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PHARMACOGNOSTICAL STANDARDISATION OF *TYPHONIUM ROXBURGHII* SCHOTT

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Abstract ***Typhonium roxburghii*** Schott of Araceae is a common medicinal plant. The corms possess rubifacient properties and they are used in diarrhea and for dermatitis. In South India, it occurs in Kerala and Karnataka. In Tamil Nadu, it is cultivated, and occurs as an escape. Pharmacognosy is an important link between pharmacology and medicinal chemistry. Pharmacognostical standards are prepared by systematic study of the drug. Morphological and anatomical descriptions of plants, pharmacognostical standards such as structural standards, analytical standards and physical constants were obtained by employing standard methods of analysis as described in Pharmacopoeia of India. The results of the present investigation provide dependable diagnostic features of the vegetative organs of the plant for the identity of the drug in entire and in fragmentary conditions.

Keywords: *Typhonium roxburghii, pharmacognosy, morphology, anatomy, physicochemical constants, phytochemistry*

INTRODUCTION

There are about 30 species of *Typhonium* (Airy, 1973), nine species in India and five in peninsular India (Karthikeyan *et. al*., 1989). *Typhonium roxburghii* Schott (Araceae) is distributed in South Asia from India through New Guinea and Sri Lanka; escaped in Africa and Neotropics (Nicolson, 1987). In India, it can be found in Southern and Eastern regions (Karthikeyan *et. al*., 1989). In South India, it occurs in Kerala and Karnataka. In Tamil Nadu, it is cultivated, and occurs as an escape. The species is native to Southern India, Sri Lanka, Malaysia and Indonesia (Nicolson and Sivadason, 1981). It grows in plains among grasses in open moist places. It is also grown as an ornamental plant for its evergreen leaves. The corms possess rubefacient properties and they are used in diarrhea (Agarval, 1997). Corms are reported to be used in Java for eruption on the skin (Anonymous, 1995) and for dermatitis, in Malaya (Timothy Johnson, 1999).

Phytochemical analysis carried out in the oil fraction of methanol extract of the corm showed the presence of methyl ester of 2-hydroxy benzoic acid, diethyl phthalate, palmatic acid ethyl ester, linoleic acid ethyl ester and bis 2-ethyl hexyl phthalate (Annie and John De, 2006)., The yellow viscous mass obtained from the petroleum ether fraction of the benzene extract of the corm induced insect mortality and the chemical constituents were identified as methyl ester of 2-hydroxy benzoic acid, diethyl phthalate and dioctyl phthalate (Annie and John De, 2012). Despite this interesting medicinal value, the taxon has not been subjected to systematic evaluation and phormacognosy so far.

Pharmacognosy is essential for the authentication and in determining the quality of the drugs. As deforestation leads to the extinction of many drugs, identification of the drugs becomes difficult. Hence, morphological and

anatomical descriptions of plants are needed. Pharmacognostical techniques used in standardization of plant material include its structural standards, analytical standards and physical constants. Pharmacognostical standards are prepared by systematic study of the drugs. This paper focuses on the pharmacognosy of the *hitherto* unexplored, medicinally valued *Typhonium roxburghii* Schott

MATERIALS AND METHODS

1. Collection and Macroscopic studies of the Plant

Collection of the plant was undertaken in Palayamkottai, Tamil Nadu. In determining the identity, Hooker's (1894) *Flora of British India*, Gamble's *Flora of the Presidency of Madras* (Fischer, 1928), Nicolson's (1987) Araceae in Dassanayake's *Flora of Ceylon*, Mohanan and Henry's (1994) *Flora of Thiruvananthapuram*, Kerala and more recent revisionary and other critical works were consulted. Voucher of the collection was incorporated at the Herbarium of St. John's college, Palayamkottai, Tamilnadu. Identification of the species was confirmed with authentic herbarium specimens. Mature and healthy plants were collected and morphological characters were studied. Plant was examined using a hand lens in the field and a dissection microscope in the laboratory and the characters were noted down. Photographs of the specimens taken are also provided for easy identification.

2. Microscopic studies

2.1. Anatomy

The fresh plant parts (leaf, petiole, underground stem and root) were collected, cleaned, cut into pieces and fixed in Formalin/acetic acid/ethanol (FAA; 70% ethanol: formalin: acetic acid, 18:1:1) The fixed materials were dehydrated in tertiary butyl alcohol series (Sass, 1940) cleared in xylol and embedded in paraffin wax (Melting point 58°-60°C). Sections of 10 µm thickness were cut in a rotary microtome, stained with toluidine blue (O' Brien *et.al.*,, 1964) and mounted by following the usual plant microtechnique (Johanson, 1940). The anatomical characters were determined using NIKON-Lab phot 2 – Photographic Trinocular Microscopic Unit, using normal light and polarized light. Measurement of cells was made with micrometer. The permanent slides are kept in the Department of Botany, St. John's College, Palayamkottai, Tamil Nadu, India.

