Agricultural Journal 1 (4): 230-234, 2006


# Floral Characters in the Discrimination of the Nigerian Sp. of *Aloe* (Linn)

B.O. Akinyele
Department of Crop, Soil and Pest Management,
Federal University of Technology, P. M. B. 704, Akure, Nigeria

**Abstract:** A taxonomic study based on floral features was carried out on four Nigerian species of *Aloe,* namely *A. schweinfurthii, A. macrocarpa* var *major, A. keayi* and *A. buettneri.* At anthesis, 12 floral characters of each species were investigated using the completely randomized design. The features investigated are number of flowers per reproductive shoot, pedicel length, bract length, tepal length, filament length, style length, anther length, anther width, ovary length, ovary diameter, stigma length and stigma width. Number of flowers per reproductive shoot was counted while the other characters were measured with a ruler graduated in centimeters and millimeters. Means of counts and measurements were determined, subjected to analysis of variance and separated using Duncan's Multiple Range Test. Available information provided sufficient evidence to justify the existing taxonomy of Nigerian *Aloe.*

**Key words:** Floral characters, taxonomy, *Aloe*

## INTRODUCTION

*Aloe* L. is an arborescent member of the family Liliaceae Akinyele and Oyewole,[1]. The plant is native to Africa Anselm,[2] but is also found growing in regions of similar climatic conditions in the Caribbean, Europe, Far East and America Fasanmi,[3]. According to Anselm[4], over 325 species of the genus *Aloe* have been identified by 2004. Apart from its use as ornament in homes, gardens and yards, *Aloe* is one of the medicinal plants widely used throughout the world Sofowora,[4]. Its members are perennial herbs used in some countries as laxative by Swaminathan and Kochhar,[5]. The dried exudate of *Aloe,* as observed by Tyler *et al.*[6], contains glycosides of various anthraquinones, anthranols and anthranones which function as cathartics based on their ability to stimulate peristalsis by increasing the tone of the smooth muscle in the wall of the large intestine. The main species used commercially are *A. vera* and *A. ferox* and the principal producers are the African and South American countries. The USA imports of crude aloes are in the order of 40 tonnes per annum and in 1982 the market in the USA alone was estimated to be about $300 million by ITC,[7]. Basically, all the various species of *Aloe* have similar constituents but *A. vera* is more popular all over the world because it propagates itself faster than any other known species of *Aloe* denoted by Anselm,[2]. Hence, it is more readily available for use than any other species of *Aloe.* Works carried out on *A. vera* show that the plant is effective in the treatment of cancer Grimando *et al.*[8] and intestinal ulcer and has a modulating effect on Human Immunodeficiency Virus-HIV Anselm,[2]. *Aloe vera* is also used to cure such illnesses as impotence, liver and kidney problems, piles, eczema and glaucoma.

For the meantime, a survey on available *Aloe* representatives in Nigeria is being made in order to authenticate the level of variations among them. In agreement with Adansonian principles, all available data should be used in constructing a classification without preference for one sort over another. However, Stace[9] observed that in practice the great majority of taxanomists are forced, by strictures of time and manpower, to be selective in their use of characters. Today, much discussion on the most valuable sorts of characters for the purpose of classification still takes place. Also in his observation, Stace[9] noted that the early taxonomists believed that some characters, which defined the essence of the organism, were taxonomically the most important. The flowers, for example, which were considered essential structures have played and still play, a prominent role in the classification of Angiosperms. Akinyele[10] studied the floral morphology of the Nigerian species of *Dipcadi* and found out that there was no need to reappraise the existing taxonomy of the plant in Nigeria. Gill[11] employed floral characters, among others, in the taxonomy of some flowering plants. Other studies that have highlighted the importance of the flower in plant taxonomy include those carried out by Ghazanfar[12], Miller[13], Mustapha[14], Stace and Fripp[15], Mogford[16] and Abbe[17].

The aspects of the plant used so far in the classification of the four known Nigerian species of *Aloe* are the vegetative morphology by Hepper,[16]; Akinyele,[18] and the karyotype by Akinyele and Oyewole,[1]. Since floral characters, according to Heywood and Moore[19], are known to provide the most valuable indicators of taxonomic affinity, the aim of this study is to attempt a classification of the four known Nigerian representatives of *Aloe* based on their floral characters.

