MACROMORPHOLOGICAL STUDY OF SOME SPECIES IN FAMILY CUCURBITACEAE

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ABSTRACT

Nine genera in the family Cucurbitaceae were subjected to morphological study with a view to find additional diagnostic characters of taxonomic importance within the family. Qualitative and quantitative data were taken. Quantitative data were subjected to SPSS analysis and Duncan Multiple Range Test to show significant differences. Result of this study reveals that there are similarities in many vegetative morphological characters in the family. However, characters useful in the delimitation of the species include stem surface; mature fruit colour, where it is almost taxon-specific; seed colour; seed surface; leaf type: simple palmately lobed leaves and compound palmate leaves; tendril type: simple unbranched and branched, with the simple unbranched tendrils occurring in *Cucumeropsis mannii, Cucumis sativus* and *Momordica charantia*. Tendrils in these species are more advanced than the branched ancestral tendrils observed in the other species of the family studied. An overall trend for the transformation of flower colour from yellow to white was observed and documented. Flowers of *Telfairia occidentalis* are unique in having reddish-purple colour at the base, while those of *Trichosanthes cucumerina* are also unique in having deeply fringed or lacy petal edges. All the species of the family studied are sexually monoecious except in *Telfairia occidentalis* where they are dioecious, suggesting the ancestral state of sexuality in *Telfairia occidentalis* in comparison with the other species of the family studied. This study also documents the noteworthiness of seed morphology in the taxonomy of family Cucurbitaceae. Result generated from the quantitative data shows that the characters are quantitatively taxon-specific. An indented artificial dichotomous key was constructed to simplify the relatedness and identification of the species studied.

Key words: Cucurbitaceae, morphological, diagnostic, taxonomic.

INTRODUCTION

The Cucurbitaceae family include nearly 1000 species that are primarily native to tropical and subtropical regions of the world, but a small number of species are also found in temperate region (Schaefer and Renner, 2011, Guo *et al.*, 2020; Markin-Gomez *et al.*, 2024). They are largely tendril climbers and have characteristic pepo fruits (Guo *et al.*, 2020). The ability of climbing plants to grow upward along others to reach the canopy for photosynthesis is hypothesized as a key innovation in flowering plants. Guo *et al.* (2020), reported that the cucurbit-specific tendril identity gene *TEN* originated from a paleo-polyploidization event at the origin of the family.

Cucurbitaceae members include many important vegetables and fruits such as, cucumber (*Cucumis sativus*), melon (*Cucumis melo*), watermelon (*Citrullus lanatus*), and bitter gourd (*Momordica charantia*) (Guo *et al.*, 2020). Cucurbits have also served as model systems for understanding molecular regulation of tendril development and bitter compound biosynthesis (Zhou *et al.*, 2016).

Cucurbits exhibit antioxidant properties because of a variety of bioactive components, such as cucurbitacins B and E and ellagitannins, which are tannins and have the ability to scavenge free radicals (Guo *et al.*, 2020). Majority of the vegetables in the Cucurbitaceae family are also high in carotenoids which increase the nutritional value and safety of food due to their antioxidant capacity.

According to Ajuru and Okoli (2013), about three genera of Cucurbitaceae bear the common name melons. They acre *Cucumis, Citrullus* and *Cucumeropsis*. The genus *Cucumis* includes *Cucumis melo* L. (true melon), *Citrullus* includes *Citrullus lanatus* Thunb. Matsum and Nakai (watermelon, and brown-seeded melon or egusi melon in Nigeria) and *Cucumeropsis* is represented by one species in Nigeria, *Cucumeropsis mannii* Naud. (Synonym *Cucumeropsis edulis* (Hooker f.) cogn.) (white seeded melon or Mann's Cucumeropsis).

The study of plant morphology and anatomy in the era of climate change provides valuable insights into plant adaptation, resilience, resource use efficiency, carbon dynamics and ecosystem dynamics, all of which are essential for sustainable management and conservation efforts in a changing environment (Adamakis, 2025). Ikechukwu and Ndukwu, (2004) in their study on some *Cucurbita* species reported that leaf morphological features such as shape, size, margin and colour were diagnostic for the genus, either at the generic or specific level. Agbagwa

and Ndukwu, (2004) also reported on the morphological features of the three species of *Cucurbita* cultivated in Nigeria.

The general morphology in the family Cucurbitaceae is very similar. This has contributed to confusion in the taxonomy and classification of the family and has been fraught with ambiguity and abounding synonymy (Jeffrey, 2005; Zhang *et al*., 2006; Schaefer *et al.*, 2009). To complement the existing taxonomic evaluation of species in this family, morphological characters of some species of plants from nine genera of the family namely*; Luffa, Citrullus, Cucurbita, Cucumis, Telfairia, Trichosanthes, Cucumeropsis, Lagenaria and Momordica* have been studied.

MATERIALS AND METHODS

A preliminary study of herbarium materials of the family Cucurbitaceae was carried out in Obafemi Awolowo University Herbarium (IFE) and Forestry Research Institute of Nigeria Herbarium (FRIN). The Flora of West Tropical Africa by Hutchinson and Daziel (1972) was consulted for further clarifications and guidance. Seeds of the cultivated plants were collected from National Center for Genetic Resources and Biotechnology (NACGRAB) research institute, Moor Plantation Ibadan, Oyo State and Teaching and Research Farm OAU Ile – Ife while seeds of the non- cultivated ones were collected from the wild. The species in the family Cucurbitaceae studied are distributed within nine genera and are: *Citrullus lanatus* (Thunb.) Matsum. and Nakai (Black seeds), *Citrullus lanatus* (Thunb.) Matsum. and Nakai (Brown seeds), *Luffa aegyptiaca* Mill. (Synonym: *Luffa cylindrica* M.Roem.), *Lagenaria siceraria* (Molina) Standl. (Spatulate fruit shape), *Lagenaria siceraria* (Molina) Standl. (Oval fruit shape), *Cucumeropsis mannii* Naudin (Synonym: *Cucumeropsis edulis* (Hook.f.) Cogn.), *Cucumis sativus* L., *Momordica charantia* L., *Telfairia occidentalis* Hook.f., *Cucurbita maxima* Duchesne, *Trichosanthes cucumerina* L. (Synonym: *Trichosanthes anguina* L.).

The seeds were identified and confirmed in the IFE herbarium before planting them and were planted in the Botanical Garden of Obafemi Awolowo University Ile-Ife Nigeria, in order to have free access to the plant species for the research work. Matured plants were further authenticated at the IFE and FRIN Herbaria. Qualitative morphological characters were observed

and recorded for each species, these include: Flora type, life cycle, habit, stem shape, stem surface, stem colour, leaf type, leaf shape, leaf apex, leaf base, leaf margin, leaf venation, phyllotaxy, leaf lamina surface, leaf colour, petiole surface, tendril type, flower colour, fruit shape, fruit colour, seed shape, seed colour, seed surface, sex description. Quantitative morphological characters measured and recorded were leaf length (cm) and breadth (cm), petiole length (cm), sepal length (cm) and breadth (cm), petal length (cm) and breadth (cm), seed length (cm) and breadth (cm). Photographs of diagnostic morphological characters were taken. Voucher specimens of each species used for this study were deposited in the Obafemi Awolowo University herbarium (IFE).

Quantitative data generated from this work were subjected to SPSS analysis and one - way Analysis of Variance using Duncan Multiple Range Test to show significant differences.