2.2. Stomatal index

Stomatal index is the percentage, which the number of stomata forms the total number of epidermal cells, each stoma being counted as one cell (Salisbury, 1927). Fully developed leaves were cut into pieces of one sq. cm and boiled in 5% potassium hydroxide solution for 10 minutes. After thorough washings in water, the lower epidermal peels were taken off, stained with 1% aqueous safranin solution, and mounted in 50% glycerol. The stomatal index for a species is constant and was calculated by using the equation,

$$I = \frac{S \times 100}{E + S}$$

Where,

I = Stomatal index

S = Number of stomata per unit area

E = Number of epidermal cells in the same unit area

Averages of 10 measurements counting were taken after random sampling.

2.3. Starch grains and raphides

Finely powdered corms of the plants were mounted on glycerine as a thin film with Lugol's iodine solution and the characters of the starch grains and raphides were studied under light microscope. The sizes of starch grains and raphides were measured using micrometer and recorded.

3. Scanning Electron Microscopic study

Finely powdered and sieved samples (corm) were mounted on specimen stubs using Scotch double adhesive tapes and coated with gold to a thickness of 100 A° using Hitachi vacuum evaporator model HUS 5GB. Gold-coated plates were observed in a Hitachi Scanning Electron Microscope model S-450, operated at 15 KV and photographed.

4. Fluorescence analysis

The powdered sample and the extract of the powder in various solvents such as petroleum ether (40°-60°C), benzene, chloroform, methanol and water were examined under ordinary light and ultra violet light (365 nm and 255 nm). The powder was also treated with various chemical reagents and the change in colour due to fluorescence on exposure to UV light (365 nm and 255 nm) was recorded.

5. Physicochemical characters

The percentage of loss of weight on drying, total ash, acid-insoluble ash, water-soluble ash, sulphated ash and residue on ignition were obtained by employing standard methods of analysis as described in Pharmacopoeia of India (Anonymous, 1996).

6. Phytochemistry

6.1. Preliminary phytochemical analysis

10 g of the powdered sample was successively extracted with 200 ml of petroleum ether (40°-60°C), benzene, chloroform, and methanol in a Soxhlet apparatus. The different extracts were tested for the steroids, sugars, reducing sugars, triterpenoids, alkaloids, phenolic compounds, flavonoids, catechins, saponins, tannins, anthroquinones and amino acids (Gurdeep, 1983).

6.2. Thin-Layer Chromatography

The petroleum ether (40°-60°C), benzene, chloroform and methanol extracts of the powdered sample were subjected to thin-layer chromatographic analyses.

6.3. Paper Chromatography

The water extract of the dry powder was subjected to paper chromatographic studies using Whatmann No. 1 filter paper. Identification of amino acids by paper chromatography was also performed **(**Sadasivam and Manickam., 1996).

6.4. Detection of cyanogenic glycosides

10 g of the fresh corm was cut into pieces and placed in a conical flask

with 1 N HCl. The cut pieces were soaked in diluted hydrochloric acid for a few hours. HCN formed. A drop of sodium hydroxide and ferrous sulphate solution was taken in a filter paper. HCN solution was added to the impregnated filter paper. Appearance of Prussian blue colour shows the presence of cyanogenic glycosides (Sim, 1988).

6.5. Quantitative estimations

Quantitative estimations of starch, sugars, lipids, amino acids, proteins, nitrogen, phenolic compounds, flavonoids, calcium, sodium, potassium and iron were carried out according to AOAC, (2001).

RESULTS AND DISCUSSION

Morphological features

Cormous herb; corm subglobose 2.5 – 3.5 cm thick, rooting at top. Roots contractile. Petiole ca. 15 cm long, sheathing in lower third. Blade usually 3-lobed, usually broader than long 4 - 8 X 5 - 13 cm. Inflorescene emits unpleasant odour in early morning. Peduncle ca. 4 cm long. Spathe 15 - 25 cm long, lower portion persistent, upper portion ovate-lanceolate, withering, dark red to purple, usually 3-4 times longer than broad, usually twisted at tip. Spadix shorter than spathe, pistillate portion ca. 0.5 cm long, pink; sterile flower portion up to 1 cm long; sterile flowers curved with yellowish acicular down curved tips, interstice naked, ca. 1.5 cm long, staminate flower portion ca. 1 cm long, coral pink; appendix dark red to purple, tapering above, 10-15 cm long, sterile. Berries few, ovoid, seeds 1 - 2.

