

Pharmacognostical and physicochemical analysis of *Tamarindus indica* Linn. stem

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ABSTRACT

Tamarindus indica Linn. fruits (*Chincha*) are extensively used in culinary preparations in Indian civilization. Its vast medicinal uses are documented in *Ayurvedic* classics and it can be used singly or as a component of various formulations. Besides fruit, the *Kasta* (wood) of *T. indica* L. is also important and used to prepare *Kshara* (alkaline extract) an Ayurvedic dosage form. Pharmacognostical and physicochemical details of *Chincha Kasta* are not available in authentic literature including API (Ayurvedic Pharmacopoeia of India). The study is an attempt in this direction. *T. indica* L. stem with heartwood was selected and morphological, microscopic and physicochemical standardization characters along with TLC finger print, and fluorescence analysis were documented. Transverse section of stem showed important characters such as phelloderm, stone cells layer, fiber groups, calcium oxalate, crystal fibers, and tylosis in heartwood region. Four characteristic spots were observed under UV long wave, in thin layer chromatography with the solvent combination of toluene: ethyl acetate (8:2). The study can help correct identification and standardization of this plant material.

Key words: Ayurveda, *Chincha*, powder microscopy, tamarind, thin layer chromatography

INTRODUCTION

Tamarind is one of the major culinary articles obtained from *Tamarindus indica* Linn. belonging to *Caesalpinaceae* subfamily of *Fabaceae* family. The tree is a long-lived, large, evergreen or semi-evergreen tree, 20–30 m tall with a thick trunk up to 1.5–2 m across and up to 8 m in circumference. The trunk forks at about 1 m above ground and is often multistemmed with branches widely spreading, drooping at the ends and often crooked but forming a spreading, rounded crown. The bark is brownish-gray, rough, and scaly. Young twigs are slender and puberulent. A dark red gum exudes from

the trunk and branches when they are damaged.^[1] India is a major producer and consumer of Tamarind in the world.^[2] Along with culinary usage, there is a vast medicinal utility of *T. indica* L. described which are enumerated in different Ayurvedic classics. Besides fruit being an important part, the *Kasta* (wood) is another part used specially for the purpose of *Kshara* (alkaline extract) preparation.

Tamarind, commonly called as *Imli* in Hindi, which is known as *Chincha* in *Ayurveda* is a *Kshara* tree categorized under *Ksharastaka* (eight *kshara* plants).^[3] *Chincha kshara* is an independent medicine, and is also used as an ingredient in formulations such as *Shankha Vati*,^[4] *Mahashankha Vati*,^[5] *Agnisandeepano Rasa*,^[6] *Gudapippali*,^[7] *Bhrubhat Gudapippali*,^[8] and *Shankhadravaka rasa*^[9] etc. Even though entire plant is generally recommended for the purpose of *kshara* preparation, indicating that any part of the plant is suitable for it, the *Rasashastra* text *Rasa Tarangini* advocates *Kasta* (wood) as the usable part for the preparation of *Kshara*.^[10]

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MATERIALS AND METHODS

The stem of *T. indica* L. was collected from Udupi, Karnataka (India) and was authenticated in Pharmacognosy Laboratory, IPGT and RA, Jamnagar. (Voucher specimen: Phm No. 6009)

Macroscopic and Organoleptic evaluation of the specimens was done.^[11]

For Microscopic evaluation, thin transverse hand sections of stem including its well developed heartwood were taken and studied under distilled water to observe crystals of calcium oxalate, starch, etc. The sections were then stained with Phloroglucinol and Conc. HCl to study lignified tissues. Microphotographs were taken using Carlzeiss Microscope.^[12]

Shade-dried powder of the stem including heartwood was used for physicochemical evaluation as per standard methods.^[13] The ash value represents the inorganic salts present in the drug.^[14] Extracts obtained by exhausting crude drugs are indicative of approximate measures of certain chemical compounds, thus representing the quality and purity of the drug.^[15]

Stem powder was subjected to powder microscopy, and microphotographs were taken.^[16]

For fluorescence analysis, the powdered drug was treated with different reagents and was observed for fluorescence under UV light.^[17]

RESULTS

Macroscopically the stem was about 26 mm thick. Hard and uneven outer surface was reddish brown and marked by silvery gray lichen deposits. Thickness of outer stem bark was 2 mm. The inner surface was smooth and cream colored. Thick, hard and well developed heartwood was enclosed in the bark. The Organoleptic characters were as depicted in Table 1.

