

MACROMORPHOLOGICAL STUDIES ON THE VEGETATIVE AND FLORAL ORGANS OF *Kalanchoe pinnata* (Crassulaceae) FROM SOUTH EASTERN NIGERIA.

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### Abstract

The vegetative and floral morphology of *Kalanchoe pinnata* (Lam.) Pers. was studied with the motive of providing information for the characterization, identification and improvement of its classification. The plant is erect, branched, perennial shrub, about 100cm tall. The stem is ribbed and glabrous; leaves are simple succulent, opposite, glabrous, obovate, crenate-serrate, margin apex acute and base rounded, 12cm long and 8cm wide, subtended by a petiole, 3-5cm long; inflorescence is a terminal panicle, arranged on peduncle, 7cm long; flowers are showy, bisexual, actinomorphic; perianth 4-lobed and fused; fruit is a follicle. The vegetative and floral morphological characters of *Kalanchoe pinnata* are discussed in line with their importance in the taxonomy of this medicinal plant.

**Keywords:** Macromorphology, *Kalanchoe pinnata*, Identification, Classification

### Introduction

The genus, *Kalanchoe* (syn. *Bryophyllum*) is a member of the angiosperm family Crassulaceae commonly known as the stonecrop or the orpine family. Crassulaceae are mostly succulents which store water in their succulent leaves. The family consists of about 34-35 genera and approximately 1,400 species (Nikulin *et al.*, 2016), or 40 genera and 1,500 species (Watson and Dallwitz, 1994). It has a cosmopolitan distribution, predominantly in the temperate and subtropical regions of the Northern hemisphere and Africa with the greatest diversity in

Southern Africa and Madagascar (Smith, Figueiredo and van Araham, 2019). No member of this family is an important plant, but many are popular for horticulture. Many members have a bizarre intriguing appearance, and are quite hardy, typically requiring only minimal care (Gontcharova and Gontcharova, 2007). Familiar species of the family include *Crassula ovata* (Jade plants or friendship tree), *Kalanchoe blossfeldia* (florists' kalanchoe), and *Kalanchoe pinnata* (syn. *Bryophyllum pinnatum*), commonly known as life plant, Air plant or Resurrection plants.

The family is of physiological interest in view of the fact that it exhibits Crassulacean acid metabolism (CAM), an adaptation for growth in acid habitats (Judd, Campbell, Kellogg, Stevens and Donoghue, 2015). In these plants, the stomata open primarily at night and close during

the day, thus reducing water loss. Carbon fixation occurs in the leaves at night, leading to the formation of malic acid and during the day, when the stomata are closed, the fixed carbon is reduced to carbohydrate (Klavnsen and Madsen, 2012).

Morphologically, the plants of the family are mainly succulent herbs or shrubs and mostly xerophytic with evergreen, alternate or opposite or whorled leaves. The plants are usually hermaphrodite with cymose inflorescence. The flowers are actinomorphic and with calyx and corolla segments (Watson and Dallwitz, 1994). The gynoecium is composed of 3-many carpels, apocarpous, and often the number of pistils equals the number of corolla segments, ovary superior, 1-many ovules, anatropous, bitegmic (ovule with two integuments), endospermic with straight embryo, and usually with ridged seed coat (Van Ham and Hart, 1998). The present research was motivated by the fact that *Kalanchoe pinnata* is reported to be popularly used in traditional medicine and sometimes grown as an ornamental plant due to its distinctive succulent leaves and also usually used to demonstrate vegetative propagation by leaves. *Kalanchoe* is a medicinal plant largely used in folk medicine for the treatment of kidney stones, gastric ulcer, pulmonary infections, rheumatoid arthritis, boils, wounds, cough, diarrhea, dysentery, bruises, boils, wounds, and insect bites (Gill, 1992; Burkill, 2015). It has notable pharmacological properties including anti-diabetic, anti-neoplastic, antioxidant, immunomodulatory, anti-lipidemic, anti-allergic and others (Aejazuddin, Tatiya, Khurshid and Nazin, 2011; DeFilipps, Maina and Crepin, 2019). The morphological characters of *Kalanchoe pinnata* under investigation have been scantily described (Akobundu and Agyakwa, 1998; Nyananyo, 2006). In view of these potentials of *Kalanchoe pinnata*, there is the need to investigate the macro-morphological characters to improve the information available for its taxonomy. The present investigation therefore aims at a very comprehensive survey of the morphology of this species particularly with modern techniques.

