



Comparative Morphology and Taxonomic Study of *Chlorophytum sabiense* And Two Other Species in the Genus *Chlorophytum* Ker-Gawl

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ABSTRACT: *Chlorophytum sabiense* Omok. (a newly identified species in the family Asparagaceae) is unique, having multiple styles emerging from fused ovaries. This specialized character may be overlooked in conjuring up archetype for the genus *Chlorophytum*, since the genus is characterized by single and simple style. Comparative morphology and taxonomic study of *Chlorophytum sabiense* and two other species in the genus (*Chlorophytum macrophyllum* and *C. stenopetalum*) was carried out to appraise level of relatedness of *Chlorophytum. sabiense* and these existing members. Distribution of the three species is sympatric in the North Central part of Nigeria. *Chlorophytum sabiense* may be confused with either of the two species because of the attributes they have in common. Samples collected were raised in a garden and closely observed for duration of three years. Data collected from morphological studies were analyzed statistically. The three species show similarity in most of the vegetative characters studied, however *Chlorophytum sabiense* is distinguished from the two others having; multiple styles, smaller fruit size and shorter length of pistil relative to the stamen. Exceptional characteristics exhibited by *Chlorophytum sabiense* makes it stand out among species in the genus, while its close resemblance with its allies accounts for reason why it had escaped recognition for a long time.

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Chlorophytum plants are well known for their wide usage in the tropical and sub-tropical regions of Africa and Asia. These regions are believed to be its center of origin and diversification (Gudadhe *et al.*, 2012). In spite of their importance, species in the genus are often confused. Sardassi *et al.* (2006) attributed taxonomic difficulty in the genus to misidentification of its species. Adsul *et al.* (2014), gave the following reasons as responsible for difficulty encountered in identifying species in the genus. These are; restricted distribution and remote habitats of the species, short seasonal flowering and fruiting period, identification keys with overlapping characters, beside most of the species have similar sized flower and leaf pattern. Taxonomic difficulty in the genus, especially between *Chlorophytum macrophyllum* and *C. stenopetalum* has been investigated by many workers (Hepper, 1975; Adeyemi, 1984; Omokanye *et al.*, 2020). In such quest, a new species (*Chlorophytum sabiense*), was identified (Omokanye, 2020). *Chlorophytum sabiense* appears to be an intermediate between *Chlorophytum macrophyllum* and *C. stenopetalum*; having sympatric distribution and morphologically identical.

Chlorophytum sabiense is however, characterized by having 3- 6 free styles on fused ovaries. The Liliales order to which *Chlorophytum* Ker-Gawl belongs (Engler and Prantle, 1930), is defined as having a calyx of six equal coloured parts, six stamens, a superior ovary, single style, and trilocular capsule (Jussieu, 1778; Lindly, 1830).

Gynoecium in *Chlorophytum* consists of 3 carpels, placentation axile, ovary 3-lobed, more or less globose, sessile or subsessile, trilocular, style simple, and terminal, and long, filiform, stigma simple and rarely capitate. Capsule is acutely triquetrous or emerginate, dehiscence loculicidal Panda *et al.* (2011). *Chlorophytum sabiense* therefore represents a departure from the above definitions; having 3-6 free styles on separate ovaries.

Therefore, in the present contribution, comparative morphology and taxonomic study of *Chlorophytum sabiense* and level of relatedness amongst its two other species in the genus; *Chlorophytum macrophyllum* and *C. stenopetalum* were appraised.

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MATERIALS AND METHODS

Field trips and ecological survey were carried out between April and September, 2015, in areas where species of *Chlorophytum* are known to be distributed. These areas include; Kufena, Shikadam, Samaru, Malufashi and Sabi, all in the North Centre part of Nigeria. Several taxa of *Chlorophytum* especially *C. stenopetalum*, *C. macrophyllum* and *C. sabiense* were collected and taken to the herbarium of the University of Ilorin for proper identification. These were later raised under the same environmental condition in a

Biological garden in Offa, Kwara State. Morphological observations were noted and recorded for a period of three years.

