

Full Length Research Paper

Characterization of *Dodonaea viscosa* Leaves through Pharmacognostical and Physicochemical Parameters

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Dodonaea viscosa Jacq is a popular medicinal plant. Its leaves are used as anti-inflammatory, anti-ulcer, anti-bacterial and antifungal agents and in the treatment of fractures. In view of its medicinal importance and taxonomic confusion, pharmacognostic studies, microscopical structure, morphological characters, chemical analysis and numerical values in epidermal study were carried out. These studies provided referential information for identification of this crude drug.

Key words: *Dodonaea viscosa*, macroscopy, anatomy, ash values, extractive values, leaf constants, microscopy, phytochemical.

INTRODUCTION

Standardization of natural products is a complex task due to their heterogeneous composition, which is in the form of whole plant, plant parts or extracts obtained thereof. To ensure reproducible quality of herbal products, proper control of starting material is utmost essential. The first step towards ensuring quality of starting material is authentication. Thus, in recent years there has been a rapid increase in the standardization of selected medicinal plants of potential therapeutic significance (Reddy et al., 1999; Venkatesh et al., 2004). Despite the modern techniques, identification of plant drugs by pharmacognostic studies is more reliable. According to the World Health Organization (WHO, 1998), the macroscopic and microscopic description of a medicinal plant is the first step towards establishing the identity and the degree of purity of such materials and should be carried out before any tests are undertaken.

Dodonaea viscosa Jacq., a member of the family Sapindaceae which is popularly known as *aliar* and *Vilayati mehandi* in India. It is an evergreen shrub or small tree abundantly available in Western Ghats of Tamilnadu and distributed throughout India. The reported medicinal uses of *D. viscosa* species by indigenous peo-

ple in different parts of the world show considerable similarities. In broad sense, preparations were employed largely as analgesic, anti-inflammatory, antiviral, spasmolytic, laxative, antimicrobial and hypotensive agents (Ghisalberti, 1998). In India, the infusion of leaves were used to treat rheumatism, gout, hemorrhoids, fractures and snake bites (Kirtikar and Basu, 1995; Nadkarni and Nadkarni, 1982). The leaves were reported to possess local anesthetic, smooth muscle relaxant (Rojas et al, 1996), antibacterial (Ogunlana and Ramstad, 1975; Rojas et al., 1992) antifungal (Al-Yahya et al., 1983; Naovi et al., 1991) anti-inflammatory (Mahadevan et al., 1998; Getie et al., 2003) and anti-ulcerogenic activity (Veerapur et al., 2004). Sukkawala and Desai (1962) have reported that 95% ethanol extract of *D. viscosa* leaves has shown anti-ascariasis, anthelmintic, cardiac depressant, hypotensive, uterine relaxation and vasoconstrictor activity in different experimental models. Aliarin, dodonic acid, viscosol (Sachdev and Kulshreshtha, 1986) stigmsterol, isorhamnetin (Rao, 1962; Ramachandra et al., 1975) penduletin, quercetin, doviscogenin (Khan et al., 1988) dodonosides A and B (Wagner et al., 1987) have been isolated *D. viscosa*. In spite of its abundant uses, the pharmacopoeial standards of *D. viscosa* leaves have not been reported.

A perusal of existing reports reveals that the morphological and taxonomic confusion was reported among *D. Viscosa* Jacq, *Dodonaea thunbergiana* var. *Linearis* E. et.

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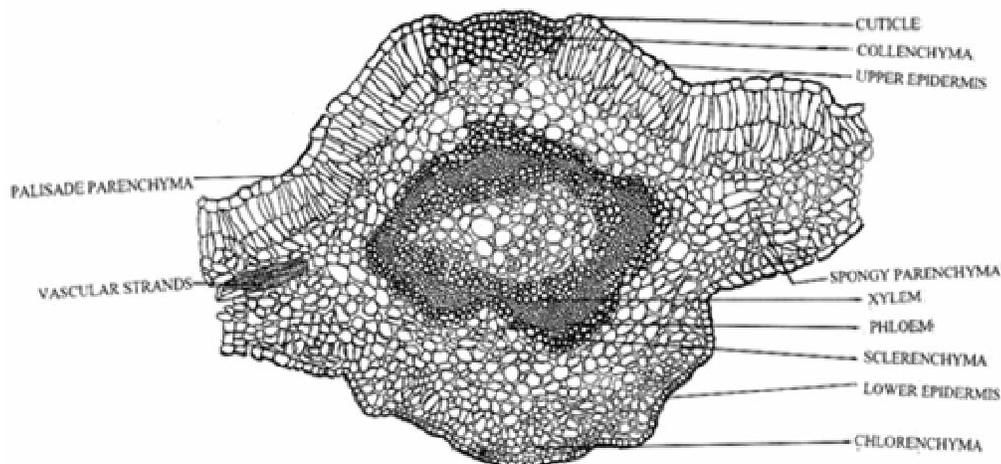


