was 7.99%, and the rate of arterial thrombosis was 5.1%.10

Causes of thrombosis:

Diagram text: Virchow' s triad

- Blood flow
- Hypercoagulability
- Endothelial damage

Age, obesity, DM, hypertension, immobility, family history (genetics), surgery, and other conditions are among the various risk factors for thrombosis.

The effect of thrombosis on different body systems:

- Cardiovascular system: when blood clots form in the heart' s artery, they obstruct it and lessen the flow of oxygenated blood to the heart, which damages the heart' s tissue and ultimately results in a heart attack, myocardial infarction, or heart failure.
- Nervous system: when a clot forms in an artery that supplies oxygenated blood to the brain, it blocks the artery and lowers oxygen flow to the brain, resulting in stroke due to oxygen insufficiency.
- Musculoskeletal system and peripheral circulation: thrombosis affects these by originating different diseases, namely deep vein thrombosis, post-thrombotic syndrome, and peripheral artery diseases.11

Consequences of Blood Clot Development

- Impaired blood flow—reduced oxygen and nutrient transport to tissues.
- Swelling and pain—especially affecting the limbs (e.g., DVT).
- Organ damage—clots in the heart, brain, or lungs may cause heart attacks, strokes, or pulmonary embolism.
- Respiratory difficulties—shortness of breath and chest pain can be caused by clots in the lungs.
- Risk of recurrent thrombosis.
- Untreated and severe clots can be lethal and increase mortality.

Management of thrombosis

Thrombosis can be prevented by changing day-to-day activities, such as maintaining a healthy weight, diet, exercise, and lowering cholesterol.

Medication for thrombosis:

- Anticoagulants/blood thinners: They prevent the formation of new clots and stop the growth of existing clots. E.g., warfarin, heparin, etc.
- Thrombolytics/clot busters: They are used only in serious conditions because they cause bleeding.

Anticoagulant intolerance has been observed in certain patients due to physiological inadequacy alone, resulting in significant bleeding from the gastrointestinal tract or through the urine.

Role of hyperlipidemia in thrombus formation:

- Platelet activation—hyperlipidemia activates platelets by enhancing the formation of thromboxane A2 and the release of more serotonin from platelets.
- Hyperlipidemia promotes a pro-coagulant state by increasing the release of pro-coagulants from cells. Extensively high levels of LDL cholesterol lead to atherosclerotic plaque formation.

Limitations of synthetic therapy

Drug Class	Limitations
Statins	Myopathy, hepatotoxicity, diabetes risk
Warfarin	Narrow therapeutic window, bleeding
Heparin	Thrombocytopenia
Thrombolytics	Life-threatening hemorrhage

These limitations justify exploration of plant-based multitarget agents.

Medicinal plants with antihyperlipidemic and thrombolytic activity

Mechanistic Classification

- Cholesterol synthesis inhibition
- Antioxidant and anti-inflammatory effects
- Platelet aggregation inhibition
- Fibrinolytic activity

Need for herbal medication With modernization and lifestyle changes, various diseases such as diabetes, cancer, cardiovascular disorders, and stroke are arising. Therefore, under current conditions, it is necessary to control the increased disease rate. For this, a number of treatments or drugs are available on the market; however, most of them are synthetic or semisynthetic and have many side effects that make them harmful for long-term use. As chronic diseases, such as cardiovascular and neurological disorders, require long-term drug therapy, long-term use of synthetic drugs results in harmful effects on human health.

Since herbal medications are derived from natural sources, they are considered safer than synthetic alternatives. Herbal remedies consist of a combination of phytochemicals, meaning they are abundant in biologically active plant constituents such as tannins, alkaloids, flavonoids, carbohydrates, steroids, and phenols, which contribute to their therapeutic effectiveness. Numerous scientific investigations have been carried out on various herbs to evaluate their medicinal potential, and these studies have shown that herbal extracts from different plants are often more effective and advantageous than synthetic drugs, as they offer multiple biological effects and have fewer or even no side effects.

