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## MORPHOLOGICAL ATTRIBUTES OF *Combretum* Loefl. FROM SOUTHEASTERN NIGERIA.

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### ABSTRACT

Morphology of stems, leaves, inflorescence, flowers and fruits were studied in 9 species of *Combretum* Loefl namely, *Combretum bracteatum*, *C. calobotrys*, *C. dolichopetalum*, *C. hispidum*, *C. mannii*, *C. mooreanum*, *C. platypterum*, *C. racemosum* and *C. zenkeri*. Characters such as habit, branching pattern, reticulate venation, entire margin, acuminate apex and glabrous leaves were common to all the species. Petiole length, leaf shape, length and width, floral length, leaf base, inflorescence type, bract colour, petal and sepal colour, fruit colour and number of wings were found to be variable among the species. Un-weighted Paired Group with Mean Average (UPGMA) cluster analysis based on morphological parameters assorted the species into five groups. These data would provide more information on the taxonomic relationship of *Combretum* species.

### INTRODUCTION

Combretaceae R. Br. consists of trees, shrubs and lianas, with up to 23 genera currently recognized (Stace, 2007). Plants belonging to Combretaceae have compartmented hairs, known as the “combretaceous hairs”, which apart from the Combretaceae occur only in Cistaceae and Myrtaceae. Within the family, two subfamilies, Strephonematoideae and Combretoideae have been recognized (Fyhrquist, 2007). The subfamily Strephonematoideae contains a single genus comprising six species, distributed in West Africa. The subfamily Combretoideae contains 19 genera, including the mangrove species, and is characterized by a wholly inferior ovary and seeds with small, folded and spirally twisted cotyledons. Combretoideae is a taxonomically and phylogenetically complex group. Species of this subfamily are not always easy to recognize on the basis of their morphological characters, because the variation is wide in flowers, fruits and vegetative shoot morphology. In West Africa, the family Combretaceae is represented by 9 genera with 72 species and the genus *Combretum* Loefl. is the largest genus with 48 species and 8 imperfectly known species. In Nigeria, the genus *Combretum* is represented by 25 species which are mainly straggling shrubs or lianas. *Combretum* occurs in tropical and subtropical regions (America, Africa, Madagascar, India, Asia, Malasia, Australia), but is absent from the Pacific Islands (Stace, 2007).

*Combretum* species are mainly trees, shrubs, shrublets or woody climbers, very rarely sub-herbaceous. Scales (subgen. *Combretum*) or microscopic (sometimes macroscopic) stalked glands (subgen. *Cacoucia*) are present. The subgenus *Combretum* is sometimes, in addition, divided into eleven sections, based on the floral, scale and fruit anatomy (Fyhrquist, 2007). In the genus *Combretum* the leaves are opposite, verticillate or rarely alternate, usually petiolate, almost always with entire margins. Indumentum on leaves, flowers and fruit consists of unicellular, compartmented or combretaceous hairs (sharp-pointed, thick-walled with a bulbous base), multicellular stalked glands and multicellular scales. Mature scales can be classified into three major groups and have proved to be important in assessing taxon boundaries and phylogenetic relationships (Olivier *et al.* 2010). The petiole is sometimes persistent, and especially in climbers it forms a hooked wooded spine when the leaf abscises. The flowers are hermaphroditic, regular or slightly zygomorphic, 4-5-merous and they are borne in elongated or subcapitate axillary or extra-axillary spikes or racemes or in terminal or terminal and axillary, often leafy panicles. The receptacle is usually clearly divided into a lower part (lower receptacle)