RESULTS AND OBSERVATIONS

The quantitative and qualitative characteristics of the species studied are recorded below (Plates 1 – 11, Tables 1-6:

Citrullus lanatus **(Black seeds) (Thunb.) Matsum. and Nakai (Plate 1, Tables 1-6).**

Common name is watermelon. It is commonly cultivated in gardens or homes. It is an annual trailing or climbing herbaceous vine. Stem is green in colour, angular and slightly ridged, covered with whitish to brownish hairs. Petiole is green in colour and about 4.7 – 8.5cm long. The Leaf is simple and alternate in arrangement, palmately lobed, the base is slightly cordate to flat, apex acute to slightly acuminate, 8.5 – 17.2 cm in length and 8.2 – 13.7 cm in breadth, its major vein pattern is actinodromous perfect basal, though middle veins tend to be camptodromous cladodromous. The flower is monoecious. Male flowers: 5 yellow petals, 3 stamens largely, no ovary. Female flowers: solitary and axillary, yellow in colour. Sepal pentamerous, and green in colour, 0.3 – 0.6 cm in length and 0.1 – 0.2 cm in breadth while petal is pentamerous, pubescent and yellow in colour, 1.2 – 2.0 cm in length and 0.4 – 1.2 cm in breadth. The pedicel is green in colour, 2.4 – 2.8 cm. The fruit is a berry or pepo, green when immature and matured, oval to round in shape. The seeds are black in colour, oval in shape, smooth, 1.0 – 1.3 cm in length and 0.6 – 0.8 cm in breadth, tendril branched and coiled at the tail end.

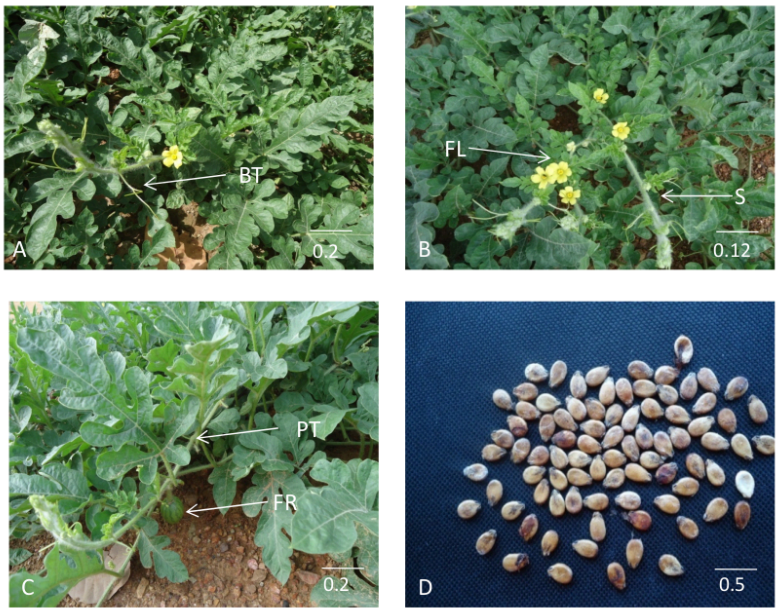
Morphology of *Citrullus lanatus* (Black Seeds)

BT – Branched Tendrils, FL – Flower, FR – Fruit, S – Stem, PT – Petiole.

Plate 1: A – Plant habit showing branched tendril; B – Plant habit showing coiled branched tendril and flower; C – Fruit; D - Seeds

Citrullus lanatus **(Brown seeds) (Thunb.) Matsum. and Nakai (Plate 2, Tables 1-6).**

Common name is watermelon. It is an annual climbing or trailing plant cultivated in gardens or homes, the stem is angular, green in colour, covered with whitish hairs. Petiole is green in colour and round, 5.3 – 13.0 cm long. Leaves are simple and alternate in arrangement, palmately lobed, the base is slightly cordate to flat, apex is acute to acuminate. Leaf is 9.4 – 19.0 cm in length and 7.0 – 16.0 cm in breadth. Major veins pattern is actinodromous perfect basal, though middle veins tend to be camptodromous cladodromous. Flower is monoecious. Male flowers: 5 yellow petals, 3 stamens largely, no ovary. Female flowers: solitary and axillary, with yellow colour. Pedicel green in colour, 2.3 – 2.9 cm. Sepal is pentamerous and green in colour, 0.3 – 0.6 cm in length and 0.1 – 0.2 cm in breadth. Petal is pentamerous, pubescent and yellow in colour, 1.2 – 2.0 cm in length and 0.4 – 1.3 cm in breadth. Fruit is a pepo, green when mature and immature, oval to round in shape. Seeds are brown in colour, oval in shape, smooth, 0.7 – 0.9 cm in length and 0.4 – 0.6 cm in breadth and tendril is branched and coiled at the tail end.



Morphology of *Citrullus lanatus* (Brown seeds)

BT – Branched Tendril, S – Stem, FL – Flower, FR - Fruit, PT – Petiole,

Plate 2: A – Plant habit showing branched tendril; B – Plant habit showing flowers and stem; C – Plant habit showing petiole and fruit; D – Seeds.

***Luffa aegyptiaca* Mill. (Synonym: *Luffa cylindrica* M. (Roem)) (Plate 3, Tables 1-6).**

Common name is sponge gourd or loofah. It is a weed commonly found in the bush and by the road side. An annual climbing or trailing herbaceous vine that climbs on wall and vegetation, often found in the wild. The stem is green in colour, angular and pubescent. Petiole is green in colour and round, 5.5 cm – 15.5 cm long. Leaf is simple and alternate in arrangement, palmately lobed, the base is cordate, apex acute to occasionally acuminate, 8.0 cm – 11.0 cm in length and 9.3 – 14.5 cm in breadth. Major veins pattern is actinodromous perfect marginal basal. The flower is monoecious. Male flowers: 5 yellow petals, 5 stamens, no ovary. Female flowers: solitary and axillary, with yellow colour. The pedicel is green in colour, 1.4 cm – 4.0 cm in length. Sepal is pentamerous, and green in colour, 1.0 – 1.3 cm in length and 0.3 – 0.5 cm in breadth. Petal is pentamerous, and yellow in colour, 2.5 – 4.5 cm in length and 2.0 – 2.8 cm in breadth. Fruit is a pepo, green when young, brown when mature and cylindrical to oblong in shape, with longitudinal ridges. Seeds are dull black in colour, elliptical in shape, smooth, 1.0 – 1.1 cm in length and 0.7 – 0.8 cm in breadth. Tendril branched and coiled.

Morphology of *Luffa aegyptiaca*

FR – Fruit, S – Stem, FL – Flower, BT – Branched Tendril

Plate 3: A – Plant habit showing branched tendril and stem; B – Plant habit showing flower; C – Plant habit showing fruit with sharp longitudinal ridges; D - Seeds.

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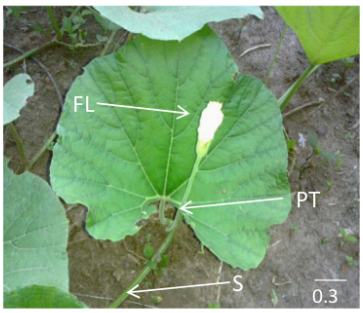
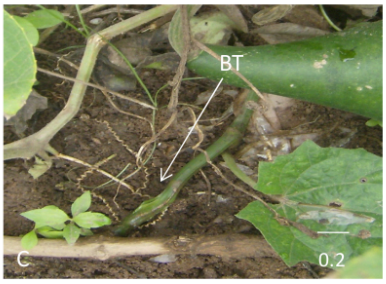
***Lagenaria siceraria* (Spatulate Fruit Shape) (Molina) Standl. (Plate 4, Tables 1-6).**

Common name is calabash or bottle gourd. It is a cultivated plant commonly found in gardens or homes. They are largely annual herbaceous vine, usually trailing or climbing. Stem is green in colour, angular and often pubescent (covered with white hair). Petiole is green in colour and round, 8.5 cm – 21.0 cm long. Leaf simple and alternate in arrangement, palmate, shape is broadly ovate to orbicular, margin undulate and shallowly lobed, the base is cordate, apex acute to slightly acuminate, 10.2 cm – 19.0 cm in length and 13.5 – 26.9 cm in breadth. Major veins pattern is actinodromous perfect reticulate basal. The flower is monoecious. Male flowers: 5 white petals, 3 stamens, no ovary. Female flowers: solitary and axillary with white colour. Pedicel is green in colour, 4.0 – 6.0 cm in length. Sepal is pentamerous, green in colour, 0.4 – 0.6 cm in length and 0.1 – 0.2 cm in breadth. Petal is pentamerous, white in colour, 3.4 – 5.5 cm in length and 2.0 – 3.3 cm in breadth. Fruit is a pepo, spatulate in shape, green when young, yellow or brown at maturity. Seed shape is oblong to oval, cream to light brown in colour, rough with 2 – 3 flat facial ridges, 1.3 – 1.5 cm in length and 0.7 – 0.9 cm in breadth. Tendril branched and coiled.





