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## Pharmacognostic and preliminary photochemical studies on *Adansonia digitata* Linn. Root bark and stem bark

**Shikha Sharma, VJ Shukla, CR Harisha and BR Patel**

**Abstract**

*Adansonia digitata* L. commonly known as “Baobab” tree, belongs to the family Bombacaceae. The stem bark and root bark of the plant are used traditionally in the treatment of malaria, diarrhea, inflammation, and pain. Although it is used traditionally, scientifically the plant is yet to be evaluated for its Pharmacognostical characters. Hence, the plant was subjected to macro-microscopic, Photomicrographic, physicochemical, and preliminary phytochemical tests to fix the quality standards for this drug. The plant was collected from the Jamnagar district in Gujarat. Plant authentication, Pharmacognostical study, physicochemical and phytochemical study was performed by following standard procedures as per Ayurvedic pharmacopeia of India. Microscopic studies have shown in the root bark presence of stone cells with the narrow lumen and long striations, rosette crystals and cluster crystals while in the stem bark presence of pitted stone cells and cluster crystals. Physicochemical parameters show higher ash content in root bark ( $12.47 \pm 1.42\%$  w/w) than the stem bark ( $6.22 \pm 0.28\%$  w/w) and water-soluble extractive value of both the samples has been found more in comparison to alcohol soluble extractive value. This study would be useful in the identification and authentication of the raw drug.

**Keywords:** *Adansonia*, bombacaceae, pharmacognosy, phytochemistry, baobab

**Introduction**

*Adansonia digitata* L. belonging to family Bombacaceae, is commonly known as “Baobab” tree. The baobab has extremely broad range of uses ranging from food and beverages to medicinal uses. The tree has mythological significance and is known as ‘*Kalpavriksha*’ in India [1]. Leaves, bark, and fruits of this tree are traditionally employed in several African regions as foodstuffs and for the medicinal purposes, for this reason baobab is also named “The small pharmacy” or “Chemist tree” [2]. It is medium-sized deciduous tree having smooth light brownish ash coloured bark. Leaves are pubescent beneath when young, glabrous digitate [3] leaflets three in young plant, five or seven in older plants. Flowers white [4], solitary, axillary, pendulous, peduncled. Fruit is Capsule, long- ovoid, grey with soft yellowish felt outside with farinaceous, whitish or yellowish sometimes pink-tinged pulp; seed reniform, shining brown or blackish with thick testa [5]. It is native of Africa, In India found in UP, Bihar, Bombay, and Madras [6].

Ethnomedicinally the dried powdered roots prepared as a mash is sometimes taken as a tonic by malaria patients. The leaf and stem bark of *A. digitata* have significant free radical scavenging, cytotoxic, membrane stabilizing, thrombolytic, analgesic, immunostimulant and antidiarrheal properties. The bark of *A. digitata* has been reported to be used for inflammation, diarrhea, pain, and other health disorders [7-9]. In traditional medicine bark is used as a substitute for quinine in case of fever or as a prophylactic.

Review reveals that the Pharmacognostical young stem of the *Adansonia digitata* [10] has been explored where as there has been no work done on matured stem bark and root bark of *Adansonia digitata*. Hence, this research article focuses on the pharmacognosy and preliminary phytochemical analysis of root and stem bark of plant.

**Materials and Methods****Collection and Authentication**

Root bark and Stem bark of *Adansonia digitata* L. was collected and identified by the local taxonomist from its natural habitat Jamnagar, Gujarat during the months of January 2018. Herbarium was submitted to the Pharmacognosy Laboratory, Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University and authenticated by the Pharmacognosist of the institute, provided with herbarium reference number no. Ph.m:6162/18-19 [Fig. 1].

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**Fig 1:** (A) Plant in natural habitat; (B) Herbarium Ph.M: 6162/18-19

### Pharmacognostical Study

Morphological characters of root bark and stem bark of *Adansonia digitata* L. were studied as per visual observation, following the standard procedure of taxonomy and verified with existing floras for authentication<sup>[11-13]</sup>. Thin free hand transverse sections of root and stem bark were taken and observed under the microscope. After that sections were stained with phloroglucinol along with hydrochloric acid and iodine solution, respectively and again examined to assess different cellular structure and content. The samples were observed under the compound microscope (Quasma, India) and photomicrography was done.