Anatomical features

Lamina

Dorsiventral. Epidermis is single layered and composed mainly of isodiametric cells, more or less barrel shaped. Cuticle is thin and smooth. Stomata are present on abaxial and adaxial surfaces, paracytic and cyclocytic. Undulation of the sidewalls of the epidermal cells is less pronounced on both the surfaces. Mesophyll includes single layered palisade in the adaxial surface and 2-3 layered spongy parenchyma in the abaxial surface. Palisade is transcurrent. Below the epidermis, thick-walled hypodermis is present at the region of thick veins. The vascular tissue is organized into many discrete vascular bundles, xylem consisting of tracheids and thin-walled parenchyma. Xylem occupies adaxial and phloem abaxial positions. Raphide sacs containing bundles of calcium oxalate is common in mesophpyll.

Petiole

Outline is wavy in cross section. Epidermis is single layered with thick cuticle. Sclerenchymatous strand is discontinuous and present below the raised portion of the epidermis. Parenchymatous ground tissue with cells of varied sizes is arranged with intercellular spaces. Vascular bundles are many and arranged irregularly consisting of tracheary elements and parenchyma. Each vascular bundle has one file of wide metaxylem elements and a phloem strand; some include extended protoxylem.

Corm

The transverse section of unpeeled corm of *Typhonium roxburghii* shows epidermis replaced by a corky layer. Cork is many layered with thin-walled cells in radial rows. Small, condensed, amphivasal vascular bundles are scattered in the parenchymatous ground tissue. Fibres are absent. There is no sclerenchyma. Xylem consists of a few tracheids associated with parenchyma. The parenchymatous cells contain abundant starch grains. Tannin cells are present. Calcium oxalate in the form of needles is found in clusters in raphide sacs. Internal periderm is observed.

Root

Epidermis is uniseriate. Cortex is parenchymatous and lacunate. Endodermis is distinct. Xylem strands alternate with phloem units. Xylem constitutes vessels, tracheids and associated parenchyma. Xylem is exarch. The large vessels extend to the innermost portion of the root, thus reducing the pith. Tannin cells are present.

Stomatal index

The stomatal index in *T. roxburghii* is 12.3. Stomatal index is constant for any species and has been proved useful for distinguishing leaflets of Indian from those of Alexandrian Senna and leaves of *Atropa belladonna* from those of *Atropa acuminata*.

Starch grains and calcium oxalate crystals

When examined by polarized light, using crossed nicols, starch granules appear as luminous objects on a black background. When the nicols are rotated through a right angle, the field becomes bright while the granules are dark with a bright cross representing the position of the hilum. Starch grains in the corm of *Typhonium roxburghii* consists of granules that are fairly uniform in size, measuring 5 - 30 µ, mostly 15-20 µ in diameter. They are polyhedral with blunt angles or more or less rounded. In the centre, there is often a cleft, representing the position of the hilum. The granules are smooth, simple or compound (2-12). Bundles of acicular raphides are present in raphide sacs. The length of the calcium oxalate needles are 50 - 110 µ, mostly over 70 µ. A few needles with blunt ends were also observed. They are short and oblique rhomboid.

Notes:

When the powdered sample was observed under the light microscope, phenolic compounds in the form of yellow and pink patches were observed along with the remnant of the cells, starch grains, and calcium oxalate crystals.

The gross morphology gives definite information about the drug. Morphological characters for the identification of the taxon have been described and photographs are displayed (Plate 7). Microphotographs showing the anatomical characters of the plant are displayed (Plates 8 and 9). Druses are common. The taxon shows a transition between cyclocytic and paracytic stomata and it is amphistomatic. This has been quite regularly used for many years by pharmacognosists when identifying and maintaining acceptable standard of purity for crude drugs (Tomlinson, 1969). Undulation of leaf

epidermal cell wall is less pronounced. Most undulations of the sidewalls of the epidermal cells appeared in leaves grown in shade (Watson, 1942). Variation in the epidermal structure has been extensively exploited for the purpose of taxonomy and phylogeny in vascular plants (Ghouse and Mohd, .

