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Thrombolytic potentials revisited of some important haemostatic medicinal plants

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Abstract
The outstanding advancement in the field of science, technology and medicine has been observed over the past few decades of twenty first century. But traditional and herbal medicines still holding its own position and popularity since the ancient time. The reason behind the long-term popularity of herbal remedies is nothing but its patient-friendly nature, no side effects and easiest mode of application. Medicinal plant based bioresources are the key components of herbal medicines according to the indigenous knowledge of ethnic people of different tribe in India. As a megadiversity country, India has wide range of diversity and distribution of medicinal and aromatic plant species which have own potentiality and credibility in the field of medical sciences. In this paper, the names, uses, and importance of some major medicinal plants to promote blood coagulation have been dealt with the blood coagulating factors and its basic concepts to create and concern about the sustainable livelihood with herbal plants for health benefits and furthermore research to unveil unknown application.

Keywords: Efficacy, haemostasis, blood coagulation, thrombolytic activity

Introduction

Medicinal plants are recognized as 'Natural First aid' in Ayurveda. Medicinal plant species are the potential candidate, widely used for the treatment of multipurpose disease or health care systems in human beings throughout the World. Blood coagulation is a natural biochemical reaction in human body by which blood stops random flowing after a certain time from cutting site. Due to this mechanism, human body prevents excessive loss of blood and balance the regulation of body fluid. Several proteins, enzymes or enzyme complex like fibrin, fibrinogens, thrombin, prothrombin, thrombokinase and some ions are involved serially in blood coagulation process. An injury or cutting region stimulate platelets in blood to release some other factors and calcium ion (Ca^{2+}) from affected tissues which can initiate clotting and coagulation of blood. But sometimes blood coagulation is not properly happened for some genetically inherited diseases such as haemophilia (both category A and B), Von Willebrand disease etc. Vitamin K deficiency, fibrinolysis overactivity, dysfunction of platelets and metabolical disorders are other reasons for anticoagulation of blood. Ethnobotanical literature survey explored that some medicinal plants have genuine capacity to boost up blood coagulation process within few minutes after injury. Authors are hopeful that this paper will unveil some common medicinal plants which are abundantly grown in different corners of geographical regions having blood coagulation properties.

Methodology: Thorough literature survey has been done on blood coagulation, coagulating factors and impacts of medicinal plants on cutting or injury and its recovery. In the following table, we enlisted some common and significant medicinal plants having the capabilities to promote blood coagulation with their mode of administration and action. Most of the tabulated plants are abundantly grown in West Bengal and easily available to use in emergency purposes. Literature review was strictly based on bibliographic databases, Google Scholar, Pubmed, Science Direct, Scopus etc. The scientific names of the plants were verified from The Plant List (www.theplantlist.org).

Medicinal plants: Natural booster of blood coagulation

Herbal remedies are the best alternative approach instead of contemporary medicine in terms of their application, favourable outcome and instant action without any harmful side effects. Bleeding is one of the most common symptoms in injury, cutting, accidental damage of skin and other associated disorders. Generally bleeding is stopped within few minutes from the affected area and this process is known as blood coagulation. But due to lacking some blood clotting factors, vitamin K deficiency and genetic disorders, blood coagulation phenomenon is not properly performed. Continuous bleeding from an injury is a serious threat of human life for excessive blood loss and internal damage. Several medicinal plants have the significant potentiality to boost up blood coagulation and simultaneously reduce excessive blood flow.

Correlation of Blood Coagulation Mechanism with Styptic Medicinal Plants

Blood coagulation is a complex physiological cascade that culminates in the formation of a stable fibrin clot. It involves sequential activation of clotting factors including fibrinogen (F I), prothrombin (F II), and factors V, VII, VIII, IX, X, XI, XII, and XIII, along with essential cofactors such as calcium ions (Ca^{2+}), phospholipids (PL), and negatively charged surfaces. Calcium ions are indispensable for multiple steps, including the conversion of prothrombin to thrombin, while phospholipids (PL) provide a catalytic surface for the formation of enzyme complexes such as the intrinsic *tenase* complex (F VIIIa–F IXa–Ca^{2+}–PL) and the *prothrombinase* complex (F Va–F Xa–Ca^{2+}–PL). The intrinsic pathway is initiated by F XII, PK, and HMWK on negatively charged surfaces, whereas the extrinsic pathway is triggered by Tissue Factor (TF) with F VII. Finally, F XIII stabilizes fibrin through cross-linking.

Several styptic medicinal plants such as *Acalypha indica*, *Achyranthes aspera*, *Aloe vera*, *Curcuma longa*, *Tridax procumbens*, and *Ficus racemosa* exhibit haemostatic properties that correlate with these mechanisms.

