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# Comparative Macro-microscopic Atlas of Two Aroids Used in Siddha Medicine

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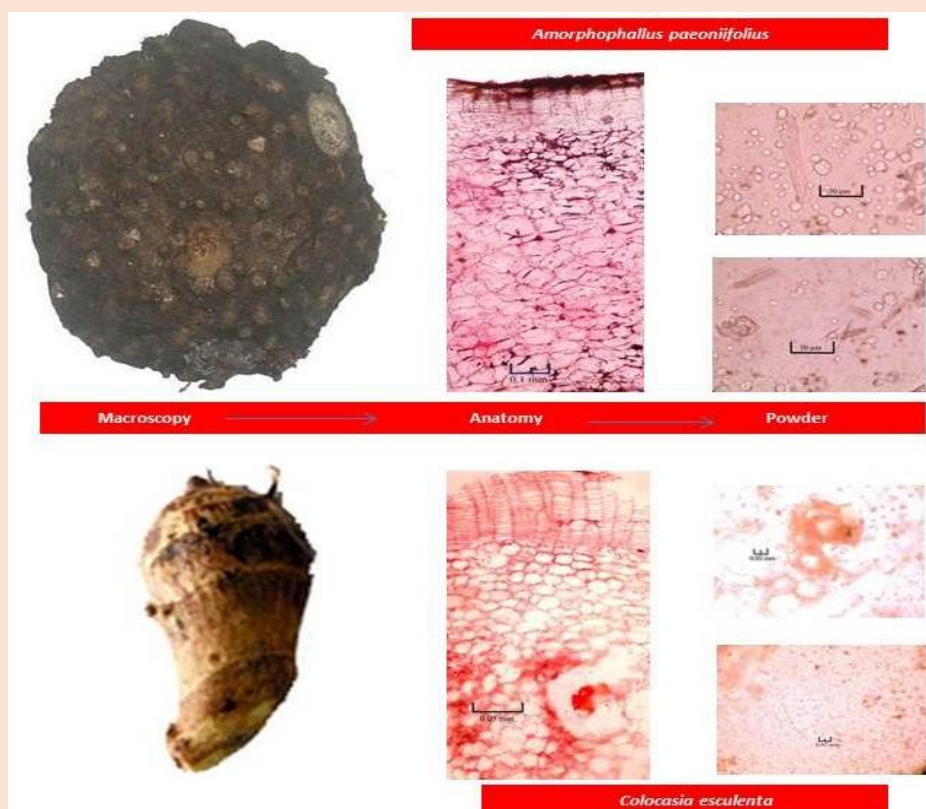
## ABSTRACT

**Introduction:** *Amorphophallus paeoniifolius* and *Colocasia esculenta*, two aroids used as a source of food possess various medicinal properties too. The present study is aimed at the macro microscopic comparison of these two species. **Methods:** The fresh rhizomes of the *A. paeoniifolius* and *C. esculenta* were collected from Mettur and market respectively. Detailed macroscopy followed by anatomy and powder characters were studied in accordance to standard pharmacopoeial procedures. **Results:** The two rhizomes differed morphologically; *A. paeoniifolius* is larger and blackish brown externally while *C. esculenta* is lighter in colour with concentric rings of leaf scars. The rhizome transverse section also showed difference in number of cork layers (less in *A. paeoniifolius*). The inner cork cells contained rosette crystals in *A. paeoniifolius* (absent in *C. esculenta*). Raphide bundles of acicular crystals are present in *A. paeoniifolius* (prismatic crystals in *C. esculenta*). Starch grains both simple and compound were present in both species but the grains in *C. esculenta* were comparatively smaller when compared to *A. paeoniifolius*. Mucilage cells are seen in both rhizomes while latex tube was visible only in *A. paeoniifolius*. These differences were reflected in the powder microscopy of the two species. **Conclusion:** The outcomes of the paper provides a crisp and concise information about the detailed macro -microscopy of the two aroid medicinal plant materials.