Morphology of *Lagenaria siceraria* (Spatulate Fruit Shape)

FR – Fruit, S – Stem, FL – Flower, BT – Branched Tendril

Plate 4: A – Plant habit; B – Showing flower closed on a cool day and petiole; C – Showing branched tendril; D – Showing fruit shape; E – Seeds.

***Lagenaria siceraria* (Oval Fruit Shape) (Molina) Standl. (Plate 5, Tables 1-6).**

Common name is calabash or bottle gourd. It is a cultivated plant commonly found in gardens, homes and farms**.** They are largely annual herbaceous vine, usually trailing to climbing. Stem green in colour, angular and pubescent. Petiole green in colour and round, 8.5 – 19.0 cm long. Leaf is simple and alternate in arrangement, palmately lobed, shape broadly ovate to orbicular with undulate margin, the base is cordate, apex is acute to slightly acuminate. Leaf is 9.0 – 24.1 cm in length and 9.0 – 24.1 cm in breadth. Major veins pattern is actinodromous perfect marginal basal. The flower is monoecious. Male flowers: 5 white petals, 3 stamens, no ovary. Female flowers: solitary and axillary with white colour. Pedicel is green in colour, 13.0 – 14.0 cm in length. Sepal is pentamerous, pubescent and green in colour, 0.3 – 0.6 cm in length and 0.1 – 0.2 cm in breadth. Petal is pentamerous, and white to cream in colour, 3.6 – 5.7 cm in length and 2.8 – 3.6 cm in breadth. Fruit is a pepo, green in colour when immature, yellow or brown at maturity, oval in shape. Seeds are cream to light brown in colour, oblong to oval in shape, no facial ridges, 1.7 – 2.3 cm in length and 0.6 – 0.9 cm in breadth. Tendril branched and coiled at the tail end.

Morphology of *Lagenaria siceraria* (Oval Fruit Shape)

FR – Fruit, S – Stem, FL – Flower, BT – Branched Tendril

Plate 5: A – Plant habit; B – Flower; C – Plant habit showing fruit; D – Plant habit showing branched tendril; E – Seeds.

***Cucumeropsis mannii* Naudin. (Synonym: *Cucumeropsis edulis* (Hooker.f) Cogn.) (Plate 6, Tables 1-6).**

Common name is melon seed or white-seed melon or "egusi itoo". It is a cultivated plant commonly found in gardens or homes, an annual to perennial herbaceous vine, usually climbing. Stem is green in colour, angular and pubescent (with few hairs). Petiole green in colour and round, up to 5.0 cm – 14.0 cm in length. Leaf is simple and alternate in arrangement, shape broadly ovate to reniform cordate, margin slightly serrated or undulate, base cordate, apex acute or slightly acuminate, 6.0 cm – 13.5 cm in length and 10.5 – 15.2 cm in breadth. Major veins pattern is actinodromous perfect reticulate basal. The flower is monoecious. Male flowers: 5 yellow petals, 3 stamens, no ovary. Female flowers: solitary and axillary with yellow colour. Pedicel green, 1.4 – 4.0 cm in length. Sepal is pentamerous, and green in colour, 0.4 – 0.5 cm in length and 0.1 – 0.2 cm in breadth. Petal is pentamerous, and yellow in colour, 1.2 – 1.5 cm in length and 1.0 – 1.3 cm in breadth. Fruit a pepo, green when immature, pale green to yellow when mature, oval to oblong to round in shape. Seeds are white in colour, flat, oval in shape, smooth, 1.6 – 2.1 cm in length and 0.7 – 0.9 cm in breadth. Tendril simple, unbranched and coiled.

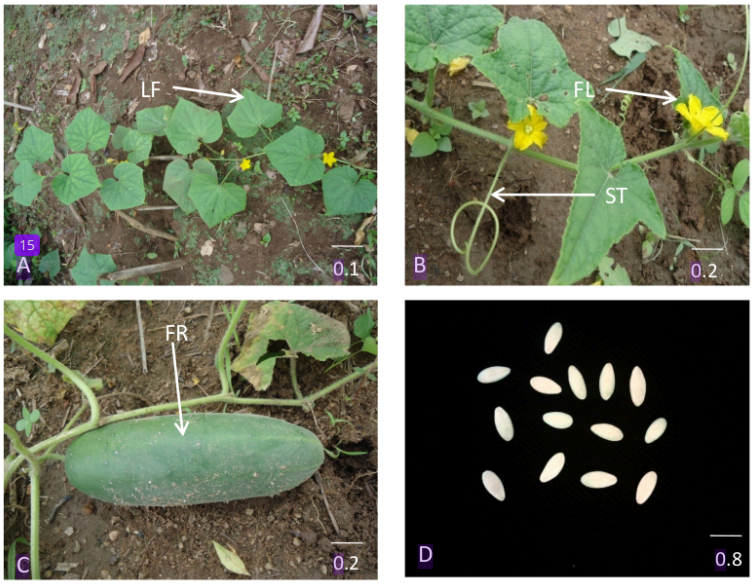
Morphology of *Cucumeropsis mannii*

FL – Flower, S – Stem, FR – Fruit, ST – Simple Tendrils.

Plate 6: A – Plant habit and fruit shape; B – Showing the flower; C – Plant habit and flowers; D – Seeds.

***Cucumis sativus* Linn. (Plate 7, Tables 1-6).**

Common name is cucumber. It is a cultivated plant commonly found in gardens or homes. An annual herbaceous vine, usually trailing, occasionally climbing. Stem is green in colour, angular and pubescent. Petiole is green in colour and round, 11.8 – 12.5 cm long, Leaf is simple, palmately lobed and alternate in arrangement, shape is triangular to broadly ovate, margin slightly serrated or undulate, the base is deeply cordate, apex acute to slightly acuminate, 4.7 – 12.2 cm in length and 5.0 – 15.0 cm in breadth, leaf surface slightly wrinkled. Major veins pattern is actinodromous perfect marginal basal. The flower is monoecious. Male flowers: 5 yellow petals, 3 stamens, no ovary. Female flowers: solitary and axillary with yellow colour. Pedicel green in colour, up to 0.5 – 0.9 cm in length. Sepal pentamerous, pubescent and green in colour, up to 0.3 – 0.4 cm in length and 0.1 – 0.2 cm in breadth. Petal is pentamerous, and yellow in colour up to 1.3 – 1.5 cm in length and 0.8 – 1.1 cm in breadth. Fruit is a pepo, of varying sizes and shape, green in colour when immature, orange-yellow when mature, globose to cylindrical in shape. Seeds are cream or dirty white in colour, oval to oblong in shape, smooth, 0.7 – 0.8 cm in length and 0.3 – 0.4 cm in breadth. Tendril is simple and coiled at the tail end.



