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## Taxonomic studies in the genus *Aframomum* (Zingiberaceae)

J. M. LOCK & J. B. HALL

### SUMMARY

After a definition of the genus *Aframomum*, the authors discuss the usefulness of various floral and vegetative characters. Possible lines of approach to the classification of the genus are discussed.

### RÉSUMÉ

Après avoir donné une définition du genre *Aframomum*, les auteurs discutent de l'utilité des divers caractères floraux et végétatifs et envisagent ensuite différentes manières d'obtenir une classification du genre.

The genus *Aframomum* was described by K. Schumann in 1904 to accommodate the African plants formerly placed in the genus *Amomum*. It originally contained 41 species, and five more names were included as *incertae sedis*. There are now about 70 names in the genus, representing at least 50 species.

*Aframomum* poses considerable problems to the herbarium taxonomist. The plants are often large, with leafy shoots up to 8 m tall, and often with extensive rhizome systems. Often the inflorescences grow from the rhizomes and may thus appear from the ground, remote from the leafy shoot. This has given rise to many confusing mixed gatherings. The flowers, although large, are very delicate and each opens for less than twelve hours. They are difficult to dry well. Collections containing both flower and fruit are rare. Ridges on the fruits, although useful in classification, often become obscure on drying. Finally, many old species were described from very inadequate material, because of the importance of the fruits in medicine as Grains of Paradise and Cardamoms. In West Africa, *Aframomum melegueta* is still important locally as a spice and medicine (Van Haarten, 1970), and was formerly exported in very large quantities.

This study has attempted to overcome some of the difficulties of herbarium studies. Examination of populations in the field has allowed a better appreciation of variation, and has given a better idea of characters which may be useful in distinguishing species. After seeing many of the species in the field, herbarium material can be named with rather more certainty. More use has been made of vegetative characters

