World Journal of Pharmaceutical Science and Research

www.wjpsronline.com

Review Article

ISSN: 2583-6579
SJIF Impact Factor: 6.916
Year - 2026
Volume: 5; Issue: 11
Page: 201-212

A COMPREHENSIVE REVIEW: ETHNOPHARMACOLOGICAL STUDY OF DODONAEA VISCOSE

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Article Received: 14 September 2026 | | ***Article Revised: 05 October 2026*** | | ***Article Accepted: 26 October 2026***

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DOI: https://doi.org/10.5281/zenodo.23804024

How to cite this Article: Sushant S. Dhandore, Sanjay K. Bais, Samruddhi S. Patil (2026) A COMPREHENSIVE REVIEW: ETHNOPHARMACOLOGICAL STUDY OF DODONAEA VISCOSE. World Journal of Pharmaceutical Science and Research, 5(11), 201-212.

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ABSTRACT

This investigation examines the phytochemical profile and pharmacological properties of the genus Dodonaea, a taxonomic group of flowering plants within the family Sapindaceae. Although species in this genus are widely used in traditional medicine and distributed across biodiverse regions such as the Indian subcontinent, their therapeutic efficacy remains relatively underexplored within contemporary biomedicine. Phytochemical profiling of Dodonaea viscosa demonstrates a rich concentration of bioactive secondary metabolites, notably alkaloids, Flavonoids, tannins, saponins, steroids, phytosterols, triterpenoids, and essential oils. Ethnomedicinal accounts document the use of crude plant extracts—derived mainly from leaves, stems, and fruits to manage a range of physiological disorders, including inflammatory conditions, gastrointestinal distress, infectious diseases, and reproductive system dysfunctions. Empirical evaluations further confirm that these botanical extracts exert significant biological effects, showcasing antimicrobial, antioxidant, anti-diabetic, hepatoprotective, and antispasmodic capabilities. Consequently, this review synthesizes current knowledge regarding the genus Dodonaea, detailing its botanical features, ethnobotanical applications, phytochemical composition, pharmacological attributes, and potential agricultural utility.

KEYWORDS: Dodonaea viscosa, Sapindaceae, Ethnomedicinal, hepatoprotective, antimicrobial, antioxidant, antispasmodic.

INTRODUCTION

Dodonaea viscosa Jacq. is an angiospermous shrub or small, arborescent plant characterized by erect, ramified branches. Taxonomically, it belongs to the family Sapindaceae, a major botanical family comprising approximately 150 genera and 2,000 species. Vernacularly designated as Aliar and Vilayti Mehendi within the Indian subcontinent, the species exhibits a ubiquitous distribution across the country. Although current biogeographical evidence suggests an

origin in Australia, D. viscosa demonstrates a pantropical and subtropical distribution, extending into temperate zones across Africa, South America, Oceania, North America, and various island ecosystems. Concurrently, interest in phytotherapy and botanical pharmacological research has experienced substantial expansion in recent decades.[1]

Botanical pharmaceuticals represent a crucial foundational framework for modern drug discovery and therapeutic application. Specifically, phytochemical compounds isolated from plant root structures exhibit potent antimicrobial properties with favorable safety profiles and negligible adverse effects, offering significant potential in the management of infectious pathologies. To optimize therapeutic efficacy and ensure batch-to-batch consistency, robust taxonomic and statistical characterization data are essential. Consequently, the World Health Organization (WHO) mandates rigorous macroscopic and microscopic botanical authentication as an indispensable preliminary protocol to verify raw material identity, structural purity, and quality before downstream pharmacological evaluation.[2]

Historically, botanical species have served as the foundational source of raw materials for therapeutic applications. A comprehensive repository of traditional preventive and curative medicinal knowledge is preserved in classic scholastic treatises, including the Atharvaveda, Charaka Samhita, and Sushruta Samhita.

Globally, an estimated 13,000 plant species have documented applications in medicine. In contemporary pharmacology, there is a marked resurgence in the utilization of natural products, with active plant extracts frequently screened to isolate novel phytotherapeutic compounds and identify new candidates for drug discovery.

