Pergamon

0305-1978(95)00063-1

Biochemical Systematics and Ecology, Vol. 23, No. 7/8, pp. 805–808, 1995

0305-1978/95 $9.50+0.00

The Chemotaxonomic Significance of Root Anthraquinones and Pre-anthraquinones in the Genus *Lomatophyllum* (Asphodelaceae)

BEN-ERIK VAN WYK,* ABIY YENESEW† and ERMIAS DAGNE†

*Department of Botany, Rand Afrikaans University, P.O. Box 524, Auckland Park, Johannesburg, 2006, South Africa;

†Department of Chemistry, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia.

Key Word Index—*Lomatophyllum*; Alooideae; Asphodelaceae; roots; anthraquinones; pre-anthraquinones; chemotaxonomy.

Abstract—The roots of seven species of *Lomatophyllum* were analysed by TLC and HPLC for the presence of nine different anthraquinones and pre-anthraquinones which are all known to be characteristic constituents of the subterranean metabolism of *Aloe*. Chrysophanol and asphodelin were detected in all the samples analysed. In addition, the 1-methyl-8-hydroxyanthraquinones aloesaponarin I, aloesaponarin II and laccaic acid D-methyl ester, together with the corresponding pre-anthraquinones were detected in all seven species. The results support the inclusion of *Lomatophyllum* in *Aloe*.

Introduction

Lomatophyllum Willd. comprises 12 species confined to Madagascar, Mauritius and the Aldabra Islands (Smith and van Wyk, 1991). The genus is closely related to the genus *Aloe* and the only known diagnostic character is that the fruits are fleshy at maturity in *Lomatophyllum* while they are capsular in *Aloe*. We here present chemotaxonomic evidence that the close similarity between the two genera is more than just superficial and that *Lomatophyllum* may be no more than a natural section of *Aloe*.

Materials and Methods

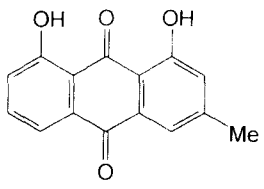
Plant materials. Nine root samples from seven species of *Lomatophylum* were collected from the Johannesburg Botanic Garden (JBG) and from the gardens of the National Botanical Institute, Pretoria (NBI), South Africa. Voucher numbers are indicated in Table 1.

Procedures. Freshly harvested roots were air-dried and powdered. Approximately 1 g of each sample was extracted in acetone and prepared for TLC and HPLC analyses as described previously (van Wyk *et al.* 1994). Compounds were directly compared with authentic reference samples (the same as in Dagne *et al.* 1994), using TLC spot characteristics and R_f values (UV light; 254 and 366 nm), as well as HPLC (R_t values and UV/VIS spectra). Details of the methods used are given elsewhere (van Wyk *et al.* 1994).

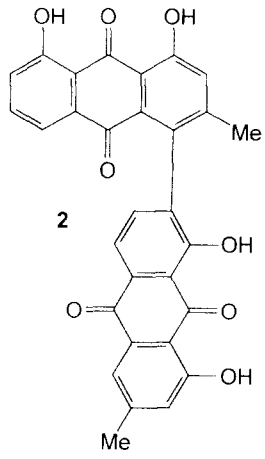
Results and Discussion

The 1,8-dihydroxyanthraquinones chrysophanol (**1**), asphodelin (**2**) and the pre-anthraquinone aloechrysone (**3**), as well as the 1-methyl-8-hydroxyanthraquinones aloesaponarin I (**4**), aloesaponarin II (**5**) and laccaic acid D-methyl ester (**6**), together with the corresponding pre-anthraquinones aloesaponol I (**7**) and aloesaponol II (**8**) have been reported to be characteristic constituents of the roots of *Aloe* species (Dagne *et al.*, 1994). The distribution of these lipophilic anthranoid aglycones in seven *Lomatophyllum* species is presented in Table 1, together with a summary of the main chemical patterns in *Aloe* so that the two genera can be directly compared.

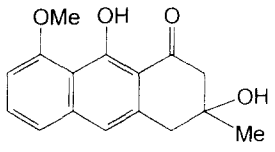
(*Received* 3 *October* 1994; *accepted* 9 *May* 1995)



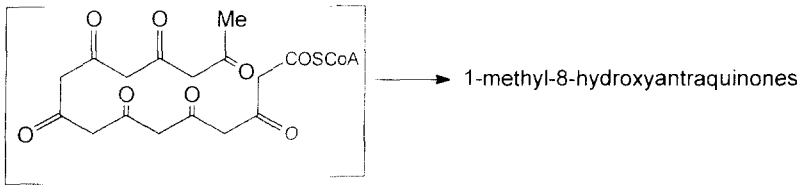
1

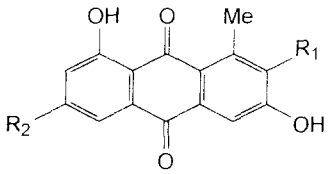


2

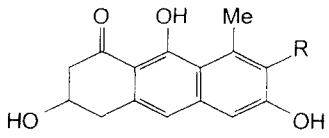


3

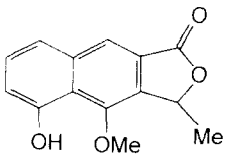




4 $R_1 = CO_2Me$, $R_2 = H$
5 $R_1 = R_2 = H$
6 $R_1 = CO_2Me$, $R_2 = OH$



7 R = H
8 $R = CO_2Me$



9

FIG. 1. STRUCTURES OF ANTHRAQUINONES AND PRE-ANTHRAQUINONES IN *LOMATOPHYLLUM*.

