

## Application of Biosystematic and Nutritional Parameters in the Delimitation of Family Areceae

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**Abstract:** Tuber producing members of Areceae (*Xanthosoma sagittifolia*, *Dieffenbachia picta*, *Colocasia esculenta* and *C. esculenta* variety *antiquorum*) were investigated for nutrient value, epidermal features and starch grain structures. The finding revealed remarkable variations in all features. The remarkable variations between *Colocasia esculenta* were significant. The stomatal index for *C. esculenta* is 0.20 while that of *C. esculenta* variety *antiquorum* is 0.12. In starch grains, while *C. esculenta* had 16.67% prism shaped grains and 83.33% round shaped types, *C. esculenta* variety *antiquorum* had 63.16% prism and 36.84% round shaped grains. Differences in nutrient value was even more significant. While *C. esculenta* had 5.27% protein, *C. esculenta* variety *antiquorum* has 3.61% protein. The author is of the opinion that the botanical world should support the idea of *C. esculenta* variety *antiquorum* being a species of its own instead of a variety.

**Key words:** Biosystematics • nutrition • areceae • vitamins • minerals

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### INTRODUCTION

The famous cocoyam species in Nigeria are members of the family Areceae. Ngoka [1] reported that the cocoyams ranks the third most valuable root crop in Nigeria, the Tania and the tora being the most popular. The corms and the cormels could be roasted, boiled, pounded or even exported as cash crop. Green [2] reported that the protein and mineral content of cocoyam is higher than other tubers like yam and potatoes.

Cocoyams are grown in alluvial soil in hot humid areas of tropical rain forest. They are mostly herbaceous plants growing in damp shaded places. Thus the cultivated species are usually grown in wetter parts of the tropics. The stems are short with watery or milky latex. Leaves in all taxa are larger with long petioles. The large spadix inflorescence characterizes the family [3, 4].

Family Areceae has 115 genera, 2000 spp globally; 18 genera and 60 species in West Africa [5]. Many members of Areceae are also useful as medicinal plants [6].

Edible members of Areceae include *Xanthosoma* species and the *Colocasia* species. The taxonomy of *Xanthosoma* is usually confusing. A number of edible species have been identified in the tropics and subtropics. These include *X. sagittifolium* (in Nigeria and many West-African countries), *X. atrovirens* and *X. bransiliensis* (small herb grown for its leaves) *Xanthosoma* is native to

America from Ancient times and came into W-Africa in the 19th century. In many W-African countries, it is known as “New cocoyam” an addition to the well known Colocasis.

About 100 cultivars of *Colocasia* are recognized and grouped into two basic groups (the Eddoe and the taro) which has small corm surrounded by large well developed cormels and a chromosome number of 42 while the second (the dasheen) has large central corn and small cormels (with 28 chromosomes). Though many literatures are of the opinion that the toras or eddoes should be called *colocasia esculenta* while the dasheen is *C. antiquorum* [7], other taxonomists like Gill [5] feels that the whole *Colocasia* saga is a polymorphic species *C. esculenta*. Under this classification, Gill [5] and Ngoka [1] reported that the white cocoyam is *Colocasia esculenta* variety *esculenta* red cocoyam is known as *Colocasia esculenta* variety *antiquorum* (syn. *Colocasia esculenta*, var. *globulifera*)

*Dieffenbachia picta* is a native of Costa-Rica and Columbia. Presently, they are planted in many tropical and subtropical climates. Through very poisonous when ingested, it has been of use as ornamental since the 1820s [7]. There are about 23 cultivars of this plant, known particularly due to its variegated or spotted leaves which makes it useful as ornamental plants [8, 9].

Green [10] reported the importance of stomatal types in the taxonomy of any plant. The author reported seven stomato types as predominant in family Apocynaceae. Stace [11] reported epidermal characteristics as one of the most important parameters in taxonomic studies of the family Combretaceae.

Ergastic substances especially starch grains are useful in plant delimitation Okoli and Green [12] used starch grains and calcium oxalate crystals in the taxonomy of *Dioscorea* species.

