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Original Article

Pharmacognostical and Physicochemical Analysis of Stem Bark of *Soymida febrifuga* (Roxb.) A. Juss.

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ABSTRACT

Background: *Soymida febrifuga* (Roxb.) A. Juss. *Meliaceae* family, these plants are usually referred to as Indian redwood or Mamsarhohini. A tribal claim concerning the use of Mamsarohini in the dealing of muscular dystrophies, leucorrhea, menorrhagia, and dysmenorrhea was documented and stem bark's ability to heal wounds. **Objectives:** In order to verify the plant material, identify adulteration, and ascertain the quality and appropriateness for medical use, the physicochemical and pharmacognostical analysis of the crude medicine aims to objectively evaluate its morphological, anatomical, and chemical characteristics. The current study set out to examine the pharmacognostical and physicochemical characteristics of stem bark of the *Soymida febrifuga* (Roxb.) A. Juss. **Materials and Methods:** The pharmacognostic studies were conducted using the following approaches: physicochemical factors, such as fluorescence analysis, ash values, extractive values, and drying loss, analysis of organic elements, and macroscopic (Macroscopic evaluation refers to evaluate its size, shape, texture, color, odour, taste, and special features like touch, texture, fracture, outer and inner surface) and powder microscopic evaluations. **Results:** *Soymida febrifuga* (Roxb.) A. Juss. stem bark is found in curving quills or portions that are roughly 5-13 cm long, 3.5-8.0 cm broad and 0.5-1.5 cm thick. It has longitudinal creases and sporadic grayish lichen patches, giving it a reddish brown color. The bark's inner surface is reddish brown, has tiny striations, and has a short, granular fracture. The bark has a sharp, bitter flavor and a little smell. Phloem and phellogen are the primary microscopic features of the bark, followed by 12-18 layered phelloderms. Sieves tubes and secretory canal are two more significant microscopic elements that were seen. Rhomboidal calcium oxalate crystals, hexagonal phelloderm cells alongside thick-walled oval to polygonal cork cells, phloem fibers, lignified medullary ray, and vessels were all visible in the powdered stem bark. The physicochemical study of the stem bark powder revealed that the total ash, loss on drying, water-soluble ash, acid-insoluble ash, and extractive values soluble in water and alcohol were 4.05%, 17.05%, 7.3%, 5.05% w/w, 18.96%, and 19.88% w/w, respectively. Another crucial standardization criterion that is specific to the plant and indicates the existence of chromospheres in the medication is fluorescence analysis. Carbon, hydrogen, and oxygen are all present in varying amounts, according to the element analysis (CHNSO-analysis). **Conclusion:** In conclusion, this study's collection of pharmacognostical and physicochemical analysis of the stem barks of *Soymida febrifuga* (Roxb.) A. Juss. confirms its identity and provides essential parameters for its standardization and medicinal use. The study helps in ensuring the quality and authenticity of the crude drug.

Keywords: Elemental Analysis, Fluorescence Analysis, Macroscopic and Microscopic Characteristics, Physicochemical Parameters, Powder Microscopy, *Soymida febrifuga* (Roxb.) A. Juss.

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INTRODUCTION

The complex traditional medical systems that have existed for countless years are derived from plants. There has been utilization of plants as medicines from the beginning of human history (Traoré *et al*., 2025). They are an important component of health care programs and a trustworthy supplier of both conventional and contemporary drugs (H *et al*., 2024). The Indian government started the Vanaspathi Van Project to grow medicinal plants in damaged forests and to promoting the Indian system of medicine (Kumudhaveni *et al*., 2024). A straight forward and trustworthy method for determining plant quality control characteristics is pharmacognostical and physicochemical analysis, which yields comprehensive data on the crude medicine. Since many pharmaceutical preparations are made from crude plant medications, identifying the drug accurately is a crucial component of its research. It becomes crucial to work toward

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standardizing the use of plant material as medication (Jeevitha *et al*., 2021). These investigations aid in plant material identification, authenticity, and adulteration avoidance. Additionally, these tests guarantee that plant material and herbal items in commerce are of reproducible quality. Additionally, necessary for the global acceptability of herbal products in the contemporary medical system are plant standardization and quality control. Accordingly, every nation has enacted a set of standards for herbal medicine quality control (Khan *et al*., 2024).

Soymida febrifuga (Roxb.) A. Juss. also referred as *Swietenia febrifuga*. "*Febrifuga*" is originated from a Latin term "febris," that implies "fever," and "fugare," it indicates "to expel," while "*Soymida*" is derived from the telugu name "Somida," which means "Swami / God." This genus is monotypic and indigenous to India (Roy *et al*., 2025). With a height of 22-25 M and girths of 2.5-3.00 M, this is a tall, deciduous native medicinal tree of the *Meliaceae* family thrives on stony, arid slopes and in laterite soil (Kachhava, 2023). The *Meliaceae* family comprises 40 genera and 600 species (Roy *et al*., 2025). The hard bark of *Soymida febrifuga* (Roxb.) A. Juss. exfoliates big plates or scales, making it one of the most respected medicinal plants in the *Meliaceae* family (Sinalkar *et al*., 2024). These plants are usually referred to as Indian redwood, bastrol cedar, or Mamsarhohini. A tribal claim concerning the use of Mamsarohini in the dealing of muscular dystrophies, leucorrhea, menorrhagia, and dysmenorrhea was documented (Karunasree *et al*., 2012). In two DMD cases, the bark decoction Mamsarohini (50 mL daily two times) was reported to efficiently lower the CPK levels. There have been reports of stem bark's ability to heal wounds (Ram *et al*., 2025).

In the Puri district of Orissa, *Soymida febrifuga* (Roxb.) A. Juss. stem bark juice taken orally in combination with water as a treatment of Kala ajar, often known as "Black water fever", as well as overall debility (Kachhava, 2023). The plant *Soymida febrifuga* (Roxb.) A. Juss. has demonstrated inflammatory-reducing, antioxidant, anti-microbial, antibacterial, antifungal, anti-diabetic, and anti-cancer properties in pharmacological investigations employing pure extract components (Sinalkar *et al*., 2024). From the many parts of *Soymida febrifuga* (Roxb.) A. Juss. plants, an assortment of compounds were extracted, including tannins, steroids, alkaloids, flavonoids, and phenols. *Soymida febrifuga* (Roxb.) A. Juss. possesses outstanding therapeutic qualities, according to numerous investigations (Srivastava *et al*., 2016). These include the rheological characteristics of different plant sections, pharmacological and phytochemical analysis, hepatoprotective and antihelminic activities, antihistamine and anthelmintic activities, hypoglycemic and antihyperglycemic activities, and free radical scavenging activity (Nirawane *et al*., 2018).