The root bark and stem bark were shade dried then powdered individually by using mechanical grinder and sieved through 60# for powder microscopy, physicochemical parameters, and qualitative tests. The powder was stored in the airtight glass container. The Root bark and Stem bark powder (60#) were kept on a slide and studied under the microscope. The samples were also examined after staining with different suitable reagents i.e. phloroglucinol along with hydrochloric acid and iodine solution under the compound microscope and photomicrography was done<sup>[14]</sup>.

### Physicochemical and Phytochemical parameters

Assessment of the parameters such as foreign matter, moisture content, ash value, acid insoluble ash, pH, water-soluble extractive, and alcohol-soluble extractive was carried out by following standard procedures recommended by Ayurvedic Pharmacopoeia of India. For qualitative analysis, the presence of various secondary metabolites was done as per reference. All determinations were performed in triplicate and the results are presented as mean  $\pm$  SEM<sup>[15, 16]</sup>.

## Results

### Morphological study

The root bark is light brown ash in colour externally with longitudinal striations while inner is creamish, cut pieces of the root bark measures  $3-7.5 \times 1.9-3.4$  cm, fracture is fibrous with astringent taste and odour.

The stem bark is ash colour with horizontally arranged lenticels externally and creamish internally, with fibrous fracture, astringent taste and odour. The cut pieces of stem bark measures about  $6.1-12.4 \times 2.2-4.9$  cm.

### Microscopy Study

#### Transverse Section of Root Bark

Transverse section of the root bark measures about  $6.5-6.9 \mu\text{m} \times 3.9-4.1 \mu\text{m}$ . T.S. of the root bark shows a moderately

developed 11-16 layers of cork cells followed by several layers of cortex often embedded with rosette and cluster crystals of calcium oxalate.

Cork is made up of several layers, which can be differentiated into outer cork and inner cork. The thickness of outer cork tissue is  $0.1 \mu\text{m}$  and is composed of 2-3 layers of compactly arranged rectangular cells filled with brown content.

The inner cork cells possess comparatively wider zones than cells of outer cork with  $0.3 \mu\text{m}$  in thickness at the periphery within the cork. The peripheral 2-3 rows of cells are thin-walled and slightly larger than the innermost cork cells, followed by well-developed cortex.

The cortex comprises of several layers of polygonal to rectangular, slightly tangentially elongated parenchyma cells. Rosette ( $1 \mu\text{m} \times 0.9 \mu\text{m}$ ) and cluster crystal ( $1.1 \mu\text{m} \times 0.9 \mu\text{m}$ ) of calcium oxalate are embedded in the very first layer of cortex. The small group of stone cells arranged in a tangential order forming discontinuous bands occurs in the cortical zone. Towards the inner cortex, the group of stone cells measuring about  $3.0 \mu\text{m} \times 1.9 \mu\text{m}$  and are randomly arranged throughout the inner cortex. Two different types of stone cells are found i.e. stone cells with large lumen and stone cells with the narrow lumen. The Most of cortical cells contain few starch grains, brown content and oil globule. Numerous rosette and cluster crystal are found in the several of parenchyma cells adjacent to the group of stone cells.

The cortical zone chiefly consists of alternative segments of phloem elements and mechanical cells i.e. pericyclic fiber. Pericyclic fibers consist of 4-5 layers and a group of 25-26 thick-walled cells and are lignified. In this region some of the phloem elements found to be compressed and collapsed manner. Some of the starch grains and oil globules occur within the some of the thin-walled phloem parenchyma cells.

