

REVIEW ARTICLES

THE BOTANY AND CHEMISTRY OF ALOES OF AFRICA

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BOTANICAL ASPECTS OF ALOES OF NORTH EAST AFRICA

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1. INTRODUCTION

The genus *Aloe* is indigenous to eastern, southern Africa and Madagascar, but has been introduced into the West Indies and many other tropical countries. It is a unique genus with almost all of its members concentrated in the wild in Africa except for a few species which extend into the Arabian Peninsula. Because of their beauty and medicinal importance, some species have now become truly cosmopolitan. The interest in the study of succulent plants such as aloes, both for pleasure and scientific pursuit, has been going on for a long time. The efforts of succulent enthusiasts such as Harold Basil Christian, who in the 1950's established a scenic Aloe Garden near Harare, Zimbabwe, greatly contributed to making aloes one of the most popular botanic garden plants in the world.

Two monumental works by Reynolds, which described aloes of South Africa (1950) and Tropical Africa and Madagascar (1966) greatly contributed to increased knowledge of the botany of many members of this genus and consequently also spurred taxonomic research of the taxa in specific geographic regions. Recent taxonomic studies on the genus *Aloe* in eastern and northeastern Africa indicated the presence of a large number of endemic species. For example in eastern Africa, of the 83 species known, 50 (60%) are endemic to the region (Carter, 1994). In N.E. Africa (Ethiopia, Eritrea, Sudan, Somalia and Djibouti), of the 76 species reported to occur, 56 (74%) are believed to be endemic to the region (Carter, 1994; Lavranos, 1995, and Sebsebe Demissew and Gilbert, in press).

At this particular point in time, aloe plants are one of the most threatened taxa known. This problem arises as a result of the fact that aloes are one of the highly sought-after plants, due to their use in horticulture, medicine and commerce. It is therefore imperative to document information on the botany, ecology, distribution and chemistry of these species, in the hope that such knowledge will stimulate research and aid conservationists to take appropriate measures to conserve and promote the sustainable utilization of these botanic treasures.

2. THE RECLASSIFICATION OF THE FAMILY LILIACEAE

The recently revised family, Liliaceae, in the order *Liliflorae*, was one of the widely distributed families of flowering plants. It consisted of over 250 genera comprising 3700 species, mostly perennial herbs with rhizomes or bulbs (Hutchinson, 1973). When Dahlgren and Clifford (1982) made a major revision of superorders, orders and families within the monocotyledons, this family was sub-divided into several other families. Accordingly, most of the genera earlier classified in the family Liliaceae, except for the cultivated genera such as *Lilium* and *Fritillaria*, are now classified under other smaller and more homogenous families such as the Asparagaceae, Alliaceae, Asphodelaceae, Dracaenaceae, Eriospemaceae and Hyacinthaceae. According to Dahlgren & Clifford (1982), the family Asphodelaceae (which was previously

included in the Liliaceae in the wider sense) comprised three sub-families namely Astelioideae, Asphodeloideae and Anthericoideae with the following genera.

Astelioideae: *Astelia*, *Cohnia*, *Cordyline* and *Milligania*;

Asphodeloideae: *Aloe*, *Alectorurus*, *Aprica* (*Astroloba*), *Asphodeline*, *Asphodelus*, *Bulbine*, *Bulbinella*, *Bulbinopsis*, *Chamaealoe*, *Chortolirion*, *Eremurus*, *Gasteria*, *Glyphosperma*, *Haworthia*, *Kniphofia*, *Lomatophyllum*, *Trachyandra* and *Verinea*

Anthericoideae: *Agrostocrinum*, *Alania*, *Anthericum*, *Arnocrinum*, *Dasystachys*, *Debesia*, *Dichopogon*, *Diuranthera*, *Paradisica*, *Simethis*, *Tricoryne*, *Verdickia*, etc.

Later Dahlgren, Clifford and Yeo (1985), raised the Anthericoideae and Astelioideae to separate families Anthericaceae and Asteliaceae respectively. These authors kept the family Asphodelaceae comprising the Asphodeloideae and the newly defined sub-family Aloioideae. Accordingly, the genera *Asphodeline*, *Asphodelus*, *Bulbine*, *Bulbinella*, *Eremurus*, *Hemiphylacus*, *Jodrellia*, *Kniphofia*, *Paradisica*, *Simethis* and *Trachyandra* are placed in the Asphodeloideae while the genera *Aloe*, *Gasteria*, *Haworthia*, *Lomatophyllum* and *Poellnitzia* are placed in the Aloioideae.

More recently Mabberley (1987) and Brummit (1992) raised the above two distinct sub-groups to the families Asphodelaceae and Aloaceae respectively. This viewpoint seems to enjoy universal acceptance at present.