Taxonomical classification of Dodonaea viscose

Kingdom	**Plantae**
Division	Spermatophyte
Subdivision	Angiospermae
Class	Dicotyledon
Subclass	Magnoliidae
Order	Sapindales
Genus	Dodonaea
Family	Sapindaceae
Species	Dodonaea viscosa

Description

Dodonaea viscosa is a dioecious or monoecious multi-stemmed shrub or single-stemmed small tree growing up to 7 m in height. Its bark is blackish, variable in roughness, thin, and exfoliates in long, narrow strips. The twigs range from black to reddish-brown, feature glandular surfaces with developing vertical fissures, and have greenish, prominently angled tips on young branches. The leaves are simple, exstipulate, and arranged alternately on very short petioles (up to 2.5 mm long) or are completely sessile. Leaf blades are oblanceolate to broadly or narrowly elliptical, featuring a narrowly cuneate base, an obtuse yet minutely apiculate apex, and entire margins; both leaf surfaces are glabrous, glandular, and coated in a characteristic resinous secretion.[3]



Fig.1: Dodonaea viscose plant.[18]

Traditional and Medicinal Uses of Dodonaea viscose

Dodonaea viscosa is an evergreen shrub or small tree widely distributed across India, with notable abundance throughout the Western Ghats of Tamil Nadu. Ethnobotanical documentation reveals remarkable global convergence in its traditional applications among indigenous populations. Broadly, crude preparations of this species serve as analgesic, antiviral, antispasmodic, antimicrobial, and hypotensive agents. Ethnomedicinally, localized populations utilize foliar formulations to alleviate rheumatic conditions, cutaneous disorders, pyrexia, inflammatory edemas, general somatic pain, and gastrointestinal distress, including diarrhea.[2]

The topical application of pulverized Dodonaea viscosa foliage to thermal injuries, including burns and scalds, exhibits marked antipyretic and febrifuge properties, making it an effective remedy for diverse dermatological pathologies. Ethnomedicinal literature documents its conventional application as an antispasmodic, while specialized root extracts demonstrate significant anti-inflammatory, antipyretic, and broad-spectrum antimicrobial activities. Phytochemical investigations of this species have yielded diverse bioactive secondary metabolites, notably flavonoids, terpenes, coumarins, and steroids. Therapeutically, D. viscosa is indicated for the management of rheumatism, cutaneous infections, gastroenteritis, diarrhea, hepatosplenic discomfort, uterine colic, and various smooth muscle disorders.[3]

Dermatological & Traumatological Interventions: Topical formulations—including triturated leaf poultices, lotions, and crude extracts—are traditionally applied to accelerate wound healing and manage thermal burns, soft tissue sprains, contusions, dermatological rashes, and superficial dermatomycoses. Analgesic & Anti-inflammatory Activity: Decanted leaf and stem extracts are widely utilized in traditional medicine to mitigate inflammatory arthropathies, including rheumatism and gout, as well as peripheral edema and generalized somatic pain.

Pulmonary & Febrile Conditions: Aqueous infusions derived from bark, foliar, or root tissues are administered orally for the symptomatic relief of upper respiratory tract infections, influenza, pharyngitis, and pyrexia. Gastrointestinal Therapeutics: Orally ingested decoctions serve to alleviate functional dyspepsia, peptic ulceration, chronic constipation, and acute diarrheal syndromes.[4]

Categorization

Functional Category	Plant Part Used	Therapeutic Preparation	Target Clinical Indications
Dermatological	Leaves	Poultices, lotions, topical washes	Wounds, thermal burn, burises, sprains, dermatomycoses
Analgesic/ Anti-inflammatory	Stems , Leaves	Aqueous extracts, decocctions	Rheumatism, gouty arthritis, edema, musculoskeletal pain

Rerspiratory and Febrile	Bark, Leaves, Roots	Infusions	Common cold, influenza, pharyngitis, pyrexia
Gastrointestinal	Whole plant/ Leaves	Oral decoction	Dyspepsia, peptic ulcer disease, constipation, diarrhea

