

SUMMARY

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

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This thesis focuses on the biocultural value of *Aloe* L. (Asphodelaceae), the influence of utility on taxonomic complexity and conservation concern, and the systematics and phylogeny of section *Pictae*, the spotted or maculate group.

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 gathered, the majority (74%) of which described medicinal uses, including species used for natural products such as *A. ferox* Mill. and *A. perryi* Baker. In southern Africa, 53% of approximately 120 *Aloe* species in the region are used for health and wellbeing. Homogeneity in the literature was quantified using consensus analysis; consensus ratios showed that, overall, uses of *Aloe* spp. for medicine and invertebrate pest control are of the greatest biocultural importance. The rich ethnobotanical history and contemporary value of *Aloe* substantiate the need for conservation to mitigate the risks of exploitation and habitat loss.

A systematic evaluation of the problematic maculate species complex, section *Pictae* Salm-Dyck, was undertaken. In a phylogenetic study, 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*. Parsimony analysis and Bayesian inference (maximum likelihood) were used to generate trees of comparable topology from these and augmented sequence data. A well supported holophyletic (monophyletic) maculate group was recovered. 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. East African maculate species were associated with the single West African maculate species, *A. macrocarpa*. Further geographical trends were evident among ingroup clades.

Analogous patterns were identified in chemosystematic and comparative morphological studies of maculate species, respectively, and insights were gained into interspecific relationships. The flavonoids isoorientin and isovitexin, and a new C-glycosylanthrone, 6'-malonylnataloin, were characterised in *Aloe* for the first time using hyphenated chromatographic techniques and nuclear magnetic resonance (NMR) spectroscopy. 6'-Malonylnataloin is common among East African species in section *Pictae* but is not a convincing "chemotaxonomic marker" for them. Leaf surface features typical of section *Pictae* were identified from scanning electron micrographs of 36 maculate species. Leaf surface sculpturing, stomata and lobes surrounding the epistomatal pore are of potential taxonomic significance, particularly at species level.

Evidence presented here indicates that the current circumscription of section *Pictae* does not reflect evolutionary relationships among maculate species. Importantly, 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 the marginal maculates species with unusual flowers.

CURRICULUM VITAE

Olwen Megan Grace was born in Durban, South Africa in 1977. Her interest in natural history was established during her childhood in the rural outskirts of Hillcrest in KwaZulu-Natal. She matriculated from Hillcrest High School in 1995 and enrolled at the University of Natal in Pietermaritzburg, where she completed her BSc in 1998 and BSc (Hons) *cum laude* in 1999, in the Department of Botany. During a sojourn from her studies in 2000, she joined the Centre for Economic Botany at the Royal Botanic Gardens, Kew to research documented uses of African plants. She returned to the University of Natal and was awarded her MSc *cum laude* in 2002. Her dissertation on the use of bark in traditional healthcare was awarded the Junior Captain Scott Medal from the Suid-Afrikaanse Akademie vir Wetenskap en Kuns, and earned the S₂A₃ Bronze Medal from the Southern African Association for the Advancement of Science. In 2003, she was appointed by the National Botanical Institute at Natal Herbarium to work on medicinal plants and systematics. She returned to the Royal Botanic Gardens, Kew, in 2004, where her work has focused on the sustainable use and conservation of the African flora. Olwen is the author or co-author of about 25 scientific papers, book chapters and popular articles.



APPENDIX A

References to the use of *Aloe* 135

APPENDIX A

References to the uses of *Aloe* spp.

- ABBIW, D. 1990. Useful plants of Ghana: West African uses of wild and cultivated plants. Intermediate Technology Publications, London; Royal Botanic Gardens, Kew.
- ABEBE, D. & AYEHU, A. 1993. Medicinal plants and enigmatic health practices of northern Ethiopia. Dawit Abebe and Ahadu Ayehu, Ethiopia.
- ADAMS, S. P., LEITCH, I. J., BENNETT, M. D., CHASE, M. W. & LEITCH, A. R. 2000. Ribosomal DNA evolution and phylogeny in *Aloe* (Asphodelaceae). *American Journal of Botany* 87: 1578–1583.
- ADAMS, W. M. & HULME, D. 2001. If community conservation is the answer in Africa, what is the question? *Oryx* 35: 193–200.
- ADJANOHOON, E. J. 1987. Médecine traditionnelle et pharmacopée: contribution aux études ethnobotaniques et floristiques au Togo. Agence de Cooperation Culturelle et Technique, Togo.
- ADJANOHOON, E. J. 1993. Médecine traditionnelle et pharmacopée: contribution aux études ethnobotaniques et floristiques au Togo. Agence de Cooperation Culturelle et Technique, Togo.
- AFOLAYAN, A. J., GRIERSON, D. S., KAMBIZI, L., MADAMOMBE, I. & MASIKA, P.J. 2002. In vitro antifungal activity of some South African medicinal plants. *South African Journal of Botany* 68: 72–76.
- AITKEN, R. 2007. Botanical riches: stories of botanical exploration. Linda Humphries, Aldershot.
- AMUSAN, O. O. G., DLAMINI, P. S., MSONTHI, J. D. & MAKHUBU, L. P. 2002. Some herbal remedies from Manzini region of Swaziland. *Journal of Ethnopharmacology* 70: 109–112.
- ANGIOSPERM PHYLOGENY GROUP (APG).1998. An ordinal classification for the families of flowering plants. *Annals of the Missouri Botanical Garden* 85: 531–553.
- ANONYMOUS. 1967. One up on nature. *South African Panorama* 12: 16–18.
- ARNOLD, T. H., PRENTICE, C. A., HAWKER, L. C., SNYMAN, E. E., TOMALIN, M., CROUCH, N. R. & POTTAS-BIRCHER, C. 2002. Medicinal and magical plants of southern Africa: an annotated checklist. Strelitiza 13. National Botanical Institute, Pretoria.
- AWADH ALI, N. A., JÜLICH, W.- D., KUSNICK, C. & LINDEQUIST, U. 2001. Screening of Yemeni medicinal plants for antibacterial and cytotoxic activities. *Journal of*

Ethnopharmacology 74: 173–179.

- BABAC, M.T. & BISBY, F.A. 1984. A chemotaxonomic database. In R. Allkin & F. A. Bisby (eds.). *Databases in Systematics*. Systematics Association Special Volume 26. Pp 209–218. Academic Press, London.
- BAH, S., DIALLO, D., DEMBELE, S. & SEMSTAD PAULSEN, B. 2006. Ethnopharmacological survey of plants used for the treatment of schistosomiasis in Niano District, Mali. *Journal of Ethnopharmacology* 105: 367–399.
- BALLY, P. R. O. 1938. Heil-und giftpflanzen der eingeborenen von Tanganyika. *Repetorium specierum nobarum regni vegetabilis*, Berlin.
- BARNES, J., ANDERSON, L. A. & PHILLIPSON J. D. 2002. *Herbal medicines: a guide for healthcare professionals*. 2nd Edition. Pharmaceutical Press, London.
- BAUER, R. 1998. Quality criteria and standardization of phytopharmaceuticals: can acceptable drug standards be achieved? *Drug Information Journal* 32: 101–110.
- BAYER, M. B. 1975. Some comments on the maculate aloes. *Aloe* 13: 101–102.
- BEAUMONT, J., CUTLER, D. F., REYNOLDS, T. & VAUGHAN, J. G. 1986. Secretory tissues in the East African shrubby aloes. *Botanical Journal of the Linnean Society* 92: 399–403.
- BENTLEY, R. & TRIMEN, H. 1880. *Medicinal Plants*. J. & A. Churchill, London.
- BEPPU, H., KOIKE, T., SHIMPO, K., CHIHARA, T., HOSHINO, M., IDA, C. & KUZUYA, H. 2003. Radical-scavenging effects of *Aloe arborescens* Miller on prevention of pancreatic islet B-cell destruction in rats. *Journal of Ethnopharmacology* 89: 37–45.
- BEPPU, H., SHIMPO, K., CHIHARA, T., KANEKO, T., TAMAI, I., YAMAJI, S., OZAKI, S., KUZUYA, H. & SONODA, S. 2006. Antidiabetic effects of dietary administration of *Aloe arborescens* Miller components on multiple low-dose streptozotocin-induced diabetes in mice: investigation on hypoglycemic action and systemic absorption dynamics of aloe components. *Journal of Ethnopharmacology* 103: 468–477.
- BIRDWOOD, G. C. M. 1865. *Catalogue of the vegetable productions of the presidency of Bombay including a list of the drugs sold in the Bazars of Western India*. 2nd Edition. Education Society's Press, Bombay.
- BISBAY, F. A. 1984. Information services in taxonomy. In R. Allkin & F. A. Bisby (eds.). *Databases in Systematics*. Systematics Association Special Volume 26. Pp. 17–33. Academic Press, London.
- BISRAT, D., DAGNE, E., VAN WYK, B.- E. & VILJOEN, A. 2000. Chromones and anthrones from *Aloe marlothii* and *Aloe ruprestris*. *Phytochemistry* 55: 949–952.
- BLITZKE, T., MASAOUD, M. & SCHMIDT, J. 2001. Constituents of *Aloe rubroviolacea*. *Fitoterapia* 72: 78–79.

