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UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Contributions to the systematics and biocultural value of *Aloe* L. (Asphodelaceae)

by

Olwen Megan Grace BSc, BSc (Hons), MSc (Natal)

Submitted in partial fulfilment of the requirements for the degree

PHILOSOPHIAE DOCTOR

in the Faculty of Natural and Agricultural Sciences (Department of Plant Science)

University of Pretoria

March 2009

Supervised by Prof. Dr. A. E. van Wyk

Co-Supervised by Prof. Dr. G. F. Smith



“I don’t know of any tribe of plants which afford a more pleasing variety than these, for the odd shape of their leaves and manner of spotting, and being some of them covered as it were with pearls.”

(Richard Bradley, *Dictionarium Botanicum* [T. Woodward & J. Peele, London, 1728], cited by Adrian Haworth, [1801] *A new arrangement of the genus Aloe. Transactions of the Linnean Society* 7: 1–28).



DECLARATION

I, Olwen Megan Grace, declare that the thesis which I hereby submit for the degree Philosophiae Doctor at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

A handwritten signature in black ink, appearing to read 'Olwen Megan Grace'.

3 March 2009

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Aloe L. (Asphodelaceae) is a monocotyledonous group of considerable popularity among succulent plant collectors and with a long history of medicinal use. It comprises ca. 500 species occurring throughout Africa, the Arabian Peninsula and western Indian Ocean islands. The first comprehensive ethnobotanical study of *Aloe* (excluding the cultivated *A. vera*) was undertaken using the literature as a surrogate for data gathered by interview methods. Over 1400 use records representing 173 species were collated, the majority (74%) of which described medicinal uses, including species used for natural products. In southern Africa, 53% of approximately 120 *Aloe* species in the region are used for health and wellbeing. Consensus ratios indicated that the uses of *Aloe* spp. for medicine and pest control are of the greatest biocultural importance.

Utility has contributed to the recognition of diversity, taxonomic complexity, and conservation concerns, in *Aloe*. A systematic evaluation of the problematic maculate (spotted) species complex, section *Pictae*, was undertaken. New sequences were acquired of the nuclear ribosomal internal transcribed spacer (ITS), chloroplast *trnL* intron, *trnL-F* spacer and *matK* gene in 29 maculate species of *Aloe*. A well supported monophyletic (holophyletic) maculate group was recovered in phylogenetic trees of comparable topology generated by parsimony analysis and Bayesian inference. A representative of the related section *Paniculatae*, *A. striata*, was recovered in the maculate group, whereas doubtful maculate species with unusual floral morphology (*A. leptosiphon* and *A. suffulta*) comprised a sister

group. Analogous patterns were identified in chemosystematic and comparative morphological studies of 34 and 36 maculate species, respectively, and insights were gained into interspecific relationships. The flavonoids isoorientin and isovitexin, and a new C-glycosylanthrone, 6'-malonylnataloin, were characterised using hyphenated chromatographic techniques and nuclear magnetic resonance (NMR) spectroscopy. Leaf surface sculpturing, stomata and lobes surrounding the epistomatal pore observed under a scanning electron microscope (SEM) are of potential taxonomic significance. Available evidence indicates that floral characters, namely a basally swollen perianth with constriction above the ovary, are of greater significance than maculate leaves as synapomorphies for section *Pictae*. An evolutionary hypothesis for section *Pictae* excludes marginal maculate species with unusual flowers.

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KEYWORDS: *Aloe*, Asphodelaceae, biocultural value, C-glycosylanthrone, consensus analysis, epistomatal pore, ethnobotany, flavonoid, leaf surface, maculate, molecular data, *Paniculatae*, phylogeny, *Pictae*, spotted, stomata, synapomorphy, systematics, taxonomy.



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