## KEYWORDS

Karakarunai, Sembu, Raphide bundles

## PICTORIAL ABSTRACT



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## 1. Introduction

According to Indian traditional medicinal system all plants have some medicinal properties. *Amorphophallus paeoniifolius* (Dennst.) Nicolson (Elephant Foot Yam) which is one among the largest genus of Araceae comprises more than 200 species<sup>[1]</sup>. *A. paeoniifolius* has its distribution in Madagascar eastwards via India to Malaysia, southern China, Indo China, Polynesia and northern Australia<sup>[2]</sup>. Commonly called as *Karanai kilangu* or *Karakkarunai* is a perennial, terrestrial herb which flowers before leafing every year from the previous year's corm during April to May<sup>[3]</sup>. *A. paeoniifolius* is chiefly valued for its edible tuber and profound medicinal properties<sup>[4]</sup>. The leaves are simple or forked, leaflets are of different width, veined,

obovate-oblong, acute with recurved wavy and crisped margins. Inflorescence is spadix, flowers emits putrid, pungent smell. Male flowers have 2 to 4 stamens with crowded anthers while female flowers have 2 to 3 lobed large stigma<sup>[5]</sup>. The underground corm is large with numerous terete roots<sup>[6]</sup>. Elephant foot yam is a rich source of carbohydrate, protein, minerals like calcium, iron, phosphorous, vitamin A, B, C, flavonoids and fibre<sup>[7]</sup>. It is one of the major important of Siddha, Ayurveda and Unani medicines<sup>[8]</sup>. The corm extract is applied externally as an irritant to treat acute rheumatism, administered internally in the treatment of dysentery, diarrhoea, piles, hemorrhoids and in the formulation of indigenous

medicines to cure inflammatory conditions and ophthalmia<sup>[9-10]</sup>. It is used in the folk medicine to cease tumor growth, lung swelling asthma, vomiting, abdominal pain, piles, hemophilic conditions, skin diseases, obesity, dyspepsia, debility and to control intestinal worms<sup>[11-13]</sup>. In Siddha medicine it is used for the treatment of anorectal abscess and hemorrhoids<sup>[14]</sup>.

*Colocasia esculenta* (L.) Schott commonly called as Elephant ear due to its large leaves is another member of Areaceae comprising of 25 species is widely distributed in tropical latitudes and Asia and the Pacific<sup>[15]</sup>. It is a perennial herb, 1.5 m tall with the shoots coming directly from the corm. Leaves are fleshy, ovate, acuminate, and have 7 inches long lamina. Leaves appear together with the flowers. Inflorescences of *C. esculenta* comprises of a spathe 20 to 40 cm in length surrounding a spadix measuring 6 to 14 cm that contains unisexual flowers. It is borne on a stout pedicel which is somewhat shorter than the petioles<sup>[16]</sup>. Male and female flowers are interposed with flat neuters<sup>[17]</sup>. Both the leaves and corm are edible and is one of the major food sources of 500 million people living in Asia, Africa, Middle America, and the Pacific Islands<sup>[18]</sup>. In Indian traditional medicinal systems of Ayurveda (*Pindaaluka*) and Siddha (*Chaembu*), the plant is considered to have medicinal value. The juice from petiole is considered styptic and rubifacient, and juice of corm is used in alopecia. Cooked leaves are taken orally for lowering post-prandial blood glucose levels. The corm commonly called as taro, is a rich source of protein, ascorbic acid, dietary fibre<sup>[19]</sup>, minerals like calcium, phosphorous, iron and vitamins like vitamin C, thiamine, riboflavin and niacin<sup>[20]</sup>. The rural people of Dhemaji district of Assam, use the corm to control blood glucose levels in diabetic patients<sup>[21]</sup>. Juice of *C. esculenta* rhizome is used by practitioner in Vellore district of Tamil Nadu to treat baldness<sup>[22]</sup>. The tribal inhabitants of Nagaland uses the whole plant juice for the curing internal Hemorrhage, cuts wounds and bruises<sup>[23]</sup>.