Pharmacological activities of Dodonaea viscose

Anti-inflammatory activity

The labdane diterpene hautriwaic acid (HA), isolated from Dodonaea viscosa foliage, demonstrates significant anti-inflammatory activity in the murine ear edema model. Specifically, evaluation of the D. viscosa dichloromethane extract (DvDE) at a dose of 3 mg/ear yielded a 97.8% inhibition of 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced ear edema in mice. Furthermore, in silico molecular docking simulations demonstrate that nebrodenside A, a bioactive glycoside isolated from D. viscosa, possesses favorable binding affinity toward key pro-inflammatory protein targets, highlighting its potential as an anti-inflammatory lead compound.[1] Crude extracts of Dodonaea viscosa exhibit significant anti-inflammatory activity, producing a 30% to 60% inhibition of acute edema in animal models. Specifically, a 50% ethanolic leaf extract administered orally at a dose of 1000 mg/kg achieved a maximum inhibition of 56.67% in carrageenan-induced rat hind paw edema. This efficacy is comparable to the standard anti-inflammatory drug phenylbutazone, which demonstrated 66% edema inhibition when administered intraperitoneally at a dose of 100 mg/kg. Furthermore, aqueous extracts evaluated at a lower dose of 100 mg/kg also showed statistically significant anti-inflammatory activity in the carrageenan-induced rat paw edema assay.[5]

Antimicrobial activity

The antimicrobial activities of aqueous, methanolic, ethanolic, and ethyl acetate leaf extracts from Dodonaea viscosa var. angustifolia were evaluated against Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans, and Mycobacterium smegmatis. Enhanced inhibitory efficacy was observed across all crude extracts in the liquid dilution bioassay. Specifically, the methanolic and ethanolic extracts of D. viscosa demonstrated potent antibacterial activity against S. aureus and M. smegmatis, displaying minimum inhibitory concentration (MIC) values of 2.5 mg/mL and 1.25 mg/mL, respectively.[5] The antimicrobial evaluation of aqueous, methanolic, ethanolic, and ethyl acetate leaf extracts from Dodonaea viscosa and Dodonaea angustifolia demonstrated broad-spectrum inhibitory activity against Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans, and Mycobacterium smegmatis. In liquid dilution bioassays, methanolic and ethanolic extracts of D. viscosa exhibited potent inhibition against S. aureus and M. smegmatis, displaying minimum inhibitory concentration (MIC) values of 2.5 mg/mL and 1.25 mg/mL, respectively. Additionally, essential oil preparations displayed selective antibacterial efficacy against S. aureus, while demonstrating no inhibitory effects against Micrococcus flavus or Sarcina lutea.[6]

Antiulcer activity

The antimicrobial activities of aqueous, methanolic, ethanolic, and ethyl acetate leaf extracts from Dodonaea viscosa var. angustifolia were evaluated against Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans, and Mycobacterium smegmatis. Enhanced inhibitory efficacy was observed across all crude extracts in the liquid dilution bioassay. Specifically, the methanolic and ethanolic extracts of D. viscosa demonstrated potent antibacterial activity against S. aureus and M. smegmatis, displaying minimum inhibitory concentration (MIC) values of 2.5 mg/mL and 1.25 mg/mL, respectively.

Preliminary phytopharmacological screenings of Dodonaea viscosa leaves confirmed the presence of diverse secondary metabolites, including flavonoids, tannins, phytosterols, bitter principles, polyphenols, and saponins, which collectively contribute to its marked antiulcerogenic potential. Subsequent bioactivity-guided fractionation of leaf extracts across various experimental gastric ulcer models revealed that the ethyl acetate fraction exhibited the highest gastroprotective efficacy—significantly reducing the ulcerative lesion index, elevating serum calcium levels, and decreasing alkaline phosphatase (ALP) activity across all tested models.[1,5]

Anti-fertility activity

The growing imperative for population management, particularly in densely populated nations such as China and India, has accelerated research into botanical contraceptives and antifertility agents. In in vivo murine models, the methanolic extract of Dodonaea viscosa demonstrated superior antifertility activity compared to aqueous extracts. Dose-response evaluations indicate a biphasic physiological effect: lower, acceptable therapeutic doses enhance fertility outcomes, whereas high-dose administration induces abortifacient effects leading to pregnancy termination. Multiple animal models corroborate the antifertility potential across various crude extract fractions of D. viscose.[1]