1972). The polarized light was very much useful to detect the lignified elements, crystals and starch grains. The identity of many adulterants of drugs can be established or confirmed by an examination of calcium oxalate crystals (Wallis, 1997)

Plate – 7

***Typhorium roxburghii* schott**

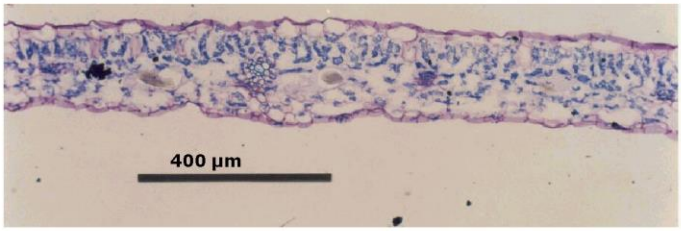
7.1. ***Typhorium roxburghii*** **– Potted plant**

7.2. ***Typhorium roxburghii*** **With inflorescence**

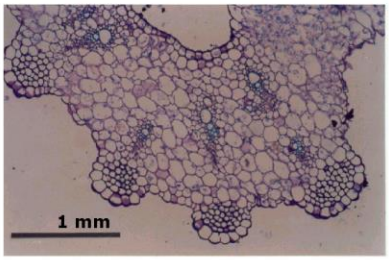
7.3. Corm

Plate – 8

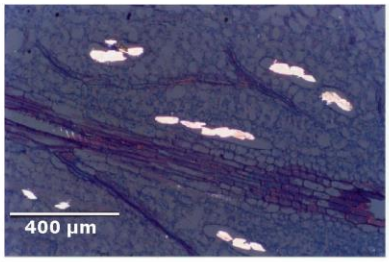
Typhorium roxburghii **- Leaf**



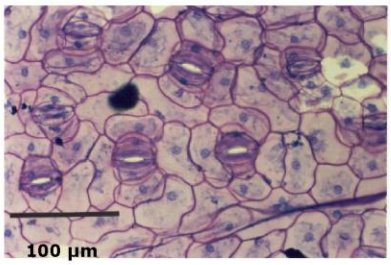
8.1. Leaf lamina T.S.



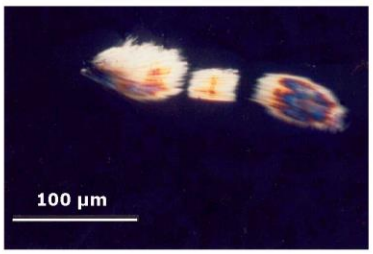
8.2. Mid-rib T.S.



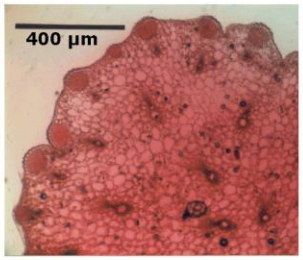
8.3. Leaf Paradermal section



8.4. Leaf Paradermal section – paracytic stomata



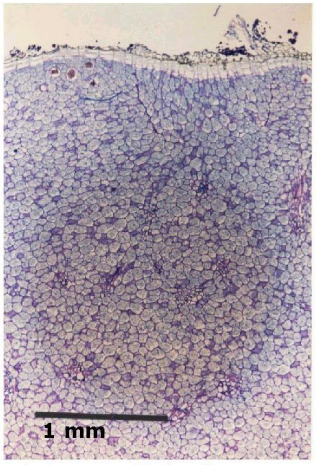
8.5. Leaf section (Polarised Light)



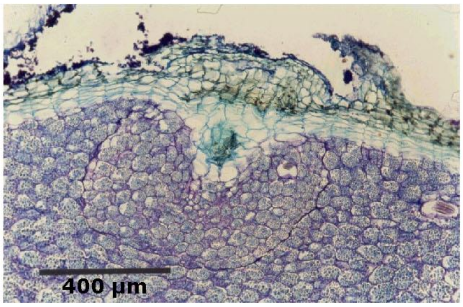
8.6. Petiole T.S.

