

A REVIEW: MEDICINAL HERBS CAPABLE FOR ANTICOAGULANT PROPERTIES

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ABSTRACT:

When someone is wounded, a procedure called blood coagulation is used to stop blood loss. In the wound site, the blood coagulates to form a barrier that stops bleeding. Blood clotting is an important physiological process in the human body and is affected by numerous factors. Many adjustments and wrong item selections can disrupt the authoring process and cause problems for the user. In the literature review, Google Scholar, Science Direct, PubMed, High Wire, Google Scholar, MD Consult and Scopus databases included a total of 19 published articles. Nineteen anticoagulant medicinal plants were identified and assessed in this investigation. Ultimately, this study indicates that a variety of medicinal herbs contain various substances that effectively prevent blood coagulation through different mechanisms. These plants are extremely effective resources for making valuable medications that treat blood coagulation-related illnesses.

Keywords: Medicinal plants, coagulation, coagulation factors

INTRODUCTION

The process of blood coagulation stops blood loss during wound-related bleeding. In the wound site, the blood coagulates to form a barrier that stops bleeding. Clotting occurs in blood even as it causes the body's vessels. During the coagulation process, clots form and separate from the blood, a condition called serum. When either factor VII, XII, or both are activated, the blood coagulation system starts. The thrombin protein is triggered by them. The fibrinogen molecule's alpha and beta chains are directly broken up into fibrin monomers by the thrombin, which then turns them into a highly ordered polymerized fibrin clot. Furthermore, thrombin stimulates platelets physiologically and strongly. When calcium ions are present, prothrombin is converted to thrombin by platelets. In the meantime, there is an increase in thrombin, which means that the reactions will inevitably get more severe. Fibrin polymer, which still has some consistency, is the result of these reactions, but they electrostatic.

Garlic :-(Allium sativum)**Fig. 1: Garlic****Synonym:**

Allium contraversum schrad

Family:

Amaragllidaceae

Description:

The perennial flowering plant *Allium sativum* develops from a bulb. It can reach a height of 1 m (3 ft) on erect flower stalks. The leaves are about 1.25-2.5 cm (0.5-1.0 in) wide, pointed, flat, linear and stiff. This plant produces pink to pink flowers from July to September in the Northern Hemisphere. Aromatic seeds usually contain ten to twenty cloves. Cloves in the middle may be asymmetrical, whole cloves closer to the centre may be symmetrical. Each clove is covered with an outer layer of leaves and the clove is wrapped in a plastic bag.¹ Garlic will grow as much as it can if planted at the proper time and depth.²

Garlic as an anticoagulant:

Garlic contains a blood-anticoagulant compound that isolated and investigated for its chemical and physical characteristics. This garlic extract is dissolved after the pH is brought down to 3.0 using hydrochloric acid, and it precipitates in a neutral solution as the calcium salt. These chemical characteristics made it easier to isolate garlic extract than it had been previously, and the extract's antioxidant effect persisted. This paper describes the modified procedure for preparing the anticoagulant factor from garlic and reports its anticoagulant effects.³

There is a substance found in garlic called allicin that may thin blood. Because of its possible cardiovascular benefits, it has been used in traditional medicine. It's crucial to remember that research is still ongoing regarding garlic's effects on blood clotting.

Other properties of garlic:

1. Garlic reduces blood pressure,
2. Cholesterol, and sugar levels,
3. Inhibits and eliminates bacteria, fungus, and parasites
4. Protects the liver by preventing blood clotting.
5. It has anticancer properties as well
6. Additionally, garlic can strengthen immunity, fend off illness, and maintain overall health.

Chemical Constituents of Garlic:

Garlic is said to contain hundreds of phytochemicals, including sulphur compounds.

