



## COMPARATIVE LEAF AND ROOT ANATOMICAL STUDIES OF FIVE VARIETIES OF *COLOCASIA ESCULENTA* (L.) SCHOTT

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### ABSTRACT

Transverse sections of leaf and root of five varieties of *Colocasia esculenta* (L.) Schott present in Anambra State, Southeastern, Nigeria were evaluated to determine the anatomical characters of these plant parts. Fresh leaf and root of three months old plants, grown in March, 2014 were collected, and used for the study. The leaves possessed anomocytic stomatal type with the stomata present in both adaxial and abaxial surfaces. The root of *Colocasia esculenta* var. *antiquorum*, 'kochuo' and 'ogeriobosi' had air chambered cortex, with greater number present in *Colocasia esculenta* var. *antiquorum*. These anatomical characters could serve as additional data in delimitation of this species.

**KEYWORDS:** *Colocasia*, Araceae, transverse section, epidermal features, anomocytic stomatal type.

### INTRODUCTION

*Colocasia esculenta* (L.) Schott is a monocotyledonous plant of the genus *Colocasia*, belonging to the family Araceae. It is a perennial herb with tuberous stems and stolons found in marshy places, streams, rivers and ponds (Swapna *et al.*, 2011). In addition, in deep water it may develop floating leaves; inflorescence axillary, differentiated into basal green convolute tube and upper, expanded, yellow limbs. This plant does not produce flowers frequently.

*C. esculenta* is a popular tuber crop in Southeastern Nigeria. It has different varieties which vary in their vegetative features. Doku (1981) reported that the wide variety of *Colocasia* was due to their polyploidy nature, making Linnean taxonomic application difficult at best. In addition, confusion of the taxonomy of edible *Colocasia* (Cocoyam) has been reported (Onyilagha *et al.*, 1987). This has led to a debate whether there are two distinct species of the aroid, namely *C. antiquorum* (L.) Schott and *C. esculenta* (L.) Schott or one polymorphic species, either *C. antiquorum* or *C. esculenta* with several varieties because of variance within *Colocasia* (Plucknett, 1983; Onyilagha *et al.*, 1987). Currently, *C. esculenta* is considered as the major species with two varieties, *C. esculenta* var. *antiquorum* (L.) (Schott) Hubbard & Rehder and *C. esculenta* var. *esculenta* (L.) Schott (Brooks, 2001; Nyananyo, 2006).

Plants are classified based on similarities and differences provided by taxonomic information. Anatomy, which is the internal structure of plant cell, tissue and organ, is one of the taxonomic tools for provision of such information. Furthermore, due to confusion in the taxonomy of *C. esculenta*, anatomical study of its varieties becomes a necessity. The objective of this work, therefore, was to investigate the anatomical characters of leaf and root of varieties of *C. esculenta* in order to provide additional characters which could help plant taxonomists in delimitation of *C. esculenta*.

### MATERIALS & METHODS

#### Sources of Materials

Cormels of varieties of *C. esculenta* were obtained from the local farmers from the three senatorial districts in Anambra State, namely: Agulu in Anaocha LGA (Anambra North); Umuikwu-Anam in Anambra West LGA (Anambra Central) and Uga in Aguata LGA (Anambra South).

Five varieties, namely, *C. esculenta* var. *antiquorum* (eddoe), *C. esculenta* var. *esculenta* (dasheen), 'kochuo', 'nwine' and 'ogeriobosi' were then selected from the three senatorial districts, and grown in Uga, after proper identification. The voucher specimens were authenticated by Mrs C.A. Ezeabara in liaison with Prof. C.U. Okeke, Plant Taxonomists, and deposited in the herbarium of Department of Botany, Nnamdi Azikiwe University, Awka, Anambra State.