In the innermost part of the cortex the newly formed phloem element are found without any pericyclic fibers. The sieve elements and fibers are distinct. All the cells are thin-walled, small and polygonal in shape. A few parenchyma cells contain rosette and cluster crystal, oil globules and starch grains. Medullary rays are bi-tri serriate, long, abruptly moving and extended up to the cortex and loaded by starch grains and crystals. [Fig. 2]

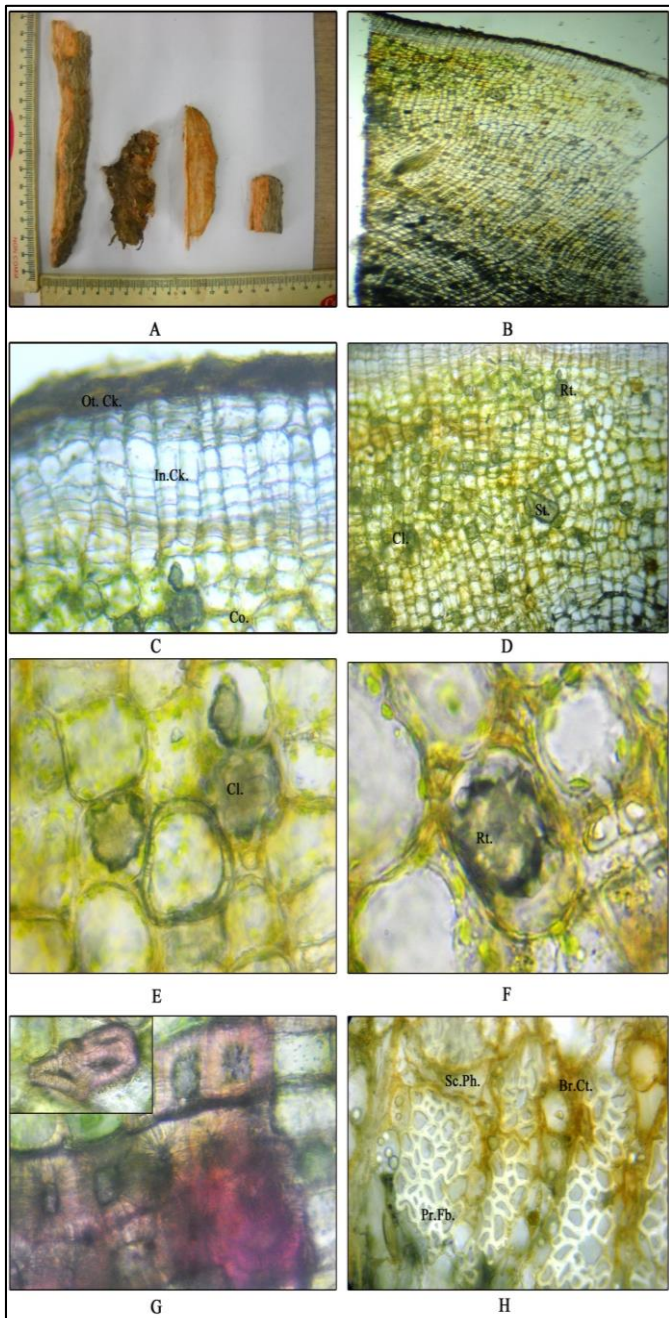
#### Transverse section of Stem Bark

Transverse section of the stem bark measures about  $7.8-8.1 \mu\text{m} \times 4.7-5.1 \mu\text{m}$ . T.S. of the stem bark shows well-developed cork. The outermost cork layer is shiny, papery and peels off easily. The cork tissue which has the thickness of about  $0.2-0.3 \mu\text{m}$  is composed of 2-3 rows of thin-walled rectangular cells compactly arranged along with the brown content. The cortex occupies  $1/3^{\text{rd}}$  of the bark area, outer cortical cells rectangular to oval-shaped having deposition of chlorophyll pigments, brown content, and cluster crystal ( $1 \mu\text{m} \times 0.7 \mu\text{m}$ ) and oil globules.

The inner cortical cells are also compactly arranged rectangular to oval shaped and consist of ample amount of cluster crystal rarely starch grains and are devoid of chlorophyll pigment. Some of the parenchyma cells contain brown pigment. Continuous layers of 1-3 group of stone cells is observed just beneath the inner cortical cells. Both the type of stone cells i.e. with wide lumen and group of narrow lumen thick walled and with more striation are observed. Some of the wide lumen stones cells are pitted.

