

The Morphological Characterization of the Melon Species in the Family Cucurbitaceae Juss., and their Utilization in Nigeria

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Abstract Detailed morphological study of the vegetative and floral parts of the melon species belonging to the family, Cucurbitaceae, found in Nigeria was conducted in search of intergeneric and intraspecific characters that may be of taxonomic value in the species identification. Important and significant diagnostic characters were observed. Morphological characters that may be of taxonomic value are variations in the fruit colour, seed color, and seed sizes. Branched tendrils were found in the *C. lanatus* species, and *C. moschata* (Duch. Ex Lam.) Duch. Ex Poiret, while *Cucumis melo* L. (sweet melon), and *Cucumeropsis mannii* Naud. (syn. *C. edulis* (Hooker f.) cogn.) (White-seeded melon), have simple tendrils. The morphological differences existing between watermelon and brown-seeded melon in particular and among the melons as a whole are presented.

Keywords Morphology, Cucurbitaceae, Melons, *Cucumis*, *Citrullus*, *Cucumeropsis*, *Cucurbita*

1. Introduction

There are nearly 100 genera and more than 750 species in the family, Cucurbitaceae Juss., which is a moderately large family of flowering plants[8]. A very interesting and an outstanding family of dicotyledons, distributed widely over the tropical parts of the world[2]. They have common features: large leaves, creeping or climbing stems usually with simple or branched tendrils, fleshy fruits called pepo, with leathery exocarp, containing numerous seeds, and a woody root stock.

About three genera of Cucurbitaceae bear the common name, melons. They are *Cucumis*, *Citrullus* and *Cucumeropsis*. The genus *Cucumis* includes *C. melo* L. (true melon), *Citrullus* includes *C. lanatus* Thunb. Matsum and Nakai (Watermelon, and Brown-seeded melon or egusi melon in Nigeria) and *Cucumeropsis* is represented by one species in Nigeria, *C. mannii* Naud. (syn. *C. edulis* (Hooker f.) cogn.) (White-seeded melon or Mann's Cucumeropsis). *Cucurbita moschata* (Duch. Ex Lam.) Duch. Ex Poiret (Squash melon or Pumpkin) has non-edible seeds, which are usually mixed with the edible brown-seeded melon, and sold in the market as *Citrullus lanatus* –brown-seeded melon to

misguide buyers.

The different species of Cucurbitaceae have served humans for over 10,000 years as important foods and as many useful products. In Nigeria, they are used for different purposes in different parts of the country. They occupy a special place in the life and culture of many ethnic groups[6].

Comparative morphological studies on the vegetative and floral parts of all the melon species belonging to the Cucurbitaceae family in Nigeria is being presented together for the first time. This paper forms part of an ongoing research aimed at providing basic anatomy, cytology, molecular genetics, and histochemistry and palynology data on the Nigerian Cucurbitaceae family.

2. Materials and Methods

Morphological studies of all the melon species presented in this paper, which are found in Nigeria were studied between 2008 and 2012 within the Botanical garden of the University of Port Harcourt main campus, Choba, Port Harcourt, Rivers State, Nigeria. Seeds collected during field trips to various parts of Nigeria were germinated in plastic bags and transplanted directly into the soil in the Botanical garden. Roots, stems, leaves, flowers, fruits, and seeds were studied from mature plants in the garden. Qualitative morphological plant features studied include the shape, base, surface, apex, margin, type, venation, phyllotaxy, and petioles of leaf, habit, type of tendril, flower colour and type,

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fruit type, shape, and colour, seed arrangement, sizes, and colour, petal colour, sepal colour, number of stamen, and ovary type.

Quantitative morphological plant features were studied and measured including length and width of leaves, petiole, petals, fruit, seed, and pedicel. The seeds, sepals, and petals were counted and recorded. In all cases, measurements were taken using ten of each of the plant parts. For example, leaf measurement was taken from 10 leaves and the average length and width was recorded, and so on. Photographs of morphological features of each species used for the study were also taken with the use of a SONY (DSC-S950) digital camera.