- BOND, A. J. 1995. Ethnobotany and land use in Soqotra (Socotra, Sokotra, Suqutra). MSc Thesis, University of Edinburgh, Edinburgh.
- BORNMAN, H. & HARDY, D. 1971. Aloes of the South African veld. Voortrekker Pers, Johannesburg.
- BOULGER, G. S. 1889. The uses of plants: a manual of economic botany. Roper & Drowleg, London.
- BOULOS, L. 1983. Medicinal plants of North Africa. Reference Publications, Algonac.
- BRANDE, W. T. 1839. A dictionary of materia medica and practical pharmacy including a translation of the formulae of the London Pharmacopoeia. John W. Parker, London.
- BRANDHAM, P. E., CARTER, S. & REYNOLDS, T. 1994. A multidisciplinary study of relationships among the cremnophilous aloes of northeastern Africa. *Kew Bulletin* 49: 415–428.
- BRANDHAM, P. E. & DOHERTY, M. J. 1998. Genome size variation in the Aloaceae, an Angiosperm family displaying karyotypic orthoselection. *Annals of Botany Supplement A* 82: 67–83.
- BREDENKAMP, G. J. & VAN VUUREN, D. R. J. 1987. Notes on the occurrence and distribution of *Aloe marlothii* Berger on the Pietersburg Plateau. *South African Journal of Science* 83: 498–499.
- BREEBAART, L., BHIKRAJ, R. & O'CONNOR, T. G. 2002. Impact of goat browsing on *Aloe ferox* in a South African savanna. *African Journal of Range and Forage Science* 19: 77–78.
- BRENAN, J. P. M. 1981. Plants for man – their diversity, codification and exploitation. *International Relations* 7: 1005–1020.
- BROWN, N. E. 1923. The genera of *Aloe* and *Mesembryanthemum* as represented in Thunberg's herbarium. *Bothalia* 1: 139–169.
- BRUCE, W. G. 1974. The origin of Natal aloes. *Aloe* 12: 20–29.
- BRUCE, W. G. G. 1975. Medicinal properties in the *Aloe*. *Excelsa* 5: 57–68.
- BRYANT, A. T. 1909. Zulu medicine and medicine-men. *Annals of the Natal Museum* 2: 1–103.
- BURKILL, I. H. 1935. A dictionary of the economic products of the Malay Peninsula. Crown Agents for the Colonies, London.
- CAVALLINI, A., NATALI, L., CIONINI, G., SASSOLI, O. & CASTORENA-SANCHEZ, I. 1993. In vitro culture of *Aloe barbadensis* Mill.: quantitative DNA variations in regenerated plants. *Plant Science* 91: 223–229.
- CHASE, M. W., DE BRUIJN, A., COX, A., REEVES, G., RUDALL, P. J., JOHNSON, M. A. T. & EGUIARTE L. E. 2000. Phylogenetics of Asphodelaceae (Asparagales): an analysis of plastid *rbcL* and *trnL-F* DNA sequences. *Annals of Botany* 86: 935–951.

- CHAUSER-VOLFSON, E. & GUTTERMAN, Y. 1997. Content and distribution of the secondary phenolic compound homonataloin in *Aloe hereroensis* leaves according to leaf part, position and monthly changes. *Journal of Arid Environments* 37:115–122.
- CHAUSER-VOLFSON, E. & GUTTERMAN, Y. 2004. Influences of leaf pruning on the content of the secondary phenolic metabolites barbaloin, aloeresin and aloenin, in the leaves of *Aloe arborescens*. *South African Journal of Botany*. 70: 582–586.
- CHEN, D., WANG, R., BAO, G., ZHANG, X. & GONG, B. 2005. Effect of the polysaccharide from Fujian *Aloe arborescens* on immune function in the immune inhibited mice. *Journal of Fujian Medical University* 39: 154–155.
- CHESSELET, P., SMITH, G. F., VAN WYK, A. E. 2000. Systematic and evolutionary significance of morphology in the Mesembryanthemaceae: interactive database and illustrated atlas for identification. *Aloe* 37: 46–51.
- CHESSELET, P., VAN WYK, A. E., GRIFFIN, N. & SMITH, G. F. 2003. Patterns of floristic diversity in Mesembryanthemaceae . *Aloe* 40: 80–85.
- COIMBRA, R. 1994. Manual de Fitoterapia. 2nd Edition. Editora Cejup, Belem.
- CONNER, J. M., GRAY, A. I., REYNOLDS, T. & WATERMAN, P. G. 1987. Anthraquinone, anthrone and phenylpyrone components of *Aloe nyeriensis* var. *kedongensis* leaf exudate. *Phytochemistry* 26: 2995–2997.
- CRANE, E. 1976. Honey: a comprehensive survey. Heinemann, London.
- CROUCH, N., SYMMONDS, R., SPRING, A. & DIEDERICHS, N. 2006. Fact sheets for growing popular medicinal plant species. In: Diederichs, N. (ed.). Commercialising Medicinal Plants: a Southern African Guide. Pp. 99–142. Sun Press, Stellenbosch.
- CUNNINGHAM, A. B. 1993. African medicinal plants: setting priorities at the interface between conservation and primary healthcare. People and Plants Working Paper. UNESCO, Paris.
- DAGNE, E., BISLAT, D., VAN WYK, B.- E., VILJOEN, A. M., HELLWIG, V. & STEGLICH, W. 1996. Anthrones from *Aloe microstigma*. *Phytochemistry* 44: 1271–1274.
- DAGNE, E., BISLAT, D., VILJOEN, A. & VAN WYK, B.- E. 2000. Chemistry of *Aloe* species. *Current Organic Chemistry* 4: 1055–1078.
- DAROKAR, M. P., RAI, R., GUPTA, A. K., SHASANY, A. K., RAJKUMAR, S., SUNDARESAN, V. & KHANUJA, S. P. S. 2003. Molecular assessment of germplasm diversity in *Aloe* species using RAPD and AFLP analysis. *Journal of Medicinal and Aromatic Plant Sciences* 25: 354–361.
- DAVIS, R. H., LEITNER, M. G., RUSSO, J. M & BYRNE, M. E. 1989. Wound healing: oral and topical activity of *Aloe vera*. *Journal of the American Podiatric Medical Association* 79: 559–562.

- DE SMET, P. A. G. M. 1998. Overview of herbal quality control. *Drug Information Journal* 3: 3717-724.
- DE WET, A. 1996. Landscaping with aloes. *Aloe* 33: 44-45.
- DER MARDEROSIAN, A., BEUTLER, J. A. 2004. *Aloe*. The Review of Natural Products, Wolters Kluwer Health Inc.
- DLAMINI, B. 1981. Swaziland flora: their local names and uses. Ministry of Agriculture and Co-operatives, Mbabane, Swaziland.
- DOBIE, J. J. 1989. The medicinal plants of Mauritius by Malcy de Chazal 1803-1880. Schoolhouse Gallery, Abbey St. Bathans.
- DOKOSI, O. B. 1998. Herbs of Ghana. Ghana Universities Press, Accra.
- DOLD, T. & COCKS, M. 2000. The intelezi plants of the eastern Cape: traditional and contemporary medicines. *Aloe* 37: 415-448.
- DOLD, T. & COCKS, M. 2001 A succulent herbal - the medicinal and cultural use of some succulent plants traded in the Eastern Cape Province of South Africa. *Cactus and Succulent Journal (U.S.)* 73: 141-145.
- DRAGENDORFF, G. 1898. Die heilpflanzen der verschiedenen völker und zeiten. Verlag von Ferdinand Enke, Stuttgart.
- DRING, J. V., NASH, R. J., ROBERTS, M. F. & REYNOLDS, T. 1984. Hemlock alkaloids in Aloes. Occurrence and distribution of γ -coniceine. *Planta Medica* 50: 442.
- DRUMMOND, R. B., GELFAND, M. & MAVI, S. 1975. Medicinal and other uses of succulents by the Rhodesian African. *Excelsa* 5: 51-56.
- DRURY, H. 1858. The useful plants of India. Asylum Press, Madras.
- DRURY, H. 1873. The useful plants of India: with notices of their chief value in commerce, medicine, and the arts. 2nd Edition. William H. Allen & Co., London.
- DUKE, J. A., BOGENSCHUTZ-GODWIN, M. J., DUCCELLIER, J. & DUKE, P.- A. K. 2002. Hand of medicinal herbs. 2nd Edition. CRC Press, Boca Raton.
- DUNCAN, J., HOFFMANN, T., ROHDE, R., POWELL, E. & HENDRICKS, H. 2006. Long-term population changes in the giant quiver tree, *Aloe pillansii* in the Richtersveld, South Africa. *Vegetatio* 185: 73-84.
- DUONG, N. V. 1993. Medicinal plants of Vietnam, Cambodia and Laos. Ngyen Van Duong, Cambodia.
- DURI, L., MORELLI, C. F., CRIPPA, S. & SPERANZA, G. 2004. 6-Phenylpyrones and 5-methylchromones from Kenya aloe. *Fitoterapia* 75: 520-522.
- EBADI, M. 2002. Pharmacodynamic basis of herbal medicine. CRC Press, Boca Raton.
- EGGLI, U. 1985. A bibliography of succulent plant periodicals. *Bradleya* 3: 103-119.