Table No.1: List of some sulphur-containing compounds isolated from garlic:

Sr No.	Compound Name	Molecular formulas
1	Allicin	C ₆ H ₁₀ OS ₂
2	Alliin	C ₆ H ₁₁ no ₃ s
3	z-Aioene	C ₉ H ₁₄ OS ₃
4	E-Ajoene	C ₉ H ₁₄ OSO ₃
5	Diallyl disulfide	C ₆ H ₁₀ S ₂
6	Diallyl sulphide	C ₆ H ₁₀ S
7	2-vinyl-4H-1, 3-dithiin	C ₆ H ₈ S ₂

8	Diallyl trisulfide	C ₆ H ₁₀ S ₃
9	Allyl methyl sulphide	C ₄ H ₈ S

Ginkgo biloba:**Fig. 2: Ginkgo biloba****Synonym:**

gingko, maidenyair

Family:

Ginkgoaceae

Description:

Ginkgoes are large trees, generally 20–35 m (66–115 ft) tall, although in China some specimens have reached a height of over 50 m (165 ft). The tree generally has an angular crown, has long, swaying branches, can withstand wind and snow damage, and has deep roots. As the tree ages, its crown expands; Young trees are generally tall and compact with small branches. Ginkgoes are tenacious and some are reported to be over 2,500 years old.⁵ These are disease- and insect-resistant trees, and their ability to develop roots and shoots contributes to their longevity.

**Fig.3: Ginkgo leaves**

Among seed plants, leaves are unique in having fan-like veins and veins that extend toward the blade, sometimes bifurcating (dividing) but never forming an anastomosing connection.⁶ Dichotomous venation occurs when two veins repeatedly split into two at the base of the leaf blade. Usually ranging from 5 to 10 cm (2 to 4 in), the leaves can occasionally reach a length of 15 cm (6 in). The leaves of the maidenhair fern, *Adiantum capillus-veneris*, have a pinnae-like appearance, which is where the old common name "maidenhair tree" originated. Ginkgoes are highly valued for their rich saffron-coloured autumn foliage. Long leaves often have lobes or spaces between the veins, but only on the outer surface. They grow on short, stubby branches with terminal clusters, as well as at the tips of fast-growing branches, where they change and break off. The upper and lower parts of the leaf are green, except for the stomata on each side. The leaves turn yellow before they fall, sometimes in just one to fifteen days.

Ginkgo biloba as an anticoagulant:

For millennia, ginkgo biloba has been utilised in traditional medicine. It contains terpenes and flavonoids that may have anticoagulant properties. According to some studies, ginkgo biloba may help improve circulation and reduce blood clots. It is important to note that more research is needed to understand its safety and effectiveness as an anticoagulant. For centuries, Traditional Chinese medicine has utilised ginkgo biloba extract, which is made from the leaves of the most ancient living thing on Earth: the ginkgo biloba tree. When the active ingredients in ginkgo biloba—flavonoids and terpenoids—combine, dosages between 80 and 720 mg/day for two weeks to two years are thought to have beneficial effects. Its extract has been linked to antioxidant qualities, altered vasomotor function, and decreased blood cell adhesion to endothelium. These effects may improve blood flow to muscle tissue through enhanced microcirculation, which in turn improves aerobic endurance by boosting oxidative capacity of muscle tissue. Due to the herbal supplements Vaso regulatory and cognitive-enhancing properties, which are said to improve alertness and cognitive function, the majority of research on ginkgo biloba supplementation has been done on older adults. A one 120 mg dose of ginkgo biloba a portion has been shown to improve memory function somewhat in young, healthy individuals. Because of its strong antioxidant qualities and effects on cerebral and peripheral circulation, ginkgo's main use is in the treatment of peripheral vascular disorders and cerebrovascular dysfunctions. Nevertheless, while ginkgo biloba supplementation has been linked to improvements in peripheral arterial disease patients' exercise performance (measured by walking distance), there is no proof that these effects happen in young, healthy athletes.⁷

Other properties ginkgo biloba:

1. Ginkgo has long been used to treat memory problems and blood disorders.
2. Nowadays, it is most well-known as a possible means of maintaining memory function.
3. Ginkgo increases blood circulation by widening blood vessels and decreasing blood clotting, according to lab research.
4. It has antioxidant properties as well

Chemical Constituents:

Table No.2: List of Chemical Constituents

Sr. No.	Compound names	Molecular formula
1	Bilolide	C ₁₆ H ₁₈ O ₈

2	Ginkgolic acid	C22H34O3
3	Isorhamnetin	C16H12O7
4	Kaempferol	C15H10O6
5	Ginkgotoxin	C9H13O3N

Cinchona officinalis:**Fig. 4: Cinchona officinalis****Synonym:**

Carscarilla officinalis (L) Ruiz

Family:

Rubiaceae

Description:

