

Taxonomic Significance of Morphological Characters in some Species of Cucurbitaceae Common in Abakaliki Ebonyi State

ABSTRACT

Morphological properties have been used as indices in taxonomical studies for more than hundred years. The present study was carried out in Mgbabor, Abakaliki Local Government Area of Ebonyi State Nigeria with an aim to determine the taxonomic significance of morphological features in three (3) species (*Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*) of family Cucurbitaceae. Five (5) samples from each species were randomly collected. The morphological features of each sample were identified after which the leaf, flower and fruit measurements were taken. The statistical method used in the analysis of data was ANOVA. The result of the morphological characteristics (leaf type, colour of the flower, fruit shape, leaf arrangement, colour of corolla, leaf texture, rind on the fruit, leaf surface, number of seeds, fruit shape, flower symmetry, receptacle etc) of *C. vulgaris*, *M. charantia* and *L. cylindrica* was recorded. A comparison of morphological characteristics revealed that tendrils was present in *C. vulgaris* and *L. cylindrica* but absent in *M. charantia*. *M. charantia* and *L. cylindrica* had an oval fruit shape while *C. vulgaris* was globular. Morphological characteristics shared among the three species are alternate leaf arrangement, cordate leaf base, inferior ovary, pubescent leaf surface, simple leaf type amongst others. The flower of all the three species was radically symmetrical, and all the three species had a total of 5 petals each. The petals of *C. vulgaris* and *L. cylindrica* were yellow while *M. charantia* was white. *C. vulgaris* and *M. charantia* had axillary inflorescence while *L. cylindrica* was axillary. The mean leaf area, fruit area and flower area of *C. vulgaris*, *M. charantia* and *L. cylindrica* was also calculated. The result generated in this study can be useful as morphological evidence for delineating taxa of the plants at the generic level. Hence this work is of great taxonomic significance in delimiting these species of family cucurbitaceae studied.

Keywords: Morphology, Taxonomy, Cucurbitaceae, Plant, Flower, Leaf, Stem, Fruit, *Citrullus vulgaris*, *Momordica charantia*, *Luffa cylindrica*

1. INTRODUCTION

Plant taxonomy is the science that finds, identifies, describes, classifies, and names plants. Three goals of plant taxonomy are the identification, classification and description of plants. The distinction between these three goals is important and often overlooked. Plant identification is the determination of the identity of an unknown plant by comparison with previously collected specimens or with the aid of books or identification manuals. The process of identification connects the specimen with a published name. Once a plant specimen has been identified, its name and properties are known. Plant classification is the placing of known plants into groups or categories to show some relationship. Scientific classification follows a system of rules that standardizes the results, and groups successive categories into a hierarchy. The classification of plants results in an organized system for the naming and cataloging of future specimens, and reflects scientific ideas about inter-relationships between plants [1].

Morphological properties are indices used in taxonomical studies for more than hundred years. Solereder [2] summarized a lot of morphological characters of some dicotyledonous families followed by Metcalf and Chalk [3] who gave a synthesis of previous works. The importance of leaf morphology for plant classification has been recognized and studied by many authors [4], [5], [6], [7]. Former studies of Al-Edany [8] indicated the importance of morphological features on the palaeobotanical and taxonomical studies. Kantachoket al [9], Iroka et al [10], [11] stated that leaf anatomical data support morphological evidence for separating taxa of plants at the generic level.

Cucurbitaceae is a medium sized and botanically highly specialized family of mainly climbing plants. Cucurbitaceae is a fairly large family containing about 100 genera (the most important of which are: *Cucurbita*, *Lagenaria*, *Citrullus*, *Cucumis* and *Luffa*) and 800 species which are mainly tropical or subtropical in distribution, with a few species extending into temperate climate. This family ranks among the highest of plant families for number and percentage of species used as human food. These are used as fruits and vegetables, and most of them have considerable economic value [7]. Many members of the Cucurbitaceae family are ancient and have been feeding humanity for millennia and are also sources of medicine. Some are widely cultivated in the field for vegetable and

