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Original Article

Establishment of Quality Parameters for Leaf, Stem and Root of *Sonchus wightianus* DC. through Pharmacognostical Standardization

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ABSTRACT

The present communication attempts to evaluate the pharmacognostical, physicochemical and phytochemical studies on the leaf, stem and root of *Sonchus wightianus* DC. (Family-Asteraceae). *S. wightianus* is a tall perennial herb, 0.6-1.5 m high, with a tuft of radical leaves. Pharmacognostic studies have not been carried out so far in this plant. So, the present study was undertaken to evaluate pharmacognostic characters of leaf, stem and root of *S. wightianus*. Leaf transverse section showed presence of uniseriate trichomes, anomocytic stomata, oil globules. Lignified spiral, scalariform vessels, vittae are observed in stem powder microscopy. In root powder cork cells with oil globules, phloem fibres and starch grains are observed. Physicochemical studies of leaf, stem and root shows, total ash (19.65, 9.5, 5.2%), acid insoluble ash (0.9,0.8,0.5%), alcohol soluble extractive values (18.08,6.24,5.6%), and water soluble extractive values (42.4,17.92,39.2%) respectively. Phytochemical analysis revealed the presence of phenols, terpenoids, carbohydrates, glycosides and flavonoids.

Key words: *Sonchus wightianus*, anomocytic stomata, scalariform vessels, total ash, extractive values.

1. INTRODUCTION

Pharmacognosy is the systematic study of crude drugs derived from natural sources, mainly from plants. It basically deals with standardization, authentication and study of natural drugs[1]. Most of the research in pharmacognosy has been done in identifying controversial species, authentication of commonly used, rarely available traditional medicinal plants through morphological, phytochemical and physicochemical analysis. This type of studies will help in

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authentication of the plants and ensures quality of crude drugs which will lead to safety and efficacy of natural products[2]. *Sonchus* genus name comes from the Greek word meaning, "Hollow" which refers to hollow stems[3]. *Sonchus wightianus* is distributed throughout India, Nepal, Sri Lanka, Afganistian and Pakistan[4]. The plant is diuretic, good in chronic fevers[5]. Its leaves are reported for its antibacterial activity[6], antimotility effect[7]. Root decoction (one teaspoon, two times daily) is taken to check diarrhea, crushed leaves are directly applied on minor cuts to check bleeding[8]. Leaves are used to treat abscess, boils[9]. Researchers have found that the *Sonchus* genus plants have antidiabetic, antioxidant, anti-tumor anti-ageing activities[10,11]. Ethnobotanical information revealed that various parts of *Sonchus* genus are used in jaundice, deafness, gout, cough, bronchitis, asthma, eye diseases, appendicitis, tonsillitis and in sore throat[12]. Despite the great significance of *Sonchus* species, much work has not been reported on Pharmacognosy of different plant parts of *Sonchus wightianus*. Hence pharmacognostical standardization including macroscopy, organoleptic characters, transverse section, powder micropy, physicochemical parameters, preliminary phytochemical standards of *Sonchus wightianus* DC. were determined.

2. MATERIALS AND METHODS

Chemicals and instruments

All the solvents used for the study were of laboratory grade. Compound microscope, watch glass, glass slides, cover slips and other common glassware's were used in this experiment. Photomicrographs were taken with using Leica DM 1000 LED microscope attached with Leica EC3 camera. Chloral hydrate was procured from Tokyo Chemical Industry Co., Ltd; Tokyo, Japan. Phloroglucinal, iodine, picric acid and all other reagents were procured from Sisco Research Laboratories Pvt. Ltd; Maharashtra, India.

Collection of Plant materials

The whole plant of *Sonchus wightianus* DC. was collected from Hooghly district, Kolkata, India. Authentication of plant was done in Department of Pharmacognosy, Central Ayurveda Research Institute for Drug Development, Kolkata. Fresh plant parts were used to study the macroscopic and histological parameters; whereas shade dried powdered leaf, stem and root material was used for the microscopical, physico-chemical and preliminary phytochemical investigations.