- EL GHAZALI, G. E. B. 1986. Medicinal plants of the Sudan. Part 1: Medicinal plants of Erkowit. National Council for Research, Khartoum.
- ELSOHLY, M. A., GUL, W. & MURPHY, T. P. 2004. Analysis of the anthraquinones aloemodin and aloin by gas chromatography/ mass spectrometry. *International Immunopharmacology* 4: 1739–1744.
- FAO. 1988. Traditional food plants. FAO Food and Nutritional Paper 42. FAO, Rome.
- FAROOQI, M. I. H. 1998. Medicinal plants in the traditions of Prophet Muhammad. Medicinal, Aromatic and Food Plants Mentioned in the Traditions of Prophet Muhammad (SAAS). Sidrah, Lucknow.
- FIELD MUSEUM OF NATURAL HISTORY, CHICAGO. 1915. *Publications of the Field Museum of Natural History. Anthropological Series* 15: 480–481.
- FLÜCKIGER, F. A. 1891. Pharmakognosie des pflanzenreiches. Gaertner's Verlagsbuchhandlung, Berlin.
- FODEN, W., MIDGLEY, G. F., HUGHES, G., BOND, W. J., THUILLER, W., HOFFMAN, M. T., KALEME, P., UNDERHILL, L. G., REBELO, A. & HANNAH, L. 2007. A changing climate is eroding the geographical range of the Namib desert tree *Aloe* through population declines and dispersal lags. *Diversity and Distributions* 13: 645–653.
- FOWLER, D. G. 2007. Some Zambian plants: their vernacular names and uses. Royal Botanic Gardens, Kew.
- GAO, B., YAO, C., ZHOU, J., CHEN, R. & FANG, W. 2006. Active constituents from *Aloe arborescens* as BACE inhibitors. *Acta Pharmaceutica Sinica* 41: 1000–1003.
- GELFAND, M., DRUMMOND, R. B., MAVI, S. & NDEMERA, B. 1985. The traditional medical practitioner in Zimbabwe: his principles of practice and pharmacopoeia. Mambo Press, Harare.
- GHAZANFAR, S. A. 1994. Hand of Arabian Medicinal plants. CRC Press, Boca Raton.
- GILL, S. 1992. Ethnomedical uses of plants in Nigeria. Uniben Press, Benin City.
- GILLET, J. B. 1967. The identification of Aloes in East Africa. *Journal of the East African Natural History Society* 26: 65–73.
- GITHENS, T. S. 1979. Drug plants of Africa. University of Pennsylvania Press, Philadelphia.
- GLEN, H. F., SMITH, G. F., BREUER, I., STEYN, E. & ARCHER, C., MANNING, J., WILLIAMSON, E., VAN JAARVELD, E. & MEYER, N. L. 2003. Asphodelaceae. In G. Germishuizen & N. L. Meyer (eds.). Plants of Southern Africa: an annotated checklist. *Strelitzia* 14. South African National Botanical Institute, Pretoria.
- GLEN, H. F. & HARDY, D. S. 2000. Flora of Southern Africa. Volume 5, Part 1, Fascicle 1: Aloaceae (first part): *Aloe*. National Botanical Institute, Pretoria.

- GRAYER, R. J., CHASE, M. W. & SIMMONDS, M. S. J. 1999. A comparison between chemical and molecular characters for the determination of phylogenetic relationships among plant families: An appreciation of Hegnauer's *Chemotaxonomie der Pflanzen*. *Biochemical Systematics and Ecology* 27: 369–393.
- GREENISH, H. G. 1929. A text of materia medica. 5th Edition. J & A Churchill, London.
- GRIME, W. E. 1976. Botany of the Black Americans. Scholarly Press, St. Claire Shores, Michigan.
- GRINDLAY, D. & REYNOLDS, T. 1986. The *Aloe vera* phenomenon: a review of the properties and modern uses of the leaf parenchyma gel. *Journal of Ethnopharmacology* 16: 117–151.
- GROENEWALD, E. G., WESSELS, D. C. J. & KOELEMEN, A. 1976. Embryoid formation in callus cultures of *Aloe pretoriensis* Pole Evans. *South African Journal of Science* 72: 89–90.
- GROENEWALD, E. G., WESSELS, D. C. J. & KOELEMEN, A. 1976. Die gebruik van weefselkulture vir die voorplanting en moontlike hibridisasie van aalwyne en ander naverwante plantsoorte. *Aloe* 14: 52–58.
- GROENWALD, E. G., KOELEMEN, A. & WESSELS, D. C. J. 1979. The use of tissue cultures in the propagation and possible hybridization of aloes and related plants. *Aloe* 17: 37–40
- GROOM, Q. J. & REYNOLDS, T. 1987. Barbaloin in *Aloe* species. *Planta Medica* 53: 345–348.
- GURIB-FAKIM, A. & BRENDLER, T. 2004. Medicinal and aromatic plants of Indian Ocean Islands. Medpharm, Stuttgart.
- GUTTERMAN, Y. & CHAUSER-VOLFSON, E. 2000. Peripheral defence strategy: variation of barbaloin content in the succulent leaf parts of *Aloe arborescens* Miller (Liliaceae). *Botanical Journal of the Linnean Society* 132: 385–395.
- GUTTERMAN, Y. & CHAUSER-VOLFSON, E. 2000. The distribution of the phenolic metabolites barbaloin, aloeresin and aloenin as a peripheral defence strategy in the succulent leaf parts of *Aloe arborescens*. *Biochemical Systematics and Ecology* 28: 825–838.
- HAMMER, K., ESQUIVEL, M. & KNUPFFER, H. 1992. Y tienen faxones y fabas muy diversos de los nuestros ... Origin, evolution and diversity of Cuban plant genetic resources. Volume 1. Institut für Pflanzengenetik und Kulturpflanzenforschung, Gaterslaben.
- HAMMER, K., ESQUIVEL, M. & KNUPFFER, H. 1992...y tienen faxones y fabas muy diversos de los nuestros ... origin, evolution and diversity of Cuban plant genetic resources. Volume 3. Institut für Pflanzengenetik und Kulturpflanzenforschung Gaterslaben.

- HARDY, D. S. 1989. A note on utilisation of *Aloe marlothii* by kudu during drought. *Aloe* 26: 55.
- HARGREAVES, B. J. 2005. *Aloe marlothii* in Botswana and beyond. *Alsterworthia International* 5: 40–62.
- HARGREAVES, B. J. 2007. Aloes with short stems in Botswana. *Alsterworthia* 7: 6–7.
- HEDBERG, I. & STAUGARD, F. 1989. Traditional medicine in Botswana: traditional medicinal plants. Ipelegeng, Gabarone.
- HEDRICK, U. P. 1919. Sturtevant's notes on edible plants. Report of the New York Agricultural Experiment Stations for the Year 1919. J. B. Lyon Company, Albany.
- HEINE, B. & LEGÉRE, K. 1995. Swahili Plants: an ethnobotanical survey. Rüdiger Köppe Verlag, Köln.
- HERBIN, G. A. & ROBINS, P. A. 1968. Studies on plant cuticular waxes. I. The chemotaxonomy of alkanes and alkenes of the genus *Aloe* L. (Liliaceae). *Phytochemistry* 7: 239–255.
- HESTER, A., SCOGINGS, P. F. & TROLLOPE, W. S. W. 2006. Long-term impacts of goat browsing on bush-clump dynamics in a semi-arid subtropical savanna. *Vegetatio* 183: 277–290.
- HILL, A. F. 1937. Economic botany: a text of useful plants and plant products. McGraw-Hill, New York.
- HILLER, K. & MELZIG, M. F. 1999. Lexikon der arzneipflanzen unde drogen in zwei banden. Spektrum Akademischer Verlag, Heidelberg.
- HOCKING, G. M. 1997. A dictionary of natural products. Plexus Publishing, Medford.
- HODGE, W. H. 1953. The drug aloes of commerce, with special reference to the Cape species. *Economic Botany* 7: 99–129.
- HOLLAND, J. H. 1922. Useful plants of Nigeria. Part 4. *Kew Bulletin Additional Series IX*.
- HOUGHTON, P. J. 1998. Establishing identification criteria for botanicals. *Drug Information Journal* 32: 461–469.
- HOWES, F. N. 1949. Vegetable gums and resins. Waltham, USA.
- HUMAN, H. & NICOLSON, S. W. 2006. Nutritional content of fresh, bee-collected and stored pollen of *Aloe greatheadii* var. *davyana* (Asphodelaceae). *Phytochemistry* 67: 1486–1492.
- HUMPHREY, J. 1921. Drugs in commerce: their source, preparation for the market, and description. Sir Isaac Pitman & Sons, London.
- HUSSEIN, F. T. K. 1985. Medicinal plants in Libya. Arab Encyclopedia Hosue, Beirut.
- HUTCHENS, A. R. 1994. Indian herbology of North America. Shambhala, Boston.