Table 1. Sources of Cucurbit Materials Studied

Species	Collector and Number	Locality
<i>Cucumis melo</i> L.	Ajuru 20	Bought in the Port Harcourt fruit garden, Kaduna Street, Rivers State.
Watermelon (<i>Citrullus lanatus</i>) Thunb.) Matsum and Nakai	Ajuru 23	Cultivated at the University of Port Harcourt Botanic Garden
Brown-seeded melon (<i>C. lanatus</i>)	Ajuru 25	Cultivated at the University of Port Harcourt Botanical Garden
<i>Cucumeropsis mannii</i> Naud. (syn. <i>C. edulis</i> (Hooker f.) Cogn.)	Ajuru 29	Cultivated farmland, Ozuaha village, Port Harcourt, Nigeria
<i>Cucurbita moschata</i> (Duch. Ex Lam.) Duch. Ex Poiret	Ajuru 30	Cultivated farmland, Ozuaha village, Port Harcourt, Nigeria.

3. Results

3.1. Morphology

The habit, vegetative, floral, fruit, and seed characteristics of the melon species studied are presented below. "Reference[4] has described the species to a certain extent".

Cucumis melo, honey melon or true melon, "Figure 1", is an annual, trailing herbaceous plant with a woody rootstock, short, often angled stem with bristly hairs. The leaves are simple, alternate on long petioles, cordate with seven shallow lobes and variously serrated margins, very hairy on the abaxial surface, acute, deep green, and about 7–15cm in diameter. Tendrils are simple and spiral. Male and female flowers grow on the same plant. Male flowers are found in clusters and appear before the female flowers. Both have yellow petals, five in number, and sepals, also five in number and greenish in colour. Occasional hermaphrodite flowers are produced. The fruits are globular with shallow grooves, about 14–20cm long. The skin is greenish yellow. The flesh is almost white/light yellow, sweet, delicately flavoured, juicy, a pepo. The seeds are small, light brown and smooth, between 0.4 and 1.1cm long and 0.2–0.3cm wide.

Cucurbita moschata, squash melon or pumpkin, is an annual creeping plant, "Figure 2". The stem is light green, trailing on the ground, and highly pubescent. The leaves are also light green in colour, simple, alternate, broadly ovate, about 23cm long by 28cm wide, roughly serrate, broadly cordate, palmately lobed, highly pubescent, hairs forming a cushion on the adaxial surface. Tendrils are branched. Petioles are very long and pronounced, hairy, about 17.1cm long by 0.7cm wide. The plant is monoecious. The flowers are yellow, with petals joined for half their length. The male flowers are 8–9cm in diameter, borne on long peduncles while the female flowers, which are about 14–15cm long, are borne on shorter peduncles. The fruit is dark green with white streak and warty. The fruits are about 15–20cm long, and the flesh is yellow. The seeds are flat, about 1.2cm long by 0.8cm wide, white, tapering at one end with grooved edges.

Cucumeropsis mannii, "Figure 3", Mann's *Cucumeropsis* or white-seeded egusi melon is an annual, herbaceous, climbing plant. The stem is light green and pubescent. The leaves are alternate, simple, acuminate, broadly cordate, deep green, with three regular lobes, evenly serrate. The leaf surface is crinkled and shiny, about 12cm to 18cm long. Tendrils are simple and curly. Flowers are monoecious, yellowish in colour and about 2cm to 3.5cm wide. The fruits are yellow green, spherically elongated, about 14cm–20cm long. The flesh is white and not edible. The seeds are white, flat, smooth and about 1.8cm by 0.9cm wide.

Watermelon – *Citrullus lanatus*, "Figures 4, 5, and 6", is represented by one species in Nigeria. However, there is a lot of confusion about its botanical name. But the correct name is *Citrullus lanatus* for both watermelon and brown-seeded melon which are distinguished almost exclusively by their fruits.

Both plants are trailing herbaceous and annual vines with woody rootstocks. The stem is pubescent and greenish in colour. The leaves are roughly serrate, palmately lobed, deeply cleft into fine irregular lobe, simple, pubescent, alternate, acuminate apex and a cordate base. Although in brown-seeded melon, the leaves are more deeply cleft, longer and wider than in the watermelon plants. Brown-seeded melon leaves, "Figure 7", are about 20.2cm by 18.1cm while the watermelon leaves are about 17.5cm by 15.3cm wide. The petioles are long and pubescent, about 8.5cm by 0.6cm wide in the brown-seeded melon and 6.3cm by 0.3cm wide in watermelon. The tendrils in watermelon are branched and spiral, likewise in the brown-seeded melon.

