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BRIDGING AYURVEDA AND HEMATOLOGY: INGREDIENT RATIONALE AND HYPOTHESIZED ACTION OF *RAKTAMRUT VATI* IN HEMOPHILIA

Dr. Shubham Ramnarayan Dhoot[1], Dr. N. S. Gangasagre[2], Dr. Shreya Dhanaji Bhosale[3], Dr. Sonal Sharad Patil[4], Shraddha Sunil Funne[5], Zainab Yousuf Shaikh[6]

[1]Founder and Principal Investigator, Raktamrut in Hemophilia Research and Development Cell, Government Ayurveda College & Hospital, Dharashiv, Maharashtra, India, sdhoot1008@gmail.com, ORCID : 0009-0003-6745-5034
[2]Research Guide and Principal Advisor, Raktamrut in Hemophilia, Research and Development Cell, Government Ayurveda College & Hospital, Dharashiv, Maharashtra, India. Dean, Government Ayurvedic College and Hospital, Nanded, Maharashtra, India.gangasagrens@gmail.com
[3]Ph.D. Scholar, Department of Rasa Shastra and Bhaishajya Kalpana, All India Institute of Ayurveda, New Delhi-110076, shreyab0496@gmail.com, ORCID – 0009-0000-2236-3935
[4]BAMS, MD, Department of Agadtantra evam Vidhivaidyaka, Maharashtra University of Health Sciences, Nashik, Maharashtra, India, sonalsharad27@gmail.com, ORCID - 0009-0009-0236-3749
[5]Project Associate, Raktamrut in Hemophilia Research and Development Cell & Dharashiv Pattern, Raktamrut in Hemophilia, Research and Development Cell, Government Ayurveda College & Hospital, Dharashiv, Maharashtra, India.funneshraddha@gmail.com
[6]Project Associate, Raktamrut in Hemophilia, Research and Development Cell, Government Ayurveda College & Hospital, Dharashiv, Maharashtra, India. zainabsk31052004@gmail.com
***Corrosponding Author:** Dr. Shubham Ramnarayan Dhoot: sdhoot1008@gmail.com, ORCID : 0009-0003-6745-5034

Collaborative Research Affiliation:
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This collaborative research initiative was conceptualized and developed in line with the visionary foresight of Shri Virendra Kumar Ji, Hon'ble Minister of Social Justice & Empowerment, Government of India, and Shri Rajesh Aggarwal Ji, former Secretary, Department of Empowerment of Persons with Disabilities (DEPwD), within the broader national vision of promoting integrative rehabilitation for persons with disabilities. The initiative seeks to advance evidence-based research by integrating traditional Indian systems of medicine with modern rehabilitation approaches, with the aim of developing scientifically assessable strategies to improve rehabilitation outcomes and quality of life for persons with disabilities, including those affected by blood disorders such as hemophilia.

ABSTRACT

Background: Haemophilia A and B are rare X-linked bleeding disorders caused by deficiency or absence of coagulation factor VIII (FVIII) or factor IX (FIX) essential for normal blood clotting. Despite advances in factor replacement and non-factor therapies, challenges such as high treatment costs, inhibitor development, breakthrough bleeding, and progressive arthropathy persist, particularly in low- and middle-income countries. In Ayurveda, the clinical manifestations of haemophilia may be interpreted in the context of *Raktavaha Strotodushtijanya Vyadhi* such as *Raktapitta, Pandu* and *Vatarakta*. *Raktamrut Vati* is a novel polyherbo-mineral formulation comprising nine classical ingredients, including *Dravyas* from *Panchavalkala Varga*, *Swarna Bhasma,* and four *Bhavana Dravyas* including cow's milk used as processing media. All ingredients were rationally selected for their potential haemostatic, anti-inflammatory, joint-protective, and quality-of-life-enhancing effects, while aiming to provide an affordable adjunct to standard care.

Methods: A narrative integrative review was conducted of classical Ayurvedic texts alongside PubMed and Scopus indexed literature on haemophilia pathophysiology and the phytochemistry and pharmacology of each ingredient. The findings were correlated with Ayurvedic concept of pathogenesis *(Samprapti)* and contemporary understanding of bleeding and tissue injury.

Results: In Ayurvedic terms, the formulation combines haemostatic (*Raktastambhana*), *Pitta*-pacifying and blood-restoring *(Rakta-prasadana*), digestive and *Vata*-balancing, and rejuvenating *(Rasayana*) actions. Biomedical evidence suggests that its constituents act downstream of the factor defect through four mechanisms: support of platelet and mucosal haemostasis, antioxidant protection against haem-iron-driven tissue injury, inhibition of NF-κB, cytokine, cyclooxygenase and VEGF signalling in the synovium, and promotion of tissue repair, analgesia and hepatic function. Several ingredients also showed antiplatelet or anticoagulant activity in experimental studies.