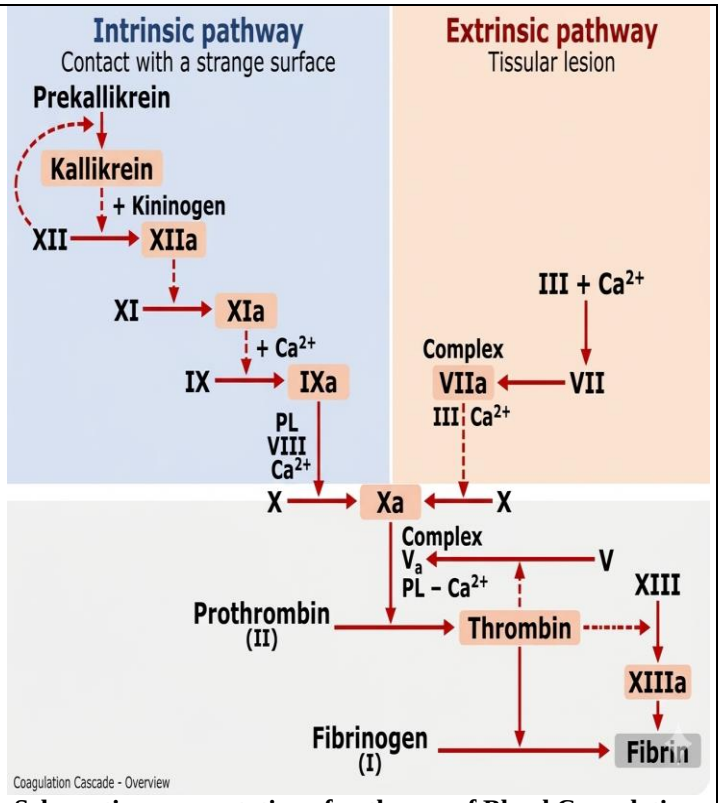
Phytochemicals like tannins induce protein precipitation and vasoconstriction, functionally mimicking fibrin stabilization by F XIII. Flavonoids and terpenoids enhance platelet aggregation and may support PL-mediated activation of factors such as F V, F VIII, and F X. Experimental studies report reduced bleeding time with *Tridax procumbens*, indicating enhanced thrombin-mediated fibrin formation. Additionally, plant exudates and latex (e.g., *Jatropha multifida*, *Ficus racemosa*) create a physical barrier and may simulate negatively charged surfaces, facilitating intrinsic pathway activation. Some phytoconstituents may also enhance local Ca^{2+} availability, thereby promoting multiple Ca^{2+}-dependent reactions in the coagulation cascade.

We are going to discuss some commonly found medicinal plants with their mode of application and utilization as 'natural booster' of blood coagulation in the followings: -

Table 1: Names of Clotting factors and Co-factors

Symbol	Names	Co-factors
F1	Fibrinogen	Ca^{2+}
FII	Prothombin	Ca
FV	Proaccelerin	Ca.PL
FVII	Procovertin	TF.Ca.PL.
FVIII	Antihaemophilic globulin A	Ca.PL
FIX	Antihaemophilic Factor B or Christmas Factor	Ca. F VIIIa.PL
FX	Stuart-Power-Factor	Ca.Fva.PL
FXI	Plasma Thromboblastin anteceden	Ca.PL negatively charged surfaces
FXII	Hagemann Factor	Negatively charged surfaces
FXIII	Fibrin stabilizing Factor, Plasma transglutaminase	Fibrin, CA
TF	Tissue Factor	PL, Ca membrane
PK	Prekallikrein	Negatively charged surfaces
HMWK (or HK)	High Molecular Weight Kininogen	Negatively charged surfaces

Source: [1]



Schematic representation of pathways of Blood Coagulation Mechanism

Table 2: Common and Selected Plants Useful for Rapid Blood Coagulation (Styptic use in Cuts)