Figure 1. Transverse section of *Dodonaea viscosa* leaf (X 50)

S and *Dodonaea attenuata* Cunn var. *linearis* Benth (Ghisalberti, 1998). Hence, it is felt desirable to pursue a study on pharmacognostical and preliminary phytochemical studies of *Dodonaea viscosa* leaves to supplement useful data in regard to its correct identity of this plant and, as this plant is broadly used in indigenous system of medicine.

Experimental

Plant material

Fresh aerial parts of *Dodonaea viscosa* were collected in Nilgiri hills, Tamilnadu, India and authenticated by Dr. Vijayan, Taxonomist, Botanical Survey of India (Southern Circle), Coimbatore, India. A voucher specimen (SV/106/1995) is maintained in J.S.S. College of Pharmacy, Ooty, India. The fresh leaves were separated and used for the study of macroscopic and microscopical characters, whereas dried leaf powder material was used for the determination of ash values, extractive values, and phytochemical constituents. All the reagents used were of analytical grade obtained from Sigma Chemical Co, St. Louis, USA or Fine Chemicals Ltd., Mumbai, India.

RESULTS AND DISCUSSION

Macroscopical characters

Color - Upper surface dark green and lower surface pale green.

Size - 3.8 to 10 cm (l) and 0.6 to 3.9 cm (w)

Form - Simple, lanceolate, acute at both ends and narrowed to distinct petiole, stipulate, symmetrical base, midrib prominent with closely arranged lateral nerves; Venation – pinnately parallel; margin – entire Odor – Odorless. Taste – Sour to bitter.

Upper surface is shining, more or less viscid with a

yellowish resinous exudation

Anatomy

Transverse section of leaf (Figure 1)

The thin transverse sections of leaf were treated with appropriate reagents and mounted on a glass slide. Transverse section of a leaflet shows a dorsiventral structure. Following are the important tissues in the lamina and the midrib region.

Lamina

Upper epidermis is single layered with more or less rectangular cells covered with a thick cuticle. Stomata are seen at regular intervals.

Mesophyll is differentiated into upper palisade and lower spongy parenchyma. Palisade parenchyma is two layered in thickness and made up of compactly arranged columnar cells and extended up to the midrib region. Spongy parenchyma many layered, oval, loosely arranged. Palisade and spongy parenchyma are provided with chloroplasts. Lower epidermis is very similar to upper epidermis.

Midrib

A large conspicuous, concentric vascular bundle is present at the midrib region. Xylem and phloem are arranged in ring. Xylem ring present towards the center and is surrounded by phloem ring. Around the vascular tissues sclerenchymatous tissue occurs as bundle sheath. A strip of collenchyma appears below the upper epidermis and a patch of chlorenchyma appears above the lower epider