RESULTS AND DISCUSSION

Morphological variations observed on the field were maintained even under uniform cultivation, suggesting that the variation is genetically based, thus confirmed the fact that the three species are distinct taxa. The species are; *Chlorophytum macrophyllum*, *C. stenopetalum* and *C. sabiense* (Fig 1a-c).

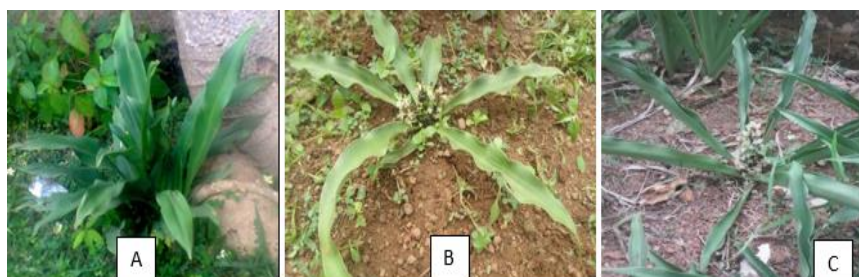


Fig 1 a-c. Showing external morphology of a matured sample of the three species; a, *Chlorophytum macrophyllum* b, *C. stenopetalum* c, *C. sabiense* (new species).

The three taxa exhibit morphological similarity in most of the characters studied, these include; leaf apex, leaf shape, leaf margin, colour of leaf base, shape of leaf margin etc (Table 1). Variations however occur in leaf orientation; it was observed that, at flowering period, leaves are more inclined to the horizontal in *Chlorophytum sabiense*. At later period, when fruits become matured and dehisce, leaves gradually become erect, before it finally wither. Leaves are erect or nearly so in *C. macrophyllum* and are close to the ground in *C. stenopetalum*. Leaf dimensions also vary as shown in Table 2.

Chlorophytum macrophyllum has the longest leaf length ranging from 33.0-51.0 cm, this is followed by *C. sabiense* (36.0 -40.0 cm) and then *C. stenopetalum* (24.0 - 32.0 cm). The variation follows the same pattern for leaf width; leaf width is widest in *Chlorophytum macrophyllum* (3.0 – 6.5cm), followed by *C. sabiense* (5.5 – 6.5 cm) and *C. stenopetalum* (2 - 4cm). Differences among the taxa are more noticeable when considering flower morphology. Pistil is longer than the filaments in *Chlorophytum macrophyllum* and *C. stenopetalum* but shorter in *C. sabiense* (Fig 2i, ii and iii).

Table 1: Qualitative morphological studies

Species/character	<i>Chlorophytum macrophyllum</i>	<i>Chlorophytum stenopetalum</i>	<i>Chlorophytum sabiense</i>
Leaf apex	Acuminate	Acuminate	Acuminate
Leaf shape	Lanceolate	Linear lanceolate	Lanceolate
Leaf margin	Entire	Entire	Entire
Type of leaf base	Petiolate	Petiolate	Petiolate
Colour of leaf base	Green	Green	Green
Shape of the leaf margin	Wavy	Wavy	Wavy
Presence of hairs on leaf surface	Absent	Absent	Absent
Tepals arrangement	Large tepals in the outer part	Large tepals in the outer part	Large tepals in the outer part
Type of inflorescence	Raceme	Raceme	Raceme
Position of Inflorescence	Central	Central	Central
Shape of peduncle	Cylindrical	Cylindrical	Cylindrical
Shape of pistil	Cylindrical	Cylindrical	Flattened with broad base
Number of style	One	One	Six
Number of carpels	Three	Three	Six
Stigma lobes	Present	Present	Present
Shape of fruit	Deeply lobed	Deeply lobed	Shallowly lobed
Number of seed chamber	Three	Three	Three

Most striking difference between the newly identified species (*C. sabiense*) and its close allies

(*Chlorophytum macrophyllum* and *C. stenopetalum*) is the presence of multiple carpels in the former.