Morphology of *Cucumis sativus*

LF – Leaf, FL – Flower, FR – Fruit, ST – Simple Tendril.

Plate 7: A – Plant habit; B – Showing leaves and flowers; C – Fruit; D – Seeds.

***Momordica charantia* Linn. (Plate 8, Tables 1-6).**

Common name is bitter melon, bitter gourd, bitter squash, or balsam pear. It is a wild plant commonly found by the road side and in the bush. An annual herbaceous vine, usually trailing or climbing. Stem is green in colour, angular, and occasionally sparsely pubescent to pubescent. Petiole is green in colour and round, 1.2 cm – 7.5 cm long. Leaf is simple and alternate in arrangement, palmately lobed, broadly ovate to reniform or orbicular in shape, base is cordate, apex is acute to acuminate, margin irregularly serrated, 3.5 cm – 8.5 cm in length and 4.2 – 10.5 cm in breadth. Major veins pattern is actinodromous perfect basal.The flower is monoecious. Male flowers: 5 yellow petals, 3 stamens, no ovary. Female flowers: solitary and axillary with yellow colour. Pedicel is green, 5.4 – 11.0 cm in length. Sepal is pentamerous, and green in colour, 0.4 – 0.5 cm in length and 0.1 – 0.3 cm in breadth. Petal is pentamerous, pubescent and yellow in colour, 1.1 – 1.9 cm in length and 0.5 – 1.0 cm in breadth. Fruit is a pepo, green when immature and orange in colour when mature, shape is ovate-elliptic to cylindrical. Seeds are brown in colour often encased in red warty exterior or arils, oval to oblong in shape, 0.7 – 1.0 cm in length and 0.4 – 0.5 cm in breadth. Tendril is simple and coiled at the tail end.

Morphology of *Momordica charantia*

FL – Flower, S – Stem, FR – Fruit, ST – Simple Tendril.

Plate 8: A – Plant habit; B – Plant habit showing fruit; C – Plant habit showing simple unbranched coiled tendril and flower; D – Seeds

Telfairia occidentalis **(Hook.f) (Plate 9, Tables 1-6).** Common name is fluted pumpkin, fluted gourd or 'ugwu". It is a cultivated vine plant commonly found in gardens, a perennial herb, trailing to climbing. Stem is green in colour, angular and glabrous to sparsely pubescent. Petiole is green in colour and round, 4.5 cm – 11.7 cm long. Leaf is compound, 3-5 foliolate with short petiole. They are alternate in arrangement, with entire or slightly wavy margin, leaf shape broadly ovate, base rounded to slightly cordate, apex acute to acuminate, 6.8 cm – 15.6 cm in length and 3.1 – 7.9 cm in breadth. Major veins pattern is actinodromous perfect basal. Flower is dioecious: Male flowers: 5 creamy white petals, 5 stamens, no ovary. Female flowers: solitary and axillary, creamy white with reddish-purple colour at the base. Pedicel green, 3.0 – 4.2 cm in length. Sepal is pentamerous, and green in colour, 0.5 – 1.0 cm in length and 0.3 – 0.4 cm in breadth. Petal is pentamerous, creamy white in colour, with reddish-purple colour at the base, 2.5 – 3.5 in length and 0.8 – 1.5 in breadth. Fruit is a pepo, green in colour when immature, pale green when mature, cylindrical to ellipsoid in shape, often with 10 prominent ribs or ridges on it. Seeds are brown to black in colour, oval in shape 3.0 – 3.4 cm in length and 3.1 – 3.4 cm breadth. Tendril branched and coiled towards the end.


A
0.1
B
BT
S
0.3
C
FLF
0.2
D
FLM
0.5
E
FR
0.2
F
0.5

Morphology of *Telfairia occidentalis*

FLF – Flower of Female, FLM – Flower of male, FR – Fruit, BT – Branched Tendril, S – Stem.

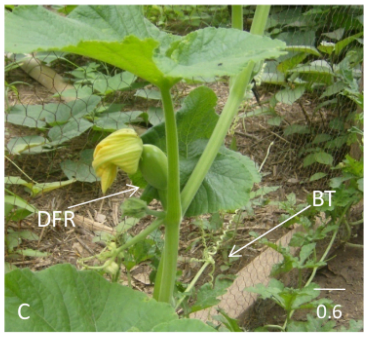
Plate 9: A – Plant habit showing trailing nature of plant; B – Plant habit showing climbing nature of plant, branched tendril and stem; C – Showing flower of female *Telfairia occidentalis*; D – Showing flower of male *Telfairia occidentalis*; E – Fruit; F – Seeds.

***Cucurbita maxima* Duch.ex Lam. (Plate 10, Tables 1-6).**

Common name is giant pumpkin or squash. It is a cultivated plant commonly found in gardens and homes. It is an annual herbaceous vine, usually trailing or climbing. Stem is green in colour, round to angular and pubescent. Petiole is green in colour and round, 16.0 – 21.5 cm long. Leaf is simple, palmate and alternate in arrangement, shape is orbicular to peltate to reniform, with entire or very slightly serrated margin, base is cordate, apex acute to rounded, 13.2 – 21.5 cm in length and 19.5 – 30.5 cm in breadth. Major veins pattern is actinodromous perfect basal. The flower is monoecious. Male flowers: 5 yellow petals, 5 stamens, no ovary. Female flowers: solitary and axillary with yellow colour. Pedicel is green in colour, 14.4 – 20.7 cm in length. Sepal is pentamerous, pubescent and green in colour, 1.4 – 1.8 cm in length and 0.1 – 0.2 cm in breadth. Petal is pentamerous, and yellow in colour, 8.0 – 8.7 cm in length and 3.0 – 3.5 cm in breadth. Fruit is a pepo, green in colour when immature, orange when mature, oval to round in shape. Seeds are white to light brown in colour, smooth to occasionally slightly rough, oval to oblong in shape, 1.2 – 2.2 cm in length and 0.9 – 1.2 cm in breadth. Tendril is branched and coiled at the tail end.


A
0.2


B
0.7


DFR
BT
C
0.6


D
0.8

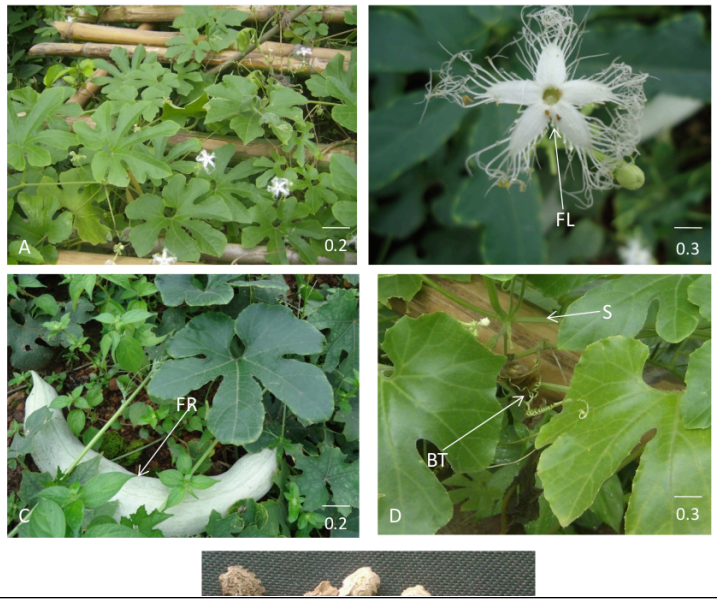
Morphology of *Cucurbita maxima*

DFR – Developing fruit, BT – Branched Tendril.

