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Research Article

A Comparative Morphological Study on *Dacryodes edulis* (G. Don) H.J. Lam. and *Canarium schweinfurthii* Englund (Burseraceae)

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Abstract

Background and Objective: Taxonomists group plants by utilizing among others external structures, bioactive chemicals, internal forms and normal functions of plants as taxonomic lines of evidence to decide their similitudes and dissimilitudes to categorise them into various taxa. The fundamental similitudes in the morphology of seeds, flowers and fruits within various species, genera, families and orders prepare a solid base in characterizing taxonomic groups. Morphology provides most of the characteristics used in the building of systems of classification. Thus, morphology is closely related to taxonomy and would continue to power for years to come. A morphological study on *Dacryodes edulis* and *Canarium schweinfurthii* was assessed and compared to ascertain their forms and structural characters that demarcate them as members of the family Burseraceae. **Materials and Methods:** This was carried out by visual observations of the various plant's parts. **Results:** Results revealed similitudes in growth habit, plant type, leaf apex, leaf margin, leaf type, leaf arrangement and inflorescence. Differences were observed in all quantitative characters and the leaf shape, leaf base, leaf surface, stem bark, fruit shape and fruit colour. **Conclusion:** The similitudes between them justify their placement in the same family Burseraceae, while the differences between them justify their placement in different genus and species. Data from this research study is of great taxonomic significance and provide keys for species identification and characterization. The whitish resinous exudate produced by *Canarium schweinfurthii* is used for lighting purposes. It is also used as incense and when melted is used to repair broken pottery.

Key words: Burseraceae, *Canarium schweinfurthii*, *Dacryodes edulis*, taxonomic significance, characterization, broken pottery, leaf apex

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Burseraceae, the family of Angiosperms comprised about 16 genera of resin ducts trees and shrubs. They occur basically in tropical America though some species are found in Africa and Asia. Members of Burseraceae have alternate leaves with many leaflets, solitary or group flowers and soft edible fruits. The leaf base is swollen and may be adaxially concave. They contain seeds and fruits that are rich in vegetable protein, fats and oil, minerals and vitamins¹. Some of the species are used traditionally in the treatments of various sicknesses. Their extracts have been found to possess antimicrobial and antioxidant potency². Among the species in this family are *Dacryodes edulis* and *Canarium schweinfurthii* which are the point of interest in the research.

Canarium schweinfurthii is a typical tropical African tree usually known as African *Canarium* or African elemi. The fruit is known as "ube" in Igbo and atili in Hausa in Nigeria³. The fruits are of two varieties known by their shape: The long spiral and the short round varieties. The fruits have one shaped seed with small protrusion at the three edges. The seeds are firmly fixed in a slightly purple green pulp which is edible and oily with a pleasant taste. The fruit can be eaten raw or softened in hot water or ash from firewood to add or increase the palatability. The oil from the pulp is about 71% palmitic acid and 18% oleic acid. The seed kernel contains an appreciable amount of vitamin C and is used as a flavour in snacks and non-alcoholic beverages. *C. schweinfurthii* is good fuelwood, burning readily with a lot of heat. African elemi tree is among the economically useful oleoresin known 'elemi'. The resin is locally burned in West Africa for fumigating dwellings and mixed with oil for body paint⁴. *C. schweinfurthii* bears edible fruit with a thick, dense, hard shell. The whitish resinous exudate is used for lighting purposes. It is also used as incense and when melted is used to repair broken pottery⁵.

Dacryodes edulis (G. Don) (H. J. Lam) (African pear) is a well-known fruit tree in West Africa that does not shed its leaves seasonally. The fruits are comestible and the extracts (bark, leaves, stem and roots) are used for different intentions³. The fruit pulp may be cooked (softened) or eaten raw. The fruit oil is abundant in amino acids and triglycerides and can supplement usual domestic oils⁶⁻⁸. The fruits are sold in local markets and to some extent, have attracted international trade⁹. In addition to the use of African pears as a staple food, there is growing interest in preparing fruits into preserves like jams, jellies and in the extraction of the oil for cooking or use in the margarine, soap and perfume industries⁹. *D. edulis* trees are of vital values in provision of shade and are mainly seen in home gardens and smallholder cocoa farms in Cameroon⁷.