- HUTCHINGS, A., HAXTON SCOTT, A., LEWIS, G. & CUNNINGHAM, A. 1996. Zulu medicinal plants: an inventory. University of Natal Press, Pietermaritzburg University of Zululand, KwaDlangezwa National Botanical Institute, Cape Town.
- HYDE, M. A. & WURTSTEN, B. 2008. Flora of Zimbabwe. zimbabweflora.co.zw. Accessed 14 April 2008.
- IMPERIAL ECONOMIC COMMITTEE. 1936. An index of the minor forest products of the British Empire. Imperial Economic Committee, London.
- ITFG & IITR. 1996. Ethnoveterinary medicine in Kenya: a field manual of traditional animal health care practices. Intermediate Technology Kenya, Nairobi Institute of Rural Reconstruction, Nairobi.
- IVANOVA, M., NOVAK, O., STRNAD, M. & VAN STADEN, J. 2006. Endogenous cytokinins in shoots of *Aloe polyphylla* cultured in vitro in relation to hyperhydricity, exogenous cytokinins and gelling agents. *Plant Growth Regulation* 50: 219–230.
- IWU, M. M. 1993. Hand of African medicinal plants. CRC Press, Boca Raton.
- JACKSON, J. R. 1890. Commercial botany of the nineteenth century. Cassell & Co., London.
- JEX-BLAKE, A. J. 1939. Gardening in East Africa: a practical handbook. 2nd Edition. Longmans, Green & Co., London.
- JEX-BLAKE, A. J. 1934. Gardening in East Africa: a practical handbook. Longmans, Green & Co., London.
- JOHANNSMEIERS, M. F. 1995. Beeplants of the South-Western Cape. Nectar and pollen sources of honeybees. Plant Protection Research Institute, Agricultural Research Council, Pretoria.
- JOHANNSMEIERS, M. F. 1995. Beeplants of the South-Western Cape. Nectar and pollen sources of honeybees. Plant Protection Research Institute, Agricultural Research Council, Pretoria.
- JOHNSON, T. 1999. CRC Ethnobotany Desk Reference. CRC Press, Boca Raton.
- KAMBIZI, L., SULTANA, N. & AFOLAYAN, A. J. 2005. Bioactive compounds isolated from *Aloe ferox*: A plant traditionally used for the treatment of sexually transmitted infections in the Eastern Cape, South Africa. *Pharmaceutical Biology* 4: 26–36.
- KAMETANI, S., KOJIMA-YUASA, A., KIKUZAKI, H., KENNEDY, D. O., HONZAWA, M. & MATSUI-YUASA, I. 2007. Chemical constituents of Cape aloe and their synergistic growth-inhibiting effect on Ehrlich ascites tumor cells. *Bioscience, Biotechnology and Biochemistry* 7: 11220–11229.
- KARAGIANIS, G., VILJOEN, A. & WATERMAN, P. G. 2003. Identification of major metabolites in *Aloe littoralis* by high-performance liquid chromatography-nuclear

- magnetic resonance spectroscopy. *Phytochemical Analysis* 14: 275–280.
- KEITH, M. 2003. Threatened Species Programme - an overview of succulent plants in South Africa. *Aloe* 40: 64–67.
- KHORY, R. N. & KATRAK, N. N. 1999. *Materia medica of India and their therapeutics*. Komal Prakashan, Delhi.
- KING, E. G. 2007. Facilitative effects of *Aloe secundiflora* shrubs in degraded semi-arid rangelands in Kenya. *Journal of Arid Environments* 72: 358–369.
- KING, E. G. & STANTON, M. L. 2007. Facilitative effects of aloe shrubs on grass establishment, growth, and reproduction in degraded Kenyan rangelands: implications for restoration. *Restoration Ecology* 3: 93–98.
- KINGHORN, A., EUN-KYOUNG, Y. & SEO, M. S. 1998. Chromatographic spectroscopic combination methods for the analysis of botanical drugs. *Drug Information Journal* 32: 487–495.
- KLEINSCHMIDT, B. 2004. South African wild aloe juice enters international market. *Fruit Processing* 14: 194–198.
- KOKWARO, J. O. 1993. *Medicinal plants of East Africa*. 2nd Edition. Kenya Literature Bureau, Nairobi.
- LANE, S. S. 2004. *A field guide to the aloes of Malawi*. Umdaus Press, Hatfield, Pretoria.
- LATHAM, P. 2004. *The useful plants of Bas-Congo Province*. Paul Latham, Blairgowrie.
- LAZARIDES, M. & HINCE, B. 1993. *CSIRO Handbook of economic plants of Australia*. National Library of Australia Cataloguing-in-Publication Entry. CSIRO, Victoria.
- LAZAROWYCH, N. J. & PEKOS, P. 1998. Use of fingerprinting and marker compounds for identification and standardization of botanical drugs: strategies for applying pharmaceutical HPLC analysis to herbal products. *Drug Information Journal* 32: 497–512.
- LEFFERS, A. 2003. *Gemsbok Bean and Kalahari Truffle*. Traditional plant use by the Jul'hoansi in northeastern Namibia. Gamsberg Macmillan, Windhoek.
- LEONARD, C. H. & CHRISTY, T. 1892. *Dictionary of materia medica and therapeutics*. Bailliere, Tindall & Cox, London.
- LEWIS, W. H. & ELVIN-LEWIS, M. P. F. 2003. *Medical botany. Plants affecting human health*. 2nd Edition. Wiley, Hoboken.
- LIAO, H. M. & SHENG, X. Y. 2006. Ultrastructural studies on the process of aloin production and accumulation in *Aloe arborescens* (Asphodelaceae) leaves. *Botanical Journal of the Linnean Society* 150: 241–247.
- LINDLEY, J. 1869. *Medical and economical botany*. Bradbury & Evans, London.
- LINDSEY, K. L., JÄGER, A. K. & VILJOEN, A. M. 2002. Cyclooxygenase inhibitory activity of

- Aloe* species. *South African Journal of Botany* 68: 47–50.
- LINDSEY, K. L., VILJOEN, A. M. & JÄGER, A. K. 2003. Screening of *Aloe* species for antioxidant activity. *South African Journal of Botany* 69: 599–602.
- LOCK, C. G. W. 1882. Spons' encyclopaedia of the industrial arts, manufactures, and commercial products. Division IV. Spon, Charing Cross.
- LOCK, C. G. W. 1882. Spons' encyclopaedia of the industrial arts, manufactures, and commercial products. Division III. Spon, Charing Cross.
- LOCK, C. G. W. 1882. Spons' encyclopaedia of the industrial arts, manufactures, and commercial products. Division V. Spon, Charing Cross.
- LOPEZ, C. & SHANLEY, P. 2004. Riches of the forest: for health, life and spirit in Africa. Centre for International Forestry Research, Indonesia
- MABOGO, D. E. N. 1990. The ethnobotany of the Vhavenda. MSc thesis, University of Pretoria, Pretoria.
- MALIEHE, E. B. 1997. Medicinal plants and herbs of Lesotho: a visual guide to 60 species from around the country. Mafeteng Development Project, Maseru.
- MANDER, M., MANDER, J., CROUCH, N., MCKEAN, S. & NICHOLS, G. 1995 Catchment action: growing and knowing muthi plants. Share-Net, Howick Institute of Natural Resources, Scottsville.
- MAPP, R. K. & MCCARTHY, T. J. M. 1970. The assessment of purgative principles in aloes. *Planta Medica* 18: 361–365.
- MARCAN, H. 1999. African myrrh tree, crabwood and dog almond. Ethnobotany and traditional culture of central African economic plants, including wild and cultivated food crops and other resources. Helen Marcan, UK.
- MARSHALL, N. T. 1998. Searching for a cure: conservation of medicinal wildlife resources in east and southern Africa. TRAFFIC International, Cambridge.
- MATHABE, M. C., NIKOLOVA, R. C., LALL, N. & NYAZEMA, N. Z. 2006. Antibacterial activities of medicinal plants used for the treatment of diarrhoea in Limpopo Province, South Africa. *Journal of Ethnopharmacology* 105: 286–293.
- MATZKE, E. B. 1947. The three-dimensional shape of epidermal cells of *Aloe aristata*. *American Journal of Botany* 34: 182–195.
- MAUNDU, P. et al. 2001. Ethnobotany of the Loita Maasai: towards community management of the Forest of the Lost Child experiences from the Loita Ethnobotany Project. UNESCO, Paris.
- MAUNDU, P. M., NGUGI, G. W. & KABUYE, C. H. S. 1999. Traditional food plants of Kenya. Kenya Resource Centre for Indigenous Knowledge, National Museums of Kenya,

Nairobi.