Watermelon and brown-seeded melon are monoecious, that is, male and female flowers grow on the same plant. The male and female flowers are yellow, male on long peduncles and female on peduncles shorter than that of the male, enlarged at the base containing the ovary. They are borne on the leaf axils. The brown-seeded melon fruit is oval to roundish, light – green/deep green since there are two fruit types. The fruits are between 13 and 18 cm in diameter, with a dull skin and white pulp which is very bitter to the taste.

Watermelon has three fruit types in Nigeria: the light green exocarp colour fruit, the deep green exocarp colour fruit, and light green with deep green vertical stripes exocarp colour fruit. In all cases, the fruits are much larger than the fruit of the brown-seeded melon, oval to round, about 25 – 85cm long, sometimes more. The flesh colour ranges from pink to reddish. The seeds of brown-seeded melon are brownish

yellow, oval with thick margins and about 1.6cm long by 0.9cm wide. The seeds of the light green, deep green and light green with deep green striped exocarp colour watermelons are brownish yellow, about 0.9cm long by 0.5cm wide, brownish black, about 1.0cm long by 0.6cm wide, and black, about 1.2cm long by 0.8cm wide respectively.



Figure 1. Morphological features of *C. melo*. A = the plant trailing on the ground showing the structure of the leaves, B = Unbranched tendrils at the shoot apex, C = The fruit, D = The seeds; Bar : 2cm

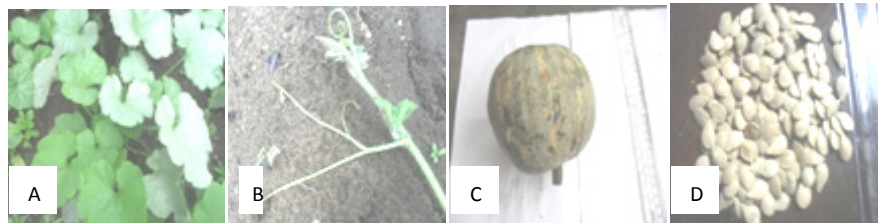


Figure 2. Morphological features of *C. moschata*. A = The growing plant, B = Branched tendrils, C = The fruit, D = The seeds; Bar : 2cm

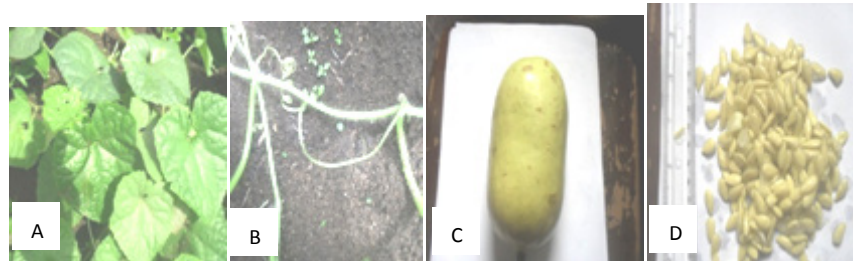


Figure 3. Morphological features of *C. mannii*. A = The growing plant, B = Unbranched tendrils, C = The fruit, D = The seeds; Bar : 2cm

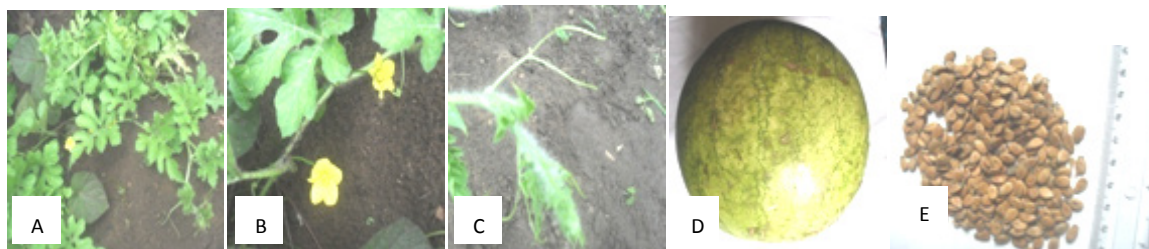


Figure 4. Morphological features of *C. lanatus* (light-green exocarp colour watermelon). A = the plant with flowers at the leaf axils, B = male flowers borne on the leaf axils, C = Branched tendrils at the shoot apex, D = The fruit, E = The seeds; Bar : 2cm



