

Gasteria croucheri (Hook. f.) Baker (Asphodelaceae): a synthesis and review of its medicinal potential

Alfred Maroyi

Medicinal Plants and Economic Development (MPED) Research Centre, Department of Botany, University of Fort Hare,
Private Bag X1314, Alice 5700, South Africa

Abstract

Gasteria croucheri is a valuable succulent perennial herb widely used as herbal medicine in South Africa. This study reviewed medicinal uses of *G. croucheri* so as to provide baseline data required in evaluating the therapeutic potential of the species. Relevant information on medicinal uses of *G. croucheri* was collected from electronic scientific databases such as ScienceDirect, SciFinder, PubMed, Google Scholar, Medline, and SCOPUS. Pre-electronic literature search of conference papers, scientific articles, books, book chapters, dissertations and theses was carried out at the University library. Literature search revealed that *G. croucheri* is used mainly as a protective charm against evil spirits or lightning. The leaves and whole plant parts of *G. croucheri* are used as blood purifier, emetic, purgative, tonic wash, induce vomiting and herbal medicine for skin problems such as ringworm, skin rash and warts, diarrhoea, hysteria, paralysis and rheumatism. There is need for detailed scientific investigations aimed at elucidating the chemical, pharmacological and toxicological properties of *G. croucheri*.

Keywords: Asphodelaceae, *Gasteria croucheri*, South Africa, traditional medicine, Xanthorrhoeaceae

INTRODUCTION

Gasteria croucheri (Hook.f.) Baker is a succulent herbaceous perennial belonging to the Asphodelaceae or Aloe family. The family Asphodelaceae has had a complex history and at some stage referred to as Xanthorrhoeaceae¹⁻⁵ based on recommendations made by the Angiosperm Phylogeny Group.⁶ The family name Asphodelaceae has been conserved over Xanthorrhoeaceae based on arguments presented by the Angiosperm Phylogeny Group.⁷ Members of the Asphodelaceae family are known to be used medicinally as a purgative, as herbal medicines for arthritis, eczema, skin irritations, burns, hypertension and stress.⁸ Species of the Asphodelaceae family are also widely used as traditional medicines in Algeria, Cyprus, Egypt, India, Libya, Pakistan, Palestine, Spain and Turkey for burns, wounds, colds, earache, eczema, microbial infections, inflammatory disorders, haemorrhoids, jaundice, nephritis, parasitic infections, peptic ulcers, rheumatism and skin diseases.⁹⁻³⁰ Research carried out by Malmir et al.³⁰ revealed that crude extracts and compounds isolated from the species of the Asphodelaceae family are characterized by anti-inflammatory, antimalarial, antimelanogenic, antimicrobial, antioxidant, apoptotic, antiparasitic, antiviral, cytotoxicity, diuretic and hypotensive activities. The genus *Gasteria* Duval consists of herbaceous succulent perennials with roots that are cylindrical or rarely fusiform.³¹ About 35 taxa of *Gasteria* are recognized confined to South Africa, mainly in the Eastern and Western Cape provinces³² with one species, *G. pillansii* Kensit extending its distribution into Namibia.^{33,34} Flowers of two *Gasteria* species have traditionally been consumed by local people in South Africa. The buds of *G. brachyphylla* (Salm-Dyck) Van Jaarsv. were reported to be cooked by the early Khoi people as rice, hence the vernacular name "hottentotsry's".^{35,36} *Gasteria disticha* (L.) Haw. flowers are stripped from the flowering stalks and cooked as vegetables.^{36,37} The *Gasteria* species flowers are full of nectar and are usually eaten when raw.³⁶ Van Wyk³⁸ argued that these edible *Gasteria* species can be