Synthetic drugs available for the treatment of thrombosis and hyperlipidemia include statins, fibrates, niacin, warfarin, heparin, etc. Antithrombotic drugs such as warfarin and heparin lead to excessive bleeding, while long-term use of statins leads to kidney damage, and niacin shows dose-dependent side effects such as heart attack and stroke. As most scientific studies have concluded that herbal drugs such as garlic, turmeric, ginger, etc., are more beneficial for the treatment of thrombosis and hyperlipidemia.

Challenges in using herbal drugs

- Lack of standardization
- Presence of adulterants
- Misidentification of plant species and isolated compounds
- Safety and toxicity issues due to lack of scientific concerns
- Difficulty in selecting a therapeutic dose
- Required isolation techniques to isolate biologically active phyto-constituents

List of herbal plants having antihyperlipidemic and thrombolytic activity

Sr. No.	Plant	Synonym	Part of plant	Therapeutic activity	Extract	Active phyto-constituents
1	*commiphora mukul* (*Burseraceae*)	Gum guggul	Resin	Antilipidemic (improve lipid metabolism)	-	Guggulsterone
2	*Hibiscus rosa sinensis* (*malvaceae*)	Hibiscus, China rose and Jaswand	Flower	Antilipidemic (reduce lipid formation)	Ethanolic extract	cyanidon –3-sophoroside, beta-sitosterol
3	*Hibiscus sabdariffa* (*malvaceae*)	Roselle	Flower	Antilipidemic (increasing HDL level)	Hydro-ethanolic extract	anthocyanin, phenolic acids, flavonoids
4	*Cassia auriculata* (*Fabaceae*)	Eared Senna, Avaram Senna, Tarwar	Flower	Antilipidemic (reduce lipid formation)	Ethanolic extract	flavonoids, beta-sitosterol, polysaccharides, anthracene,

Sr. No.	Plant	Synonym	Part of plant	Therapeutic activity	Extract	Active phyto-constituents
5	*Impatiens balsamina* (*Balsaminaceae*)	Rose balsam, Garden balsam	Flower	Antilipidemic (prevent lipid peroxidation)	Methanolic extract	flavonoids
6	*Eriobotrya japonica* (*Rosaceae*)	Japanese pulm, medlar, and loqua	Flower	Antilipidemic (prevent lipid peroxidation)	–	Triterpenic acids, flavonoids, phenolic compounds
7	*Clerodendrum paniculatum* (*Lamiaceae*)	Pagoda flower	Flower	Antilipidemic (reduce lipid formation)	Methanolic/ethanolic extract	Flavonoids

No.	Botanical name (family)	Common name	Part used	Activity	Extract	Phytoconstituents
8	*Hagenia abyssinica* (*Rosaceae*)	African red wood	Flower	Antilipidemic	Hydro-alcoholic/organic extract	Flavonoids, phenols, anthro-quinones
9	*Michelia champaca* (*Magnoliaceae*)	Magnolia champaca-champak	Flower bud	Antilipidemic, prevents lipid peroxidation	Methanolic extract	Flavonoids, tannins, saponins, steroids
10	*Bauhinia variegata* L. (*Fabaceae*)	Kachnar, orchid tree	Flower	Antilipidemic	–	Flavonoids, saponins
11	*Phyllanthus niruri* (*Euphorbiaceae*)	Niruris annua, phyllanthus amarus	Leaves, stems	Antilipidemic, reduces lipid formation	Alcoholic extract	Flavonoids

No.	Botanical name (family)	Common name	Part used	Activity	Extract	Phytoconstituents
12	*Ocimum sanctum* (*Labiatae*)	Tulsi, sacred basil	Leaves	Antilipidemic and antithrombotic	Aq. extract	Eugenol, urosilic acid
13	*Terminalia arjuna* (*Combretaceae*)	Arjun bark	Bark	Lipid-lowering activity	Organic/alcoholic extract	Triterpenoids, steroids, saponins
14	ShanZha (*Rosaceae*)	Haw fruit, Chinese haw	Fruits, flowers, leaves	Lipid-lowering activity	Hawthorn extract	Triterpenoids, flavonoids
15	*Filipendula ulmaria* (*Rosaceae*)	Meadowsweet	Flower	Anticoagulant/thrombolytic	-	Salicylic acid and its derivatives
16	*Allium cepa* (*Amaryllidaceae*)	Onion	Bulb	Thrombolytic and anticlotting	-	Flavonoids, especially quercetin and kaempferol
17	*Brassica oleracea* L. (*Brassicaceae*)	Wild cabbage	Flower	Thrombolytic, clot dissolving	Methanolic extract	Polyphenols and flavonoids
18	*Moringa oleifera* Lam. (*Moringaceae*)	Drumstick tree	Flower	Thrombolytic, clot dissolving	Aq. and methanolic extract	-
19	*Musa acuminata* var (*Musaceae*)	Banana, Nanjangud Rasabale	Flower	Thrombolytic, clot lysis	Aq. extract	Polyphenols, coumarin, steroids
20	*Saraca indica* (*Fabaceae*)	Ashoka tree, *Saraca bijuga*	Flower	Thrombolytic, clot lysis	Alcoholic extract	Polyphenols, tannins