Chlorophytum sabiense has 3-6 free styles which emanate from the top of an ovary (fig. 3a-c) in the other two.

Table 2: Qualitative morphological studies

Species /characters	<i>Chlorophytum macrophyllum</i>	<i>Chlorophytum stenopetalum</i>	<i>Chlorophytum sabiense</i>
Leaf Length (cm)	33.0 (45.6) 51.0	24.0 (25.9) 32.0	36.0 (38.7) 40.0
Leaf width (cm)	3.0 (5.1) 6.5	3.0 (4.23) 4.9	3.3 (4.65) 6.5
Leaf index	7.42 (8.95) 9.81	5.0 (6.79) 6.5	6.24 (8.52) 10.81
No of leaf	6.0 (6.8) 7.0	6.0 (6.4) 7.0	6.0 (7.1) 9.0
Length of peduncle	4.5 (10.8) 16.0	4.0 (8.5) 12.0	10.0 (10.2) 12.0

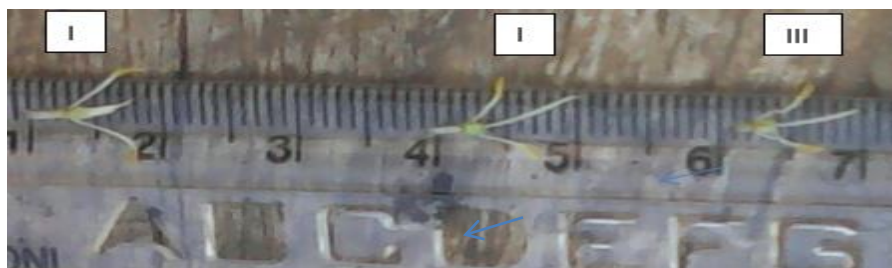


Fig 2 i, ii and iii. Showing pistils and few stamens of a matured sample of flower of the three species; ai, *Chlorophytum sabiense* (the new species) aii, *C. macrophyllum* aiii, *C. stenopetalum*

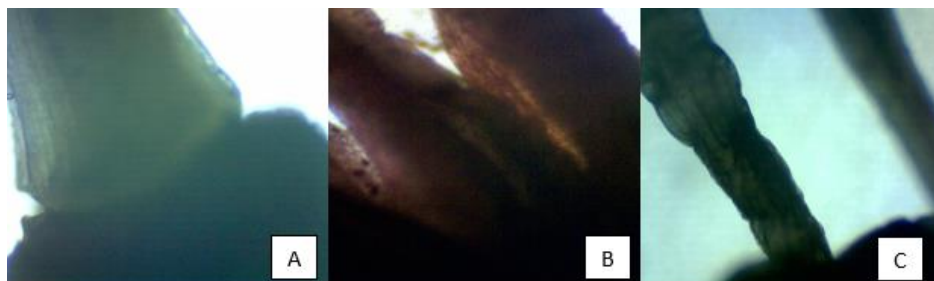


Fig 3 a-c. Showing base of style of matured sample of the three species x40; a, *Chlorophytum macrophyllum* b, *C. stenopetalum* c, *C. sabiense* (stained to make it distinct).