used as novel fresh salad ingredients particularly young and fleshy flower parts which can be used for this purpose. *Gasteria* species such as *G. bicolor* Haw. and *G. croucheri* are used as traditional medicines.³⁹⁻⁴⁹ However, *G. croucheri* is threatened with extinction, categorized as Vulnerable⁵⁰⁻⁵⁴ due mainly to the decline in the number of mature individual plants over the years as a result of high rates of harvesting for the medicinal plant trade. Other *Gasteria* species that are threatened with extinction include *G. armstrongii* Schönland (Critically Endangered), *G. batesiana* G.D. Rowley var. *batesiana* (Near Threatened), *G. disticha* (L.) Haw. var. *langebergensis* Van Jaarsv. (Endangered) and *G. pillansii* Kensit var. *hallii* Van Jaarsv. (Endangered).⁵¹⁻⁵⁵ Despite the threats *G. croucheri* is currently facing in the wild, the species is an important indoor ornamental plant in South Africa, India and other parts of the world.⁵⁶⁻⁵⁹ Given its importance as both ornamental, traditional medicine and also the fact that the species is threatened with extinction, *G. croucheri* has been selected to be a component of the systematic conservation planning of the eThekweni Municipality in the KwaZulu Natal province in South Africa.⁶⁰ Systematic conservation planning is important for identifying areas, landscapes and species that are important for retaining habitat quality, conservation of biodiversity and the ecosystem services provided by biodiversity to the benefit of citizens of the eThekweni Municipality.⁶⁰ *Gasteria croucheri* is among the top ten most traded or used medicinal plants in the Cape Peninsula region in the Eastern and Western Cape provinces in South Africa.⁶¹ The leaves and whole plant parts of *G. croucheri* are sold in informal herbal medicine markets in Gauteng, KwaZulu Natal, Eastern Cape and Western Cape provinces in South Africa.^{41,62-68} Research by Philander et al.⁶⁹ revealed that *G. croucheri* is managed and cultivated in home gardens of the Western Cape province where the species is required for sustained utilization as herbal medicine but also as a tool for combined biodiversity conservation and poverty alleviation through income generated through its marketing in informal herbal medicine markets. It is

within this context that this review was undertaken aimed at reviewing the medicinal uses of *G. croucheri* so as to provide baseline data required in evaluating the therapeutic potential of the species.

Botanical profile of *Gasteria croucheri*

The generic name *Gasteria* is derived from the Greek word “*gaster*” which means “belly” in reference to the inflated lower perianth tube of the species.^{32,70} The species epithet “*croucheri*” is in honour of Mr Joseph Croucher (1838-1917), head gardener and Superintendent at Kew Gardens and succulent specialist. *Gasteria croucheri* is subdivided into three subspecies, namely *G. croucheri* subsp. *croucheri*, *G. croucheri* subsp. *pendulifolia* (Van Jaarsv.) Zonn. and *G. croucheri* subsp. *pondoensis* N.R.Crouch, Gideon F.Sm. & D.G.A.Styles,^{32,71} distinguished on the basis of geographical distribution and morphological characteristics. Synonyms associated with *G. croucheri* include *Aloe croucheri* Hook.f., *G. disticha* (L.) Haw. and *G. ensifolia* Haw. var. *natalensis* Baker.^{32-34,72,73} The English common names of *G. croucheri* include “forest gasteria”, “forest ox-tongue” and “Natal gasteria”. *Gasteria croucheri* is a solitary or cluster-forming perennial succulent plant growing to a height of 60 cm.^{32,73} *Gasteria croucheri* is rarely erect with ascending, spreading, dividing or proliferating from the base to form dense groups. The leaves occur in opposite rows or rosettes, tapering, strap-shaped, dark green or glaucous, surface smooth with white spots, the lower surface having an excentric keel. The flowers are tubular borne on a spreading, flat-topped flower stalks. *Gasteria croucheri* has been recorded on cliff faces, growing in quartzitic sandstone rock formations, rocky outcrops in subtropical shrub forest, river valleys, thicket vegetation, scarp forest in coastal areas of the summer-rainfall regions of the Eastern Cape and KwaZulu Natal provinces at an altitude

ranging from near sea level to 1000 m above sea level.^{32,73,74}

Medicinal uses of *Gasteria croucheri*

The leaves or entire herbaceous *G. croucheri* are used mainly for magical uses, see Table 1. *Gasteria croucheri* is usually planted in pots and vessels and placed on the roof above a doorway or in trees alongside approaches to a home as a protective charm against evil spirits or lightning.^{37,39,41,47,75-80} The leaves and whole plant parts of *G. croucheri* are mixed with those of *Clivia miniata* (Lindl.) Bosse and *Haworthia limifolia* Marloth var. *limifolia* as protective charm.^{41,81} The whole plant parts of *G. croucheri* are used as blood purifier, purgative, tonic wash and herbal medicine for skin problems such as ringworm, skin rash and warts.⁷⁶ The leaves of *G. croucheri* are used as emetic,^{39,41,78,82,83} induce vomiting,⁸⁴ herbal medicine for diarrhoea,^{41,83} hysteria,^{85,86} paralysis^{37,84} and rheumatism.⁸²