Cinchona officinalis is a tree or shrub with minute hairs covering its branchlets and rugose bark. Sharp or blunt, glabrous, lanceolate or oblong stipules. The leaves are lanceolate to elliptical or oval, usually 3.4 - 4 cm (1.4 -- 1.6 inch) long and 10 cm (3.9 inch) wide. Thick; round to weaken; hard, hairless and mostly shiny; under hairs that are glabrous or downy, especially along the veins; apex acute, pointed or blunt. The terminal panicle has a multi-flowered inflorescence; the glass has short, thick hair; pale red calyx glabrous or nearly glabrous, triangular-lobed; The crown is pink or red, silky, oval, sharply lobed and approximately tuberous. 1 cm long. The fruit is in the form of an almost hairless oval capsule and is 1-2 cm long.^{8,9}

Cinchona officinalis as an anticoagulant:

Cinchona, obtained from the bark of the *Cinchona* tree, has a concentration-dependent inhibitory effect on platelet aggregation caused by epinephrine, ADP, PAF, collagen and Ca^{2+} ionophore A-23187. In addition to PAF at low concentrations (up to 80 nM), the inhibitory effects of phorbol myristate acetate and protein kinase C activator were also noted. It was discovered that the primary mechanisms underlying the anti-platelet effect were the inhibition of protein kinase C and Ca^{2+} influx in human platelets.¹⁰

Other properties of cinchona officinalis:

1. One of the several Cinchona species used to produce quinine, an anti-fever agent, is the medicinal plant Cinchona officinalis.
2. It is particularly helpful in treating and preventing malaria.
3. This tree also yields quinidine, cinchonine, and cinchonidine as other alkaloids.

Chemical Constituents:**Table No.3: List of Chemical Constituents**

Sr. No.	Compound names	Molecular formula
1	Quinine	C ₂₀ H ₂₄ N ₂ O ₂
2	Cinchonine	C ₁₉ H ₂₂ N ₂ O
3	Cinchonic acid	C ₂₈ H ₁₉ O ₁₉
4	Cinchonidine	C ₁₉ H ₂₂ N ₂ O
5	Quinic acid	C ₇ H ₁₂ O ₆

Cayenne pepper:**Fig. 5: Cayenne pepper****Synonym:**

Chili pepper, hot pepper

Family:

Solanaceae

Description:

One variety of *Capsicum annuum* pepper is cayenne pepper. Usually used to add flavor to food, this chili pepper is moderately hot. *Capsicum annuum* is a group of peppers, mostly skinned, mostly red, tapering to 10 to 25 cm long, that hang from the bush rather than growing upright. They often have curved tips and slightly corrugated skin. Most animals have a Scoville rating between 30,000 and 50,000.¹¹ Chili peppers are a mixture of peppers, sometimes without red pepper and sometimes without seeds. The fruits are generally dried and ground into flour to obtain the flour of the same name.¹² Spicy foods are prepared with all or part of hot pepper. It is also a supplement made from herbs.

Cayenne pepper as an anticoagulant:

Because of their high salicylate content, cayenne peppers can have a strong blood-thinning effect on your body. They easily grind up into a spice for food or taken as capsules. Cayenne peppers have the ability to improve circulation and low blood pressure.¹³

In addition to being spicy, peppers are also said to have some health benefits. It contains a warming substance called capsaicin. Since platelets play a role in blood clotting, capsaicin has been shown to have an anti-coagulant effect by reducing their activity. This will help reduce blood clots. Of course, more research is needed to determine the accuracy and safety of cayenne pepper's anticoagulant properties.¹⁴

Other properties of Cayenne pepper:

1. There are many health-promoting nutrients in cayenne pepper.
2. It contains a variety of antioxidants, such as potassium, manganese, and the vitamins A, B, C, and E.
3. It promotes weight loss
4. Improve the heart health

Chemical Constituents:**Table No.4: List of Chemical Constituents**

Sr. No.	Compound names	Molecular formula
1	Capsaicin	C ₁₈ H ₂₇ NO ₃
2	Dihydrocapsaicin	C ₁₈ H ₂₉ NO ₃
3	Cryptoxanthin	C ₄₀ H ₅₆ O

Ginger:**Synonym:**

Zingiber officinale Roscoe var *Sunti* Val.