## Materials and Methods

### Collection of Plant Materials

Fresh plants of *Kalanchoe pinnata* investigated (Fig.1) were collected in natural conditions in different locations of South Eastern Nigeria and identified with appropriate floras and illustrations by the authors. The investigation was carried out between April and September, 2020 at the Science Laboratory of Federal Polytechnic, Oko, Anambra State, Nigeria.

### Morphological Studies

Morphological studies were conducted using thirty (30) mature fresh specimens of the plant. The heights of the 30 plants specimens were measured using a 100cm rule. From these plants, 30 mature leaves from the middle portions of the plant specimens were collected and the lengths and widths measured with a 30cm rule. This was done by spreading the leaves on a flat surface of a laboratory bench. The data collected were recorded and appropriately subjected to statistical analysis involving the computation of averages and standard deviations. The qualitative characters were determined by assessing the type of plant habit; nature and texture of stem; type of leaf, texture, nature, venation, shape, margin, apex, base, and leaf phyllotaxy; type of inflorescence and location; floral symmetry, number of sepals and petals, union, and color; ovary type, placentation; type of fruit etc.



Fig.1: Sample of Plant of *Kalanchoe pinnata* Used in the Investigation

## Results

The results of the vegetative and floral morphological studies of *Kalanchoe pinnata* investigated are presented in Tables 1 and 2. The results showed that the plant is an erect, succulent perennial shrub, up to 100cm tall; stem thick, succulent, pale green in color, usually ribbed, glabrous, branching usually from the base. The leaves opposite, thick, succulent, greenish purple, usually simple, lamina pinnately veined, shaped obovate, about 12cm long and 8cm wide, glabrous, shiny, apex acute, base rounded with crenate to serrate margins and petioles about 3.5cm long (Table 1).

**Table 1: Vegetative characters of *Kalanchoe pinnata* investigated.**

Characters	Observations
<b>A. STEM</b>	
1. Habit	Perennial shrub
2. Nature	Ribbed, Succulent and thick.
3. Texture	Glabrous (Hairless/smooth).
4. Color	Pale Green
5. Branching pattern	From the Base
<b>B. LEAVES</b>	
1. Phyllotaxy	Opposite
2. Type	Simple
3. Texture	Glabrous
4. Color	Greenish purple
5. Texture	Succulent and thick
6. Venation	Pinnate
7. Shape	Obovate
8. Margin	Create-serrate
9. Apex	Acute
10. Base	Rounded
11. Leaf length(cm)	12.0±2.06

12. Leaf width(cm)	$8.0 \pm 1.69$
13. Petiole length(cm)	$3.5 \pm 0.99$
14. Plant Height (cm)	$100 \pm 2.86$

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The inflorescence was observed to be terminal panicles (cymes), usually drooping on peduncle of 7cm long, flowers showy, subtended by pedicels, 4cm long, regular (actinomorphic), bisexual; perianth of calyx made of 4 inflated, fused, greenish-yellow sepals, and corolla of 4 fused, reddish-purple petals; androecium composed of 8 free stamens; gynoecium of 4 free(apocarpous) pistils, ovary superior, ovules anatropous, 4 per locule, placentation marginal; fruits follicles(Table.2).



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Table 2: Floral Characters of *Kalanchoe pinnata* investigated.