The bark has aphrodisiac, laxative, acrid, refrigerant, and anthelmintic properties, according to Ayurveda (Reddy *et al*., 2008). Additionally, it relieves sore throats, gets rid of "vata," cures "tridosha" fevers, coughs, and asthma, gets rid of blood impurities and helps with leprosy, ulcers and dysentery (Kachhava, 2023). Yunani claims that the bark helps with gastrointestinal issues and fevers (Ozoh *et al*., 2024). The bark has antiperiodic, tonic and astringent properties (Reddy *et al*., 2008). It has been successfully utilized in conditions necessitating the use of astringents, such as diarrhea, advanced stages of dysentery, intermittent fevers, and overall debility (Yadav and Kashaw, 2018). The infusion works well for enemas, vaginal infections, and gargles and is a decent alternative to oak bark. Like cinchona, the bark of this tree is said to be a good antimalarial and a bitter tonic. In cases of malarial fever, vaginal infections, rheumatic pains, and stomachaches, a one-ounce dose of a bark decoction was administered three times a day (Sinalkar *et al*., 2024). In addition; it is utilized as an anticancer agent to treat wounds, dental conditions, uterine bleeding, and hemorrhage. Crushed bark is combined with water and used as a cough remedy (Nuhu *et al*., 2017). As of right now, there is no information available about pharmacognostical and physicochemical analysis of any portion of *Soymida febrifuga* (Roxb.) A. Juss. The objective of this study is to provide baseline data for the authenticity and standardisation of *Soymida febrifuga* (Roxb.) A. Juss. stem bark by methodically assessing its pharmacognostical traits and physicochemical parameters. It is anticipated that these results will help upcoming phytochemical and pharmacological research as well as the scientific basis for the use of *Soymida febrifuga* (Roxb.) A. Juss. in both conventional and contemporary medical applications. The taxonomic classification of *Soymida febrifuga* (Roxb.) A. Juss. is shown in Table 1.

Taxonomy of the plant

Ayurvedic Properties

GUNA (Quality): Ruksh (dryness), Laghu (easy to digest).

RASA (taste): Madhura (sweet), Katu (pungent), and Kashay (astringent).

VIPAK (Metabolism): Following digestion, katu experiences a pungent test conversion.

VIRYA: Sheet (potency).

PRABHAV (Impact): aphrodisiac, angmard-prashman, increases vitality (Kachhava and Rajput, 2019).

Geographical distribution of *Soymida febrifuga* (Roxb.) A. Juss

Tropical dry deciduous woodlands are home to *Soymida febrifuga* (Roxb.) A. Juss. a well- aware traditional indigenous advantageous plant of Central India (Reddy, *et al*., 2008). This monotypic genus is primarily native to India and Sri Lanka. It extends south to Travancore and is found in the hilly areas of Central, Southern and North-western India. It is common in the deciduous woods of Maharashtra (Sinalkar *et al*., 2024). Other states include Andhra Pradesh dry deciduous forests, Uttar Pradesh, Uttrakhand,

Bihar, Odisha, Karnataka, Tamil Nadu and Kerala (Ahirwar *et al*., 2021). The districts of Chhotaudepur, Panchmahals, Dangs, Vyara and Rajpipla in South Gujarat, as well as some parts of Saurashtra, India, in Gujarat state, are where they are occasionally seen (Sinalkar *et al*., 2024). It is mainly found in tropical dry deciduous forests of India. Extending north to Chota Nagpur, Ceylon, the Mirzapur hills, and Merwara. It grows on laterite hills from Ganjam to Godavari in the N. Circars, the highlands of Chingleput, and the forests of the Deccan from Kurnool to Mysore (Roy *et al*., 2025). The A.P. regions of Rajamundry, Tirupathi, and Pakhal are home to it prefers stony, dry slopes, black cotton soils, and lime soils. Furthermore, it can be found in Manu Devi, which is in the Satpuda ranges of northern Maharashtra. It is restricted to India and Sri Lanka. Its range extends south to Travancore and includes the hilly areas of Central, Southern, and North Western India (Metri *et al*., 2024). On the hill slopes of the Aravalli and its outliers in Rajasthan, it is occasionally found in mixed deciduous forests. The number of old trees in Gujarat has been decreasing and is now classified as Near Threatened on a regional basis due to excessive bark extraction and lack of scientific research (Ranjani and Ponne, 2024).

Morphology of *Soymida febrifuga* (Roxb.) A. Juss

Soymida febrifuga (Roxb) A. Juss. morphology indicates that it is a tall, native deciduous medicinal tree, *Soymida febrifuga* (Roxb) A. Juss. is commonly found on stony, arid hills (Kachhava, 2023).

Leaves

Plant leaves are 18-25 cm long, complex, and grouped close to the tips of branches. Three to six opposing pairs of obtuse, glabrous, penninerved leaflets that is elliptic (or oblong) and has several visible nerves underneath. The bottom half of an equilateral base extends farther down the petiole than the top because they are rounded. The size of the red petioles is between 0- and 5-mm. Leaves are opposite, coriaceous, oblong to lanceolate, with a full margin, and paripinnately clustered at the end of branches. Petioles expand at the base (Kachhava, 2023).

Flower

A flower typically, it blooms from February to May. The blooms are greenish-white and grow in big clusters (or auxiliary divaricately branched panicles that frequently resemble leaves). The petals are five obovate; 6 mm long, clawed, and frequently have notches at the apex. The sepals are five rotund and have membranous, slightly lacerate borders. About half as long as the petals, the staminal tube is joined by the middle of the back and has somewhat urceolate anthers. The discoid, glabrous ovary has a big stigma. Only carpellary ventrals supply the ovary. Attachment to parietal placentae is demonstrated by ovules (Nandyala and Chandrasekhar, 2017).

Fruits

The woody capsule is where the plant's fruits develop. May and June is when fruit ripens. Black, woody, rectangular or oblong, 7.5×5 cm, and 2.5 to 6 cm long, the capsules have five cells and five valves with winged seeds that separate from dissepiments that stay attached to a thick, spongy axis (Sinalkar *et al*., 2024). They are also reddish purple or blackish brown in color. Each cell has many flat, winged seeds with a soft, felty coating. Indian redwood fruits are frequently used as elements in potpourri that is imported. Whole fruits are marketed as "wild lily flowers," columellas (central internal columns) as "lily pods," and pericarp segments or valves as "lily petals." Compressed, oblong, 4x1.5 cm seeds (Kachhava and Rajput, 2019).

Bark

Young trees' bark is either straight or slightly curled, and they have half-tubular quills that are at least an inch in diameter and roughly 1.2 inches thick. The bark has a fibrous fracture, the quills' inner side and margins are a vivid reddish brown colour and the bark contains numerous tiny corky warts that create tiny, elliptic scars or circles with a brown core. The more ancient bark is made up of dense, substantial fibrous fragments that are rusty, grey, or red on the inside and brown exterior (Asante-Kwatia *et al*., 2022). A blood-red exudate may be released when the bark is cut. Additionally, the bark is used to dye, tanning, and intoxicate fish. Indian redwood timber is sturdy, long-lasting, and highly prized for furniture, wells, and other construction projects. The wood of the plants is durable and has a variety of uses. Native American tribes and the surrounding population, together with local healers, have long utilized plant components to treat a variety of illnesses (Huang *et al*., 2014).

MATERIALS AND METHODS

Plant material

In December 2023, fresh *Soymida febrifuga* (Roxb.) A. Juss. stem bark and plant specimen was gathered from from forest hill area of Kotdwar, Uttarakhand, India.

Identification and Authentication

In Moradabad, Uttar Pradesh, India, Dr. Ashok Kumar, Head of Botanical department IFTM University identified and confirmed the plant specimens. A voucher specimen has been added to the herbarium with the reference number 2023/SOS/BOT/140.

Drying and Pulverization

Soymida febrifuga (Roxb) A. Juss. healthy stem bark was carefully scraped, chopped into tiny pieces, and allowed to dry out room temperature, in the shade. The content was ground into a fine powder with mechanical grinder once it had dried wholeheartedly and placed in an airtight glass jar for additional analysis (Kumudhaveni *et al*., 2024).