surrounding and adnate to the ovary, and an upper receptacle which sometimes is differentiated into a lower part containing the disk and an often more expanded upper part. Sepals are 4-5 (rarely more), deltate to subulate or filiform, sometimes scarcely developed. Petals are 4-5, small and inconspicuous or showy (white, purple, red) and exceeding the sepals. The disk of the receptacle is glabrous or hairy, with or without a free margin, sometimes inconspicuous and absent. The calyx is produced into a short, campanulate or cup-shaped limb above the inferior ovary. Stamens are inserted on the hypanthium, usually twice as many as the sepals or petals, and usually exerted beyond the petals. The stamens vary in colour from yellow, orange, pinkish, crimson or reddish to red-brown. A glabrous or pilose, green or red, well-developed nectariferous disc is often present at the base of the upper hypanthium. Nectar production is indicative of flowers that are pollinated by a wide range of insects or birds (Stace, 2007). The ovary is inferior and 1-locular with two pendulous anatropous ovules of which only one develops into a seed. The fruit is 4-5 winged and ridged or angled, sessile or stipitate, indehiscent or rarely dehiscent; the pericarp is usually thin and papery, sometimes leathery, more rarely fleshy. Even if the fruits are often used as a good species identification character, species identification is not always easy at the fruiting stage (Fyhrquist, 2007).

The shrublike growth forms are found in savanna-like habitats such as grasslands and wooded grasslands, whereas the treelike forms often grow in Miombo woodland. Climbers can be found in riverine forests and thickets as well as on ruderal habitats. Some species can be found in coastal and swamp forests. Many species grow in lowland rainforests (Fyhrquist, 2007). Not much is known about *Combretum* species in Southeastern Nigeria. This study was designed to investigate the morphology of *Combretum* collected from various locations in Uyo, Akwa Ibom State.

#### METHODOLOGY

The plants were collected within Uyo urban from January to December 2014, mostly at their flowering stage for easy identification. Fresh plant materials were collected from University of Uyo main campus, along Ibiom street and Uyo village road into a sack bag. Specimen number, collection point using Global Position System (GPS) and date were indicated on each specimen. Pictures of the collected specimens were taken. The plant materials were identified and authenticated by a taxonomist in the Department of Botany and Ecological Studies, University of Uyo, Uyo, Nigeria. A voucher specimen of each species used for this research was also deposited in the University of Uyo Herbarium (UUH). Quantitative characters were measured using a 30cm meter rule and thread for accurate measurement (Soladoye *et al.* 2010) while qualitative parameters were assessed following the description of (Basse and Denise 2003).

#### RESULTS

##### Diverse Species of *Combretum* Encountered in Uyo Vegetation

*Combretum bracteatum* (Laws) Engl. & Diels (Fig. 1):

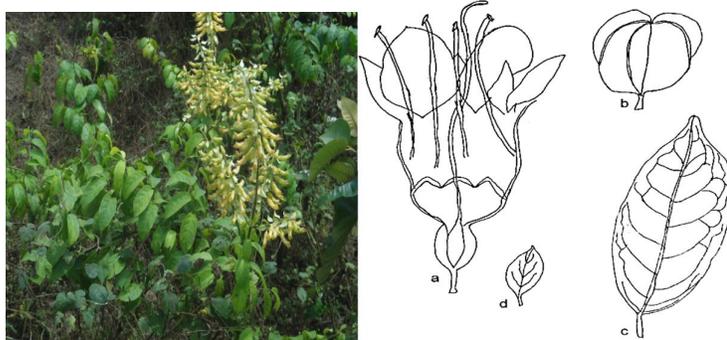


Figure 1: *Combretum bracteatum* (Laws)Engl.&Diels

A shrub with an erect, glabrous stem which possesses prominent scars left by fallen leaves and is about 1cm in diameter.

The plant can grow to a height of about 2 - 2.5m tall. The leaf is simple, alternate at the base and opposite towards the apex of branches, petiolate (petioles are 0.8cm – 0.9cm long), acuminate, entire, truncate, lanceolate, glabrous and 6cm-14cm long and 3.5cm-5cm wide. The inflorescence is a raceme. *C. bracteatum* flowers between December and February. The flowers are bracteate (bracts are persistent, light green in colour, 1-2cm long and lanceolate in shape). The filament is up to 2cm long and red in colour. Sepals 5, yellowish green in colour and occurs above the ovary with long white pilose hairs at the inner base of the sepal tube. Petals 5, yellowish green in colour, alternating with sepals and stamen 8 – 10. Both sepals and petals have an orange tinge at the tip. The ovary is completely inferior. The fruit has 5 wings, glabrous and yellow in colour when matured and when dried the colour changes to light brown (3 - 4.3cm long and 3 – 4.1cm wide).