Figure 5. Morphological features of *C. lanatus* (light-green with deep green vertical stripe exocarp colour watermelon). A = the branched tendrils, B = the male flower borne on the leaf axils, C = the trailing plant, D = the fruit, E = the seeds; Bar : 2cm

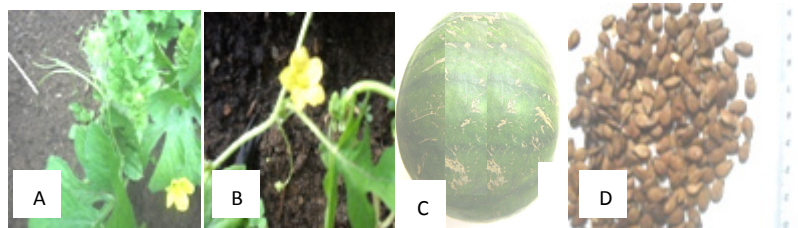


Figure 6. Morphological features of *C. lanatus* (Deep-green exocarp colour watermelon). A = the branched tendrils, B = the male flower borne on the leaf axils, C = the fruit, D = the seeds; Bar : 2cm



Figure 7. Morphological features of *C. lanatus* (Brown-seeded melon). A = Branched tendrils at the leaf axils B = the plant showing the male flower at the leaf axils, C = the fruit, D = the seeds; Bar : 2cm

Table 2. Vegetative and Floral Morphology of the Melon Species Studied

Character	<i>C. lanatus</i> (Water melon)	<i>C. lanatus</i> (Brown-seeded melon)	<i>C. mannii</i>	<i>C. melo</i>	<i>C. moschata</i>
Root system	Extensive	Extensive	Extensive	Extensive	Extensive
Habit	Trailing/Creeping annual	Trailing / Creeping annual	Climbing annual	Trailing / Creeping annual	Trailing / Creeping annual
Stem	Aerial	Aerial	Aerial	Aerial	Aerial
Leaf type	Simple	Simple	Simple	Simple	Simple
Phyllotaxy	Alternate	Alternate	Alternate	Alternate	Alternate
Leaf apex	Acuminate	Acuminate	Alternate	Alternate	Alternate
Leaf base	Cordate	Cordate	Cordate	Cordate	Cordate
Tendrils type	Branched	Branched	Simple	Simple	Branched
Leaf surface	Pubescent	Pubescent	Pubescent	Pubescent	Highly pubescent
Inflorescence type	Solitary	Solitary	Solitary	Solitary	Solitary
Inflorescence position	Axillary	Axillary	Axillary	Axillary	Axillary
Corolla color	Yellow	Yellow	Yellow	Yellow	Yellow
Calyx color	Green	Green	Green	Green	Green
Number of corolla	Five	Five	Five	Five	Five
Number of calyx	Five	Five	Five	Five	Five
Position of ovary	Inferior	Inferior	Inferior	Inferior	Inferior
Fruit type	Simple (Pepo)	Simple (Pepo)	Simple (Pepo)	Simple (Pepo)	Simple (Pepo)
Fruit size (10 fruits)	25 -85cm	16 – 22cm	17 -20cm	12 – 16cm	14 – 22cm
Fruit shape	Oval – roundish	Oval – roundish	Spherically elongated	Globular	Round / elongated
Fruit color	Yellow green – deep green	Light green – deep green	Yellow green	Greenish yellow	Dark green
Seed arrangement	Vertically in about two rows	Vertically in two rows	Vertically in two rows	Vertically in two rows	Vertically in two rows
Seed colour	Brownish – black	Yellow	Creamy white	White	Brownish
Seed size (10 seeds)	1.1 by 0.6cm	1.6 by 0.9cm	1.8 by 0.9cm	0.5 by 0.25cm	1.1 – 0.8cm
Seed shape	Spherical	Oval with entire margin	Spherically elongated	Spherically elongated	Spherical / oval

3.2. Utilization of Melons in Nigeria

Citrullus lanatus, watermelon, is cultivated extensively for its fruits and seeds. The sweet, red juicy pulpy flesh of the watermelon is eaten as a dessert. In some parts of Nigeria,

the skin and the mesocarp, including the seeds, are eaten as a delicacy. The fruit contains 93% of water, with small amounts of protein, fat, minerals and vitamins and the major nutritional components of the fruit are carbohydrates (6.4/100g)[6]. In some cases, the extracted juice is fermented

to produce an alcoholic drink and the fruits have been served as a reserve water source in parts of Nigeria where there is drought or where the source of water is contaminated.