3. THE GENUS ALOE

This genus consists of more than 360 species distributed mainly in Tropical Africa, Madagascar and Southern Arabia (Mabberley, 1987) and includes herbs, shrubs and trees. The leaves are fleshy, strongly cuticularized and are usually prickly at the margins. The flowers are of various colours, white, yellow, pink, greenish and red.

Aloe L. (1753); Berger (1908).

Perennial leaf succulents, sometimes developing into shrubs or even trees. Roots thick, rarely fusiform, usually bright yellow. Stems often \pm hidden, very fibrous, rarely with well-developed secondary thickening. Leaves usually crowded into rosette, less often more widely spaced along stem, amplexicaul with thin basal sheath, sublinear to ovate, very fleshy, glabrous, often marked with pale spots, upper surface often canaliculate; margin usually armed with sharp horny teeth. Inflorescence an axillary, very rarely terminal, raceme occasionally simple, usually branched. Flowers 1 in each bract and pedicel never articulated. Perianth usually very fleshy, slightly zygomorphic, 6-lobed, glabrous or hairy. Stamens 6, free for most of length, exerted at anthesis; anthers linear to oblong. Ovary superior, ovules numerous; style longer than stamens; stigma lobes capitate. Fruit a loculicidal capsule, papery or slightly woody when mature. Seeds irregularly 3-sided to flattened, narrowly to broadly winged.

3.1 Aloes of North East Africa

Table 1. Check list of *Aloe* species of North East Africa.

Species Name	ETH	ERT	SOM	DJI	SUD	EAF	ARA
<i>Aloe adigratana</i> Reynolds	+	+	-	-	-	-	-
<i>Aloe albovesita</i> S. Carter & Brandham	-	-	+	+	-	-	-
<i>Aloe ambigens</i> Chiovenda	-	-	+	-	-	-	-
<i>Aloe ankoberensis</i> Gilbert & Sebsebe (in ed.)	+	*	-	-	-	-	-
<i>Aloe bargalensis</i> Lavranos & S. Carter	-	-	+	-	-	-	-
<i>Aloe bella</i> G. Rowley	-	-	+	-	-	-	-
<i>Aloe breviscapa</i> Reynolds & Bally	-	-	+	-	-	-	-
<i>Aloe brunneostriata</i> Lavranos & S. Carter	-	-	+	-	-	-	-
<i>Aloe calidophila</i> Reynolds	+	-	-	-	-	+	K
<i>Aloe camperi</i> Schweinfurth	+	+	-	-	-	-	-
<i>Aloe canarina</i> S. Carter	-	-	-	-	?+	+	U
<i>Aloe citrina</i> S. Carter & Brandham	+	-	+	-	-	+	K
<i>Aloe crassipes</i> Baker	-	-	-	-	+	-	-
<i>Aloe cremnophila</i> Reynolds & Bally	-	-	+	-	-	-	-
<i>Aloe debrana</i> Christian	+	*	-	-	-	-	-
<i>Aloe elegans</i> Todaro	+	+	-	-	-	-	-
<i>Aloe ellenbeckii</i> Berger	+	-	+	-	-	+	K
<i>Aloe emimens</i> Reynolds & Bally	-	-	+	-	-	-	-
<i>Aloe erensii</i> Christian	-	-	-	-	+	+	K
<i>Aloe eumassawana</i> S. Carter, Gilbert & Sebsebe (in ed.)	-	+	-	-	-	-	-
<i>Aloe gilbertii</i> Sebsebe & Brandham	+	*	-	-	-	-	-
<i>Aloe gillettii</i> S. Carter	-	-	+	-	-	-	-
<i>Aloe glabrescens</i> (Reynolds Bally) S. Carter & Brandham	-	-	+	-	-	-	-
<i>Aloe gracilicaulis</i> Reynolds & Bally	-	-	+	-	-	-	-
<i>Aloe grisea</i> S. Carter & Brandham	-	-	+	+	-	-	-
<i>Aloe heliuderana</i> Lavranos	-	-	+	-	-	-	-
<i>Aloe hartana</i> Reynolds	+	*	-	-	-	-	-
<i>Aloe henmingii</i> Reynolds	-	-	+	-	-	-	-
<i>Aloe hildebrandtii</i> Baker	-	-	+	-	-	-	-
<i>Aloe jacksonii</i> Reynolds	+	*	-	-	-	-	-
<i>Aloe jucunda</i> Reynolds	-	-	+	-	-	-	-
<i>Aloe kafaensis</i> Gilbert & Sebsebe (in ed.)	+	*	-	-	-	-	-
<i>Aloe labworana</i> (Reynolds) S. Carter	-	-	-	-	+	+	U
<i>Aloe lateritia</i> Engler	+	-	-	-	-	+	KT
<i>Aloe luntii</i> Baker	-	-	+	-	-	-	+
<i>Aloe macleayi</i> Reynolds	-	-	-	-	+	-	-
<i>Aloe macrocarpa</i> Todaro	+	+	+	-	+	-	-
<i>Aloe mcloughlinii</i> Christian	+	*	-	-	-	-	-
<i>Aloe medishiana</i> Reynolds & Bally	-	-	+	-	-	-	-
<i>Aloe megalacantha</i> Baker	+	-	+	-	-	-	-
<i>Aloe microdonta</i> Chiovenda	-	-	+	-	-	-	-
<i>Aloe molederana</i> Lavranos & Glen	-	-	+	-	-	-	-
<i>Aloe monticola</i> Reynolds	+	*	-	-	-	-	-
<i>Aloe officinalis</i> Forsskål	-	-	+	-	-	-	-
<i>Aloe otallensis</i> Baker	+	*	-	-	-	-	-
<i>Aloe parvidens</i> Gilbert & Sebsebe	+	-	+	-	-	+	K,T
<i>Aloe peckii</i> Bally & Verdoorn	-	-	+	-	-	-	-
<i>Aloe percassa</i> Todaro	+	+	-	-	-	-	-
<i>Aloe pirotae</i> Berger	+	*	-	-	-	-	-
<i>Aloe pubescens</i> Reynolds	+	*	-	-	-	-	-
<i>Aloe pulcherrima</i> Gilbert & Sebsebe (in ed.)	+	*	-	-	-	-	-
<i>Aloe rabaiensis</i> Rendle	-	-	+	-	-	-	-
<i>Aloe retrospicans</i> Reynolds	+	-	+	-	-	-	-
<i>Aloe rigens</i> Reynolds & Bally	-	-	+	-	-	-	-
<i>Aloe rivae</i> Baker	+	-	-	-	-	+	K