Plate – 9

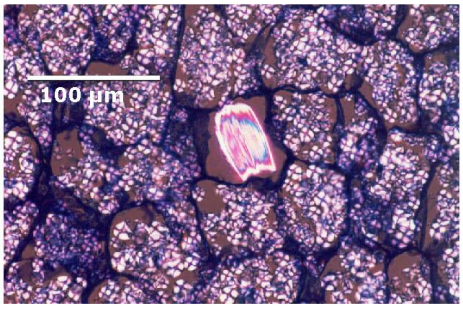
Typhorium roxburghii **- Corm**



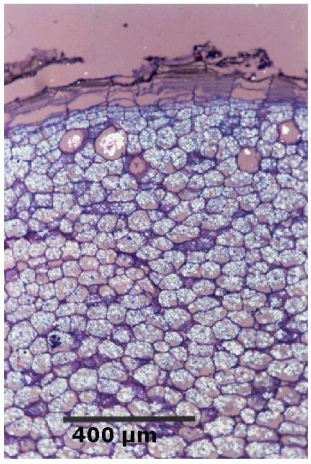
9.1. Corm T.S. - Outer sector



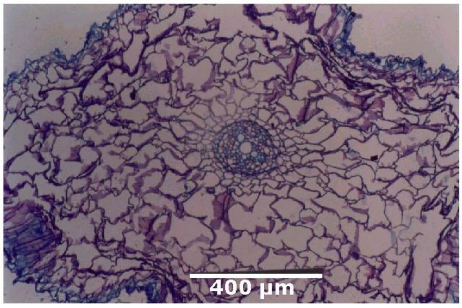
9.2. Corm T.S. - Periderm tube



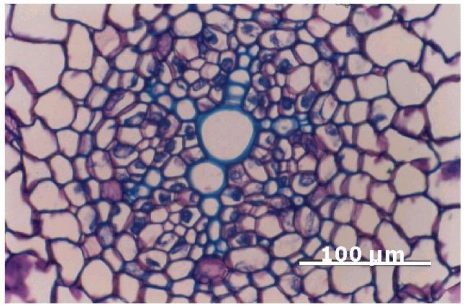
9.3. Corm T.S. - Inner sector (Plorised Light) Starch grains and raphides



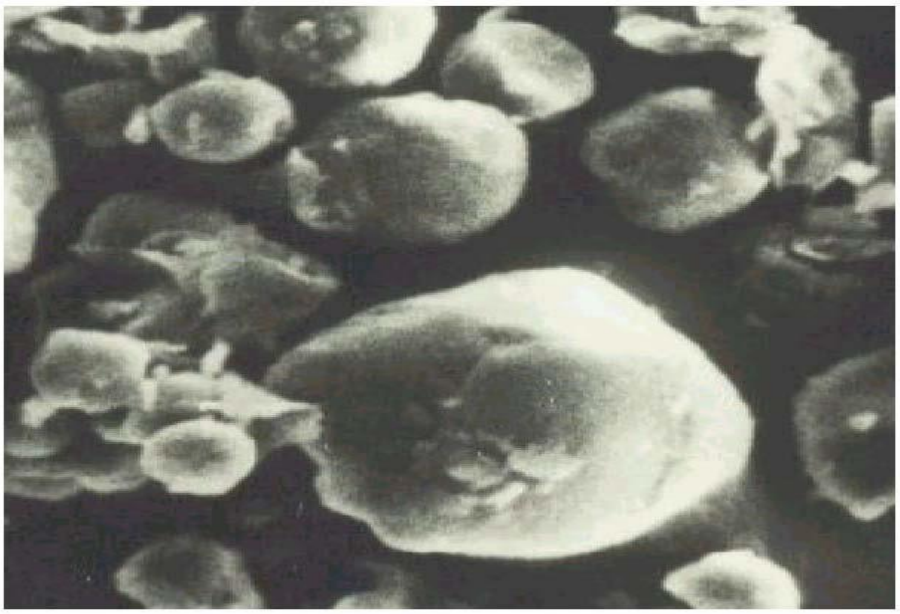
9.4. Corm T.S. - Outer Sector (Polarised Light)



9.5. Root T.S.



9.6. Root T.S. - Stelar portion



Scanning Electronmicrograph of Starch grain of *T. roxburghii*

Phenolic compounds in the form of pink and yellow patches have been observed in the dry powder of corm. Presence of colouring matter also may be of assistance for the identification of the drugs and the deduction of adulterants.

The shape of the starch granule, its size and position of its hilum vary with the species and therefore are important elements for microscopical identification (Jean, 1999). The diameter of the starch granules assists in distinguishing varieties of Ipecacuanha and in distinguishing Cassia bark from Cinnamon and in detecting Senna stalk in powdered Senna leaf (Wallis, 1997). Hence, the Scanning Electron Microscopic study on the starch grains of the species will be of great use in confirming the identity of the crude drug.