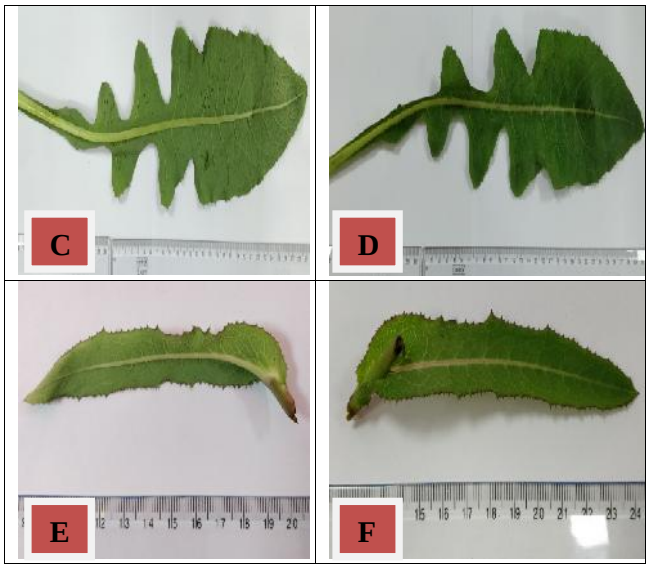

Fig. 1: Morphology of root, stem and leaf of *Sonchus wightianus* DC.
A. Root; B. Stem; C. Lower leaf ventral surface; D. Lower leaf dorsal surface; E. Upper leaf ventral surface; F. Upper leaf dorsal surface

Macroscopy

Macroscopical evaluation was done by observing the leaf, stem and root under simple microscope and with the naked eyes and taking note of the colour, size, odour and other diagnostic parameters. Different macroscopic parameters of the leaves, stem and root were noted. Evaluation of the leaves included the observation of type of leaf, shape, arrangement, apex, margin, venation, base, texture *etc*[13].

Histological studies

For qualitative microscopic analysis, freehand transverse sections of the leaf, stem and root were made using razor blade. Lignified, cellulosic and other identifying features were studied by staining the sections with safranin dye, phloroglucinol in concentrated HCl and 0.02N iodine reagent. Photomicrographs of all the sections in different magnifications were taken[14].

Powder microscopy

The coarsely powdered leaf, stem and root of *S. wightianus* were studied under the microscope. All the powders were macerated in chloral hydrate reagent. The macerated powder was then stained with phloroglucinol, iodine reagents separately. Small quantities of the various stained powders were mounted on a slide with glycerine. Photomicrographs of the different cellular structures and inclusions were taken[15].

Physicochemical studies

Physicochemical parameters such as foreign organic matter, total ash, acid insoluble ash, alcohol and water soluble extractives as well as loss on drying of various plant parts were determined according to standard methods[16].

Phytochemical screening

Preliminary phytochemical screening was performed by using standard procedures. The aqueous, alcohol soluble extracts of leaf, stem and roots obtained were diluted with

respective solvents and subjected to chemical tests for the detection of different phyto constituents like alkaloids, glycosides, phenols, volatile oils, flavonoids *etc*[17].

3. RESULTS AND DISCUSSIONS

Macroscopy

Morphology of root: Roots are glabrous, divided into primary root (tap root), secondary root. Primary root is cylindrical, having profuse secondary roots. Primary root is 16 cm in length. Secondary roots are 2-6 cm. Fresh roots are odorless, cream in color outside, white color inside.

Morphology of stem: Fresh stem is branched from base, erect, glabrous, and green in color. Stems have fine ridges and usually branch only in the floral array.

Morphology of leaves: Fresh lower leaves having rosulate base, narrowly inverted-lanceshaped, sub acute, deeply lobed, runcinate-pinnatifid; middle and upper stem leaves are slightly lobed, all with spiny-toothed margins; are arranged alternately i.e. one leaf per node along the stem, without characteristic odour. They are lanceolate in shape with acuminate apex having arcuate venation. All these leaves clasp the stems at their bases to a greater or less extent. The ventral surface is medium to dark green and dorsal surface are light green and sparsely short-pubescent. Lower leaves are larger than upper leaves. Lower leaves are 35- 43 cm in length, 3-4 cm in diameter. Upper leaves are 10-14 cm in length, 0.5.-1.5 cm in diameter.