TABLE 1. DISTRIBUTION OF LIPOPHILIC ANTHRANOID AGLYCONES (pre-anthraquinones and anthraquinones) IN ROOTS OF SEVEN SPECIES OF THE GENUS *LOMATOPHYLLUM*, COMPARED WITH THE MAJOR PATTERNS IN *ALOE*

Genera and species	Voucher number/ source	Major compounds (see list below) 1	2	3	4	5	6	7	8	9
Lomatophyllum aldabrense	NBI 19835	+	+	+	−	+	−	+	+	−
L. antsingyense	ex hort. JBG	+	+	−	−	+	+	+	−	
L. lomatophylloides	NBI 31156	+	+	+	+	+	+	+	+	−
	NBI 10854	+	+	−	+	+	+	+	+	−
L. macrum	ex hort. JBG	+	+	+	+	+	+	+	+	−
L. occidentale	NBI 31221	+	+	+	+	+	+	+	+	−
L. purpureum	NBI 19135	+	+	+	+	−	+	+	+	−
	NBI 31155	+	+	+	+	+	+	+	+	−
L. cf. *purpureum*	NBI 17829	+	+	−	+	−	+	+	+	−
Summary of the major patterns in *Aloe* species (see van Wyk *et al.*, 1994):										
A. The common pattern, present in 129 out of 172 species sampled		+	+	±	±	±	±	+	+	−
B. Absence of 1-methyl-8-hydroxyanthraquinone pathway, observed in 43 out of 172 species sampled (series *Mitriformes, Macrifoliae* and other smaller groups, including all tree aloes)		+	+	±	−	−	±	−	−	−
C. Isoeleutherol present (all 16 species of the series *Saponarieae* that were sampled)		+	+	−	±	±	±	+	+	+
D. All nine compounds absent (series *Serrulatae*)		−	−	−	−	−	−	−	−	−

Compounds: **1**, chrysophanol; **2**, asphodeline; **3**, aloechrysone; **4**, aloesaponarin I; **5**, aloesaponarin II; **6**, laccaic acid D-methyl ester; **7**, aloesaponol I; **8**, aloesaponol II; **9**, isoeleutherol.

As in *Aloe*, chrysophanol (**1**) and asphodeline (**2**) were detected in the roots of all the species of *Lomatophyllum*. These compounds appear to be common in most genera of the Asphodelaceae (Rheede Van Oudtshoorn 1964; Beaumont *et al.* 1985; van Wyk *et al.*, 1994). The pre-anthraquinone aloechrysone (**3**) which was reported to occur sporadically in different groups of *Aloe*, was detected in six of the nine samples.

Interestingly, the 1-methyl-8-hydroxyanthraquinone pathway, which was reported to be characteristic of the genus *Aloe*, have now been observed in all the *Lomatophyllum* species included in this study. Such compounds have not been reported in any other genera of the Asphodelaceae. The occurrence of this pathway in both *Aloe* and *Lomatophyllum* is therefore clear evidence of a close affinity between these genera. Investigations of other genera in the subfamily Alooideae (*Astroloba, Chortolirion, Gasteria, Haworthia* and *Poellnitzia*) will shed more light on the chemotaxonomic significance of the subterranean metabolism at the suprageneric level. On the basis of root anthraquinones and pre-anthraquinones, there are larger discontinuities within *Aloe* than between *Aloe* and *Lomatophyllum* and the generic status of the latter can now be seriously questioned.

Acknowledgments—We wish to thank the directors and staff of the Johannesburg Botanic Garden and the National Botanical Institute (NBI) for providing the samples used in this study. Pieter J.D. Winter is thanked for the HPLC analyses. Financial support from the Foundation for Research Development and South African Druggists Ltd. is gratefully acknowledged. A.Yenesew is thankful to B.-E. van Wyk for a research fellowship at RAU.

References

Beaumont, J., Cutler, D. F., Reynolds, T. and Vaughan J. G. (1985) The secretory tissue of aloes and their allies. *Isr. J. Bot.* **34**, 265–282.

Dagne, E., Yenesew, A., Asmellash, S., Demissew, S. and Mavi, S. (1994) Anthraquinones, pre-anthraquinones and isoeleutherol in the roots of *Aloe* species. *Phytochemistry* **35**, 401–406.

Dahlgren, R. M. T., Clifford, H. T. and Yeo, P. F. (1985) *The Families of the Monocotyledons*. Springer-Verlag, Berlin.

Rheede Van Oudtshoorn, M. C. B. (1964) Chemotaxonomic investigations in Asphodeleae and Aloineae (Liliaceae). *Phytochemistry* **3**, 383–390.

Smith, G. F. and van Wyk, B-E. (1991) Generic relationships in the Alooideae (Asphodelaceae). *Taxon* **40**, 557–581.

van Wyk, B-E., Yenesew, A. and Dagne, E. (1994) Chemotaxonomic survey of anthraquinones and pre-anthraquinones in roots of *Aloe* species. *Biochem. Syst. Ecol.* **23**, 267–275.

Yenesew, A., Wondimu, A. and Dagne, E. (1988) A comparative study of anthraquinones in rhizomes of *Kniphofia* species. *Biochem. Syst. Ecol.* **16**, 157-159.