Plate 10: A – Plant habit; B – Flower; C – Plant habit showing developing fruit, branched tendrils and stem; D - Seeds

***Trichosanthes cucumerina* L. (Synonym: *Trichosanthes anguina* L.) (Plate 11, Tables 1-6).**

Common name is snake gourd or serpent gourd or snake tomato. It is a cultivated plant commonly found in gardens, an annual to perennial herb usually a climber. Stem is green in colour, angular and pubescent. Petiole is green in colour and round, 4.5 cm – 9.0 cm long. Leaf is simple, alternate in arrangement, palmately lobed with entire or wavy margin, the base is cordate to truncate, apex acute to slightly acuminate, 7.7 cm – 11.0 cm in length and 11.2 – 15.9 cm in breadth. Major veins pattern is actinodromous perfect marginal basal. The flower is monoecious. Male flowers: 5 white petals with fringed or lacy petal margins, 5 stamens, no ovary. Female flowers: solitary and axillary, white in colour with deeply fringed or lacy petal edges. Pedicel is green, 2.7 – 3.1 cm in length. Sepal is pentamerous and green in colour, 0.1 – 0.3 cm in length and 0.1 – 0.2 cm in breadth. Petal is pentamerous, white with deeply fringed or lacy petal edges, 3.4 – 4.8cm in length and 3.1 – 5.2 cm in breadth. Fruit is a pepo, green in colour when immature, red when mature, sickle or snake-like to cylindrical in shape. Seeds are oblong to oval in shape, brown in colour with wavy ridges, 1.3 – 1.5 cm in length and 0.7 – 0.9 cm in breadth. Tendril branched and coiled at the tail end.


A
0.2
FL
0.3
FR
C
0.2
S
BT
D
0.3

Morphology of *Trichosanthes cucumerina*

FL – Flower, FR - Fruit, BT – Branched Tendril, S - Stem.

Plate 11: A – Plant habit; B – Showing flower; C – Plant habit showing fruit; D – Showing branched tendril and stem; E - Seeds

Table 1: Summary of Flora Type, Life Cycle, Plant Habit and Stem Characteristics of the Species of Family Cucurbitaceae Studied

Species	Flora type	Life Cycle	Plant Habit	Stem Shape	Stem Surface	Stem Colour
Citrullus lanatus (Black Seeds)	Cultivated	Annual	Trailing, Climbing	Angular	Pubescent	Green
Citrullus lanatus (Brown Seeds)	Cultivated	Annual	Trailing, Climbing	Angular	Pubescent	Green
Luffa aegyptiaca	Wild	Annual	Trailing, Climbing	Angular	Pubescent	Green
Lagenaria siceraria (Spatulate Fruit Shape)	Cultivated	Annual	Trailing, Climbing	Angular	Pubescent	Green
Lagenaria siceraria (Oval Fruit Shape)	Cultivated	Annual	Trailing, Climbing	Angular	Pubescent	Green
Cucumeropsis mannii	Cultivated	Annual to Perennial	Climbing	Angular	Pubescent	Green
Cucumis sativus	Cultivated	Annual	Trailing, Climbing	Angular	Pubescent	Green
Momordica charantia	Wild	Annual	Trailing, Climbing	Angular	Pubescent	Green
Telfairia occidentalis	Cultivated	Perennial	Trailing, Climbing	Angular	Glabrous to sparsely pubescent	Green
Cucurbita maxima	Cultivated	Annual	Trailing, Climbing	Angular	Pubescent	Green
Trichosanthes cucumerina	Cultivated	Annual to Perennial	Trailing, Climbing	Angular	Pubescent	Green

Table 2: Summary of Leaf and Tendril Characters of the Species of Family Cucurbitaceae Studied

Species	Leaf Type	Leaf Shape	Leaf Apex	Leaf Base	Leaf Margin	Leaf Venation (Major Veins)	Phyllotaxy	Leaf Lamina Surface	Leaf Colour	Petiole Surface	Tendril Type
Citrullus lanatus (Black Seeds)	Simple and palmately lobed	Oblong, Ovate to Triangular	Acute to slightly Acuminate	Slightly Cordate to Flat	Shallow Serrate or Wavy	Actinodromous Perfect Basal, middle veins tend to be Camptodromous Cladodromous	Alternate	Slightly pubescent	Green	Slightly pubescent	Branched and coiled at tail end
Citrullus lanatus (Brown Seeds)	Simple, palmately lobed	Oblong to Ovate to triangular	Acute to slightly Acuminate	Cordate to Flat	Slightly Serrated	Actinodromous Perfect Basal, middle veins tend to be Camptodromous Cladodromous	Alternate	Slightly pubescent	Green	Pubescent	Branched and coiled at tail end
Luffa aegyptiaca	Simple, palmately lobed often	Ovate, Orbicular to Reniform	Acute to occasionally Acuminate	Cordate	Shallowly Serrate to Undulate	Actinodromous Perfect Basal	Alternate	Pubescent	Green	Slightly pubescent	Branched and spirally coiled
Lagenaria siceraria (Spatulate Fruit Shape)	Simple, palmately lobed	Broadly Ovate to Orbicular	Acute to slightly Acuminate	Cordate	Undulate	Actinodromous Perfect Basal	Alternate	Pubescent	Green	Pubescent	Branched and spirally coiled
Lagenaria siceraria (Oval Fruit Shape)	Simple, palmately lobed	Broadly Ovate	Acute to slightly Acuminate	Cordate	Undulate	Actinodromous Perfect Basal	Alternate	Pubescent	Green	Slightly pubescent	Branched and coiled at tail end
Cucumeropsis mannii	Simple, unlobed or slightly palmately lobed	Broadly Ovate to Reniform-Cordate	Acute or slightly Acuminate	Cordate	Slightly Serrated or Undulate	Actinodromous Perfect Basal	Alternate	Pubescent, especially on veins	Green	Pubescent	Simple, Unbranched and Coiled
Cucumis sativus	Simple, palmately lobed	Triangular to broadly Ovate	Acute to slightly Acuminate	Cordate	Slightly Serrated or	Actinodromous Perfect Basal	Alternate	Pubescent and slightly	Green	Pubescent	Simple, Unbranched, coiled at tail

					Undulate			wrinkled			end
Momordica charantia	Simple, palmately lobed	Broadly Ovate, Reniform or Orbicular	Acute to slightly Acuminate	Cordate	Irregularly Serrated	Actinodromous	Alternate	Pubescent	Green	Pubescent	Simple, Unbranched, coiled at tail end
Telfairia occidentalis	Palmately compound with 3-5 leaflets.	Leaflets broadly Ovate	Acute to Acuminate in each leaflet	Rounded to slightly Cordate	Entire or slightly Wavy	Actinodromous Perfect Basal	Alternate	Pubescent	Green	Pubescent	Branched, spirally coiled at tail end
Cucurbita maxima	Simple, palmately shallowly lobed	Orbicular, Peltate, Reniform	Acute to Rounded	Cordate	Entire or very slightly Serrated	Actinodromous Perfect Basal	Alternate	Pubescent	Green	Pubescent	Branched and spirally coiled at tail end
Trichosanthes cucumerina	Palmately lobed	Broadly Ovate or Sub-Orbicular	Acute or slightly Acuminate	Cordate to Truncate	Entire or Wavy	Actinodromous Perfect Basal	Alternate	Sparsely pubescent	Green	Pubescent	Branched and spirally coiled at tail end

Table 3: Summary of Floral Morphological Characters of Species of the Family Cucurbitaceae Studied