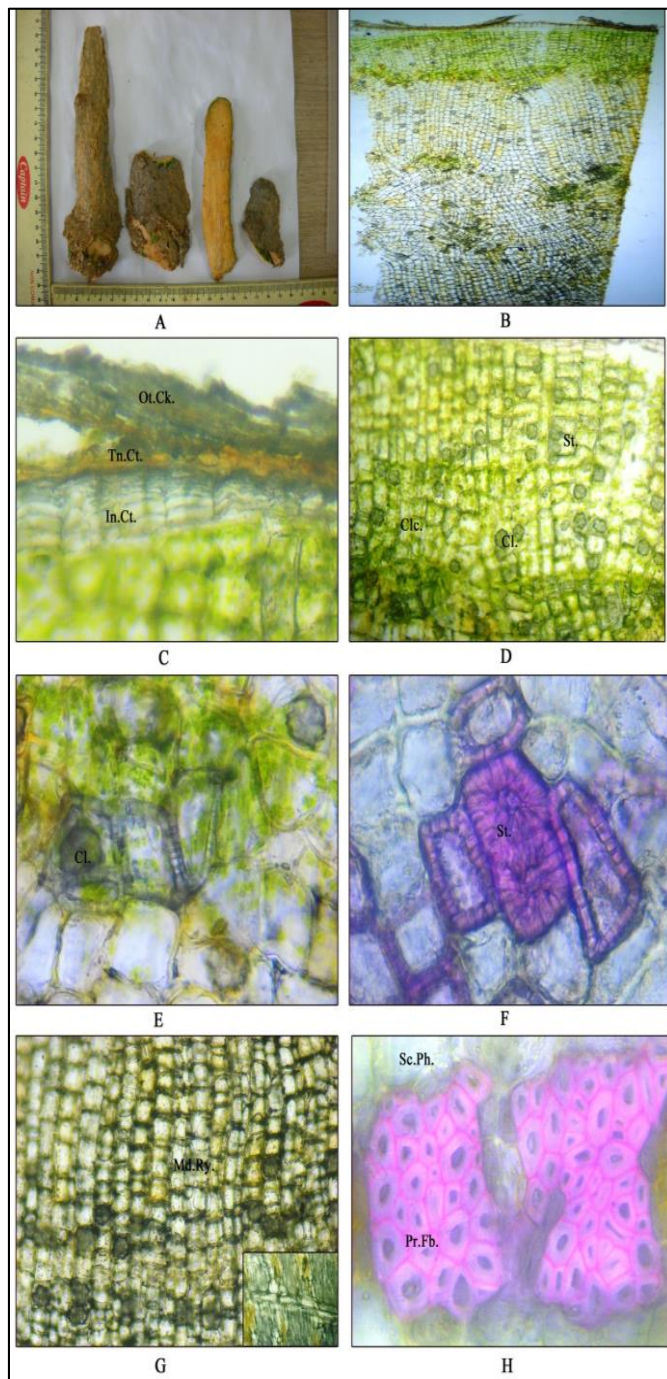
Inner cortical zone consists of a continuous alternate layer of pericyclic fiber and secondary phloem throughout the transverse section. Pericyclic groups consist of 4-5 layers and

25-26 lignified thick-walled cells. The upper secondary phloem consists of very few sieve elements and fibers and oil globules. Inner phloem components are very specific and consist of sieve elements and fiber. The zone of fiber and phloem region is separated by abruptly passing haphazardly arranged medullary rays. Medullary rays are biseriate to triseriate and tangentially elongated and consist of oil globules and rarely rosette and cluster crystal. [Fig. 3]



**Fig 2:** Microscopic characters of root bark of *Adansonia digitata* Linn.

(A) Root bark cut pieces (B) Transverse section of root bark, (C) Cork layers(Outer cork & inner cork), (D) Cortical zone with stone cells, brown content, rosette & cluster crystals (E) Cluster (F) Rosette crystals, (G) Group of stone cells and sieve elements along with medullary rays, (H) Pericyclic fibers along with secondary phloem and brown content  
 Ot. Ck- outer cork; In. Ck.- Inner cork; Co.- Cortex; Rt.- Rosette crystal; Cl-Cluster crystal; St.- stone cells; Sc. Ph.- Secondary phloem; Br. Ct.- Brown content; Pr.Fb.- Pericyclic fibers