Conclusion: *Raktamrut Vati* has a coherent Ayurvedic and biomedical rationale as a multi-target adjunct to standard haemophilia care. However, its net haemostatic effect must be established through preclinical and controlled clinical studies before any therapeutic claims are made.

KEYWORDS: Ayurveda; Hemophilia; Hemophilic arthropathy; *Raktapitta; Raktamrut Vati*.

1. INTRODUCTION

Haemophilia is an X-linked recessive bleeding disorder in which pathogenic variants of the *F8* or *F9* gene cause deficiency of coagulation factor VIII (haemophilia A, about 80–85% of cases) or factor IX (haemophilia B).[1,2] A meta-analysis of national registries estimated more than 1.1 million affected males worldwide, most of whom remain undiagnosed,[3] and India is believed to carry one of the largest undiagnosed burdens, with substantial social and economic costs.[4]

Deficiency of FVIII or FIX impairs the propagation phase of coagulation, in which the intrinsic tenase complex on activated platelets generates the thrombin burst needed for a stable fibrin clot. The resulting clot is loose, poorly cross-linked and susceptible to premature fibrinolysis.[5,6] Clinically, this manifests as recurrent bleeding into joints and muscles, prolonged bleeding after trauma or dental extraction, and occasional life-threatening haemorrhage.[1,2] Repeated intra-articular bleeding releases iron that drives oxidative injury, synovitis and fragile neovascularisation, culminating in chronic haemophilic arthropathy. [7,8]

Current management, although transformative, has important limitations. Prophylactic factor replacement is the standard of care, but the short half-life of standard concentrates requires frequent intravenous infusions. Extended half-life products reduce this burden but do not eliminate it. [2,9] Neutralising inhibitors develop in about 25–30% of previously untreated patients with severe haemophilia A, and less often in haemophilia B. Inhibitors make replacement ineffective and require costly bypassing agents or immune tolerance induction.[10] Non-factor therapies such as emicizumab allow subcutaneous dosing, yet breakthrough bleeds still need factor or bypassing agents. Thrombotic microangiopathy has also been reported with concomitant activated prothrombin complex concentrate, and long-term costs remain high.[9,11] Gene therapy can provide sustained factor expression in some patients. However, variable and declining factor levels, hepatotoxicity, exclusion of patients with pre-existing AAV antibodies and very high one-time prices limit its use.[12,13] Moreover, subclinical bleeding and progressive joint damage can continue even during prophylaxis.[14] These gaps are widest in low and middle-income countries, where most people with haemophilia remain undiagnosed or depend on-demand treatment. [2,11]

Although hemophilia is not explicitly described as a distinct disease in Ayurveda, Ayurvedic principles classify disorders based on *Dosha*, *Dhatu*, and *Srotas* involvement. The clinical manifestations of hemophilia may be understood in the context of *Raktapitta*, particularly its hereditary aspects.[15,16] *Sushruta* describes hereditary diseases arising from defects of the parental reproductive elements as *Adibalapravritta Vyadhi,*[17] and he explains that a defect in the portion of the seed (*Bija*) that forms a tissue produces a congenital defect of that tissue (*Bijabhagavayava Dushti)*, a concept that parallels a gene variant. In the classical pathogenesis, aggravated *Pitta*, with its hot *(Ushna*), sharp *(Teekshna*) and liquid *(Drava*) qualities, vitiates *Rakta*, which becomes abnormally fluid and escapes from its channels *(Raktavaha Strotas*), whose roots are the liver *(Yakrit*) and spleen *(Pliha*); bleeding may occur through the upper or lower orifices.[16] Repeated bleeding into joints involves *Vata*, producing pain, swelling and stiffness resembling *Vatarakta*, while chronic blood loss produces pallor resembling *Pandu.*

The classical management of *Raktapitta* focuses on haemostasis (*Raktastambhana*) using drugs with astringent, bitter, and sweet tastes and cold potency; pacification of *Pitta*; restoration of *Rakta* and its roots *(Rakta-prasadana*); preservation of digestive function *(Agni*) and *Vata* balance; and rejuvenation *(Rasayana*).[16] *Raktamrut Vati* is a novel, formulation designed on these principles. Its base consists of three of the five *Panchavalkala* trees, *Udumbara (Ficus racemosa*, fruit and stem bark)[18], *Ashwattha (Ficus religiosa*, stem bark)[19] and *Nyagrodha (Ficus benghalensis*, stem bark),[20] fortified with *Swarna Bhasma* (incinerated gold). This base is triturated sequentially *(Bhavana*) with *Rohitaka (Tecomella undulata*, stem bark),[21] *Sariva (Hemidesmus indicus*, root)[22] and *Krishna Tulasi (Ocimum tenuiflorum*, leaf),[23] and finally with milk of the Indian Gir cow.[24] Each ingredient is described in classical lexicons for *Raktapitta* or related disorders of blood, but their combination, proportions and processing is novel. The composition is shown in Table 1.