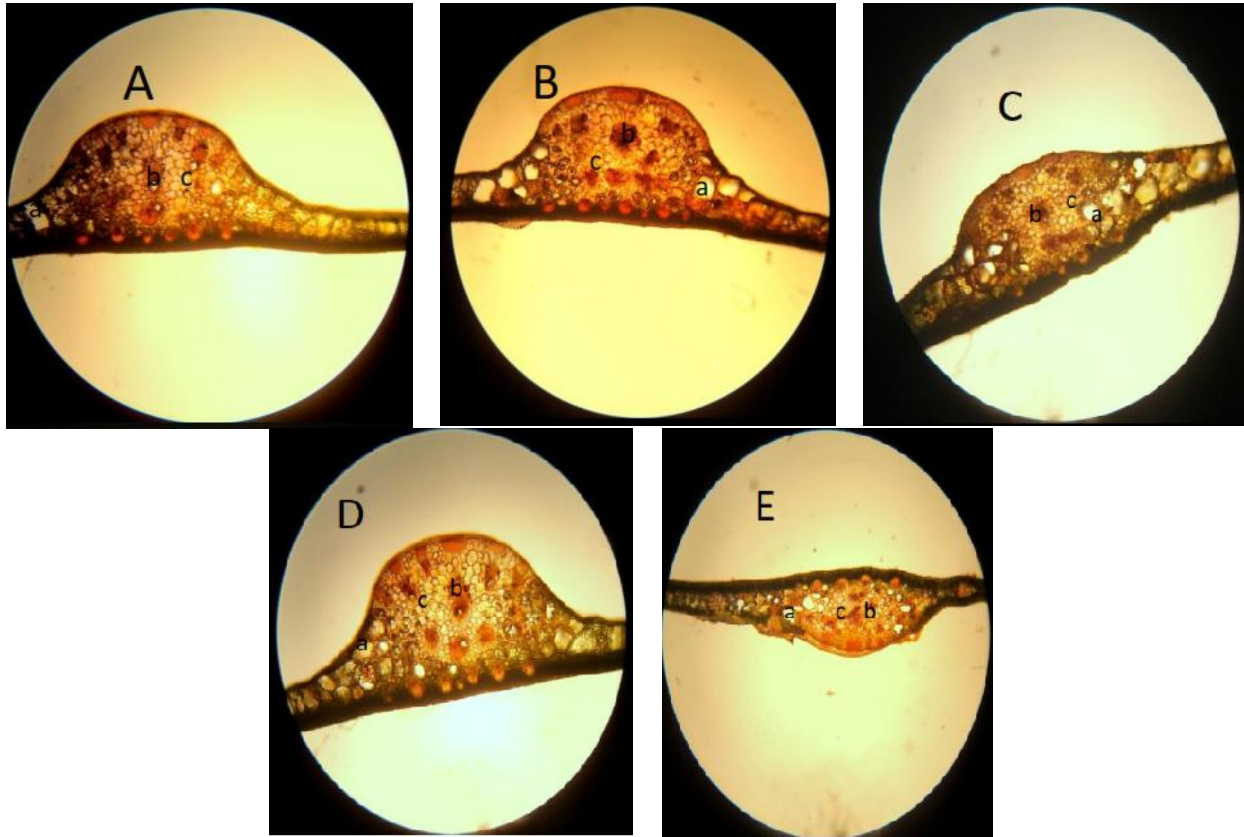
#### Anatomical Studies

Fresh leaves and roots of three-month old plants, grown in March, 2014 were used for anatomical study. They were collected and then free-hand-sectioned transversely, with a new sharp razor blade. A drop of water was placed on a clean slide; the specimen section was mounted on it, and then stained with a drop of 0.1% safranin solution and counter stained with a drop of 1% alcian blue solution. The specimen was then carefully covered with a coverslip and observed under an OLYMPUS (XSZ-107BN, China) light microscope at X4 and X10 magnifications. They were studied and photomicrographs taken with digital camera (Sony DSC-W230, China).

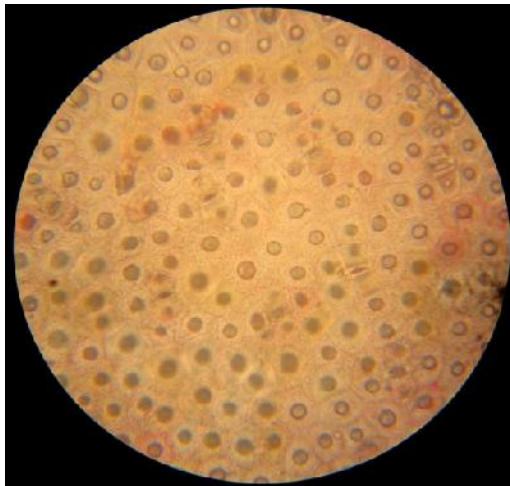
### RESULTS

The arrangements of the mesophyll were the same in all the varieties (Figure 1A-E). The vascular bundles were small in size, collateral and closed (Figure 1A-E). The stomata were present in both adaxial and abaxial surfaces, and they possessed anomocytic stomatal type (Plates 1-10). The centre of roots of all the varieties was occupied