Pharmacognostical evaluation

Macroscopic evaluation

Size, form, texture, odor, color, taste, and other distinguishing features including fracture, feel, and the appearance of both the exterior and inner surfaces are all evaluated during the macroscopic examination of *Soymida febrifuga* (Roxb.) A. Juss. stem bark. The samples were positioned on a white paper substrate, and the unaided eye was used to observe them in order to complete the macroscopic description of stem bark. Shape, size, color, taste, fracture, and smell were then assessed as organoleptic traits (Metri *et al*., 2024).

Microscopic evaluation

After the stem bark of the *Soymida febrifuga* (Roxb.) A. Juss. was incubated with in a test tube with the appropriate distilled water, it was boiled for a couple of minutes (Nirawane *et al*., 2018). When the bark was sufficiently softened, thin transverse sections were carefully cut. The cut sections were then given a 0.1% w/v phloroglucinol solution; concentrated hydrochloric acid was added last. The stained sections were then viewed under a microscope that allowed for clear demarcation and identification of the various layers of the cells unique to each cellular component. Images were then captured using photomicrography (Ahmed *et al*., 2022).

Powder Microscopic evaluation

The cellular structures of the finely powdered dried stem bark of the *Soymida febrifuga* (Roxb.) A. Juss. were identified and examined using a microscope. Phloroglucinol staining was used to detect lignin. A tiny bit of powdered stem bark and one or two drops of the freshly made 0.1% phloroglucinol solution were put on a microscope slide (Khan *et al*., 2024). After that, a drop of strong hydrochloric acid is added. We put a cover slip over the sample and looked at it through a microscope. The appearance of a pink coloration or fuchsia shade in the cell walls indicated the presence of lignin. Lignin was present particularly in the xylem and inters fascicular fibers, due to the reaction of phloroglucinol with the cinnamaldehyde end groups in lignin. The slide preparations were mounted in glycerol to preserve the specimens and allow for detailed observation. To document observations, photomicrography was used to take photographs of the distinctive structures and cell components (Jeevitha *et al*., 2021).

Physicochemical evaluation

Plants are analyzed using physicochemical methods to examine their physical and chemical properties, which are necessary for quality control, validation and understanding of their potential medicinal uses. It also assists in determining whether they may have been contaminated and mishandled as medicines derived from plants (Ranjani and Ponne, 2024). The physical-chemical characteristics of *Soymida febrifuga* (Roxb.) A. Juss. powdered stem bark, like its ash residue that is total, water-soluble, and acid-insoluble, were investigated. Values of alcohol and water extractives were computed to determine the proportion of soluble components in each. The approach used to determine the moisture content and determine whether there was any remaining water in the sample was the loss-on-drying method (Khan *et al*., 2024).

Calculating Total Ash value

One by one, silica crucibles that had previously been weighed and heated were filled with roughly 5 g of powdered stem bark of the *Soymida febrifuga* (Roxb.) A. Juss. After spreading the powder evenly as a thin layer near the base of the crucible, it was put in a muffle furnace, where the temperature slowly went up until it reached a dull red-hot, ensuring that all of the carbon had been eliminated. After cooling, the crucible was weighed once again. This procedure was continued until the weight stayed constant. We utilized the air-dried powder to figure out how much total ash was present (Ahirwar *et al*., 2021).

$$\%\ \text{Ash residue} = \frac{\text{Crucible weight with ash} - \text{Empty crucible weight}}{\text{Crucible weight with powdered stem bark} - \text{Empty crucible weight}} \times 100$$

Calculating Loss on drying

Weigh out 2 to 5 g of powdered stem bark of the *Soymida febrifuga* (Roxb.) A. Juss. into a Petri dish that has been previously weighed and records the weight accurately. Dry the sample at 105°C for 5 to 6 hr, and then let it cool in a silica gel-filled desiccator. Determine the percentage of loss on drying after the material's weight is stable (Baskar *et al*., 2024).

$$\%\ \text{LOD} = \frac{\text{Weight of Petri dish with powdered drug} - \text{Weight of Petri dish with residue after drying}}{\text{Weight of powdered drug}} \times 100$$

Calculating Water soluble ash

The ash residue generated through the total ash value approach is used to estimate the water-soluble ash residue of stem bark of *Soymida febrifuga* (Roxb.) A. Juss. The total ash residue was boiled for 5 min in 25 mL of distilled water. The insoluble residue was collected on ash-free filter paper and then processed with hot water. The insoluble residue was moved to a silica crucible that had been previously weighed, fired for 15 min at an approximate temperature of no more than 450°C in a muffle furnace, allowed to cool in a desiccator, and then weighed to ascertain the amount of water-soluble ash residue. Until the weight remained consistent, the procedure was repeated. The water-soluble ash residue was determined by deducting the weight of the insoluble stuff from the overall weight of the ash residue. The weight of the air-dried sample was subsequently utilized to determine the proportion of water-soluble ash residue (More *et al*., 2024).

$$\%\ \text{Water soluble ash} = \frac{\text{Weight of crucible with ash residue} - \text{Weight of empty crucible}}{\text{Weight of powdered drug}} \times 100$$

Calculating Acid-insoluble Ash Value

In a muffle furnace, powdered stem bark of the *Soymida febrifuga* (Roxb.) A. Juss is cooked to a high temperature of 550°C. This process creates ash, the residue that remains after burning organic molecules. A beaker containing 15 mL of 10% hydrochloric acid was filled with the ash. 5 mL of the same acid were used twice to rinse the crucible. After the beaker was brought to a boil for within that time frame, the insoluble substance was gathered in a sintered crucible or on ash-free filter paper. After washing the beaker with warm water, the rinse water was run through the filter paper (Marrone *et al*., 2024). This cleaning procedure was repeated three times to ensure that the residue remained at the tip of the filter paper cone. After that, the funnel and filter paper dried in an oven set to 105°C. After drying the crucible, the final weight was noted. After the filter paper with the insoluble residue was folded into a little bundle, it was reinserted into the crucible. The crucible was gradually heated to 500°C in a furnace for 2 hr until its weight didn't change. Remaining residue was allowed to cool to ambient temperature in a desiccator before being weighed along with the crucible (Kumar *et al*., 2012).

$$\% \text{ Acid insoluble ash} = \frac{\text{Crucible weight with ash residue} - \text{Empty crucible weight}}{\text{Powdered drug weight}} \times 100$$

Calculating extractive value soluble in alcohol

The alcohol-soluble extractive value of *Soymida febrifuga* (Roxb.) A. Juss. procedure determines the percentage of bark active ingredients that are soluble in alcohol, typically ethanol. 100 mL of 90% ethanol were placed in a 250 mL conical flask, and 5 g of air-dried, coarsely crushed *Soymida febrifuga* (Roxb.) A. Juss stem bark was added. A stopper was used to close the flask. The sample should be macerated (soaked) for 24 hr, standing for the last 18 hr after being shaken constantly throughout the first 6 hr. To obtain the liquid extract from the plant material, quickly filter the macerated mixture. Transfer 20 mL of the filtrate, weighing it in advance, into an evaporating dish. After the solution was dried by evaporation, the residue was dried for approximately 3 min in an oven set at 105°C until the extract was thoroughly dry. After recording the residue's constant weight, the extractive value was computed using extrapolation (Thakur *et al*., 2018).

$$\text{Extractive value soluble in alcohol} = \frac{\text{Weight of residue}}{\text{Weight of the powdered drug}} \times 100$$

Calculating extractive value soluble in water

The water-soluble extractive value of *Soymida febrifuga* (Roxb.) A. Juss. stem bark is evaluated. Weigh 5.0 g of the air-dried, coarsely ground sample precisely. The powder should be transferred to a conical flask—250 mL. Pour in 100 mL of purified water. Tightly cork the flask. After giving the mixture a good shake, leave it for 6 hr. For the next 18 hr, give it another good shake. To prevent solvent evaporation, filter the mixture as soon as possible after a day. Fill a tared (pre-weighed) porcelain plate with the filtrate (25 mL). In a water bath, evaporate until completely dry. The residue is typically dried to constant weight at 105°C (Ts *et al*., 2023).