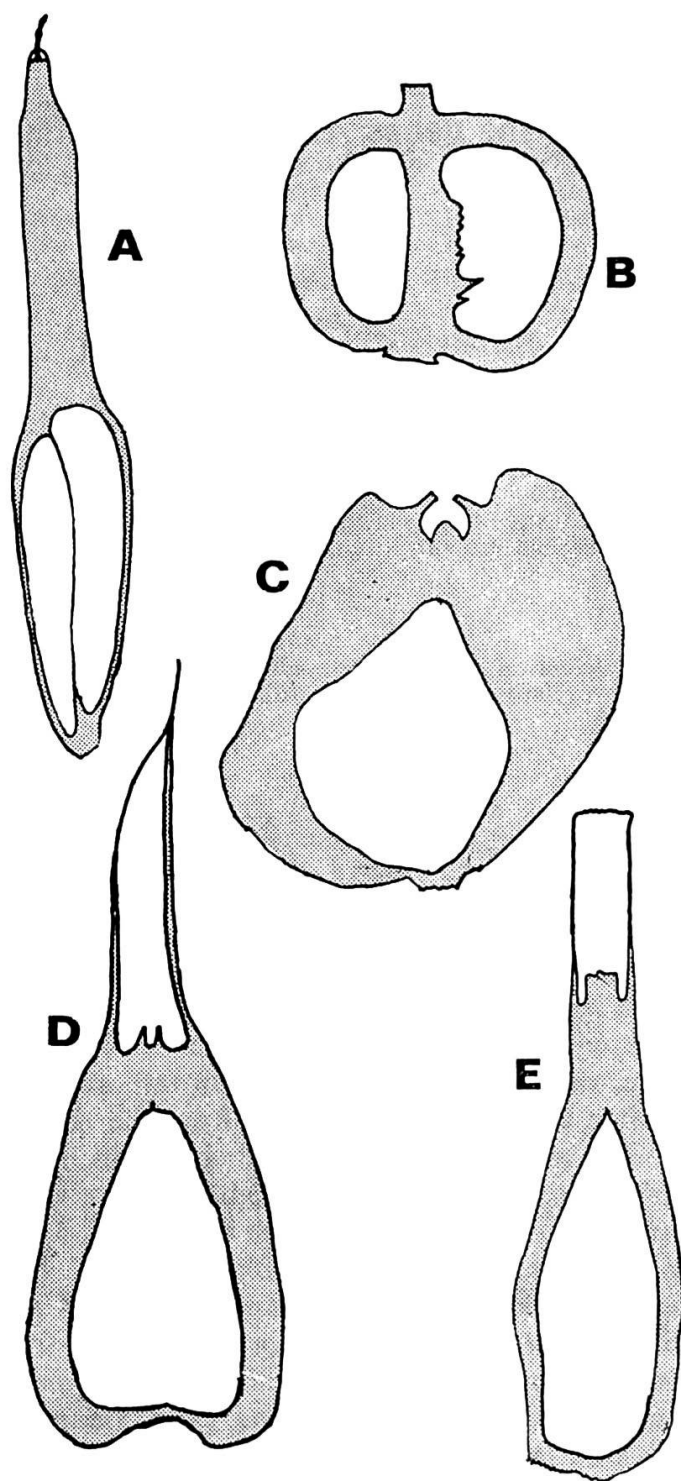


Fig. 1. — Longitudinal sections of fruits of *Aframomum*, showing the different origins of the beak. A: *Aframomum strobilaceum*. B: *A. geocarpum* (note the very thick septum in this species). C: *A. chlamydanthum*. D: *A. cordifolium*. E: *A. daniellii*.

than has been customary; in spite of the impression of great uniformity in the genus, there are in fact a number of small but constant characters which are useful taxonomically.

### The definition of the genus

Schumann (1904) used characters of two organs in his definition. He considered the sterile appendage at the apex of the anther connective to be three-lobed in *Aframomum*, but absent or entire in *Amomum*. Burt & Smith (1972) have pointed out that the apical appendage is sometimes three-lobed in *Amomum*. In *Aframomum strobilaceum* (Sm.) Hepper it is two-lobed, and in *A. laxiflorum* Loes. ex Schlieben it is entire. This supports Burt's view that more weight should be placed on the second character, the fleshiness and dehiscence of the fruit. In *Aframomum* the fruit is always fleshy and indehiscent, while in *Amomum* it tends to be dry and dehiscent although many more observations are needed on this point. The fruit of *Aframomum* is not always flask-shaped, neither does it always have a long sterile beak. Figure 1 shows that the beak in the mature fruit may be derived from the solid base of the corolla tube, from the solid sterile apex of the ovary, or from an accrescent calyx. The absence of a common morphological origin for the beak makes it of doubtful value in defining the genus.

### Additional characters for identification of species

Hepper (1968) first drew attention to the value of vein spacing in the leaves as a specific character. This should be observed and measured on both leaf surfaces. The number of orders of lateral veins is also useful. In *A. melegueta* (Fig. 2A), for example, all lateral nerves are of about the same size, but in *A. strobilaceum* at least four orders of veins are visible. Sections of the lamina, cut at right angles to the lateral veins, show a number of specific characters which can also be seen in rehydrated herbarium material. Tomlinson (1969) has described the anatomy of the family; his account of *Aframomum* is, however, based on an undetermined species cultivated at Kew, and does not indicate the wide range of variation found in the genus. In nearly all species there are strands of sclerenchyma in the adaxial hypodermis. These strands may be associated with the vascular bundles, but separated from them by the palisade mesophyll, or they may be attached to the bundle sheath, forming buttresses in the sense of Tomlinson (1969). In a few species there are scattered strands of sclerenchyma in the adaxial hypodermis, not associated with the vascular bundles. These can be seen with a x20 lens on the upper surface of dried leaves as structures resembling very narrow discontinuous veins. These hypodermal sclerenchyma strands are found in all the species which have a narrow labellum (Group A, below), and also in a small group of species including *A. sulcatum* (Oliv. & Hanb.) K. Schum. (Fig. 2B), *A. subsericeum* (Oliv. & Hanb.) K. Schum., and *A. alpinum* (Gagnep.) K. Schum. Some of these features are shown in Fig. 2.

Other vegetative features of value include the indumentum, and the pattern on the leaf sheaths. The former is often confined to the underside of the midrib and margin. The leaf sheaths may be smooth, longitudinally ridged, or marked with a

