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Standardization of *Saraca asoca* Bark Using Physicochemical and Fluorescence Profiles

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KEYWORDS

Saraca asoca bark, pharmacognosy, physicochemical parameters, fluorescence analysis, phenolics.

ABSTRACT:

Introduction: Pharmacognostical standardization is essential to ensure the identity, purity, and quality of crude medicinal plants. Physicochemical constants, fluorescence characteristics, and phytochemical profiling are reliable tools for authentication. The bark of *Saraca asoca* is traditionally valued for its phenolic-rich composition and therapeutic relevance, but is prone to adulteration due to high demand.

Objectives: This study aimed to establish standard pharmacognostical parameters for *Saraca asoca* bark through selected physicochemical evaluation, fluorescence analysis, and preliminary phytochemical screening with emphasis on phenolic constituents.

Methods: Shade-dried bark powder was subjected to loss on drying, total ash, water-soluble extractive value, and swelling index using standard methods. Fluorescence behavior of the powder treated with specific reagents was observed under UV light (254 nm, 366 nm) and visible light. Aqueous and ethanolic extracts were prepared and tested qualitatively for tannins, flavonoids, carbohydrates, and proteins.

Results: The bark showed low moisture content (5.3% w/w), acceptable ash value (6.9% w/w), high water-soluble extractive value (21.6% w/w), and swelling index (2.4% w/w), indicating richness in water-soluble phenolics. Characteristic fluorescence responses with ferric chloride, sodium hydroxide, nitric acid, and sulphuric acid confirmed the predominance of tannins and phenolic compounds. Phytochemical tests revealed the presence of tannins, flavonoids, and carbohydrates, while proteins were absent.

Conclusions: The integrated findings provide a reproducible pharmacognostical fingerprint for authentication and quality control of *Saraca asoca* bark and serve as baseline data for future studies.

1. Introduction

Medicinal plants remain a primary source of therapeutic agents and continue to contribute significantly to modern drug discovery and traditional healthcare systems. The reliability of plant-based medicines, however, depends greatly on the authentication, purity, and standardization of the crude drug. Pharmacognostical evaluation—through physicochemical constants, fluorescence behavior, and preliminary phytochemical profiling—provides simple, reproducible, and cost-effective tools for ensuring the quality of herbal materials before they are used for extraction or pharmacological studies (1,2).

Saraca asoca (family: *Fabaceae)*, commonly known as Ashoka, is an evergreen tree widely distributed in the Indian subcontinent and valued in traditional medicine. The bark is especially renowned and has long been used in classical formulations for its astringent, uterotonic, anti-inflammatory, antioxidant, and metabolic regulatory properties. These therapeutic claims are largely attributed to the presence of tannins, flavonoids,

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glycosides, phenolic acids, and carbohydrates, which are predominantly water-soluble in nature (3,4).

Despite its extensive traditional use and growing commercial demand, the crude bark is often prone to adulteration and substitution, primarily due to morphological similarities with other species and variations arising from geographical sources. In such cases, organoleptic features alone are insufficient for authentication. Therefore, establishing standard physicochemical parameters and characteristic fluorescence profiles becomes essential for the identification and quality control of the crude drug (5,6).

Physicochemical constants such as loss on drying, ash values, extractive values, and swelling index provide insight into the moisture content, inorganic impurities, and extractable bioactive constituents of the plant material. Fluorescence analysis, on the other hand, serves as a rapid and distinctive method for detecting the presence of specific phytochemical classes based on their behavior under ultraviolet light after treatment with different reagents. Complementing these, selective phytochemical screening helps in confirming the predominance of major bioactive groups, particularly phenolics and flavonoids, which are responsible for many of the pharmacological activities of the bark (7,8).

In this context, the present study was designed to establish a pharmacognostical standardization profile of *S. asoca* bark by integrating physicochemical evaluation, fluorescence analysis, and selective phytochemical screening. These parameters together create a reliable reference framework that can be employed in routine quality control, authentication, and future pharmacological investigations of this important medicinal plant (7,8).

2. Objectives

The present study aimed to establish a comprehensive pharmacognostical standardization profile for the bark of *Saraca asoca*. The objectives were to determine key physicochemical parameters such as loss on drying, total ash value, water-soluble extractive value, and swelling index; to evaluate the characteristic fluorescence behavior of the bark powder under UV and visible light after treatment with selected reagents for authentication purposes; and to carry out preliminary phytochemical screening with emphasis on phenolic constituents including tannins, flavonoids, and carbohydrates. The study further sought to develop a reproducible reference framework that can be used for assessing the identity, purity, and quality of the crude drug and to generate baseline data for future phytochemical and pharmacological investigations (9,10).