- MCCARTHY, T. J. M. & MAPP, R. K. 1970. A comparative investigation of methods used to estimate aloin and related compounds in aloes. *Planta Medica* 18: 36–43.
- MCGUFFIN, M., HOBBS, C., UPTON, R. & GOLDBERG, A. 1997. Botanical safety handbook. CRC Press, Boca Raton.
- MEBE, P. P. 1987. 2'-p-methoxycoumaroylaloeresin, a C-glucoside from *Aloe excelsa*. *Phytochemistry* 26: 2646–2647.
- MIJATOVIC, S., MAKSIMOVIC-IVANIC, D., RADOVIC, J., MILJKOVIC, D., KALUDJEROVIC, G. N., SABO, T. N. & TRAJKOVIC, V. 1997. Aloe emodin decreases the ERK-dependent anticancer activity of cisplatin. *Cellular and Molecular Life Sciences* 62: 1275–1282.
- MORRIS, B. 1996. Chewa medical botany. A study of herbalism in southern Malawi. International African Institute, London.
- MORTON, J. F. 1961. Folk uses and commercial exploitation of aloe leaf pulp. *Economic Botany* 15: 311–319.
- MULULUMA, M. G. 2000. A study of ethnoveterinary knowledge and practices in resource poor communities of the Eastern Cape province of South Africa. MSc Dissertation. Faculty of Veterinary Medicine, University of Edinburgh, Edinburgh.
- MWALE, M., BHEBHE, E., CHIMONYO, M. & HALIMAN, T. E. 2005. Use of herbal plants in poultry health management in the Mushagashe small-scale commercial farming area in Zimbabwe. *International Journal of Applied Research in Veterinary Medicine* 3: 163–170.
- NADKARNI, K. M. 1976. Dr K. M. Nadkaarni's Indian materia medica. Volume I. Popular Prakashan, Bombay.
- NAIR, D. M. N. 1967. The selected families of Zambian flowering plants. University of Lusaka, Lusaka.
- NANDHA, B. & SARASAN, V. 2007. Micropropagation of *Aloe calcairophila* and *Aloe polyphylla*: the effect of different carbon sources on shoot multiplication and rooting. *Bradleya* 25: 33–36.
- NATIONAL DEPARTMENT OF AGRICULTURE, SOUTH AFRICA. 2008. How to store grain. National Department of Agriculture, Pretoria Agricultural Research Council, Pretoria. nda.agric.za/docs/grain/grain.htm. Accessed 02 April 2008.
- NEPI, M., HUMAN, H., NICOLSON, S. W., CRESTI, L. & PACINI, E. 2006. Nectary structure and nectar presentation in *Aloe castanea* and *A. greatheadii* var. *davyana* (Asphodelaceae). *Plant Systematics and Evolution* 257: 45–55.
- NEUWINGER, H. D. 1996. African ethnobotany: poisons and drugs, chemistry,

- pharmacology, toxicology. Chapman & Hall, London.
- NEWALL, C. A., ANDERSON, L. A. & PHILLIPSON, J. D. 1996. Herbal medicines. A guide for health-care professionals. The Pharmaceutical Press, London.
- NEWTON, L. E. 1996. Succulents and people in Africa. *Aloe* 33: 98–99.
- NEWTON, L. E. 1972. Taxonomic use of the cuticular surface features in the genus *Aloe* (Liliaceae). *Botanical Journal of the Linnean Society* 65: 335–339.
- NEWTON, L. E. 1995. Natural hybrids in the genus *Aloe* (Aloaceae) in east Africa. *Journal of East African Natural History* 84: 141–145.
- NEWTON, L. E. 2004. Aloes in habitat. In Reynolds, T. (ed.). Aloes: the genus *Aloe*. Medicinal and Aromatic Plants - Industrial Profiles. CRC Press, Boca Raton.
- NEWTON, L. E. 2001. Poisonous aloes. *East African Natural History Society Bulletin* 3: 8 –9.
- NEWTON, L. E. & LAVRANOS, J. J. 1990. Two new aloes from Kenya, with notes on the identity of *Aloe turkanensis*. *Cactus and Succulent Journal (U.S.)* 62: 215–221.
- NJOROGE, G. N. & BUSSMANN, R. W. 2007. Ethnotherapeutic management of skin diseases among the Kikuyus of Central Kenya. *Journal of Ethnopharmacology* 111: 303–307.
- NOWAK, R. & STAREK, K. 2003. The chemical components of plants of *Aloe* L. genus and their pharmacological activity. I. Anthracene's derivatives. *Herba Polonica* 49: 115–123.
- OKAMURA, N., ASAI, M., HINE, N. & YAGI, A. 1996. High-performance liquid chromatographic determination of phenolic compounds in *Aloe* species. *Journal of Chromatography A* 746: 225–231.
- OKETCH-RABAH, H. A., DOSSAJI, S. F. & MBERU, E. K. 1999. Antimalarial activity of some Kenyan medicinal plants. *Pharmaceutical Biology* 37: 329–334.
- OKETCH-RABAH, H. A. T. 1996. Leaf compounds in potential plantation species of *Aloe* in Kenya. *Journal of Herbs, Spices and Medicinal Plants* 4: 25–33.
- OLDFIELD, S. 2005. Trade in East African aloes. *Medicinal Plant Conservation Newsletter* 11: 19–24.
- OLEMBO, N. K., FEDHA, S. S. & NGAIRA, E. S. 1995. Medicinal and agricultural plants of Ikolomanin Division, Kakamega District. Development Partners, Kakamega.
- OLIVER, B. E. P. 1960. Medicinal plants in Nigeria. Nigerian College of Arts, Science and Technology, Ibadan.
- PABST, G. 1887. Kohler's medizinal pflanzen in naturgetreuen abbildungen mit kurtz erlauerndem texte. Kholer, Gera-Untermhaus.
- PARK, M. K., PARK, J. H., KIM, N. Y., SHIN, Y. G., CHOI, Y. S. & LEE, J. G. 1998. Analysis of 13 phenolic compounds in *Aloe* species by high performance liquid chromatography. *Phytochemical Analysis* 9: 186–191.

- PEREIRA, J. 1855. The elements of materia medica and therapeutics. 4th Edition. Longman, Brown, Green & Longmans, London.
- PEREIRA, W. 1993. Tending the earth: traditional, sustainable agriculture in India. Earthcare, Bombay.
- PETHIYAGODA, R. 2004. Biodiversity law has had some unintended effects. *Nature* 429: 129.
- PEZZATA, S. 1997. Fitoterapie e medicine tra passato e presente (alcuni Ricettari inediti dell'Itali centrale, secc. XV-XVIII, svelano i segreti delle piante curative). Orior, Perugia.
- PFAB, M. F. & SCHOLE, M. A. 2004. Is the collection of *Aloe peglerae* form the wild sustainable? An evaluation using stochastic population modelling. *Biological Conservation* 118: 695-701.
- POLE-EVANS, I. B. 1919. Our aloes: their history, distribution, and cultivation. *Journal of the Botanical Society of South Africa* 5: 11-16.
- POWELL, B. H. 1868. Handbook of products of the Punjab, with a combined index and glossary of technical vernacular words. Volume 1. Economic Raw Produce. Thomason Civil Engineering College Press, Roorkee.
- PUJOL, J. 1990. NaturAfrica: the herbalist handbook. African flora, medicinal plants. Jean Pujol Natural Healers Foundation, Durban.
- RAFFAUF, R. F. 1996. Plant alkaloids: a guide to their discovery and distribution. Food Products Press, New York.
- RAINA, M. K. 1982. *Aloe*. In: C. K. Atal, B. M. Kapur (eds.). Cultivation and utilization of medicinal plants. Council of Scientific & Industrial Research, Jammu-Tawi.
- RAPONDA-WALKER, A. & SILLANS, R. 1961. Les plantes utiles du Gabon. Editions Paul Lechevalier, Paris.
- RAUWALD, H. W., BEIL, A. & PRODOHL, C. P. 1991. Occurrence, distribution, and taxonomic significance of some C-glucosylanthrones of the aloin-type and C-glucosylchromones of the aloeresin-type in *Aloe* species. *Planta Medica Supplement* 2 57: A129.
- RAUWALD, H. W. & NIYONZIMA, D. D. 1991. Free and cininamoylated 8-O-methyl-7-hydroxyaloin from *Aloe barbadensis*: isolation, structure, and configurational determination of the diastereomers. *Planta Medica Supplement* 2 57: A129.
- REBECCA, W., KAYSER, O., HAGELS, H., ZESSIN, K. H. & MADUNDO, M. 2003. The phytochemical profile and identification of main phenolic compounds from the leaf exudate of *Aloe secundiflora* by high-performance liquid chromatography-mass spectroscopy. *Phytochemical Analysis* 14: 83-86.

