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RESEARCH ARTICLE

RHIZOME AND LEAF ANATOMICAL VARIATIONS IN *ALPINIA CALCARATA* AND *ALPINIA GALANGA*

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ABSTRACT

In recent times, medicinal plants and their extracts have received the attention of scientific communities for their therapeutic value. Several pharmacological studies confirm the above. Members of Zingiberaceae constitute a vital group of rhizomatous medicinal and aromatic plants characterised by the presence of volatile oils and oleoresins of export value. *Alpinia* is a large genus most widespread and taxonomically complex with 230 species. *Alpinia calcarata* and *Alpinia galanga* are known for their medicinal values. The present investigation was carried out on these two species to study the anatomic variations in rhizome and leaf. In *Alpinia galanga* Linn. the rhizome is highly branched with yellowish colour, cylindrical, 2-8×2-3 cm, while *Alpinia calcarata* rhizome is less branched with creamy yellow, cylindrical, 2-6×2 cm. The leaf anatomy in both species shows numerous vascular bundles and presence of bundle sheath and its extension upto lower epidermis.

INTRODUCTION

Plants are major sources of herbal medicines and the presence of secondary metabolites many therapeutic activities Ogunleye and Ibitoye (2003). The medicinal plants with time tested healing properties are now in vogue. An urgent need is therefore being felt for their proper identification and utility. *Alpinia calcarata* Rosc. (Zingiberaceae), is a commercially valuable important aromatic medicinal plant, native to India and China Mangaly and Sabu (1992). The rhizomes are reported to have antimicrobial Robinson *et al.* (2009), antinociceptive Arambewela *et al.* (2004), and anti-inflammatory activities Arawwawala *et al.* (2012). Apart from these bioactivities, the rhizome exhibits insecticidal activity Dutta *et al.* (1985). In India, the dried rhizome forms a major ingredient of several Ayurvedic drug formulations as Rasna in the preparation of *Ashwagandharistam, Rasnadichurnam*, *Rasnadikashayam* and *Rasnadithailam* Sabu (2006). Drugs prepared from rhizomes are used in the treatment of rheumatism,bronchial catarrah and asthma Asha *et al.* (2012). It is also used to stimulate digestion, treating colds and reducing swelling Ahmed *et al.* (2005). *Alpinia galanga*, commonly called greater galangal, is yet another much exploited medicinal plant with diverse pharmacological spectrum. It has been used in traditional medicine systems for its carminative, anti-inflam- matory and anti-plasmodic activities Abdulmajeed (2010).

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Its uses are in the treatment of bronchitis, heart diseases, chronic entertitis, diabetes and rheumatism etc., Rao *et al.* (2010); Latha *et al.* (2009); Indrayan *et al.* (2009). Most of the South Indian Physicians of traditional Ayurveda and Siddha medicine system use *Alpinia galanga* to treat various kinds of disease including Diabetes mellitus Shivkanya *et al.* (2009). and it is also reported to have anti-HIV agents (Ying and Baoan, 2006). Owing to its wide therapeutic importance it is essential to obtain various qualitative and quantitative standards of drug to prevent its adulteration. Anatomical features of vegetative as well as reproductive organs have been studied to aid taxonomic identification. The knowledge of plant structure is essential to solve several common everyday problems such as identification of unknowns, food contaminants and forensic problems. This study focuses on the comparative anatomy of *Alpinia calcarata* and *Alpinia galanga* for a better understanding of the interrelationships among these species.

MATERIALS AND METHODS

Healthy disease free, mature fresh leaves and rhizomes were collected in Rapinat Herbarium and Centre for Molecular Systematics, Tiruchirappalli, Tamilnadu. A Voucher specimen of the rhizome and leaf has been deposited at the Department Herbarium. They were washed thouroughly 2-3 times with running tap water and once with sterile water to remove the dust and adhering materials.

Anatomical Studies

A few fully matured rhizomes were preserved in fixative solution FAA (Formalin-5ml + Acetic acid-5ml + 70% Ethyl

alcohol-90ml) for more than 48 hours. The preserved specimens were cut into thin transverse section using sharp blade. The free hand sections were stained with safranine, Aniline blue, Eosin Y as per standard methodology. The selected diagnostic characters of the transverse section were photographed under suitable magnification using camera.

cells, vascular bundle with xylem and phloem cells and presence of bundle sheath and its extension upto lower epidermis (Fig.1-2 & Table:2).

Table 1. Comparative morphological and anatomical profile of rhizome of *Alpinia galanga* and *Alpinia calcarata*

Character	*Alpinia galanga*	*Alpinia calcarata*
Rhizome	Profusely branched	Less branched
Colour	Yellow	Creamy yellow
Length	2-8cm	2-6cm
Width	2-3cm	2cm
Shape	Cylindrical	Cylindrical
Epidermis	Single layered	Single layered
Hypodermis	Cells are smaller without intercellular spaces	Parenchymatous cells without intercellular spaces
Cortex	Parenchymatous with numerous vascular bundles and starch grains	Parenchymatous with less vascular bundles and starch grains
Endodermis	Thin walled cells without starch grains	Thin walled cells without starch grains
Pericycle	Single layered	Single layered
Bundle sheath	Sclerenchymatous,1-6 rows	Sclerenchymatous,1-4 rows
Cambium	Meristematic cells	Meristematic cells
Xylem	Vessels - scalariform or reticulate	Vessels - scalariform
Phloem	Sieve tube,1-2 companion cells, phloem parenchyma present	Sieve tube, companion cells and phloem parenchyma present
Ground parenchyma	Smaller cells with starch grains and oleoresin cells	Smaller cells with starch grains and oleoresin cells
Starch grains	Circular , rod and muller shaped	starch grains mostly oval shaped