The results of fluorescence analyses of the dry powder of the taxa are presented in Table 1**.** Many alkaloids, in the solid-state show distinct colours, when placed under the UV lamp. The reaction of the various chemical compounds present in the dry powder of the plant drug with different acid and alkali shows the colour change and the fluorescence can be determined under UV light. Drugs such as Hydrastis, Calumba, Viburnum and wild Cherry bark show brilliant effect in ultraviolet light and these may be used to aid in identification and to detect certain adulterants, which do not exhibit a similar fluorescence (Kokate , 1997).

Table 1 - Fluorescent character of the powder of *T. roxburghii* (Corm)

S.No.	Particulars of treatment	Under ordinary light	Under UV light	
			365 nm	255 nm
1.	Powder as such	Colourless	Pale yellow	Brilliant white
2.	Powder + 1N NaOH (ethanolic)	Yellowish brown	Yellow	Brilliant white
3.	Powder + 1N NaOH (aqueous)	Yellowish brown	Yellow	Brilliant white
4.	Powder + HCl (1:1)	Yellowish brown	Yellowish brown	Brown
5.	Powder + H_2SO_4 (1:1)	Pale Yellow	Pale yellow	Brilliant white
6.	Powder + HNO_3 (1:1)	Brown	Yellowish brown	Brown
7.	Extracts			
	a) Petroleum ether (40° - 60°C)	Pale yellow	Pale yellow	White
	b) Benzene	Yellow	Greenish yellow	Brilliant white
	c) Chloroform	Yellowish brown	Yellow	Brilliant white
	d) Methanol	Yellowish brown	Yellow	Very brilliant white
	e) Water	Yellowish brown	Yellow	White

Table 2 shows the physicochemical characters of the drug. The physicochemical characters such as percentage of loss of weight on drying, total ash, acid-insoluble ash, water-soluble ash, sulphated-ash, residue on ignition of the sample was determined. These values are rarely constant for drugs, but may be within a range.

Table 2 - Physicochemical characters of the corm of *T. roxburghii*

S.No.	Characters	*Typhonium roxburghii* (Corm)
1.	Percentage of Loss of weight on drying	61.15
2.	Percentage of Total ash	5.52
3.	Percentage of water- soluble ash	1.53
4.	Percentage of acid- insoluble ash	0.83
5.	Percentage of residue on ignition	4.23
6.	Percentage of sulphated ash	6.23

Loss of water in the sample is principally due to water; small amounts of other volatile materials also contribute to the weight loss. The moisture content of a drug should be minimized in order to prevent the decomposition of crude drugs due to either chemical change or microbial contamination. The total ash usually consists mainly of carbonates, phosphates, silicates, and silica. The ash value is a criterion to judge the identity or purity of the crude drugs. In sulphated-ash determination, all oxides and carbonates are converted to sulphates. The sulphated-ash content is more than the total ash content. The water-soluble ash is used to detect the presence of material exhausted by water. Exhausted ginger and tea leaves are determined by water-soluble ash (Wallis, 1997). Acid insoluble-ash, which is a part of total ash, insoluble in diluted hydrochloric acid is also recommended as standard for certain drugs. Adhering dirt and sand may be determined by acid-insoluble ash content. Excessive earthy matter is likely to occur with roots and corms.

The percentages of solvent soluble extractives with reference to the powdered sample are given in Table 3**.** The extractive values of the methanol and aqueous extracts are generally high when compared to the other extractive values of the less polar solvents. Ether soluble extractive represents fat, volatile oil, resin, fixed oil or colouring matter present in the drug. Methanol is an ideal solvent for the extraction of various chemicals like tannins, flavonoids, amino acids and phenolic compounds. Water-soluble active constituents chiefly include tannins, sugars, plant acids, mucilage and glycosides. The determination of different solvent soluble extractive values is used as means of evaluating drugs, the constituents of which are not estimated by other means. Nevertheless, as suitable assays become available the extractive tests are no longer required as pharmacopoeial standards.

Table 3 - Solvent soluble extractive values of the corm of *T. roxburghii*

Name of the plant	Name of the solvent	Percentage of extractive values
Typhonium roxburghii (Corm)	Petroleum ether (40° - 60°C)	3.92
	Benzene	8.66
	Chloroform	12.56
	Methanol	17.34
	Water	22.26

The results of the fluorescent analyses (Table 1), physicochemical characters (Table 2), extractive values (Table 3), Preliminary phytochemical screening (Table 4), Thin layer chromatographic studies of the various extracts (Table 5), Paper chromatographic studies of the water extract (Table 6), Elemental analysis of the corm of *T. roxburghii* (Table 7) Paper chromatographic analysis of amino acids (Table 8) and Quantitative estimation of total sugars, starch, amino acids, proteins, lipids, total phenolic compounds and flavonoids (Table 9) of the corm are presented.