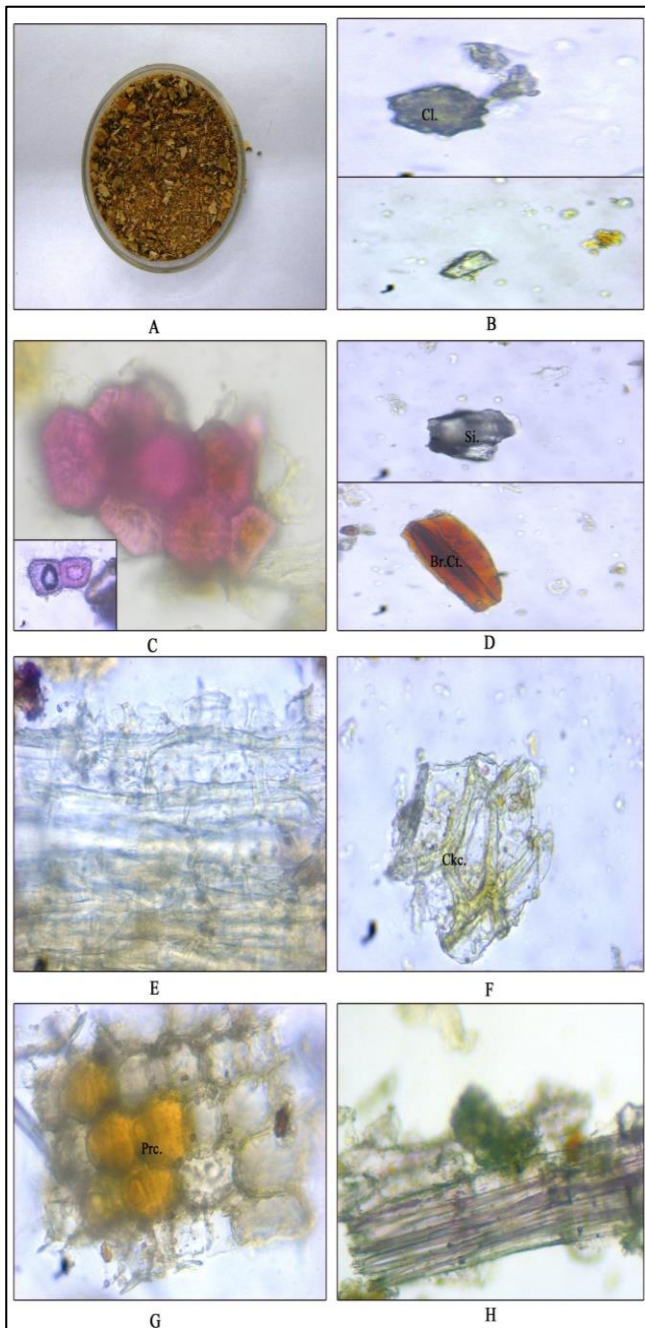


**Fig 3:** Microscopic characters of stem bark of *Adansonia digitata* Linn.

(A) Stem bark cut pieces (B) Transverse section of stem bark (C) Cork layers(Outer cork & inner cork with Tannin content), (D) Cluster crystals, angular stone cells & collenchymatous cells, (E) Stone cells with cluster crystal (F) Lignified stone cells (G) Cortical zone with medullary rays, cluster crystal & biseriate and triseriate medullary rays, (H) Pericyclic fiber along with secondary phloem  
 Ot. Ck- outer cork; In. Ck.- Inner cork; Cl- Cluster crystal; St.- stone cells; Tn.Ct.- Tannin content; Clc.- Chlorenchymatous cells; Md. Ry.- medullary rays; Sc. Ph.- Secondary phloem; Pr.Fb.- Pericyclic fibers