Srl No	Scientific name of the Plant species	Family	Common name /Vernacular name	Habit	Traditional mode of Use	Bioactive compounds	Mode of Action	Comment	Reference
1	*Acalypha indica* L.	Euphorbiaceae	Indian Copperleaf /Muktojhuri	Herb	Leaf paste applied to cuts and wounds to stop bleeding	Tannins, flavonoids, alkaloids	Tannins cause local vasoconstriction and promote platelet adhesion.	Works best on cuts as effective haemostatic	[2]
2	*Achyranthes aspera* L.	Amaranthaceae	Prickly Chaff Flower/Aapang	Herb	Fresh leaf paste applied to cuts and wounds to stop bleeding	Alkaloids, tannins, saponins and flavonoids.	Tannins cause protein precipitation leading to vasoconstriction and clot formation, saponin accelarate platelet aggregation.	Works as natural, topical wound coagulant	[3]
3	*Aegle marmelos* L.	Rutaceae	Wood apple/Bael	Tree	Leaf paste applied on wound.	Tannins, Alkaloids.	Astringent action reduces oozing.	Works best on superficial cuts	[4]
4	*Ageratum conyzoides* L.	Asteraceae	Goat weed	Shrub	Leaf juice is used externally to arrest bleeding from minor cuts and wounds	Alkaloids (ageratochrome), flavonoids and tannins.	Increase clotting time by stimulating platelet activity and tissue contraction.	Topical clot promoter in Minor wound	[5]
5	*Aloe vera* (L.) Burm.f	Asphodelaceae	Ghritkumari, Indian *Aloe*	Succulent herb	Fresh leaves gel applied directly to fresh cuts to arrest bleeding; leaf sap used as a topical coagulant in traditional	Acemannan, Aloin, Anthraquinones (aloe-emodin), Saponins, Glycoprotein	Acemannan promotes fibroblast proliferation and platelet aggregation, leading to clot formation; Saponins cause local vasoconstriction;	Natural bio-coagulant. Its polysaccharides and glycoproteins accelerate clot formation and	[6]

					medicine.	s, Polysaccharides, Tannins	Tannins precipitate proteins at the wound surface forming a protective coagulum; Glycoproteins inhibit bradykinin activity, reducing inflammation and further blood loss.	tissue regeneration.	
6	*Asparagus racemosus* Willd.	Asparagaceae (formerly Liliaceae)	Shatavari (Sanskrit, Hindi), Satmuli (Bengali), Wild Asparagus	Climbing perennial herb (tuberous roots)	Roots (powder, decoction, paste) used for wounds, ulcers and bleeding disorders (e.g., menorrhagia, epistaxis); root preparations applied to cuts and used internally for "blood-strengthening" formulations.	Steroidal saponins (shatavarins I–VIII and related saponins / asparosides); Flavonoids, phenolics and tannins (astringent/antioxidant); Alkaloids (asparagamine A), proteins, amino acids.	Astringent / protein-precipitating action (tannins/phenolics) Local application of decoction/paste can cause superficial protein precipitation and vasoconstriction that helps reduce capillary oozing; Saponins / steroidal saponins: Indirectly support haemostasis by immunomodulatory, anti-inflammatory and trophic effects on tissue (promote collagenization, fibroblast activity and faster epithelialization), which helps secondary haemostasis and wound closure.	Strong traditional and preclinical support for wound-healing and supportive haemostatic effects (especially via topical application plus systemic benefit when used internally).	[7, 8]
7	*Ayapana triplinervis* (M. Vahl) R.M. King & H. Rob.	Asteraceae	Ayapana, (English: water-hemp / ayapana)	Perennial, erect to ascending aromatic herb/shrub up to ~0.5–1.5 m.	Fresh leaves crushed and applied as a poultice or leaf juice smeared on cuts, wounds, ulcers and insect/animal bites to arrest bleeding and promote healing.	- Coumarins: ayapanin (herniarin), ayapin, umbelliferone and related coumarin derivatives. - Volatile/essential oil-Phenolics / flavonoids / tannins (reported in polar extracts); - Sterols (stigmasterol), carotenoids	Tannins / phenolics (astringent effect): precipitate surface proteins and form a thin coagulum on the wound surface → mechanical sealing and reduced capillary bleeding. - Coumarins: may contribute to local vasoconstriction and antimicrobial/anti-inflammatory effects, supporting haemostasis indirectly (coumarins have varied bioactivity depending on substitution).	Ethnobotanical and preclinical (in-vitro, phytochemical and some animal) studies support *Ayapana*'s role in wound healing and antisepsis.	[9, 10]
8	*Azadirachta indica* A. Juss.	Meliaceae.	Neem	Tree	Leaf pastes or bark extract used in wounds and ulcer to stop bleeding	Nimbin, azadirachtin, tannins and polyphenols	Tannins induce hemostasis by precipitation and local vasoconstriction	Antimicrobial healer and traditional haemostatic	[11]
9	*Bellis perennis* L.	Asteraceae	Common daisy; English Daisy; "Bruisewort", "Poor-man's Arnica"	Perennial herb	Fresh or dried flowers/leaves, applied to bruises, cuts, wounds, broken bones and sprains; used to promote wound healing and to stop bleeding.	Flavonoids (e.g., kaempferol, quercetin, apigenin derivatives); Tannins / phenolic acids; Saponins (oleanane-type triterpene sapon; Terpenoids/acetylenes.	tannins/phenolics may precipitate proteins at the wound surface, leading to a mechanical sealing of capillaries and reduction of bleeding. - Flavonoids and phenolics support capillary stability and reduce oxidative damage/inflammation, which helps wound repair and secondary haemostasis. - Saponins/terpenoids may promote fibroblast proliferation, collagen synthesis and tissue regeneration	Direct studies specifically measuring haemostatic endpoints (such as bleeding time or clotting time) are limited in the literature. Thus while it is reasonable to infer hemostatic benefit via wound-healing mechanisms.	[12, 13]