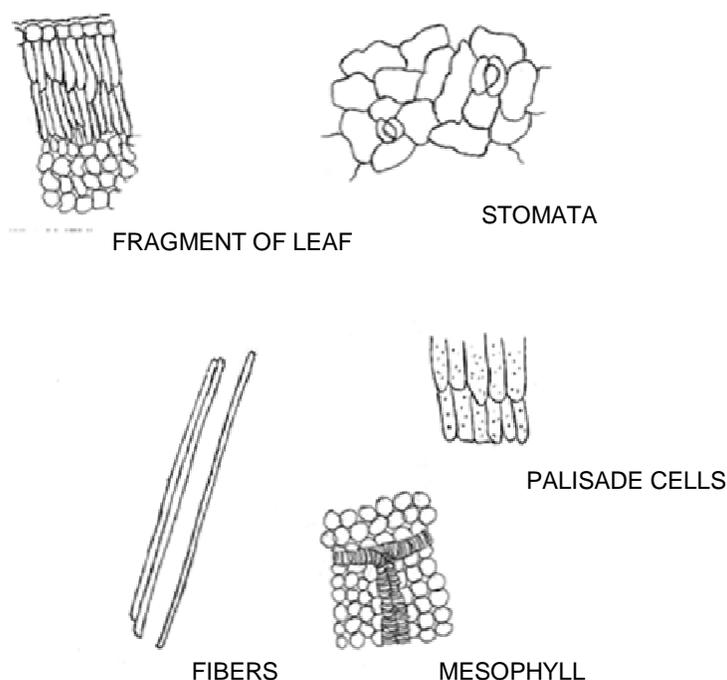


Figure 2. Power analysis of *Dodonaea viscosa* Leaf (X 50).

Table 1. Quantitative microscopy of *D. viscosa* leaf

Leaf constants	Values
Palisade ratio	5-7
Stomatal index	8.8-9.6
Vein-islet number	6-8
Vein termination number	10-14

mis. Surface preparation of leaf shows Ranunculaceous (anomocytic) stomata.

Powder analysis (Figure 2)

- i). Fibers are few, lignified well developed sclerenchymatous fibers from the vascular bundle region, thin, and isolated fibers measure 200 - 600 microns in length and 10 - 20 microns in breadth.
- ii). Numerous anomocytic or ranunculaceous stomata meaning thereby that the cells surrounding the stomatal pores are irregularly arranged and cannot be differentiated from other epidermal cells.
- iii). Fragments of mesophyll tissue containing vascular strands are seen good many in number.
- iv). Fragments of leaf showing dorsiventral structure.

Quantitative microscopy

The vital quantitative microscopic leaf constants like vein-

islet, vein termination number, palisade ratio and stomatal index were carried out according to the standard method (Wallis, 1985) and the results were shown in Table 1.

Histochemical color reactions

Histochemical color reactions were carried out on the leaf transverse sections by the reported methods (Kokate, 1994; Trease and Evans, 1983) and results were given in Table 2.

Behavior of powder with chemical reagents

Behavior of leaf powder with different chemical reagents was studied to detect the presence of phytoconstituents with color changes under daylight by reported method (Pratt and Chase, 1949) and the results were shown in Table 3.

Ash values

Total ash, acid-insoluble ash, water-soluble ash, and sulphated ash values of the leaf powder were done as per the Indian Pharmacopoeia (Anonymous, 1985) and the results are tabulated in Table 4.

Extractive values

Extracts were prepared with various solvents by reported

Table 2. Histochemical color reactions of *D. viscosa* leaf

Reagent	Constituent	Color	Histological zone	Degree of intensity
Aniline So ₄ + H ₂ SO ₄	Lignin	Yellow	Xylem	++
Phloroglucinol + HCl	Lignin	Pink	Xylem, Sclerenchyma	+++
Conc. H ₂ SO ₄	Cellulose	Green	Mesophyll	+
Weak Iodine solution	Starch	--	--	--
Millons reagent	Proteins	--	--	--
Dragendorffs reagent	Alkaloids	--	--	--
Caustic alkali + HCl	Ca. Oxalate	--	--	--
Keddy reagent	Glycosides	--	--	--
SbCl ₃	Steroids/Triterpenoids	Reddish pink	Mesophyll	+++
5% Aq. KOH	Anthraquinone glycosides	--	--	--

+++ High, ++ Moderate, + Slight, – Negative

Table 3. Behavior of the *D. viscosa* leaf powder with different chemical reagents

Reagent	Color/precipitate	Constituent
Picric acid	No precipitation	Alkaloids absent
Conc. H ₂ SO ₄	Reddish brown	Steroids/Triterpenes present
Aq. FeCl ₃	Greenish black	Tannins, Flavonoids present
Iodine solution	No change	Starch absent
Ammonia solution	No change	Anthraquinone glycosides absent
5% Aq. KOH	No change	Anthraquinone glycosides absent
Mayer's reagent	No precipitation	Alkaloids absent
Spot test	Stain observed	Fixed oils present
Aq. AgNO ₃	No precipitation	Proteins absent
Aq. NaOH	Yellow	Flavonoids present, Coumarins absent
Mg-HCl	Magenta	Flavonoids present
Dragendorffs reagent	No precipitation	Alkaloids absent
Aq. Lead acetate	White precipitate	Tannins present
Lieberman Burchard test	Reddish green	Steroids/triterpenoids present

