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## Review

# Southern African medicinal plants used to treat skin diseases



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## ABSTRACT

This overview of southern African medicinal plants of dermatological relevance explores the fundamental knowledge available on the antimicrobial, anti-inflammatory, and wound healing properties of medicinal plants used to treat skin ailments. Also included is an overview undertaken on the phytochemistry and toxicity of plants used in treatments related to diseases of the skin. Some findings include the predominance of leaf material used (48%), as well as the frequent use of decoctions (35%). Dermatological skin pathogens such as *Propionibacterium acnes*, *Microsporium canis*, *Trichophyton mentagrophytes* and *Epidermophyton floccosum* are recommended for study in future antimicrobial research. Attention to these aspects should lead to new directives for commercialization and provide insight towards the understanding of some neglected plant species used for the treatment of skin diseases.

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## 1. Introduction

According to the World Health Organization (WHO, 2011) about 70–95% of the world's population in developing countries relies mainly on plants for their primary health care. Traditional medicine has not only gained popularity and approval, but it is sometimes the only system available in many rural areas. Furthermore, the use of

medicinal plants to treat skin infections is very common in many rural areas (Naidoo and Coopposamy, 2011). If one considers the implications of skin infections, which tend to be persistent, in many cases contagious and often associated with immunocompromised patients, it is not surprising that traditional medicine has become the first treatment of choice. Medicinal plants are highly sought after to treat dermatological ailments due to their (perceived?) ability to stop bleeding, speed up wound healing, as treatments for burns and to alleviate other skin conditions (Naidoo and Coopposamy, 2011). Furthermore, the increased demand for cheaper medicines, high

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rates of unemployment and greater incidences of infection from the human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) make the purchase of traditional medicines sold in the informal market place a more attractive option. These treatment regimens are less expensive, freely available and the use is based on extensive knowledge and expertise amongst the local communities (Shai et al., 2008; Street et al., 2008).

More specifically, in southern Africa, research on medicinal plants used for dermatological afflictions has not been given the attention it so rightly deserves. This is surprising as many plant species (e.g. *Centella asiatica*, *Harpagophytum procumbens*, *Lobostemon fruticosus*, *Trichilia emetica*, *Warburgia salutaris*, *Withania somnifera* and *Xysmalobium undulatum*), which have been targeted for commercialization (George et al., 2001; Van Wyk, 2008a,b; Vermaak et al., 2011), have not been adequately studied. In-depth phytochemistry, toxicity and pharmacological efficacy for many of these plants are still lacking. Medicinal plants used for dermatological purposes, both traditionally and in the cosmetic industry, are gaining more value, as many skincare products are now being supplemented with plant extracts (for example, the African extracts™ Rooibos body care products (<http://www.africanextracts.com/>) and Elixir™ skin care products which contain *Aloe ferox* (<http://www.elixirskincare.com/>)).

Keeping this in mind, it has now become important, while examining the ethnobotanical literature (Watt and Breyer-Brandwijk, 1962; Hutchings, 1996; Von Koenen, 1996; Felhaber, 1997; Rabe and Van Staden, 1997; Van Wyk et al., 2000, 2009), to identify gaps in research directed at plants of dermatological importance so that further commercialization directives can be based on a firm grounding of basic research.

Upon further examination of the available ethnobotanical literature, over 100 plant species were identified as being of importance when considering the traditional dermatological medicinal plant use in southern Africa. An overview of the uses related to the skin is given in Fig. 1. Wound healing was the most prevalent (41%) treatment regimen, followed by infectious diseases (32%). These may comprise of bacterial (e.g. acne, boils, abscesses and leprosy), fungal (e.g. ringworm) or viral (e.g. shingles and measles) to a lesser extent. Some medicinal plants (25%) are indicated for the treatment of sores and ulcers (kept separate from wound healing due to the implications of severity). Skin irritations including rashes, eczema, psoriasis, cancer and tumours account for 16% of southern African medicinal plants. Less attention has been given to plants used for the treatment of burns and anti-inflammatory conditions (10%). Only a minority (4% and 3% respectively) of the plants were used to treat growths (such as warts or corns on the skin), or used for the treatment of contusions (bruises, bumps etc.). There is a selection of plants (8%, unspecified) where the exact application or reference to the treatment of the skin is vague (Fig. 1.). It is possible that these plants may be used for multiple purposes. Anti-inflammatory, wound

healing and anti-infective applications are all closely related. Different compounds within a plant may possibly result in different healing strategies. Furthermore, these plants could be used to treat afflictions to the skin as a result of insect or snake bites. Tables 1–9 provide a more in-depth analysis of the specific plants used for each skin condition, their healing properties, parts of the plants used and the respective modes of administration.

