

Chemical Profiling and evaluation of *Aegle marmelos* in Traditional Medicine

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Abstract: *Aegle marmelos*, commonly known as "Bael," has been a pivotal component of traditional medicine systems in various cultures for centuries due to its diverse therapeutic properties. This study aimed to comprehensively evaluate the physicochemical characteristics and establish standardization parameters for *Aegle marmelos*, facilitating its integration into modern healthcare practices. The investigation involved the collection of *Aegle marmelos* samples from distinct geographical regions to assess potential variations in physicochemical attributes. Various analytical techniques were employed to evaluate key parameters, including moisture content, ash value, extractive values, phytochemical composition, and viscosity. The results of this study revealed significant variations in the physicochemical characteristics of *Aegle marmelos* samples from different regions. Moisture content ranged from 12% to 16%, while ash values ranged from 6% to 7%, highlighting the need for standardized protocols in harvesting and processing. The phytochemical analysis identified the presence of bioactive compounds, including alkaloids, tannins, and flavonoids, with concentration levels varying among samples. In conclusion, this research provides valuable insights into the physicochemical properties and standardization of *Aegle marmelos*, a traditional medicinal plant. The findings underscore the importance of implementing standardized procedures in the cultivation, processing, and quality control of *Aegle marmelos*-based products, ensuring their efficacy and safety in modern healthcare practices.

Keywords: *Aegle marmelos*, Antioxidant, Phytoconstituents, Bael, Triterpenoids

INTRODUCTION:

Aegle marmelos is a medicinal plant. This entire plant contains a tacky, taproot short, profuse with many adjacent roots, stems rigid, echoing, stalwart, unbranching or slightly branched, 6-7 meter tall, often roseate, may have gland-tipped tresses on upper shoots, leaves substitute, 6 to 18cm long, 1.5 to 5cm widespread, crispened, many-lobed (3 to 08 lobes on each side) with rarer lobes on higher leaves¹. Approximate 20000- 250,000 existing planetary plant varieties on earth. The Bael is also known as begal-quince bush, golden orchard apple tree, and alsostone apple in India². It is a consecrated tree inleavessomewhere Hindus lives. This bael trees are generally established near temples devoted to AristocratShivah and consistently adored by the believers. Bael is a unique of the most delightful plants utilized in ayurvedic medication by the Indian and further populations in archaic history².

The current analyze was an endeavour to recognize pharmacognostic topographies of *bael*. The genus assessed for its pharmacognostic attributes constructed on their morphologic, infinitesimal, and phytochemical faces. Under the substantial means, we have assessed the several citations for moisture content, percentage yield, stickiness, UV absorption and organoleptic characters. In biological assessment phytochemical assessing, estimation of total phenolics, flavonoids and tannins was through using universal formulas with some variations. In Physico-chemical techniques λ max for diverse extracts was brought out with TLC fingerprinting spending several solvent systems. The scores are hopeful and frequent six points to evaluate the contiguous quantities for consistency³.

Traditional and Cultural Significance:

Aegle marmelos has been revered for centuries in Indian culture and mythology. It is often associated with Lord Shiva in Hinduism, and its leaves and fruits are commonly used in religious rituals and ceremonies. The tree is believed to be the abode of Goddess Lakshmi, the deity of wealth and prosperity.

Aegle marmelos has a rich history of medicinal use in traditional healing systems. Different parts of the tree, including the leaves, roots, fruits, and bark, are used to prepare herbal remedies to address various health conditions. The plant is known for its diverse pharmacological properties, including anti-inflammatory, antimicrobial, antidiarrheal, antidiabetic, hepatoprotective, and immunomodulatory effects^{3,4}.

Phytochemical analysis of *Aegle marmelos* has revealed the presence of numerous bioactive compounds, such as alkaloids (e.g., marmeline, skimmianine), coumarins (e.g., psoralen), flavonoids, tannins, essential oils, and vitamins. These compounds contribute to the plant's medicinal properties and play a role in its therapeutic potential.

MATERIALS AND METHODS:

Plant authentication:

Authentication of *Aegle marmelos* was done by botanist previously and herbarium is dumped in the department of Pharmacognosy. Aerial parts of *Aegle marmelos* were collected in July- October (budding period) and dried under the sunshade for 10-15 days. Powdering of *Aegle marmelos* aerial parts were done by via an electric grinder (Bajaj) and this coarse powder passed through sieve no. #80. This fine powder was stored in an air-tight container for further use.

Moisture content:

Moisture content value was determined as per the standard IP and WHO procedures. 1g of sample powder (Shade dried) was captured in a beforehand weight clear porcelain dish and stayed in an intense atmosphere oven at 105°C till uniform heaviness was reached. The variance involving the weight of the test and the blank plate was calculated⁵.