Table 4 - Preliminary phytochemical screening of *T.* (Corm)

S.No.	Phytochemicals	Petroleum ether (40° -60°C) extract	Benzene extract	Chloroform extract	Methanol extract
1.	Steroids	+	+	+	+
2.	Triterpenoids	-	-	-	+
3.	Reducing Sugars	+	+	+	+
4.	Sugars	+	+	+	+
5.	Alkaloids	-	+	-	-
6.	Phenolic compounds	-	-	-	+
7.	Flavonoids	-	-	-	+
8.	Catechins	-	-	-	+
9.	Saponins	-	-	-	+
10.	Tannins	-	-	+	+
11.	Anthroquinones	-	-	-	-
12.	Amino acids	-	-	-	+

- Absent
+ Present

Table 5 - Thin layer chromatographic studies of the various extracts of the dry powder of the corm of *T. roxburghii*.

Name of the extract	Solvent system used	Rf values of spots obtained by viewing under UV light (365 nm)	Rf values of spots obtained by keeping plates in an Iodine chamber
Petroleum ether (40° – 60° C)	Petroleum ether (40° – 60° C): Benzene (5:1)	Brown 0.15	0.15^{θ}
Benzene	Benzene: Chloroform (4:1)	Yellow 0.13 Orange 0.42 Brown 0.50	$0.13^{\bullet}$ 0.25° 0.50°
Chloroform	Chloroform: Methanol (9:1)	Brown 0.2 Orange 0 .93	0.20^{θ}

Methanol	Chloroform: Methanol (6:1)	Yellow 0.19 Dark Brown 0.93	0.09• 0.16θ 0.25• 0.93•

- Intense

θ Moderately intense

○ Faint

Table 6 - Paper chromatographic studies of the water extract of the dry powder of *T. roxburghii* corm

Solvent system used	Rf values of the spots obtained by viewing under UV light	Rf values of the spots obtained by keeping the paper in an Iodine chamber
	Typhonium roxburghii	*Typhonium roxburghii*
n-butanol : acetic acid : water (1:1:2)	Brown 0.85•	0.85°
Methanol: Water (1:1)	Dark brown 0.76• Dark brown 0.85•	0.76° 0.85°

• Intense

° Faint

Table 7 - Elemental analysis of the corm of *T. roxburghii*

Name of the plant	Calcium mg/gdw	Sodium mg/gdw	Potassium mg/gdw	Iron mg/gdw
Typhonium roxburghii (Corm)	3.14	0.001	0.24	0.033

Table 8 -Paper chromatographic analysis of amino acids of the corm of *T. roxburghii*

S.No.	Aminoacids	Rf value	Name of the plant
			Typhonium roxburghii (Corm)
1.	Arginine	0.21	+
2.	DL-asparticacid	0.25	+
3.	DL-calamine	0.38	+
4.	DL-serine	0.28	+
5.	DL-Threonine	0.37	+
6.	DL-Tryptophan	0.63	+
7.	DL-valine	0.54	-
8.	Glycine	0.30	+
9.	Histidine	0.20	-
10.	L-cystine	0.12	+
11.	L-glutamicacid	0.34	+
12.	L-Leucine	0.58	+
13.	L-Proline	0.41	-
14.	L-Tyrosine	0.56	+
15.	Lysine	0.15	+

- Absent
\+ Present

Solvent system – n-butanol: acetic acid: water (4:1:5)

Table 9 - Quantitative estimation of total sugars, starch, amino acids, proteins, lipids, total phenolic compounds and flavonoids in the corms of *Typhonium roxburghii*

Name of the Plant	Total Sugars mg/gdw	Starch mg/gdw	Amino acids mg/gdw	Proteins mg/gdw	Lipids mg/gdw	Total Phenolic compounds mg/gdw	Flavonoids A/gdw
Typhonium roxburghii (Corm)	105.66	585.50	31.33	97.50	9.46	31.25	3.65

gdw = gram dry weight
A = Absorbance

Rf values obtained by thin layer chromatography patterns are useful to establish their identity and purity of the herbs. Stahl (1969) has discussed in detail, the importance of Thin-Layer Chromatography as a legally binding method for characterization of drugs. Cyanogenesis, the ability to produce hydrocyanic acid (HCN) is common among Araceae. HCN does not occur free in higher plants but is released from cyanogenic precursors as the result of enzymatic action. Presence of triglochinin glycoside has been reported in *Alocasia, Anthurium, Arum, Dieffenbachia, Lasia, Pinellia* of Araceae (Jean, 1999).