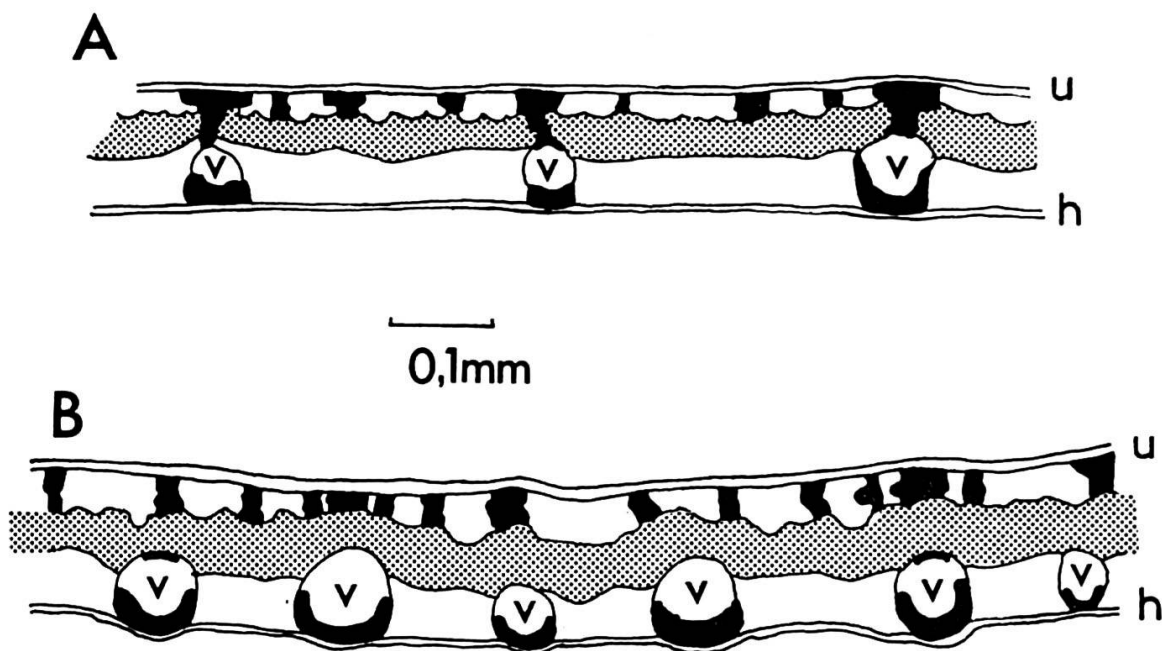


Fig. 2. — Transverse sections of lamina of *Aframomum* species, showing features mentioned in the text, p. 227.

A: *A. melegueta*. B: *A. sulcatum*. — Black areas — sclerenchyma; stippled areas — palisade mesophyll; v — vascular bundles; u — upper epidermis; h — hypodermis.

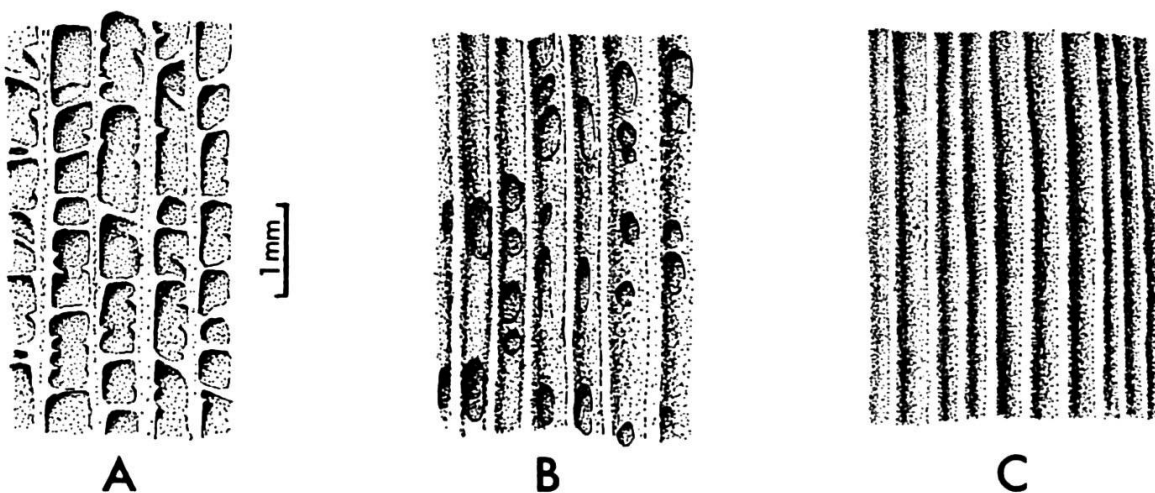


Fig. 3. — Patterns on leaf sheath surfaces in *Aframomum*.