Microscopic characters

Transverse section of stem shows outer bark, containing light brown-colored outer most layer, the cork. The cork composed of three to five zones of slight thick-walled cells alternating with narrower zones of thin-walled cells. Most of the cells are filled with reddish brown-colored contents, followed by phelloderm, parenchymatous layer in which large groups of stone cells are present. The stone cell groups are mostly large, and there are many thick-walled cells of varied size in each group. The inner most zone

of bark contains phloem. The region between stone cell layer and inner most zone contains many small rounded stone cells, small size fiber groups, and compressed parenchymatous tissue present along with small thin-walled parenchyma cell. In this region, groups of fiber cells are arranged. A few parenchyma cells adjacent to the fiber groups contain small crystals of calcium oxalate. The medullary ray cells are radially elongated and thin walled at the inner region of the phloem. Gradually, cells become widen and elongated toward the distal end of the ray. At the dilated end of the rays, some of the rays are found to contain crystals of calcium oxalate.

Transverse section of matured stem including centrally situated heartwood shows alternative bands of xylem and lignified fibers due to the secondary growth of the stem; lignified fibers and the xylem vessels are continuously bounded with medullary rays. Medullary rays are usually biseriate to triseriate. Xylem is surrounded by xylem parenchyma, and some of the xylem vessels are filled with oleoresin, wax, and gum-forming tylosis [Figure 1].

Powder microscopy

Diagnostic characteristics of *T. indica* L. stem powder show

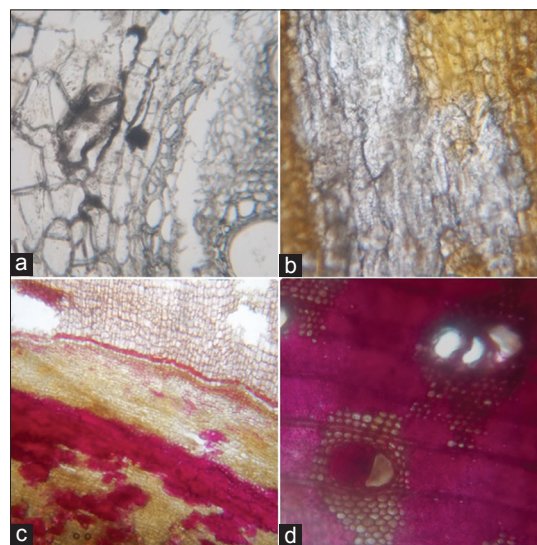


Figure 1: Tranverse section of *Tamarindus indica* Linn. stem (a) TS showing cortex zone with sclerenchyma, crystals, and starch grains. (b) TS of stem showing stone cell layer with tannin contents. (c) TS of stem showing cork, cortex, stone cells layer, and fibers. (d) TS of heartwood showing xylem, xylem fibers, tylosis, and medullary rays

Table 1: Organoleptic characters

Characters	Stem	Powder
Color	Reddish brown	Yellowish brown
Odor	Characteristic	Characteristic
Taste	Astringent (Kashaya)	Slightly astringent
Touch	Hard	Coarse

Table 2: Physicochemical analysis

Parameters	Values
Loss on drying	5.37% w/w
Total ash	4.5% w/w
Water-soluble extractive	6.6% w/w
Alcohol-soluble extractive	7.3% w/w
pH	6.31

lignified cork in surface view, tannin contents from cortex, lignified fibers from xylem, crystal fibers, simple starch grains with hilum from cortical and medullary rays, prismatic crystals of calcium oxalate from cortex and medullary rays, lignified parenchyma, tylosis from pith heartwood region, and border pitted vessels from xylem [Figure 2].

Physicochemical analysis

Results of physicochemical analysis are tabulated in Table 2.