## 2. Wound healing effects of medicinal plants used to treat skin ailments

The majority of plants used traditionally for dermatological purposes are related to wound healing (Table 1). The use for sores or ulcers (Table 2) are also of importance but to a lesser extent. Addressing some studies where attention has been given to validating wound healing potential, are the examination of medicinal plants such as *Cissus quadrangularis*, *Grewia occidentalis*, *Gunnera perpensa*, *Malva parvifolia*, *Ricinus communis* and *Terminalia sericea*, taking into account the possible impact of bacterial infection (Grierson and Afolayan, 1999; Steenkamp et al., 2004; Luseba et al., 2007). In addition to this, a study by Pather et al. (2011) also identified the *in vivo* wound healing properties of *Bulbine frutescens* and *Bulbine natalensis* on pigs, where the leaf gel extracts of the plants showed notable effects. Other studies further afield, such as the study by Dahanukar et al. (2000) on the pharmacology of medicinal plants and natural products from India details the wound healing effects of aqueous extracts of latex from *Euphorbia neriifolia* (Nivadung) topically applied to surgical wounds on guinea pigs. In addition, the study focuses on the wound healing effects of organic extracts (alcoholic, petroleum ether, chloroform, propylene glycol and glycosidal) of *Centenella asiatica* used topically in various formulations (ointments, creams and gels) to treat open wounds on rat models where the gel formulation shows prominent activity. Furthermore, the wound healing effects of four other plants extracts on both immunocompromised and healthy rats i.e. *Aloe vera* (leaves); *Aegle marmelos* and *Moringa oleifera* (root and root bark) and leaves of *Tridax procumbens* were undertaken (Dahanukar et al., 2000). Studies such as these are lacking on southern African plant species.

## 3. Anti-inflammatory effects of medicinal plants used to treat skin ailments

While looking at the wound healing effects of the medicinal plants, it is also important to consider the inflammatory processes involved in wound formation and many other skin conditions (urticaria, skin allergies, acne vulgaris, eczema and psoriasis). Many southern African plants are used traditionally for their anti-inflammatory properties (Table 3). A study by Pillay et al. (2001) identified the cyclo-oxygenase inhibiting and antibacterial activities of South African *Erythrina* species. Cyclo-oxygenase is an enzyme responsible for inflammatory processes expressed as two isomers COX-1 and COX-2, with COX-2 induced in inflamed tissue. *Erythrina* is a genus with approximately 120 species traditionally used across South African rural areas for a variety of ailments including the disinfection of wounds. A study by Luseba et al. (2007) identified the anti-inflammatory (cyclo-oxygenase-1 and -2 inhibition) effects of some of the South African medicinal plants used to treat skin diseases such as; *C. quadrangularis*, *R. communis* and *Ziziphus mucronata*. A study by Ahmed et al. (2012) also identified the anti-inflammatory effects of four South African *Bauhinia* species, where the ability of *Bauhinia petersiana* to inhibit COX-1 and COX-2 was identified. Marnewick et al. (2005) identified the anti-oxidant, anti-inflammatory and antitumour properties of *Aspalathus linearis* and the respective chemical compounds. In addition, Frum (2006) investigated the *in vitro* inhibitory effects against 5-lipoxygenase and anti-oxidant activities of South African medicinal plants commonly used topically to treat skin diseases. The study included plants such as; *A. ferox*, *Artemisia afra*, *Bulbine* species, *Carpobrotus edulis*, *Cotyledon orbiculata*, *Datura stramonium*, *Halleria*