<i>Aloe rugosifolia</i> Gilbert & Sebsebe	+	-	-	-	-	+ ^K	-
<i>Aloe ruspoliiana</i> Baker	+	-	+	-	-	+ ^K	-
<i>Aloe schelpei</i> Reynolds	+*	-	-	-	-	-	-
<i>Aloe schoelleri</i> Schweinfurth	-	+*	-	-	-	-	-
<i>Aloe schweinfurthii</i> Baker	-	-	-	-	+	+ ^U	-
<i>Aloe scobinifolia</i> Reynolds & Bally	-	-	+*	-	-	-	-
<i>Aloe secundiflora</i> Engler	+	-	-	-	+	+ ^{K, T}	-
<i>Aloe sinana</i> Reynolds	+*	-	-	-	-	-	-
<i>Aloe sinkana</i> Reynolds	-	-	-	-	+*	-	-
<i>Aloe somaliensis</i> Watson	-	-	+*	-	-	-	-
<i>Aloe steudneri</i> Schweinfurth	+*	-	-	-	-	-	-
<i>Aloe tewoldei</i> Gilbert & Sebsebe (in ed.)	+*	-	-	-	-	-	-
<i>Aloe tororoana</i> Reynolds	-	-	-	-	+	+ ^U	-
<i>Aloe trichosanta</i> Berger	+	+	-	-	?+	-	-
<i>Aloe trigonantha</i> Leach	+*	-	-	-	-	-	-
<i>Aloe turkanensis</i> Christian	-	-	-	-	+	+ ^K	-
<i>Aloe tweediae</i> Christian	-	-	-	-	+	+ ^{K, U}	-
<i>Aloe vituensis</i> Baker	?+	-	-	-	-	+ ^K	-
<i>Aloe yavellana</i> Reynolds	+*	-	-	-	-	-	-
<i>Aloe wrefordii</i> Reynolds	-	-	-	-	+	+ ^U	-

ETH (Ethiopia), ERT (Eritrea), SOM (Somalia), DJI (Djibouti), SUD (Sudan), EAF (East Africa, K = Kenya, T = Tanzania, U = Uganda), ARA (Arabia). + presence, - absence, +* endemism.

3.2 Descriptions of some species of Aloe of North East Africa

There are about 75 species in NE Africa (Table 1). Of these, 36 species with 18 endemics occur in Ethiopia, 8 species with 2 endemics occur in Eritrea, 32 species with 22 endemics occur in Somalia, 2 species occur in Djibouti and 14 species with 2 endemics occur in the Sudan (Carter 1994; Lavranos, 1995; Sebsebe Demissew and Gilbert, in press). In this monograph taxonomic descriptions (habit, leaf and inflorescence characters), ecology and distribution of 12 endemic or near-endemic species of Ethiopia, which have also been investigated chemically, are given.