No.	Botanical name (family)	Common name	Part used	Activity	Extract	Phytoconstituents
21	*Pterospermum aceri-folium* (*Mal-vaceae*)	Kanak Champa, Muchund	Leaf	Thrombolytic; clot busting	Methanolic extract	Polyphenols, tannins, kaempferol
22	*Nerium oleander* (*Apocy-naceae*)	Kaner, rose bay	Flower	Thrombolytic; clot busting	Methanolic extract (10 mg)	Polyphenols, tannins
23	*Lawsonia inermis* (*Lythraceae*)	Henna	Leaves	Thrombolytic; clot bust-ing/antithrombotic	Aq. extract	Coumarins, naph-tho-quinones, phenols
24	*Thevetia peru-viana* (*Apocy-naceae*)	Yellow olean-der, Mexican olean-der, Lucy nut	Latex	Thrombolytic; clot bust-ing/dissolves fibrin by protease enzyme	–	Thevetin A carde-nolides
25	*Allium sativum* (*Amaryl-lidaceae*)	Garlic	Bulb/clove	Thrombolytic; reduces platelet aggrega-tion	–	Allicin and thiosul-fates
26	*Murraya koenigii* (*Ru-taceae*)	Curry leaf	Leaves/roots	Thrombolytic; clot lysis	Aq. extract	Phenols and flavonoids
27	*Angelica sinensis* (*Api-aceae*)	Chinese angelica, female ginseng	Roots (volatile oil)	Fibrinolytic; prevents platelet aggrega-tion	Aq. ex-tract/methanolic extract	Ferulic acid, ligustilide

No.	Botanical name (family)	Common name	Part used	Activity	Extract	Phytoconstituents
28	*Zingiber officinale* (*Zingiberaceae*)	Ginger	Roots/rhizomes	Thrombolytic; inhibits thromboxane and platelet aggregation	Aq. extract/methanolic extract	Gingerol, zingiberol, linalool

Different Herbs with Thrombolytic and Antilipidemic Potential

- **Gum guggul (*Commiphora mukul*; Burseraceae)**
  Gum guggul is native to Africa. In India, it is found in Gujarat and Rajasthan. The resin of this plant has been used in Ayurveda for more than 20 centuries to treat a variety of ailments. Both animal and human studies of guggul resin conclude that it helps reduce circulating lipid levels. Guggulsterone is an active constituent of the resin responsible for lipid-lowering activity.12

- **China rose (*Hibiscus rosa sinensis*; Malvaceae)**
  China rose is native to South China. It is known as hibiscus, China rose, and Jaswand. Petal infusion and decoction of hibiscus have been used in India as Ayurvedic medicine to treat fever and bronchial asthma, respectively. Different extracts of hibiscus flower were studied for their effects on serum lipid levels in Triton-induced hyperlipidemic rats, with simvastatin as the standard drug. In this study, it was found that ethanolic extract of hibiscus flower shows significant lipid-lowering activity.13

- **Roselle (*Hibiscus sabdariffa*; Malvaceae)**
  Roselle has been studied for the last few decades because of its significant effects in managing CVD progression by exhibiting antidiabetic, antihypertensive, antioxidative, antifibrosis, and anti-inflammatory effects in preclinical as well as clinical studies. The main phytochemical constituents of roselle that exhibit a variety of biological activities include anthocyanins, phenolic acids, flavonoids, organic acids, saponins, and tannins. Clinical studies on roselle have concluded that it is completely safe and nontoxic to human health. It exerts a positive impact on the lipid profile by reducing total cholesterol, LDL cholesterol, triglycerides, and increasing HDL cholesterol. The extract of roselle flower may contribute to reducing body weight and adiposity.14

- **Cassia auriculata (Fabaceae)**
  It is commonly known as eared senna, avaram senna, tarwar, and tarvād.