food. Cultivation of the vegetable as a food source began roughly 3000 years ago. A few taxa are also grown as ornamental plants. They originated in India and other parts of Western Asia. It is also found in Nigeria. Most of the plants in this family are annual vines, but some are woody lianas, thorny shrubs, or trees (*Dendrosicyos*). All species are sensitive to frost. Many species have large, yellow or white flowers. The stems are hairy and pentangular. Tendrils are present at 90° to the leaf petioles at nodes. Leaves are exstipulate alternate simple palmately lobed or palmately compound. The flowers are unisexual, with male and female flowers on different plants (dioecious) or on the same plant (monoecious). The female flowers have inferior ovaries. The fruit is often a kind of modified berry called a pepo. Cucurbitaceae is the largest group of summer vegetable crops. These include cucumber, musk melon, water melon, tinda, bottle gourd, luffa and bitter melon, pumpkin, squashes, parwal and snake gourd. Most of the members of the family Cucurbitaceae are monoecious and a few are dioecious. They are all summer season crops and are susceptible to frost [12]. Literature on species taxonomic significance and morphological description are scarce [13], [14]. Hence, the present study looks to explore several selected morphological features in three (3) species of family Cucurbitaceae and to determine their taxonomic importance in delimiting the species and/or supporting the interrelationship among the members studied.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in Mgbabor under Abakaliki Local Government Area located at latitude 60° 19N and longitude 8° 04 E in Ebonyi State. The rainy season lasts only for a few months while the rest of the year is hot and dry with a temperature of 36° C. the type of vegetation found in this area is called Sudan savannah

2.2 Sample Collection

Five samples were randomly collected from each species of cucurbitaceae (*Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*) were collected from the study site.



Citrullus vulgaris

Momordica charantia

Luffa cylindrica

Fig 1. Morphological view of *Luffa cylindrica*

2.3 Sample Identification

The samples were identified by taxonomist Dr. J.C. Okafor

2.4 Sample Analysis

The qualitative morphological features of each sample were observed and notes were taken, after which the leave, flower and fruit measurements were taken for the quantitative morphological data.

2.5 Statistical Analysis

The statistical method used in the analysis of data collected was analysis of variance (ANOVA) and results were presented in mean and standard deviation.

3. RESULT

3.1 Result of the qualitative morphological characteristics of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*

The result of the qualitative morphological characteristics (leave type, colour of the flower, fruit shape, tendrils, leaf arrangement, colour of corolla, stem, leave texture, rind on the fruit, leave surface, no of seeds, fruit shape, flower symmetry, receptacle and growth rate) of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica* is presented in Table 1, Table 2 and Table 3 respectively.

UNDER PEER REVIEW

Table 1: Qualitative Morphological Features in Five (5) Plants of *Citrullus vulgaris*