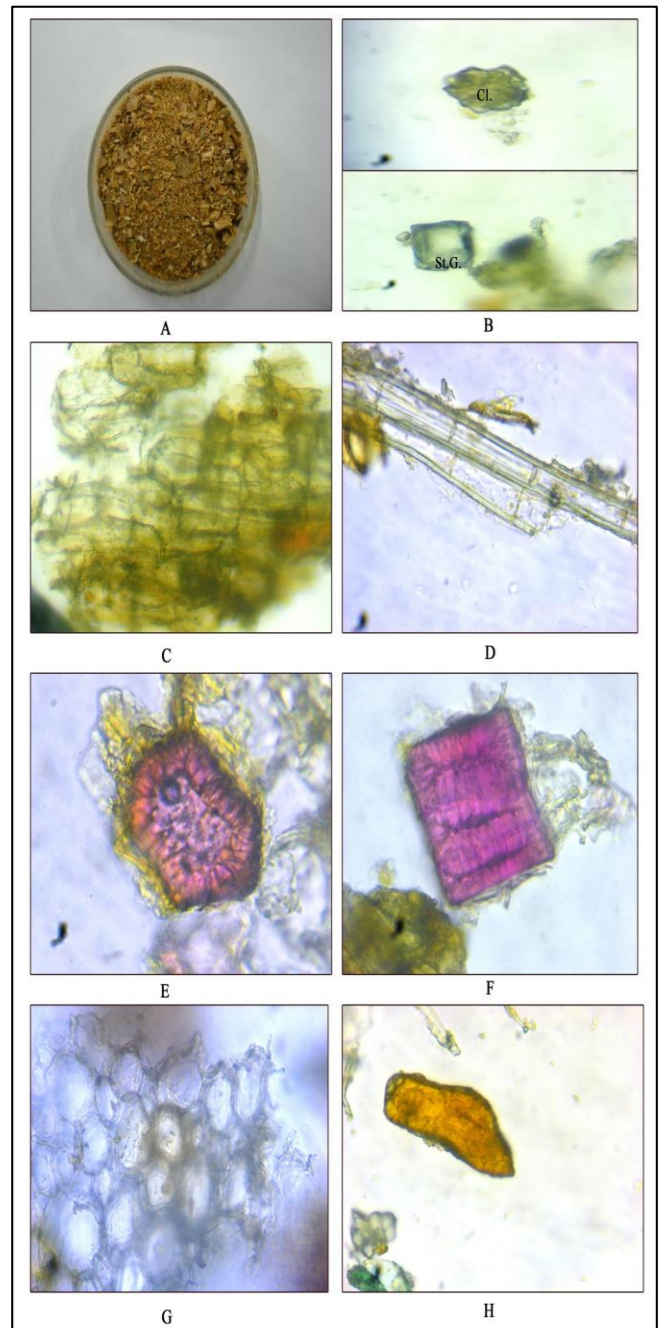
**Powder Microscopy**

Root bark powder is light brown in colour, the odour is characteristic; taste is astringent and rough in touch. The diagnostic character of the root bark powder shows both groups of stone cells with



**Fig 4:** Powder characters of root bark of *Adansonia digitata* Linn.

(A) Powder of Root bark (B) Cluster and Prismatic crystals, (C) Lignified stone cells, (D) Silica deposition and brown content (E) Septate fiber, (F) Cork in surface view (G) Parenchymatous cells with brown content, (H) Fibers  
 Cl- Cluster crystal; Pr.- Prismatic crystal; Si.- silica deposition; Br.Ct.- Brown content; Ckc.- Cork cells; Prc. Parenchymatous cells



**Fig 5:** Powder characters of stem bark of *Adansonia digitata* Linn.

(A) Stem bark powder (B) Cluster crystals & starch grains (C) Cork in surface view (D) Fibers, (E) Pitted Stone cells with wide lumen (F) Stone cells with narrow lumen (G) Parenchymatous cells, (H) Brown content  
 Cl- Cluster crystal; St.G.- Starch grain