***Combretum callobotrys* Engl. and Diels (Fig. 2):**

An erect shrub with a woody, cylindrical and branched stem that can grow to 2.5 – 3m in height. The leaf is simple with opposite arrangement. Petiolate (petioles are 0.6cm – 0.9cm long) acuminate, entire, truncate, elliptic, glabrous, 10cm – 12cm long and 4cm – 4.9 cm wide. The inflorescence is a spike-like raceme. *C. callobotrys* flowers between July and September. The flower is pedicelate, early caducous which does not allow for the formation of fruits and bracteate with caducous bracts up to 2cm long and orange in colour. The filament is up to 2cm long and green in colour. Sepals 5, orange in colour and occurs above the ovary with long white pilose hairs at the inner base of the sepal tube. Petals 5, orange in colour alternating with sepals and stamens 10. The ovary is completely inferior. No fruits were observed.



Figure 2: *Combretum callobotrys* Engl. & Diels

***Combretum dolichopetalum* Engl. & Diels (Fig. 3):**

A climbing shrub with a cylindrical woody stem that is glabrous and alternately branched. The plant can grow to a height of about 2.8 – 3.2m.

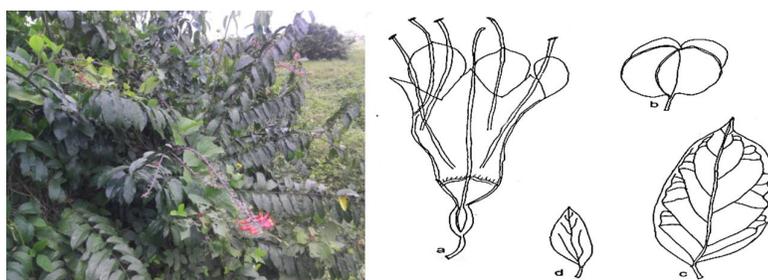


Figure 3: *Combretum dolichopetalum* Engl. & Diels

The leaf is simple with opposite arrangement. Petiolate (petioles are 0.4cm – 0.8cm long), glabrous, acuminate, entire, truncate, elliptic and 8cm - 10cm long and 3cm – 5cm wide. *C. dolichopetalum* flowers between March and May. The flowers are bracteate (bracts are early caducuous, 1cm – 2cm long and reddish - green in colour). The filament is up to 2cm long and red in colour. Sepals 5, red in colour and occurs above the ovary with long reddish white pilose hairs at the inner base of the sepal tube. Petals 5, orange in colour alternating with sepals and stamens 10. It has an inferior ovary. Fruit has 5 wings, glabrous, red in colour and persistent (3 – 4cm long and 2 – 3.5cm wide).

***Combretum hispidum* Laws. (Fig. 4):**

A woody shrub. The stem is climbing, branched, rounded, hairy, and greenish in colour and grows to the height of about 1.8 – 2.3m. The leaf is simple, alternate at the base of branches and opposite towards the apex, Petiolate (petioles are 0.5cm – 0.8cm long) cuspidate, entire, auriculate, lanceolate, glabrous and 5cm – 7cm long and 3-5cm wide. The inflorescence is a spike-like raceme. *C. hispidum* flowers between December and February. The flowers are pedicelate and bracteate (bracts are early caducuous, greenish yellow in colour, lanceolate in shape and 0.5 – 1.5cm long). The filaments are longer than the petals up to 2cm long, stamens are 10 in number. Filaments are green in colour and the anthers are reddish in colour. Sepals 5, greenish yellow and occur above the ovary with long white spinuous hairs at the inner base of the sepal tube. Petals 5, green in colour with orange tinge at the tip. The ovary is completely inferior. The fruit is yellow when matured, dries to light brown and has 5 wings (3.5 - 4cm long and 3.5 – 4.2cm wide).