Monoamine oxidase inhibition

Stafford et al.⁸⁷ evaluated monoamine oxidase inhibition activities of ethanol root extract of *G. croucheri* using a peroxidase-linked photometric monoamine oxidase inhibitor bioassay with clorgyline and selegiline as positive controls. The extract exhibited good monoamine oxidase-B inhibition activities with half maximal inhibitory concentration (IC₅₀) value of 72.0 µg/ml.⁸⁷

Serotonin reuptake transport protein

Nielsen et al.⁸⁸ evaluated the serotonin reuptake transport protein activities of aqueous and 70% ethanolic leaf extracts of *G. croucheri* using an *in vitro* serotonin reuptake transport protein binding assay. Both aqueous and 70% ethanolic extracts exhibited low concentration-dependent inhibition activities.⁸⁸

Table 1: Medicinal uses of *Gasteria croucheri*

Medicinal use	Parts used	References
Blood purifier	Whole plant	Philander ⁷⁶ ;
Diarrhoea	Leaves	Crouch et al. ⁴¹ ; Smith et al. ⁸³
Emetic	Leaves	Hutchings et al. ³⁹ ; Crouch et al. ⁴¹ ; Zukulu et al. ⁷⁸ ; Pujol ⁸² ; Smith et al. ⁸³
Hysteria	Leaves	Hulme ⁸⁵ ; Sobiecki ⁸⁶
Magical purposes (protection against evil spirits, lightning)	Leaves and whole plant	Van Jaarsveld ³⁷ ; Hutchings et al. ³⁹ ; Crouch et al. ⁴¹ ; Koopman ⁴⁷ ; Mander et al. ⁷⁵ ; Philander ⁷⁶ ; Cooposamy and Naidoo ⁷⁷ ; Zukulu et al. ⁷⁸ ; Smith et al. ⁷⁹ ; Smith et al. ⁸⁰
Magical purposes (protective charm)	Leaves and whole plant mixed with those of <i>Clivia miniata</i> (Lindl.) Bosse and <i>Haworthia limifolia</i> Marloth var. <i>limifolia</i>	Crouch et al. ⁴¹ ; Crouch et al. ⁸¹
Paralysis	Leaves	Van Jaarsveld ³⁷ ; Watt and Breyer-Brandwijk ⁸⁴
Purgative	Whole plant	Philander ⁷⁶
Rheumatism	Leaves	Pujol ⁸²
Skin problems (ringworm, skin rash and warts)	Whole plant	Philander ⁷⁶
Tonic wash	Whole plant	Philander ⁷⁶
Vomiting	Leaves	Watt and Breyer-Brandwijk ⁸⁴

Future research and perspectives

This review showed that *G. croucheri* is a valuable plant species in South Africa. The plant species is used as an ornamental plant and also as an important source of traditional medicines used to treat and manage a wide spectrum of human ailments. This detailed report on medicinal uses of *G. croucheri* indicate that plant species are valuable sources of ethnomedicines. This review strengthens the firm belief that traditional indigenous knowledge represent not only an important heritage, developed over the centuries, but also considerable mass of data that should be exploited in order to provide new and useful knowledge on plant resources. It is therefore, necessary to preserve this indigenous knowledge on traditional medicines by proper documentation, identification of plant species used, herbal preparation and dosage. From a chemical, pharmacological and toxicological point of view, *G. croucheri* has not received any major emphasis. Currently, there is not yet enough data on ethnopharmacological evaluations on the species that can be correlated with its medicinal applications. Therefore, detailed phytochemical, pharmacological and toxicological studies of *G. croucheri* are recommended. Therefore, future research should aim at establishing the link between the phytochemistry, biological activities and the medicinal applications of *G. croucheri*.

Conflict of interest

The author declares that he has no conflict of interest.

Acknowledgements

I would like to express my gratitude to Mbeki Research and Development Centre (GMRDC), University of Fort Hare for financial support to conduct this study.