It is native to South Asia, India, and Sri Lanka. In India, it is found in different states, viz., Andhra Pradesh, Maharashtra, Gujarat, Haryana, Karnataka, etc. *Cassia auriculata* is widely used in Ayurveda for the management of diabetes and cardiovascular disorders. It helps to control dyslipidemia, blood glucose, and cardiovascular risk associated with high lipid levels and diabetes. Its main bioactive constituents, such as flavonoids, beta-sitosterol, polysaccharides, anthracene, and myristyl alcohol, are known to have antioxidant, antidiabetic, and antilipidemic potential.15

- **Impatiens balsamina (Balsaminaceae)**
  Rose balsam and garden balsam are the common names of *Impatiens balsamina*. It is indigenous to South Asia, India, and China. In India, it is generally found in the hilly regions of Maharashtra, Kerala, and Tamil Nadu. Phytochemical investigation of *Impatiens balsamina* suggested that it is a rich source of flavonoids, so it may exhibit antihyperlipidemic activity. To verify the antilipidemic potential of *Impatiens balsamina*, methanolic extracts of the flowers of *Impatiens balsamina* were tested against dexamethasone-induced hyperlipidemia in rats, and the study strongly concluded that co-treatment with methanolic extract of IB flowers and dexamethasone results in reducing the LDL and TG levels in serum, which can be elevated by administration of dexamethasone.16

- **Eriobotrya japonica (Rosaceae)**

Japanese plum, medlar, and loquat are common names of *Eriobotrya japonica*. It is native to the cooler hills of China and is also cultivated in Japan. In India, it is grown in northern states, namely Punjab, Delhi, Himachal Pradesh, Maharashtra, and Uttar Pradesh. Traditionally, it is used to treat cough. The medicinal plant *Eriobotrya japonica* is a rich source of triterpenic acids such as ursolic acid, tormentic acid, and corosolic acid, as well as flavonoids and phenolic compounds. All these phytoconstituents contribute to antihyperlipidemic activity by increasing the excretion of total cholesterol, promoting lipid metabolism, and inhibiting lipid formation, i.e., lipogenesis. The flower extract of *Eriobotrya japonica* has been studied against streptozotocin (STZ)-induced diabetes in mice. The study indicated that the flower extract of *Eriobotrya japonica* shows hypolipidemic activity.17

- Bauhinia variegata L. (Fabaceae)
  Orchid tree, mountain ebony, kachnar, and camel' s foot are synonyms of *Bauhinia variegata*. This medicinal plant is native to South Asia, India, and China. Kachnar is a valuable medicinal plant in Ayurveda and is used for various ailments, namely cough, inflammation, goiter, and skin problems, owing to its active phytochemicals such as terpenoids, flavonoids, and phenols. Traditionally, its flowers are helpful in cough, pitta imbalance, and bleeding. It exhibits antitumor, antidiabetic, antimicrobial, antioxidant, laxative, and anticonvulsant activity. The antilipidemic activity of *Bauhinia variegata* alcoholic and aqueous extracts has been tested in Tri-

ton WR-1339-induced hyperlipidemia in rats against the standard drugs fenofibrate and simvastatin. The study strongly indicated that *Bauhinia variegata* has promising antilipidemic and antioxidant activities, and that these two activities are interrelated.18

- Filipendula ulmaria (Rosaceae)
  Meadowsweet, bridewort, and queen of the meadow are alternative names for *Filipendula ulmaria*. It is indigenous to Europe and Western Asia. It is a European medicinal herb that shows analgesic, anti-inflammatory, and antipyretic activity, along with thrombolytic activity, due to its aspirin-like compounds, i.e., salicylates. Traditionally, it is used for arthritis, pain, digestive issues, and as a diuretic, owing to the presence of flavonoids, tannins, and phenolic compounds. The flower extract (aqueous and acetone) shows the presence of aspirin-like molecules (salicylates) and demonstrates significant thrombolytic activity.19