Extractive value soluble in water = Residue weight / Powdered drug weight ×100

Table 1 : Taxonomic Classification of *Soymida febrifuga* (Roxb.) A. Juss.

Sl. No.	Kingdom	Plantae
1	Sub Kingdom	Viridaeplantae
2	Division	Tracheophyta
3	Sub class	Rosidae
4	Class	Magnoliopsida
5	Super Order	Rutanae
6	Order	Rutales
7	Subfamily	Swietenioideae
8	Family	Meliaceae
9	Species	Febrifuga
10	Genus	Soymida
11	Common Name	Indian red wood, Rohuna

Fluorescence analysis

Fluorescence analysis of plant-derived substances that emit light Under Visible or Ultraviolet (UV) illumination serves as a key method for detecting, quantifying, and characterizing drugs, explosives, toxins, or counterfeit materials. The presence and varieties of phytochemical components can be established by observing fluorescence exhibits under various wavelengths combined with treatment with various reagents. This provides a means of verifying that herbal products have been standardized and are of quality (Huang *et al*., 2014). The stem barks powder of *Soymida febrifuga* (Roxb.) A. Juss. was taken according to a standard method. A quantity of stem bark powder of *Soymida febrifuga* (Roxb.) A. Juss. that had been finely ground (1 g) was placed in individual test tubes. Freshly made reagents were added to the test tubes individually. After shaking the combinations slightly, they were left for 30 min. The color from each test tube was first observed in natural daylight; then the test tubes were viewed under UV light. Observations of color changes were made at 254 nm and 365 nm. Determinations of specific types of phytochemicals including, terpenoids, phenols, flavonoids, and alkaloids can be made from the fluorescence exhibits (Arif *et al*., 2021).

Elemental analysis

Elemental analysis determines the types and an number of elements- usually Oxygen (O), Hydrogen (H), Sulfur (S), Nitrogen (N), and Carbon (C) is all present in a sample. It heavily relies on this analysis to determine the structure of organic compounds and stipulate the contents and purity of the material. This type

of elemental analysis specifically aims to determine the ratio of oxygen, sulfur, nitrogen, hydrogen and carbon (Ahmad *et al*., 2019). The following spectra of elements were obtained for stem bark powder of *Soymida febrifuga* (Roxb.) A. Juss. C, H, N, S and O.

Ethical Statement

The pharmacognostical and physicochemical study of the stem bark of *Soymida febrifuga* (Roxb.) A. Juss. was conducted in strict accordance with ethical norms and legal restrictions governing the gathering and use of forest plant resources. The plant material was only gathered from legally designated forest regions. To reduce the environmental impact, sustainable and non-destructive harvesting methods were used. Only healthy, mature specimens were chosen, and bark was carefully removed in small amounts without causing girdling or lasting damage, allowing for spontaneous regeneration of the species. Neither threatened nor protected populations were harmed during the study.

Dr. Ashok Kumar, certified botanist taxonomically Head of Botanical department IFTM University authenticated the plant specimen, and a voucher specimen was stored in a recognized herbarium for future reference. The study did not include any human subjects or animal experiments.

This study was carried out with complete respect for environmental sustainability, legal compliance, and biodiversity conservation principles.

Statistical Analysis

All experiments related to the pharmacognostical and physicochemical evaluation of the stem bark of *Soymida febrifuga* (Roxb.) A. Juss. were performed in triplicate to ensure accuracy and reproducibility of results. The values obtained for physicochemical parameters, including total ash, acid-insoluble ash, water-soluble ash, alcohol-soluble extractive, and water-soluble extractive values, were expressed as mean±Standard Deviation (SD). Repeated heating, cooling, and weighing were done to maintain a constant weight until there was no discernible variation. The experiment was repeated and any unusual fluctuation between measurements was rechecked. Since the study was more concerned with standardization and quality assessment than with comparison or inference, descriptive statistical analysis was employed. This process guaranteed the reported physicochemical data's precision, repeatability, and dependability.

RESULTS

Pharmacognostical evaluation

Macroscopic Characterizations

Size: 0.5 cm-1.5 cm thick, 5.0 cm-13 cm long, 3.5 cm-8.0 cm width.

Shape: The bark exfoliates into scales or broad stripes that resemble half quills. Young trees have straight or slightly curled bark.

Surface: Exfoliating cork was seen on the rough outer surface. It has many tiny corky warts but also cracks or furrows. These create tiny, elliptic scars or circles with a brown core. Quills are a vivid reddish colour on the inside and the margins.

Fracture: There is no discomfort, yet the bark exhibits a fibrous fracture.

Colour

External the bark might be dark brown, rusty, grey, or brown, with longitudinal crackling on the exterior and reddish brown to meaty on the interior. When the outer bark was removed, blood hue was released. Thick fibres and a pale greyish hue characterize the innermost layer of dried bark.

Odour: Astringent.

Taste: Aggressive and astringent, sweet taste in the ends.

The macroscopic examination of *Soymida febrifuga* (Roxb.) A. Juss. Stem bark size, texture, color, and distinguishing features including fracture are shown in Figure 1.

Microscopic Characterizations

When *Soymida febrifuga* (Roxb.) A. Juss. stem bark was inspected under a microscope; the following traits were discovered.

Two areas make up the inner bark: the inner zone of intact phloem and the outside zone of crushed and collapsed phloem tissue.

Cork

The outermost layer of cork is visible in the T.S. of the stem bark. The stem differentiates into thick-walled, lignified barrel-shaped cells with dense packing and dark brownish colouring materials. Compactly grouped barrel-shaped cells were subarized by the inner cork. Clusters of crystals are frequently seen in the outer layer of the cork, which is covered with radially adapted to cells of varying sizes and shapes.

Cortex

There is a cortex underneath the cork. The cortex is a very broad zone made up of multiple rows of radially elongated, very big cells with slim walls. There are many rows of cells with thin walls that are long and thin and have simple and complex starch grains in the periphery rows, which are more consistently organized, narrower, and tangentially elongated. Oval secretory canals are also seen in the cortex, and cells with a rich reddish-brown coloration are discovered.

Secondary cork

The secondary cork, which comes after the cortex, comprises six to eight layers of big, square cells with thin walls.

Medullary rays

Usually two cells wide, but occasionally four, these rays extend to the inner edge of the cork layer. The majorities of medullary rays have a brownish coloring substance and are biserrete, triseriate or tetraseriate to multiserrete. Made of extremely thin-walled and travel through the phloem region.

Phloem

Vertically elongated cells of phloem parenchyma that contain calcium oxalate and have thicker walls than rays. Phloem parenchyma is surrounded by external tissue in the form of jumbled sieve tubes and transverse by tangential bands of sclerenchyma. The bast is wide, with broad phloem bands, appropriate sclerenchyma segments, and a few secretary cavities. Grain forms of simple and complex starch are dispersed across the area.