The aim of this research is to recheck the taxonomic limit of the family Areceae using biosystematics and plant metabolites as parameters.

### MATERIALS AND METHODS

Plant taxa and parts studied personal collection of the authors from various locations in Nigeria rain forest (Table 1) All taxa belong to the family Areceae.

#### Methods

**(1) Phytodermology:** Abaxial and adaxial epidermal layers were peeled with free hand, rehydrated in distilled water, bleached for 3 minutes in 5% sodium hypochloride, rinsed in distilled water and examined under light microscope. In

this procedure, the stomatal types, stomatal index and cell geometries were observed and recorded.

**(2) Starch grains:** Tubers of plants studied were crushed with laboratory mortar and pistil. Distilled water was added and the paste mounted on the slide. Under light microscope, various shapes of starch grain and their frequencies were recorded using method of Okoli and Green [12], Okoli [13] and Green [10].

**(3) Nutritional values of plants:** Mineral, vitamins and other food analysis were done using standard equipment and parameters [14].

### RESULT AND DISCUSSION

The result of epidermal study was interesting. There was no trichome in any taxa of the family Areceae studied. Stomatal types were paracytic in *Colocasia* species Anomocytic in *Xanthosoma* species and alleloparacytic in *Dieffenbachia* species Cell geometries were hexagonal and pentagonal for all except for *Dieffenbachia* which had hexagonal cells only. The results were interesting and showed that stomatal type was diagnostic at the genus level while the cell geometry showed the relationship

Table 1: Plant taxa, taxonomy and localities

Common names	Taxonomic names	Localities
White cocoyam	<i>Colocasia esculenta</i> , var. <i>esculenta</i>	Farmland, RSUST.
Red cocoyam	<i>Colocasia esculenta</i> , Var. <i>antiquorum</i>	Farmland, RSUST P.H.
New cocoyam	<i>Xanthosoma sagittifolia</i>	Farmland, COE P.H.
Spotted cocoyam	<i>Dieffenbachia picta</i>	Alikor's house. COE P. H.

Table 2: Plant taxa and nutritional values of family areceae

Nutritional values in % & Vit and min in mg	<i>Colocasia esculenta</i>	<i>C. esculenta</i> var. <i>antiquorum</i>	<i>X. sagittifolium</i>	<i>D. picta</i>
Moisture (%)	70.00	82.5	77.5	77.5
Ash (%)	3.9	3.15	3.6	4.5
Lipid (%)	-0.06	0.65	0.55	0.60
Protein (%)	5.27	3.61	6.71	5.37
Fibre (%)	0.90	1.5	0.45	2.00
Carbohydrate (%)	73.08	36.53	65.38	71.15
Calcium Ca <sup>+</sup> (mg)	0.15	0.02	1.4	0.005
Pottasium K <sup>+</sup> (mg)	4.34	0.71	3.15	0.002
Sodium Na <sup>+</sup> (mg)	0.77	0.12	0.65	0.056
Phosphorus P <sup>+</sup> (mg)	3.6	9.0	3.0	1.60
Iron Fe <sup>+</sup> (mg)	0.06	0.02	0.08	0.01
Magnesium Mg <sup>++</sup> (mg)	3.6	2.38	3.5	0.50
Vitamin C (mg)	9.05	0.001	10.05	0.004



Plate 1A-D: Morphological representations of Areceae species

- 1A: *Xanthosoma sagittifolia* x ¼
- 1B: *Colocasia esculenta* var *esculenta* x ¼
- 1C: *Dieffenbachia picta* x
- 1D: *Colocasia esculenta* var. *antiquorum* x ¼