10	*Centella asiatica* (L.) Urb.	Apiaceae	Indian Pennywort/Gotukala/Thankuni	Herb	Used in Ayurveda for healing wounds and controlling bleeding	Asiaticoside, madecassoside, triterpenoids.	Enhances collagen synthesis and reduces capillary permeability, aiding clot stabilization.	Works as strong capillary stabilizing agent to clot fast	[14]
11	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Asteraceae.	Siam weed	Herb	Crushed leaves used as a natural bandage for cuts, post-surgical wounds and nose bleeds.	Flavonoids (eupolin A, B), alkaloids and tannins	Enhances thrombin activity and fibroblast proliferation; accelerates clot formation and tissue regeneration.	Helps in clot formation and tissue regeneration	[15]
12	*Croton bonplandianus* Baill.	Euphorbiaceae	Railway weed, Ban-tulsi.	Perennial undershrub / erect herb or subshrub (0.3–1.0+ m)	Fresh leaf paste, crushed leaves, latex or decoction applied directly on fresh cuts, wounds and bleeding sites as a styptic/antiseptic; Latex/leaf juice often used in indigenous practice to arrest bleeding and as a wound dressing.	Tannins/phenolics; flavonoids; alkaloids; saponins; terpenoids (including diterpenes); vitamins (ascorbic acid reported); proteins/enzymes in latex.	- Tannins / phenolics (primary): cause local protein precipitation and astringent effect → mechanical sealing of capillaries and immediate reduction of bleeding. - Latex proteins / enzymes: may provide rapid coagulative/vasoconstrictive action when applied freshly (latex from cut stems reported very quick haemostatic effect).	Multiple preclinical studies consistently report wound-healing and haemostatic utility of leaf extracts and latex. Notably, comparative haemostatic assays (animal models) found *C. bonplandianus* latex/extract produced very rapid haemostasis	[16]
13	*Curcuma longa* L.	Zingiberaceae	Turmeric/Haldi	Herb	Powdered rhizome applied to wounds to stop bleeding and prevent infection	Curcumin, tumerone, dimethoxy-curcumin	Curcumin accelerates wound contraction, platelet aggregation and fibrin formation	Natural clot enhancer to promote fibrin formation	[17]
14	*Ficus racemosa* L.	Moraceae	Cluster Fig Tree/ Dumur	Tree	Latex and bark powder applied to bleeding wounds.	Tannins, sterols, flavonoids	Latex forms a physical barrier and promotes blood clotting through calcium mediate fibrin polymerization	The astringent nature of bark and latex helps to shrink tissues enhancing to stop bleeding.	[18]
15	*Hamamelis virginiana* L.	Hamamelidaceae	Witch hazel	Small tree	Bark and leaves extract (witch-hazel water) used topically to to cuts, hemorrhoids, varicose bleeding and minor external bleeding	Rich in tannins (proanthocyanidins, gallotannins), hamamelitannin (a hydrolysable tannin), flavonoids.	Astringent / protein-precipitating action of tannins → local vasoconstriction, protein coagulation at wound surface, reduced capillary oozing; antioxidant/anti-inflammatory effects reduce secondary tissue damage and help wound contraction	Effective for minor external bleeding and anorectal/skin oozing in traditional and OTC topical use	[19]
16	*Jatropha multifida* L.	Euphorbiaceae	Coral plant, coral bush	Evergreen shrub / small tree	latex (milky sap) and leaf extracts are applied directly on cuts	flavonoids, saponins, tannins, and alkaloids	Reducing oxidative stress in wound tissue; Promoting coagulation and tissue regeneration	"Natural Betadine" compared to pharmaceutical antiseptics.	[20, 21]
17	*Mikania micrantha* Kunth.	Asteraceae	Mile-a-minute, bitter vine, climbing hemp vine; local names: "Japani lota", "Taru-lota"	Fast-growing perennial climbing/creeping herbaceous vine;	Fresh crushed leaves or leaf paste applied directly to recent cuts, wounds, sores and burns to stop bleeding and accelerate healing.	Tannins & phenolics, flavonoids, saponins, terpenoids (including sesquiterpene lactones), alkaloids, steroids/triterpenoids,	Tannins / phenolics (primary haemostatic mechanism): local protein precipitation and formation of an astringent coagulum on wound surface → mechanical sealing and vasoconstriction that reduces bleeding. - Flavonoids / phenolics:	Ethnopharmacology + *in-vivo* studies support a haemostatic/wound-healing role: preclinical work (cell assays + rodent wound models)	[22, 23]