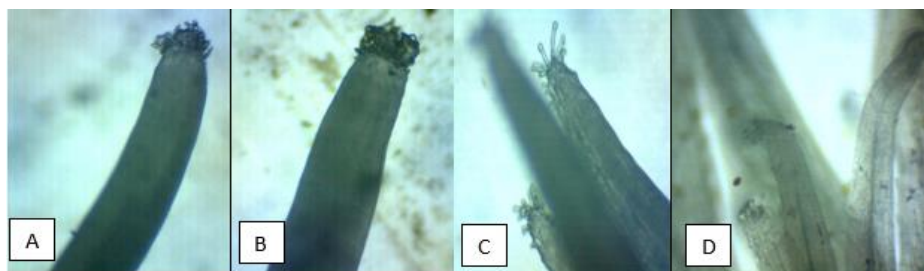


Fig 4 a-c. Showing upper part of styles of matured samples of the three species. x40 a, *Chlorophytum macrophyllum* b, *C. stenopetalum* c, *C. sabiense* (new species). d, pistil of *C. sabiense* midway up

Styles in *Chlorophytum sabiense* are of unequal height, flattened and with broad base. It consists of; 3 with long styles and 3 with short styles. These are more visible at x40 mag (Fig 4a-d). Peduncle lengths are in the same range (7-11cm) in both *Chlorophytum stenopetalum* and *C. sabiense*, but longer in *Chlorophytum macrophyllum* (10-17cm). Fruits are densely arranged along the length of peduncle in

Chlorophytum stenopetalum whereas fruit setting is sparse in *Chlorophytum sabiense*. In term of capsules size, *Chlorophytum sabiense* has the smallest fruit size; less than 3 mm, followed by *C. stenopetalum* 5 mm and *C. macrophyllum* 7-10 mm (Fig. 5 i, ii, iii). The tiny fruits in *C. sabiense* are hardly noticeable as they are covered up by dark tepals and persistent perianth segments.

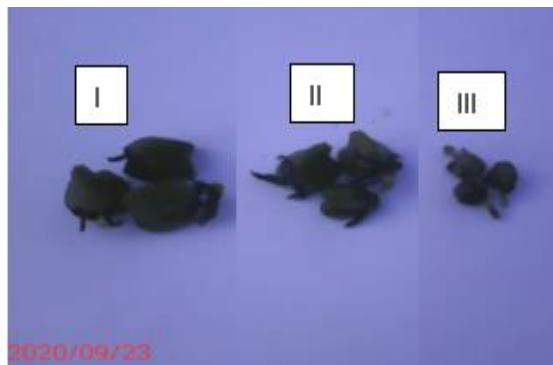


Fig 5 I, II and III. Showing matured samples of fruits of the three species. i, *Chlorophytum macrophyllum* ii, *C. stenopetalum* iii, *C. sabiense* (the new species).

Taxonomic difficulties in the genus *Chlorophytum* are not unconnected with mistakes of identity (Sardesai *et al.*, 2006, Adsul *et al.* 2014). The three taxa under investigation were found to exhibit similarity in most of characters studied; this is in correlation with earlier observation by Adsul *et al.* (2014). These similarities thus indicate a high degree of closeness among the species. Variation observed in leaf orientation in *Chlorophytum sabiense* makes the species to blend with either *Chlorophytum macrophyllum* or *C. stenopetalum* at any particular point in time. The newly identified species is also easily confused with either of the two species based on the dimension of its floral and vegetative parts; its leaf dimension overlaps with that of *Chlorophytum macrophyllum* having long and broad leaves, with distinct nerves. Also there is an overlap in the length of peduncle of *C. sabiense* and *C. stenopetalum*. Despite these resemblances, marked differences exist among them. In identifying species, orthodox taxonomists prioritized floral features above other features used for easy identification because reproductive features are least affected by environmental changes, hence are more stable and reliable. According to Panda, Das, and Tripathy (2011), gynoecium in *Chlorophytum* consists of 3 carpels. This is expected since *Chlorophytum* is one of the genera in Liliaceae family and tricarpellary syncarpous pistil is an attribute of species in the family. The present study however revealed ovary with 3 lobes and simple style in two of the species studied, these are; *C. stenopetalum* and *C. macrophyllum*. These species thus comply with the existing definition of flowers in the genus. The third species (*C. sabiense*) which is newly identified has three long free styles. Microscopic examination of the pistils further revealed three additional shorter styles. Each style broadens to the base and terminate on separate ovary (the ovaries thus appear separated). This is the main diagnostic feature of the new species. It is important to note that multicarpellary pistil is entirely new to the literature of the genus