- Allium sativum (Amaryllidaceae)
  Allium sativum is commonly known as garlic. It is a widely used spice in India and has medicinal uses, including antioxidant and antihyperlipidemic effects; it is also used to improve cardiac health. In a scientific study, it was observed that administration of garlic along with warfarin therapy leads to excessive bleeding and may create a serious condition. The anticoagulant effect of garlic extract was achieved by preventing clot formation and prolonging clotting time. Ethanolic extract of *A. sativum* bulb at a dose of 10 mg/ml showed effective fibrinolytic potential. To assess the fibrinolytic potential of garlic, an aqueous bulb extract (500 mg/kg) was tested in rabbits. The study concluded that the aqueous extract has antithrombotic potential, preventing platelet aggregation induced by arachidonic acid, platelet activators, and ADP.20,21

- Zingiber officinale (zingiberaceae)
  Z. officinale is a valuable spice and powerful medicinal plant. The roots of *Z. officinale* are a rich source of active phytoconstituents such as gingerol, shogaol, eugenol, and others, which provide anti-nausea, antioxidant, anti-inflammatory, and digestive properties. It also helps improve immunity and circulation. Traditionally, it is used to treat motion sickness and for digestive purposes as well. Several studies have shown that excessive consumption of ginger with warfarin causes bleeding. The methanolic extract of rhizomes of *Z. officinale* showed thrombolytic activity at a concentration of 10 mg/ml. In silico and in vitro studies of *Z. officinale* indicated clot-busting and antiplatelet activity due to the presence of bioactive constituents such as isovanillin, gingerol, and beta-sitosterol.21,22

- Angelica sinesis (Apiaceae)
  Female ginseng is another name for *Angelica sinesis*. *Angelica sinesis* is a traditional Chinese medicinal herb that is primarily used to improve blood flow, regulate the menstrual cycle, relieve pain, and act as a hematopoietic agent and blood tonic. It is a rich source of bioactive constituents such as

polysaccharides and phthalides, which possess antioxidant, immunomodulatory, cardioprotective, and anti-inflammatory properties. The study concluded that prothrombin time increases after administration of *Angelica sinesis*. It exhibits fibrinolytic potential by blocking platelet activation and aggregation. Key components responsible for the thrombolytic activity of *Angelica sinesis* are Z-ligustilide and ferulic acid.22,23

- Clerodendrum paniculatum (lamiaceae)
  It is commonly known as pagoda flower. It is native to tropical regions of Asia, including India, Sri Lanka, and Southeast Asia. *Clerodendrum paniculatum* is traditionally used in India, China, and Japan for various medical conditions such as inflammation and pain, skin ailments, and asthma. It is known for its antioxidant, anti-inflammatory, and antimicrobial potential. Ethanolic extract of *Clerodendrum paniculatum* flowers was tested against high-fat-diet-induced hyperlipidemia in rats. The study concluded that *Clerodendrum paniculatum* has a potent antilipidemic effect. It works by reducing total cholesterol levels and increasing HDL levels.24

- Hagenia abyssinica (rosaceae)
  Hagenia abyssinica (African red wood) is an African medicinal plant traditionally used for different ailments such as parasitic infections, fever, cough, and stomachache. Various scientific studies confirm its antihelminthic, antioxidant, antimicrobial, and anti-inflammatory potential due to the presence of bioactive constituents, namely phenols and flavonoids. Methanolic extract of *Hagenia abyssinica* was tested in STZ-induced diabetic mice against the standard drug glibenclamide. The study concluded that *Hagenia abyssinica* extract shows a positive influence on the lipid profile. It acts by delaying fatty acid absorption and inhibiting the cholesterol esterase enzyme.25

- Michelia champaca (magnoliaceae)
  In traditional systems of medicine such as Ayurveda, *Michelia champaca* (magnolia champaca champak) has been used for various ailments related to cardiovascular disorders and diabetes-associated complications. It is often used to modify the lipid profile. Methanolic extract of *Michelia champaca* flowers shows significant antihyperlipidemic activity by demonstrating the ability to reduce total cholesterol and increase HDL cholesterol.26