A. debrana Christian (1947: Pl 1016). **Type:** McLoughlin 812A live plant collected from Ethiopia, Shewa, Debre Berhan, cultivated in Pretoria, Specimens preserved under PRE 27173 (PRE, holo.)

A. berhana Reynolds (1957: 5). **Type:** Ethiopia, Shewa, 9 km SW of Debre Berhan (9°40'N 39°40'E), Reynolds 8135 (PRE, holo. not seen; K, iso.).

Habit: Herb, suckering from base to form small groups, mostly stemless but some old plants developing thick, prostrate stems. It grows in gardens with ease and multiplies readily. **Leaves:** in very dense rosette, spreading-recurved, 25-60 x 7.5-15 cm, dull green, old leaves drying brown; marginal teeth 7-10(-14) per 10 cm, 2-4 mm long, red tipped. **Inflorescence:** 1 m high, compoundly branched with 8-15 racemes, which are capitate to cylindrical, 6-15 cm long, lax or dense, 4-9 flowers per cm. Bracts ovate, 3-6.5(-8.5) x 1.5-3 mm. Pedicels 10-13(-16 in fruit) mm long. Perianth cylindrical, 24-30 mm long, 5-6 mm wide pressed; outer lobes free for 6-10 mm.

Ecology: Common in areas of grassland on thin soil overlying basalt, usually on gentle slopes occurring between altitudes of 2000-2670 m. **Distribution:** Endemic to Shewa and Wello provinces, central Ethiopia.

A. calidophila Reynolds (1954: 26). **Type:** Ethiopia, Sidamo, Dida Cheena Plains, 49 miles WNW of Moyale on road to Mega, *Reynolds* 7029 (PRE, holo. not seen, K, iso).

Habit: Succulent shrub, stems 1-1.5 m, erect or basally decumbent. **Leaves:** crowded, 60-80 x 16 cm, spreading with recurved tip, deeply canaliculate, uniformly dull green to grey-green; margin with ca. 5 spines per 10 cm, spines 3-5 mm high, dull white. **Inflorescence:** branched with up to 20 cylindrical racemes, 5.5-24 cm long, densely flowered with 6-7 flowers per cm. Bracts ovate, 3-5 x 1.5-2 mm, scarious. Pedicels 10-15 mm long, extending to 22 mm in fruit. Perianth clavate, 17-22 mm long, widest part 6-7 mm when pressed, scarlet turning orange towards throat; outer segments free for 8-10 mm.

Ecology: *Acacia-Commiphora* woodland or open wooded grassland occurring between altitudes of 1280-1620 m. **Distribution:** Gamo Gofa and Sidamo provinces (Ethiopia) and N. Kenya.

A. camperi Schweinfurth (1894: 67). **Types:** Eritrea, Ghinda, *Schweinfurth* 514a & Asmara, *Schweinfurth* 605 & Arbashiko, *Schweinfurth* 668 & Gheleb, *Schweinfurth* 1074 & Acrur, *Schweinfurth* 1342, 1306 (B, syn. not seen).

Habit: succulent shrub, stems erect or ascending, 0.5-1 m long, 6-10 cm thick. **Leaves:** crowded, 40-60 x 5.5-8(-12) cm, recurved, canaliculate, dark green or brownish, often spotted especially towards base, margin with 6-7 spines per 10 cm, spines 3-5 mm high, brown tipped. **Inflorescence:** branched with 2-6 cylindrical racemes, 3-14 cm long, dense, 8-12 flowers per cm. Bracts triangular-ovate, 2-3(-5) x 1-2 mm. Pedicels 12-25 mm long. Perianth clavate, 18-22 cm long, 3-4 mm wide near base, 7-8 mm at widest point, yellow, orange or scarlet, outer segments free for 7-8 mm.

Ecology: abundant on rocky slopes and sandy alluvial plains along eastern escarpment occurring between altitudes of 550-2700 m. **Distribution:** Tigray and Welo provinces (Ethiopia) and Eritrea.

A. elegans Todaro (1882: 25, t.29). **Lectotype:** Tab. 6620 in Bot. Mag. 108 (1882) drawn from plant of Ethiopian origin, perhaps grown from seed sent by *Schimper* c 1870.

Habit: succulent herb, rarely developing decumbent stem to 30 cm long, solitary or forming small groups. **Leaves:** dense, 16-20 (-30) per rosette, up to 60 x 15-18 cm, usually incurved, grey- to bluish-green, sometimes obscurely spotted near base, slightly canaliculate towards tip; marginal spines 4-7(-9) per 10 cm, 2-3(-4) mm high, brownish-red.