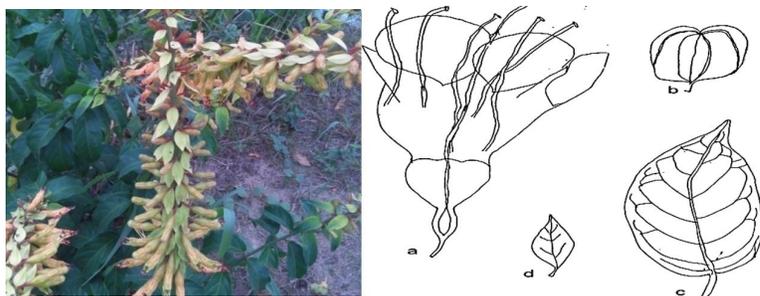


Figure 4: *Combretum hispidum* Laws

***Combretum mannii* Engl. and Diels (Fig. 5):**

A climbing shrub with a woody, glabrous, cylindrical and alternately branched stem that can grow to a height of 2.5 – 4.5m.

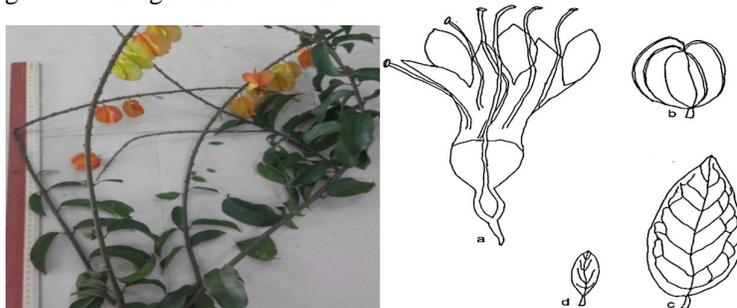


Figure 5: *Combretum mannii* Engl. & Diels

The leaf is simple, alternate at base of branches and opposite at the apex, petiolate (with petioles that are 0.9cm – 1.2cm long) acuminate, entire, truncate, elliptic, glabrous, 7 – 16cm long and 4 – 8.5 cm wide. *C. mannii* flowers between September and November. The inflorescence is a raceme. The flowers are pedicelate and bracteate (bracts are persistent, red in colour and 1cm –

2cm long). The filament is up to 2cm long and orange in colour. Sepals 5, orange in colour and occur above the ovary with long white spinuous hairs at the inner base of the sepal tube. Petals 5, green in colour alternating with sepals and stamens 10. It has an inferior ovary. The young fruit is light orange, when matured turns bright red in colour and has 4 wings (3.6 - 4.2cm long and 3.5 - 3.8cm wide).

***Combretum mooreanum* Exell (Fig. 6):**

A climbing shrub with a woody, glabrous, cylindrical and alternately branched stem that can grow to a height of 2.5 - 3.8m. The leaf is simple with alternate arrangement, petiolate (petioles are 0.8cm - 1.1 cm long) acuminate, entire, auriculate, lanceolate, glabrous and 10cm - 16cm long and 4.2 - 8.8cm wide. The inflorescence is a raceme. *C. mooreanum* flowers between July and November. The flower is pedicelate, early caducuous which does not allow for the formation of fruits and bracteate with caducuous bracts up to 2cm long and orange in colour. The filament is up to 2cm long and green in colour. Sepals 5, orange in colour and occur above the ovary with long white spinuous hairs at the inner base of the sepal tube. Petals 5, greenish orange in colour alternating with sepals and stamens 10. It has an inferior ovary. No fruits were observed.

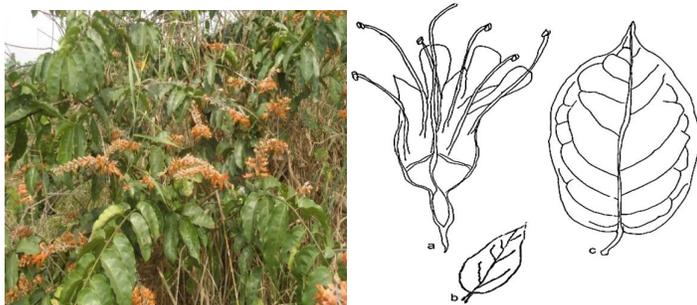


Figure 6: *Combretum mooreanum* Exell;

***Combretum platypterum* (Welw.) Hutch. & Dalz. (Fig. 7):**

A climbing shrub or liane with a woody and hollow stem, glabrous and alternately branched stem that can grow to a height of 2.7 - 3.9m. The leaf is simple with alternate arrangement, petiolate (petioles are 0.9cm - 1.2cm long), acuminate, entire, truncate, elliptic, glabrous and 11cm - 13cm long and 4 - 5.7 cm wide. The inflorescence is a raceme. *C. platypterum* flowers between April and June. The flowers are bracteate (bracts are early caducuous orange in colour and 2cm - 4cm long). The filament is up to 2cm long and green in colour. Sepals 5, greenish orange in colour and occur above the ovary with long white spinuous hairs at the inner base of the sepal tube. Petals 5, green in colour alternating with sepals and stamens 10. It has an inferior ovary. The fruit is 4 winged, and yellowish red in colour (2.9 - 3.6cm long and 2.4 - 3.2cm wide).