3. Materials and Methods

3.1 Plant Material

The bark of *Saraca asoca* was collected from a mature tree during the appropriate season. The plant material was authenticated by a qualified taxonomist, and a voucher specimen was deposited for future reference. The collected bark was washed to remove adhering debris, shade-dried at room temperature, and coarsely powdered using a mechanical grinder. The powder was passed through a suitable sieve and stored in an air-tight container for further analysis (11).

3.2 Physicochemical Evaluation of Bark Powder

Physicochemical parameters were determined according to standard pharmacognostical procedures.

- **Loss on Drying (LOD):** About 2 g of accurately weighed bark powder was dried in a hot air oven at 105 °C until constant weight was obtained. The percentage moisture content was calculated (12,13).
- **Total Ash Value:** Approximately 2 g of air-dried powder was incinerated in a silica crucible at 450–600 °C until carbon-free ash was obtained. The residue was weighed and the percentage ash value calculated (14,15).
- **Water-Soluble Extractive Value:** 5 g of powder was macerated with 100 mL of distilled water in a closed flask for 24 h with intermittent shaking. The solution was filtered, 25 mL of filtrate was evaporated to dryness in a tarred dish, dried at 105 °C, and the percentage calculated (16).
- **Swelling Index:** 1 g of bark powder was placed in a 25 mL graduated cylinder, 20 mL of distilled water was added, and the mixture was shaken at intervals for 1 h and allowed to stand

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for 24 h. The final volume occupied by the swollen material was measured (17).

3.3 Fluorescence Analysis

Fluorescence characteristics of the bark powder were studied by treating the powder with different chemical reagents and observing the color changes under:

- UV light at 254 nm
- UV light at 366 nm
- Visible light

A small quantity of bark powder was treated separately with distilled water, 5% ferric chloride, 10% sodium hydroxide, 50% nitric acid, and 50% sulphuric acid. The treated samples were placed on clean glass slides and observed in a UV chamber. The characteristic color changes were recorded (18,19).

3.4 Preparation of Extracts for Phytochemical Screening

- **Aqueous Extract:** 25 g of bark powder was macerated with distilled water for 48 h with intermittent shaking. The extract was filtered and concentrated on a water bath.
- **Ethanolic Extract:** 25 g of bark powder was extracted with ethanol using maceration for 48 h. The extract was filtered and concentrated under reduced temperature.

The dried extracts were preserved in air-tight containers for phytochemical tests (20,21).

3.5 Preliminary Phytochemical Screening (Selected Tests)

The aqueous and ethanolic extracts were subjected to qualitative phytochemical tests:

- **Tannins:** Lead acetate test and ferric chloride test
- **Flavonoids:** Shinoda test (magnesium turnings + concentrated HCl)
- **Carbohydrates:** Molisch's test and Fehling's test
- **Proteins:** Xanthoprotein test and Biuret test

The development of characteristic color changes or precipitates indicated positive reactions (22,23).

4. Results

4.1 Physicochemical Evaluation of Bark Powder

The physicochemical parameters of the crude bark powder were evaluated to establish the identity, purity, and quality of the plant material as per standard pharmacognostical procedures represented in Table 1.

The **loss on drying (5.3% w/w)** indicated low moisture content, suggesting good stability of the powdered drug and minimal chances of microbial degradation during storage.

The **total-ash value (6.9% w/w)** reflected the total inorganic content present in the bark and confirmed the absence of excessive adulteration or extraneous matter.

The **water-soluble extractive value (21.6% w/w)** was notably high, indicating that the bark is rich in water-soluble phytoconstituents such as tannins, phenolics, glycosides, and carbohydrates, which contribute significantly to its therapeutic potential.

The **swelling index (2.4% w/w)** suggested the presence of mucilage and polysaccharides, which may impart protective and soothing properties.

Table 1. Physicochemical parameters of bark powder

S.N.	Parameter	% w/w
1	Loss on drying at 105 °C	5.3
2	Total-ash value	6.9
3	Water-soluble extractive value	21.6
4	Swelling index	2.4

4.2 Fluorescence Analysis

Fluorescence characteristics of the bark powder were examined under UV light (254 nm and 366 nm) and visible light after treatment with selected reagents. The observed color changes indicated the predominance of phenolic compounds and tannins in the bark shown in Table 2.

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- The **untreated powder** showed brownish green (254 nm) and dull orange (366 nm) fluorescence, indicating natural phenolics.
- Treatment with **distilled water** produced brown shades, confirming water-soluble tannins.
- **Ferric chloride (5%)** produced greenish black coloration, a confirmatory indication of tannins.
- **Sodium hydroxide (10%)** resulted in greenish brown fluorescence due to formation of phenolic salts.
- **50% nitric acid** showed greenish to orange fluorescence, characteristic of phenolic acids.
- **50% sulphuric acid** produced black coloration due to charring of polyphenols.