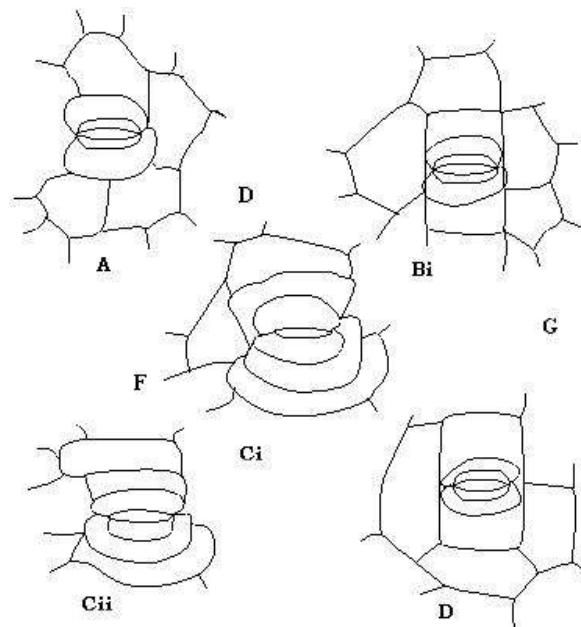


Fig. 1A-D: Cell geometries and stomatal types in Areceae

- 1A: Paracytic stoma and pentagonal-hexagonal cells in *C.esculentus*
- 1B: Paracytic stoma and pentagonal-hexagonal cell geometries. *C.esculenta* var. *antiquonum*
- 1Ci-Cii: Alleloparacytic stomata and hexagonal cell geometries in *D. picta*
- 1D: Paracytic stoma and hexagonal-pentagonal cells in *X.sagittifolia*

Table 3: Plant taxa studied, stomatal index, phytodermology and ergastic substances

Parameter	<i>C. esculentus</i>	<i>C. esculents</i> var. <i>antiquorum</i>	<i>Xanthosoma</i> <i>sagittifolium</i>	<i>D. picta</i>
Stomatal index	0.21	0.16	0.21	0.3
Starch gram	17% prism,	63% prism	29% prism	8% prism
Types in %	83% round.	34% round	71% round	92% round
Stomatal	Paracytic	Paracytic	paracytic	Cyclopara
Types	stomata	stomata		cytic
Cell	Pentagonal	Pentagonal	Hexagonal and	Hexagonal
Geometry	hexagonal	hexagonal	Pentagonal	cells

among the taxa studies. The presence of stomata in both adaxial and abaxial surfaces shows high absorption rate of the roots and subsequent transpiration and water relation in the species studied [15].

The stomatal index result is quite revealing. While *Colocasia esculenta* had stomatal index of 0.2, *C. esculenta* variety *antiquorum* had 0.12. This was quite remarkable and suggested that there was much difference in the two *Colocasia*. *Xanthosoma* has 0.25 while *Dieffenbachia* has 0.07. The implication of the above is far reaching and showed that absorption was most in *Xanthosoma* sp. The starch grains in the taxa studied were remarkable. There were only two basic types, the round and the prism types. Their frequencies were also peculiar. The more rounded the grains, the more compact the tuber is. This is why *Colocasia esculenta* (17% prism, 83% round) is very heavy meal (Table 2). This was similar to the finding of Okoli and Green [12] who reported starch grain variation as a delimiting factor in *Dioscorea* spp. *Colocasia esculenta* had the highest value in carbohydrate (73.08%) and calcium (0.15%), potassium (4.34%) and phosphorus (36.0%). This was a very important combination of nutrients. The potassium and sodium balance was particularly good for human health and many should be encouraged to take it. This was followed by *Xanthosoma* species which had the highest in protein (6.7/mg) and highest in vitamin C (10.05 mg). Very low lipid content in all species of cocoyam is of health advantage (Table 2).

### CONCLUSION

Two major cell geometries (pentagonal and hexagonal) were found in the taxa studied.

Stomatal types were paracytic and alleloparacytic in all taxa studied Alleloparacytic stoma in *X. sagittifolia* is a mark of divergent evolutionary change in the family Areceae.

Starch grains were mainly prism and round shape. The variabilities and frequencies within the two types are taxonomic.

Nutritional values in the species under studies shows that *Colocasia esculenta* had higher nutrient except of course in iron where *C. esculenta* var. *antiquorum* ranks highest.

In conclusion the authors are of the opinion that the two varieties of *Colocasia esculenta*, *C. esculenta*, var *esculentus* and *C. esculenta* var. *antiquorum* be given difference taxonomic status; *C. esculentus* and *C. antiquorum*.

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