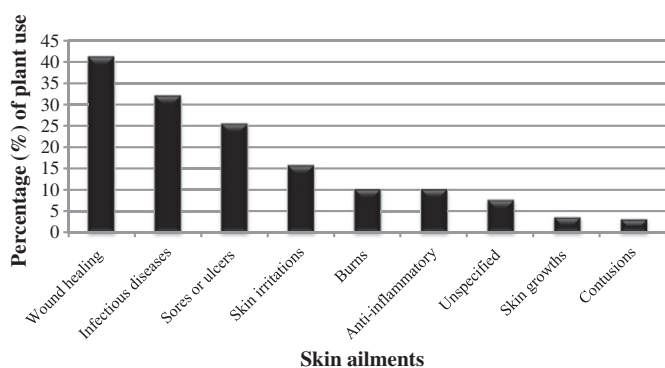


Fig. 1. Frequency of use (%) of southern African medicinal plants for the treatment of various skin ailments.

**Table 1**  
Southern African medicinal plants used for wound healing.

Botanical name/family	Common name	Parts used	Use	References
<i>Acacia erioloba</i> Edgew., Fabaceae	Giraffe thorn	Wood ash	Applied topically	Smith (1996) and Von Koenen (1996)
<i>Acacia mellifera</i> Benth., Fabaceae	Hookthorn or black thorn	Roots	Poultice	Smith (1996), Von Koenen (1996), Mutai et al. (2009) and Van Wyk et al. (2011)
<i>Adansonia digitata</i> L., Malvaceae	Baobab	Leaves	Applied topically	Von Koenen (1996) and Lagnika et al. (2012)
<i>Agathosma betulina</i> (P.J.Bergius) Pillans, Rutaceae	Buchu	Bachu vinegar with leaf	Infusion/tincture	Watt and Breyer-Brandwijk (1962), Smith (1996), Van Wyk et al. (2000), Van Wyk (2008a,b) and Moola (2005)
<i>Aloe arborescens</i> Mill., Asphodelaceae	Krantz aloe	Leaves	Applied topically	Van Wyk et al. (2000), Jia et al. (2008), Ghuman and Cooposamy (2011)
<i>Aspilia natalensis</i> (Sond.) Wild, Asteraceae	Wild creeping sunflower	Leaves	Leaf paste and infusion	Hutchings (1996)
<i>Barleria rigida</i> Spreng., Acanthaceae	Scorpion thistle	Roots or leaves	Decoction and powder	Von Koenen (1996)
<i>Bauhinia petersiana</i> Bolle, Fabaceae	Camels foot	Leaves	Leaf extract	Von Koenen (1996) and Ahmed et al. (2012)
<i>Boophane disticha</i> (L.f.) Herb., Amaryllidaceae	Tumbleweed, veld fan or windball	Bulbs	Applied topically	Watt and Breyer-Brandwijk (1962), Bruce (1975), Rabe and Van Staden (1997), Shale et al. (1999) and Van Wyk et al. (2000)
<i>Bridelia micrantha</i> Baill., Euphorbiaceae	Coastal golden leaf	Bark	Decoction	Mabogo (1990), Hutchings (1996), Samie et al. (2005), Adefuye et al. (2011) and Van Wyk et al. (2011)
<i>Bulbine frutescens</i> (L.) Willd., Asphodelaceae	Burn jelly plant	Slimy leaves	Applied topically	Rabe and Van Staden (1997), Van Wyk et al. (2000) and Ghuman and Cooposamy (2011)
<i>Bulbine natalensis</i> Baker, Xanthorrhoeaceae	Ibhucu	Leaves, roots and leaf sap	Applied directly to skin	Watt and Breyer-Brandwijk (1962), Pujol (1990), Rood (1994), Van Wyk et al. (2000) and Ghuman and Cooposamy (2011)
<i>Capparis tomentosa</i> Lam., Capparaceae	Woolly caper bush	Roots	Paste applied topically	Hutchings (1996) and Buwa and Van Staden (2006)
<i>Carpobrotus edulis</i> (L.) L. Bolus, Aizoaceae	Sour fig	Leaf juice and pulp	Juice directly applied to skin	Watt and Breyer-Brandwijk (1962), Rood (1994), Van Wyk et al. (2000) and Van der Watt and Pretorius (2001)
<i>Centaurea benedicta</i> (L.) L., Asteraceae	Holy thistle	Whole plant	Applied topically	Van Wyk et al. (2000)