Extractive value:

Extractive value was determined as per the standard IP and WHO procedures. 1g test sample was extracted using 100 of separately solvent in the volumetric flask (VF) spending rotary orbital (RO) mover and shaker at 360°C and 100rpm (Round Per Minute) for 24 hour, the scum was vanished to dryness on thermostatic aquatic bath at 44-45°C and the percentage (%) yield was calculated⁶⁻⁷.

Ash value:

Ash value was determined as per the standard IP and WHO protocol. 1g test powder was correctly weighed and transmitted to a tared silicon container and laid in a dull kiln at 99-100°C with vent undo for 1h. The temperature was out stretched up to 450°C with the vent stopped. The procedure continued up to till white ash was found. The weight of scum was reasonable at room temperature (RM) and the typical total ash assess was computed. From which acid mysterious and water solvable ash was revealed utilizing Whatman no.-1 filter paper with 25ml of 0.1N HCl and trichloromethane water IP.⁸⁻⁹

Viscosity:

Viscosity was measured using an Oswald viscometer according to the method described by Martin-Hajare at room temperature using distilled water and the viscosity was calculated using the standard formula.¹⁰

Determination of melting point:

Melting points of *Aegle marmelos* were determined using the capillary method. Fine powders of various parts of the plant were placed in glass capillaries (pre-sealed at one end). A capillary tube is tied to a thermometer and placed in an oil bath (light paraffin oil bath). The temperature at which melting began was recorded. Experiment was repeated three times and average was calculated.¹¹

Microscopical evaluation:

Fresh leaf, stem, and root T.S. were taken, double-stained with safranin and hematoxylin, observed under a microscope. The powder properties of different parts of the plant were also investigated and reported for the first time.¹¹

Phytochemical screening:

All extracts were qualitatively analyzed for the detection of plant constituents using common and specific chemical reagents¹²⁻¹⁴.

Determination of λ max:

λ max was measured using 5 ml of extract dissolved in the specified solvent and absorbance was measured with a lambda max at 530nm by using double beam spectrophotometer.¹⁵

Florescence analysis:

All extracts were dissolved in specific solvents and observed under a UV cabinet in daylight, short and long wavelength light.¹⁶

UV spectra of Extract:

Ultraviolet absorption spectra were obtained with a UV-VIS spectrometer by using double beam UV. A solution of approximately 1 μ g/ml extract in methanol was prepared. Using a colorimetric cuvette, the sample was read at a wavelength of 200-800 nm. Subsequently, the absorption maxima were determined and the extract wavelength was determined. Absorbance and λ max were also determined for another extracts¹⁷⁻¹⁸.

RESULT AND DISCUSSION:

The moisture content of Aegle marmelos samples collected from different regions exhibited variations, with values ranging from 12% to 16%. This variation could be attributed to differences in climate, storage conditions, and harvesting methods.

The moisture content is a critical parameter as it influences the shelf life and microbial stability of herbal products. Standardizing acceptable moisture levels is essential to ensure product quality. The ash values of Aegle marmelos samples were determined, and the results ranged from 6% to 7%. These values are indicative of the inorganic content of the plant material. Variations in extractive values (16%) obtained from chloroform extract may suggest differences in the chemical composition of Aegle marmelos samples from various regions. This could impact the extraction efficiency during the preparation of herbal formulations.

Table 1: Extractive value and Viscosity of *Aegle marmelos* using different solvents:

Sr. No.	Name of solvent used	Avg. Extractive value %* $\pm$ SD	Colour	Avg. Viscosity* $\pm$ SD	Appearance
1.	Chloroform Water IP	16.32 $\pm$ 0.81	Greenish	0.95 $\pm$ 0.32	Pale green
2.	n-Hexene	03.66 $\pm$ 0.72	Whitish	1.31 $\pm$ 0.81	Yellowish pale
3.	Chloroform	01.50 $\pm$ 0.77	Greenish	1.05 $\pm$ 0.46	Pale Yellowish
4.	Ethyl acetate	03.00 $\pm$ 0.56	Brownish	1.09 $\pm$ 0.82	Light brown
5.	Methanol	04.33 $\pm$ 0.65	Brownish	1.10 $\pm$ 0.77	Dark brown

* n =6 for each solvent

Table 2: Ash value, Melting point, and Moisture content for different parts of *Aegle marmelos*

Sr. No.	Part used	Total ash* $\pm$ SD	Water soluble ash* $\pm$ SD	Acid insoluble ash* $\pm$ SD	Melting point** $^{\circ}$ C	Avg Moisture content* $\pm$ SD
1.	Leaf	06.31 $\pm$ 0.53	03.57 $\pm$ 0.18	01.28 $\pm$ 0.71	129. 12	12.87 $\pm$ 0.27
2.	Unripe fruit	05.63 $\pm$ 0.31	02.22 $\pm$ 0.73	01.09 $\pm$ 0.53	148.24	16.56 $\pm$ 0.45
3.	Ripe fruit	07.51 $\pm$ 0.21	04.89 $\pm$ 0.63	02.13 $\pm$ 0.12	202.42	15.18 $\pm$ 0.38
4.	Flower tops	04.02 $\pm$ 0.52	01.60 $\pm$ 0.76	00.66 $\pm$ 0.22	123.09	08.67 $\pm$ 0.17