Histological studies

Microscopy of Leaf: The transverse section of *S. wightianus* leaf shows that the leaf is dorsiventral, with midrib and lamina.

Midrib: The mid rib portion is almost spherical with a large portion on the lower side. The epidermis is usually made up of a single layer of uniseriate barrel shaped cells that are closely packed. Trichome developed from the upper epidermis, uniseriate in nature. Below which there are layer of collenchynma. Vascular bundles are of conjoint, collateral and closed. Xylem is present towards the upper epidermis, while the phloem towards the lower epidermis. Vascular bundles are surrounded by a compact layer of parenchymatous cells called bundle sheath or border parenchyma. Xylem consists of metaxylem vessels and protoxylem vessels. Protoxylem vessels are present towards the upper epidermis. The minute openings found on the epidermis are called stomata. It is anomocytic type of stomata, is distributed on the lower epidermis. A stoma is surrounded by a pair of bean shaped cells called guard cells. Oil globules are scattered throughout the parenchymatous cells.

Lamina: The entire tissue between the upper and lower epidermis is called the mesophyll. There are two regions in the mesophyll. They are palisade parenchyma and spongy parenchyma. Palisade parenchyma cells are seen beneath the upper epidermis. It consists of vertically elongated cylindrical cells in one or more layers. These cells are compactly arranged without intercellular spaces. Spongy parenchyma lies below the palisade parenchyma. Spongy cells are irregularly shaped. These cells are very loosely arranged with numerous airspaces. As compared to palisade cells, the spongy cells contain lesser number of chloroplasts. Stomata present on the spongy parenchyma. The air space that is found next to the stoma is called respiratory cavity or sub-stomatal cavity.

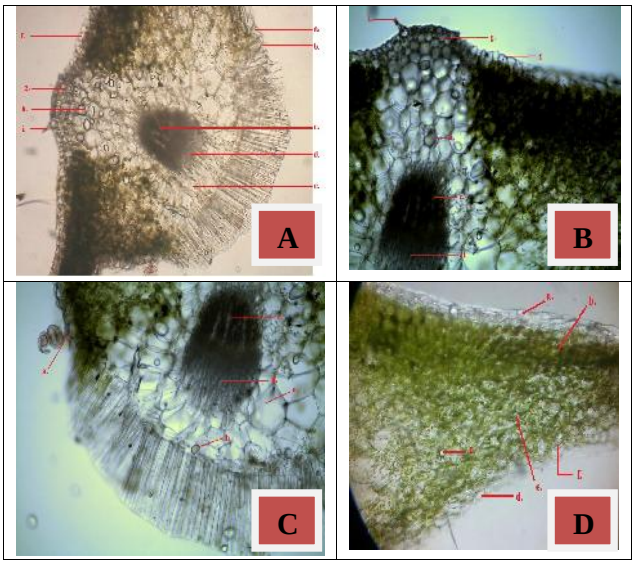

Fig 2 : Transverse section of leaf

A. Midrib B. Midrib (upper portion) C. Midrib (Lower portion)
a. Lower epidermis; b. Stoma; c. Xylem; d. Phloem; e. Collenchyma; f. Upper epidermis; g. Collenchyma; h. Oil globule; i. Trichome.
D. Lamina- *a. Upper epidermis; b. Palisade tissue; c.Oil globule; d. Lower epidermis; e.Spongy tissue; f. Stoma.*

Histology of stem

The stem, in cross-section, shows circular contour with coating system represented by a epidermis. It is the outermost uniseriate zone, consisting of tubular cells attached end on end without leaving intercellular spaces. Cortex occurs next to epidermis and represents the extra stelar ground tissues. Just internal to epidermis there are a few layers of collenchymatous, usually angular ones, forming a continuous band. This collenchymatous band meant for gving mechanical support to the growing stem. Vascular bundles are conjoint, bicollateral, open and endarch. Each vascular bundle consists of centrally located xylem, surrounded on its outer and inner faces by strips of outer and inner cambia. Outside the outer cambium is present a patch of outer phloem, and inner to the inner cambium is present the inner phloem, thus representing the open and bicollateral condition of vascular bundles. Xylem consists of wide vessels present on the outer side representing the metaxylem and narrow vessels present towards inner side representing the protoxylem. Cambium is present in the form of strips on both the sides of the xylem. Phloem is situated in the form of patches of outer phloem and inner phloem. Thin-walled polygonal parenchymatous cells of ground tissue from the pith.