Inflorescences: with 3-11 racemes, which are subcapitate to cylindrical, 5-15 cm long, dense (10 or more flowers per cm). Bracts ovate, 7-12(-15) x 2.5-4 mm, acuminate. Pedicel 10-20 mm long. Young buds horizontal to slightly reflexed. Perianth subclavate, 21-26 mm long, yellow, orange or scarlet; outer segments free for 7-13 mm.

Ecology: rocky slopes, mostly on sandstone or limestone, in areas of evergreen bushland or wooded grassland occurring between altitudes of 1500-2400 m. **Distribution:** Known from Tigray, Gojam, Shewa and Harerge provinces (Ethiopia) and Eritrea.

A. gilbertii Reynolds ex Sebsebe & Brandham: (1992: 509). **Type:** Ethiopia, Sidamo Region, Alamura Hill, c 4 km S of turning for Awassa on main Addis Abeba - Dilla road, *Gilbert*, *Sebsebe D.* & *Ermias D.* 9307 (ETH holo; K, UPS iso.).

Habit: usually a succulent shrub, stem erect to 1-1.5 m long, occasionally ± stemless. **Leaves:** crowded, 40-60 x 9-11 cm, canaliculate, recurved towards tip, dark green or glaucous,

often flushed brown or mauve above and below; marginal teeth 7-10 per 10 cm, 3-5 mm high, tips brown.

Inflorescence: up to 1.2 m high, compoundly branched with 15-25 cylindrical racemes, 6-15 cm long, lax, 2-5 flowers per cm. Bracts ovate, acute, 4-6 x 2-3 mm. Pedicels 9-10 mm long. Perianth cylindrical to sub-clavate, trigonously indented, 23-27 mm long, 4.5-8 mm wide when pressed, orange to red; outer segments free for 8-11 mm.

Ecology: *Acacia* woodland, often found in hedges and along field margins occurring between altitudes of 1300-1900 m. **Distribution:** Endemic to Ethiopia, in Shewa, Gamo Gofa and Sidamo provinces.

A. lateritia Engler (1895: 140). **Type:** Tanzania, Moshi District, Rombo, Volkens 404 (B holo.; BM iso.).

A. lateritia Engl. var. *graminicola* (Reynolds) S. Carter (1994); *A. graminicola* Reynolds (1953: 9). **Type:** Kenya, Nyeri District, 13 km s of Nanyuki, Reynolds 6576 (PRE hol.; EA, K iso.).

Habit: rosettes stemless, rarely with a short erect stems, solitary or forming small groups.

Leaves: 20-60 x 5-10 cm, very soft, green, usually with numerous whitish spots, always with distinct darker longitudinal lines; marginal teeth 8-10 per 10 cm, 3-5 mm long, tipped with brown.

Inflorescence: erect, up to 1.25 m high, with 3-7 lax to capitate racemes, 4-22 cm long. Bracts 6-20 x 4 mm. Fruiting pedicels 11-45 mm long. Perianth 25-35 mm long, with a distinct \pm globose basal swelling 4.5-7 mm wide when pressed, red with paler margins to lobes, very rarely yellow; outer lobes free for 5-6 mm. Capsule cylindrical to ellipsoidal, 25-30 x 12-15 mm.

Ecology: open grassland, deciduous woodland c. 1500 m. **Distribution:** Known from Sidamo province (Ethiopia), Kenya and Tanzania.

A. macrocarpa Todaro (1876: 36, t.9). **Type:** T. 9 of protologue based on material of Ethiopian origin, apparently sent as seed by *Schimper* in 1870 and thus probably originally from Tigray Region.

Habit: rosettes stemless, rarely developing short erect stems in shaded sites, solitary or forming small groups.

Leaves: 16-20, 10-35 x 3-12 cm, very soft, green, usually with numerous pale spots, always with distinct darker longitudinal lines; marginal teeth 10-24 (-40) per 10 cm, 2-3 mm high, tipped with brown.

Inflorescence: erect, up to 1.5 m high, with (1-)3-5(-7) lax to capitate racemes, 2-22 cm long. Bracts 6-20 x 2-4 mm. Fruiting pedicels 11-45 mm long. Perianth 19-30(-35) mm long, with a distinct \pm globose basal swelling 5-7 mm wide when pressed abruptly constricted, red with paler margins to lobes, very rarely yellow; outer lobes free for 5-6 mm. Capsule cylindrical to ellipsoidal, 22-40 x 12-15 mm.

Ecology: open grassland, often between evergreen thickets, on rocky slopes to level areas with darker soil occurring between altitudes of 1400-2200(-3000) m. **Distribution:** Known from Shewa, Arsi and Harerge provinces (Ethiopia), Eritrea, Somalia and from Sudan as far west to Dahomey.