Figure 7: *Combretum platypterum* (Welw.) Hutch & Dalz

***Combretum racemosum* P. Beauv (Fig. 8):**

A climbing shrub with a woody stem. The stem has thorns, branched up to 3m in height. The leaf is simple with opposite arrangement, petiolate (petioles are 0.1cm – 0.4cm long) acuminate, entire, truncate, lanceolate, glabrous and 5cm – 10cm long and 3cm – 5cm wide. *C. racemosum* flowers between January and March. The inflorescence is a panicle; the peduncle is hairy. The flowers are bracteate (bracts are hairy, white in colour with green vein and 0.8cm – 1.7cm long). The calyx is 4, tubular, up to 0.3cm long, and green in colour. The petal is 4 in number, yellowish at the tip and reddish at the base. The stamens are 9-10 and vivid dark red in colour. The ovary is completely inferior. The fruit is yellow when matured, turns light brown when dried and has 4 wings (2.4 – 3.5cm long and 2 – 3.4cm wide).



Figure 8: *Combretum racemosum* P. Beauv

***Combretum zenkeri* Engl. & Diels (Fig. 9):**

A straggling scandent shrub which has a woody, angled, scantily hairy and has a brown stem. It can grow to a height of 2.3 – 3.5m. The leaf is simple with opposite arrangement, petiolate (petioles are 0.2cm – 0.4cm long) acuminate, entire, obtuse, lanceolate, glabrous and 4.5cm - 13cm long and 0.2 - 0.5cm wide. *C. zenkeri* flowers between December and February. The inflorescence is a raceme, the flowers have bracts which are green in colour, and the calyx is tubular, bright/light green in colour with 5 sepals. Stamens are longer than the petals, and 8 -10 anthers. The petals are 5 in number and white in colour. The Ovary is completely inferior. The fruit is greenish when matured and when dried turns light brown and has 5 wings (1.7 – 2.4cm long and 1.5 – 1.8cm wide).



Figure 9: *Combretum zenkeri* Engl. & Diels

**Morphological Attributes and Quantitative Traits of *Combretum* Species in Uyo**

The morphological characters (Table 1) and the quantitative and qualitative traits (Table 2) of species of *Combretum* found in Uyo metropolis, Akwa Ibom State showed variations between species.

*Bassey and Ntukidem : Morphological Attributes of  
Combretum Loefl. from South Eastern Nigeria.*

