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Leaf architectural studies: A valuable identification tool for quality assurance

Kiran Negi and Ghazala Javed

Abstract

Quality control and standardization of the drug is a dire need today. The raw materials brought into the market in various forms are frequently adulterated with cheap or less potent plant materials. Some greedy manufacturers in order to achieve maximum profit utilize these plants and their products to prepare spurious and unbalanced therapeutic formulations which prove to be ineffective to cure any ailment. Hence proper identification and authentication of a plant material is a must.

Syzygium cumini (Linn.) Skeel (Family: Myrtaceae) commonly called Jamun, Jaman, Kalajam or Black Plum is known for its many therapeutic uses. Almost all the parts of the plant are used in Unani System of Medicine. Literature survey indicates that the extract of Jamun leaf possess moderate antibiotic activities. The juice of tender leaf is given in diarrhea and dysentery and its ash is used for strengthening the teeth and gums.

Present paper deals with leaf architectural studies with special reference to Jamun leaf. The main aspects of the study are detailed macro and microscopical studies besides quantitative studies such as stomatal number, stomatal index, palisade ratio, vein-islet-number, surface studies of abaxial and adaxial surface etc. All these characters will be helpful in authentic identification and quality assurance.

Keywords: Leaf architectural studies, identification tool, quality assurance

Introduction

The use of traditional medicine has been very popular all over the world since the time immemorial. But for the last few years developed nation too have been tremendously growing interest in the use of traditional medicines. In India, traditional system of medicine especially Unani System of Medicine has been practiced to great advantage in the treatment of diseases for centuries. Today everyone wants a safe and effective treatment for various non communicable ailments including diabetes, jaundice, arthritis, malaria, filaria and obesity etc. These expectations of the people lead to concern over the quality of these medicines. The World Health Organization has laid down a set of guidelines for the entire herbal standardization process. As leaves are morphologically and anatomically most variable plant organs; architectural studies serves as an important tool in their identification and detection from possible adulterants.

The term leaf architecture is used to denote the placement and form of those elements constituting the outward expression of the leaf structure, including venation pattern, marginal configuration, leaf shape and gland position ^[1]. Now a days the leaf architecture is gaining significance in phylogeny and classification of angiosperms especially it is used for the diagnosis of fossil and living materials ^[2]. Leaf architecture studies are very useful to trace the evolutionary features of angiosperm leaves ^[3] and hence have gained the great taxonomic significance ^[4-6].

Present paper deals with architectural studies in Jamun leaf which is botanically identified as *Syzygium cumini* (Linn.) Skeel (Family: Myrtaceae). It is known as Black plum in English; Jamun; Jaman or Kalajaman in Hindi; Jambavam, Mahaskandha, Rajphala in Sanskrit and Jaman in Urdu ^[7, 8]. It is a large evergreen tree, found throughout India upto an altitude of 1,800 m ^[9]. In Unani System of Medicine almost all the parts of Jamun are used to cure various ailments. Literature survey indicates that the extract of Jamun leaf possess moderate antibiotic activity. The juice of tender leaf is given in diarrhoea and dysentery and its ash is used for strengthening the teeth and gums ^[10, 11]. Detailed macro and microscopical characters of the leaf have been reported besides quantitative studies such as stomatal number, stomatal index, palisade ratio, vein-islet number, surface studies of abaxial and adaxial surface etc.

All these characters will be helpful in authentic identification and quality assurance.

Materials and Methods

Fresh Jamun leaves were collected from Janakpuri, New Delhi. Macroscopical characters were observed [1]. The cell content and the cell wall structures were studied accordingly [12, 13]. For quantitative studies standard methods were followed. (14) The representative micro-photographs were taken from computer with microscopic attachment. Measurement of the individual cell/tissues of the various parts of the leaf were recorded. The powder and its behaviour on treatment with different chemical reagents were studied.