## MATERIALS AND METHODS

The four *Aloe* sp. investigated are *A. schweinfurthii, A. macrocarpa* var *major, A. keayi* and *A. buettneri.* Their vegetative habit is shown in Plate 1. Areas from which they were collected are as follows: *A. schweinfurthii*-700 m South of Okene, Kogi State, Nigeria; *A. macrocarpa* var *major*-rocky outcrop situated about ½ km East of Adetunji village, near Oyo, Oyo State, Nigeria; *A. keayi*-Botanical Garden of Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria; *A. buettneri*-rocky humous soil on the outskirts of Eruku, along Obo-Ile-Eruku road, Kwara State, Nigeria. They were brought into cultivation for six years in the Screen House of the Department of Crop, Soil and Pest Management, Federal University of Technology, Akure, Nigeria. The experimental design adopted was the completely randomized design.

Characters investigated are number of flowers per reproductive shoot, pedicel length, bract length, tepal length, filament length, style length, anther length, anther width, ovary length, ovary diameter, stigma length and stigma width. Number of flowers per reproductive shoot was counted and mean calculated from five randomly selected plants was recorded for each species. Flowers were later plucked at anthesis and taken to the laboratory where their various parts were dissected out. Measurement of the floral characters was done with a ruler graduated in centimeters and millimeters. For each character investigated, mean value for each species was calculated from five replicates. The various means were then subjected to analysis of variance and separated using Duncan's Multiple Range Test.

## RESULTS

Generally, the reproductive shoot is tall, thick and borne among a rosette of green fleshy leaves; the distal half of the reproductive shoot bears two or more inflo rescences; flowers are pedicelled, mauve with biseriate six-segmented perianth; a two-segmented anther is borne on each of the six long filaments of the flower; the ovary bears a long, thin style which lies in-between the filaments; the stigma is held in position by the style; bract is pyramidal lanceolate.

Plate 1: Vegetative habit of the four *Alose* species

**A. schweinfurthii:** Number of flowers per reproductive shoot ranges from 30-36; pedicel length 1.60-1.70 cm; bract length. 1.30-1.80 cm; tepal length 3.32 -3.40 cm; filament length 2.30-2.50 cm; style length 2.10-2.20 cm; anther length 3.10-3.52 mm; anther width 1.00-1.50 mm; ovary length 7.10-8.10 mm; ovary diameter 3.00-3.51 mm; stigma width 0.18-0.19 mm; stigma length 0.20-0.22 mm.

***A. macrocarpa* var *major*:** Number of flowers per reproductive shoot ranges from 50-75; pedicel length 2.00-2.50 cm; bract length 1.30 -1.40 cm; tepal length 3.40-3.50 cm; filament length 2.50 -2.70 cm; style length 2.30 cm-2.60 cm; anther length 3.20-3.50 mm; anther width 1.20-1.60 mm; ovary length 7.00-8.10 mm; ovary diameter 2.88-3.45 mm; stigma width 0.17-0.18 mm; stigma length 0.20-0.22 mm.

**A, keayi:** Number of flowers per reproductive shoot ranges from 20-27; pedicel length 1.30-1.80 cm; bract length 1.00-1.50 cm; tepal length 3.40-3.50 cm; filament length 2.35-3.45 cm; style length 2.20-2.30 cm; anther length 3.00-3.35 mm; anther width 1.00-1.20 mm; ovary length 7.00-8.00 mm; ovary diameter 3.00-3.50 mm; stigma width 0.19-0.20 mm; stigma length 0.18-0.20 mm.

**A. buettneri:** Number of flowers per reproductive shoot ranges from 90-94; pedicel length 2.50-2.80 cm; bract length 0.90 -1.30 cm; tepal length 3.50-3.70 cm; filament length 2.60-2.80 cm; style length 2.50-2.90 cm; anther length 4.00 -4.30 mm; anther width 2.10-3.60 mm; ovary length 7.00-10.00 mm; ovary diameter 3.50-3.60 mm; stigma width 0.22-0.30 mm; stigma length 0.30-0.42 mm. Summary of data analysis is shown in Table 1.