Table 2. Fluorescence profile of bark powder

S. N.	Reagent	254 nm	366 nm	Visible light	Inference
1	Powder	Brownish green	Dull orange	Brown	Natural phenolics
2	Distilled water	Dark brown	Brownish orange	Light brown	Water-soluble tannins
3	5% $FeCl_3$	Dark green	Greenish black	Dark yellow	Tannins present
4	10% NaOH	Greenish brown	Yellowish orange	Dark brown	Phenolic salts
5	50% HNO_3	Greenish	Orange	Brownish yellow	Phenolic acids
6	50% H_2SO_4	Black	Blackish brown	Dark greenish brown	Polyphenols

4.3 Preliminary Phytochemical Screening (Phenolic Group)

Preliminary phytochemical tests on the extracts indicated the predominance of phenolic and water-soluble constituents shown in Table 3.

- **Tannins** showed positive reactions with lead acetate and ferric chloride tests, confirming the abundance of hydrolysable and condensed tannins.
- **Flavonoids** showed moderate to strong positivity in the Shinoda test, indicating rich flavonoid content.
- **Carbohydrates** were confirmed by Molisch's and Fehling's tests, suggesting the presence of water-soluble sugars.
- **Proteins** were absent as indicated by negative Xanthoprotein and Biuret tests, supporting the purity of the crude drug.

Table 3. Phytochemical profile (selected classes)

S.N.	Class	Test	Result
1	Tannins	Lead acetate / Ferric chloride	+ / ++
2	Flavonoids	Shinoda test	++ / +++
3	Carbohydrates	Molisch / Fehling	+ / ++
4	Proteins	Xanthoprotein / Biuret	–

5. Discussion

The present investigation established a pharmacognostical standardization profile for the bark of *Saraca asoca* by integrating physicochemical constants, fluorescence characteristics, and selective phytochemical screening with a phenolic emphasis. Together, these parameters provide reliable markers for identity, purity, and quality control of the crude drug (24).

The low loss on drying (5.3% w/w) reflects minimal residual moisture, which is desirable for crude plant materials as it limits microbial proliferation and enzymatic degradation during storage. This supports the stability of the powdered bark under normal conditions. The total ash value (6.9% w/w) falls within acceptable limits for bark drugs and indicates the absence of excessive inorganic adulterants. Importantly, the high water-soluble extractive value (21.6% w/w) highlights the predominance of water-soluble constituents, primarily tannins, phenolics, glycosides, and carbohydrates which are widely reported as major

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contributors to the therapeutic relevance of this species. The swelling index (2.4% w/w) further suggests the presence of mucilage and polysaccharides, supporting the traditional use of the bark in soothing and protective formulations (25).

Fluorescence analysis served as a rapid and distinctive authentication tool. The dull orange fluorescence of the untreated powder under 366 nm UV light is typical of phenolic-rich bark drugs. Reagent-based fluorescence provided diagnostic reactions: the greenish-black coloration with ferric chloride confirmed tannins; the greenish-brown fluorescence with sodium hydroxide indicated phenolic salt formation; and the orange hues with nitric acid supported the presence of phenolic acids through nitration reactions. The blackening with sulphuric acid reflected charring of high-molecular-weight polyphenols. Such reproducible color signatures are valuable in detecting substitution or adulteration in routine quality checks.

Selective phytochemical screening aligned with these observations. Positive reactions for tannins and flavonoids corroborate the fluorescence findings and the high water-soluble extractive value. The confirmation of carbohydrates supports the swelling behavior and water affinity of the bark powder. The absence of proteins is also noteworthy, as it reduces the risk of nitrogenous impurities and supports the purity of the crude drug matrix.

Overall, the convergence of (i) physicochemical limits, (ii) characteristic fluorescence responses, and (iii) phenolic-dominant phytochemistry creates a coherent standardization fingerprint for *S. asoca* bark. These parameters are practical, reproducible, and economical, making them suitable for routine pharmacognostical evaluation in raw-drug quality control laboratories (26,27).

6. Conclusion

The present study established a clear pharmacognostical standardization profile for the bark of Saraca asoca through selected physicochemical parameters, characteristic fluorescence behavior, and focused phytochemical screening. The low moisture content, acceptable ash value, high water-soluble extractive value, and measurable swelling index confirmed the purity, stability, and predominance of water-soluble constituents in the crude drug. Distinct fluorescence responses with specific reagents provided rapid and reproducible identification markers, particularly for phenolic compounds and tannins. Preliminary phytochemical tests further supported the abundance of tannins, flavonoids, and carbohydrates, while confirming the absence of proteins.

Together, these findings generate a reliable and economical pharmacognostical fingerprint that can be applied in routine quality control, authentication, and detection of adulteration of *Saraca asoca* bark. The established parameters also provide essential baseline data for future phytochemical isolation and pharmacological investigations.

7. Declarations

Ethical Approval: Not applicable

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