Table 4. Ash values *D. viscosa* leaf

Type of the ash value	% w/w
Total ash	2.09
Acid insoluble ash	0.25
Water soluble ash	1.45
Sulphated ash	5.47

Table 5. Extractive values of *D. viscosa* leaf.

Type of solvent	% w /w
Petroleum ether 60-80 ^o	1.38
Chloroform	1.28
Ethyl acetate	2.67
Butanol	0.89
Ethyl alcohol	9.6

method (Kokashi et al., 1958). Percentages of the extractive values were calculated with reference to air-dried drug (Table 5). Color and consistency of extracts (Pratt and Chase, 1949) are given in Table 6.

Fluorescence analysis of extracts

All the leaf extracts are examined in daylight, short and

long UV to detect the fluorescent compounds by the reported method (Kokashi et al., 1958). The observations are given in Table 6.

Qualitative phytochemical screening

Freshly prepared leaf organic extracts were tested for the

Table 6. A consistency, color, and fluorescence character of extracts *D. viscosa* leaf

Parameter	Extracts				
	Pet. ether	Chloroform	Ethyl acetate	Butanol	Ethyl alcohol
Consistency	Viscous	Resinous	Sticky	Sticky	Viscous
Color (day light)	Green	Green	Brownish green	Reddish brown	Brownish green
Short UV	Yellow	Green	Yellowish green	Green	Bluish green
Long UV	Green	Blue	Bluish green	Blue	Yellowish green

Table 7. Qualitative phytochemical analysis of *D. viscosa* leaf extracts

Constituent	Pet. ether	Chloroform	Ethyl acetate	Butanol	Ethyl alcohol
Alkaloids	-	-	-	-	-
Carbohydrates	-	+	+	+	+
Coumarins	-	-	-	-	-
Flavonoids	-	+	+	+	+
Fixed oils	+	-	-	-	+
Glycosides	-	-	-	-	-
Gums and resins	-	-	-	-	-
Mucilages	-	-	-	-	-
Proteins and amino acids	-	-	-	+	+
Saponins	-	-	+	+	+
Steroids and sterols	+	+	+	+	+
Tannins	-	-	+	+	+
Triterpenoids	-	-	-	+	+

+ Present, - Absent

presence of phytochemical constituents using reported methods (Farnsworth, 1966) and the results are given in Table 7.

Conclusion

In conclusion, the present study on pharmacognostical characters of *Dodonaea viscosa* (L). Jacq leaves will be providing useful information in regard to its correct identity and help to differentiate from the closely related other species of *Dodonaea*. Around the vascular tissues sclerenchymatous tissue occurs, as bundle sheath is a characteristic feature of *Dodonaea viscosa*. The pre-sence of isolated lignified sclerenchymatous fibers along with numerous anomocytic stomata is important obser-vation in powder form of leaf. The other parameters observed may be useful for the future identification of the plant.

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REFERENCES

- Anonymous (1985). Indian Pharmacopoeia, Vol. II, 3rd ed., Government of India, Ministry of Health, Controller of Publications, New Delhi, India, p. 74.
- Al-Yahya MA, Al-Meshal IA, Mossa, JS, Khatibi A, Hammonda Y (1983). Phytochemical and biological screening of Saudi medicinal plants- Part II. *Fitoterapia*. 54:21-24.
- Farnsworth NR (1966). Biological and phytochemical screening of plants. *J. Pharm. Sci.* 55: 225-276
- Getie M, Gebre-Marian T, Reitz R, Hohne C, Huschka C, Schmidtke M, Abate A, Neubert RHH (2003). Evaluation of the anti-microbial and anti-inflammatory activities of the medicinal plants *Dodonaea viscosa*, *Rumex nervosus* and *Rumex abyssinicus*. *Fitoterapia*, 74: 139-143
- Ghisalberti EL (1998). Ethnopharmacology and Phytochemistry of *Dodonaea* species. *Fitoterapia*. 69: 99-113
- Khan MSY, Shamshad Ahmed, Jain PC (1988). Chemical investigation of root bark of *Dodonaea viscosa* Linn. *J. Nat. Products*. 4: 12-13
- Kirtikar KR, Basu BD (1995). Indian Medicinal Plants, Vol. I, International Book Distributors, Dehradun, India. pp. 641-643.
- Kokashi C J, Kokashi RJ, Sharma M (1958). Fluorescence of powdered vegetable drugs in ultra-violet radiation. *J. Am. Pharm. Assoc.* 47: 715-717
- Kokate CK (1994). Practical Pharmacognosy, 4th ed., Vallabh Prakashan, New Delhi, India, pp. 112-120.