Family:

Zingiberaceae

Description:

Ginger (*Zingiber officinale*) is widely used as a spice, and its rhizome, also known as ginger root, is widely used in traditional medicine. This perennial herbaceous plant grows from erect, one-meter-high annual pseudostems or false stems consisting of narrow-leaved curled leaf stems. The inflorescences sprout directly from the different buds of the rhizome and produce flowers with pale yellow petals and purple edges.¹⁵ The Zingiberaceae

family includes galangal, cardamom (*Elettaria Cardamomum*), turmeric (*Curcuma longa*) and ginger. Austronesians came from the coast of South Asia and were the first to domesticate ginger. It was transported to Hawaii via the Indo-Pacific during the expansion of Austronesia about 5000 years ago. Ginger was one of the first spices brought to Europe from Asia through the spice trade and was used by the ancient Greeks and Romans. Wild ginger belongs to a group of dicotyledonous plants in the genus *Asarum* in terms of flavour.



Fig.6: Ginger

Ginger as an anticoagulant:

This study demonstrates the anticoagulant activity of ginger rhizome methanolic extract, which suggests that it may be a promising source of novel oral anticoagulants with improved safety margins.³⁰

Chemical Constituents:

Table No.5: List of Chemical Constituents

Sr. No.	Compound names	Molecular formula
1	Gingerol	C ₁₇ H ₂₆ O ₄
2	Shogaol	C ₁₇ H ₂₄ O ₃
3	Zingiberene	C ₁₅ H ₂₄
4	trans-6-shogaol	C ₁₇ H ₂₄ O ₃

Urtica dioica (Common Nettle):



Fig.7: Urtica dioica

Binomial Name:

Urtica dioica L.

Family:

Urticaceae

Description:

The plant, commonly called stinging nettle, stinging nettle (but not all members of this genus), nettle leaf, or simply stinging nettle or stinging nettle, is a herbaceous perennial plant belonging to the family Urticaceae. Its natural distribution area covers most of Asia, Europe and Western North Africa.¹⁶ It has now spread all over the world. Five of the six subspecies of this plant have numerous hollows, spiny hairs called trichomes on their leaves and stems. These hairs do the same thing with histamine injections, hypodermic injections, and other medications that cause contact (called "contact urticaria," a type of dermatitis).^{17,18}

Urtica dioica as an anticoagulant:

The thrombin and ADP-induced aggregation were both dose-dependently inhibited by urtica dioica extract. The plant may be effective because of the polyphenolic compounds found in its extracts, which suggest that it may be involved in the prevention or treatment of complications related to platelet aggregation in cardiovascular diseases.^{17,18,19}

Other properties of Common Nettle:

Nettle is traditionally used to control heart disease, especially high blood pressure. Nettle leaf extract has been reported to improve glucose homeostasis in the body.

Chemical Constituents:**Table No.6: List of Chemical Constituents**

Sr. No.	Compound name	Molecular formula
1	Caffeoylmalic acid	C13H12O8
2	Benzylisoquinoline	C16H13N
3	Benzopyran	C9H8O

Glycyrrhiza glabra (Liquorice):**Fig. 8: Glycyrrhiza glabra**

Binomial name:

Glycyrrhiza glabra

Family:

Leguminosae

Description:

Glycyrrhiza glabra, a fascinating flowering plant from the legume family, is known as licorice (British English) or licorice root. A sweet and aromatic condiment obtained from the roots of the plant.²⁰ Licorice is a plant that can reach a height of one metre (40 in) and has pinnate leaves that are 9 to 17 leaflets long and 7 to 15 centimetres (3 to 6 in) high. It produces loose racemes of purple to pale white-blue flowers, 8–12 mm (5/16–1/2 in) long. The fruit is an oval capsule 20-30 mm (3 ½ 4-1 + 1/8 in) long, filled with many seeds. Roots are accessible.²¹

Glycyrrhiza glabra as an anticoagulant:

Glycyrrhiza glabra produces glycyrrhizin (GL), an anti-inflammatory drug discovered as a novel thrombin inhibitor: it has two effects: (a) prolongs plasma recalcification time, thrombin and fibrinogen clotting time; (b) prevents platelet aggregation via thrombin but not collagen, PAF, or convulsin. However, in S-2238, GL did not affect the amide cleavage activity of thrombin. In addition, dansyl thrombin exhibits an increase in fluorescence emission intensity when bound to GL. In addition, GL acts as an inhibitor of the thrombin-catalyzed hydrolysis of S-2238 rather than hirudin. GL is the first thrombin inhibitor found from plants and selectively inhibits thrombin by interacting with the anionic binding exosite of the enzyme. Our data proves this. The results show that GL, a sialo-Lewis X (SLe[X]) mimetic, inhibits the selectivity of the pharmacophore for SLe(X). However, SLe(X) is not involved in the coagulation activity of thrombin; this indicates that it separates the two molecules and does not interact with thrombin. Some have suggested that GL has a strong antithrombin effect and is therefore protective.²²