Table 1: Compositions and proportion of ingredients of *Raktamrut Vati*

Sr. No.	Ingredients	Botanical names	Part used	Ratio
1.	*Udumbara*	*Ficus racemosa* L.	Fruit	1 part
2.	*Udumbara*	*Ficus racemosa L.*	Stem bark	1 part
3.	*Ashwattha*	*Ficus religiosa* L.	Stem bark	1 part
4.	*Nyagrodha*	*Ficus benghalensis* L.	Stem bark	1 part
5.	*Swarna Bhasma*	Incinerated gold particles (Aurum)	*Bhasma*	0.008 part
6.	*Rohitaka*	*Tecomella undulata* (Sm.)	Stem bark	Qs
7.	*Sariva*	*Hemidesmus indicus* R.Br.	Root	Qs
8.	*Krishna Tulasi*	*Ocimum tenuiflorum* L.	Leaf	Qs
9.	*Go-ksheera*	Whole milk of Indian Gir cow	Milk	Qs

(Qs – As much as Sufficient)

Bhavana imparts the properties of the processing liquid to the base powder, reduces particle size and is classically held to increase potency at a lower dose.[25] The aim of this review was to justify the selection of the seven

ingredients of *Raktamrut Vati* and to propose, from both Ayurvedic and biomedical perspectives, the mechanisms by which they may act in haemophilia.

2. MATERIALS AND METHODS

This narrative integrative review combined classical and modern sources. The classical texts *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya* and *Sharangadhara Samhita*, together with the lexicons *Dhanvantari*, *Raja*, *Kaiyadeva*, *Priya* and *Bhavaprakasha Nighantu*, were examined for the taste *(Rasa*), qualities *(Guna*), potency *(Virya*), post-digestive effect *(Vipaka*), actions *(Karma*) and indications of each ingredient, and these properties were interpreted within the Ayurvedic pharmacological framework.[17–26] PubMed and Scopus were searched up to September 2026 using the botanical name of each ingredient combined with the terms "platelet", "coagulation", "fibrinolysis", "antioxidant", "anti-inflammatory", "NF-κB", "angiogenesis", "wound healing", "analgesic" and "hepatoprotective", and using haemophilia pathophysiology terms; the reference lists of retrieved reviews were also screened. Original studies on human blood or plasma, animal models and cell systems, and peer-reviewed reviews, were included when they concerned the same species and plant part used in the formulation; evidence from other plant parts was reported separately and was not transferred. For each ingredient, the principal constituents, molecular or cellular targets and direction of effect were extracted and mapped onto the Ayurvedic pathogenesis *(Samprapti*) and modern sequence of haemostatic failure and blood-induced tissue injury. Because the evidence was heterogeneous in extract type, dose and model, the findings were synthesised narratively.

3. RESULT

3.1 Ayurvedic pharmacological profile and *Samprapti Vighatana*

The Ayurvedic properties of the ingredients are summarised in Table 2. The formulation is predominantly astringent *(Kashaya*), bitter *(Tikta*) and sweet *(Madhura)* in taste with cold potency *(Shita Virya*), which is the profile prescribed for *Raktapitta.*[16]

Table 2: Ayurvedic pharmacological properties and principal constituents of the ingredients

Ingredient	*Rasa*	*Guna*	*Virya*	*Vipaka*	*Karma*	Key constituents
Udumbara	*Kashaya* (fruit *Madhura)*	*Guru, Ruksha*	*Shita*	*Katu*	*Raktastambhana, Raktapittahara, Dahashamana, Shothahara*	Tannins, lupeol, β-sitosterol, β-amyrin, gallic acid
Ashwattha	*Kashaya, Madhura*	*Guru, Ruksha*	*Shita*	*Katu*	*Raktastambhana, Raktashodhana, Vranaropana, Sangrahi*	Tannins, catechin, epicatechin, ellagic acid, bergapten, stigmasterol, vitamin K
Nyagrodha	*Kashaya*	*Guru, Ruksha*	*Shita*	*Katu*	*Stambhana, Grahi, Vranaropana, Shothahara*	Bengalenoside, procyanidins, friedelin, β-sitosterol
Swarna Bhasma	*Madhura, Tikta, Kashaya*	*Guru, Snigdha*	*Shita*	*Madhura*	*Rasayana, Balya, Hridya, Vishaghna, Ojovardhaka*	Elemental gold, nanocrystalline particles
Rohitaka	*Katu, Tikta, Kashaya*	*Laghu, Ruksha*	*Shita*	*Katu*	*Rakta-prasadana, Yakrit–Plihaghna, Lekhana, Deepana*	Betulinic acid, rutin, quercetin, vanillic acid, lapachol, tecomin
Sariva	*Madhura, Tikta*	*Guru, Snigdha*	*Shita*	*Madhura*	*Raktashodhana, Pittashamana, Dahahara, Sangrahi*	2-hydroxy-4-methoxybenzaldehyde, hemidesmine, lupeol acetate, coumarinolignoids
Krishna Tulasi	*Katu, Tikta*	*Laghu, Ruksha*	*Ushna*	*Katu*	*Deepana, Shothahara, Vata–Kaphahara, Krimighna*	Eugenol, rosmarinic acid, apigenin, β-caryophyllene, ursolic acid
Go-ksheera	*Madhura*	*Guru, Snigdha*	*Shita*	*Madhura*	*Jivaniya, Rasayana, Raktapittahara*	Casein, whey proteins, lipids, calcium