Results and Discussion

Botanical Name: *Syzygium cumini* (Linn.) Skeel

Scientific Classification

Kingdom	:	Plantae
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Order	:	Myrtales
Family	:	Myrtaceae
Genus	:	<i>Syzygium</i>
Species	:	<i>S. cumini</i>

Synonyms

- *Eugenia cumini* (L.) Druce
- *Eugenia jambolana* Lam
- *Syzygium jambolanum* DC

Macroscopical studies

Leaf simple, 7.5-15 cm. x 3.8-6.3 cm.; variable in shape; lanceolate, elliptic oblong or broadly ovate-elliptic; acute or acuminate; coriaceous; smooth and shiny; numerous nerves uniting within the margin to form intramarginal vein. (Fig. A)



Fig A: Jamun Leaf showing adaxial and abaxial surface

Microscopical Studies

T. S. of the petiole shows single layered epidermis covered by thick cuticle. Epidermal cells thick walled, square shaped; hypodermis collenchymatous, 5-6 layered; cortical region several layered, cells parenchymatous, spherical to oval, thick walled with intercellular spaces. Some cells contain rosette shaped crystals of calcium oxalate. Ovoid schizogenous oil cavities present in the hypodermal and cortical region. Crescent shaped bicollateral vascular bundle encircled by groups of sclerenchyma fibres present at the center. Intraxylary phloem present. All the cells give positive test for tannin. (Fig.1-6).



Fig 1: x4 T. S. through petiole



Fig 2: x10 T.S. through petiole showing oil cavity

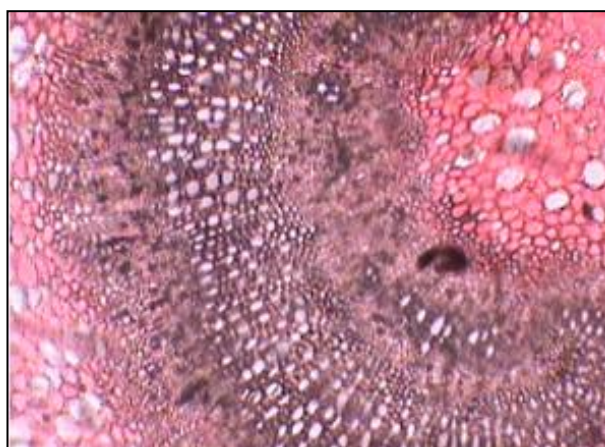


Fig 3: x10 T. S. through petiole showing vascular bundle



Fig 4: x40 Oil cavity in petiole

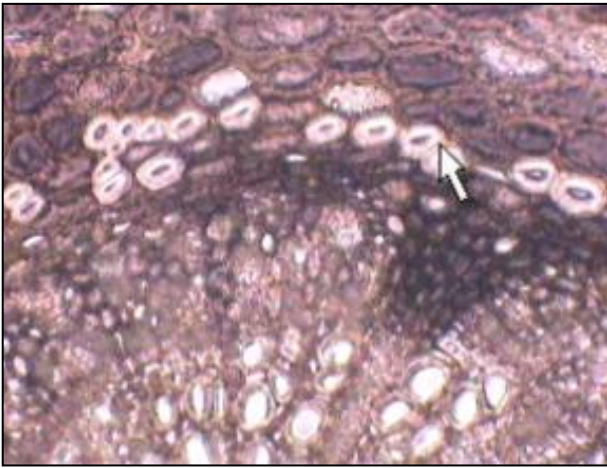


Fig 5: x40 T.S. through petiole showing pericyclic fibres

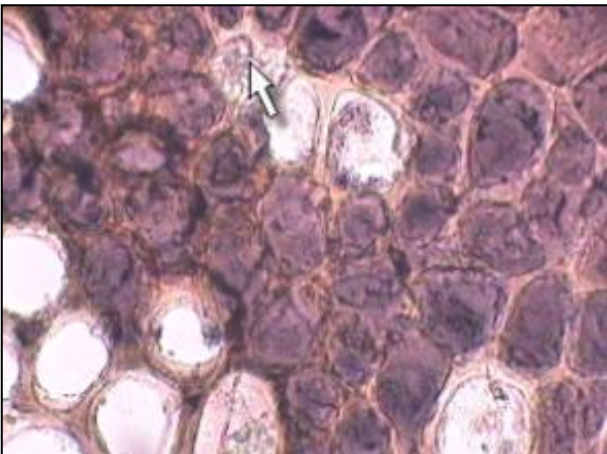


Fig 6: x40 Calcium oxalate crystals in petiole

T. S. of lamina shows isobilateral structure. Single layered epidermis covered by thick cuticle on either side. Epidermal cells thick walled, square to rectangular in shape. Adjacent to each epidermis single layer of palisade cells present. Palisade layer adjoining the lower epidermis is characterized by cells which are smaller than upper palisade cells. The regions are often invested with sub-globular internal glands which contain oil. Those cells which have discharged their contents are lined with a layer of cork. Between these palisade region 4-5 layers of spongy parenchyma present and some of its cells contain rosette crystals of calcium oxalate. All the cells give positive test for tannin. (Fig.7-10).