Species	Flower Colour	Fruit Shape	Fruit Colour	Seed Shape	Seed Colour	Seed Surface	Sex Description
Citrullus lanatus (Black Seeds)	Yellow	Oval to Round	Immature: Green; Mature: Green	Oval	Black	Smooth	Monoecious
Citrullus lanatus (Brown Seeds)	Yellow	Oval to Round	Immature: Green; Mature: Green	Oval	Brown	Smooth	Monoecious
Luffa aegyptiaca	Yellow	Cylindrical to Oblong	Immature: Green; Mature: Brown	Elliptical	Dull Black	Smooth	Monoecious
Lagenaria siceraria (Spatulate Fruit Shape)	White	Spatulate	Immature: Green; Mature: Yellow or Brown	Oblong to Oval	Cream to light Brown	Rough with 2-3 flat facial ridges	Monoecoius
Lagenaria siceraria (Oval Fruit Shape)	White to Cream	Oval	Immature: Green; Mature: Yellow or Brown	Oblong to Oval	Cream to light Brown	Smooth	Monoecious
Cucumeropsis mannii	Bright Yellow	Oval to Oblong to Round	Immature: Green; Mature: Pale Green-Yellow	Oval	White	Smooth	Monoecious
Cucumis sativus	Bright yellow	Globose-Cylindrical	Immature: Green; Mature: Orange-Yellow	Oval	Dirty White to Cream	Smooth	Monoecious
Momordica charantia	Yellow	Ovate-Elliptic to Cylindrical	Immature: Green Mature: Orange	Oval to Oblong	Brown, often encased in red warty exterior or arils	Rough or warty with ridges	Monoecious
Telfairia occidentalis	Creamy White with Reddish-Purple colour at base	Cylindrical to Ellipsoid	Immature: Green Mature: Pale green	Oval	Brown to Black	Smooth	Dioecious
Cucurbita	Yellow	Oval to Round	Immature:	Oval to Oblong	White to light	Smooth to	Monoecious

maxima			Green; Mature: Orange		Brown	occasionally slightly rough	
Trichosanthes cucumerina	White with deeply fringed or lacy petal edges	Sickle or Snake-like to Cylindrical	Immature: Green; Mature: Red	Oval to Oblong	Brown	Rough, with wavy ridges	Monoecious

Table 4: Minimum and Maximum Values of Quantitative Morphological Characters of the Species of the Family Cucurbitaceae Studied.

Species	Leaf Length (cm)	Leaf Breadth (cm)	Petiole Length (cm)	Seed Length (cm)	Seed Breadth (cm)	Pedicel Length (cm)	Sepal Length (cm)	Sepal Breadth (cm))	Petal Length (cm)	Petal Breadth (cm)
Citrullus lanatus (Black seeds)	8.5 – 17.2	8.2 – 13.7	4.7 – 8.5	1.0 – 1.3	0.6 – 0.8	2.4 – 2.8	0.3 – 0.6	0.1 – 0.2	1.2 – 2.0	0.4 – 1.2
Citrullus lanatus (Brown seeds)	9.4 – 19.0	7.0 – 16.0	5.3 – 13.0	0.7 – 0.9	0.4 – 0.6	2.3 – 2.9	0.3 – 0.6	0.1 – 0.2	1.2 – 2.0	0.4 – 1.3
Luffa aegyptiaca	8.0 – 11.0	9.3 – 14.5	5.5 – 15.5	1.0 – 1.1	0.7 – 0.8	1.4 – 4.0	1.0 – 1.3	0.3 – 0.5	2.5 – 4.5	2.0 – 2.8
Lagenaria siceraria (Spatulate Fruit Shape)	10.2 – 19.0	13.5 – 26.9	8.5 – 21.0	1.3 – 1.5	0.7 – 0.9	4.0 – 6.0	0.4 – 0.6	0.1 – 0.2	3.4 – 5.5	2.0 – 3.3
Lagenaria siceraria (Oval Fruit Shape)	9.0 – 24.1	9.0 – 24.1	8.5 – 19.0	1.7 – 2.3	0.6 – 0.9	13.0 – 14.0	0.3 – 0.6	0.1 – 0.2	3.6 – 5.7	2.8 – 3.6
Cucumeropsis mannii	6.0 – 13.5	10.5 – 15.2	5.0 – 14.0	1.6 – 2.1	0.7 – 0.9	1.4 – 4.0	0.4 – 0.5	0.1 – 0.2	1.2 – 1.5	1.0 – 1.3
Cucumis sativus	4.7 – 12.2	5.0 – 15.0	11.8 – 12.5	0.7 – 0.8	0.3 – 0.4	0.5 – 0.9	0.3 – 0.4	0.1 – 0.2	1.3 – 1.5	0.8 – 1.1
Momordica charantia	3.5 – 8.5	4.2 – 10.5	1.2 – 7.5	0.7 – 1.0	0.4 – 0.5	5.4 – 11.0	0.4 – 0.5	0.1 – 0.3	1.1 – 1.9	0.5 – 1.0
Telfairia occidentalis	6.8 – 15.6	3.1 – 7.9	4.5 – 11.7	3.0 – 3.4	3.1 – 3.4	3.0 – 4.2	0.5 – 1.0	0.3 – 0.4	2.5 – 3.5	0.8 – 1.5
Cucurbita maxima	13.2 – 21.5	19.5 – 30.5	16.0 – 21.5	1.2 – 2.2	0.9 – 1.2	14.4 – 20.0	1.4 – 1.8	0.1 – 0.2	8.0 – 8.7	3.0 – 3.5
Trichosanthes cucumerina	7.7 – 11.0	11.2 – 15.9	4.5 – 9.0	1.3 – 1.5	0.7 – 0.9	2.7 – 3.1	0.1 – 0.3	0.1 – 0.2	3.4 – 4.8	3.1 – 5.2

Table 5: Mean Values and Standard Error of Quantitative Morphological Characters of the Species of the Family Cucurbitaceae Studied

Species	Leaf Length (cm)	Leaf Breadth (cm)	Petiole Length (cm)	Seed Length (cm)	Seed Breadth (cm)	Pedicel Length (cm)	Sepal Length (cm)	Sepal Breadth (cm))	Petal Length (cm)	Petal Breadth (cm)
Citrullus lanatus (Black seeds)	14.64±0.41	11.31±0.29	6.72±0.21	1.15±0.02	0.70±0.01	2.59±0.05	0.48±0.03	0.13±0.02	1.47±0.09	0.79±0.10
Citrullus lanatus (Brown seeds)	13.73±0.56	11.24±0.48	8.92±0.54	0.78±0.01	0.49±0.01	2.62±0.05	0.45±0.03	0.13±0.02	1.60±0.08	0.85±0.12
Luffa aegyptiaca	9.40±0.18	11.68±0.26	9.82±0.60	1.08±0.01	0.72±0.01	2.96±0.29	1.16±0.04	0.39±0.02	3.51±0.22	1.17±0.10
Lagenaria siceraria (Spatulate Fruit Shape)	15.47±0.58	20.80±0.85	15.07±0.61	1.43±0.01	0.82±0.01	5.50±0.22	0.51±0.03	0.17±0.02	4.24±0.23	2.81±0.13
Lagenaria siceraria (Oval Fruit Shape)	15.28±0.57	19.79±0.61	13.65±0.66	2.02±0.03	0.80±0.01	13.64±0.13	0.50±0.03	0.15±0.02	4.67±0.23	3.28±0.09
Cucumeropsis mannii	9.62±0.29	12.95±0.22	9.52±0.48	1.94±0.02	0.79±0.01	1.87±0.13	0.44±0.02	0.16±0.02	1.38±0.03	1.17±0.04
Cucumis sativus	8.40±0.41	10.32±0.54	6.86±0.52	0.76±0.01	0.36±0.01	0.74±0.05	0.36±0.02	0.13±0.02	1.40±0.02	0.92±0.05
Momordica charantia	6.36±0.32	7.56±0.39	3.88±0.36	0.84±0.01	0.46±0.01	8.13±0.60	0.48±0.01	0.22±0.20	1.23±0.08	0.66±0.06
Telfairia occidentalis	10.85±0.47	4.97±0.26	7.14±0.31	3.24±0.02	3.23±0.02	3.73±0.13	0.74±0.05	0.35±0.02	3.21±0.11	1.25±0.08
Cucurbita maxima	16.62±0.38	24.41±0.48	17.96±0.28	1.86±0.04	1.11±0.02	17.96±0.63	1.60±0.05	0.16±0.02	8.40±0.07	3.30±0.06
Trichosanthes cucumerina	9.42±0.18	13.50±0.26	6.62±0.25	1.38±0.01	0.79±0.01	2.92±0.05	0.22±0.03	0.15±0.02	4.05±0.15	4.57±0.20