The tree is extremely useful in herbal medicines². It has been reported to be employed in the traditional medicine of some African countries to cure various ailments such as wounds, skin diseases, dysentery and fever. The extracts and secondary metabolites have been found to show antimicrobial and antioxidant activities².

Taxonomists group plants by utilizing among others external structures, bioactive chemicals, internal forms and normal functions of plants as taxonomic lines of evidence to decide their similitudes and dissimilitudes to categorise them into various taxa. *Canarium schweinfurthii* and *Dacryodes edulis* are grouped into the family Burseraceae based on their similarities and into different genera based on differences. Morphological characteristics of plants are easily observable and obtainable and thus are used frequently in plant identification^{10,11}. The external morphological evidence provides the basic language for plant characterization, identification, classification and relationships¹⁰ noted morphological characters as vegetative, phonological floral characters, seeds and fruit morphology thus morphological features of plants are those external diagnostic features of plants¹⁰. Assessment of these resemblances and distinctions with regards to external structures and physical forms based on the result of the study was the aim of this research.

MATERIALS AND METHODS

Study area: The study was performed at the Department of Botany, Nnamdi Azikiwe University Awka Anambra State from March-May, 2019.

Procurement and identification of plant materials: The plant species: *C. schweinfurthii* and *D. edulis* were gathered from March-May 2019 inside the environment of Nnamdi Azikiwe University Awka (6° 12 N', 7° 04E') Anambra State. The species were certified and provided voucher numbers by a taxonomist in the Department of Botany, Nnamdi Azikiwe University, Awka.

Morphological studies: Morphological characteristics of the species were examined and studied by utilizing materials gathered from a complete or mature plant. The third and fourth completely unfolded leaves from the stem tip were used. The plant parts: Leaf length, petiole length and leaf base were taken using the meter rule. Plant height and stem girth were measured with the aid of a tape rule, while the phyllotaxy and other leaf morphology were studied by close examination of the part¹².

RESULTS

Morphological result

Plant habitat: The species *D. edulis* and *C. schweinfurthii* are both trees and (Fig. 1a-b) indicate their natural habitat.

Growth habit: *D. edulis* and *C. schweinfurthii* are erect trees (Fig. 1a-b).

Leaf morphology: The leaf morphology examination of *D. edulis* showed the following characteristics: Leaf shape is oblong-lanceolate, leaf base-cuneate, leaf apex-acuminate, leaf length-10.7 cm, margin-entire, leaf type-compound, leaf surface-glabrous, leaf arrangement-opposite. *C. schweinfurthii*: Leaf shape is oblong, leaf base-cordate, leaf apex-acuminate, leaf length-6.3 cm, margin-entire, leaf type-compound, leaf surface-glabrous above and pubescent below, leaf arrangement-opposite (Fig. 2a-b).

Fruit and seed morphology: The morphology of the fruit of *D. edulis* showed the following characteristics: Fruit mass is 59.2 g, flesh mass-47.1 g, kernel mass- 7.4 g, fruit type- drupe, fruit shape-oblong/ellipsoidal, fruit length-3.4 cm, fruit width-1.2 cm, fruit colour (ripe)-dark blue, fruit colour (unripe)-pink.

***C. schweinfurthii*:** Fruit mass is 36.2 g, flesh mass-25.7 g, kernel mass-10.5 g, fruit type-plume, fruit shape-spindle trigonous, fruit length-5-16 cm, fruit width-3-7 cm, fruit colour (ripe)-purplish, fruit colour (unripe)-green (Fig. 3a-b, 4a-b, 5a-b) seed (Fig. 6a-b).

Stem morphology: The morphology of the stem of *D. edulis* showed scaly with striation stem bark while *C. schweinfurthii* showed fairly smooth stem bark (Fig. 7a-b).