Characters	Observations
<b>A. INFLORESCENCE</b>	
1. Type	Paniculate cyme
2. Location	Terminal
3. Floral symmetry	Actinomorphic (Regular)
4. Peduncle length(cm)	7.0±1.78
5. Pedicel length(cm)	4.0±0.88
<b>B. SEPALS</b>	
1. Number	4
2. Union	Gamosepalous (Fused)
3. Color	Greenish-yellow
<b>C. PETALS</b>	
1. Number	4
2. Union	Gamopetalous (fused)
3. Color	Reddish-purple
<b>D. ANDROECIUM</b>	
1. Number of stamens	8
2. Union	Free
<b>E. GYNODECIUM</b>	
1. Number of Pistils	4
2. Connate	Apocarpous (free)
3. Ovary type	Superior

4. Type of ovule	Anatropous
5. No. of ovules per locule	4
6. Placentation	Marginal
7. Fruit type	Follicle

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## Discussion

The *Kalanchoe pinnata* investigated is an erect, succulent, perennial, branched shrub with glabrous, ribbed, pale-green stem and with simple, opposite and obovate, often glabrous leaves. The inflorescence is a terminal panicle and flowers showy, regular, and bisexual with 4 sepals and petals both fused; stamens 8 in number and free, while the gynoecium composed of 4 pistils, apocarpous and fruit a follicle. Vegetative and floral morphological characters of plants have been of immense application in the treatment of many groups of angiosperms. These morphological characters are employed in taxonomy for various purposes including species description, identification, delineation, circumscription, classification, nomenclature and other taxonomic treatments. In the present study, the morphological character obtained can be employed in the description, identification, and separation of *Kalanchoe pinnata* from closely related taxa. Morphological characters have been in use in taxonomy for many decades ago emphasizing the significance of morphology in general. Sattler and Frutishauser (1997) noted that plant morphology including morphogenesis remains relevant to practically all disciplines of plant biology such as molecular genetics, physiology, ecology, evolutionary biology, taxonomy and systematics. Mbagwu and Edeoga (2006) conducted a study on the vegetative and floral morphology of eight species of *Vigna*. They used morphological characters such as creeping or climbing herbs, leaf texture, leaf shape, leaf length, floral symmetry, length of pod, and seed number per pod to separate these species. In their study, Idu, Erhabor and Ogie-Odia (2009) used morphological features such as presence of angular stem and pubescent leaves in *Starchytarpheta cayanensis* to morphologically distinguish it from *S. jamaicensis* which is characterized by smooth circular stem and glabrous leaves. Fergan, Ferhat and Kutbay (2010) utilized morphological data as well as ecological and palynological data for proper circumscription of the genus *Sempervivum* into three species- *S. sasnowski*, *S. armenum* and *S. glabrifolium*. Moreover, Okeke, Chigor, Odika and Nwaogwugwu (2010) investigated the vegetative and floral morphology of *Leucas martinicensis* and *Salenastemon monostachyus* and revealed that the variation in the vegetative and floral morphological characters was enough justification for the delineation of the two taxa into separate genera. Also, Okeke, Izundu and Okoli (2011) conducted the vegetative and floral morphological survey of *Fleurya aestuans* and inferred that the data derived from there could be added to other information for the improvement of the taxonomy and characterization of the taxon. In another survey on the vegetative and floral morphology of three species of *Euphorbia* - *E. hirta*, *E. hetarophylla* and *E. hyssopifolia*. Okeke, Izundu, Okoli and Isama (2012), found that the differences in the morphology of these species were adequate evidence for their separation into distinct species while the similarities among them were enough information for their unification into the same genus. Most recently,

Mechinet and Nuraniye (2016) investigated the morphological features of the plant *Haplophyllum telephioides* including dimension of leaf, sepal and fruit, size of filament, anther and pistil, diameter of the ovary, plant height and petal length and inferred that these characters could be used in the description of the species and could equally contribute to the pharmacognostical evaluation of species.

### **Conclusion**

Morphological characters are employed in various aspects of plant taxonomy. Therefore the observation from the morphological investigation on the vegetative and floral parts of *Kalanchoe pinnata* studied revealed some important traits that could be added to other lines of evidence for the improvement of the classification of the taxon. Moreover, the vegetative and floral traits observed could be utilized for the characterization, identification and construction taxonomic keys of *Kalanchoe pinnata*. It is recommended that further studies be conducted on other areas of this plant including phytochemical, pharmacological, and pharmacognostical aspects to ascertain its medicinal potentials and capabilities in pharmaceutical formulation of drugs.



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