<i>Centella asiatica</i> (L.) Urb., Apiaceae	Pennywort	Leaves	Tinctures	Boiteau et al. (1949), Smith (1996), Von Koenen (1996), Van Wyk et al. (2000), Van Wyk (2008a), Jagtap et al. (2009), Ullah et al. (2009), Dash et al. (2011), Malik et al. (2011)
<i>Chrysocoma ciliata</i> L., Asteraceae	Beebossie	Whole plant	Applied topically	Von Koenen (1996) and Ashafa and Afolayan (2009)
<i>Cissampelos capensis</i> Thunb. Menispermaceae	Davidjies	Rhizome, roots and leaves	Paste	Van Wyk et al. (2000) and Babajide et al. (2010)
<i>Cissus quadrangularis</i> L., Vitaceae	Veldt grape or devil's backbone	Shoots	Crushed shoots applied directly to wounds	Murthy et al. (2003), Kashikar and George (2006), Luseba et al. (2007) and Mishra et al. (2009)
<i>Cnicus benedictus</i> L., Asteraceae	Holy thistle	Whole plant	Paste	Bruneton (1995), Van Wyk et al. (2000) and Szabó et al. (2009)
<i>Combretum kraussii</i> Hochst., Combretaceae	Forest bushwillow	Root	Applied topically as a dressing	Masoko et al. (2007) and Van Wyk et al. (2009)
<i>Combretum molle</i> R.Br. ex G.Don, Combretaceae	Velvet bushwillow	Fresh or dry leaves	Applied topically as a dressing	Hutchings (1996), Van Wyk et al. (2011) and Masoko et al. (2007)
<i>Datura stramonium</i> L., Solanaceae	Jimson weed	Leaves	Skin patch	Watt and Breyer-Brandwijk (1962), Bruneton (1995), Rabe and Van Staden (1997), Van Wyk et al. (2000), Priya et al. (2002) and Saadabi and Moglad (2011)
<i>Dicoma anomala</i> Sond. Asteraceae	Fever bush or stomach bush	Charred root, stems and leaves	Paste	Boily and Van Puyvelde (1986) and Hutchings (1996)
<i>Diospyros mespiliformis</i> Hochst. ex A.DC., Ebenaceae	African ebony	Roots and leaves	Decoction	Von Koenen (1996), Van Wyk et al. (2011), Dangoggo et al. (2012) and Shagal et al. (2012)
<i>Elephantorrhiza elephantina</i> (Burch.) Skeels, Fabaceae	Eland's bean or elephant's root	Roots and rhizomes	Infusion applied topically, the root powder is sprinkled onto wounds	Pujol (1990), Van Wyk et al. (2009) and Mathabe et al. (2006)
<i>Embelia ruminata</i> (E.Mey. ex A.Dc.) Mez, Myrsinaceae	Vidanga	Leaves	Leaf paste	Kumara Swamy et al. (2007)
<i>Eriosperrum abyssinicum</i> Baker, Eriosperraceae	Cotton-seed lily	Leaves	Ointment	Von Koenen (1996)
<i>Erythrina lysistemon</i> Hutch., Fabaceae	Common coral tree or lucky bean tree	Bark	Applied as poultice or powdered burnt bark for open wounds	Coates Palgrave (1977), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000), Takahashi et al. (2004), More et al. (2008) and Van Wyk et al. (2011)

(continued on next page)

Table 1 (continued)