The bitter variety of *C. lanatus* – brown-seeded melon, after shelling and grinding, the seeds are used for thickening soup and the bitter pulpy flesh is sometimes cooked and fed to pigs. In Akwa Ibom State, Nigeria, the seeds of the brown-seeded melon are ground and mixed with pepper (*Capsicum annum*), and salt, baked and eaten. I particularly find it very delicious and irresistible. Sometimes, during traditional marriage ceremonies, they are ground and baked in form of a cake and presented as a traditional cake.

Cucumis melo, musk melon or honeydew, is a ‘fruit’ rather than a vegetable; the sweet, delicately flavoured, juicy flesh of the pepo is eaten raw, often as a dessert. In the eastern part of Nigeria, the small white seeds are roasted and eaten as a delicacy.

Cucumeropsis mannii, the white – seeded egusi melon has edible and oily seeds which are used like the seeds of *Citrullus lanatus* – brown-seeded melon[6]. The seeds are also fried and chewed as a delicacy in the South – South part of Nigeria.

The squash melon, *Cucurbita moschata*, is edible. The young leaves are cooked and eaten as a vegetable. The leaves are some used as a replacement for Okra (*Abelmoschus esculentus* (L.) Moench) in soups and stews. The flesh of the fruit is cooked and eaten with palm oil, (*Elaeis guineensis* Jacq.). The dried shell of the fruit is sometimes used as a container[3].

The seeds of *C. lanatus* – brown-seeded melon are sometimes adulterated with the seeds of *C. moschata* by traders and sold as brown-seeded melon. The seeds of *C. moschata* are not known to be edible and the nutritive value has not been analyzed.

4. Discussion

Morphological characters among all the Cucurbitaceae species had been reported by[4]. But even at that, emphasis is placed on only the so-called diagnostic features. Some morphological characters which were common among the species were not included.

These characters which are typical of the Cucurbits are the exhibition of the same habit, root structure, leaf type, phyllotaxy, leaf base, inflorescence type and position, corolla and calyx colour, number of corolla and calyx, position of ovary, fruit type and seed arrangement and correspond to the report made by[2]. But, they differ in the aspect of leaf apex which is acuminate in the *C. lanatus* – brown-seeded melon and watermelons, *C. mannii*, and acute in *C. melo* and *C. moschata* and correspond to the report made by[5]. The watermelon and brown-seeded melon are the only Cucurbit species with lobed leaves. All other Cucurbit species have unlobed leaves. The tendrils are

simple and curly in *C. mannii*, and *C. melo*, but branched and curly in *C. lanatus* – watermelons, brown-seeded melon, and *C. moschata*. Other features include differences in fruit sizes, fruit shape, fruit colour, seed colour, seed sizes and shapes. These features are constant and are not affected by environment. This fact makes these traits very useful in species delimitation. The variation in seed colour is probably due to genetic factors concretely manifested in biochemical pathways which result in production and accumulation of different chemicals (pigments) in the seed coat. Further investigation in Chemotaxonomy will clarify this.

5. Conclusions

The three varieties of watermelons studied should be classified as varieties under the same species, including the brown-seeded melon which should also be classified as a variety under the same species, *C. lanatus*. Other species studied, *C. melo*, *C. mannii* and *C. moschata* confirm in one hand to the findings made by other researchers[6] and in the other hand, show some variations from the earlier researches[1]. All the species display characteristics typical of plants belonging to the family Cucurbitaceae. The brown-seeded melon, and the three types of watermelons should be classified as varieties under the species name, *C. lanatus*, which should be recognized as the only specific name for the varieties. Also, *C. moschata*, which is sometimes sold commercially as brown-seeded melon to mislead buyers is seen here to be taxonomically different.

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