Table 6: Summary of Quantitative Morphological Characters of Some Species in the Family Cucurbitaceae Studied with Duncan Multiple Range Test Values (Means with the Same Alphabet along the Same Column are not significantly Different (Unit = cm)

Species	Leaf Length (cm)	Leaf Breadth (cm)	Petiole Length (cm)	Seed Length (cm)	Seed Breadth (cm)	Pedicel Length (cm)	Sepal Length (cm)	Sepal Breadth (cm))	Petal Length (cm)	Petal Breadth (cm)
Citrullus lanatus (Black seeds)	14.64^{ef}	11.31^{d}	6.72^{bc}	1.15^{e}	0.70^{d}	2.59^{bc}	0.48^{c}	0.13^{a}	1.47a	0.79^{abc}
Citrullus lanatus (Brown seeds)	13.73^{e}	11.24^{d}	8.92^{d}	0.78^{bc}	0.49^{c}	2.62^{bc}	0.45^{c}	0.13^{a}	1.60^{abc}	0.85^{bc}
Luffa aegyptiaca	9.40^{b}	11.68^{d}	9.82^{d}	1.08^{d}	0.72^{d}	2.96^{c}	1.16^{e}	0.39^{d}	3.51^{d}	1.17^{f}
Lagenaria siceraria (Spatulate Fruit Shape)	15.47^{f}	20.80g	15.07^{g}	1.43^{f}	0.82^{ef}	5.50^{e}	0.51^{c}	0.17^{ab}	4.24^{e}	2.81^{g}
Lagenaria siceraria (Oval Fruit Shape)	15.28^{f}	19.79^{g}	13.65^{f}	2.02^{j}	0.80^{e}	13.64^{g}	0.50^{c}	0.15^{a}	4.67^{f}	3.28^{h}
Cucumeropsis mannii	9.62^{b}	12.95^{e}	9.52^{d}	1.94^{i}	0.79^{e}	1.87^{b}	0.44^{bc}	0.16^{a}	1.38^{a}	1.17^{de}
Cucumis sativus	8.40^{b}	10.32^{d}	6.86^{bc}	0.76^{b}	0.36^{b}	0.74^{a}	0.36^{b}	0.13^{a}	1.40^{ab}	0.92^{bcd}
Momordica charantia	6.36^{a}	7.56^{c}	3.88^{a}	0.84^{c}	0.46^{c}	8.13^{f}	0.48^{c}	0.22^{b}	1.23^{a}	0.66^{ab}
Telfairia occidentalis	10.85^{c}	4.97^{b}	7.14^{c}	3.24^{k}	3.23^{i}	3.73^{d}	0.74^{d}	0.35^{cd}	3.21^{d}	1.25^{e}
Cucurbita maxima	16.62^{g}	24.41^{h}	17.96^{h}	1.86^{h}	1.11^{h}	17.96^{h}	1.60^{f}	0.16^{a}	8.40^{g}	3.30^{h}
Trichosanthes cucumerina	9.42^{b}	13.50^{e}	6.62^{bc}	1.38^{f}	0.79^{e}	2.92^{c}	0.22^{a}	0.15^{a}	4.05^{e}	4.57^{i}

KEY TO THE SPECIES OF THE FAMILY CUCURBITACEAE STUDIED (SFS: Spatulate Fruit Shape; OFS: Oval Fruit Shape)

1a. Tendril branched

2a. Mature fruit green

3a. Flower colour, creamy white — *Telfairia occidentalis*

3b. Flower colour, yeloow

4a. Seeds colour black — *Citrullus lanatus* (Black seeds)

4b. Seeds colour brown — *Citrullus lanatus* (Brown seeds)

2b. Mature fruit not green

5a. Colour of seed black — *Luffa aegyptiaca*

5b. Colour of seed not black

6a. Petal edges deeply fringed or lacy — *Trichosanthes cucumerina*

6b. Petal edges not fringed or lacy

7a. Fruit colour at maturity orange — *Cucurbita maxima*

7b. Fruit colour at maturity yellow or brown

8a. Shape of fruit spatulate — *Lagenaria siceraria* (SFS)

8b. Shape of fruit oval — *Lagenaria siceraria* (OFS)

1b. Tendril unbranched

9a. Leaf surface slightly wrinkled — *Cucumis sativus*

9b. Leaf surface not wrinkled

10a. Fruit with warty exterior — *Momordica charantia*

10b. Fruit without warty exterior — *Cucumeropsis mannii*

DISCUSSION

Many authors have stressed the importance of morphological characters as taxonomic tools; these include Hutchinson and Dalziel (1958), Adedeji (2005), Adedeji and Illoh (2005), Yiblet (2022). According to Adamakis (2025), the study of plant morphology and anatomy in the era of climate change provides valuable insights into plant adaptation, resilience, resource use efficiency, carbon dynamics, and ecosystem dynamics, all of which are essential for sustainable management and conservation efforts in a changing environment.

Without correct identification, it may be unsafe to use some species of family Cucurbitaceae as food or medication because they may resemble both poisonous and edible wild species (Yiblet, 2022). Because incidents of food poisoning in both people and domestic animals have been documented, care must be taken when gathering members of the Cucurbitaceae family for food or medicine. According to Yiblet (2022), in certain instances, species are so similar in vegetative morphology that the flower and fruit characters are the sole means to differentiate between them. Result from this study reveals that there are many vegetative morphological characters that are indeed similar among the species of the family studied, however, there are some notable differences, both vegetative and floral, useful in the delimitation of the species.

Plant habit is generally trailing to climbing, stem shape angular and green in colour in the family; leaf base is largely cordate, major veins are largely actinodromous perfect basal, phyllotaxy is alternate, leaf surface is pubescent, leaf colour is green and the fruit is a pepo, described as a fleshy fruit with a relatively hard shell, typified by several commercial species such as cucumber, watermelon and pumpkin.

Species of this family are largely cultivated, except in *Momordica charantia,* and *Luffa aegyptiaca* where they occur wild in Nigeria and are commonly found by the road side and inside the bush. The life cycle of the species studied is generally annual, except in *Telfairia occidentalis* where it is perennial and in *Trichosanthes cucumerina* and *Cucumeropsis mannii* where it is annual to perennial.

Stem surface is generally pubescent in all the species except in *Telfairia occidentalis* where it is glabrous to sparsely pubescent. Also, *Telfairia occidentalis* is the only species with compound leaves with 3-5 leaflets, whereas all other species are with simple palmately lobed leaves. Lobes

may be absent in some leaves of *Cucumeropsis mannii* and may be shallow in the leaves of *Cucurbita maxima*.

The most observed leaf shape in the family is broad ovate with other shapes, oblong, triangular, orbicular and reniform often observed in some species too. Leaf apex is largely acute to slightly acuminate except in *Cucurbita maxima* where it is largely acute to round. This delimits *Cucurbita maxima* from the other species studied. Leaf base is largely cordate in all the species except in *Citrullus lanatus* where it may be cordate to flat. Leaf margin in the family is largely shallowly or slightly serrated to undulate except in *Telfairia occidentalis*, *Cucurbita maxima* and *Trichosanthes cucumerina* where entire leaf and leaflet margins were observed.