- REDWOOD, T. 1857. A supplement to the pharmacopoeia being a concise but comprehensive dispensatory, and manual of facts and formulae, for the use of practitioners in medicine and pharmacy. Longman, London.
- REVIEW OF NATURAL PRODUCTS. 2004. *Aloe*. Wolters Kluwer Health Incorporated.
- REYNOLDS, G. W. 1937. New aloes from Natal and Zululand, with notes on *A. macracantha* Bak. *Journal of South African Botany* 3: 37–49.
- REYNOLDS, G. W. Date unknown. The *Aloe* in nature and cultivation. *South African Horticultural Journal* 1, pages unknown.
- REYNOLDS, G. W. 1950. The aloes of South Africa. Aloes of South Africa Fund, Johannesburg.
- REYNOLDS, G. W. 1966. The aloes of tropical Africa and Madagascar. Aloes Fund, Mbabane.
- REYNOLDS, T. 1985. Observations on the phytochemistry of the *Aloe* leaf-exudate compounds. *Botanical Journal of the Linnean Society* 90: 179–199.
- REYNOLDS, T. 1994. A chromatographic examination of some old samples of drug aloes. *Pharmazie* 49: 524–529.
- REYNOLDS, T. 1997. Comparative chromatographic patterns of leaf exudates components from *Aloe* Section Pachydendron Haw. *Botanical Journal of the Linnean Society* 125: 45–70.
- REYNOLDS, T. 1996. Chemotaxonomy of *Aloe turkanensis* and *Aloe scabrifolia* from Kenya. *Biochemical Systematics and Ecology* 24: 347–352.
- REYNOLDS, T. 1990. Comparative chromatographic patterns of leaf exudate components from shrubby aloes. *Botanical Journal of the Linnean Society* 102: 273–285.
- REYNOLDS, T. 1986. A contribution to the phytochemistry of the East African tetraploid shrubby aloes and their diploid allies. *Botanical Journal of the Linnean Society* 92: 383–392.
- REYNOLDS, T. 1985. The compounds in *Aloe* leaf exudates: a review. *Botanical Journal of the Linnean Society* 90: 157–177.
- REYNOLDS, T. & DWECK, A. C. 1999. *Aloe vera* leaf gel: a review update. *Journal of Ethnopharmacology* 68: 3–37.
- REYNOLDS, T. & NICHOLLS, E. 1986. An examination of phytochemical variation in *Aloe elgonica* Bullock. *Botanical Journal of the Linnean Society* 92: 393–397.
- RILEY, B. W. & BROKENSHA, D. 1988. The Mbeere in Kenya. Volume 2: Botanical identities and uses. Institute for Development University Press of America, Lanham.
- ROACH, E. S. 1951. A dictionary of antibiosis. Columbia University Press, New York.
- ROBERTS, M. 1990. Indigenous healing plants. Southern Publishers, Halfway House.
- ROBERTSON, H. M. 1979. The *Aloe* boers of the Gouritz River District. *Quarterly Bulletin of the South African Library* 34: 59–69.

- RODIN, R. J. 1985. The Ethnobotany of the Kwanyama Ovambos. Missouri Botanic Garden, St. Louis.
- ROECKLEIN, J. C. & LEUNG, P. 1987. A profile of economic plants. Transactions, New Brunswick.
- ROOD, B. 2008. Uit die veldapteek. 2nd Edition. Protea Boekhuis, Pretoria.
- ROOD, B. 2008. Kos uit die veldkombuis. 2nd Edition. Protea Boekhuis, Pretoria.
- ROSENTHAL, D. A. 1862. Synopsis plantarum diaphoricarum. Systematische uebersicht der heil-, nutz- und giftplanzen aller lander. Verlag von Ferdinan Enke, Erlangen.
- ROUILLARD, G. & GUÉHO, J. 1999. Les Plantes ed leur histoire a l'Ile Maurice. Guy Rouillard et Joseph Guého, Mauritius.
- ROWLEY, G. D. 1976. Aloe breeding in England. *Aloe* 14: 21–23.
- ROYLE, J. F. 1853. A manual of materia medica and therapeutics including the preparations of the pharmacopoeias of London, Edinburgh, and Dublin with many new medicines. 2nd Edition. John Churchill, London.
- SACHEDINA, H. & BODEKER, G. 1999. Wild *Aloe* harvesting in South Africa. *Journal of Alternative and Complementary Medicine* 5: 121–123.
- SCHIPPMAN, U. 2001. Medicinal plants significant trade study. CITES Projekt S-109, Plants Committee Document PC9 9.1.3 (rev). German Federal Agency for Nature Conservation, Bonn.
- SCHWEGLER, M. 2003. Medicinal and other uses of southern Overberg fynbos plants. Mathia Schwegler, Farm Heidehof, Gansbaai.
- SCOTT, R. 2005. *Aloe ferox* and the red wattle bird. *Alsterworthia* 5: 15.
- SEBIRE, R. P. A. 1899. Les plantes utiles du Senegal. Plantes indigenes – plantes exotiques. Librairie J.- B. Bailliere et Fils, Paris.
- SHACKLETON, C. N. & GAMBIZA, J. 2007. Growth of *Aloe ferox* Mill. at selected sites in the Makana region of the Eastern Cape. *South African Journal of Botany* 73: 266–269.
- SHIMPO, K., CHIHARA, T., SHINZATO, M., BEPPU, H., KANEKO, T., SHAMOTO, M. & KUZUYA, H. 2003. Reduction of 1,2-dimethylhydrazine-induced colorectal proliferative lesions in mice by *Aloe arborescens* var. *natalensis* (Kidachi aloe). *Pharmaceutical Biology* 4: 16–31.
- SHIODA, H., SATOH, K., NAGAI, F., OKUBO, T., SETO, T., HAMANO, T., KAMIMURA, H. & KANO, I. 2003. Identification of *Aloe* species by random amplified polymorphic DNA (RAPD) Analysis. *Journal of the Food Hygienics Society of Japan* 44: 203–207.
- SILBERBAUER, G. B. 1981. Hunter and habitat in the central Kalahari desert. Cambridge University Press, Cambridge.

- SIMMONDS, P. L. 1865. Commercial products of the vegetable kingdom. TFA Day, London.
- SIMMONDS, P.L. 1862. Waste products and undeveloped substances; or hints for enterprise in neglected fields. Hardwicke, Piccadilly.
- SIMUTE, S., PHIRI, C. L. & TENGNAS, B. 1998. Agroforestry extension manual for eastern Zambia. Technical Handbook 17. Regional Land Management Unit, RELMA, Nairobi.
- SMITH, A. 1888. A contribution to the South African materia medica, chiefly from plants in use among the natives. 2nd Edition. Lovedale, South Africa.
- SMITH, G. F. 2003. First field guide to aloes of southern Africa. Struik, Cape Town.
- SMITH, G. F. & DE S. CORREIA, R. I. 1988. Notes on the ecesis of *Aloe davyana* (Asphodelaceae: Alooideae) in seed-beds and under natural conditions. *South African Journal of Science* 84: 873.
- SMITH, G. F. & DE S. CORREIA, R. I. 1992. Establishment of *Aloe greatheadii* var. *davyana* from seed for use in reclamation trails. *Landscape and Urban Planning* 23: 47–54.
- SMITH, G. F. & GLEN, H. F. 1993. Of aloes, artists and coins: *Aloe aculeata* on the 'old' 10c piece. *Aloe* 30: 17–18.
- SMITH, G. F., KLOPPER, R. R. & CROUCH, N. R. 2007. *Aloe arborescens* (Asphodelaceae: Alooideae) and CITES. *Haseltonia* 14: 189–198.
- SMITH, G. F., STEYN, E. M. A. & CROUCH, N. R. 2005. *Aloe affinis*. Aloaceae. *Curtis's Botanical Magazine* 22: 95–99.
- SMITH, G. F., STEYN, E. M. A., VICTOR, J. E., CROUCH, N. R., GOLDING, J. & HILTON-TAYLOR, C. 2000. Aloaceae. The conservation status of *Aloe* in South Africa: an updated synopsis. *Bothalia* 30: 206–211.
- SMITH, G. F., VAN WYK, A. E., JOHNSON, L. A. S. & VAN WYK, B.- E. 1996. Southern African plant systematics: needs, priorities and actions. *South African Journal of Science* 92: 317–320.
- SMITH, G. F. & VAN WYK, B.- E. 1991. Generic relationships in the Alooideae (Asphodelaceae). *Taxon* 40: 557–581.
- SOFOWORA, A. 1979. African medicinal plants. Proceedings of a conference. University of Ife Press, Ile-Ife.
- SPICKETT, A., MERWE, D. & MATTHEE, O. 2007. The effect of orally administered *Aloe marlothii* leaves on *Boophilus decoloratus* tick burdens on cattle. *Experimental and Applied Acarology* 41: 139–146.
- SPRING, W. & DIEDERICHS, N. 2006. Farming medicinal plants. In: N. Diederichs (ed.). Commercialising medicinal plants: a Southern African guide. Pp. 67–86. Sun Press, Stellenbosch.