Parameter	1 st plant	2 nd plant	3 rd plant	4 th plant	5 th plant
Growth habit	Herbaceous climber	Herbaceous climber	Herbaceous climber	Herbaceous climber	Herbaceous climber
Root system	Extensive	Extensive	Extensive	Extensive	Extensive
Leaf type	Palmately lobed	Palmately lobed	Palmately lobed	Palmately lobed	Palmately lobed
Leaf arrangement	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf apex	Acuminate	Acuminate	Acuminate	Acuminate	Acuminate
Leaf base	Cordate	Cordate	Cordate	Cordate	Cordate
Tendrils	Tendrils are branched	Tendrils are branched	Tendrils are branched	Tendrils are branched	Tendrils are branched
Leaf surface	Glabrous	Glabrous	Glabrous	Glabrous	Glabrous
Leaf margin	Serrate	Serrate	Serrate	Serrate	Serrate
Stem	The stem is thin, hairy, angular and have branched tendrils at each node	The stem is thin, hairy, angular with branched tendrils at each node	The stem is thin, hairy, angular with branched tendrils at each node	The stem is thin, hairy, angular and have branched tendrils at each node	The stem is thin, and hairy with branched tendrils
Inflorescence type	Solitary	Solitary	Solitary	Solitary	Solitary
Inflorescence position	Axillary	Axillary	Axillary	Axillary	Axillary
Colour of corolla	Green outside bright yellow inside	Green-veined outside and pale yellow inside	Green veined out-side and pale-yellow inside	Green-veined outside and pale yellow inside	Green outside and bright yellow inside
Calyx color	Greenish	Greenish	Greenish	Greenish	Greenish
No of corolla	5	5	5	5	5
Distinct aroma	Present	Presence	Presence	Present	Present
No of calyx	5	5	5	5	5
Position of ovary	Inferior	Inferior	Inferior	Inferior	Inferior
Receptacle	Long, broadly campanulated and hairy	Long, broadly campanulated and hairy	Long, broadly campanulated and hairy	Long broadly campanulated and hairy	Long, campanulated and hairy.
Fruit type	Simple	Simple	Simple	Simple	Simple
Fruit shape	Globular shape	Globular shape	Round to cylindrical	Round to cylindrical	Round to cylindrical
Fruit colour	Green	Green	Green	Dark green	Green
Flower symmetry	Radically symmetrical	Radically symmetrical	Radically symmetrical	Radically symmetrical	Radically symmetrical
Seed arrangement	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows
No of seeds	Numerous	Numerous	Numerous	Numerous	Numerous

Table 2: Morphological Features of Five (5) Plants of *Momordica charantia*

Parameter	1 st plant	2 nd plant	3 rd plant	4 th plant	5 th plant
Growth habit	Herbaceous climber	Herbaceous climber	Herbaceous climber	Herbaceous climber	Herbaceous climber
Root system	Extensive	Extensive	Extensive	Extensive	Extensive
Leaf type	Simple (5-lobed)	Simple (5-lobed)	Simple 5-lobed	Simple 5-lobed	5-lobed(simple)
Leaf arrangement	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf apex	Acuminate	Acuminate	Acuminate	Acuminate	Acuminate
Leaf base	Broadly cordate	Broadly cordate	Broadly cordate	Broadly cordate	Broadly cordate
Tendrils	Spirally twisted	Spirally twisted	Absent	Spirally twisted	Absent
Leaf surface	Glabrous	Glabrous	Glabrous	Glabrous	Glabrous
Leaf margin	Irregularly Serrate	Serrate	Irregularly Serrate	Irregularly Serrate	Serrate
Stem	The stem is thin, less hairy and angular	The stem is thin, less hairy and angular	The stem is thin, less hairy and angular	The stem is thin, less hairy and angular	The stem is thin, less hairy and angular
Inflorescence type	Solitary	Solitary	Solitary	Solitary	Solitary
Inflorescence position	Axillary	Axillary	Axillary	Axillary	Axillary
Colour of petal	White-Yellow	White-Yellow	Yellow	Yellow	White-Yellow
Calyx color	Greenish	Greenish	Greenish	Greenish	Greenish
No of petal	5	5	5	5	5
Distinct aroma	Present	Presence	Presence	Present	Present
No of calyx	5	5	5	5	5
Position of ovary	Inferior	Inferior	Inferior	Inferior	Inferior
Receptacle	Long, broadly campanulate and hairy	Long, broadly campanulate and hairy	Long, broadly campanulate and hairy	Long broadly campanulate and hairy	Long, campanulate and hairy.
Fruit type	Simple and fleshy	Simple and fleshy	Simple and fleshy	Simple and fleshy	Simple and fleshy
Fruit shape	Elliptical, rough and conspicuously ridged	Elliptical, rough and conspicuously ridged	Elliptical, rough and conspicuously ridged	Elliptical, rough and conspicuously ridged	Elliptical, rough and conspicuously ridged
Fruit colour	Green to orange colour	Greenish	Greenish	Green to orange colour	Greenish
Flower symmetry	Radically symmetrical	Radically symmetrical	Radically symmetrical	Radically symmetrical	Radically symmetrical
Seed arrangement	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows
No of seeds	Numerous	Numerous	Numerous	Numerous	Numerous