Histology of root

In cross-section, the root of *S. wightianus* presents a circular contour. It was observed the development of secondary growth with the presence of peridermis, composed of two to three layers of suber. The cortical region consists of about ten layers of parenchymatic cells. The endodermis is uniseriate and has casparian strips. Secretory cavities are found associated with the endodermis. The vascular system is formed by xylem, which occupies the entire center of the central cylinder, and by phloem, located externally to the xylem. However, the phloem is not continuously but arranged in isolated clusters, associated with fibers.

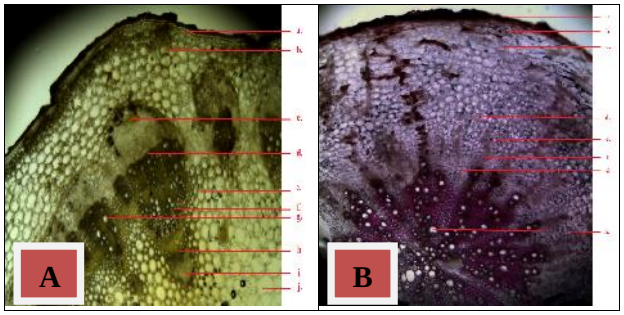

Fig 3: Transverse section of stem, root

A. **Stem-** *a. Epidermis; b. Collenchyma; c. Outer phloem; d. Outer cambium; e. Ground tissue; f. Proto xylem; g. Meta xylem; h. Innercambium; i. Inner phloem; j. Pith*

B. **Root-** *a. Suberise wall; b. Peridermis; c. Cortical parenchyma; d. Endodermis; e. Secretory cavity ; f. Fibre; g. Phloem; h. Xylem;*

Powder microscopy

Leaf powder microscopy

Leaf powder is pale green in color, without odour and taste. Powder microscopy showed anomocytic stomata, scalariform vessels.

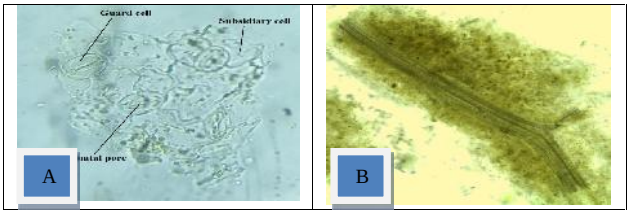

Fig 3: Powder microscopy of leaf

A. Stomata; B- Vessels

Stem powder microscopy

Stem powder is cream in color, with no taste and odour. Powder microscopy showed lignified spiral, scalariform vessels. Anomocytic stomata, vittae, bundle of lignified fibers, thick walled epidermal cells are observed.

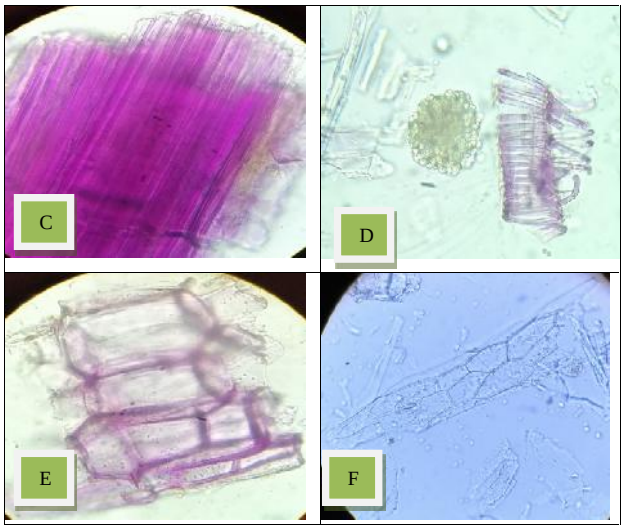

Fig 4 : Powder microscopy of stem

A- Spiral vessel; B- Scalariform vessel; C- Fibers; D- Vittae; E- Epidermis; F- Stomata

Root powder microscopy

Root powder is buff color with astringent taste, without odour. Powder microscopy showed thick walled cork cells with oil globules, lignified scalariform vessels, starch grains, group of oil globules, thin walled endosperm cells with oil globules, narrow lumen phloem fibres.