Observations on the morphological features of *D. edulis* and *Canarium schweinfurthii* (Table 1) revealed that both species are erect trees. Both species have similar phyllotaxy, leaf margin, leaf type and inflorescence which are opposite, entire, compound and panicle, respectively. However, *D. edulis* is about 20-40 m in height with scaly striation stem bark. Leaf shape, base and apex are oblong-lanceolate, cuneate and acuminate respectively. Leaf length is 10.7 cm, leaf surface-glabrous. Fruit type, shape and colour are drupes, oblong/ellipsoidal and dark blue (ripe), pink (unripe), respectively. Fruit mass, length and width are 59.2 g, 5-16 cm and 3-7 cm, respectively (Table 1).

Canarium schweinfurthii is about 35-40 m in height with fairly smooth stem bark. Leaf shape, base and apex are oblong, cordate and acuminate, respectively. Leaf length



Fig. 1(a-b): *D. edulis* and *C. schweinfurthii* in their natural habitat, respectively



Fig. 2(a-b): Leaves of *D. edulis* and *C. schweinfurthii*, respectively



Fig. 3(a-b): Twigs of *D. edulis* and *C. schweinfurthii*, respectively



Fig. 4 (a-b): Fruits of *D. edulis* and *C. schweinfurthii*, respectively

Table 1: Morphological features of *D. edulis* and *Canarium schweinfurthii*

Parameters	<i>Dacryodes edulis</i>	<i>Canarium schweinfurthii</i>
Growth habit	Erect	Erect
Plant type	Tree	Tree
Plant height (m)	20-40	35-40
Leaf shape	Oblong-lanceolate	Oblong
Leaf base	Cuneate	Cordate
Leaf apex	Acuminate	Acuminate
Leaf length (cm)	10.7	6.3
Leaf margin	Entire	Entire
Leaf type	Compound	Compound
Leaf surface	Glabrous	Glabrous above and pubescent beneath
Leaf arrangement	Opposite	Opposite
Stem bark	Scaly with striation	Fairly smooth
Fruit mass (g)	59.2	36.2
Flesh mass (g)	47.1	25.7
Kernel mass (g)	7.4	10.5
Fruit type	Drupe	Plume
Fruit shape	Oblong/ellipsoidal	Spindle trigonous
Fruit length (cm)	5-16	3.4
Fruit width (cm)	3-7	1.2
Inflorescence	Panicle	Panicle
Fruit colour (ripe)	Dark blue	Purplish
Fruit colour (unripe)	Pink	Green

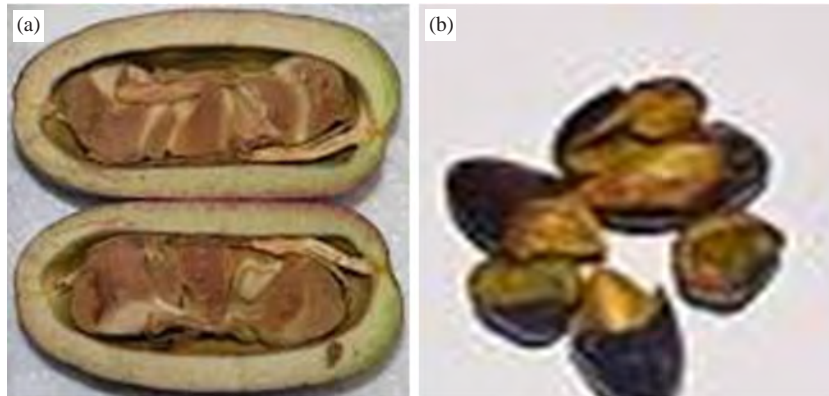


Fig. 5 (a-b): Fruits flesh of *D. edulis* and *C. schweinfurthii*, respectively



Fig. 6 (a-b): Seeds of *D. edulis* and *C. schweinfurthii*, respectively



Fig. 7 (a-b): Stem barks of *D. edulis* and *C. schweinfurthii*, respectively

is 6.3, leaf surface-glabrous above and pubescent beneath. Fruit type, shape and colour are plumes, spindle trigonous and purplish (ripe), green (unripe), respectively. Fruit mass, length and width are 36.2 g, 3.4 cm and 1.2 cm, respectively (Table 1).