A. megalacantha Baker (1898: 469). **Type:** Ethiopia, Ogaden, Milmil, *Ruspoli & Riva* 905 (FT, holo.).

Habit: succulent shrub, with stems 0.5-2 m high. **Leaves:** crowded, 60-80 x 13-15 cm, deeply canaliculate recurved, dull light green to bluish green, marginal spines 5-7 per 10 cm, 4-6 mm high, pinkish- to reddish-brown.

Inflorescence: 0.5-1 m high, with 6-13 racemes. Racemes cylindrical to conical, 5-14 cm long, lax or dense. Bracts triangular ovate, 5-12 x 2-4 mm. Pedicels (8-)10-15(-17 in fruit) mm long. Perianth cylindrical-triangular, 23-30 mm long, 4-7 mm wide, yellow orange or scarlet; outer segments free for 10-14 mm.

Ecology: on rocky hillsides and sandy alluvial plains in open *Acacia -Commiphora -Balanites* bushland; frequently planted on graves occurring between altitudes of 1100-1850 m.

Distribution: Known from Bale and Harerge provinces (Ethiopia) and northern Somalia.

A. pubescens Reynolds (1957: 10). **Type:** Ethiopia, Shewa, 16 km N of Shashemene, by old bridge along stream crossing main Addis Abeba road just S of Arsi Negele, *Reynolds 8144* (PRE, holo. not seen; K, iso.).

Habit: Rosettes stemless, usually suckering freely to form groups. **Leaves:** *c* 16, 35-45 x 6-13 cm, suberect with slightly recurved tips, grey green without markings except for seedling plants; marginal teeth 8-11 per 10 cm, 2-3.5 mm long, upper half reddish brown.

Inflorescence: 0.7-1.5 m high with 1-3 racemes, 20-35 cm long. Racemes cylindrical to conical, dense. Bracts ovate-triangular, 15-21 x 6-14 mm, acute. Pedicels 12-20 mm long. Perianth 33-40 mm long, 4-5 mm wide, minutely pubescent, pink; outer lobes free for *ca.* 12 mm. Capsule 21 x 7.5 mm, ellipsoidal. Seeds \pm blackish, 3-angled, 5 mm long, terminal wing 1.2 mm wide, densely dark-veined.

Ecology: growing along rocky banks of stream, general area with remnants of *Podocarpus* forest and along field margins occurring between altitudes of 1800-25500 m. **Distribution:** Endemic to Ethiopia and known only from Shewa and Harerge provinces.

A. pulcherrima Gilbert & Sebebe (in ed.). **Type:** Ethiopia, Shewa, 17 km from Addis Abeba along road to NE towards Debra Berhan and Dessie, *M. & S. Gilbert 1669* (K holo.; ETH, iso.).

Habit: prostrate or pendent shrub, mostly unbranched, stem to 1 m long, *c* 8 cm thick, sometimes branching dichotomously at apex within leaf rosette, especially when cultivated. Our observation of this plant in the garden for many years shows that it does not multiply itself with ease.

Leaves: 35-50 in dense rosette, arcuate, up to 50 x 12 cm, pale blue-green, slightly glaucous, with fine but distinct longitudinal lines and, especially in dry season, red margin; marginal teeth almost obsolete, up to 3 per 10 cm, 0.2-0.3 mm high, hardly visible; sap turning purple, as do old leaves. The beauty of this endemic species is accentuated by the lack of spines and by the color and shapes of its leaves. **Inflorescence:** at first descending then ascending so as to be \pm U-shaped, branched with 3-6(-11) erect racemes, racemes 12-28 cm long, lax (3-5 flowers per cm). Bracts ovate, 8-9(-15) x 7-8 mm, acuminate, rather fleshy. Pedicels 8-12 mm long. Perianth cylindrical, 32-33 mm long, 6-8.5 mm wide pressed, red; outer lobes free for *c* 20 mm.

Ecology: steep basalt slopes or cliffs with sparse cover of evergreen bushland occurring between altitudes of 2480-2700 m. **Distribution:** Endemic to central Ethiopia, Shewa province.

A. rivae Baker (1898: 465). **Types:** Ethiopia, Sidamo Region, Gobbo Duaya (between Coromma, (5°31'N 38°14'E), and Burgi, (5°23'N 37°50'E), *Ruspoli & Riva 1509* (B, syn.;

K, fragm. of syn.; FT, isosyn.) & near Coromma, *Ruspoli & Riva* 1766 (?B, syn. not seen; FT, isosyn.).

Habit: rosettes usually stemless, sometimes with procumbent to ascending stem to 60 cm, solitary or in small groups. **Leaves:** ca. 20, 40-60 x 9-13.5(-17) cm, ascending, incurved to slightly reflexed, dull olive to brownish-green flushed red towards margins; marginal teeth 7-14 per 10 cm, 3.5-4 mm long, with minute brown tip.