Table 3: Morphological Features of Five (5) Plants of *Luffa cylindrica*

Parameter	1st plant	2nd plant	3rd plant	4th plant	5th plant
Growth habit	Herbaceous climber/trailer	Herbaceous climber/trailer	Herbaceous climber/trailer	Herbaceous climber/trailer	Herbaceous climber/trailer
Root system	Extensive	Extensive	Extensive	Extensive	Extensive
Leaf type	Simple (palmate)	Simple (palmate)	Simple (palmate)	Simple (palmate)	Simple(palmate)
Leaf arrangement	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf apex	Acute	Acute	Apiculate	Acute	Apiculate
Leaf base	Cordate	Cordate	Cordate	Cordate	Cordate
Tendrils	Branched tendrils	Branched tendrils	Branched tendrils	Branched tendrils	Branched tendrils
Leaf surface	Slightly pubescent	Slightly pubescent	Slightly pubescent	Pubescent	Pubescent
Leaf margin	Dentate	Sinuate-dentate	Sinuate-dentate	Dentate	Dentate
Stem	5 angled, finely hairy	5 angled, finely hairy	5 angled, finely hairy	5 angled, finely hairy	5 angled, finely hairy
Inflorescence type	Solitary	Solitary	Solitary	Solitary	Solitary
Inflorescence position	Axillary	Axillary	Axillary	Axillary	Axillary
Colour of corolla	Yellow	Yellow	Yellow	Yellow	Yellow
Calyx color	Greenish	Greenish	Greenish	Greenish	Greenish
No of corolla	5	5	5	5	5
Distinct aroma	Present	Presence	Presence	Present	Present
No of calyx	5	5	5	5	5
Position of ovary	Inferior	Inferior	Inferior	Inferior	Inferior
Receptacle	Short broadly companulated and slightly hairy	Short broadly companulated and slightly hairy	Short broadly companulated and slightly hairy	Short broadly companulated and slightly hairy	Short broadly companulated and slightly hairy
Fruit type	Simple and fleshy	Simple and fleshy	Simple and fleshy	Simple and fleshy	Simple and fleshy
Fruit shape	Oblong	Cylindrical	Cylindrical	Oblong	Oblong
Fruit colour	Greenish	Greenish	Greenish	Dark green	Greenish
Flower symmetry	Radically symmetrical	Radically symmetrical	Radically symmetrical	Radically symmetrical	Radically symmetrical
Seed arrangement	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows
No of seeds	Numerous	Numerous	Numerous	Numerous	Numerous

3.2 Comparism of morphological characteristics of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*

A comparism of morphological characteristics revealed that tendrils was present in *Citrullus vulgaris* and *Luffa cylindrica* but absent in *Momordica charantia*. All the plants observed were yellow in color. According to fruit shape it was found that *Momordica charantia* and *Luffa cylindrica* was oval while the fruit shape of *Citrullus vulgaris* was globular. According to leaf arrangement all the three species were alternate while according to leaf base shape all were cordate. Also according to Flower description all the three species had inferior ovary. According to Leave surface the three species were Pubescent, according to Leave type all were Simple. All the three species had a fleshy fruit type. The sepal of the three species was yellow in colour. According to flower symmetry all the three species were radically symmetrical while according to petal colour *Citrullus vulgaris* and *Luffa cylindrica* were yellow while *Momordica charantia* was white. All the three species had a total of 5 petals each. According to Inflorescence position *Citrullus vulgaris* and *Momordica charantia* were one-sided while *Luffa cylindrical* was Axillary. Corolla was absent in *Citrullus vulgaris* and *Momordica charantia* but present in *Luffa cylindrical*. The three species had a trailing growth rate and there was an absence of distinct aroma in the three species. This is shown in table 4