Wound healing

The ethanolic extract of dried Dodonaea viscosa leaves exhibits pronounced wound-healing efficacy across both excision and incision wound models in rats. In excision wound assays, topical application of a 10% extract significantly accelerated the rates of wound contraction and re-epithelialization. Furthermore, both suspension and ointment formulations of the ethanolic extract induced statistically significant improvements in key tissue repair markers, including increased skin tensile (breaking) strength, enhanced formation of granulation tissue, and accelerated wound closure. Crucially, the extract effectively reversed the immunosuppressive, anti-healing effects induced by dexamethasone administration.

Analgesic and Antipyretic activity

Preliminary phytochemical screening of the ethanolic seed extract of Dodonaea viscosa revealed the presence of alkaloids, saponins, and carbohydrates. At a dose of 30 mg/kg, the extract demonstrated significant central nervous system (CNS) depressant activity comparable to standard reference drugs, including morphine sulfate, diazepam, and phenytoin. At the same dosage level, notable analgesic and anticonvulsant activities were recorded. In in vivo murine models, analgesic efficacy was validated using both the acetic acid-induced writhing test and the hot-plate thermal method. Additionally, aqueous extracts of Dodonaea angustifolia (50–200 mg/kg) exhibited a dose-dependent, statistically significant inhibition of 2% acetic acid-induced writhing. In rat models of pyrexia, the aqueous extract also demonstrated antipyretic activity at a dose of 100.0 mg/kg against lipopolysaccharide (LPS)-induced rectal hyperthermia.[6]

Macro morphological characteristics

The leaves are simple, exstipulate, and arranged alternately on short petioles (\le 2.5\text{ mm}) or are completely sessile. Leaf blades range from oblanceolate to broadly or narrowly elliptical, featuring a narrowly cuneate base, an obtuse yet minutely apiculate apex, and entire margins. Both surfaces are glabrous and densely glandular, covered with a sticky, resinous exudate that is especially prominent on juvenile foliage. Venation is characterized by a conspicuous midrib prominent on both adaxial and abaxial surfaces, accompanied by 15 to 20 pairs of often indistinct lateral veins.[3]



Fig. 2: Dodonaea viscose leaves.

Dodonaea viscosa, commonly known as the hop bush, is an evergreen shrub reaching heights of 1 to 3 meters, though exceptionally developing into a small tree up to 10 meters tall. The common moniker derives from its vibrant, winged capsular fruits, which structurally resemble the hops used in brewing. The leaves are simple, elliptical, measuring 6 to 13 cm in length and 2 to 4 cm in width, and actively secrete a sticky, resinous exudate. Inflorescences consist of short racemes bearing yellow to orange-red flowers. The fruit is a three-winged capsule approximately 2 cm in breadth, transitioning from red to brown upon maturation. Owing to the extreme density and durability of its wood, historical ethnobotanical reports document its use by the indigenous Māori of New Zealand for fabricating weaponry and traditional implements.[7]



Fig. 3: Dodonaea viscose flower.

The seeds of Dodonaea viscosa (hopbush) are minute, measuring approximately 1.5 mm (\sim 1/16\text{ inch}) in diameter, with a smooth, lustrous, pitch-black surface upon full maturation. Morphologically, individual seeds range from sub-globose (roundish) to laterally compressed or flattened. They are borne within papery, inflated, three-winged capsules that structurally resemble the strobiles of Humulus lupulus (common hops) utilized in brewing.[9]



Fig. 4: Dodonaea viscose seeds.[8]

Different species of Dodonaea[10]

Name of species of Dodonaea	Plant species
1. Dodonaea viscose	 *Dodonaea viscos*
2. Dodonaea microzyga	 *Dodonaea microzyga*
3. Dodonaea certatocaepa	 *Dodonaea certatocarpa*
4. Dodonaea viscose sub. Spatulate	 *Dodonaea viscosa* sub. *Spatulate*