Table I: Morphological characters of *Combretum* species encountered in Uyo

Characters	<i>C. bracteatum</i>	<i>C. Calobotrys</i>	<i>C.dolichopetalum</i>	<i>C.hispidum</i>	<i>C. mannii</i>	<i>C. Mooreanum</i>	<i>C. platypterum</i>	<i>C. racemosum</i>	<i>C. zenkeri</i>
<b>Habitat</b>	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial
<b>Habit</b>	Shrub	Shrub	Shrub	Shrub	Shrub	Shrub	Shrub	Shrub	Shrub
<b>STEM:</b>									
Type	Erect	Erect	Climbing	Erect	Erect at base and procumbent at apex	Erect at base and procumbent at apex	Erect at base and procumbent at apex	Climbing	Scandent
shape	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Angular
Indumentum	Glabrous	Pubescent	Glabrous	Pubescent	Glabrous	Glabrous	Glabrous	Pubescent	Pubescent
<b>LEAVES:</b>									
Arrangement	Alternate at base and opposite at the apex	Alternate	Opposite	Alternate at base and opposite at the apex	Alternate at base and opposite at the apex	Alternate	Alternate	Opposite	Opposite
Petiole length (cm)	0.8-0.9	0.6-0.9	0.4-0.8	0.5-0.8	0.9-1.2	0.8-1.1	0.9-1.2	0.1-0.4	0.2-0.4
Shape	Lanceolate	Elliptic	Elliptic	Lanceolate	Elliptic	Lanceolate	Elliptic	Lanceolate	Lanceolate
Apex	Accuminate	Accuminate	Accuminate	Cuspidate	Accuminate	Accuminate	Accuminate	Accuminate	Accuminate
Base	Truncate	Truncate	Truncate	Auriculate	Truncate	Auriculate	Truncate	Truncate	Obtuse
<b>Inflorescence type</b>	Raceme	Spike-like raceme	Raceme	Spike-like raceme	Raceme	Raceme	Raceme	Panicle	Raceme
<b>FLOWER</b>									
Bract colour	Light green	Orange	Reddish green	Greenish yellow	Red	Orange	Orange	White	Deep green
Petal colour	Yellowish green	Orange	Orange	Green	Green	Greenish orange	Green	Reddish yellow	Cream
Sepal colour	Yellowish green	Orange	Red	Yellow	Orange	Orange	Greenish Orange	Green	Green
Number of stamen	8-10	10	10	10	10	10	10	9-10	10
<b>FRUIT</b>									
Colour	Yellow	-	Red	Yellow	Orange	-	Yellowish red	Yellow	Greenish yellow
Number of wings	5	-	5	5	4	-	4	4	5

Table 2: Quantitative traits of *Combretum* species (Mean  $\pm$ S.E)

Characters	Leaf length (cm) $\pm$ SE	Leaf width(cm) $\pm$ SE	Leaf Index	Petiole length (mm)	Flower length (cm) $\pm$ SE	No. of Sepals	No. of petals	No. of Stamens
<i>C. bracteatum</i>	12 $\pm$ 2.10	4.8 $\pm$ 0.01	2.5	7	4.46 $\pm$ 0.080	5	5	8 -10
<i>C. calobotrys</i>	12 $\pm$ 0.00	4.9 $\pm$ 0.00	2.44898	9	2.49 $\pm$ 0.082	5	5	10
<i>C. dolichopetalum</i>	10.9 $\pm$ 0.04	5 $\pm$ 1.0	2.18	8	3.40 $\pm$ 0.094	5	5	10
<i>C. hispidum</i>	13.3 $\pm$ 1.82	6 $\pm$ 0.00	2.216667	10	6.32 $\pm$ 0.98	5	5	10
<i>C. mannii</i>	10.5 $\pm$ 1.17	4.8 $\pm$ 0.25	2.1875	8	3.93 $\pm$ 0.117	5	5	10
<i>C. mooreanum</i>	16.05 $\pm$ 0.05	8.8 $\pm$ 0.00	1.823864	11	4.53 $\pm$ 0.178	5	5	10
<i>C. platypterum</i>	13 $\pm$ 0.00	5.7 $\pm$ 1.3	2.280702	11	3.05 $\pm$ 0.129	5	5	10
<i>C. racemosum</i>	6.9 $\pm$ 0.02	3 $\pm$ 0.02	2.3	5	0.71 $\pm$ 0.088	4	4	9-10
<i>C. zenkeri</i>	14.3 $\pm$ 0.00	7.2 $\pm$ 0.00	1.944444	3	2.41 $\pm$ 0.09	5	5	10

Statistical analysis using quantitative features of the leaf length, width, petiole and floral length resulted in grouping the samples into four clusters shown in the dendrogram in Figure 10. Cluster I consisted of *C. racemosum* while cluster II contained *C. platypterum* and *C. zenkeri*, cluster III consisted of *C. hispidum*, *C. calobotrys*, *C. dolichopetalum*, *C. mannii* and *C. bracteatum* whereas cluster IV consisted of *C. mooreanum*.