Table 4: Comparism of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrical*

Parameter	<i>Citrullus vulgaris</i>	<i>Momordica charantia</i>	<i>Luffa cylindrical</i>
Growth habit	Herbaceous climber	Herbaceous climber	Herbaceous climber/trailer
Root system	Extensive	Extensive	Extensive
Leave type	Palmately lobed	Simple (5-lobed)	Simple (palmate)
Leave arrangement	Alternate	Alternate	Alternate
Leaf apex	Acuminate	Acuminate	Acute
Leaf base	Cordate	Broadly cordate	Cordate
Tendril	Tendrils are branched	Spirally twisted	Branched tendril
Leave surface	Glabrous	Glabrous	Slightly pubescent
Leave margin	Serrate	Irregularly Serrate	Dentate
Stem	The stem is thin, hairy, angular and have branched tendrils at each node	The stem is thin, less hairy and angular	5 angled, finely hairy
Inflorescence type	Solitary	Solitary	Solitary
Inflorescence position	Axillary	Axillary	Axillary
Colour of corolla	Green outside bright yellow inside	White- Yellow	Yellow
Calyx color	Greenish	Greenish	Greenish
No of corolla	5	5	5
Distinct aroma	Present	Present	Present
No of calyx	5	5	5
Position of ovary	Inferior	Inferior	Inferior
Receptacle	Long, broadly companulated and hairy	Long, broadly companulated and hairy	Short broadly companulated and slightly hairy
Fruit type	Simple	Simple and fleshy	Simple and fleshy
Fruit shape	Globular shape	Elliptical, rough and conspicuously ridged	Cylindrical to Oblong
Fruit colour	Green	Green to orange colour	Greenish
Flower symmetry	Radically symmetrical	Radically symmetrical	Radically symmetrical
Seed arrangement	Vertically in 2 rows	Vertically in 2 rows	Vertically in 2 rows
No of seeds	Numerous	Numerous	Numerous

3.3. Leave area, Fruit area and Flower area of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*

The leave area, flower area and fruit area of the three species were measured as presented in tables 5, 6 and 7 for *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica* respectively.

Table 5: Leave area, Fruit area and Flower area of *Citrullus vulgaris*

Parameter	Plant A	Plant B	Plant C	Plant D	Plant E
Leave area	18cm ²	12cm ²	8 cm ²	8 cm ²	1 cm ²
Fruit area	36 cm ²	46.24 cm ²	28.09 cm ²	43.56 cm ²	47.61 cm ²
Flower area	72 cm ²	98 cm ²	60.5 cm ²	69.62 cm ²	74.42 cm ²

Table 6: Leave area, Fruit area and Flower area of *Momordica charantia*

Parameter	Plan A	Plant B	Plant C	Plant D	Plant E
Leave Area	18cm ²	8cm ²	24-5 cm ²	18 cm ²	21.16 cm ²
Fruit Area	98 cm ²	12 cm ²	128 cm ²	112.5 cm ²	112.5 cm ²
Flower Area	36 cm ²	16 cm ²	36 cm ²	25 cm ²	36 cm ²

Table 7: Leave area, Flower area and Fruit area of *Luffa cylindrica*

	Plant A	Plant B	Plant C	Plant D	Plant E
Leave Area	8.cm ²	18cm ²	12.5cm ²	18cm ²	4.5cm ²
Fruit Area	30cm ²	22cm ²	26.cm ²	16.cm ²	22cm ²
Flower Area	21.16cm ²	25cm ²	17.64cm ²	23.04cm ²	6.25cm ²

3.4: Mean of the leave area, fruit area and flower area of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*

The mean of the leave area, fruit area and flower area of *Citrullus vulgaris* was 12.8, 40.3 and 74.9 respectively while *Momordica charantia* had a leave area, fruit area and flower area of 17.9, 104.6 and 29.8 respectively. *Luffa cylindrical* had a leave area, fruit area and flower area of 12.2, 23.2 and 18.6 respectively. This is shown in table 8

Table 8: The mean of the leave area, fruit area and flower area of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*

Parameter	Mean (cm ²)		
	<i>Citrullus vulgaris</i>	<i>Momordica charantia</i>	<i>Luffa cylindrica</i>
Leave area	12.8	17.9	12.2
Fruit area	40.3	104.6	23.2
Flower area	74.9	29.8	18.6

4. DISCUSSION

Morphological properties have been used as indices in taxonomical studies for more than hundred years. The importance of plant morphology for plant classification has been recognized and studied by authors like [4], [5], [6], [7].