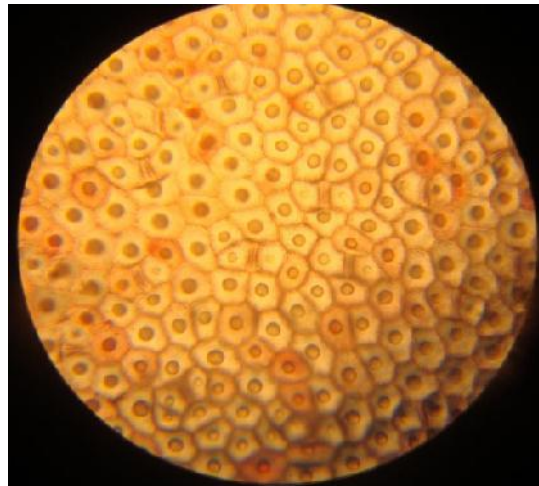
by large and well developed pith (Figure 2A-E). The roots of *C. esculenta* var. *antiquorum*, 'kochuo' and 'ogeriobosi' had air chambered cortex (Figure 2A, C, and E).



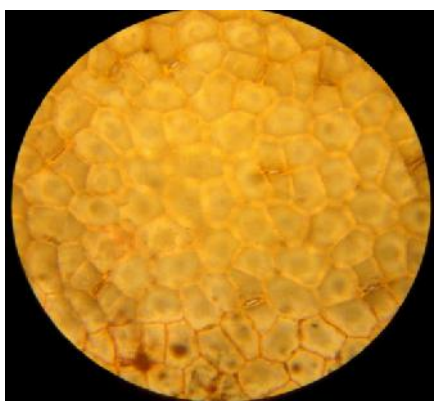
**FIGURE 1:** Transverse sections of leaf of varieties of *Colocasia esculenta* x40. 1A. *Colocasia esculenta* var. *antiquorum*. 1B. *Colocasia esculenta* var. *esculenta* 1C. 'Kochuo'. 1D. 'Nwine'. 1E. 'Ogeriobosi'.  
a=air spaces, b=vascular bundle, c=mesophyll



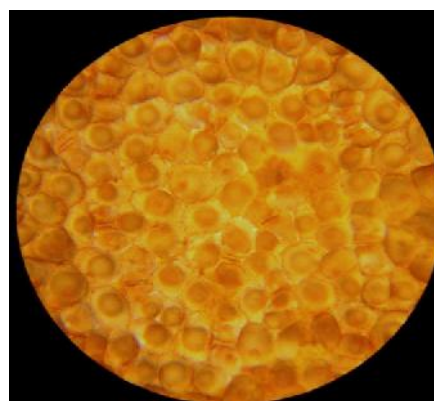
**PLATE 1:** Epidermal features of adaxial leaf surface of *Colocasia esculenta* var. *antiquorum* x100



**PLATE 2:** Epidermal features of adaxial leaf surface of *Colocasia esculenta* var. *esculenta* x100



**PLATE 3:** Epidermal features of adaxial leaf surface of 'kochuo' x100



**PLATE 4:** Epidermal features of adaxial leaf surface of 'nwine' x100



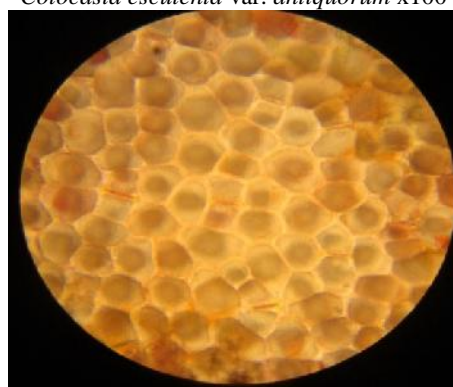
**PLATE 5:** Epidermal features of adaxial leaf surface of 'ogeriobosi' x100