5. Dodonaea polyandra[11]	 *Dodonaea polyandra*
6. Dodonaea angustifolia	 *Dodonaea angustifolia*

Extraction Process and Applications

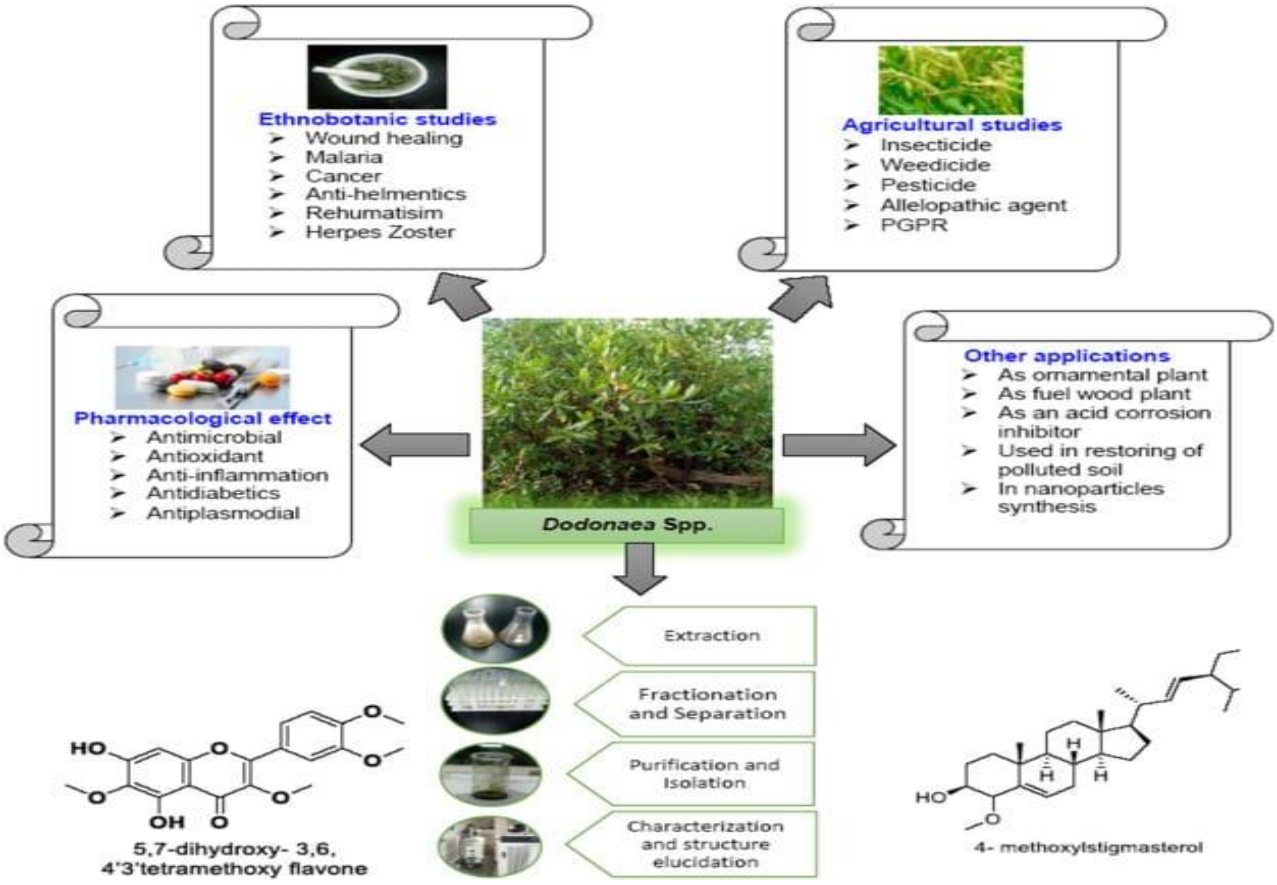


Fig. 5: Dodonaea species - extraction of phytoconstituents and their applications.