- Mahadevan N, Venkatesh S, Suresh B (1998). Anti-inflammatory activity of *Dodonaea viscosa*. *Ancient. Sci. Life.* 18:152-156.
- Nadkarni KM, Nadkarni AK, (1982). *Indian Materia Medica*, Vol. I, Bombay Popular Prakashan, Bombay, India , pp. 457.
- Naovi, SAH, Khan MSY, Vohora SB (1991). Antibacterial, antifungal and anthelmintic investigations on Indian medicinal plants. *Fitoterapia.* 62: 221-228.
- Ogunlana EO, Ramstad E (1975). Investigations into the antibacterial activities of local plants. *Planta Medica.* 27: 354-359
- Pratt RT, Chase ER (1949). Fluorescence powder vegetable drugs in particular to development system of identification. *J. Am. Pharm. Assoc.* 38: 324-331.
- Ramachandran N, Subramanian AG, Sankara S (1975). Isorhamnetin and quercetin glycosides from *Dodonaea viscosa* and *Sapindus emarginatus*. *Indian J. Chem.* 13: 639-640
- Rojas A, Hernandez L, Pereda MR, Mata R, (1992). Screening for antimicrobial activity of crude drug extracts and pure natural products from Mexican medicinal plants. *J. Ethnopharmacol.* 35: 275-283.
- Rojas A, Cruz S, Ponce-Montr H Mata R (1996). Smooth muscle relaxing compounds from *Dodonaea viscosa*. *Planta Medica.* 62: 154-159
- Reddy YSR, Venkatesh S, Ravichandran T, Subbaraju T, Suresh B (1999). Pharmacognostical studies of *Wrightia tinctoria* bark. *Pharma. Biol.* 37: 291-295
- Sachdev K, Kulshreshtha DK, Viscosol A (1986). C-3' Prenylated flavonoid from *Dodonaea viscosa*. *Phytochemistry.* 25: 1967-1969.
- Sukkwala VM, Desai VB (1962). Physiological activity of the leaves of *Dodonaea viscosa*. *J. Sci. Ind. Res.* 21: 349-351
- Trease GE, Evans WC (1986). *Pharmacognosy*, 12th ed., Bailliere Tindal, East Bourne, pp. 136 - 204.
- Venkatesh S, Madhava RB, Suresh B, Swamy MM, Ramesh M (2004). Pharmacognostical identification of *Rumex nepallensis* Spreng (Polygonaceae)- an adulterant for Indian Rhubarb. *Nat. Prod. Sci.* 10: 43-47.
- Venkateshwara RK (1962) Chemical Examination of the leaves of *Dodonaea Viscosa*. *J. Indian Chem. Soc.* 39: 561-562.
- Veerapur VP, Badiger AM, Joshi SD, Nayak VP, Shastry CS (2004). Antitumor activity of various extracts of *Dodonaea viscosa* (L) Jacq. Leaves, *Indian J. Pharm. Sci.* 66: 407-411
- Wallis TE (1985) *Textbook of Pharmacognosy*. 5th ed, CBS Publications, Delhi, India, pp. 111-117.
- Wagner H, Ludwig C, Grotjahn L , Khan MSY (1987). Biologically active saponins from *Dodonaea viscosa*. *Phytochemistry.* 26: 697-701.
- World Health Organization (1998). *Quality control methods for medicinal plant materials*, WHO Library, Geneva. pp.1-115.