Other properties Glycyrrhiza glabra:

1. Illnesses,
2. Rheumatism,
3. Stomach ulcers
4. Respiratory conditions
5. Hyperdipsia
6. Epilepsy,
7. Fever,
8. Sexual debility,
9. Paralysis,
10. Skin conditions,
11. Hemorrhagic diseases

Chemical Constituents:**Table No.7: List of Chemical Constituents**

Sr. No	Compound name	Molecular formula
1	Glycyrrhizin	C ₄₂ H ₆₂ O ₁₆
2	Glabridin	C ₂₀ H ₂₀ O ₄
3	liquiritin	C ₂₁ H ₂₂ O ₉
4	Isoliquiritigenin	C ₁₅ H ₁₂ O ₄

Bauhinia forficata:**Fig.9: Bauhinia forficata****Synonym:**

Brazilian orchid tree

Family:

Fabaceae

Description:

Bauhinia forficata is a flowering plant from the pea family, native to Argentina, Brazil, Uruguay and Peru. It is sometimes called pata-de-vaca, pezuña de vaca, or Brazilian orchid.²³

***Bauhinia forficata* as an anticoagulant:**

The aqueous extract of the flat part of the redbud flower contains anticoagulant derived from the coagulant activity caused by the crude poison of *Capsella purpurea* and ring bean. They exhibit strong properties.

The aqueous extract of the aboveground part of the Judas tree neutralizes the coagulant effect of the raw venom of *Tribulus terrestris* and rattlesnakes. *B. moogeni* venom significantly prolongs the clotting time of human plasma. Different incubation rates provided inhibition of fibrinolytic and thrombin-like coagulation activities mediated by *C. albicans* thrombin-like isolates. Although the extract was effective against rattlesnake venom-induced edema and isolated PLA₂, it was unable to prevent white herring bean venom-induced hemorrhagic activity. Furthermore, phospholipase A₂ activity is unaffected by snake venom. Analyzed by SDS-PAGE, interaction experiments between redbud extract and snake venom did not reveal any appreciable degradation of venom proteins. This extract provides a suitable option for obtaining serine protease inhibitors that affect the blood clotting effect of snake venom.²⁴

Other properties:

Treat diabetes and cardiovascular disorder

Turmeric:**Fig.10: Turmeric****Synonyms:**

Curcuma domestica Valetton

Binomial name:

Curcuma longa L

Family:

Zingiberaceae

Description:

A flowering plant belonging to the Zingiberaceae family of gingers is called *curcuma longa*. This perennial herbaceous plant, which is native to Southeast Asia and the Indian subcontinent, needs high annual rainfall and temperatures between 20 and 30 °C (68 and 86 °F) to flourish. Every year, plants are harvested for their rhizomes; some are kept for consumption, while others are multiplied for use the following season. Rhizomes can be used raw or boiled and dried. They are then processed into a dark yellow-orange powder that is often used for color and flavor in Asian dishes, especially curry. Curcumin is the main component of turmeric and also gives the powder its color. Although curcumin (also known as haridra) has long been used in Ayurvedic medicine, It cannot be effectively treated with turmeric or curcumin, according to any solid research.²⁵

Turmeric as an anticoagulant:

Curcumin is a polyphenol that gives turmeric its yellow colour, which also has anti-inflammatory, anti-proliferative and anti-angiogenic properties. However, the anticoagulant properties of curcumin have not been investigated. Here are the Anticoagulant properties of curcumin and its derivatives bisdemethoxycurcumin or BDMC. The results showed that BDMC and curcumin delayed a PTT and PT while reducing thrombin and FXa activities. They prevent the formation of thrombin or FXa. Curcumin and BDMC exhibit anticoagulant effects in vivo, consistent with anticoagulant activity. It is worth noting that the anticoagulant effect of curcumin is better than that of BDMC; This indicates that the methoxy group of curcumin controls the anticoagulant activity well. Consequently, these findings imply that BDMC and curcumin have antithrombotic properties, and regular ingestion of the curry spice turmeric may support the maintenance of anticoagulant status.^{26,29}

Other properties:

- 1.Rheumatoid arthritis
- 2.Chronic anterior uveitis

3. Conjunctivitis, skin cancer,
4. Chicken pox,
5. Smallpox,
6. Wound healing,
7. Urinary tract infections,
8. Liver conditions can all be treated with turmeric as a herbal remedy.