## 2. Materials and methods

Botanically identified and authenticated tubers of *A. paeniifolius* was procured from Mettur while *C. esculenta* tubers were procured from local market in Tamil Nadu. The macroscopy was documented by Nikon COOLPIX5400 digital camera. Part of the sample was preserved in FAA (Formalin-5ml + Acetic acid-5ml + 70% Ethyl alcohol-90ml) for sectioning the rest was dried, powdered, passed through mesh no. 60, and preserved in an air-tight covers for powder microscopy. Transverse sections of the preserved specimens

were hand cut using a 7'O clock platinum blade, stained with safranin and photographed using Nikon ECLIPSE E200 trinocular microscope attached with Nikon COOLPIX5400 digital camera under bright field light. Magnifications were indicated by the scale-bars. The powder of both the samples was mounted in glycerine on a clean microscopic slide. Slides were observed under Nikon ECLIPSE E200 trinocular microscope and diagnostic characters were identified. Individual characters of powder were magnified to 400X and photographed<sup>[24]</sup>.

## 3. Results and discussion

### 3.1 Macroscopy

#### 3.1.1 *A. paeniifolius*

The underground hemispherical corm ranging in size from 20 to 25 cm diameter bears about 5 to 6 cormels. Externally the corm is blackish-brown in colour with a warty surface while the freshly cut inner surfaces are orangish-yellow. Short roots are also present on the corm. Feeder roots are about 50 to 60 cm in length. The shape of corm varies from globose, sub globose to depressed globose (Figure 1.1).

#### 3.1.2 *C. esculenta*

The dark brown rhizome is composed, outwardly, of concentric rings of leaf scars and scales. Below the leaf base lateral buds are present from which arises smaller secondary cormels. The shape varies from elongate to spherical with an average diameter of 15 to 18 cm (Figure 1.2).

### 3.2 Microscopy

#### 3.2.1 *A. paeniifolius*

The TS of rhizome shows the outermost 2 to 4 layered dark brown outer cork layers formed of tangentially elongated rectangular thin walled cells; the inner cork is 4 to 7 layered formed by thin walled cells often containing rosette crystals of calcium oxalate; cortex is wide, parenchymatous, thin walled, multi layered, having rosette crystals and raphide bundles of acicular crystals of calcium oxalate; parenchyma of the cortex shows abundance of a few simple and mostly 2 to 4 compound starch grains; a few mucilage cells and latex canals are found in the cortical parenchyma; vascular bundles are formed from normal elements with vessels spirally thickened (Figure 2).

Figure 1. Macroscopy of underground stem



1.1 *Amorphophallus paeniifolius*

1.2 *Colocasia esculenta*



### 3.2.2 *C. esculenta*

The TS of rhizome shows the outermost 6 to 8 layered outer cork composed of thick walled periderm layer made up of tangentially elongated cells and followed by inner cork or cork cambium made up of thin walled rectangular cells. The cortex is delimited and contains thin walled multilayered parenchyma cells filled with both simple and compound starch grains. A few prismatic crystals of calcium oxalate are also present. Mucilage cells are present in the cortical parenchyma. The products of the mucilage make the cut surface slippery (Figure 3).

### 3.3 Powder microscopy

#### 3.3.1. *A. paeoniifolius*

It is creamish grey in colour with characteristic odour and taste and contains cork cells; parenchyma cells with contents; spiral vessel fragments, latex tubes, cystolith, raphides, acircular crystals; simple and compound starch grains (Figure 4).