A: *A. giganteum* (Mann 1051). B: *A. leptolepis* (Preuss 555). C: *A. sceptrum* (Mann 1034).

reticulate pattern (Fig. 3). Often small gland-like hairs occur in the depressions of the reticulation.

A floral character, noticed by K. Schumann in *Amomum* and also useful in *Aframomum*, is the dehiscence of the anthers. In a few species they dehisce to the apex, but in the majority only the lower half to two-thirds of the anther dehisces. The structures at the base of the style, which have been referred to as stylodia, but

which are better referred to as nectaries, are paired and linear in most species, but in a few they form a convoluted mass around the style base. Finally, the seeds show a considerable range of form, colour, and surface pattern. Colours of the dry seeds range from black to pale grey and various shades of brown, and surface texture may be smooth, or striate, or dull and tuberculate.

### Subdivisions within the genus

K. Schumann did not consider it appropriate to distinguish sections or subgenera; he did however divide the genus into two series on the basis of the number of flowers in the inflorescence. This is somewhat unsatisfactory; some of the species listed by him as being one-flowered, such as *A. sulcatum*, do in fact have 2-3 flowers in each inflorescence although only one fruit is usually produced. The present study has suggested that a number of groups of closely related species can be distinguished in the genus on the basis of both floral and vegetative characters. These are summarized below.

#### *Aframomum angustifolium* group

Labellum narrow; flowers red, orange or yellow; stylodia (nectaries) elongated, paired; anthers dehiscing to apex; seeds smooth and shiny; fruit often grooved; leaves with scattered sclerenchyma in the hypodermis. — (*A. angustifolium*, *A. mala*, *A. sanguineum*, *A. daniellii*, *A. hanburyi*, *A. baumannii*.)

#### *Aframomum polyanthum* group

Labellum horizontal, small; inflorescence many-flowered, umbellate; anthers dehiscence to apex; stylodia (nectaries) convoluted and surrounding the style base; seeds rough but shiny; fruit thick-walled with large ridges. — (*A. polyanthum*, *A. chlamydanthum*, *A. keniense*, *A. zambesiaceum*.)

#### *Aframomum pilosum* group

Labellum narrow, small and decurved; inflorescences one-flowered and densely aggregated; flowers yellow; anthers dehiscence to apex; stylodia (nectaries) convoluted around style base; seeds rough. — (*A. pilosum* only.)

These three groups are well-defined. Group A includes the lectotype of the genus, *A. angustifolium* (Sonn.) K. Schum. (Burt & Smith, 1972). This is a widely distributed species, occurring in Madagascar and from Zambia northwards to the Central African Republic. It is distinctive in its long-pedunculate inflorescence and smooth fruits. *Aframomum sanguineum* (K. Schum.) K. Schum. is probably conspecific. There remains a series of species extending from Tanzania, (*A. mala* (K. Schum.) K. Schum.) through Uganda to Cameroon and west to Sierra Leone. The species have been distinguished largely on the basis of flower colour, and the indumentum of the midrib. Further study is needed in this group, but inflorescence position may prove useful. In *A. daniellii* (Hook. f.) K. Schum. and *A. baumannii* K. Schum., the inflorescence is always at the base of the leafy shoot, while in *A. hanburyi* K. Schum.,

and in plants from the Obudu Plateau in south-eastern Nigeria, the inflorescences arise both at the base of the leafy stem and on the rhizome.

Group B is also distinctive. *A. polyanthum* (K. Schum.) K. Schum. is a little-known species, although Hallé (1967) has published excellent drawings of it. It occurs from Cameroon to south-western Sudan. The other species in the group are *A. chlamydanthum* Loes. & Mildbr., from Fernando Po, Cameroon Mountain and the Bamenda Highlands, *A. keniense* R. E. Fries from the highlands of East Africa, and *A. zambeziacum* K. Schum. from the highlands of Malawi. These three species are extremely similar and further study may lead to them being considered as isolated populations of a single widespread species. The distribution of the species in Group B is shown in Figure 4B.

*Aframomum pilosum* (Oliv. & Hanb.) K. Schum. is a little-known but very distinctive species of wet forest in south-eastern Nigeria and Cameroon. It would seem to be sufficiently distinct to form a distinct group on its own.