The microscopic view of Dodonaea viscose

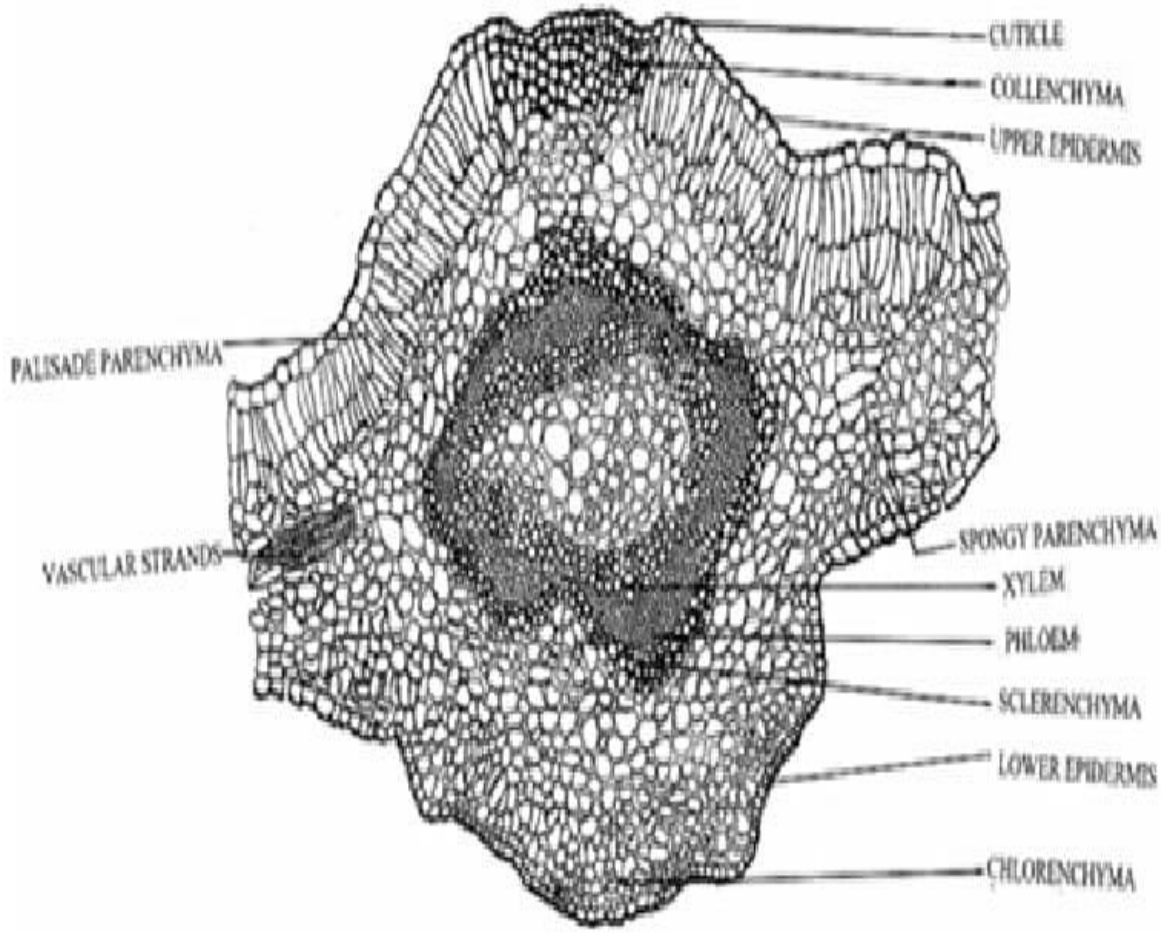


Fig. 6: Transverse section of Dodonaea viscose leaf.[13]