#### 3.3.2. *C. esculenta*

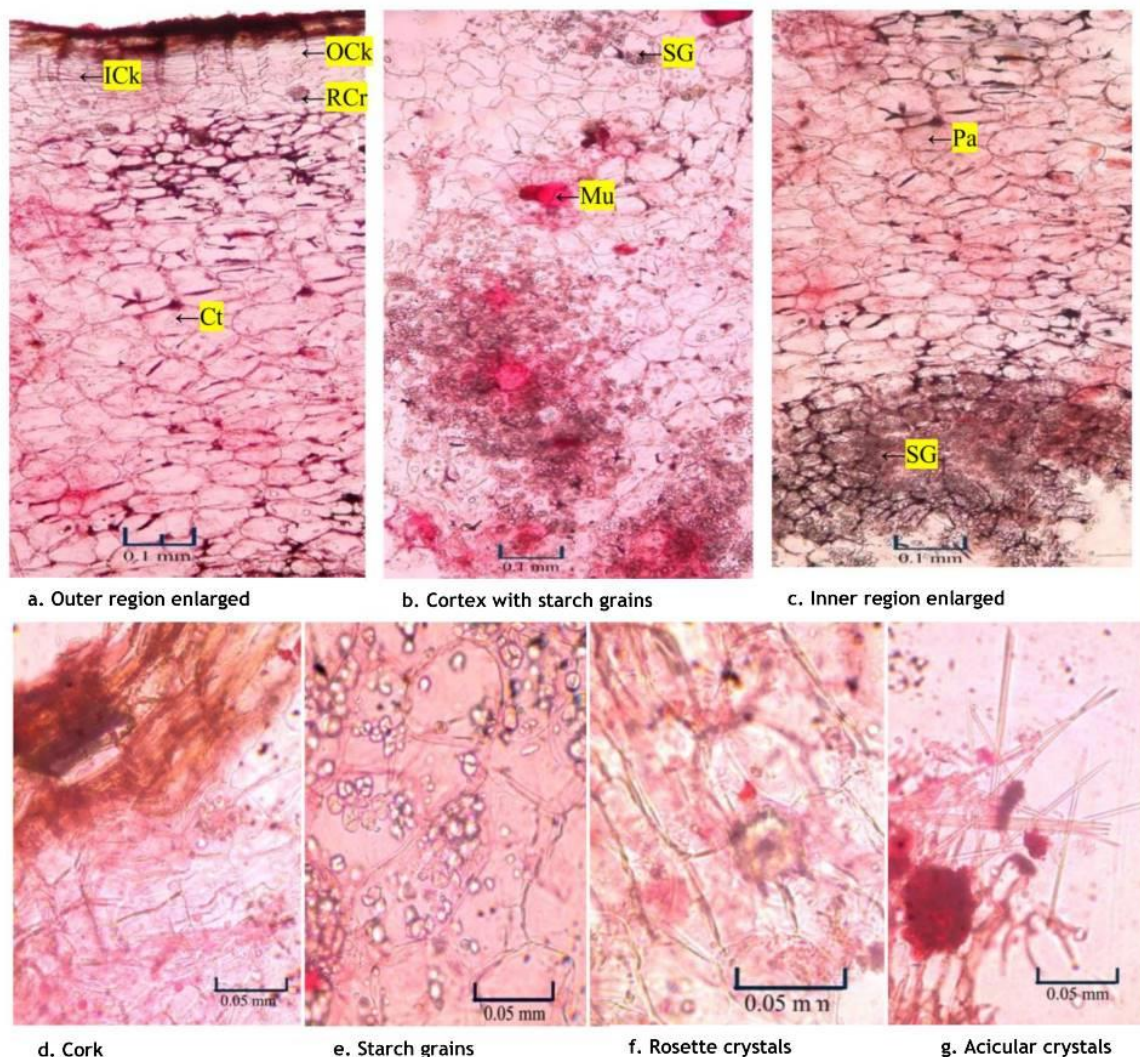
It is creamish in colour, characteristic odour and taste and slimy due to mucilage and contains cork cells, parenchyma cells with starch

grains; fragments of spiral vessels and simple and compound starch grains (Figure 5).

*A. paeoniifolius* and *C. esculenta* are two common root crops belonging to Araceae. Unlike Cassava, sweet potato and yam, *Colocasia* remains a very less studied crop. *Colocasia* forms the staple food of developing nations of Asia, Africa and the Pacific. The two species differed varying in their size and shape. Leaf scars and scales present in the outer surface of *C. esculenta* were completely absent in *A. paeoniifolius*. Feeder roots were present in *A. paeoniifolius* while absent in *C. esculenta*.