Phloem, which is composed of companion cells, medullary rays, sieve tubes, phloem fibers, and phloem parenchyma, makes up around 70% of the thickness of the bark. Both the phloem fibers and the phloem parenchyma alternate with bands. Phloem parenchyma is thin-walled cells with calcium oxalate prisms that vary in size. Phloem fibers are lignified with concentric thickening, dispersed in bands or small groups and range in length. There is phloem fibers linked to specific types of ceretanchyma.

Furthermore, it has multiple-celled clusters of large, pitted stone cells. Many secretory cavities in the medullary rays terminal segments, as well as an impressive number of big, thin-walled empty cells. The cells of these fiber sclerids are long, tapered, and fiber-like. However, their pits and walls resemble sclerids. The pits are simple and canal-like, and the walls are thick with broad lumens. The sclerids seem bright when viewed under a polarized light microscope, which suggests that the walls are lignified.

Calcium oxalate crystals

These crystals can occasionally have peculiar shapes. Calcium oxalate crystals in the cortical zone that are rhomboid in shape. There are many calcium oxalate crystals in the phloem tissue that has collapsed. The phloem contains two different kinds of crystals. Prismatic crystals and diffuses are equally common. The phloem parenchyma cells are where the crystals are primarily found. Each crystal takes up the entire cell lumen and is quite massive. Phloem parenchyma, Phloem fiber, Tannin-containing phelloderm cells, Medullary rays, Sclereids, Calcium oxalate crystal, Sieve tube and Secretory canal are in the transverse section (Figure 2).

Powder Microscopic studies

The coarse-textured, brick-red powder has an astringent flavor and a fragrant smell.

The powder of the stem bark is reddish brown in colour with aromatic odour. The taste is bitter and the texture is coarse.

Microscopic examination reveals the following characteristics of the powdered stem bark that give it its uniqueness:

Cork cell fragments are dark, solitary clusters of polygonal, thick-walled cork cells, some of which appear lignified.

Oval to spherical starch granules that are either simple or compound (comprising two to four components), with a central hilum discernible in the bigger granules.

There are many crystals in powder form throughout the sample. They are prismatic-type calcium oxalate druses. The prismatic crystals appear in strands, and the druses are dispersed throughout the powder. Numerous clusters of prismatic and calcium oxalate crystals are found in parenchyma cells, either alone or enclosed. Calcium oxalate clusters with scattered prisms. calcium oxalate clusters and prisms in cortical parenchymatous cells isolated or dispersed phloem fibers connected to calcium oxalate clusters and prisms. Tangentially cut medullary rays (Figure 3).

Physicochemical evaluation

Calculating Total Ash value

$$\%\ \text{Ash residue} = \frac{W1 - W2}{W3 - W2} \times 100 = \frac{9.764 - 19.683}{21.683 - 19683} \times 100 = 4.05\%$$

% Ash residue = 4.05%

W1=Crucible weight with ash.

W2=Empty crucible weight.

W3=Crucible weight with powdered stem bark.

Calculating Loss on drying

$$\%\text{LOD} = \frac{W1 - W2}{W3} \times 100 = \frac{24.785 - 24.444}{2} \times 100 = 17.05\%$$

%LOD = 17.05%

W1= Weight of Petri dish with powdered drug.

W2= After drying weight of Petri dish with residue.

W3= Weight of powdered drug.

Calculating Water soluble ash

$$\%\ \text{Water soluble ash} = \frac{W1 - W2}{W3} \times 100 = \frac{19.829 - 19.683}{2} \times 100 = 7.3\%$$

% Water soluble ash = 7.3%

W1=Weight of crucible with ash residue.

W2=Weight of empty crucible.

W3=Weight of powdered drug.

Calculating Acid-insoluble Ash Value

$$\%\ \text{Acid} - \text{insoluble ash value} = \frac{W1 - W2}{W3} \times 100 = \frac{19.784 - 19.683}{2} \times 100 = 5.05\%$$

W1=Weight of crucible with ash residue.

W2=Weight of empty crucible.

W3=Weight of powdered drug.

Calculating Extractive value soluble in alcohol

$$\text{Extractive value soluble in alcohol} = \frac{\text{Weight of residue}}{\text{Weight of the powdered drug}} \times 100 = \frac{0.994}{5} \times 100 = 19.88\%$$

% Extractive value soluble in alcohol = 19.88%.

Calculating Extractive value soluble in water

$$\text{Extractive value soluble in water} = \frac{\text{Weight of residue}}{\text{Weight of the powdered drug}} \times 100 = \frac{0.948}{5} \times 100 = 18.96\%$$

% Extractive value soluble in water = 18.96%.

These factors are essential for determining a drug's quality and purity. While 5.05% of the ash did not dissolve in acid, and 7.3% of the ash did dissolve in water, the overall ash content of the coarsely ground *Soymida febrifuga* (Roxb.) A. Juss. stem bark was 4.05%, which was a reasonably significant amount. The extractive value that dissolves in water (18.96%) is in contrast, the powdered stem bark of the *Soymida febrifuga* (Roxb.) A. Juss. exhibited the highest alcohol-soluble extractive value (19.88%). suggesting that more constituents are soluble in alcohol than in water.

These extractive values are essential in the evaluation of crude drugs, as they indicate the types of chemical compounds that can be extracted using specific solvents. Additionally, the moisture content (loss on drying) of *Soymida febrifuga* (Roxb.) A. Juss. stem bark was also assessed.

Fluorescence analysis

The stem bark of *Soymida febrifuga* (Roxb.) A. Juss. was subjected to fluorescence analysis after being coarsely crushed. After being treated with various chemical compounds, they were exposed to visible spectrum light and UV radiation with specific wavelengths of 254 nm and 366 nm to detect any distinctive coloration (Huang *et al*., 2014). Table 2 shows that when the powdered "stem bark of *Soymida febrifuga* (Roxb.) A. Juss." was exposed to UV light at both 254 nm and 366 nm and treated with chemicals, it displayed varying fluorescence. This fluorescence suggests the presence of chromophores within the plant material. Because fluorescence analysis may identify chemical markers unique to a plant, it is a useful method for standardizing crude medications (Baskar *et al*., 2024). Certain phytoconstituents, when reacted with suitable reagents, produce fluorescent compounds visible under UV or visible light. This conversion to fluorescent derivatives supports the qualitative assessment of crude medicines. In the study, a powdered form of the stem barks of *Soymida febrifuga* (Roxb.) A. Juss. was reacted with a diversity of chemicals to assess chemical reactivity. The tests included ammonia, petroleum ether, hydrochloric acid, sulfuric acid, formic acid, toluene and other chemical agents (Ozoh *et al*., 2024). The results of fluorescing tests in diverse thinners and reagents are summarized in Table 2.

Fluorescence study provides an understanding of the probable colour of the sample drug under ultraviolet and visible light (Jawanjal *et al*., 2022). The results of fluorescence analysis of the stem bark of *Soymida febrifuga* (Roxb.) A. Juss. stem is presented in Table 2.

Elemental analysis

The stem bark of *Soymida febrifuga* (Roxb.) A. Juss. is used to calculate the relative abundance of elements. The stem bark *of Soymida febrifuga* (Roxb.) A. Juss. was subjected to elemental analysis, focusing on their weight percentages. According to the element component identified in the bark of *Soymida febrifuga* (Roxb.) A. Juss. has both therapeutic and nutritional potential (Jawanjal *et al*., 2022).