Inflorescence: 60-70 cm high, many branched, conical, with up to 50 cylindrical racemes, (10-)15-20 cm long, lax. Bracts ovate 3-4.5 x 3-3.5 mm. Pedicels 7-12 mm long. Perianth cylindrical-trigonous with truncate base, 24-32 mm long, 9.5-10.5 mm wide near base when pressed, scarlet, rarely yellow; outer lobes free for 6-10 mm. Capsule 18-20 mm long.

Ecology: margins of deciduous woodland and *Juniperus* forest, sometimes on rock outcrops occurring between 1365-2000 m. **Distribution:** Known from Shewa and Sidamo provinces (Ethiopia) and northern Kenya.

A. secundiflora Engler (1895: 140). **Type:** Tanzania, Volkens 530 (B, holo; K photo of holo.).

Habit: rosettes stemless or nearly so, usually solitary. **Leaves:** ca. 20, 35-45 x 8-14 cm, suberect with recurving tips, dark green, slightly glossy, sometimes obscurely pale-spotted; marginal teeth 8-10 per 10 cm, 4-5 mm long, dark brown, color sometimes continuous along margin.

Inflorescence: 1-1.5 m high, many spreading branched, lower branches always branching again, with up to 50 racemes, these 12-20 cm long, distinctly 1-sided with flowers all \pm erect, \pm lax. Bracts 2.5-5 x 1.5-2.5(-4) mm. Pedicels 5.5-6(-10) mm long. Perianth cylindrical, 19-23(-28) mm long, c 4.5 mm wide when pressed, pale red minutely flecked with white when alive.

Ecology: open grassland and *Acacia* bushland on well drained soils occurring between altitudes of 1350-1550 m. **Distribution:** known from Gamo Gofa and Sidamo provinces (Ethiopia), southern Sudan, Kenya and Tanzania.

A. sinana Reynolds (1957: 3). **Type:** Ethiopia, Shewa, 18 km NE of Debra Sina (9°54'N 39°50'E), *Reynolds* 8126 (PRE, holo. not seen; EA, K, iso.).

Habit: succulent shrub, stems 1-2 m long, sprawling or ascending. **Leaves:** \pm crowded, 40-60 x 10-15 cm, canaliculate only towards tip, bluish- to greyish-green, sometimes flushed reddish, with elongated whitish spots on underside and towards base on upper side; marginal teeth 6-7 per 10 cm, 3-4 mm high.

Inflorescence: with 4-6 racemes; racemes subcapitate to cylindrical, 5.5-8.5(-14) cm long, 6-12 flowers per cm. Bracts ovate 7-8 x 2 mm, tip attenuate. Pedicels 18-25(-27 in fruit) mm long. Perianth clavate, 23-27 mm long, 3-4 mm wide near base, 6-7 mm at widest point, orange to pink; outer segments free for 12-13 mm.

Ecology: basaltic slopes in area generally of evergreen *Euclea-Rhus natalensis-Flueggea virosa* bushland occurring between altitudes of 1250-1950 m. **Distribution:** Endemic to Ethiopia and known only from Shewa and Welo provinces.

3.3 Aloes under cultivation in our botanic garden

Due to their robust and drought resistance nature, aloe plants occur widely in many parts of this region. Over the years we have collected aloe plants from various parts of Ethiopia and planted these in the Phytochemical Project Botanical Garden (PPBG), Department of Chemistry, Addis Ababa University. The plants shown below are all growing in this Botanic Garden. Approximately 23 species of Ethiopian *Aloes* and the well known cosmopolitan *Aloe vera* and the rare endemic *Aloe pulcherrima*, are under cultivation.

List of *Aloes* growing in the Phytochemical Project Botanical Garden with voucher and (garden numbers) :