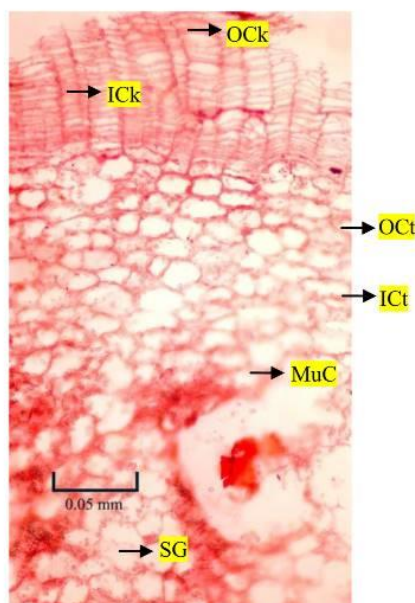
Anatomically the following variations were seen in the two species. The outer cork layers were dark brown in *A. paeoniifolius* while lighter in colour in *C. esculenta*. Presence of mucilage cells were noticed in both the species. Abundance of rosette crystals and raphide bundles were seen in *A. paeoniifolius* while in *C. esculenta* prismatic crystals were present. Even though both simple and compound starch grains were comprehended in both of them, the grains were larger in *A. paeoniifolius* when compared to *C. esculenta*.

**Figure 2. TS Of *Amorphophallus paeoniifolius* corm**

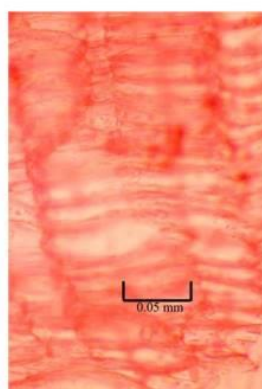


Ct - Cortex; ICK - Inner Cork; Mu - Mucilage; OCK - Outer Cork; Pa - Parenchyma; RCr - Rosette Crystal

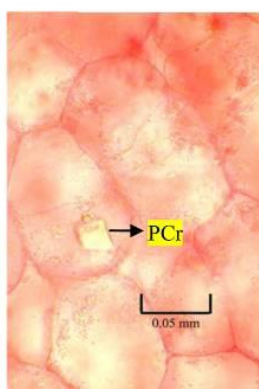
**Figure 3. TS of *Colocasia esculenta* rhizome**



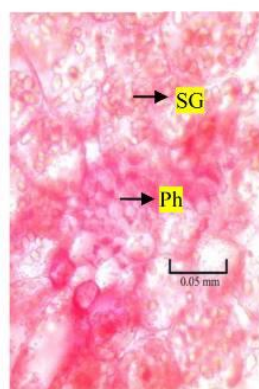
**3.1 TS of rhizome**



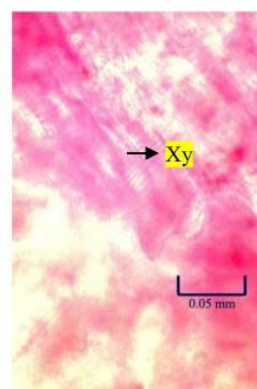
**3.2 Cork enlarged**



**3.3 Cortical cells with prismatic crystals**



**3.4 Vascular bundle**



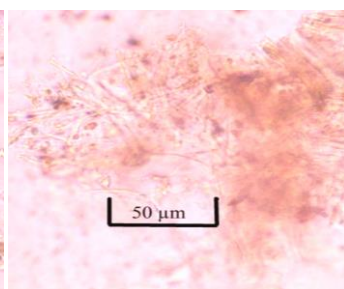
**3.5 Xylem elements**

ICk - Inner cork ; ICt - Inner cortex; MuC - Mucilage cell; Ock - Outer cork; OCt - Outer cortex; PCr - Prismatic crystal; Ph - Phloem; SG - Starch grain; Xy - Xylem