When these properties are placed against the pathogenesis of *Raktapitta*, each ingredient group interrupts a distinct step (Figure 1). The three *Ficus* barks, all astringent and cooling members of the *Panchavalkala* group, restrain the escape of fluid *Rakta* from its channels (*Raktastambhana*); *Charaka* specifically recommends astringent, cooling trees for *Raktapitta* and prescribes the buds and aerial roots of *Nyagrodha, Udumbara* and *Ashwattha* for lower-tract bleeding, while *Udumbara* fruit is advised for *Raktapitta* and epistaxis. *Sariva*, which *Charaka* names the foremost drug among those that are binding and that pacify *Raktapitta,*[16] acts together with the sweet, cooling

Udumbara fruit to pacify *Pitta* and restore the quality of *Rakta*. *Rohitaka*, described as a purifier of blood that reduces enlargement of the liver and spleen,[21] acts at the roots of *Raktavaha Srotas*. *Krishna Tulasi*, the only hot-potency ingredient, protects *Agni* from the heavy, cold base and relieves *Vata* and *Kapha* in inflamed joints.[18] *Swarna Bhasma*, a *Rasayana* that strengthens tissues, protects *Ojas* and is held to potentiate co-administered drugs *(Yogavahi*),[27] and cow milk, which *Charaka* names the foremost vitaliser *(Jivaniya*) and uses in *Raktapitta,*[16] address the constitutional weakness of *Rakta Dhatu* in a lifelong hereditary disease.

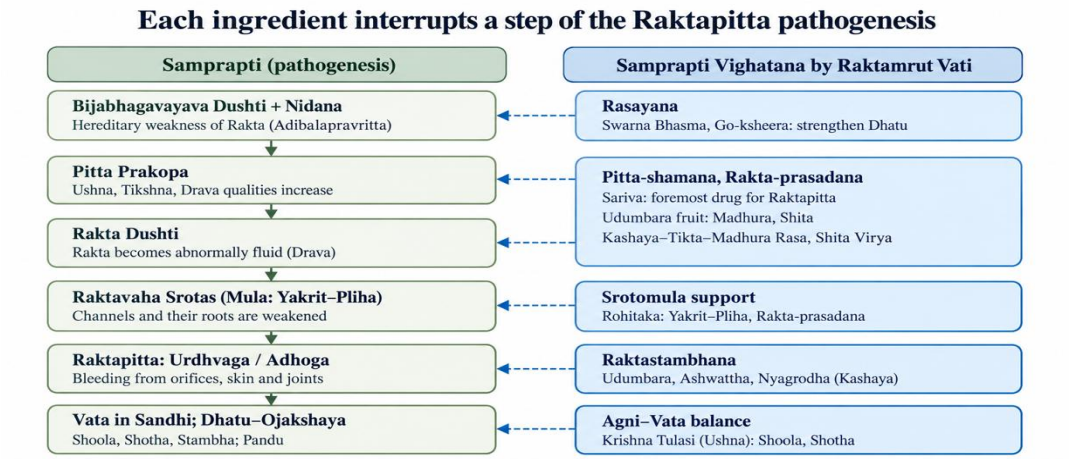


Figure 1. Ayurvedic pathogenesis of hemophilia interpreted as *Raktapitta* and the step at which each ingredient group of *Raktamrut Vati* acts.

3.2 Phytochemical basis of the proposed actions

The key constituents of each ingredient and their proposed targets are summarised in Figure 2. The three *Ficus* barks share a chemistry rich in tannins, phenolic acids, flavonoids and triterpenes, [28,29,30] and the three *Bhavana* herbs (*T. undulata, H. indicus* and *O. tenuiflorum*) add complementary triterpenes, flavonoids and phenolic compounds.[31,32,33,34] *Swarna Bhasma* consists mainly of elemental gold with nanometre-range crystallites.[35,36] Cow milk, the final *Bhavana* medium, contains casein micelles and whey proteins that bind hydrophobic bioactives and improve their stability[37] so final trituration with milk may act as a natural carrier for the lipophilic triterpenes and polyphenols of the formulation.