				aggressive invasion.		glycosides.	antioxidant and capillary-stabilizing effects reduce inflammation and capillary fragility → assists secondary haemostasis and tissue repair. - Saponins / terpenoids: reported to exert anti-inflammatory and epithelialization effects; some saponins can cause erythrocyte aggregation/precipitation *in vitro* (supporting local clot promotion in poultices).	shows *M. micrantha* extracts accelerate wound contraction, increase tensile strength and promote angiogenesis	
18	*Moringa oleifera* L.	Moringaceae	Drumstick/Sajne	Tree	Fresh leaf pastes or seed powder applied directly.	Coagulant proteins (MOCP, MO-2.1 protein), Protease enzymes, tannins, flavonoids	Plant proteases accelarate fibrin clot formation; tannins add astringency and vasoconstriction.	One of the few with lab evidence of shortened clotting time (*in-vitro*). Good choice if available.	[24]
19	*Musa paradisiaca* L.	Musaceae	Banana Plant	Tree	Stem sap and leaf juice used to stop bleeding.	Polyphenols, tannins and sterols.	Acts as a coagulant by promoting clot stabilization and vasoconstriction.	Sap / juice is used as an ingredient to reduce pain after bleeding.	[25]
20	*Ocimum sanctum* L.	Lamiaceae	Holy Basil (Tulsi)	Shrub	Fresh leaf juice used to arrest bleeding from cuts and insect bites.	Eugenol, rosmarinic acid, tannins.	Tannins promote clot formation by coagulating plasma proteins; eugenol aids in vasoconstriction.	Practical application proved itself as the best remedy to minimize the inflammation.	[26]
21	*Peperomia pellucida* Kunth.	Piperaceae	Clearweed; shining bush plant	Small annual / perennial succulent herb	Whole-plant or leaf poultices / crushed leaves applied to cuts, wounds and ulcers as a dressing to stop bleeding and speed healing. Ethnobotanical reports from several regions (e.g., Bolivia, SE Asia, Brazil, Philippines) record use of the aerial parts to arrest hemorrhage and as a wound dressing.	tannins & phenolics, flavonoids, alkaloids, saponins, terpenoids /triterpenoids, sterols.	Tannins / phenolics precipitate surface proteins → form a local coagulum and constrict small vessels → rapid local haemostasis. - Flavonoids & phenolics oxidative/inflammatory damage, stabilize capillaries and support tissue repair (helps secondary wound closure).	Ethnobotanical sources explicitly document use to stop bleeding in several countries.	[27]
22	*Pterocarpus santalinus* L.f.	Fabaceae.	Red sanders; Red sandalwood; Rakta Chandan	Small–to–medium deciduous tree (often 6–20 m)	Traditional ointments/pastes from heartwood or bark applied to cuts, burns and skin lesions to reduce bleeding and promote healing. Decoctions/ointments of heartwood or bark used externally in wound management in Ayurvedic/local practice.	Phenolic compounds & polyphenols (various phenolic acids); tannins; flavonoids; saponins; triterpenoids/ terpenoids; alkaloids reported in some extracts. (Phytochemi	Tannins / phenolics (astringent): precipitate proteins at wound surface → form a protective coagulum and induce local vasoconstriction → reduce bleeding. - Flavonoids & phenolics (antioxidant/anti-inflammatory): stabilize capillaries, reduce oxidative damage and inflammation → support faster clot formation and tissue repair. - Saponins /	phytochemical evidence supports an astringent + antioxidant mechanism for haemostasis and tissue repair. However, clinical (human) haemostatic trials are limited and most evidence is preclinical or	[28, 29]