Fig 7: x4 T.S. Jamun leaf

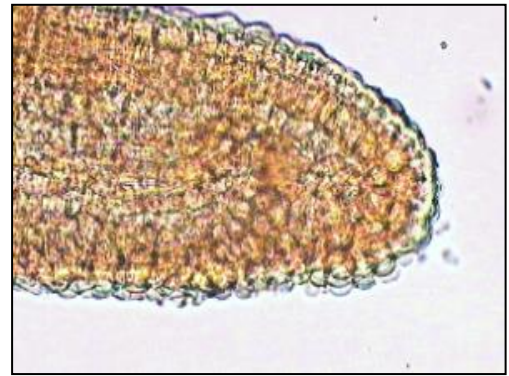


Fig 8: x40 T.S. through margin

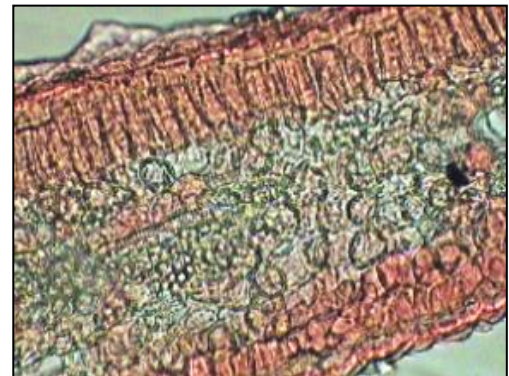


Fig 9: x40 T.S. through lamina

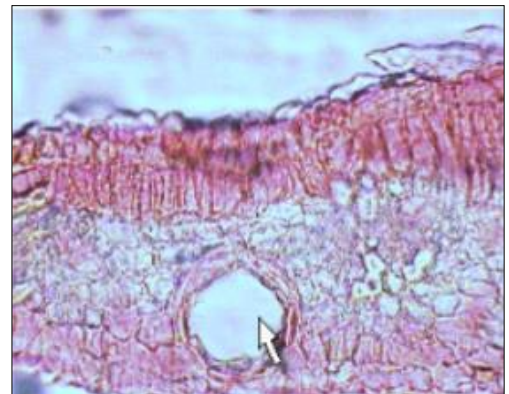


Fig 10: x40 T.S. Jamun leaf showing oil cavity

T.S of mid-rib shows that palisade is discontinuous over the stelar region and vascular bundle exhibit an arc of xylem with phloem below and the whole being nearly surrounded by slightly lignified pericyclic fibres. All the cells give positive test for tannin. (Fig. 11, 12)