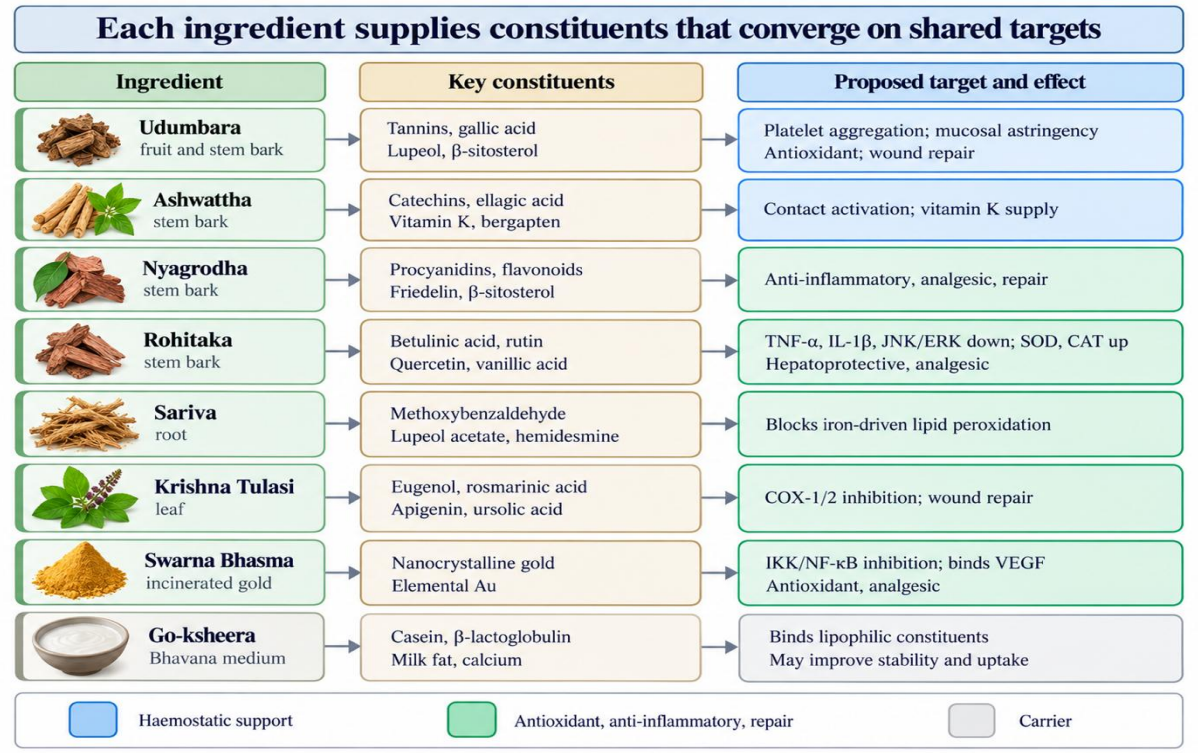


Figure 2. Multi-target map of *Raktamrut Vati*. Each ingredient (left) contributes characteristic constituents (centre) that act on shared targets (right). Blue boxes indicate haemostatic support, green boxes antioxidant, anti-inflammatory and reparative actions, and the white box the carrier role of milk. (CAT, catalase; COX, cyclooxygenase; IKK, IκB kinase; SOD, superoxide dismutase; VEGF, vascular endothelial growth factor)

3.3 Proposed haemostatic mechanisms

The proposed sites of action are shown in Figure 3. The most direct evidence is that aqueous extracts of *F. racemosa* stem bark induced concentration-dependent aggregation of human platelets.[38] Platelet aggregation cannot replace the FIXa–FVIIIa step, but the activated platelet surface is where residual thrombin is generated in haemophilia, as shown by high-dose rFVIIa, which acts there independently of FVIII and FIX.[5,39] A stronger platelet response may therefore help patients with mild or moderate disease make better use of their residual thrombin.

Locally, tannins precipitate proteins on contact, the biochemical basis of the astringent action termed *Stambhana,* [40] and polyphenol mixtures can form a haemostatic protein network with fibrinogen on bleeding surfaces.[41] After oral administration, this effect is plausible on the oral and gastrointestinal mucosa, which are common bleeding sites in haemophilia.

Ellagic acid and vitamin K in *F. religiosa* bark act on coagulation proteins but cannot bypass the defect: ellagic acid activates factor XII, a pathway that still converges on the tenase step,[42] and vitamin K supports γ-carboxylation of factors II, VII, IX and X but cannot correct a genetic deficiency of FVIII or FIX, [43] Because low thrombin generation in haemophilia also impairs TAFI activation and accelerates clot lysis;[7] future studies should examine whether any ingredient of *Raktamrut Vati* has antifibrinolytic activity.