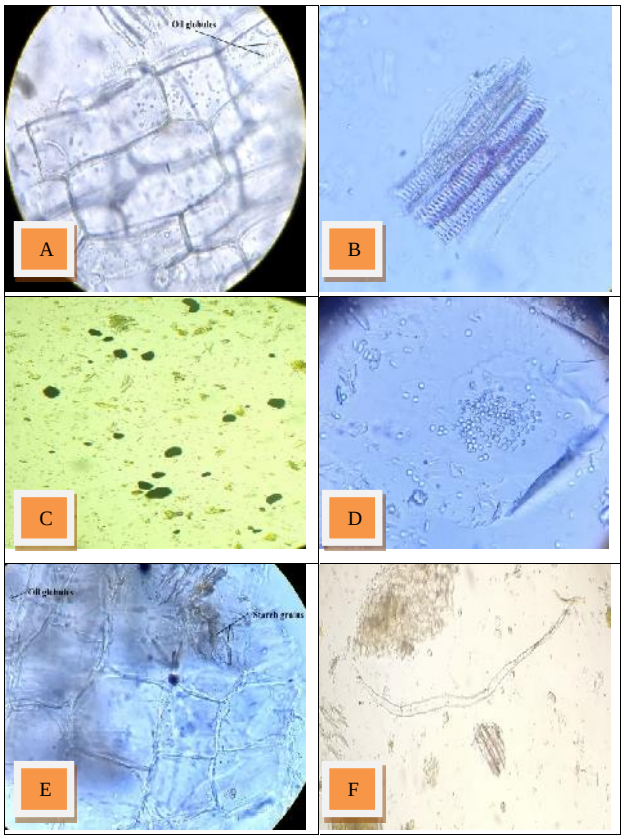

Fig 5 : Powder microscopy of root

A-Cork; B- Scalariform vessel; C- Starch grains; D- Vittae; E- Endosperm; F- Phloem fiber

Physicochemical studies

The results of physico-chemical parameters such as extractive values, ash values, moisture content, and foreign matter are shown in Table 1. The total ash values of leaf, stem and root were 19.65%, 9.5 and 5.2%. Water soluble extractives were 42.4%, 17.92% and 39.2%.

Table 1: Physico chemical parameters

Values obtained in percentage (%)				
S. No	**Parameters**	**Leaf**	**Stem**	**Root**
1	Foreign matter	0.7	0.2	1.3
2	Loss on drying	0.53	1.98	0.78
3	Total ash	19.65	9.5	5.2
4	Acid insoluble ash	0.9	0.8	0.5
5	Water soluble extractives	42.4	17.92	39.2
6	Alcohol soluble extractives	18.08	6.24	5.6

Phytochemical screening

The results of phytochemical screening are shown in Table 2. Preliminary phytochemical screening revealed that phenols are present in all extracts. Terpenoids are present in alcohol soluble extracts of leaf, stem and root.

Table 2: Preliminary phytochemical analysis

S. No	Chemical test for	AEL	EEL	AES	EES	AER	EER
1	Carbohydrates	+	+	-	-	+	-
2	Proteins	+	-	+	-	+	-
3	Alkaloids	-	-	-	-	-	-
4	Glycosides	+	+	-	-	+	
5	Phenols	+	+	+	+	+	+
6	Flavonoids	+	+	-	-	-	+
7	Terpenoids	-	+	-	+	-	+
8	Steroids	-	+	-	-	-	-

4. CONCLUSION

The present investigation established the qualitative and quantitative diagnostic features of leaf, stem and root of *S. wightianus* through histological, powder microscopical and physico chemical characters. Phytochemical analysis revealed that leaves of this plant possessing more chemical diversity than other parts. These results will help in standardization, identification and in carrying out further research in *Sonchus wightianus* plant.

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