REFERENCES

- [1] Simpson, M.G., *Plant Systematics*, Academic Press, Burlington 2010.
- [2] Grace, O.M., *S. Afr. J. Bot.* 2011, 77, 980–987.
- [3] Grace, O.M., Klopper, R.R., Smith, G.F., Crouch, N.R., Figueiredo, E., Rønsted, N., Van Wyk, A.E., *Phytotaxa* 2013, 76, 7–14.
- [4] Gildenhuis, S.D., Klopper, R.R., *Phytotaxa* 2016, 265, 1-26.
- [5] Khodaei, Z., Van Wyk, B.-E., Wink, M., *Diversity* 2018, 10, 60.
- [6] The Angiosperm Phylogeny Group, *Bot. J. Linn. Soc.* 2009, 161, 105–121.
- [7] The Angiosperm Phylogeny Group, *Bot. J. Linn. Soc.* 2016, 181, 1–20.
- [8] Koekemoer, M., Steyn, H.M., Bester, S.P., *Guide to Plant Families of Southern Africa*, Strelitzia 31, South African National Biodiversity Institute, Pretoria 2014.
- [9] Hammouda, F.M., Rizk, A.M., Ghaleb, H., Abdel-Gawad, M.M., *Planta Med.* 1972, 22, 188–195.
- [10] Saxena, V.K., Singh, R.B., *Curr. Sci.* 1975, 44, 723.
- [11] Boulos, L., *Medicinal Plants of North Africa*, Reference Publications, Michigan 1983.
- [12] Rimbau, V., Risco, E., Canigueral, S., Iglesias, J., *Phytother. Res.* 1996, 10, 421–423.
- [13] Abd El-Fattah, H., *Int. J. Pharmacogn.* 1997, 35, 274–277.
- [14] Reynaud, J., Flament, M.M., Lussignol, M., Becchi, M., *Can. J. Bot.* 1997, 75, 2105–2107.
- [15] Ali-Shtayeh, M.S., Abu Ghdeib, S.I., *Mycoses* 1999, 42, 665–672.
- [16] Gürbüz, I., Üstün, O., Yesilada, E., Sezik, E., Akyürek, N., *J. Ethnopharmacol.* 2002, 83, 241–244.
- [17] El-Seedi, H.R., *J. Nat. Prod.* 2007, 70, 118–120.
- [18] Vaghasiya, Y., Chanda, S.V., *Turk. J. Biol.* 2007, 31, 243–248.
- [19] González-Tejero, M.R., Casares-Porcel, M., Sánchez-Rojas, C.P., Ramiro-Gutiérrez, J.M., Molero-Mesa, J., Pieroni, A., Giusti, M.E., Censorii, E., de Pasquale, C., Della, A., Paraskeva-Hadjichambi, D., Hadjichambis, A., Houmani, Z., El-Demerdash, M., El-Zayatf, M., Hmamouchi, M., ElJohrig, S., *J. Ethnopharmacol.* 2008, 116, 341–357.
- [20] Safder, M., Imran, M., Mehmood, R., Malik, A., Afza, N., Iqbal, L., Latif, M., *J. Asian Nat. Prod. Res.* 2009, 11, 945–950.
- [21] Kalim, M.D., Bhattacharyya, D., Banerjee, A., Chattopadhyay, S., *BMC Compl. Alt. Med.* 2010, 10, 77.
- [22] Panghal, M., Kaushal, V., Yadav, J.P., *Ann. Clin. Microbiol. Antimicrob.* 2011, 10, 21.
- [23] Peksel, A., Altas-Kiyamaz, N., Imamoglu, S., *J. Med. Plants Res.* 2012, 6, 253–265.
- [24] Safder, M., Mehmood, R., Ali, B., Mughal, U.R., Malik, A., Jabbar, A., *Chim. Acta* 2012, 95, 144–151.
- [25] Abuhamdah, S., Abuhamdah, R., Al-Olimat, S., Paul, C., *Eur. J. Med. Pl.* 2013, 3, 394–404.
- [26] Amar, Z., Noureddine, G., Salah, R., *Glob. J. Biod. Sci. Manag.* 2013, 3, 108–110.
- [27] Ghoneim, M.M., Ma, G., El-Hela, A., Mohammad, A., Kottob, S., El-Ghaly, S., Cutler, S.J., Ross, S., *Nat. Prod. Comm.* 2013, 8, 1117–1119.