Botanical name/family	Common name	Parts used	Use	References
<i>Euclea divinorum</i> Hiern, Ebenaceae	Magic guarri	Roots and leaves	Applied topically on fresh bleeding wounds	Smith (1996), Von Koenen (1996), Geyid et al. (2005) and More et al. (2008)
<i>Ficus natalensis</i> Hochst., Moraceae	Natal fig	Leaves	Hot compress	Hutchings (1996), Rabe and Van Staden (1997) and Van Wyk et al. (2011)
<i>Galenia africana</i> L., Aizoaceae	Yellowbush	Whole plant	Decoction	Watt and Breyer-Brandwijk (1962)
<i>Grewia occidentalis</i> L., Malvaceae	Cross-berry or four-corner	Bark	Bark soaked in hot water and used as a dressing	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Grierson and Afolayan (1999)
<i>Gunnera perpensa</i> L., Gunneraceae	River pumpkin or wild rhubarb	Roots	Infusion	Hutchings (1996), Felhaber (1997), Buwa and Van Staden (2006) and Van Wyk (2008a)
<i>Haemanthus coccineus</i> L., Amaryllidaceae	Paintbrush lily or blood Flower	Leaves	Applied topically	Von Koenen (1996) and Van Wyk (2008b)
<i>Heeria argentea</i> (Thunb.) Meisn., Anacardiaceae	Kliphout (gom) or klipes Gum	Not given	mixed with sweet oil	Van Wyk (2008b)
<i>Helichrysum foetidum</i> (L.) Moench, Asteraceae	Yellow everlasting	Leaves	Applied topically	Gerstner (1938), Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Lourens et al. (2004)
<i>Hoffmannseggia burchellii</i> (DC.) Oliv., Fabaceae	Rush peas	Roots	Scrapings of fresh roots applied topically	Von Koenen (1996)
<i>Hypericum perforatum</i> L., Hypericaceae	St. John's wort	Above ground parts	Applied topically	Bruneton (1995), Van Wyk et al. (2000) and Saddiqe et al. (2010)
<i>Jatropha curcas</i> L., Euphorbiaceae	Purging nut	Rhizome	Applied topically	Perumal Samy et al. (1998) and Van Wyk et al. (2000)
<i>Jatropha zeyheri</i> Sond., Euphorbiaceae	Verfbol	Rhizome or sap	Applied topically	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Luseba et al. (2007) and Van Wyk et al. (2009)
<i>Lannea discolor</i> (Sond.) Engl., Anacardiaceae	Live-long or tree grape	Plant fibre	Fibre used as bandage	Gelfand et al. (1895) and Van Wyk et al. (2011)
<i>Lobostemon fruticosus</i> (L.) H.Buek, Boraginaceae	Pajama bush	Leaves and twigs	Ointment	Smith (1895), Watt and Breyer-Brandwijk (1962), Rood (1994) and Van Wyk et al. (2000)
<i>Malva parviflora</i> L. Malvaceae	Small-flowered mallow or cheeseweed	Leaf	Hot leaf poultice	Watt and Breyer-Brandwijk (1962), Grierson and Afolayan (1999), Von Koenen (1996) and Tadege et al. (2005)
<i>Melianthus comosus</i> Vahl, Melianthaceae	Honey flower	Leaves, leaf juice	Leaf poultice or leaf decoction. The leaf juice or paste is applied frequently for the treatment of wounds.	Smith (1895), Gerstner (1938), Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Kelmanson et al. (2000)
<i>Melianthus major</i> L., Melianthaceae	Giant honey flower	Leaves	Leaf poultice or leaf decoction	Van Wyk et al. (2009) and Srividya and Sumithra (2010)
<i>Mentha longifolia</i> L., Lamiaceae	Wild mint	Leaves	Applied topically	Van Wyk et al. (2000) and Gulluce et al. (2007)
<i>Myrothamnus flabellifolius</i> Welw., Myrothamnaceae	Resurrection plant	Leaves and twigs	Dried powdered leaves applied topically	Von Koenen (1996) and Van Wyk et al. (2000)
<i>Nymania capensis</i> (Thunb.) Lindb., Meliaceae	Chinese lantern	Roots	Powder mixed with fat into an ointment	Von Koenen (1996)
<i>Nymphaea caerulea</i> Sav., Nymphaeaceae	Blue lotus or sacred blue lily	Leaves and stems	Poultice	Von Koenen (1996)
<i>Opuntia ficus-indica</i> (L.) Mill., Cactaceae	Prickly pear or barbary fig	Leaves	Applied topically	Smith (1996) and Von Koenen (1996)
<i>Pelargonium alchemilloides</i> (L.) L'Hr., Geraniaceae	Wilde malva or garden geranium	Leaves	Leaf paste	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Shale et al. (1999)
<i>Phytolacca americana</i> L., Phytolaccaceae	Ink berry or pigeon berry	Leaves	Paste applied topically	Hutchings (1996)
<i>Phytolacca octandra</i> L., Phytolaccaceae	Red inkplant or pokeweed	Leaves	Paste applied topically	Hutchings (1996)
<i>Plantago afra</i> L., Plantaginaceae	Ribwort plantain, black psyllium or flea-seed plant	Leaves	Ointment	Hutchings (1996)
<i>Plectranthus fruticosus</i> L'Hér., Lamiaceae	Muishondblare	Leaves	Open wounds	Van Wyk (2008b)
<i>Priva cordifolia</i> (Linn. f.) Druce, Verbenaceae	Heart-leaf velvet bur or heart-leaf priva	Ground seeds	Applied topically	Hutchings (1996)
<i>Psidium guajava</i> L., Myrtaceae	Guava	Leaves	Infusions applied topically	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Van Wyk et al. (2000), Gutiérrez et al. (2008), Abubakar (2009) and Van Wyk et al. (2011)
<i>Ricinus communis</i> L., Euphorbiaceae	Caster bean tree	Leaf, burnt-pulverized seeds and bark	Applied as poultice	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Van Wyk et al. (2000), Luseba et al. (2007) and Malik et al. (2011)
<i>Rothmannia capensis</i> Thunb, Rubiaceae	Wild gardenia or common <i>Rothmannia</i>	Sap from fruit	Applied topically	Arnold and Gulumian (1984), Hutchings (1996) and Steenkamp et al. (2007)