Chlorophytum. In addition to the variations observed in the reproductive features, size of capsules also clearly separates *Chlorophytum sabiense* from the two others species. However, the fruits are tiny, few and unnoticeable and must have being over looked by previous workers. Variation in leaves orientation, which constitutes growth pattern in the *Chlorophytum sabiense*, as well as, the floral dimensions of the species, which overlap with those of the other two species, account for reasons why the species was not easily distinguished. Plants of the *Chlorophytum sabiense* must have therefore, escaped recognition for a long time, because of close identities it shares with the two closely related allies.

Taxonomic Key: Gynoecium consists of; three fused carpels, style single and simple, stigmas with numerous lobes Leaves lanceolate or oblanceolate erect, acuminate, attenuate towards the base into an indistinct petiole and broadening to the point of insertion, up 60 cm. long from base to apex and to 8cm. broad; peduncle 12-30 cm. long, apparently elongating; fruits up to 7 - 10 cm. long. Flowers congested in the upper 5 third; fruits 7-10mm long. *C. macrophyllum*: Leaves linear-lanceolate, close to ground, acute at apex, broadly petiolate, up to 40 cm. long from base to the apex, about 4 cm. broad; inflorescence about one-third as long as the leaves, a continuous dense raceme about 8 cm. long; bracts almost imbricate ribbed, 1 cm. long; fruit 5 mm. long *C. stenopetalum* Gynoecium consists of; three free carpels, 3-6 separate styles, stigmas with few lobes Leaves lanceolate, mostly erect, acute at apex, broadly petiolate, up to 40 cm. long from base to the apex, about 6.5 cm. broad; inflorescence about one-fourth as long as the leaves; peduncle 10-12 cm. long with congested flowers; fruits less than 3 mm, sparsely distributed on the peduncle *C. sabiense*

REFERENCES

- Adeyemi, FA (1981). Biosystematic studies in some Nigerian species of *Anthericum* Linn. and *Chlorophytum* Ker-Gawl (Unpublished Ph.D. Thesis) University of Ibadan. Ibadan.
- Adsul, A; Lekhak, MM; Yadav, SR (2014). *Chlorohytum shermae* (Asaragaceae): a new species from Kerala, India. *Kew Bulletin* 69:9503.
- Angiosperm Phylogeny Group II (2003). An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG II. *Botanical Journal Linnean Society* 141:399-436.
- Chandore, AN; Malpure, NV; Adsul, AA; Yadav, SR (2012). *Chlorophytum belgaumense*, a new species of