- STANER, P. 1949. Elements d'horticulture Congolaise. Ministere des Colonies, Bruxelles.
- STATE PHARMACOPOEIA COMMISSION. 2000. Pharmacopoeia of the People's Republic of China. English Edition 2000. Volume I. Chemical Industry Press, Beijing.
- STEELE, W. M. 1976. An introduction to the botany of tropical crops. 2nd Edition. Longman, London.
- STEENKAMP, V. & STEWART, M. J. 2007. Medicinal applications and toxicological activities of *Aloe* products. *Pharmaceutical Biology* 45: 411–420.
- STEFFENS, F. 1991. The Venda aloe stamps. *Aloe* 28: 40–32.
- SWART, C. 1977. Bewaar hulle: *Aloe pearsonii* Schönland. *Aloe* 15: 19–20.
- SYMES, C. T. & NICOLSON, S. W. 2007. Production of copious dilute nectar in the bird-pollinated African succulent *Aloe marlothii* (Asphodelaceae). *South African Journal of Botany* 74: 598–605.
- SYMES, C. T., NICOLSON, S. W. & MCKECHNIE, A. E. 2008. Response of avian nectarivores to the flowering of *Aloe marlothii*: a nectar oasis during dry South African winters. *Journal of Ornithology* 149: 13–22.
- TANAKA, T. 1976. Tanaka's cyclopedia of edible plants of the world. Keigaku Publishing, Tokyo.
- TATE, J. L. 1971. Cactus Cook. Succulent cookery international. Cactus & Succulent Society of America, USA.
- TE BEEST, M. 2004. The impact of medicinal plant use on biodiversity. A case study in Hluhluwe–Umfolozzi Park, KwaZulu–Natal, South Africa. Mariska Te Beest, The Netherlands.
- TERASHIMA, H., CHIKAWA, M. & OHTA, I. 1991. A flora catalogue of useful plants of tropical Africa. Part 1. Forest Areas. *African Study Monographs Supplementary Issue* 16: 1–195.
- THOMS, H. 1929. Handbuch der praktischen und wissen-schaftlichen pharmazie. Urban & Schwarzenberg, Berlin.
- THOMSON, A. T. 1852. London dispensatory: a practical synopsis of materia medica, pharmacy and therapeutics. 11th Edition. Longman, Brown, Green & Longmans, London.
- TIMBERLAKE, J. 1987. Ethnobotany of the Pokot of Northern Kenya. Jonathan Timberlake, London.
- TIZARD, I. R. & RAMAMOORTHY, L. 2004. Aloes and the immune system. In T. Reynolds (ed.). Aloes: the genus *Aloe*. Medicinal and aromatic plants – industrial profiles. CRC Press, Boca Raton.
- TREASE, G. E. 1945. A textbook of pharmacognosy. Bailliere, Tindall & Cox, London.

- TREASE, G. E. & EVANS, W. C. 1979. *Pharmacognosy*. 11th Edition. Bailliere Tindall, London.
- TREUTLEIN, J., SMITH, G. F., VAN WYK, B.- E. & WINK, M. 2003. Phylogenetic relationships in Asphodelaceae (subfamily Alooideae) inferred from chloroplast DNA sequences (*rbcL*, *matK*) and from genomic fingerprinting (ISSR). *Taxon* 52: 193–207.
- TSCHIRCH, A. 1906. *Die Harze und die Harzebehälter*. Verlag von Gebrüder Borntraeger, Leipzig.
- VAN DAMME, P. & VAN DEN EYNDEN, V. 2000. Succulent and xerophytic plants used by the Topnaar of Namibia. *Haseltonia* 7: 53–62.
- VAN DEN EYNDEN, V., VERNEMMEN, P. & VAN DAMME, P. 1992. *The ethnobotany of the Topnaar*. Universiteit Gent, Gent.
- VAN DER BANK, H., VAN WYK, B.- E. & VAN DER BANK, M. 1995. Genetic variation in two economically important *Aloe* species (Aloaceae). *Biochemical Systematics and Ecology* 23: 251–256.
- VAN HEERDEN, F., VILJOEN, A. M. & VAN WYK, B.- E. 2000. 6'-O-Coumaroylaloetin from *Aloe castanea* – a taxonomic marker from *Aloe* section Anguialoe. *Phytochemistry* 55: 117–120.
- VAN HEERDEN, F. R., VAN WYK, B.- E. & VILJOEN, A. M. 1996. Aloeresins E and F, two chromone derivatives from *Aloe peglerae*. *Phytochemistry* 43: 867–869.
- VAN KOENEN, E. 2001. *Medicinal, poisonous and edible plants in Namibia*. Klaus Hess/Verlag, Windhoek.
- VAN RHEEDE VAN OUDTSHOORN, M. C. B. 1964. Chemotaxonomic investigations in Asphodelaceae and Aloaceae (Liliaceae). *Phytochemistry* 3: 383–390.
- VAN WYK, B.- E. 1996. Priorities for biosystematic studies of the southern African flora. *South African Journal of Science* 92: 327–329.
- VAN WYK, B.- E. & GERICKE, N. 1999. *People's plants. A guide to the useful plants of Southern Africa*. Briza, Hatfield.
- VAN WYK, B.- E. & SMITH, G. F. 1996. *Guide to the aloes of South Africa*. Briza, Pretoria.
- VAN WYK, B.- E., VAN OUDTSHOORN, B. & GERICKE, N. 1997. *Medicinal plants of South Africa*. Briza, Pretoria.
- VAN WYK, B.- E., WHITEHEAD, C. S., GLEN, H. F., HARDY, D. S., VAN JAARSVELD, E. J. & SMITH, G. F. 1993. Nectar sugar composition in the subfamily Alooideae (Asphodelaceae). *Biochemical Systematics and Ecology* 21: 249–253.
- VAN WYK, B.- E. & WINK, M. 2004. *Medicinal plants of the world. An illustrated guide to important medicinal plants and their uses*. Timber Press, Portland.