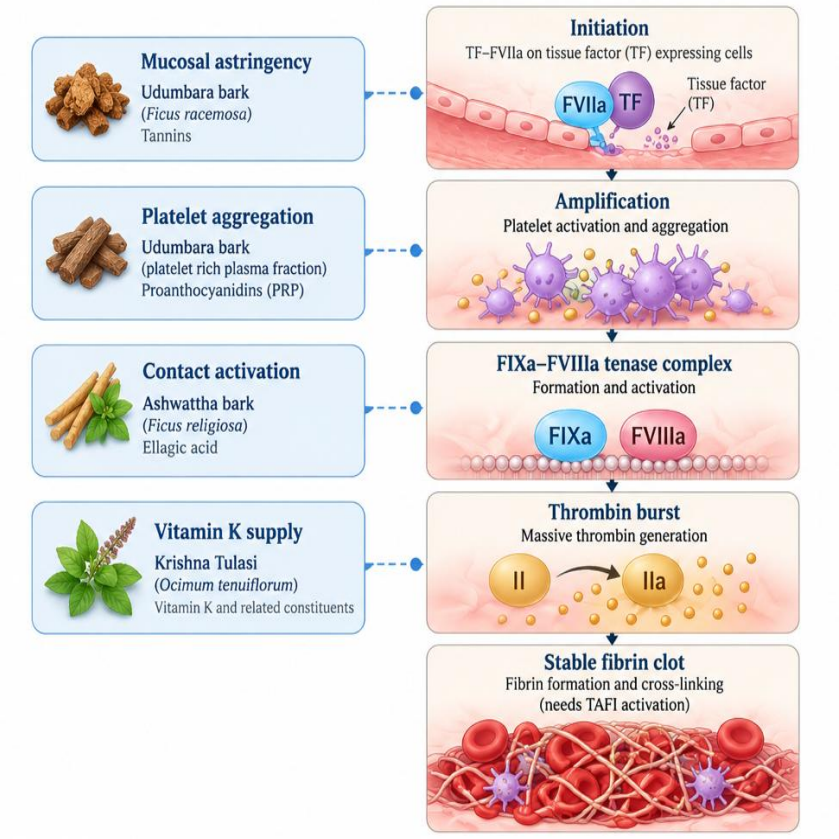


Figure 3. Proposed haemostatic sites of action of *Raktamrut Vati* on the cell-based model of coagulation. (PRP, platelet-rich plasma; TAFI, thrombin-activatable fibrinolysis inhibitor; TF, tissue factor)

3.4 Proposed protection against blood-induced joint injury

Once blood enters a joint, iron released from red cells generates hydroxyl radicals that damage cartilage and trigger synovial inflammation.[44] *Raktamrut Vati* may interrupt this cycle at three steps (Figures 4 and 5). First, *H. indicus, T. undulata,* the *Ficus* polyphenols and *Swarna Bhasma* show antioxidant activity,[45,46] and flavonoids may bind free iron.[47] Second, *T. undulata, F. benghalensis, O. tenuiflorum* and gold compounds suppress inflammatory mediators such as NF-κB, TNF-α, IL-1β and COX-2.[48,49,50,51] Third, gold nanoparticles bind VEGF and reduce synovial angiogenesis,[52] which may help break the re-bleeding cycle that creates a target joint.[53]