- Phyllanthus niruri (Euphorbiaceae)
  Phyllanthus niruri (stone breaker, chanca) is a globally used traditional medicinal plant. In Ayurveda, it is used for liver support and for kidney and urinary issues. It possesses antioxidant, antiviral, antidiabetic, and anti-inflammatory activities. A number of preclinical studies using hyperlipidemic rats demonstrate that *Phyllanthus niruri* possesses significant lipid-lowering potential. It helps reduce bad cholesterol by preventing hepatic cholesterol formation and increases good cholesterol levels in the body, while inhibiting the accumulation of cholesterol in the liver.27

- Ocimum sanctum (Labiatae)
  Ocimum sanctum (tulsi) is an aromatic plant known as the "Queen of Herbs." In Ayurveda, it is extensively used to treat conditions such as cough, cold, fever, asthma, and stress, and to improve immunity. Scientific studies confirm its antioxidant, anti-inflammatory, antimicrobial, and adaptogenic potential. Scientific in vitro study of *Ocimum sanctum* shows moderate clot-dissolving potential against the standard drug streptokinase. Key components such as eugenol, fatty acids, and flavonoids demonstrate its antilipidemic and thrombolytic potential. Both fixed oil and aqueous extract of tulsi have a positive impact on lipid levels by reducing total cholesterol levels in diabetic and hyperlipidemic rats.28,29

- *Terminalia arjuna* (Combretaceae)
  Traditionally, *Terminalia arjuna* (Arjuna tree) is valued for its antioxidant, cardioprotective, and anti-inflammatory properties and is used to treat angina, heart failure, ulcers, fractures, etc. In numerous animal studies, *Terminalia arjuna* has shown significant lipid-lowering potential. Its bark helps reduce the concentration of bad cholesterol in the body. The mechanism involves inhibiting cholesterol formation and increasing hepatic breakdown of cholesterol.30

- *Allium cepa* (Amaryllidaceae)
  The ethanolic extract of *Allium cepa* (onion) shows significant thrombolytic activity. *Allium cepa* is traditionally used to treat different diseases such as cough due to bronchitis, dysentery, inflammatory disorders, ulcer wounds, asthma, scars, keloids, and pain. According to scientific studies, *Allium cepa* has rich antilipidemic (lipid-lowering) and thrombolytic (clot-dissolving) potential. It inhibits platelet aggregation by blocking the thromboxane A2 enzyme.31

- *Nerium oleander* (Apocynaceae)
  Several studies have demonstrated the thrombolytic activity (clot-dissolving ability) of *Nerium oleander* at a 10 mg/ml concentration of methanolic flower extract. Several preclinical studies conclude that all parts of *Nerium oleander* are toxic to human health due to the presence of cardiac glycosides, oleandrin, and neriin.32

- *Murraya koenigii* (Rutaceae)

  Leaves of *Murraya koenigii* possess promising clot-lysis potential. *In vitro* studies have concluded that it shows dose-dependent thrombolytic activity. As the specific bioactive compound has not been confirmed, further study should be conducted to identify the individual component present in *Murraya koenigii* that possesses thrombolytic activity.22,33

Discussion

Hyperlipidemia and thrombosis are significant contributors to the onset of cardiovascular diseases, which continue to be a primary cause of death worldwide. While traditional therapies for lowering lipids and promoting thrombolysis are beneficial, their prolonged use frequently faces challenges due to side effects, expense, and availability. As a result, there has been significant scientific interest in herbal plants that possess antilipidemic and thrombolytic effects as potential alternative or supplementary treatment options. Many medicinal plants show considerable antilipidemic properties via mechanisms such as suppression of cholesterol production, improvement of lipid metabolism, heightened bile acid elimination, and antioxidant actions. Phytochemicals such as flavonoids, saponins, polyphenols, and alkaloids are crucial in influencing lipid profiles and inhibiting low-density lipoprotein oxidation, thus lowering the risk of atherosclerosis. Similarly, by encouraging fibrinolysis, preventing platelet aggregation, and altering coagulation pathways, various herbal plants exhibit thrombolytic and antithrombotic potential.