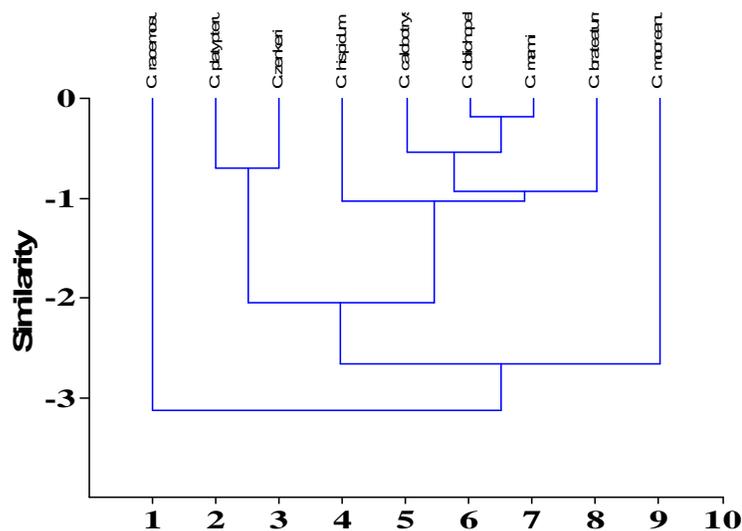


Figure 10: Cluster dendrogram using leaf length, leaf width, petiole and flower length.

### DISCUSSION

Nine species of *Combretum* were encountered during the study. Assessment of quantitative and qualitative morphological characters of the species of *Combretum* found in Uyo metropolis, Akwa Ibom State showed variations. This is of great relevance to species identification and collection (Ekeke *et al.* 2014). The study findings have shown that the *Combretum* species encountered are mainly terrestrial and shrubs with varied elevations. Phil-Eze (2012) reported that elevation influences plant species diversity, species richness and species distribution in the tropics and even at low latitudes. Dry season samples were 4 and they included *C. bracteatum*, *C. hispidum*, *C. racemosum* and *C. zenkeri* while rainy season samples were 5 and they included *C. calobotrys*, *C. dolichopetalum*, *C. mannii*, *C. mooreanum* and *C. platypterum*. The samples that flowered in the dry season have previously been by Ekeke *et al.* (2013) as being found in the South-South and South-Eastern parts of Nigeria. Fruits were observed on the stands of other species throughout rainy and dry seasons except on *C. calobotrys* and *C. mooreanum*. According to Verdu and Garcia-Fayos (1998), water addition increase the survival of reproductive structures

at early developmental stages of flower, survival after pollination and latent ovary survival. The absence of fruits in *C. calobotrys* and *C. mooreanum* could be ascribed to adjustment of progeny fruit size to the available resources; an individual feature inherent to life history of different plant species and therefore independent of the present resource level. This adjustment may have an adaptive value in relation to uncertainty of water availability. Pollen and resource limitation may lead to low fruits because of abortion of reproductive structures and development of parthenocarpic fruits (Verdu and Garcia-Fayos, 1998).

Six out of the 9 species encountered had 5 wing fruits whereas three had four wings. Only morphological traits of habit, branching pattern, reticulate venation, entire margin, acuminate apex and glabrous leaves were common to all the nine species investigated. Other morphological characters such as petiole length, leaf shape and length, flora length, inflorescence type, bract, sepal and petal colour, colour of wings were found to be variable among the species. The statistical analysis using quantitative features of the leaf length, width, petiole and floral length resulted in grouping the samples into four clusters (Fig. 10). Cluster I consisted of *C. racemosum* while cluster II contained *C. platypterum* and *C. zenkeri*, cluster III consisted of *C. hispidum*, *C. calobotrys*, *C. dolichopetalum*, *C. mannii* and *C. bracteatum* whereas cluster IV consisted of *C. mooreanum*. Ekeke *et al.* (2014) using quantitative data also deduced similar result from ten (10) *Combretum* species studied. Based on leaf length, leaf width and petiole length *C. dolichopetalum* and *C. mannii* were closely related to each other than others which is confirmed by the dendrogram in Figure 10. Soladoye *et al.* (2010) stated that numerical taxonomy is useful in providing a logical means of expressing the relationship existing between taxa. This method which was employed in this study, has become important in systematic studies in the past few years in authenticating morphological findings.

#### CONCLUSION

The analysis of nine species of *Combretum* in this study has provided useful baseline information associated with current taxonomic challenges which can be exploited for sustainable management of the rare plant species

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