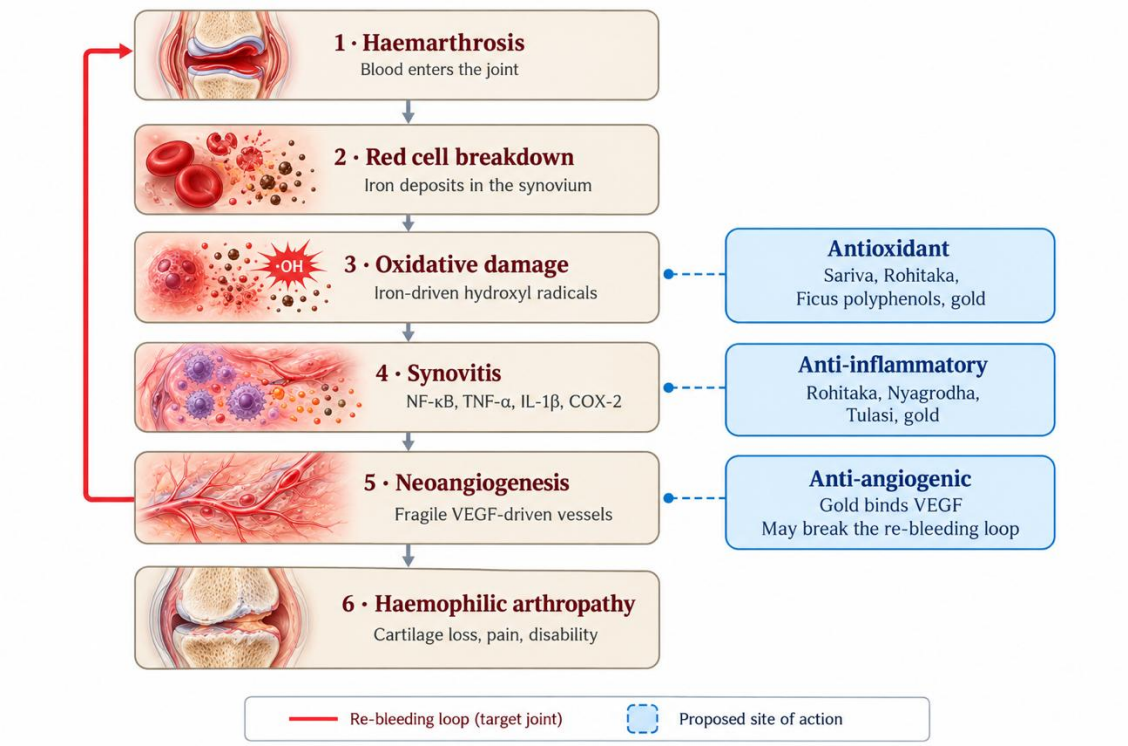


Figure 4. Proposed sites of action of *Raktamrut Vati* in the blood-induced joint injury cycle. Iron from hemarthrosis drives oxidative damage, synovitis and fragile new vessels that re-bleed, creating a target joint (red loop). Ingredients may act at the antioxidant, anti-inflammatory and anti-angiogenic steps (blue). (COX-2, cyclooxygenase-2; IL-1β, interleukin-1β; NF-κB, nuclear factor-κB; TNF-α, tumour necrosis factor-α; VEGF, vascular endothelial growth factor)

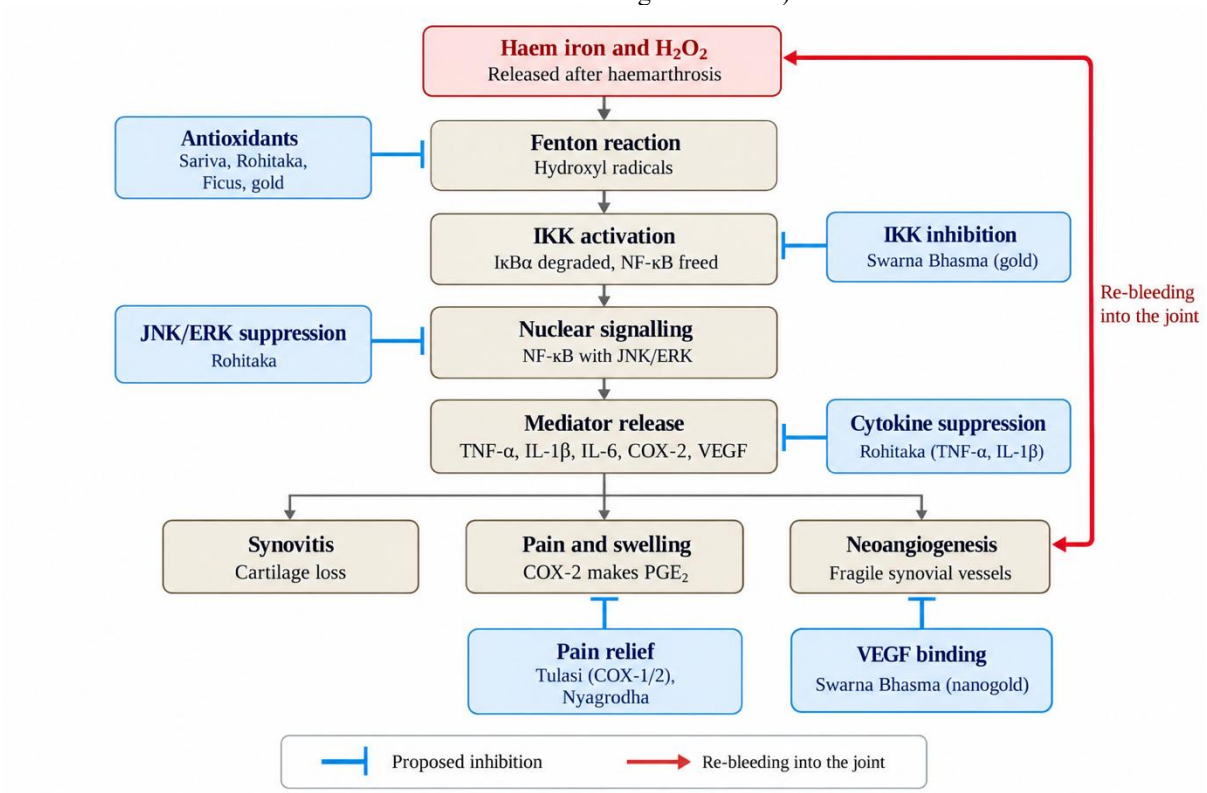


Figure 5. Proposed molecular targets of *Raktamrut Vati* in the inflamed synovium. Haem iron drives hydroxyl radical formation and NF-κB-dependent release of inflammatory mediators, leading to synovitis, pain and fragile new vessels that re-bleed into the joint (red). Blue bars show proposed inhibition by individual ingredients. (COX, cyclooxygenase; ERK, extracellular signal-regulated kinase; IKK, IκB kinase; IL, interleukin; JNK, c-Jun N-terminal kinase; NF-κB, nuclear factor-κB; PGE_2, prostaglandin E_2; TNF-α, tumour necrosis factor-α; VEGF, vascular endothelial growth factor).