Major veins patterns in the species of the family Cucurbitaceae studied are actinodromous in all the species with *Citrullus lanatus* having camptodromous cladodromous around the middle veins. Leaf venation influence photosynthetic efficiency, water transport, and resilience (Sack and Scoffoni, 2013). Actinodromous leaf venation enhances mechanical support and even distribution of vascular supply throughout the leaf. This is efficient for wide, lobed leaves exposed to full sunlight. Camptodromous venation type provides efficient water and nutrient transport without high vulnerability to damage at the leaf edge. This pattern helps the leaf to maintain leaf integrity under low-light or moist conditions (Zwieniecki and Boyce, 2014). Preserved venation in leaf fossils helps reconstruct plant evolution (Toumoulin *et al.*, 2020).

Leaf phyllotaxy is generally alternate with green leaf colour while leaf surface is generally slightly pubescent to pubescent. Climbing tendrils are a characteristic of the family Cucurbitaceae. Cucurbit tendrils can have simple (branchless) or branched forms, which either coil below the branch point or not, and this is used as a trait for cucurbit taxonomy (Schaefer and Renner, 2011). Simple tendrils permit plants to redistribute their resources, such as to produce more tendril along the fast-growing stems to increase the clinging area (Guo *et al.*, 2020). In this study, nature of tendril can be used to delimit the species of the family Cucurbitaceae into two (2): the branched tendril group and the unbranched tendril group.

Tendril is branched in *Citrullus lanatus, Luffa aegyptiaca*, *Lagenaria siceraria, Telfairia occidentalis, Cucurbita maxima* and *Trichosanthes cucumerina*. It is simple unbranched in *Cucumeropsis mannii, Cucumis sativus* and *Momordica charantia*. The tendril in all the species are terminally coiled. According to Guo *et al.*, (2020) the ancestral cucurbit tendrils were

branched with a coiling basal part, followed by a trend of simplification that included an initial reduction of the coiling base and a further change to simple, branchless tendrils. It can thus be deduced that the tendrils in *Cucumeropsis mannii, Cucumis sativus* and *Momordica charantia* are more advanced than the branched ancestral tendrils observed in the other species of the family Cucurbitaceae studied.

Modern cucurbits exhibit a tremendous diversity of flower colour that is often correlated with other floral traits contributing to pollination syndromes (Fenster *et al.*, 2004). Showy petals (yellow or orange) are more attractive to birds and pollen-foraging bees, whereas white flowers are mainly pollinated by moths and bats. According to Guo *et al.* (2020), there is an overall trend for the transformation of petal colour in Cucurbitaceae from yellow to white. The transition to white petals reduces the visibility of plants to bees (Sletvold *et al.*, 2016), implying a change of or decrease in the demand for pollinators (Guo *et al.*, 2020). As observed in this study, flower colour is quite diagnostic for the family. It is yellow in most of the species studied, but white in *Lagenaria siceraria* (spatulate fruit shape) and *Trichosanthes cucumerina*; creamy white in *Lagenaria siceraria* (oval shape fruit) and *Telfairia occidentalis*. Flowers of *Telfairia occidentalis* are unique in having reddish-purple colour at the base among all species studied while those of *Trichosanthes cucumerina* are also unique in having deeply fringed or lacy petal edges.

Fruit shape in the family Cucurbitaceae is diverse among and even within species. It is oval to round in *Citrullus lanatus* and *Cucurbita maxima*, cylindrical to oblong in *Luffa aegyptiaca* and oval in *Lagenaria siceraria*, oval to oblong to round in *Cucumeropsis mannii*, globose-cylindrical in *Momordica charantia*, cylindrical to ellipsoid in *Telfairia occidentalis*; sickle or snake-like to cylindrical in *Trichosanthes cucumerina*.

Fruit colour among the species also differs, with different colours many times, for the immature and the mature fruits. However, it is largely taxon-specific in the matured fruits of the species studied. It is green in the matured fruits of *Citrullus lanatus*, brown in *Luffa aegyptiaca*, yellow or brown in *Lagenaria siceraria*, pale green to yellow in *Cucumeropsis mannii*, orange-yellow in *Cucumis sativus*, orange in *Momordica charantia*, pale green in *Telfairia occidentalis*, orange in *Cucurbita maxima* and red in *Trichosanthes cucumerina*. It is noteworthy that fruit colour at

maturity is an excellent diagnostic qualitative character useful in the delimitation of the species studied.

The morphological and functional diversity of seeds represent the complexity of plants (Baskin and Baskin, 1998). Seed shape is the result of a complex developmental process defined by the ovule type and the relation of the ovule with the ovary and fruit structures (Markin-Gomez *et al.*, 2024). Seed morphology has been traditionally used in taxonomy with variable success in diverse families of plants (Plaza *et al.*, 2004; Adams *et al.*, 2005). This study documents the noteworthiness of seed morphology in the taxonomy of family Cucurbitaceae. Seed shape is quite diagnostic and can be used in the delimitation of some species. It is largely oval in four of the species: *Citrullus lanatus, Cucumeropsis mannii, Cucumis sativus* and *Telfairia occidentalis*; oval to oblong in *Lagenaria siceraria, Momordica charantia, Cucurbita maxima* and *Trichosanthes cucumerina*; and elliptical in *Luffa aegyptiaca*.

Seed colour among the species is also diagnostic and taxonomically useful. It is black to dull black in *Citrullus lanatus* (black seeds) and *Luffa aegyptiaca*, brown in *Citrullus lanatus* (brown seeds) and *Trichosanthes cucumerina,* cream to light brown in *Lagenaria siceraria*, white in *Cucumeropsis mannii*, dirty white to cream in *Cucumis sativus*, brown often encased in red warty exterior or arils in *Momordica charantia*, brown to black colour in *Telfairia occidentalis*, white to light brown in *Cucurbita maxima.* It is noteworthy that the two forms of *Citrullus lanatus* studied can be delimited on the basis of seed colour: brown and black.

Seed surface is largely smooth in all the species except in *Lagenaria siceraria* (spatulate fruit shape) where the surface is rough with 2-3 flat facial ridges (this separates the spatulate fruit shape *Lagenaria* from the oval fruit shape *Lagenaria*); in *Momordica charantia* where the surface is rough or warty with ridges; in *Cucurbita maxima* where the surface is occasionally slightly rough, and in *Trichosanthes cucumerina* where the surface is often rough with wavy edges. These aforementioned unique seed surface characters delimit these species from the other species studied.

The sexual strategy of monoecy in half of extant cucurbits is derived from ancestral dioecy, consistent with the little heterosis known in this family (Gusmini and Wehner, 2008; Schaefer and Renner, 2011). There have been numerous evolutionary changes between dioecy and monoecy (Volz and Renner, 2008; Schaefer and Renner, 2010). In the family Cucurbitaceae,

dioecy appears to be the ancestral state (Zhang *et al.*, 2006). In this work, all the species of the family studied are sexually monoecious except in *Telfairia occidentalis* where they are dioecious, suggesting the ancestral state of *Telfairia occidentalis* sexual strategy in comparison with all the other species studied. Taken together, reproductive organs of cucurbits tended to become simpler and requirements for pollinators reduced. This trend of simplification is similar to the evolution pattern of tendrils (Guo *et al.*, 2020).

The result generated from the morphological quantitative characters shows that the characters are quantitatively taxon-specific. Seed length has significant variations across the species. Quantitatively *Cucurbita maxima* is the species with the highest value in most of the morphological characters.

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