- [28] Peksel, A., Imamoglu, S., Altas Kiyamaz, N., Orhan, N., *Int. J. Food Prop.* 2013, 16, 1339–1350.
- [29] Faidi, K., Hammami, S., Salem, A.B., El Mokni, R., Mastouri, M., Gorcii, M., Ayedi, M.T., *J. Med. Plant Res.* 2014, 8, 550–557.
- [30] Malmir, M., Serrano, R., Caniça, M., Silva-Lima, B., Silva, O., *Plants* 2018, 7, 20.
- [31] Smith, G.F., Van Wyk, B.-E., In: Kubitzki, K. (Ed.), *The Families and Genera of Vascular Plants*, Springer-Verlag, Berlin 1998, pp. 30-140.
- [32] Van Jaarsveld, E.J., *Fl. Pl. Afr.* 2013, 63, 22-30.
- [33] Zonnerveld, B.J.M., Van Jaarsveld, E.J., *Pl. Syst. Evol.* 2005, 251, 217-227.
- [34] Van Jaarsveld, E.J., *Aloe* 2007, 44, 84-104.
- [35] Smith, C.A., *Common Names of South African Plants*, Mem. Bot. Surv. S. Afr. 35, Pretoria 1966.
- [36] Van Wyk, B.E., Gericke, N., *People's Plants: A Guide to Useful Plants of Southern Africa*, Briza Publications, Pretoria 2007.
- [37] Van Jaarsveld, E.J., *Gasterias of South Africa*, Fernwood Press, Johannesburg 1994.
- [38] Van Wyk, B.-E., *S. Afr. J. Bot.* 2011, 77, 857–868.
- [39] Hutchings, A., Scott, A.H., Lewis, G., Cunningham, A., *Zulu Medicinal Plants: An Inventory*, Natal University Press, Pietermaritzburg 1996.
- [40] Cocks, M., Dold, A.P., *Soc. Sci. Med.* 2000, 51, 1505–1515.
- [41] Crouch, N., Smith, G., Symmonds, R., Tomalin, M., *British Cact. Succ. J.* 2000, 18, 70–78.
- [42] Dold, A.P., Cocks, M.L., *Ann. East Cape Mus.* 2000, 1, 26-53.
- [43] Dold, A.P., Cocks, M., *Aloe* 2000, 37, 10–13.
- [44] Cocks, M., Möller, V., *Soc Sci Med.* 2002, 54, 387-397.
- [45] Cocks, M.L., Dold, A.P., *J. Ethnobiol.* 2006, 26, 60-81.
- [46] Maphosa, V., Masika, P.J., *Pharmaceut. Biol.* 2010, 48, 697-702.
- [47] Koopman, A., *Natalia* 2011, 41, 40-60.
- [48] Otang, W.M., Grierson, D.S., Ndip, R.N., *J. Med. Pl. Res.* 2012, 6, 2071-2080.
- [49] Afolayan, A.J., Grierson, D.S., Mbeng, W.O., *J. Ethnopharmacol.* 2014, 153, 220–232.
- [50] Hilton-Taylor, C., Smith, G.F., in: Huntley, B.J., *Botanical Diversity in Southern Africa*, Strelitzia 1, National Botanical Institute, Pretoria 1994, pp. 287-303.
- [51] Hilton-Taylor, C., *Red Data List of Southern African Plants*, Strelitzia 4. South African National Botanical Institute, Pretoria 1996.
- [52] Scott-Shaw, C.R., *Rare and threatened plants of KwaZulu-Natal and neighbouring regions*, KwaZulu-Natal Nature Conservation Service, Pietermaritzburg 1999.
- [53] Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A., Manyama, P.A., *Red List of South African Plants*, Strelitzia 25. South African National Biodiversity Institute, Pretoria 2009.
- [54] Williams, V.L., Victor, J.E., Crouch, N.R., *S. Afr. J. Bot.* 2013, 86, 23–35.
- [55] Victor, J.E., Keith, M., *S. Afr. J. Sci.* 2004, 100, 139–141.