Large lumen and stone cells with a narrow lumen, prismatic crystal (1.1×1µm), cluster crystal(1×0.9µm), oleo-resin, simple starch grains, brown content, fibers containing tannin, group of lignified fibers, septate fibers passing through medullary rays, cork cells with brown content and parenchymatous cells with brown content. [Fig. 4]

Stem bark powder is light brown in colour, the odour is characteristic; taste is astringent and rough in touch. The diagnostic character of the stem bark powder shows cork cells tangentially along with brown content, cluster crystal(1×0.8µm), prismatic crystal(1×1µm), brown content, simple starch grains, simple fiber, group of septate fibers, group of stone cells, lignified stone cells with wide lumen and narrow lumen and pitted stone cells with narrow lumen. [Fig. 5]

### Physico-chemical study

Root bark and Stem bark powder of *Adansonia digitata* were subjected to physicochemical parameters like the loss on drying, total ash, acid insoluble ash, alcohol soluble extractive value, pH value, etc. Results are depicted in Table no. 1

**Table 1:** Results of Physicochemical parameter of the Root bark and Stem bark

S. No.	Parameter	Root Bark	Stem Bark
1.	Loss on drying (%w/w)	4.21 ± 0.39	4.4 ± 0.32
2.	Ash value (%w/w)	12.47 ± 1.42	6.22 ± 0.28
3.	Acid insoluble ash (%w/w)	2.34 ± 0.09	0.31 ± 0.04
4.	Alcohol soluble extractive(%w/w)	4.4± 0.54	5.74± 0.94
5.	Water-soluble extractive (%w/w)	6.42± 0.14	6.73± 0.04
6.	pH (5% aq. Sol <sup>n</sup> )	6.6	6.0

### Preliminary phytochemical study

Preliminary phytochemical results showed the presence of tannin, flavonoids, and steroids in the root bark and stem bark of *Adansonia digitata*. Results are depicted in the Table no. 2

**Table 2:** Results of Phytochemical screening of the Root bark and Stem bark

S. No.	Phyto-constituents	Tests	Root Bark		Stem Bark	
			ME	WE	ME	WE
1.	Carbohydrates	Molisch's	-	-	-	-
2.	Proteins	Biuret	-	-	-	-
3.	Amino acids	Ninhydrin	-	-	-	-
4.	Alkaloids	Wagner	-	-	-	-
5.	Tannins	FeCl <sub>3</sub>	+	+	+	+
6.	Steroids	Salkowski	+	-	+	-
7.	Flavonoids	Lead Acetate	+	+	+	+
8.	Saponin glycoside	Foam	-	-	-	-

### Discussion

*Adansonia digitata* the plant is known as "chemist tree" has a vast number of pharmacological activities and its demand is increasing worldwide in different industries like the medical industry, food industry and cosmetic industry etc. Root bark of *Adansonia digitata* is light brown ash coloured with longitudinal streak while the stem bark is ash colored with horizontally arranged lenticels and peeled off easily. Root bark contains rosette and cluster crystal while cluster and prismatic crystals have been found in stem bark. Stone cells with the narrow lumen and wide lumen present in both the parts whereas some of the pitted stone cells found in stem bark and stone cells with the narrow lumen and long striations present in root bark. In root bark, narrow lumen stone cells are present in higher number rather than wide lumen. Silica

deposition has been found in root bark while there are no traces of silica deposition found in stem bark.

Physicochemical analysis of whole plant powder exhibits various results viz., moisture content is found more in stem bark than root bark whereas root bark has more total ash and acid insoluble ash content than the stem. Higher ash value in root may be due to the presence of silica deposition. Slight acidic pH i.e. 6 has been found. Water-soluble extractive value has been found more in comparison to the alcohol soluble extractive value which indicates the probability of the presence of high water-soluble constituents than the alcohol soluble in the sample. Qualitative tests showed the presence of tannin, flavonoid, and steroid in both the parts. Qualitative analysis output showed an overall profile of chemical moieties present in plant extract.

### Conclusion

The Pharmacognostical and phytochemical studies plays a key factor in establishing the authenticity of the plant materials. Observed parameters could be helpful to establish certain botanical standards for identification authentication and standardization of the plant. It may consider for the further research works.

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