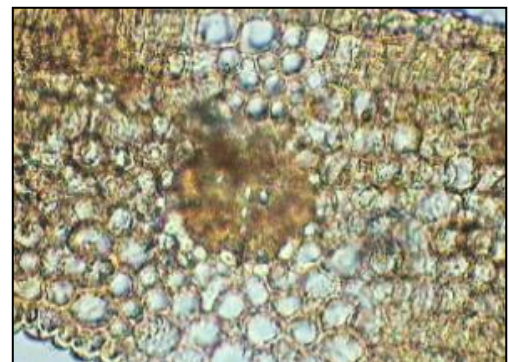


Fig 11: x40 T. S. through mid-rib region

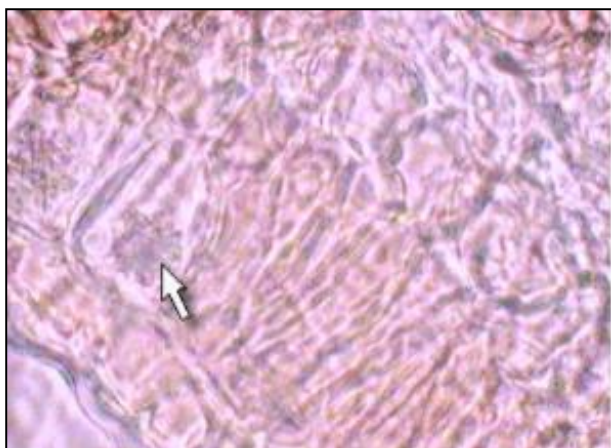


Fig 12: x40 Jamun leaf showing calcium oxalate crystal

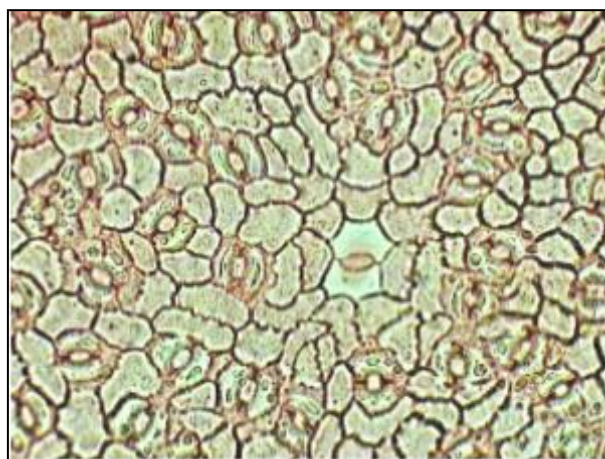


Fig 13: x40 Lower epidermal cells showing stomata (surface study)

Adaxial Surface

- Epidermal cells thick walled with sinuous outline.
- Stomata present but few in number.
- Anomocytic type of stomata present.
- Trichomes absent.

Epidermal cell = 324–412

Stomatal number = 4

Abaxial Surface

- Epidermal cells thick walled, more or less smooth in outline.
- Abundant stomata present.
- Anomocytic type of stomata present.
- Trichomes absent.

Epidermal cell = 464–524

Stomatal number = 80–120

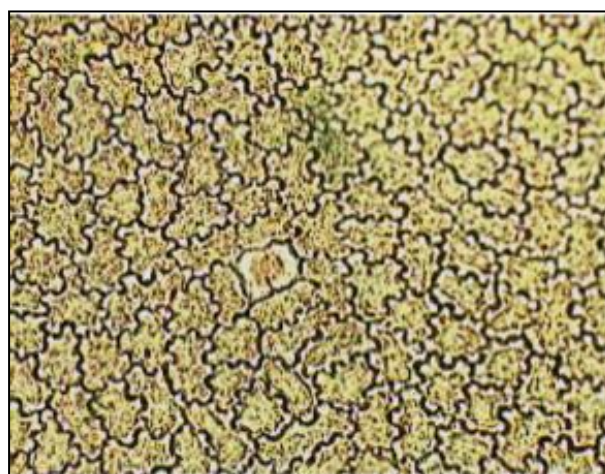


Fig 14: x40 Upper epidermal cells showing stomata (surface study)

Quantitative Analytical Parameters

S. No.	Parameters	Values (in 1 mm ² Area)
1.	Vein-islet number	14–19
2.	Palisade ratio Adaxial Surface Abaxial Surface	4.75–5.50 1-2
3.	Stomatal Index Adaxial Surface Abaxial Surface	0.96–1.22 14.71-18.99

Powder analysis

Colour: Green

Odour: Characteristic

Taste: Astringent

Microscopic examination of the powder reveals following diagnostic characters: (Fig. 15-17).

1. The fragments of lamina in surface view showing epidermal cells of both abaxial and adaxial surfaces.
2. Fragments of lower epidermal cells with anomocytic type of stomata.
3. Pieces of abundant fibres from the mid-rib which are thick walled, lignified having width 9μ – 13.50μ and found in groups.
4. The fragments of lamina in sectional view showing palisade under both epidermis; the palisade under lower epidermis measure 22.5μ – 27μ x 13.5μ – 18μ and those under the upper epidermis measure 54μ – 63μ x 13.5μ
5. Parenchyma cells containing crystals of calcium oxalate measuring 15.75μ – 18μ in diameter.
6. Vessels with spiral thickening of varying length and of thickness 9μ – 15.75μ .

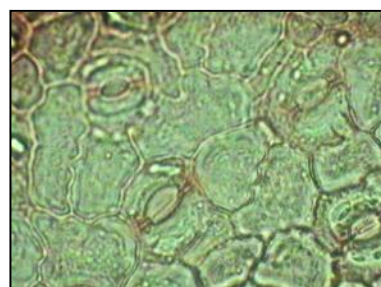


Fig 15: x100 Jamun leaf showing stomata



Fig 16: x40 Vessels showing spiral thickenings



Fig 17: x40 Pieces of fibres in powder

Conclusion

Present study illustrates that the leaf architecture pattern of jamun leaf is stable and can be used to confirm the identification with success, particularly in the absence of the reproductive structures. It has a high potential as a taxonomic tool with cost-effective, practical and theoretical relevance and significance, hence provide the quality assurance.

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