						cal screens of heartwood and bark detect tannins, flavonoids, phenols, saponins, alkaloids and terpenoids).	triterpenoids: may promote epithelialization and fibroblast activity (wound-healing support).	ethnomedicinal .	
23	*Tagetes erecta* L.	Asteraceae	African/Spanish marigold	Annual herbaceous	Leaves used for wound-care, antiseptic washes.	Essential oil (ocimene, tagetone, α-terthienyl in some species), flavonoids, carotenoids (lutein).	tannins and related phenolics in leaves bind and precipitate surface proteins, creating a thin barrier that helps blood cells oozing from capillaries.	leaves/flowers provide antisepsis and astringency for superficial cuts, abrasions and minor wounds.	[30]
24	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae	"Bahera" (Hindi/Bengali); "Bibhitaki" (Ayurveda)	Large deciduous tree, 20–30 m tall	Powdered fruit pericarp or decoction applied externally on cuts and ulcers to arrest bleeding and promote healing; fruit used internally in traditional formulations (e.g., *Triphala*) to support blood purification and tissue repair	Tannins (gallic acid, ellagic acid, chebulagic acid, chebulinic acid); Flavonoids (rutin, quercetin, luteolin); Phenolic acids; β-sitosterol; Lignans; Glycosides	Tannins and phenolic acids act as natural astringents—precipitate surface proteins, constrict blood vessels, and form a protective coagulum that seals wounds and limits bleeding. - Flavonoids stabilize endothelial cells, reduce capillary fragility, and may enhance platelet aggregation in mild injuries. - Antioxidant activity reduces oxidative stress at wound site, promoting collagen cross-linking and faster closure.	Fruit and bark extracts show significant haemostatic and wound-healing activity in animal studies. Astringent tannins are the main contributors to rapid hemostasis	[31]
25	*Tridax procumbens* L.	Asteraceae	*Tridax* daisy, Coat-buttons	Prostrate or decumbent perennial herb	Fresh leaves or leaf juice traditionally applied directly on wounds and cuts to stop bleeding; crushed leaves used as a local dressing to accelerate clotting	Flavonoids (luteolin, quercetin, apigenin, kaempferol); Tannins and phenolic acids; Alkaloids, saponins, steroids, triterpenes	Tannins precipitate proteins forming a protective layer on tissue → mechanical sealing and vessel constriction. - Flavonoids stabilize capillaries, modulate platelet aggregation and reduce oxidative stress to aid repair. - Saponins/sterols contribute anti-inflammatory and astringent actions aiding faster clot formation.	*in-vitro* and *in-vivo* reduction in clotting time with ethanolic and petroleum-ether leaf extracts; supports traditional use for minor wounds.	[32, 33]

Result and Discussion

In this review article, we documented highly applicable 25 major medicinal plant species under 25 different genera and 17 angiosperm families; among which 13 families are of Dicotyledons (Magnoliopsida) and rest 4 families are of Monocotyledons (Liliopsida). Out of 25 plant species, there are 2 climbers, 11 herbs, 3 shrubs and 9 trees.

Table-3: Analysis of medicinal plants under the families (Arranged according to the Bentham & Hooker system of classification in *Genera Plantarum*)

Name of the families (Magnoliopsida)	Number of medicinal plants
Rutaceae	1
Meliaceae	1
Fabaceae	1
Combretaceae	1
Apiaceae	1
Asteraceae	7
Lamiaceae	1
Amaranthaceae	1
Euphorbiaceae	3

Moraceae	1
Piperaceae	1
Hamamelidaceae	1
Moringaceae	1
Name of the families (Liliopsida)	Number of medicinal plants
Asphodelaceae	1
Asparagaceae	1
Musaceae	1
Zingiberaceae	1