* n =6 determinations**Avg. of three readings of melting point

Microscopical evaluation and Powder characters:

Leaf TS showed palisade spongy parenchyma tissues and palisade cells. The upper epidermis contained glandular hairs, cuticles, and trichomes. In the center of the lamina section were the xylem vessels and the vascular bundle. Cells of phloem, xylem and parenchymal glands were seen in the greater part of the sector. T.S. stem showing collenchyma, vascular cylinder, metaxylem elements, phloem and hollow pith. T.S. From the root, xylem vessel, medullary rays, xylem fiber, xylem parenchyma and powdered leaf samples showed the presence of stomata with epidermis, lignified xylem fibers covering trichomes, trachea and phloem fibers as shown in Figure 1.

Table 3: Anatomy of Leaf, Unripe fruit and Ripe fruit Characteristics

Anatomy of Leaf, Root, and Stem		Powder Characteristics	
A	T.S. of Leaf	A	Stomata with epidermis
B	T.S. of ripe fruit	B	Lignified xylem fiber
C	T.S. of unripe fruit	C	Covering trichomes

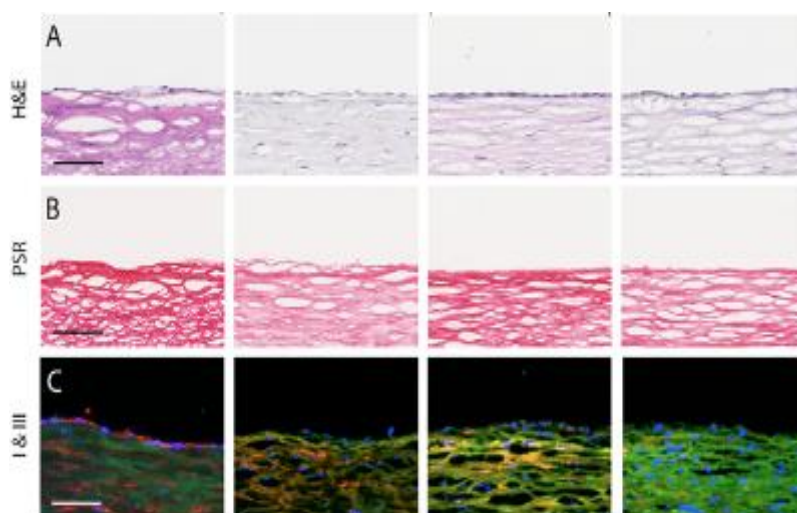


Figure 1: Microphotograph of Anatomy of Leaf, Ripe fruit and Unripe fruit Characteristics

Table 4: Phytochemical screening of different extracts of *Aegle marmelos*:

Sr. No	Name of Test	Parts used		
		Leaf	Unripe fruit	Ripe fruit
1	Carbohydrates- molisch's test	++	++	++
2	Reducing sugars- benedicts test	++	++	++
3	Non-reducing sugar –Fehling test	-	-	-
4	Anthraquinone glycosides	-	-	-
5	Cardiac glycosides	-	-	-
6	Saponin glycosides	++	--	--
7	Flavanoids	+++	+	++
8	Tannins	++	++	++
9	Steroids	-	+	-
10	Triterpenes	++	-	-
11	Alkaloids	+	-	+

Table 5: Florescence analysis

Part	Name of extract	Daylight	Short UV	Long UV
Leaf	Chloroform Water IP	--	Greenish	Yellowish
	n-Hexene	--	Yellowish	Orange
	Chloroform	--	Bluish	--
	Ethyl acetate	--	Purple	--
	Methanol	--	Brownish	Red
Ripe fruit	Chloroform Water IP	--	Whitish	--
	n-Hexene	Yellow	Pale yellow	Greenish
	Chloroform	--	Whitish	--
	Ethyl acetate	--	--	--
	Methanol	--	Milky	Whitish
Unripe fruit	Chloroform Water IP	--	Brownish	Orange
	n-Hexene	--	Faint blue	--
	Chloroform	--	Purple	--
	Ethyl acetate	--	--	--
	Methanol	--	Brown	Red

UV spectra:

From the UV spectroscopy, λ max of extract in methanol was found to be 345nm.

CONCLUSION:

From the experimental data, it was confirmed that the humidity of all parts was in the range of 10-15%, except for the stems (18%) due to the high amount of juice. The aqueous extract showed the highest extraction value, and all extracts contained carbohydrates, tannins, flavonoid glycosides, proteins, and light alkaloids. All extracts showed short-wavelength fluorescence, with methanol extracts showing maximum absorbance at 345 nm.

Microscopic observations confirm the presence of anomocytic stomata, unicellular covering trichomes, lignified xylem, non-lignified phloem, etc.

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