This entire element has different metabolic roles. By detecting and measuring the presence of contaminants, C, H, N, O, S

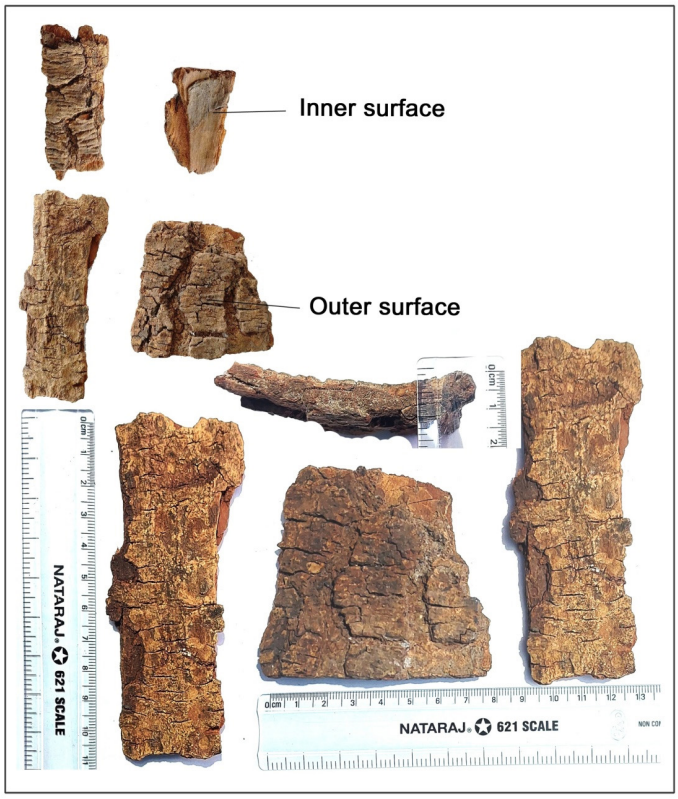

Figure 1: Macroscopy of *Soymida febrifuga* (Roxb.) A. Juss. stem bark.

Table 2 : Fluorescence analysis results of *Soymida febrifuga* (Roxb.) A. Juss. stem bark.

Test Tube no	Powdered of *Soymida febrifuga* (Roxb.) A. Juss. stem bark+Chemical Reagents	Day Light	UV 254 nm (short)	UV 365 nm (long)
	Powdered drug	Reddish Brown	Dark Olive Green	Blackish Brown
1	Powdered drug+Ethyl Acetate ($C_4H_8O_2$)	Light Reddish Brown	Lime Tree Green	Light Gray
2	Powdered drug+Pet. Ether 60-80^0(C_6H_{14})	Light Gray	Lime Tree Green	Light Gray
3	Powdered drug+Methanol (CH_3OH)	Light Gray	Olive Green	Milky White
4	Powdered drug+Chloroform ($CHCl_3$)	Reddish Brown	Lime Tree Green	Blackish Brown
5	Powdered drug+Acetone (CH_3COCH_3)	Light Gray	Lime Tree Green	Light Gray
6	Powdered drug+Ethanol (C_2H_6O)	Light Brownish	Dark Olive Green	Dark Gray
7	Powdered drug+Toluene (C_7H_8)	Light Gray	Light Gray	Light Purple
8	Powdered drug+Liquor Ammonia (NH_3)	Dark Red	Black	Orange Red
9	Powdered drug+Hydrochloric Acid (HCl)	Brown	Blackish Green	Black
10	Powdered drug+Sulphuric Acid (H_2SO_4)	Dark Brown	Blackish Green	Black
11	Powdered drug+Formic Acid (CH_2O_2)	Golden Yellow	Dark Olive Green	Dark Brown
12	Powdered drug+Acetic Acid (CH_3COOH)	Grayish Yellow	Light Gray	Dark Gray
13	Powdered drug+Lead Acetate $Pb(C_2H_3O_2)_2$	Dark Gray	Gray	Dark Gray
14	Powdered drug+Ferric chloride ($FeCl_3$)	Dark Olive Green	Black	Black
15	Powdered drug+Nitric Acid (HNO_3)	Reddish Brown	Dark Blackish Green	Black
16	Powdered drug+Sodium Hypochloride (NaClO)	Light Lavender	Dark Gray	Dark Lavender
17	Powdered drug+Iodine Solution (I_2)	Red Purple	Black	Black
18	Powdered drug+Distilled Water (H_2O)	Light Brown	Dark Olive Green	Dark Brown

analysis helps assess a crude medication's purity. It offers details about the drug's fundamental makeup, which is essential for comprehending its composition and characteristics (Ahmad *et al*., 2019). To illustrate, oxygen plays an important role in herbal medicines; it also acts as a degradative agent and is a requirement of many therapeutic uses of oxygen. It is the primary medicinal agent for the treatment of oxygen deficiency and for support of many physiological mechanisms. Oxygen plays a role in healing tissues and inflammation. Since the 1970's, Hyperbaric Oxygen therapy (HBO) has been used for the treatment of many conditions. Carbon is also critical in crude drugs as a bioorganic component and as a means of usage, and purification, being a fundamental unit/ building block of organic molecules; organic molecules are the main component of herbal medicine. Herbal medicines often contain blends of chemical compounds; thus, carbon dots can be utilized to modify some herbal medicines, and it can be also utilized to overcome some limitations like the blood-brain barrier. Hydrogen is important to life in plants as it acts as a building block, a source of energy and a regulator of many physiological process variables (Matusik and Kłapyta, 2013). Carbon, oxygen and hydrogen were present in stem bark of *Soymida febrifuga* (Roxb.) A. Juss. The percentage of carbon, oxygen and hydrogen were found to be 41.616%, 26.166% and 4.744% respectively as shown in Figure 4 given below.

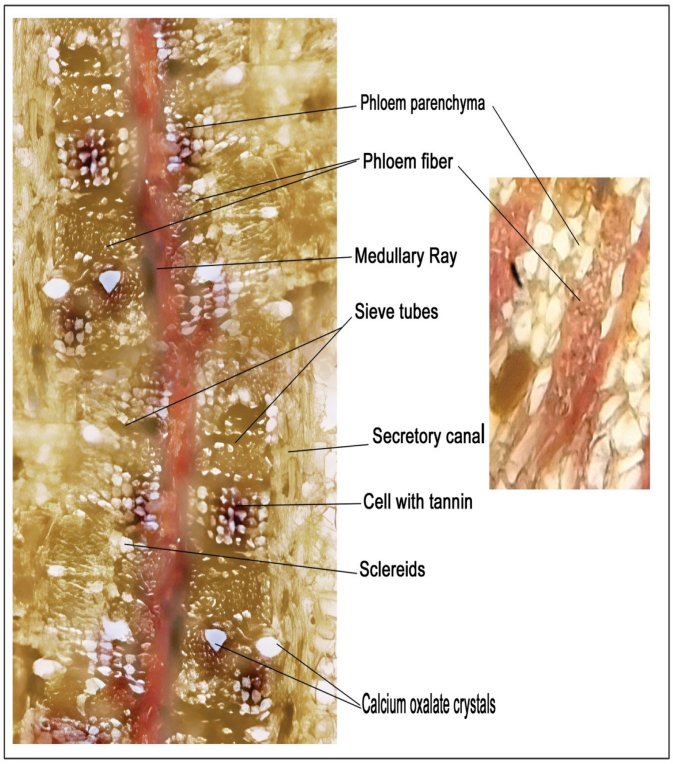

Figure 2: Transverse section of *Soymida febrifuga* (Roxb.) A. Juss. stem bark.