## DISCUSSION

The results of the investigations carried out on twelve floral characters in this work are summarized in Table 1. Data amassed clearly show that ovary length is more or less the same in all the four *Aloe* sp. Hence, the feature recognizes the four species as belonging to the same taxon. Ovary length, therefore, is most likely to be an ancestral character of the genus that has been retained over the years in spite of adaptation to new open niches to exploit. When classification is based on the number of flowers per reproductive shoot, the four *Aloe* sp. are distinctly separated from one another, each standing on its own in a different taxon. It is logical, therefore, to infer that the number of flowers per reproductive shoot is likely to play a major role in the separation of *Aloe* representatives at the specific level. While *A. schweinfurthii* and *A. macrocarpa* var *major* are separated from one another by pedicel length, bract length, tepal length, style length and anther length, they are recognized as belonging to the same taxon by other features. Apart from filament length and ovary length, all the other characters investigated put *A.schweinfurthii* and *A.* buettneri into different taxa. Though *A. schweinfurthii* and *A. keayi* are grouped together in a taxon by pedicel length, style length anther width, ovary diameter, stigma width and stigma length, they are separated from one another by other parameters. The only feature that recognizes *A. keayi* and *A. buettneri* as belonging to one taxon is the bract length. *A. macrocarpa* var *major* and *A. keayi* are separated into different taxa by tepal length, anther length, anther width, ovary diameter, stigma length and stigma width but are put together in one taxon by other parameters. The data also show that while *A. macrocarpa* var *major* and *A. buettneri* are put together in one taxon by other factors, they are separated into different taxa by pedicel length, bract length, tepal length, style length, anther length and anther width.

It is interesting to note that while the three other species flowered on yearly basis, flowering was not observed in *A. keayi* until the fifth year of experimentation. The species is likely to be a hybrid caught in the process of internal organization to stabilize its genetic system. Hence, it took its representatives sometime to restore or acquire sexual stability. Lewis[20] opined that the establishment of any new kind of organism is faced with two indispensable situations:

- The stabilization of its genetic system
- The restoration or acquisition of sexual fertility. In most cases, according to Oyewole[21], the achievement of these two situations proceeds simultaneously, with stabilization preceding acquisition of sexual fertility.

In spite of the fact that the four species are distinguished from one another by the number of flowers per reproductive shoot, the difference among *A. schweinfurthii, A. macrocarpa* var *major* and *A. keayi* are less apparent. It is possible that interaction between the genotype and new open niches to exploit might have evolved the minor morphological differences among the

Table 1: Mean values of measurements of floral characters

| Species | No of flowers/repro--ductive shoot (cm) | Pedicel length (cm) | Bract length (cm) | Tepal Length (cm) | Filament length (cm) | Style length (cm) |
|---|---|---|---|---|---|---|
| *A. schweinfurthii* | 33.40±1.17b | 1.58±0.07a | 1.54±0.09c | 3.35±0.02a | 2.37±0.04a | 2.16±0.03a |
| *A. macrocarpa* var *major* | 64.00± 5.01c | 2.35±0.10b | 1.36±0.03bc | 3.44±0.02b | 2.61±0.03a | 2.40±0.06b |
| *A. keayi* | 23.40 ±1.44a | 1.60±0.09a | 1.28±0.10ab | 3.44±0.03b | 3.19±0.21b | 2.24±0.03a |
| *A. buettneri* | 92.80 ±0.80d | 2.63±0.06c | 1.09±0.19a | 3.60±0.03c | 2.68±0.04a | 2.68±0.07c |

| Species | Anther Length (mm) | Anther width (mm) | Ovary length (mm) | Ovary diameter (mm) | Stigma width (mm) | Stigma length (mm) |
|---|---|---|---|---|---|---|
| *A. schweinfurthii* | 3.43±0.08b | 1.26±0.09a | 7.58±0.21a | 3.18±0.09a | 0.18±0.00a | 0.21±0.01a |
| *A. macrocarpa* var *major* | 3.34±0.05ab | 1.35±0.08a | 7.56±0.21a | 3.16± 0.12a | 0.18±0.00a | 0.22±0.00a |
| *A. keayi* | 3.21 ±0.06a | 1.10±0.05a | 7.48±0.16a | 3.28±0.10 b | 0.20±0.00b | 0.19±0.01a |
| *A. buettneri* | 4.16 ±0.07c | 2.72±0.34b | 8.40±0.51a | 3.55±0.002b | 0.27±0.02b | 0.37±0.02b |

Mean values in the same column followed by different letters are significantly different ($p<0.05$). Values are means ± SEM for five replicates

three species which are presumed to have originated in the same way. It is true that the use of external features in the resolution of taxonomic problems has rendered the taxonomy of some plant genera tedious and confusing because of the apparent morphological similarity among these genera and the striking morphological similarity within each genus Oyewole,[22], floral characters, especially of the essential organs, are less susceptible to modifications due to the effect of the environment on the genotype of the plant Oyewole,[23]. It is also true that the areas of occurrence of the different species are not widely separated and that they sometimes grow mingled together, nevertheless, the morphological similarity among the four *Aloe* species and the overlap in some characters between closely related species do not show any evidence of gene exchanges. Consequently, as also reported by Akinyele[24], the four species are seen as being morphologically distinct taxa, each recognizable and differentiated from any other in their basic floral morphology. The apparent morphological uniformity in the representatives of the genus in Nigeria may be due to one or a combination of the following reasons:

- little or recent divergence of the different taxa from their ancestry.
- evolution of different genetic systems by different genic arrangements and combinations rather than by different genic constitution, which invariably leads to representative groups with little morphological differentiation and divergence.