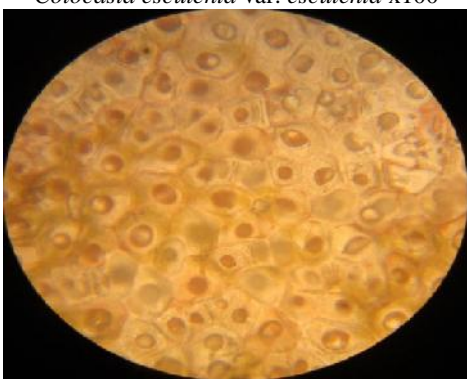
**PLATE 6:** Epidermal features of abaxial leaf surface of *Colocasia esculenta* var. *antiquorum* x100



**PLATE 7:** Epidermal features of abaxial leaf surface of *Colocasia esculenta* var. *esculenta* x100



**PLATE 8:** Epidermal features of abaxial leaf surface of 'kochuo' x100



**PLATE 9:** Epidermal features of abaxial leaf surface of 'nwine' x100



**PLATE 10:** Epidermal features of abaxial leaf surface of 'ogeriobosi' x100



**FIGURE 2:** Transverse sections of root of varieties of *Colocasia esculenta* x100. 2A. *Colocasia esculenta* var. *antiquorum* 2B. *Colocasia esculenta* var. *esculenta*. 2C. 'Kochuo' 2D. 'Nwine' 2E. 'Ogeriobosi'  
a=pith, b=metaxylem, c=protoxylem, d=pericycle, e= air chamber

### DISCUSSION

Anatomically, the vascular bundles of all the varieties were small in size, collateral and closed, which is in line with Pandey (2012), who stated that the vascular bundles of monocotyledonous stems are collateral and closed. The arrangement of primary vascular tissues was polyarch pattern because they were numerous, and this is also a characteristic of monocotyledons. The stomata were present in both adaxial and abaxial surfaces. Esau (1977) stated that stomata occur on all aerial parts of the plant, but they are most abundant on leaves. Moreover, in leaves, stomata may occur on both sides or only on one side, usually the lower side. Although, occasionally some species exist which have several types of stomata on one

leaf, most have one type only (Cutler, 1978). The arrangements of the mesophyll were the same in all the varieties. The mesophyll of monocotyledonous leaf is usually not differentiated into palisade and spongy parenchyma, but consists of parenchyma cells, having chloroplasts and intercellular spaces among them (Pandey, 2012). Since some leaves lack a distinction of layers and others have very well-marked layers, the mesophyll can be used as a guide in identification (Cutler, 1978). In addition, it cannot often be used as a guide to the taxonomic position of a plant, but within a group of related plants there may be close similarities of arrangement. Arrangement of the mesophyll, therefore, may not be

adequate for identification of these varieties, and could be regarded as differential character.

Anatomical characters shared by all the varieties which include, presence of anomocytic stomatal type in both adaxial and abaxial surfaces; the same arrangement of the mesophyll; size and appearance of vascular bundles; presence of large and well developed pith in the centre of root could be regarded as general characters shared by these varieties of *C. esculenta*, thereby suggesting an inter group affinity among them, that is, they could be the varietal identities.

However, presence of air chambered cortex in the roots of *C. esculenta* var. *antiquorum* and 'kochuo' and 'ogeriobosi' only, suggested a close affinity among them, and could be regarded as conspicuous distinguishable anatomical character from *C. esculenta* var. *esculenta* and 'nwine'. Cutler (1978) reported that the cortex is sufficiently variable to be used to assist in identification. Moreover, Sharma (1993) noted that leaf anatomy provides various characters of taxonomic importance. It has been a critical tool in the hand of taxonomists in the classification and separation of taxa (Illoh *et al.*, 2011). Okeke (2004) used anatomical parameter among others in separating the three taxa: *Dioscorea cayenensis*, *D. pruinosa* and *D. rotundata*. In addition, varietal status was suggested for *D. cayenensis*, on the basis of epidermal and starch grain evidence (Green and Okoli, 2007).

## CONCLUSION

Evidence from leaf anatomy suggested inter group affinity among all these varieties of *C. esculenta*, while root anatomy indicated a close affinity among *Colocasia esculenta* var. *antiquorum*, 'kochuo' and 'ogeriobosi'. The anatomical characters provided by this study, therefore, could be applied as additional information in delineating *C. esculenta*.

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