Table 1 (continued)

Botanical name/family	Common name	Parts used	Use	References
<i>Sarcostemma viminale</i> (L.) R.Br., Apocynaceae	Caustic bush or rapunzel plant	Whole plant	Latex	Von Koenen (1996) and Luseba et al. (2007)
<i>Scabiosa columbaria</i> L., Dipsacaceae	Wild scabious or butterfly Blue	Leaves and roots	Ointment	Von Koenen (1996) and Van Wyk et al. (2000)
<i>Scadoxus puniceus</i> (L.) Friis & Nordal, Amaryllidaceae	Red paintbrush or paintbrush lily	Bulbs and roots	Decoction applied topically	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Van Wyk et al. (2000)
<i>Securidaca longepedunculata</i> Fresen, Polygalaceae	Violet tree	Leaves and bark	Ointment	Hutchings (1996) and Van Wyk et al. (2000)
<i>Senecio concolor</i> DC., Asteraceae	Idambiso or ibohlololo	Leaves	Paste	Smith (1895)
<i>Senecio latifolius</i> DC., Asteraceae	Dan's cabbage, groundsel or ragwort	Leaves	Paste	Smith (1895)
<i>Senna italica</i> Mill., Fabaceae	Wild senna	Roots	Applied topically	Hutchings (1996) and Dabai et al. (2012)
<i>Sonchus oleraceus</i> L., Asteraceae	Milk thistle, sow thistle or smooth sow thistle	Whole plant	Ointment	Watt and Breyer-Brandwijk (1962) and Jimoh et al. (2011)
<i>Solanum hermannii</i> Dunal, Solanaceae	Devil's apple	Fruit sap, leaf paste and roots	Leaf paste or ointment	Watt and Breyer-Brandwijk (1962) and Hutchings (1996)
<i>Solanum incanum</i> L., Solanaceae	Bark weed, thorn apple or bitter apple	Leaves and roots	Applied topically	Gerstner (1938), Hutchings (1996), Von Koenen (1996) and Hamza et al. (2006)
<i>Solanum nigrum</i> L., Solanaceae	Black nightshade	Whole plant	Applied topically	Von Koenen (1996) and Malik et al. (2011)
<i>Sutherlandia frutescens</i> L. R.Br., Fabaceae	Cancer bush	Roots	Wounds	Van Wyk (2008b)
<i>Terminalia sericea</i> Burch. ex DC., Combretaceae	Silver cluster-leaf or silver <i>Terminalia</i>	Root sap or bark	Applied topically	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000) and Moshi and Mbwambo (2005)
<i>Trichilia emetica</i> Vahl, Meliaceae	Natal Mahogany	Leaves or fruits	Poultice	Adeniji et al. (1998), Germanò et al. (2005), Geyid et al. (2005), Shai et al. (2008), Komane et al. (2011) and Van Wyk et al. (2011)
<i>Urtica urens</i> L., Urticaceae	Common nettle	Leaves	Tincture applied to wounds and sores	Van Wyk (2008b)
<i>Venidium arctotoides</i> (L.f.) Less., Asteraceae	Bittergousblom or bitterblom	Leaves	Leaf paste	Smith (1895)
<i>Waltheria indica</i> L., Malvaceae	Sleepy Morning, velvet leaf or marsh-mallow	Roots	Applied topically	Von Koenen (1996) and Olajuyigbe et al. (2011)
<i>Withania somnifera</i> (L.) Dunal, Solanaceae	Poison gooseberry or winter cherry	Leaves and berries	Ointment	Watt and Breyer-Brandwijk (1962), Boily and Van Puyvelde (1986), Pujol (1990), Hutchings (1996), Van Wyk et al. (2000), Van Wyk (2008a), Malik et al. (2011) and Saadabi and Moglad (2011)
<i>Ximenia caffra</i> Sond., Olacaceae	Large sourplum	Roots	Topical	Von Koenen (1996), Fabry et al. (1998) and Van Wyk et al. (2011)
<i>Xysmalobium undulatum</i> R.Br. Apocynaceae	Milk bush, milkwort, uzura or wild cotton,	Roots	Powder applied topically	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000) and Buwa and Van Staden (2006)
<i>Zantedeschia aethiopica</i> (L.) Spreng., Araceae	Arum lily or calla lily	Leaves	Leaf applied directly	Watt and Breyer-Brandwijk (1962), Rood (1994), Van Wyk et al. (2000) and Nielsen et al. (2012)