## CONCLUSION

The information supplied by data amassed in the course of this study gives sufficient evidence in support of the existing classification of *Aloe* in Nigeria. Hence, each of the four *Aloe* species investigated should be recognized as a taxon of its own at the specific level.

## REFERENCES


1. Akinyele, B.O. and S. O. Oyewole, 2002. Karyotype studies in four Nigeria species of *Aloe* Linn. App. Trop. Agric., 7: 29-33.
2. Anselm and Adodo, 2004. Nature Power (3rd Ed.) Fr. Anselm Adodo, OSB Ewu-Esan, Nigeria, pp: 288.
3. Fasanmi, A.O., 2002. Comparative studies on the antimicrobial effects of *Aloe barbadensis.* A Bsc. thesis of the Federal University of Tech. Akure, Nigeria, pp: 70.
4. Sofowora and Abayomi, 1984. Medicinal plants and Traditional Medicine in Africa. John Wiley and Sons Ltd. New York, pp: 256.
5. Swaminathan, M.S. and S.L. Kochhar, 1989. Plants and society. The Macmillan Publishers Ltd. London and Basingstoke, pp: 284.
6. Tyler, V.E, L.R. Brady and J.E. Roberts, 1981. Pharmacognosy (8th Ed). Lea and Febiger, Philadelphia, Pa, pp: 57-67.
7. ITC, 1982. Markets for selected medicinal plants and their derivatives. ITC UNCTAD/GAAT, Geneva. pp: 206.
8. Grimando, S., M. Tomomeo and R.A. Gancitano, 1997. Effects of highly purified anthraquinoid compounds from *Aloe* barbadensis on sensitive and multidrug resistant leukemia cells. Oncology Reports. pp: 341-343.
9. Stace, C.A., 1980. Plant taxonomy and biosystematics. Edward Arnold (Publishers) Ltd. London, pp: 279.
10. Akinyele, B.O., 2005. Floral morphology and the existing taxonomy of three Nigerian species of *Dipcadi* Medic. J. Sci. and Tech. Res., 4: 15-17.
11. Gill, L.S., 1988. Taxonomy of flowering plants. Africana-Fep. Publisher Ltd. Ibadan, Nigeria, pp: 337.
12. Ghazanfar, S.A., 1989. Savanna plants. Macmillan Publishers Ltd, London, pp: 227.

13. Miller, R.B., 1981. Hawkmonths and the geographic patterns of floral variation in *Aquilegia cearulea*. Evolution 35: 763-774.
14. Mustapha, O.T., 1991. Biosystematic studies in the *Urginea indica* (Roxb). Kunth Complex, A PhD thesis of the University of Ilorin, Ilorin, Nigeria.
15. Stace, H.M. and Y.J. Fripp, 1977. Raciation in *Epacris impressa*. 1. Corolla colour and corolla length. Austral. J. Bot. 25: 299-314.
16. Mogford, D.J., 1974. Flower colour polymorphism in *Cirsium palustre*. Pollination. Heredity, 33: 257-263.
17. Abbe, E.C., 1974. Flowers and inflorescences of Amentiferae-. Bot. Rev., 40: 159-261.
18. Hepper, F.N., 1968. Floral of West Tropical Africa. 2nd Ed. pp: 90-137.
19. Heywood, V.H. and D.M. Moore, 1984. Current Concepts in Plant Taxonomy: Systematics Association. Academic Press, London. pp: 432.
20. Lewis, K.R., 1966. The evolution of chromosome systems. Ind. J. Genet. 26: 1-11.
21. Oyewole, S.O., 1984. Microsporogenesis and sexual sterility in *Drimiopsis barteri*. Cytologia 49: 87-93.
22. Oyewole, S.O., 1988. Chromosome counts and karyomorphology of some West Tropical African Scilleae (Liliaceae). Ann. Miss. Bot. Gard. 75: 196-202.
23. Oyewole, S.O., 1971. Biosystematic studies in the genus *Albuca* L. with particular reference to those species occurring in Nigeria. A PhD thesis of the University of Ibadan, Ibadan, Nigeria.
24. Akinyele, B.O., 2005. The bearing of vegetative morphology on the taxomy of four Nigerian species of *Aloe* Linn. App. Trop. Agric., 10: 8-12.