Thin layer chromatography

Reference regarding the solvent system for the TLC is not found in the available literature. On multiple trial and error basis, toluene: ethyl acetate (8:2) was found to be suitable for *T. indica* L. stem including heartwood. Methanolic extract of stem powder was subjected for the analysis. The results obtained from TLC are depicted in Table 3.

Ultraviolet fluorescence

The observations are presented in Table 4.

DISCUSSION AND CONCLUSION

The pharmacognostical and physicochemical analysis of stem including heartwood of *T. indica* L. provides substantial information for the proper identification, authentication, and scientific evaluation of the drug. Transverse section of stem showing phelloderm, stone cells layer, fiber groups, calcium oxalate, and crystal fibers are important unique characters found in this apart from tylosis from heartwood region. It can be noted that the tylosis may play a very important role in formation of chemical constituents such as tannin.

As tamarind bark is reported to be rich with tannin contents,^[18] methanol-soluble extractive was used for TLC and anisaldehyde H_2SO_4 was used for spraying in the latter stage.^[19] There were four spots found, observed under UV long wave and after the spray of anisaldehyde H_2SO_4 , five spots were observed under day light. Result of loss on drying indicates that at 105°C , 5.37% of the stem material was volatile. Total ash indicates that the drug taken has 4.5% of inorganic material in it. Only 6.6% of the drug material was found to be soluble in water and 7.3% was in methanol. The pH being 6.31 indicates that the drug taken was slightly acidic in nature.

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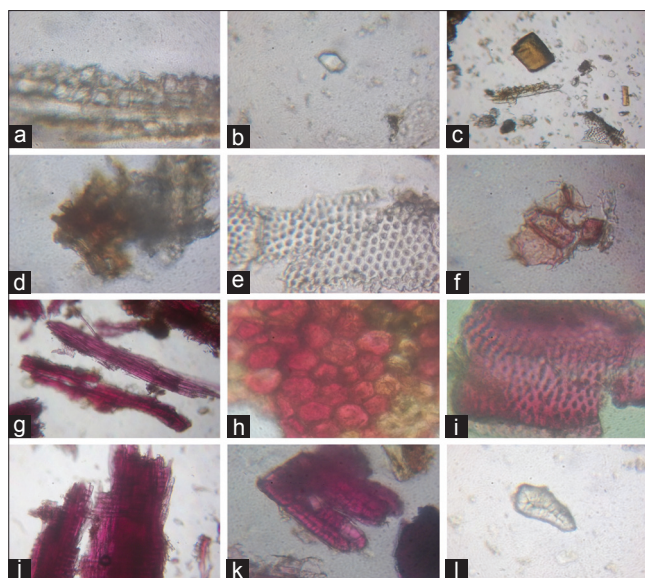


Figure 2: Powder microscopy of stem powder of *Tamarindus indica* Linn. (a) Crystal fiber. (b) Prismatic crystal. (c) Tannin-containing material. (d) Tylosis. (e) Border pitted vessel (unstained). (f) Lignified cork. (g) Lignified fiber. (h) Lignified parenchyma. (i) Border pitted vessels (stained). (j) Fibers passing through medullary rays. (k) Stone cells in group (stained). (l) Single stone cell (unstained)

Table 3: TLC analysis of methanolic extract of stem powder of *T. indica* L

Conditions	No. of spots	Rf values
UV long wave (366 nm)	4	0.13, 0.33, 0.43, 0.66
After spraying anisaldehyde H_2SO_4	5	0.25, 0.4, 0.5, 0.6, 0.66

Table 4: Ultraviolet analysis of stem powder of *T. indica* L

Treatment	Visible light	UV light - Short wave (254nm)	UV light - Long wave (365nm)
Powder as such	Yellowish brown	Brown	Greenish black
In methanol	Light brown	Brown	Creamish brown
In methanol and NaOH	Reddish brown	Reddish brown	Bluish green
In ethanol	Light yellow	Yellow	Gray
In ethanol and NaOH	Brown	Reddish brown	Green
In dilute HCl	Light brown	Dark yellowish brown	Light yellowish brown

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