- Aloe calidophila* Reynolds. Locality: Sidamo, Moyale (S220).
- Aloe camperi* Schweinfurth. Locality: Eritrea, Asmara (S250).
- Aloe camperi* Schweinfurth. Locality: Tigray, Maichew (S391).
- Aloe debrana* Christian. Locality: Shewa, 2 km N. of Goha Tsion (S169) (S172).
- Aloe elegans* Todaro, Locality: Shewa, Nile Gorge, 200 km from A.A. (S168).
- Aloe gilbertii*. Locality: Sidamo, Awassa. (S226).
- Aloe macrocarpa* Todaro. Locality: Shewa, Arsi Negele (S317).
- Aloe megalacantha* Baker. Locality: Harar, Asebeteferi (S325).
- Aloe monticola* Reynolds. Locality: Tigray, Maichew (S392).
- Aloe otallensis* . Locality: Sidamo, Yabelo. (S224).
- Aloe parvidens*. Locality: Bale, Sof Omar (S792)
- Aloe pirottiae*. Locality: Sidamo, Yabelo (S772).
- Aloe pubescens* Reynolds. Locality: Sidamo, Arsi Negele (S316).
- Aloe pulcherrima* Gilbert & Sebsebe. Locality: Shewa, Debrelibanos (S673).
- Aloe retrospiciens* Reynolds & Bally. Locality: Bale, Sof Omar (S460).
- Aloe rivae* Baker. Locality: Sidamo, Mega (S321).
- Aloe rugosifolia* Gilbert & Sebsebe. Locality: Sidamo, Borena (S223).
- Aloe ruspoliana*. Locality: Bale, Sof Omar (S791).
- Aloe schelpei* Reynolds. Locality: Shewa, Jemma river (S769).
- Aloe secundiflora* Engler. Locality: Sidamo, Moyale (S219).
- Aloe sinana* Reynolds. Locality: Wello, Senbetae (S462).
- Aloe trichosanta* Burger. Locality: Shewa, near Koka (S318).
- Aloe yavelana* Reynolds Locality: Sidamo, Yabelo (S773).



1A

Aloe debrana. Shewa: ca 120 km from Addis Abeba towards Debre Berhan at 2650 m; photo Sebsebe, 25 Dec. 1988 and 2 km N of Goha Tsion at the summit of the escarpment before descending to the Blue Nile Gorge at 2500 m; photo Sebsebe, 20 June 1989. Plates 1A and 1B showing inflorescence and habit, respectively.



1B



1C

A. calidophila. Sidamo: NE of Yabello ca 495 km from Addis Abeba towards Moyale at 1740 m; photo Sebsebe, 21 Nov. 1994. Plate 1C showing habit.



1D

A. camperi. Wello: 2 km from Kutaber towards Keskes Valley at 2580 m; photo Sebsebe, 1992, Plate 1D showing habit.



2A

A. elegans. Tigray: ca 97 km from Mekele towards Adwa at 2430 m; photo Sebsebe, 25 Oct. 1991. Plate 2A showing habit.

A. gilbertii. Shewa: Between Lake Langano and Arsi Negelle at 1850 m; photo Sebsebe, 18 Nov. 1994. Plate 2B showing habit.



2B



2C

A. macrocarpa. Shewa: Dedeba River, 15 km from Shashemene towards Addis Abeba at 1970 m; photo Sebsebe, 21 Nov. 1994. Plates 2C showing habit and 2D a close up of inflorescence.



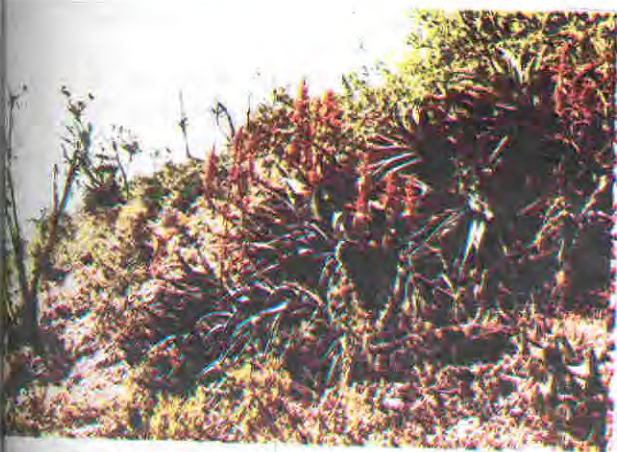


3A

A. megalacantha. Harerge: Near Jijiga at Karamara at 1900 m; photo Sebsebe, 20 April 1989 and 1 km east of Asbe Teferi town, 325 km from Addis abeba towards Harer at 1830 m; photo Sebsebe, 17 April 1989. Plates 3A and 3B respectively showing habit.



3B



3C

A. pulcherrima. Shewa: On hills near Debre Libanos Monastery at 2600 m; photo Sebsebe, 18 June 1995. Plate 3C showing habit.

A. rivae. Sidamo: Mega plateau, north of Mega town towards Yabello at 1950 m; photo Sebsebe, 20 Nov. 1994. Plate 3D showing habit.



3D



4A

A. secundiflora. Sidamo: ca 18 km from Yabello to Mega at 1670 m. Photo Sebsebe, 20 Nov, 1994. Plates 4A showing the habit and 4B close up of inflorescence.



4B



4C

A. sinana. Shewa: Past Debre Sina ca 210 km from Addis Abeba towards Dessie at 1700 m photo Sebsebe, 25 Dec. 1988. Plate 4C showing habitat and 4D habit.



4D

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