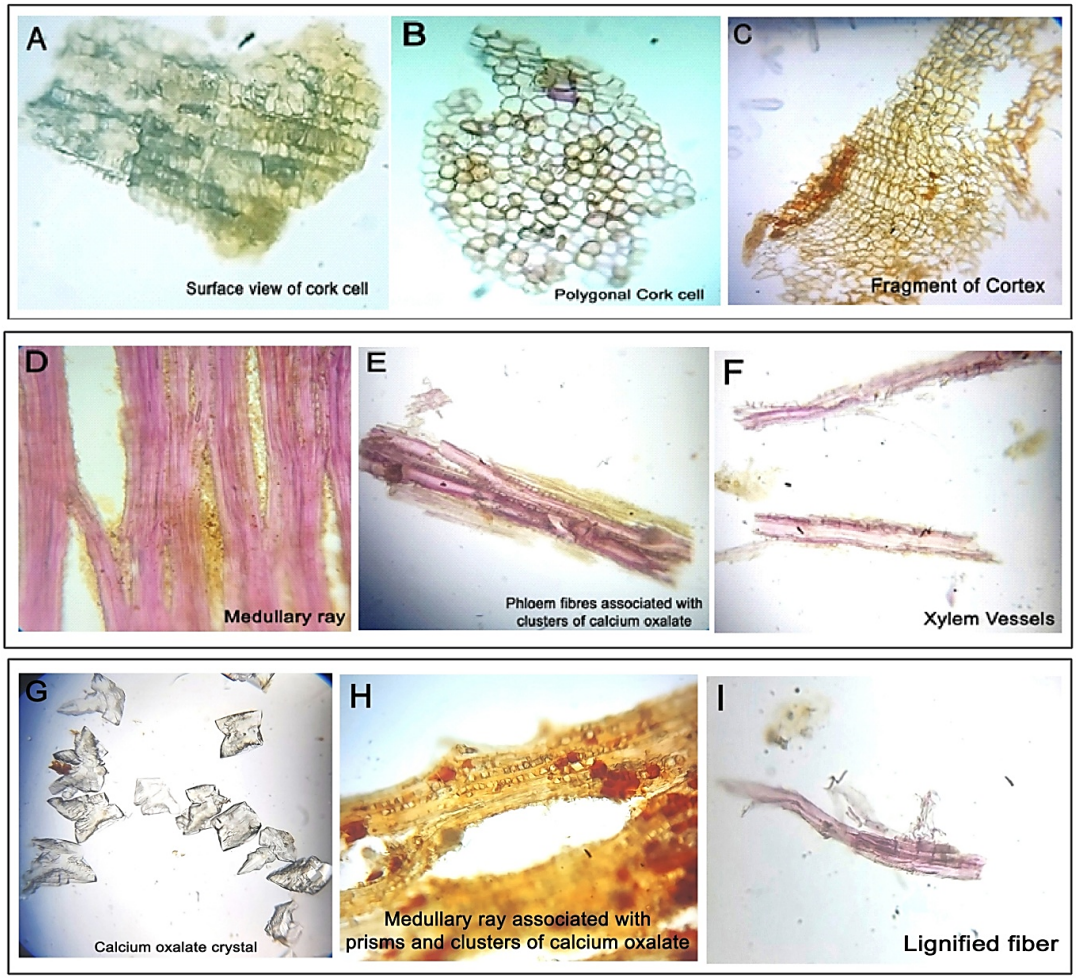

Figure 3: Powdered Microscopic view of the stem bark of *Soymida febrifuga* (Roxb.) A. Juss. (A) Cork cell surface view (B) Cork cell fragments (C) Fragments of cortex (D) Medullary ray (E) Phloem fiber with calcium oxalate crystal (F) Xylem vessels (G) Group of calcium oxalate crystal (H) Medullary ray with calcium oxalate crystal (I) Lignified fiber.

DISCUSSION

The investigation right now was undertaken to establish pharmacognostical and physicochemical standards for the stem bark of *Soymida febrifuga* (Roxb.) A. Juss. a tree of considerable medicinal value used traditionally in the treatment of fever, ulcers, and inflammatory conditions. Despite its ethnomedicinal relevance, there is limited pharmacognostic and quality control data available for this species. The current findings aim to fill this gap and support the authentication and standardization of the crude drug (Amaza *et al*., 2024).

Macroscopic features such as the rough, fissured surface and reddish-brown color of the bark are consistent with traditional and pharmacognostic descriptions of the plant. The astringent and bitter taste aligns with its documented therapeutic role in the treatment of fever, gastrointestinal disorders, and skin ailments (Sreedhar *et al*., 2012).

Microscopic analysis of the transverse section demonstrated the presence of a well-developed periderm, comprising several layers of cork cells followed by cork cambium and secondary cortex. The secondary phloem contained abundant sieve tubes, phloem parenchyma, sclereids, fibers, and medullary rays. The presence of prismatic calcium oxalate crystals and secretory canal was also noted, which serve as distinguishing features for species identification (Balachandran *et al*., 2023).

Powder microscopy confirmed these findings and revealed other diagnostic characters such as lignified fibers, cork cells, cortex, medullary ray, xylem vessels, and crystal-containing cells. These observations are vital for the caliber assessment and authentication of powdered plant material, particularly in the commercial herbal drug market where adulteration is common (Nirawane *et al*., 2018).

The physicochemical parameters analyzed in this study provide essential baseline data for quality control. The total ash number shows how much inorganic stuff there is, including physiological and non-physiological (Omenai *et al*., 2024). The insoluble ash in acid was low, indicating minimal contamination with siliceous materials like sand or earth particles (Jeevitha *et al*., 2021).

The extractive values that dissolve in water and alcohol give insight into the types of phytochemicals present. Greater alcohol-soluble extractive value means that there are alkaloids, phenolics and flavonoids in the extract, while water-soluble extractives may represent carbohydrates, glycosides, and tannins (Prasanth *et al*., 2017).

The loss on drying was within permissible limits, suggesting that the moisture content is sufficiently low to prevent microbial growth and degradation of the crude drug during storage. These values conform to standards recommended by pharmacopoeias and the World Health Organization (WHO) for crude herbal materials (Sreena *et al*., 2024).

After it was treated with several chemical reagents and then put under UV light showed characteristic colour changes. These fluorescence patterns are often specific to particular secondary metabolites and can serve as rapid and effective tools for preliminary identification and detection of adulterants (Gupta *et al*., 2012).

The CHNSO profile provides valuable baseline data for the biochemical nature of *Soymida febrifuga* (Roxb.) A. Juss. stem bark. These elemental values offer insight into the structural and functional diversity of the phytochemicals present and may help predict their solubility, polarity, and potential pharmacokinetics (Hussain *et al*., 2010).