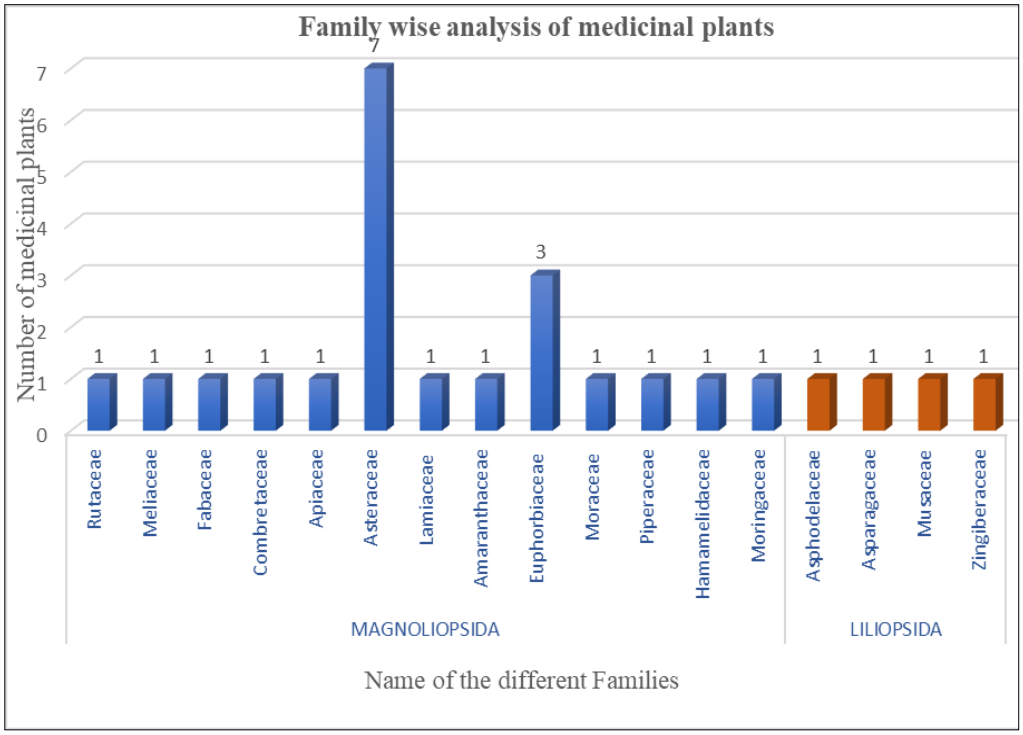


Table 4: Analysis of medicinal plant families on basis of taxonomic classes

Name of taxonomic classes	Number of medicinal plant families
Magnoliopsida (Dicotyledons)	13
Liliopsida (Monocotyledons)	4

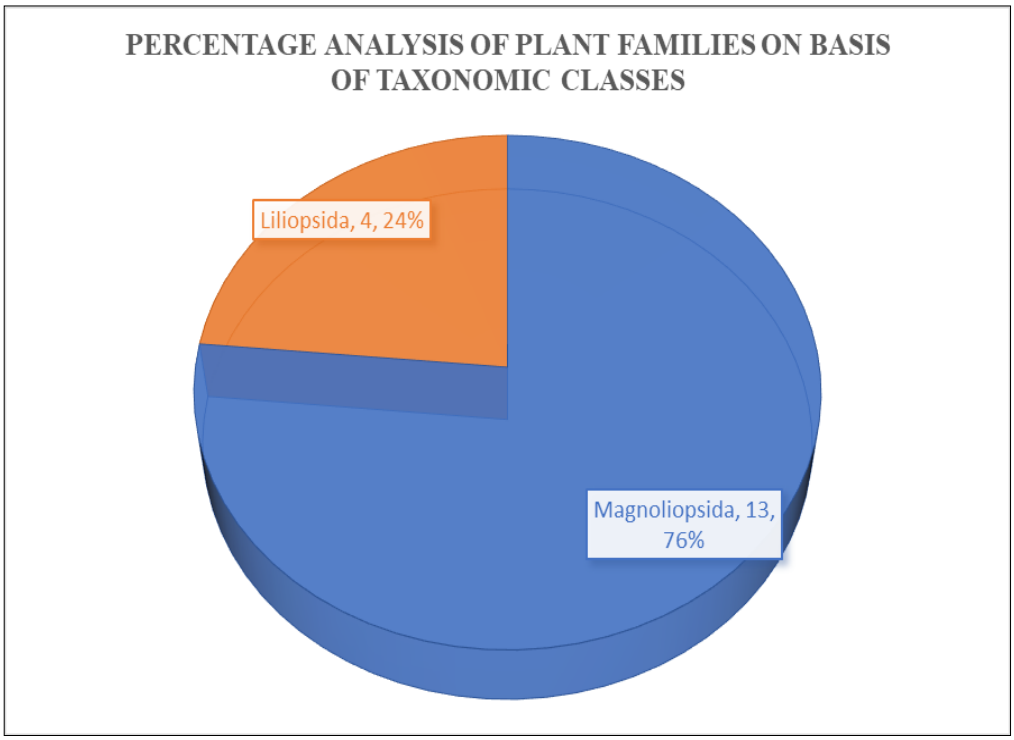


Table 5: Habit analysis of concerned medicinal plant species

Habit	Total no. of plants	Percentage value (%)
Herb	11	44
Shrub	3	12
Climber	2	5
Tree	9	36