- Asparagaceae from the Western Ghats of India. *Kew Bulletin*, 67:1-5.
- Gudadhe, SM; Nathar, VN; Dhoran, VS (2012). Meiotic Abnormalities in *Chlorophytum comosum* (Thunb) Jacq. *International Journal on Research in Plant Sci.* 2(2): 29-34.
- Hepper, FN (1972). Numerical analysis of the Flora of West Tropical Africa II. Angiosperms (Monocotyledons). *Kew Bull.* 27: 305-307.
- Hepper, FN (1968). Liliaceae in Flora of West Tropical Africa. Vol. 3 2nd ed. *Kew Bull.* 27: P.90-102.
- Malpure, NV; Yadav, SR (2009). *Chlorophytum gothanense*, a new species of Anthericaceae, from the Western Ghats of India. *Kew Bulletin* 64:739-741.
- Meerts, P; Bjora, CS (2012). Synopsis of the genus *Chlorophytum* (Asaragaceae) in Central Africa (Democratic Republic of the Congo, Rwanda, Burundi). *Pl. Ecol.* 145:(373-409).
- Obermeyer, AA (1962). A revision of the South African species of *Anthericum*, *Chlorophytum* and *Trachyandra*. *Bothalia* 7: 669–767.
- Omokanye, SB (2016). Biosystematic studies in the genus *Chlorophytum* in the forest and savana region of Nigeria (Unpublished Ph.D. Thesis), of University of Ilorin, Nigeria.
- Omokanye, BS; Mustapha, OT; Abdulrahman, AA; Kolawole, OS (2020)^a. Leaf Epidermal Studies of four Species of *Chlorophytum* in Nigeria. *J. Appl. Sci. Environ. Manage.* 24(11); 1963- 1968.
- Omokanye, SB (2020)^b, *Chlorophytum sabiense* (Asparagaceae); A new species from Nigeria. *J. Appl. Sci. Environ. Manage.* 24 (12): 2095-2098.
- Oyewole, SO (1971). Biosystematic studies in the genus *Albuca* L. with particular reference to those species occurring in Nigeria (Unpublished Ph.D. Thesis), of University of Ibadan, Nigeria.
- Oyewole, SO (1972). Cytological and cytogenetic studies in the genus *Albuca* L. in West Africa. *Biol. Soc. Brot.* 46(2): 149-171
- Oyewole, SO (1975). Cytotaxonomic studies in the genus *Urginea* Stein. in West Africa I. Karyotype analysis in *U. altissima* Bak. *U. gigantea* (Jacq.) Oyewole and *U. viridula* Bak. (Emend.) *Biol. Soc. Brot.*, 49:213-223.
- Oyewole, SO (1987)^a. Cytotaxonomic studies in the genus *Urginea* Stein. in West Africa II. Karyotype evolution in *U. altissima* (L.) Baker *Annals of the Missouri Botanical Garden.* 74 (1): 126-130.
- Oyewole, SO (1987)^b. Cytotaxonomic studies in the genus *Urginea* Stein. In West Africa. III. The case of *Urginea indica* (Roxb.) Kunth in Nigeria. *Annals of the Missouri Botanical Garden.*,74 (1): 131-136
- Oyewole, SO (1987)^c. Cytotaxonomic studies in the genus *Urginea* Stein. In West Africa. IV. Population differentiation and Karyotype variation in *Urginea indica* (Roxb.) Kunth. *Annals of the Missouri Botanical Garden.*74 (1): 136-143.
- Panda, SK; Das, D; Tripathy, NK (2011). Botanical studies of plants sold in market as ‘safed musli. International Journal of Pharmaceutical Research and Development. Platform for pharmaceutical researches and Developments. International Standard Serial Number: 0947-9446.
- Poulsen, AD; Nordal I (2005). A phenetic analysis and revision of Guineo-Congolian rain forest taxa of *Chlorophytum* (Anthericaceae). *Botanical Journal of the Linnean Society*, 148: 1–20
- Qudhia, P (2000). Can we save the endangered medicinal plant Safed Musli (*Chlorophytum borivilianum*) in India forest. An article written for an American site www.herb.com, July –Aug, 2000
- Quadhia, P (2001). Problems perceived by Safed musli (*Chlorophytum borivilianum*) growers of Chhattisgarh (India) region: A study *Journal of Medicinal and Aromatic Plant Sciences*, 22/4A and 23/1A: 396-399.
- Quadhia, P (2001). My Experiences with Wonder Crop Safed Moosli JN: Souvenir. International Seminar on Medicinal Plants and Quality Standardiation, VHERDS, Chennai, 90 – 96pp.
- Santapau, H; Fernandes, RR (1955). A new species of *Chlorophytum* from Salsette Island. *Jour. Bomb. Nat. Hist. Soc.*, 52: 897.
- Sardesai, MM; Gaikwad, SP; Yadav, SR (2006). A new species of *Chlorophytum* (Anthericaceae) from Western Ghat, India. *Kew Bulletin*, 61:269-271.
- Sharma, OP (1993). Plant Taxonomy (1stEd.). Tata McGraw—Hill Publishing Company Limited, New Delhi. 482pp.