DISCUSSION

The result of the external morphology carried out showed some resemblances and differences in the morphological traits of the two species (Table 1, Fig. 1-7). Both species are

erect trees (Fig. 1a-b). Resemblances were observed in some qualitative characters like growth habit, plant type, leaf apex, leaf margin, leaf type, leaf arrangement and inflorescence. Both species have acuminate leaf apex, entire margin, compound and opposite leaf arrangement. These similitudes could be the reason for their placement in the same family Burseraceae. Nevertheless, differences were observed in all quantitative characters and the leaf shape, leaf base, leaf surface, stem bark, fruit shape and fruit colour. *D. edulis* possess scaly with striation stem bark while *C. schweinfurthii* possess fairly smooth stem bark, (Fig. 7a-b). *D. edulis* possess oblong/ellipsoidal fruit shape, fruit type is a drupe, colour dark blue when ripe pink when unripe while *C. schweinfurthii* possess a spindle trigonous fruit shape, fruit type is a plume, colour purplish when ripe and green when unripe (Fig. 3a-b, 4a-b, 5a-b). The differences could be the reason for the placement in different genera and species. Qualitative traits are types of traits that fall into distinct classes or categories without variation within those traits. Quantitative traits are usually displayed on a continuous spectrum or range of variation. Quantitative genetic variation is the substrate for phenotypic evolution in natural populations and selective breeding of domestic crops. These characteristics observed augment the interspecific association and can be used to improve proper taxonomic characterization and identification of plant species that have huge potential as economic crops. The results tally with the work of Dutta¹³, Harley *et al.*¹⁴, who reported that members of the Burseraceae family are mostly trees or shrubs and leaves are acuminate, entire, compound and opposite. The results also tally with the report of Okeke *et al.*¹⁵ who stated that the comparative morphological studies of three species of the Amaranthaceae family revealed some similarities and differences. Variability among some crops genotypes based on observable traits has been reported by some authors Aremu *et al.*¹⁶, Adewale *et al.*¹⁷, Aziagba *et al.*¹⁸, Ilodibia, *et al.*¹⁹ and Ilodibia *et al.*²⁰. Morphological traits are of great importance in the evaluation of association in families and orders and their characteristics have shown an improving function in phylogenetic associations. These traits are of taxonomic significance and provide keys for species identification. This study is immensely worthwhile for a comprehensive systematic classification and identification of the plant species in the Burseraceae family.

Comparative phytochemical and anatomical studies of the two species are recommended to supplement information from this study.

CONCLUSION

A comparative morphological study carried out on *D. edulis* and *C. schweinfurthii* has indeed provided some information that is useful in their delimitation as members of the family, Burseraceae. The result showed some resemblances and differences in the morphological traits of the species. The similitudes between them justify their placement in the same family Burseraceae, while the differences between them justify their placement in different genera and species. *C. schweinfurthii* has slight buttresses and the bark when cut exudes a gum which on solidification turns into a white resin. The whitish resinous exudate is used for lighting purposes. It is also used as incense and when melted is used to repair broken pottery. Data from this research study is of great taxonomic significance and provide keys for species identification and characterization.

SIGNIFICANCE STATEMENT

This study discovered a new species *C. schweinfurthii* from the eastern region of Nigeria in the family Burseraceae that produces whitish resinous exudates. The whitish exudates produce a fragrant smell like incense thus it can be used as incense. In our area, it is applied to relieve pain and inflammation as in arthritis. The study is beneficial to taxonomist who uses the data to provide a foundation and framework in the preparation of classification system and diagnostic keys for proper characterization and identification of the plant species in the family Burseraceae. It is also beneficial to manufacturing industries that utilize the whitish exudates in candle production. Its use in pain alleviation indicates that it could be used in the pharmaceutical industry to manufacture analgesic drugs or balms. This study will help the researcher to unfold the critical areas of taxonomic problems that many researchers were not able to explore. Thus, intensifies the interspecific association for accurate taxonomic analysis and identification of the plant species in the family Burseraceae.

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