In the present investigation also, the corm of *T. roxburghii* was found to possess cyanogenic glycosides. Usually in the underground stems, the amount of starch is higher than the amount of sugar, because starch is the reserve food material in the corms of the plants. Phenolic compounds are important constituents of some medicinal plants. In food industry, they are utilized as colouring agents, flavourings, aromatizers and antioxidants. Phenolic classes of pharmaceutical interest are tannins, coumarins, anthroquinones, napthoquinones, flavones and related flavonoid glycosides, anthocyanidins, lignans and other simple phenolic compounds. In plants, phenolic compounds play an important role in disease resistance. Phenols are also involved in the protection of herbs from browsing animals. Flavonoids are generally present in high amount in the plants growing in high altitude, because they absorb UV radiation. Flavonoids include the colouring agents of plants. Flavonoids are essentially used to treat capillary and venous disorders, alone or in combination with other drugs, they are the common ingredients of vascular protective agents and venous tonic (Kokate, 1997). The high calcium content is probably due to the presence of calcium oxalate crystals in the corms and free calcium. Inorganic elements play an important role in various physiological processes. There are evidences for using plants as indicators for mineralization.

It should be remembered, however, biosynthesis of *secondary* metabolites although genetically controlled, is affected by environmental influences. The soil, the season and the gathering time are some of the important variable factors with plants and it can hardly be expected that the amount of constituents would be constant under all conditions. These results could be used as a diagnostic tool for the identification of the species. The amino acid profile is a consistent character because they are genetical.

CONCLUSION

Pharacognostical study on the medicinal plant *Typhonium roxburghii* Schott has been reported for the first time. The macroscopical or morphological description of this taxon helps in identification of the plant. Microscopical study in entire and powdered form of the drug is one of the aspects of histological evaluation. The size, shape and structure of the starch granules and length of calcium oxalate crystals from any particular plant only vary within definite limits, so that it is possible to distinguish the starches derived from different species. Hence, the study of starch grains and calcium oxalate crystals is useful in confirming the identity and purity of the drug.

The physicochemical constants, extractive values, fluorescence analysis of the dry powder of the corms have been determined by employing standard methods of analysis as described in Pharmacopoeia of India. Based on the pharacognostical parameters studied, it is possible to fit standard for the drugs. Thus, the results of the present investigation provide dependable diagnostic features of the vegetative organs of the plants for the identity of the drug in entire and in fragmentary conditions.

The microscopical study of the dried powder of the corms reveals that they can be used as a source for the extraction of starch and oxalic acid. In Pharmacy, the main use of starches is adjuncts in tablet formation, diluents, binders and anticaking agents. Starch is also a starting material for the reaction that yields dextrins, cyclodextrins, polyalcohols and gluconates. In mucilage form, starch is used as a skin emollient, as a basis for some enemas and as an antidote in the treatment of iodine poisoning.

The use of starch for making dusting powder for toilet purposes is due to its hygroscopic property. Sterilizable maize starch is used as lubricant for surgeon's gloves. Unlike talc, it is completely absorbed by body tissues. The structure of the starch grains of *Typhonium roxburghii* resembles maize starch. Besides multiple uses in pharmacy, starches find innumerable applications in other sectors; paper production (it consumes nearly half of the "non-food" starch), the textile industry, glues and adhesives, water and ore treatment, drilling and more.

It is concluded that the starches of this plant can further be investigated for pharmaceutical purposes since, the taxon *Typhonium roxburghii* grows well in plains in waste lands where there is stagnation of rain water or sewage water occur. Therefore, the plant, *Typhonium roxburghii* is a potential source for the extraction of starch. Cultivation of this

herb is possible because it does not prefer natural habitat. It is quick growing and needs no fencing. It can be cultivated in wastelands with fewer expenses for the extraction of starch.

While starch-yielding plants such as corn (*Zea mays*), wheat (*Triticum aestivum*), rice (*Oryza sativa*), pototo (*Solanum tuberosum*) are food plants, *Typhonium roxburghii* can be used as a substitute for them as commercial starch for industrial purposes. The positive externalities due to cultivation of *Typhonium roxburghii* would be in the form of scenic beauty of the region with its evergreen leaves, virtual absence of mosquitoes even though sewage water be used.

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