Conclusion

The effects of many medicinal plants with thrombolytic and antihyperlipidemic (lipid-lowering) action are better understood in this review. Despite this, thrombosis and hyperlipidemia can be treated using a variety of synthetic medications. However, they have the potential to have a number of dangerous effects on human health. Using plant-based substances or herbal medicine to treat thrombotic and hyperlipidemic illnesses is very appealing. Based on the information provided, a number of studies in the literature suggest that crude drugs and solvent extracts of diverse plants are important for thrombolysis and antilipidemia. Although this study examines the thrombolytic and antilipidemic capabilities of several herbal medications, more research is needed to fully understand the phytochemical and pharmacological profile of the active ingredients.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Ghube Dinesh Dnyaneshwar reports was provided by Samarth College of Pharmacy, Deulgaon Raja. Reports a relationship with that includes: Has patent pending to. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Fuster V, Kelly BB. *Epidemiology of cardiovascular disease*. Washington (DC): National Academies Press; 2010.

2. Frydrych A, Kulita K, Jurowski K, Piekoszewski W. Lipids in clinical nutrition and health: narrative review and dietary recommendations. *Foods*. 2025;14(3):473. https://doi.org/10.3390/foods14030473

3. Hill MF, Bordoni B. *Hyperlipidemia*. *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2025.

4. Ballena-Caicedo J, Zuzunaga-Montoya FE, Loayza-Castro JA, et al. Global prevalence of dyslipidemias in the general adult population: a systematic review and meta-analysis. *J Health Popul Nutr*. 2025;44(1):308. https://doi.org/10.1186/s41043-025-01054-3

5. Hyperlipidemia. Physiopedia [Internet]. 2023 Dec 22 [cited 2025 Dec 3]. Available from: https://www.physio-pedia.com/index.php?title=Hyperlipidemia.

6. Fowler P, Seed S. *What Is hyperlipidemia?* [Internet]. 2024. [cited 2025]. Medically reviewed by Sheikh Z. Available from: [publisher website].

7. Tsui J, Chen L, Ye P, et al. Adverse drug reactions of non-statin anti-hyperlipidaemic drugs in China from 1989 to 2019: a national database analysis. *BMJ Open*. 2023;13(5):e068915.

8. Furie B, Furie BC. Mechanisms of thrombus formation. *N Engl J Med*. 2008;359(9):938–949.

9. Shaikh AS, Gilani AH. Antithrombotic activity of clove oil. *J Pak Med Assoc*. 1994;44(5):112–115.

10. Bagheri B, Alipour A, Yousefi M, et al. Prevalence of thromboembolic events including venous thromboembolism and arterial thrombosis: a systematic review and meta-analysis. *J Tehran Heart Cent*. 2023;18(3):154–169.

11. Ashorobi D, Ameer MA, Fernandez R. *Thrombosis*. *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2025.

12. Kokate CK, Purohit AP, Gokhale SB. *Pharmacognosy*. Pune: Nirali Prakashan; 2002:270–310.

13. Sikarwar MS, Patil MB. Antihyperlipidemic effect of ethanolic extract of Hibiscus rosa-sinensis flowers in hyperlipidemic rats. *RGUHS J Pharm Sci*. 2011;1:117–122.

14. Sapian S, Ibrahim MZA, Jubaidi FF, et al. Therapeutic potential of *Hibiscus sabdariffa* Linn. in attenuating cardiovascular risk factors. *Phar-*

maceuticals (Basel). 2023;16(6):807. https://doi.org/10.3390/ph16060807

15. Vijayaraj P, Muthukumar K, Sabariarjan J, Nachiappan V. Antihyperlipidemic activity of *Cassia auriculata* flowers in Triton WR-1339 induced hyperlipidemic rats. *Exp Toxicol Pathol*. 2013;65(1-2):135–141. https://doi.org/10.1016/j.etp.2011.07.001

16. Agunna H, Kilari EK, Rajan K, Routhu P, Killari K. Antihyperlipidemic activity of methanolic extract of *Impatiens balsamina* flowers against dexamethasone-induced hyperlipidemia in rats. *Indian J Pharm Sci*. 2024;86. https://doi.org/10.36468/pharmaceutical-sciences.1413

17. Lin CH, Shih ZZ, Kuo YH, Huang GJ, Tu PC, Shih CC. Antidiabetic and antihyperlipidemic effects of flower extract of *Eriobotrya japonica* in streptozotocin-induced diabetic mice. *J Funct Foods*. 2018;49:122–136.