In this study, the CHNSO analysis of stem barks of the *Soymida febrifuga* (Roxb.) A. Juss. revealed the following approximate elemental composition: Carbon (C) 41.616%, Hydrogen (H) 4.744% and Oxygen (O) 26.166%. Carbon was found to be the most abundant element, as expected in all organic plant matter. High carbon content typically indicates a high concentration of organic compounds, Flavonoids, tannins, phenols, and alkaloids are some of these (Bruce *et al*., 2019). They all have different pharmacological effects, such as antioxidants, anti-inflammatory, and antibacterial. Hydrogen content relates to existence of functional groups such -OH, -NH_2, and -CH_3 in bioactive compounds (Rotich *et al*., 2024). A moderate hydrogen percentage supports existence of several secondary metabolites, such as glycosides and polyphenols, known for their medicinal value. Oxygen content, calculated by difference, reflects the degree of oxidation and polarity in plant constituents. A higher oxygen percentage often correlates with the presence of polar functional groups and hydrophilic compounds such as polyphenols, glycosides, and carbohydrates (Rotich *et al*., 2024). Moreover, the CHNSO data complements physicochemical and phytochemical screening, helping to make sure that the plant material is of good quality and follows the rules. Such comprehensive analysis also aids in chemotaxonomic classification, as variations in elemental composition can be characteristic of specific plant families or genera (Wazir *et al*., 2021).

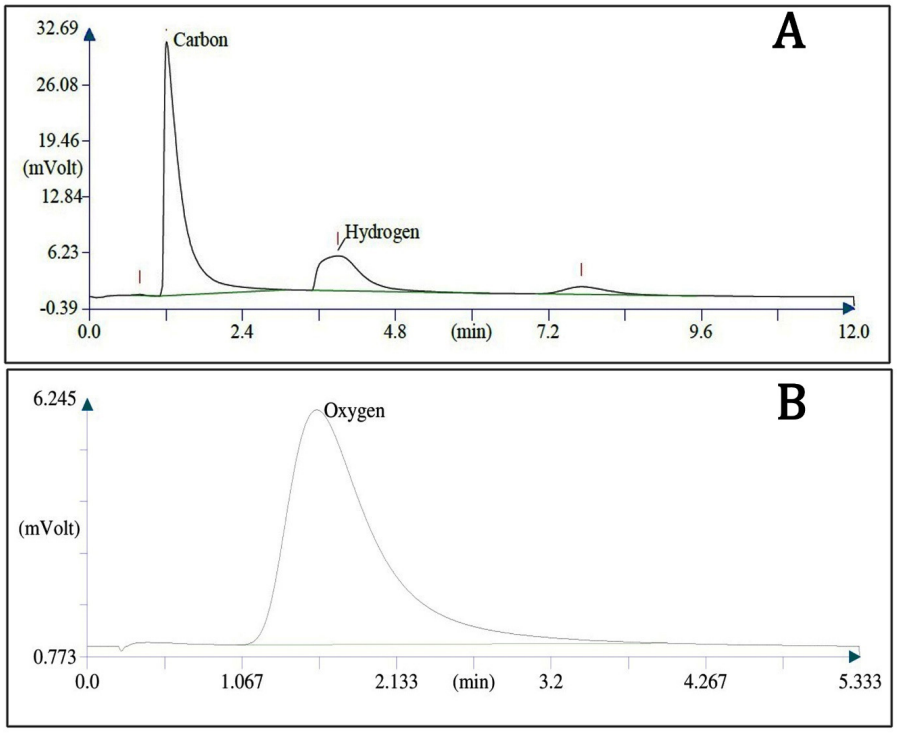

Figure 4: Composition of elements (%) in the stem bark of Soymida febrifuga (Roxb.) A. Juss. A. % of carbon and hydrogen B. % of Oxygen.

CONCLUSION

Ayurveda and Unani are systems of holistic health and herbal medicine that value *Soymida febrifuga* (Roxb.) A. Juss stem bark. Proper collection, identification, authentication, and purity of the crude drug are necessary to achieve safety, efficacy, and quality, in herbal medicinal formulations. In this study a thorough assessment of the pharmacognostical and physicochemical characteristics of *Soymida febrifuga* (Roxb.) A. Juss. stem bark. Standardization which included macroscopic, microscopic and powdered microscopic evolutions generally regarded as the basic parameter of assessment for plant-based drug. Quantitative microscopy and physicochemical assessments were employed to confirm quality and recognize possible adulterants or substitutes. Several chemical reagents were used on the powdered medications which were evaluated in both daylight and UV light (254 nm and 366 nm), the colour changes shown in the (Table 2) providing distinguishing characteristics for the stem bark. The elements C, H, O are present in *Soymida febrifuga* (Roxb.) A. Juss. stem bark, and advocate for various physiological factors. The research provided information useful for the successful identification and authentication of the stem bark of *Soymida febrifuga* (Roxb.) A. Juss. will continue to contribute to the further reduction of the risk of adulteration in herbal products. Further research is currently being done to isolate, purify, and characterize the therapeutically active compounds from its aqueous extract and these will be pharmacologically studied to assess specific mechanisms of action. The next step is to explore the bioactive compounds from *Soymida febrifuga* (Roxb.) A. Juss. stem bark and their therapeutic application - to lend further credence to its traditional uses.

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ABBREVIATIONS

CPK: Creatine Phosphokinase; **DMD:** Duchenne Muscular Dystrophy; **CHNSO:** Carbon, Hydrogen, Nitrogen, Sulfur, Oxygen; **UV:** Ultraviolet; **LOD:** Loss on drying; **HBO:** Hyperbaric Oxygen therapy; **T.S.:** Transverse Section; **w/v:** weight/volume; **w/w:** weight/weight; **$C_4H_8O_2$:** Ethyl Acetate; **C_6H_{14}:** Petroleum Ether; **CH_3OH:** Methanol; **$CHCl_3$:** Chloroform; **CH_3COCH_3:** Acetone; **C_2H_6O:** Ethanol; **C_7H_8:** Toluene; **NH_3:** Liquor Ammonia; **HCl:** Hydrochloric Acid; **H_2SO_4:** Sulphuric Acid; **CH_2O_2:** Formic Acid; **CH_3COOH:** Acetic Acid; **$Pb(C_2H_3O_2)_2$:** Lead Acetate; **$FeCl_3$:** Ferric chloride; **HNO_3:** Nitric Acid; **NaClO:** Sodium Hypochloride; **I_2:** Iodine Solution; **H_2O:** Distilled Water; **UV:** Ultraviolet; **SD:** Standard deviation.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest regarding the publication of this paper.

AUTHOR CONTRIBUTIONS

Amit Rishi: Writing - original draft, Formal Analysis, Conceptualization. Harpreet Singh: Writing-review and Editing, Supervision, Conceptualization, Visualization. Both the author have reviewed and approved the final version of the manuscript.

SUMMARY

The goal of the current study on *Soymida febrifuga* (Roxb.) A. Juss., also referred to as Indian Red Cedar, was to develop thorough pharmacognostical and physicochemical standards for the plants stem bark. A significant medicinal species in the *Meliaceae* family, used to treat a variety of skin conditions, including fever, inflammation, and ulceration. There has not been much scientific evidence to establish its identity or quality standards, nevertheless. The macroscopic features showed a rough, reddish-brown exterior with a distinct smell and harsh taste. Important anatomical characteristics that act as diagnostic markers for the plant material were revealed by microscopic analysis, including cork cells, lignified fibers, parenchymatous cells, calcium oxalate crystals, and capillaries. Moisture content, total ash, acid-insoluble ash, water-soluble ash, and extractive values in various solvents (alcohol and water) were all determined during the physicochemical analysis. These metrics offer baseline information for evaluating the crude drug's identification, quality, and purity. The findings suggested the existence of a variety of phytoconstituents, indicating that the bark contains a moderate number of extractable elements. The results of this study provide important information for *Soymida febrifuga* stem bark standardization, authentication, and quality control. To produce herbal formulations and avoid adulteration in the herbal medication industry, such parameters must be established.

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