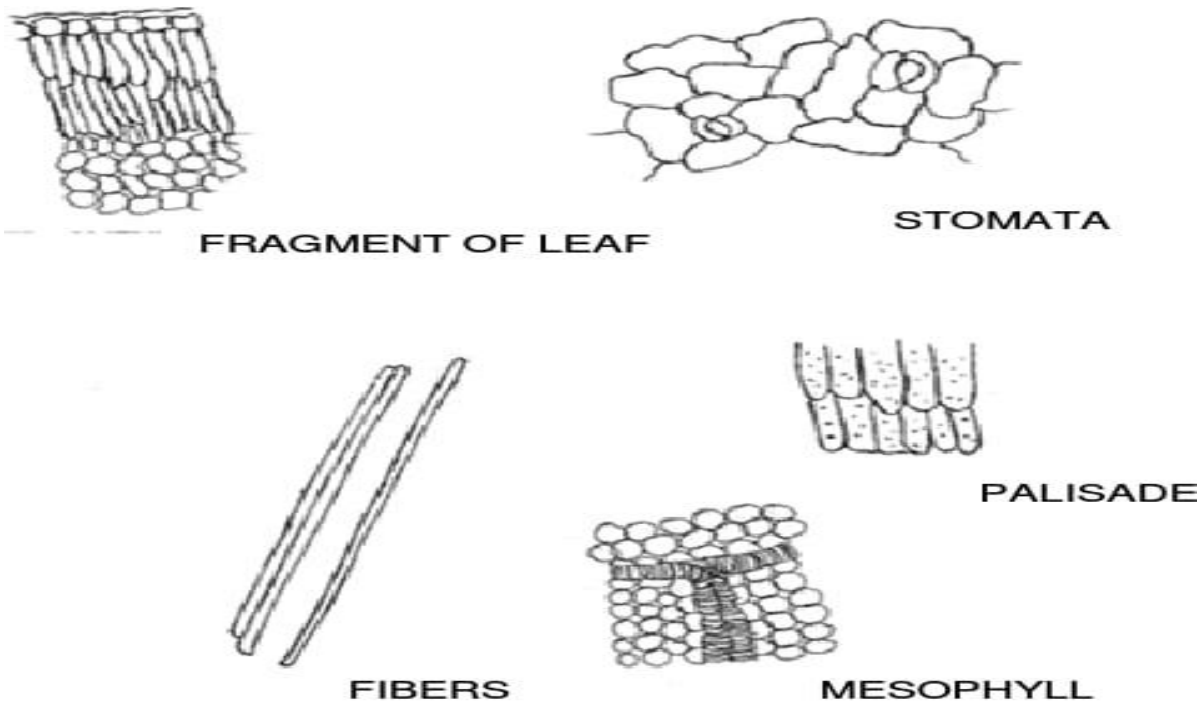
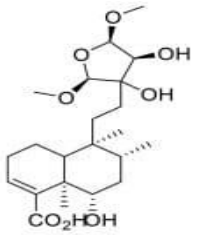
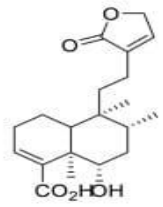


Fig. 7: Powder analysis of Dodonaea viscose leaf.[15]

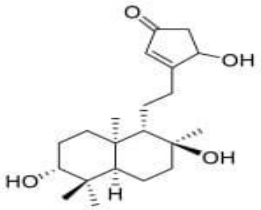
Microcsopy	Characteristics
Colour	Upper surface is dark green, whereas the lower surface is pale green
Size	The leaves approximately 3.8-10 cm in length and 0.6-3.9 cm in width
Odour	odourless
Taste	Sour to bitter
Surface	The upper surface is glossy and slightly viscid, with a yellowish resineous exudate
Venation	Pinnately parallel venation is observed
Margin	The leaf margin is entire
Form	Leaves are simple, lanceolate and acute at both ends tapering towards a distinct petiole. They are stipulate with a symmetrical base. The midrib is prominent and closely arranged lateral veins.