18. Rajani GP, Ashok P. *in vitro* antioxidant and antihyperlipidemic activities of *Bauhinia variegata* Linn. *Indian J Pharmacol*. 2009;41(5):227–232. https://doi.org/10.4103/0253-7613.58513

19. Sokolova E, Krol T, Adamov G, Minyazeva Y, Baleev D, Sidelnikov N. Phenolic composition and health-promoting properties of *Filipendula* genus plants. *Molecules*. 2024;29(9):2013. https://doi.org/10.3390/molecules29092013

20. Banerjee SK, Maulik SK. Effect of garlic on cardiovascular disorders: a review. *Nutr J*. 2002;1:4. https://doi.org/10.1186/1475-2891-1-4

21. Hossain S, Sarkar B, Prottoty M, Araf Y, Taniya M, Ullah M. Thrombolytic activity and ADME/T analysis of ginger phytochemicals. *Mod Res Inflamm*. 2019;8:29–43. https://doi.org/10.4236/mri.2019.83003

22. Guguloth S, Malothu N, Kadiri S, Kunuru S. Thrombolytic property of herbal plants: a short review. *Biomed Pharmacol J*. 2022;15:837–846. https://doi.org/10.13005/bpj/2420

23. Zhang L, Du JR, Wang J, et al. Z-ligustilide from *Angelica sinensis* decreases platelet aggregation. *Yakugaku Zasshi*. 2009;129(7):855–859. https://doi.org/10.1248/yakushi.129.855

24. Varghese S, Kannappan P, Rajasekar D, Rashmy S, Muneeswari P. Antihyperlipidemic effect of *Clerodendrum paniculatum* flower extract in rats. *Biocatal Agric Biotechnol*. 2021;36:102095. https://doi.org/10.1016/j.bcab.2021.102095

25. Kifle ZD, Yesuf JS, Atnafie SA. Anti-diabetic, anti-hyperlipidemic and antioxidant activity of *Hagenia abyssinica*. *J Exp Pharmacol*. 2020;12:151–167. https://doi.org/10.2147/JEP.S249964

26. Odoh UE, Ezugwu CO, Onu S. Antidiabetic and antihyperlipidemic effect of *Strophanthus hispidus* roots. *Planta Med.* 2015;81(5).

27. Khanna AK, Rizvi F, Chander R. Lipid-lowering activity of *Phyllanthus niruri* in hyperlipidemic rats. *J Ethnopharmacol.* 2002;82(1):19–22. https://doi.org/10.1016/S0378-8741(02)00136-8

28. Khan IN, Habib MR, Rahman MM, Mannan A, Sarker MM, Hawlader S. Thrombolytic potential of medicinal plants. *J Basic Clin Pharm.* 2011;2(3):125–127.

29. Suanarunsawat T, Boonnak T, Na Ayutthaya WD, Thirawarapan S. Anti-hyperlipidemic and cardioprotective effects of *Ocimum sanctum* fixed oil. *J Basic Clin Physiol Pharmacol.* 2010;21(4):387–400. https://doi.org/10.1515/jbcpp.2010.21.4.387

30. Dwivedi S, Chopra D. Revisiting Terminalia arjuna—an ancient cardiovascular drug. *J Tradit Complement Med.* 2014;4(4):224–231. https://doi.org/10.4103/2225-4110.139103

31. Kianian F, Marefati N, Boskabady M, Ghasemi SZ, Boskabady MH. Pharmacological properties of *Allium cepa*: preclinical and clinical evidence. *Iran J Pharm Res.* 2021;20(2):107–134. https://doi.org/10.22037/ijpr.2020.112781.13946

32. Herath S, Napagoda M. vitro thrombolytic activity of Nerium oleander flowers. *Pray Rasayan.* 2019;3(1) https://doi.org/10.53023/p.rasayan-20190119

33. Tahia F, Sikder MAA, Sayeed MA, Rashid MA. Bioactivities of Murraya koenigii and Adina cordifolia. *Bangladesh Pharm J.* 2015;18(1):25–29. https://doi.org/10.3329/bpj.v18i1.23510

Note: Figure translations are in progress. See original paper for figures.