- [56] Bayer, M.B., *The New Haworthia Handbook*, Cape and Transvaal Printers, Cape Town 1982.
- [57] Richwine, A.M., Tipton, J.L., Thompson, G.A., *HortScience* 1995, 30, 1443–1444.
- [58] Randhawa, G.S., Mukhopadhyay, A., *Floriculture in India*, Allied Publishers Pvt Ltd, New Delhi 2004.
- [59] Christenhusz, M.J.M., Fay, M.F., Chase, M.W., *Plants of the World: An Illustrated Encyclopedia of Vascular Plants*, Kew Publishing, Royal Botanic Gardens, Kew, London 2017.
- [60] McLean, C.T., Ground, L.E., Boon, R.G.C., Roberts, D.C., Govender, N., McInnes, A., *Durban's Systematic Conservation Assessment*, eThekweni Municipality, Environmental Planning and Climate Protection Department, Durban 2016.
- [61] Loundou, P., *Medicinal Plant Trade and Opportunities for Sustainable Management in South Africa*, MSc Dissertation, University of Stellenbosch 2008.
- [62] Cunningham, A.B., *An Investigation of the Herbal Medicine Trade in Natal/KwaZulu*, Investigational Report no. 29, Institute of Natural Resources, University of Natal, Pietermaritzburg 1988.
- [63] Cunningham, A.B., *African Medicinal Plants: Setting Priorities at the Interface Between Conservation and Primary Health Care*, People and Plants Working Paper 1, UNESCO, Paris 1993.
- [64] Mander, M., *Marketing of Indigenous Medicinal Plants in South Africa*, Food and Agriculture Organisation, Rome 1998.
- [65] Williams, V.L., Balkwill, K., Witkowski, E.T.F., *Bothalia* 2001, 31, 71-98.
- [66] Mander, M., Diederichs, N., Steytler, N., in: Diederichs, N. (Ed.), *Commercialising Medicinal Plants: A Southern African Guide*, Sun Press, Stellenbosch 2006, pp. 167-192.
- [67] Petersen, L.F., Charman, A.J.E., Moll, E.J., Collins, R.J., Hockings, M.T., *Soc. Nat. Res.* 2014, 27:3, 315-336.
- [68] Petersen, L.M., Moll, E.J., Hockings, M.T., Collins, R.J., *Local Environ.* 2015, 20, 1040-1061.
- [69] Philander, L.A., Makunga, N.P., Esler, K.J., *Econ. Bot.* 2014, 68, 303-315.
- [70] Court, D., *Succulent Flora of Southern Africa*, Struik Nature, Cape Town 2010.
- [71] Crouch, N.R., Smith, G.F., Styles, D.G.A., *Bothalia* 2011, 41, 183–185.
- [72] Van Jaarsveld, E.J., *Aloe* 1992, 29, 5-33.
- [73] Germishuizen, G., Meyer, N.L., *Plants of Southern Africa: An Annotated Checklist*, Strelitzia 14, National Botanical Institute, Pretoria 2003.
- [74] Mucina, L., Rutherford, M.C., *The Vegetation of South Africa, Lesotho and Swaziland*, Strelitzia 19, South African National Biodiversity Institute, Pretoria 2006.
- [75] Mander, M., Mander, J., Crouch, N., McKean, S., Nichols, G., *Catchment Action: Growing and Knowing Muthi Plants*, Share-Net, Scottsville 1995.
- [76] Philander, L.A., *J. Ethnopharmacol.* 2011, 138, 578–594.
- [77] Cooposamy, R.M., Naidoo, K.K., *Afr. J. Pharm. Pharmacol.* 2012, 6, 818-823.
- [78] Zukulu, S., Dold, T., Abbott, T., Raimondo, D., *Medicinal and Charm Plants of Pondoland*, South African National Biodiversity Institute, Pretoria 2012.
- [79] Smith, G.F., Crouch, N.R., Figueiredo, E., *Bradleya* 2015, 33, 84-91.
- [80] Smith, G.F., Crouch, N.R., Figueiredo, E., *Field Guide to Succulents in Southern Africa*, Struik Nature, Cape Town 2017.
- [81] Crouch, N.R., Smith, G.F., Nichols, G., Burden, J.A., Gillmer, J.M., *Aloe* 1999, 36, 8–13.
- [82] Pujol, J., *Natur Africa: the Herbalist Handbook*, Jean Pujol Natural Healers Foundation, Durban 1990.
- [83] Smith, G.F., Crouch, N.R., Condy, G., *Flowering Pl. Afr.* 1997, 55, 20-23.
- [84] Watt, J.M., Breyer-Brandwijk, M.G., *Medicinal and Poisonous Plants of Southern and Eastern Africa*, E and S, Livingstone, London 1962.
- [85] Hulme, M.M., *Wild Flowers of Natal*, Shuter and Shooter, Pietermaritzburg 1954.
- [86] Sobiecki, J.F., *Transact. Royal Soc. S. Afr.* 2002, 57, 1-24.
- [87] Stafford, G.I., Pedersen, P.D., Jäger, A.K., Van Staden, J., *S. Afr. J. Bot.* 2007, 73, 384–390.
- [88] Nielsen, N.D., Sandager, M., Stafford, G.I., Van Staden, J., Jäger, A.N., *J. Ethnopharmacol.* 2004, 94, 159–163.