Chemical Constituents:**Table No.8: List of Chemical Constituents**

Sr. No.	Compound name	Molecular formula
1	Curcumin	C ₂₁ H ₂₀ O ₆
2	Curcuminoid	C ₂₁ H ₂₀ O ₆
3	Bisdemethoxycurcumin	C ₁₉ H ₁₆ O ₄
4	Germacrone	C ₁₅ H ₂₂ O
5	Bisacurone	C ₁₅ H ₂₄ O ₃

Camellia sinensis:**Fig.11: Camellia sinensis****Description:**

Tea tree is a small tree or evergreen tree belonging to the flowering plant family Theaceae. Tea can be made from its stems, leaves and leaf buds. (Not to mention the *Melaleuca alternifolia*, or genus *Leptospermum*, commonly known as tea tree, which is the source of tea tree oil.) Names include tea tree, tea bush, and chai tea tree. There are two main species of *C. sinensis*. White tea, yellow tea, green tea, oolong tea, dark tea, and black tea are all produced today from Assamica and Chinese varieties. Among these teas, black tea has the highest oxidation level while green tea has the lowest because these teas go through different processes. In addition to tea leaves, dead tea or twig tea is also collected from the tea tree. Although the tea tree is native to Southeast Asia, East Asia and the Indian Subcontinent, it now grows in tropical and subtropical regions around the world. This evergreen or small tree is usually pruned to a height of less than 2 meters (6.6 feet) when grown for its

leaves. Its main root is thick. The flowers have seven or eight petals, are 2.5-4 cm in diameter and are yellow-white in color.²⁷

Green tea as an anticoagulant:

Green tea catechins reduce collagen, AA, and U46619-induced rabbit platelet aggregation in a concentration-dependent manner in vitro. Catechin inhibits AA-induced platelet aggregation in rats in vitro. Furthermore, in healthy rabbit cells, catechins block the production of thromboxane A₂ and prostaglandin D₂, whereas in washed platelets, catechins block the release of ATP from dense granules.²⁸

Other properties:

1. Diabetes, blastogenesis
2. Inflammation,
3. Heart problems,
4. Diarrhea,
5. Vomiting,
6. Multiple cancers.

Chemical Constituents:

Table No.9: List of Chemical Constituents

Sr. No	Compound name	Molecular formula
1	Catechin	C ₁₅ H ₁₄ O ₆
2	Caffeine	C ₈ H ₁₀ N ₄ O ₂
3	Gallic acid	C ₇ H ₆ O ₅
4	Epicatechin gallate	C ₂₂ H ₁₈ O ₁₀
5	Theaflavin	C ₂₉ H ₂₄ O ₁₂
6	Theaflavin-3-gallate	C ₃₆ H ₂₈ O ₁₆

CONCLUSION:

One of the main aims of this study is to provide necessary medical information about medicinal plants that are effective in the treatment of blood thinners. Twenty drugs were selected and evaluated for this study. This study shows that legume plants have many plants with anticoagulant activity. Additionally, this study covers members of other plant families, showing and confirming that although plant family members are completely different, they have similar characteristics. The biggest problem in our research is that the anticoagulant potential of each plant cannot be compared to other plants studied. This is partly due to the wide variety of metrics and metrics used, many of which are not standardized in advertising. Also, there are only a few plants in this study. There may be other herbs that are effective in preventing blood clots; these were not taken into account in this study. Finally, this research shows that different plants have different potent compounds that work through different mechanisms to prevent blood clots. This plant has the potential to be a very important and effective medicine in the treatment of coagulation disorders. Some of these plants grow in nature, while others are easy to grow. Therefore, although their compositions are complex and useful, it is possible to turn plants into medicines with very low production costs and many advantages, such as very few side effects.

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