After splitting off these obvious groups, a residuum of about 40 species remains. All have a broad labellum, less than ten flowers in the inflorescence, paired elongate stylodia (nectaries), and incompletely dehiscent anthers. Some small groups can be distinguished, such as the geocarpic species *A. amaniense* Loes., *A. geocarpum* Lock & Hall and *A. limbatum* (Oliv. & Hanb.) K. Schum. These species are very closely related; their distributions are shown in Fig. 4A. Another group contains those species with elongated inflorescences with one-flowered distichously-arranged

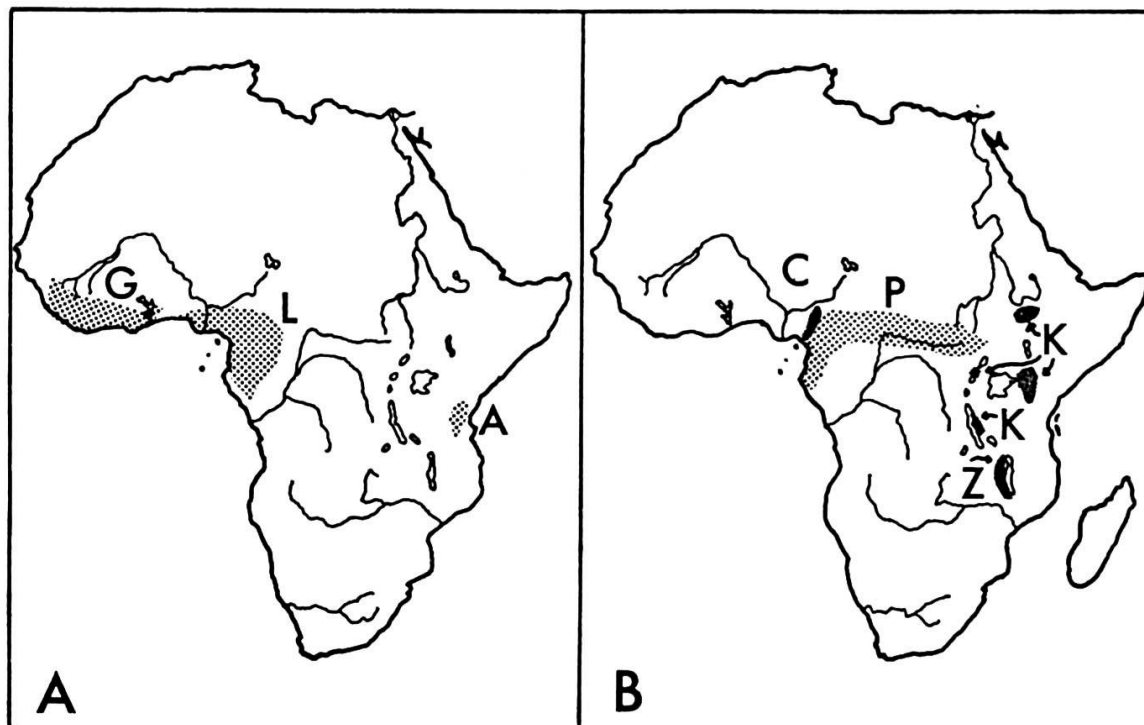


Fig. 4. — Distribution of groups of related species in *Aframomum*.

A: Geocarpic species. G - *A. geocarpum*; L - *A. limbatum*; - A *A. amaniense*. — B: Group B species. C - *A. chlamydanthum*; P - *A. polyanthum*; K - *A. keniense*; Z - *A. zambeziacum*.



side branches, such as *A. giganteum* (Oliv. & Hanb.) K. Schum., *A. pruinatum* Gagnep. and *A. letestuanum* Gagnep.

The most striking feature of the remaining species is the occurrence of characters in a reticulate distribution, rather than together in particular groups. For instance, ridged fruits are found in *A. cordifolium* Lock & Hall, *A. aulacocarpos* Pellegr. ex J. Koechlin, and *A. sulcatum* (Oliv. & Hanb.) K. Schum. These species do not appear to be otherwise closely related. Likewise, cordate leaf bases occur in *A. cordifolium*, *A. longiscapum* (Hook. f.) K. Schum., *A. citratum* (Pereira) K. Schum., and *A. letestuanum*, but once again there are no other features indicating any close relationship. The rather small number of characters available accentuates this difficulty. Further studies on a wider geographical basis may help to sort out the problems produced by such patterns of variations, and may also show how the residuum of forty species may best be subdivided.

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