Table 2. Comparative morphological and anatomical profile of leaves of *Alpinia galanga* and *Alpinia calcarata*

Character	*Alpinia galanga*	*Alpinia calcarata*
Leaf-morphology	long, narrow, green above, pale beneath, whitish on margins, median nerve very strong	Distichous, linear, glabrous, margin entire, apex long-acuminate
Vascular bundle	9-12	9-10
Epidermis	Single layered	Single layered
Hypodermis	Sclerenchymatous with 1-2 layered	Sclerenchymatous with 1-2 layered
Cortex	Large parenchyma cells without intercellular spaces	Large parenchyma cells without intercellular spaces
Bundle Sheath	Vascular bundle fully covered with sclerenchymatous bundle sheath extending to lower epidermis	Vascular bundle partially covered with sclerenchymatous bundle sheath extending to lower epidermis
Vascular bundle	Inner xylem covered with phloem	Xylem intermixed with phloem

RESULTS AND DISCUSSION

Rhizomes and leaves of *Alpinia calcarata* and *Alpinia galanga* were studied in detail to highlight important anatomical characters. Present study has revealed an easy technique to identify two medicinal plant materials microscopically. So, microscopical detection is easy, reliable and cost effective tool for detection for adulteration in medicinal plant materials. The rhizome studies in *Alpinia calcarata* Roscoe and *Alpinia galanga* (Linn.) show the following characteristic features. In *Alpinia galanga* (Linn.) the rhizome is highly branched with yellowish colour, cylindrical, 2-8×2-3 cm, single layered epidermis and pericycle, cortex with numerous vascular bundles and aggregation of starch grains. But, in *Alpinia calcarata* rhizome is less branched with creamy yellow, cylindrical, 2-6×2 cm, single layered epidermis and pericycle, outer cortex with less vascular bundles than inner cortex and consists of mostly oval shaped starch grains (Fig.3-4 & Table:1). The leaf anatomy in both species shows numerous vascular bundles, single layered epidermis in abaxial and in adaxial sides with cuticle, cortex with large parenchyma

Fig.1. *Alpinia galanga*: Leaf displaying the single layered upper epidermis,xylem, chlorenchymatous endodermal cells.

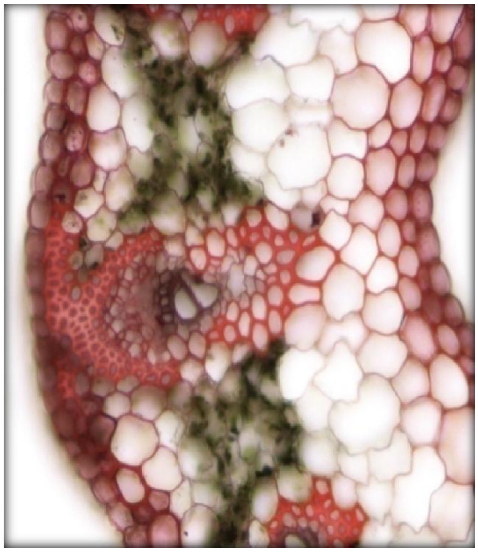

Fig.2. *Alpinia calcarata*: Enlarged view of leaf showing the xylem, phloem,chlorenchymatous endodermis

Fig.3. *Alpinia galanga* - Enlarged view of rhizome showing the xylem,phloem and sclerenchymatous bundle sheath

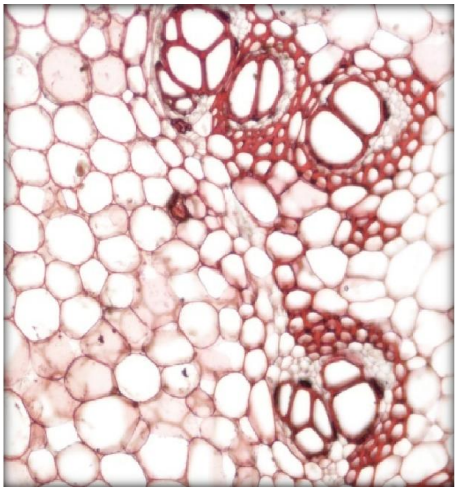

Fig.4. *Alpiniacalcarata*- Rhizome showing the xylem,phloem and fully covered sclerenchymatous bundle sheath

Conclusion

The above data confirm that *Alpinia calcarata* and *Alpinia galanga* are species of great therapeutic value. Anatomical data would help to identify species accurately and would serve as a reference for distinguishing rhizomes and leaves of *Alpinia calcarata* and *Alpinia galanga* and their substitutes and adulterants. Thus, pharmacognostic study serves as the

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