- VAN WYK, B.- E., YENESEW, A. & DAGNE, E. 1995. Chemotaxonomic survey of anthraquinones and pre-anthraquinones in roots of *Aloe* species. *Biochemical Systematics and Ecology* 23: 267–275.
- VAN ZYL, R. L. & VILJOEN, A. M. 2002. In vitro activity of *Aloe* extracts against *Plasmodium falciparum*. *South African Journal of Botany* 68: 106–110.
- VELCHEVA, M., FALTIN, Z., VARDI, A., ESHDAT, Y. & PERL, A. 2005. Regeneration of *Aloe arborescens* via somatic organogenesis from young inflorescences. *Plant Cell, Tissue and Organ Culture* 83: 293–301.
- VILJOEN, A. M. & VAN WYK, B.- E. 2001. A chemotaxonomic and morphological appraisal of *Aloe* series *Purpurascentes*, *Aloe* section *Anguialoe* and their hybrid, *Aloe broomii*. *Biochemical Systematics and Ecology* 29: 621–631.
- VILJOEN, A. M. & VAN WYK, B.- E. 2000. The chemotaxonomic significance of the phenyl pyrone aloenin in the genus *Aloe*. *Biochemical Systematics and Ecology* 28: 1009–1017.
- VILJOEN, A. M. & VAN WYK, B.- E. 1999. The chemotaxonomic value of two cinnamoyl chromones, aloeresin E and F, in *Aloe* (Aloaceae). *Taxon* 48: 747–754.
- VILJOEN, A. M. & VAN WYK, B.- E. 1998. Are chemical compounds reliable taxonomic signposts in the genus *Aloe*? *Aloe* 35: 62–66.
- VILJOEN, A. M., VAN WYK, B.- E. & DAGNE, E. 1995. The chemotaxonomic value of 10-hydroxyaloin B and its derivatives in *Aloe* series *Asperifoliae* Berger. *Kew Bulletin* 51: 159–168.
- VILJOEN, A. M., VAN WYK, B.- E. & NEWTON, L. E. 1999. Plicataloside in *Aloe* – a chemotaxonomic appraisal. *Biochemical Systematics and Ecology* 27: 507–517.
- VILJOEN, A. M., VAN WYK, B.- E. & NEWTON, L. E. 2001. The occurrence and taxonomic distribution of the anthrones aloin, aloinoside and microdontin in *Aloe*. *Biochemical Systematics and Ecology* 29: 53–67.
- VILJOEN, A. M., VAN WYK, B.- E. & VAN HEERDERN, F. R. 2002. The chemotaxonomic value of the diglucoside anthrone homonataloside B in the genus *Aloe*. *Biochemical Systematics and Ecology* 30: 35–43.
- VILJOEN, A. M., VAN WYK, B.- E. & VAN HEERDERN, F. R. 1998. Distribution and chemotaxonomic significance of flavonoids in *Aloe* (Asphodelaceae). *Plant Systematics and Evolution* 211: 31–42.
- VOGLER, B. K. & ERNST, E. 1999. *Aloe vera*: a systematic review of its clinical effectiveness. *British Journal of General Practice* 49: 823–828.
- VON MUELLER, F. 1881. Select extra-tropical plants readily eligible for industrial culture or naturalisation, with indications of their native countries and some of their uses. Thomas

Richards, Sydney.

- VON REIS, S. & LIPP, F. J. 1982. New plant sources for drugs and foods from the New York Botanical Garden herbarium. Harvard University Press, Massachusetts.
- WABUYELE, E. N. 2006. Studies on Eastern African aloes: aspects of taxonomy, conservation and ethnobotany. PhD Thesis. University of Oslo, Oslo.
- WAIHENYA, R. K., MTAMBO, M. M. A. & NKWENGULILA, G. 2002. Evaluation of the efficacy of the crude extract of *Aloe secundiflora* in chickens experimentally infected with Newcastle disease virus. *Journal of Ethnopharmacology* 79: 299–304.
- WAIHENYA, R. K., MTAMBO, M. M. A., NKWENGULILA, G. & MINGA, U. M. 2002. Efficacy of crude extract of *Aloe secundiflora* against *Salmonella gallinarum* in experimentally infected free-range chickens in Tanzania. *Journal of Ethnopharmacology* 79: 317–323.
- WANG, X. M., YANG, D. J. & ZHANG, A. L. 2000. The nutritious constituents and efficacy of *Aloe arborescens* Mill. var. *natalensis* Berger. *Chemical Analysis & Meterage* 9: 16–17.
- WANYAMA, J. B. 1997. Confidently used ethnoveterinary knowledge among pastoralists of Samburu, Kenya: preparation and administration. Intermediate Technology Kenya, Nairobi.
- WARING, E. J. 1868. Pharmacopoeia of India. W. H. Allen & Co., London.
- WATSON, J. F. 1972. The industrial survey of India. Part I. India Museum, London.
- WATT, G. 1889. A dictionary of the economic products of India. Volume 1. Government of India, Calcutta.
- WATT, G. & BREYER-BRANDWIJK, M. G. 1962. Medicinal and poisonous plants of southern and eastern Africa. 2nd Edition. E. & S. Livingstone, Edinburgh.
- WEALTH OF INDIA. 2000. The wealth of India. Second supplement series (raw materials). Volume 1A (revised). Council for Scientific and Industrial Research, New Delhi.
- WHISTLER, R. L., BEMILLER, J. N. 1993. Industrial gums: polysaccharides and their derivatives. 3rd Edition. Academic Press, San Diego.
- WILLIS, C. K. & SMITH, G. F. 2004. The Global Strategy for Plant Conservation: implications for succulent plant conservation in southern Africa. *Aloe* 41: 42–156.
- WILLS, G. S. V. 1893. A manual of elementary materia medica. 12th Edition. Simpkin, Marshall, Hamilton, Kent & Co., London.
- WOOD, G. B. & BACHE, F. 1854. The dispensatory of the United States of America. Lippincott, Grambo and Co., Philadelphia.
- WREN, R. C. 1975. Potter's New Cyclopaedia of Botanical Drugs and Preparations. 8th Edition. Health Science Press, Bradford.

- YAGI, A. 2004. Bioactivity of *Aloe arborescens* preparations. In T. Reynolds (ed.). *Aloes: the genus Aloe. Medicinal and aromatic plants – industrial profiles*. CRC Press, Boca Raton.
- YANIV, S. & BACHRACH, U. 2005. *Handbook of medicinal plants*. Haworth Press, New York.
- YEATS, J. 1870. *The natural history of commerce*. Cassell, Petter & Galpin, London.
- YENESEW, A. & DAGNE, E. 1993. Contribution to the chemotaxonomy of the Asphodelaceae. In: *Fifth NAPRECA Symposium on Natural Products, Antananarivo, Madagascar*. Pp. 143. NAPRECA, Ethiopia.
- YUAN, C. Q. & NI, T. H. 1999. The medicinal and food use of *Aloe*. *Chinese Journal of Ethnomedicine and Ethnopharmacy* 37: 81–83.
- ZHANG, G. 2000. Study on bacteriostasis of eight strains of *Aloe*. *Journal of Inner Mongolia Normal University (Natural Science Edition)* 29: 206–208.
- ZONTA, F., BOGONI, P., MASOTTI, P. & MICALI, G. 1995. High-performance liquid chromatographic profiles of aloe constituents and determination of aloin in beverages, with reference to the EEC regulation for flavouring substances. *Journal of Chromatography A* 718: 99–106.



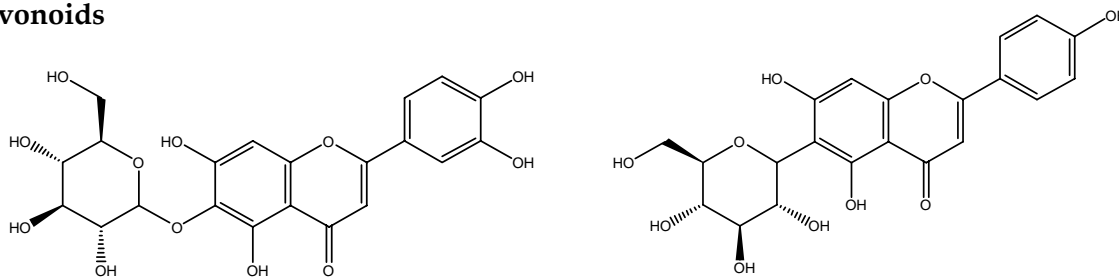
APPENDIX B

Compounds of chemosystematic interest in *Aloe* section *Pictae*: structural data 158



Compounds of chemosystematic interest in *Aloe* section *Pictae*: structural data

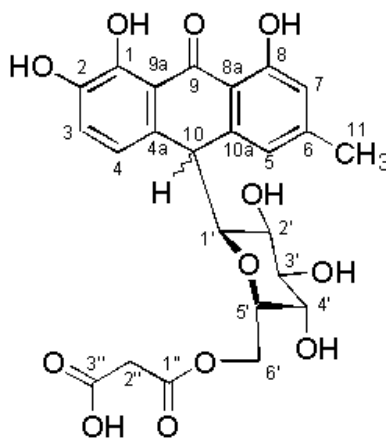
Flavonoids



isoorientin (luteolin-6-glucoside)

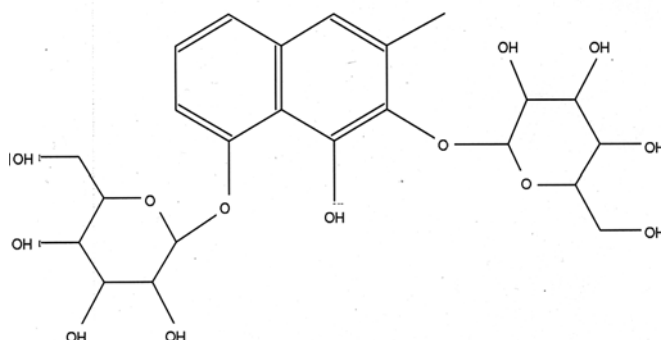
isovitexin (6-C-glucosylapigenin)

Anthrone C-glycoside



6'-malonylnataloin (anthrone C-glycoside)

Napthalene derivative



plicataloside (2,8-Di-O-β-D-glucopyranoside)