The present study was carried out with an aim to determine the taxonomic significance of morphology in three (3) species of family Cucurbitaceae (*Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica*). The result of the morphological characteristics (leave type, colour of the flower, fruit shape, tendrils, leaf arrangement, colour of corolla, stem, leave texture, rind on the fruit, leave surface, no of seeds, fruit shape, flower symmetry, receptacle and growth rate) of *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica* is presented in Table 1, Table 2 and Table 3 respectively. A comparison of morphological characteristics as shown in table 4 revealed that tendrils was present in *Citrullus vulgaris* and *Luffa cylindrica* but absent in *Momordica charantia*. All the plants observed were yellow in color. According to fruit shape it was found that *Momordica charantia* and *Luffa cylindrica* was oval while the fruit shape of *Citrullus vulgaris* was globular. According to leaf arrangement all the three species were alternate while according to leaf base shape all were cordate. Also according to Flower description all the three species had inferior ovary. According to Leave surface the three species were Pubescent, according to Leave type all were Simple. All the three species had a fleshy fruit type. The sepal of the three species was yellow in colour. According

to flower symmetry all the three species were radically symmetrical while according to petal colour *Citrullus vulgaris* and *Luffa cylindrica* were yellow while *Momordica charantia* was white. All the three species had a total of 5 petals each. According to Inflorescence position *Citrullus vulgaris* and *Momordica charantia* were one-sided while *Luffa cylindrica* was Auxillary. Corolla was absent in *Citrullus vulgaris* and *Momordica charantia* but present in *Luffa cylindrica*. The three species had a trailing growth rate and there was an absence of distinct aroma in the three species.

Furthermore, the leaf area, flower area and fruit area of the three species were measured as presented in tables 5, 6 and 7 for *Citrullus vulgaris*, *Momordica charantia* and *Luffa cylindrica* respectively. The Mean, Variance, Standard deviation and Standard error for the Leaf area, Flower area and Fruit area of the three species was also calculated and presented in table 8.

The mean of the leaf area, fruit area and flower area of *Citrullus vulgaris* was 12.8, 40.3 and 74.9 respectively while *Momordica charantia* had a leaf area, fruit area and flower area of 17.9, 104.6 and 29.8 respectively. *Luffa cylindrica* had a leaf area, fruit area and flower area of 12.2, 23.2 and 18.6 respectively; this is shown in table 8.

The result obtained in this study is in conformity with the work done by Rahman [7], in a Systematic study on Cucurbitaceae growing throughout the Rajshahi Division of Bangladesh. In his study, a total of 24 species under 13 genera of the family Cucurbitaceae were collected and identified. A complete taxonomic account of each species was also given along with their current name, local name, brief description, phenology, basic chromosome number and voucher number.

In a similar study Solereder [2] summarized a lot of morphological characters of some dicotyledonous families followed by Metcalf and Chalk [3] who gave a synthesis of previous works.

Kantachotet al [9], Irokaet al. [10], [11] stated that plant anatomical data support morphological evidence for separating taxa of plants at the generic level. Former studies of Al-Edany [8] indicated the importance of morphological features on the palaeobotanical and taxonomical studies. Walters [15] has showed in convincing style that taxonomic systems tend to reflect the history of taxonomy as a human discipline, rather than the evolutionary relationships of plants.

5. CONCLUSION

The result of this has shown that there is a clear interrelationship among the members of Cucurbitaceae family used for this study. The result obtained can be of great importance in further studies on taxonomical classifications of this noble family.

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