3.5 Tissue repair, analgesia and hepatic support

Several ingredients may aid tissue repair after bleeding. Lupeol and β-sitosterol from *F. racemosa* bark enhanced cell migration in wound assays,[54] *O. tenuiflorum* leaf accelerated wound healing even under dexamethasone suppression,[55] and wound-healing activity has also been reported for *F. benghalensis* and *H. indicus.*[29] Gold preparations and *T. undulata* show analgesic activity that may ease pain during acute haemarthrosis.[56] *T. undulata* bark is also hepatoprotective against steatohepatitis and carbon tetrachloride injury,[57] in line with the classical action of *Rohitaka* on *Yakrit*. This matters because the liver synthesises FIX and the other vitamin K-dependent factors,[39] and older patients may carry hepatitis from earlier plasma-derived products.[58]

4. DISCUSSION

This review proposes that *Raktamrut Vati*, a novel formulation, rests on a coherent rationale in which each ingredient fulfils a defined role in the classical management of *Raktapitta* and also contains constituents with plausible actions on the modern pathophysiology of hemophilia. These actions lie downstream of the genetic defect. No ingredient can replace FVIII or FIX, but together they may reduce how often the deficiency leads to bleeding and how much damage each bleed causes.

The two systems describe the same actions in different languages. *Raktastambhana* by astringent, cooling barks corresponds to platelet support and the protein-precipitating effect of tannins on bleeding mucosa. *Pitta–Rakta Shamana*, the pacification of a hot, inflammatory principle in the blood, corresponds to antioxidant and anti-inflammatory protection against iron-driven joint injury. The classical view of the liver as the root of the blood channels corresponds to hepatoprotection at the site where FIX and the other vitamin K-dependent factors are made, and *Rasayana* corresponds to tissue protection and repair in a lifelong disease. This correspondence does not prove efficacy, but it supports an integrative approach to bridging Ayurveda and modern science. [15,26]

The hypothesised mode of action also fits current haemophilia therapeutics. Network pharmacology holds that several modest actions converging on one disease network can produce a meaningful combined effect, and multi-component herbal formulations are natural candidates for this model.[59] Modern haemophilia care has itself moved beyond simple factor replacement to strategies that rebalance haemostasis through non-factor targets, such as bispecific antibodies and suppression of natural anticoagulants.[60,61] *Raktamrut Vati* may therefore be viewed as a multi-target modulator acting within this broader rebalancing paradigm, while also addressing the inflammatory and oxidative consequences of bleeding that factor therapy does not directly treat. The joint-protective hypothesis may prove more clinically relevant, because arthropathy is the main cause of long-term disability and progresses through iron, inflammation and angiogenesis even during prophylaxis.[62]

LIMITATIONS AND FUTURE SCOPE

Most of the evidences are preclinical and come from extracts that differ in plant part, solvent and dose from the formulation itself. No pharmacokinetic data exist for the constituents at the doses delivered by *Raktamrut Vati*, and the correlations drawn between Ayurvedic concepts and hemophilia are interpretive rather than equivalent. The formulation has not yet been tested in hemophilic plasma, or animal models. Future work should begin with standardisation of the formulation, followed by thrombin-generation and platelet-function studies in haemophilia A and B plasma, studies in factor-deficient animal models of bleeding and hemarthrosis, toxicological and pharmacokinetic evaluation, and finally randomised, placebo-controlled add-on trials measuring annualised bleeding rate, factor consumption, joint health and quality of life.

5. CONCLUSION

Raktamrut Vati is a rationally designed, novel Ayurvedic formulation in which seven classical ingredients provide haemostatic, *Pitta*-pacifying and blood-restoring, liver-supporting, digestive and *Vata*-balancing, and rejuvenating actions for hemophilia interpreted as hereditary *Raktapitta*. Biomedical evidence supports plausible mechanisms downstream of the factor defect, namely platelet and mucosal haemostatic support, antioxidant protection against haem-iron injury, inhibition of NF-κB, cytokine, cyclooxygenase and VEGF signalling in the synovium, and promotion of tissue repair, analgesia and hepatic function. *Raktamrut Vati* should therefore be regarded as a promising candidate adjunct to standard hemophilia therapy whose mechanism of action is proposed, not yet proven, and which now requires systematic experimental and clinical evaluation.

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