**Figure 4. Powder microscopy of *Amorphophallus paeoniifolius* corm**



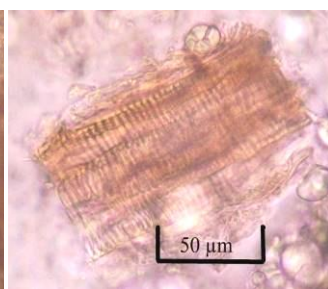
**4.1 Cork cells**



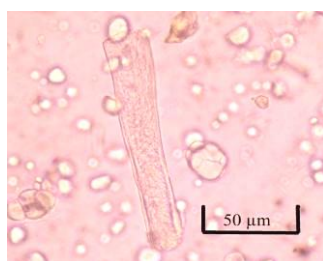
**4.2 Parenchyma cells**



**4.3 Parenchyma cells with content**



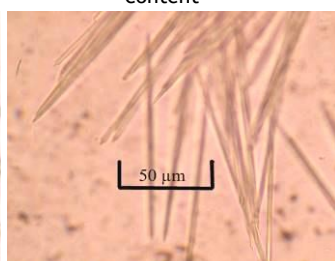
**4.4 Spiral vessel**



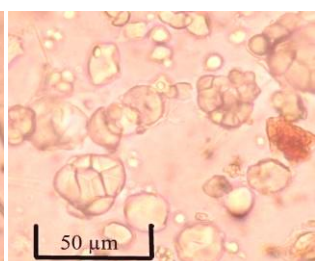
**4.5 Latex tube**



**4.6 Cystolith**



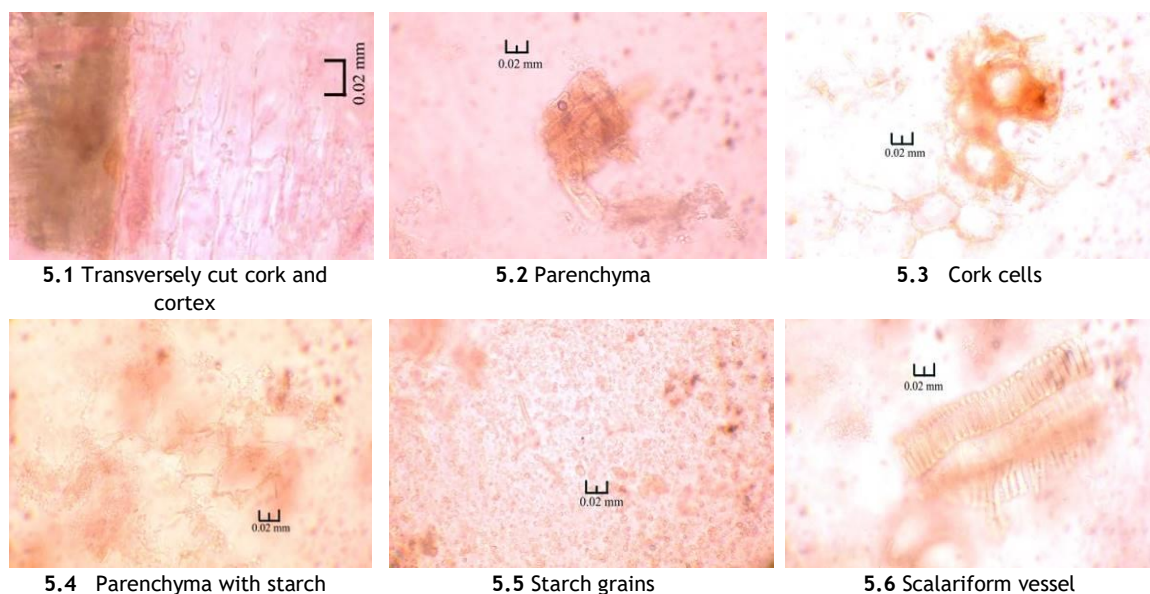
**4.7 Acicular crystals**



**4.8 Starch grains**



**Figure 5. Powder microscopy of *Colocasia esculenta* rhizome**



#### 4. Conclusion

Thus the current study provides comprehensive information regarding the morphology, anatomy and powder microscopy of the two important aroids which are renowned source of both food and medicine.

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**CONFLICT OF INTEREST** Nil

**CONTRIBUTORS** Dr. Divya contributed to the intellectual content, conceptualization of the topic, design and data acquisition, Mrs. Remya contributed to the anatomical study, photomicrography and literature review, Mrs. Brindha contributed to the powder microscopic characterization, data acquisition and micro photography, Dr. K N Sunil Kumar contributed to the data analysis, manuscript review and manuscript editing. Dr. Sathyarajeshwaran contributed to the siddha aspects of the plants studied.

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