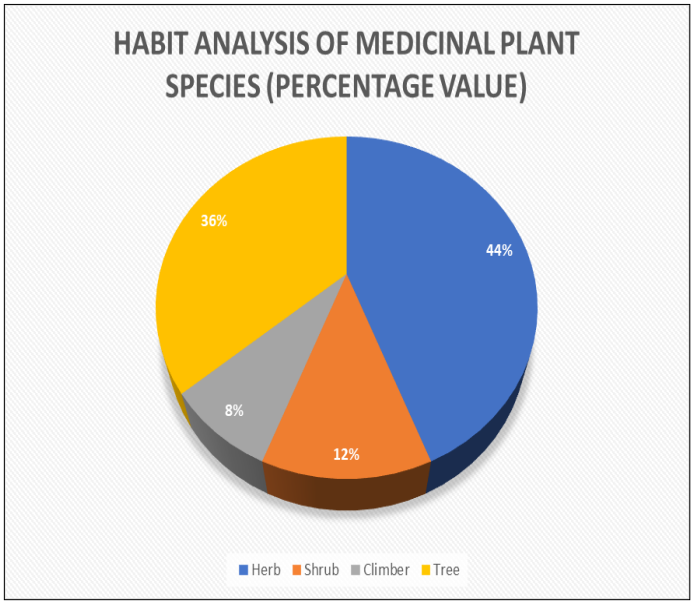
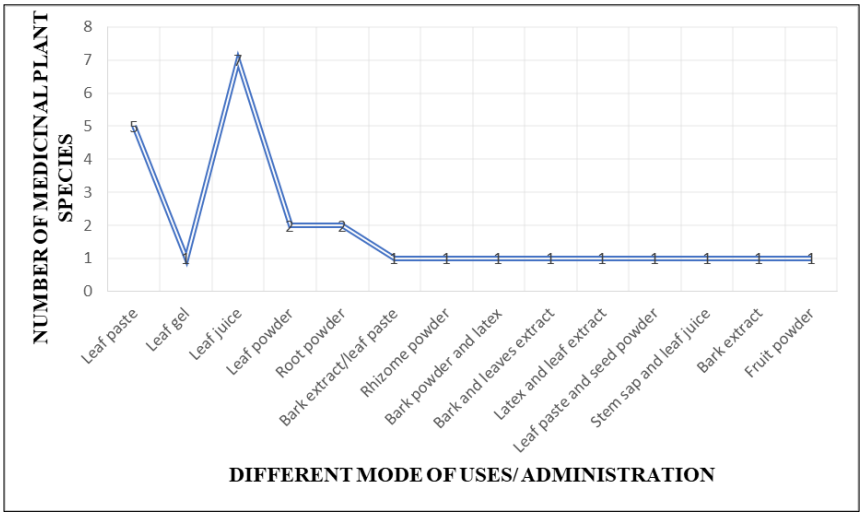


Table 6: Analysis of different mode of administration of different number of medicinal plant species

Mode of administration	Total number of medicinal plant species
Leaf paste	5
Leaf gel	1
Leaf juice	7
Leaf powder	2
Root powder	1
Bark extract / Leaf paste	1
Rhizome powder	1
Bark powder and latex	1
Bark and leaves extract	1
Latex and leaf extract	1
Leaf paste and seed powder	1
Stem sap and leaf juice	1
Bark extract	1
Fruit powder	1



Conclusion

The primary objective of the present study was to conduct a comprehensive scientific review of medicinal plants with potential haemostatic properties, focusing on their role in promoting blood coagulation and evaluating their therapeutic efficacy. The tabulated medicinal plants have widely distributed across the different states of India including West Bengal. Scientific literature on indigenous knowledge systems indicates that medicinal plants used for therapeutic purposes are generally perceived to have minimal or fewer side effects compared to conventional treatments. Furthermore, clinical trials and biomedical research are essential to explore different mode of application strategies at domestic level. Conventional allopathic medicine utilizes a range of pharmacological and topical haemostatic agents to control bleeding from cutaneous injuries. However, limitations such as cost, accessibility, and potential adverse effects have prompted increasing interest in alternative approaches. Ethnomedicinal knowledge highlights the use of diverse plant species that exhibit rapid haemostatic responses and facilitate blood coagulation. In addition to their haemostatic activity, several medicinal plants possess antimicrobial properties and are traditionally applied as 'natural antiseptic' or used as 'natural bandage' in dressings to protect wounds from microbial invasion. These plants are administered in various forms, including paste, powder, extract, gel, and fresh juice derived from leaves, stems, roots, or fruits, depending on the species and traditional practices. Therefore, the conservation of phyto-diversity is the first and foremost criteria to protect our mother nature for the mankind and sustainable man-plant relationship. Consequently, there is growing scientific interest in exploring plant-derived haemostatic agents as complementary or alternative approaches for effective and accessible bleeding control in this present era.

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