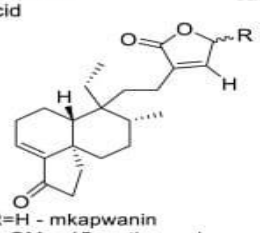
3,4-dihydroxy-2,5-dimethoxytetrahydrofuran-3-yl)ethyl)-8-hydroxy-5,6,8a-trimethyl-3,4,4a,5,6,7,8,8a-octahydronaphthalene-1-carboxylic acid



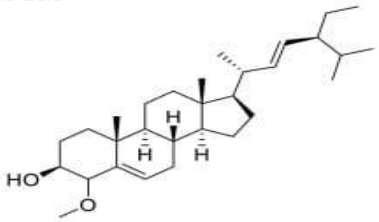
8-hydroxy-5,6,8a-trimethyl-5-(2-(2-oxo-2,5-dihydrofuran-3-yl)ethyl)-3,4,4a,5,6,7,8,8a-octahydronaphthalene-1-carboxylic acid



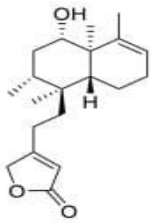
3-(2-((1*S*,2*S*,4a*R*,6*R*,8a*R*)-2,6-dihydroxy-2,5,5,8a-tetramethyl decahydronaphthalen-1-yl)ethyl)-4-hydroxycyclopent-2-en-1-one



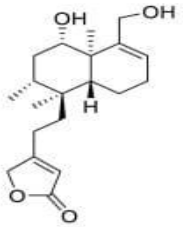
R=H - mkapwanin
R=OMe- 15-methoxymkapwanin



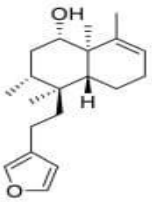
4- methoxylstigmasterol



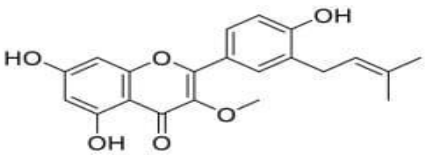
4-(2-((1*S*,2*R*,4*S*,4a*R*,8a*R*)-4-hydroxy-1,2,4a,5-tetramethyl-1,2,3,4,4a,7,8,8a-octahydronaphthalen-1-yl)ethyl)furan-2(5*H*)-one



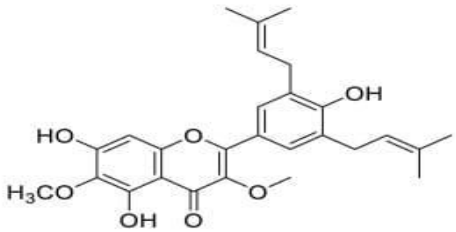
4-(2-((1*S*,2*R*,4*S*,4a*R*,8a*R*)-4-hydroxy-5-(hydroxymethyl)-1,2,4a-trimethyl-1,2,3,4,4a,7,8,8a-octahydronaphthalen-1-yl)ethyl)furan-2(5*H*)-one



(1*S*,3*R*,4*S*,4a*R*,8a*R*)-4-(2-(furan-3-yl)ethyl)-3,4,8,8a-tetramethyl-1,2,3,4,4a,5,6,8a-octahydronaphthalen-1-ol



5,7,4'-trihydroxy-3'(3-methyl but-2-enyl)-3-methoxy flavone,



5,7-dihydroxy-2-(4-hydroxy-3,5-bis(3-methyl but-2-en-1-yl)phenyl)-3,6-dimethoxy-4*H*-chromen-4-one

CONCLUSION

The preceding review highlights the phytochemical constituents, diverse pharmacological activities, and therapeutic potential of Dodonaea viscosa as a promising natural drug candidate, underscored by its established safety profile and clinical efficacy. Widely utilized in traditional herbal medicine across various geographical regions, including India,

this species represents a valuable botanical resource. The present study establishes comprehensive macroscopic, microscopic, and pharmacognostic profiles for D. viscosa, providing critical standardization parameters to serve as a reliable reference for the identification, quality control, and selection of authentic raw materials in crude drug manufacturing. The comprehensive macroscopic and microscopic evaluations, along with the physicochemical characterization and phytochemical screening of Dodonaea viscosa leaves, establish crucial quality control parameters for the standardization and authentication of its crude drug preparations. Furthermore, the documented phytochemical constituents and pharmacological activities strongly validate the traditional ethnomedicinal applications of this species, offering a rigorous scientific foundation to guide future clinical evaluations and botanical drug development.

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