*lucida*, *H. procumbens*, *Helichrysum odoratissimum*, *Kigelia africana*, *Leonotis leonurus*, *Lippia javanica*, *Melianthus comosus*, *Pentanisia prunelloides*, *Rauvolfia caffra*, *Rothmannia capensis*, *Scilla natalensis*, *T. emetica*, *W. salutaris* and *Z. mucronata*. *M. comosus* was noted as the most active with an IC<sub>50</sub> value of 13.84 ± 1.18 ppm displaying the strongest 5-lipoxygenase inhibitory effects.

#### 4. Overview of other non-infectious skin conditions

The skin is the largest organ of the body and plays a number of vital roles such as protection, thermoregulation, percutaneous absorption as well as having secretory and sensory activities (Njoroge and Busmann, 2007). The acidic sebaceous secretions and surface structure of the skin are aggressive to many pathogens. The rich blood and lymphatic supply of the dermis (which is the inner-middle layer of the skin between the epidermal and endodermal layer of the skin)

ensure that both specific and non-specific immune responses can be quickly recruited against pathogens that invade the skin. The skin's defence system may be compromised if the surface is penetrated by injury or thinned by the use of corticosteroids or excoriated by inflammatory processes (Bannister et al., 2000). The skin's defence can also be compromised in immunocompromised patients who suffer from diabetes, HIV/AIDS, patients being treated with chemotherapy, corticosteroids or systemic antibiotics such as Augmentin® (amoxicillin plus clavulanic acid) which may promote skin fungal infections (Tadeg, 2004). Consequently, this makes the skin less resistant to infections. The need for alternate treatment options is gradually becoming an important aspect of basic healthcare amongst various communities (Njoroge and Busmann, 2007). The resilient nature of skin diseases and socio economic aspects, where there is a burden of poverty, overcrowded living conditions, inadequate supply of clean water and co-habitation with pets often play a vital role in the high prevalence of skin diseases and the difficulty in

**Table 2**  
Southern African medicinal plants used to treat sores or ulcers.

Botanical name/family	Common name	Parts used	Use	References
<i>Amygdalus persica</i> L., Rosaceae	Peach tree	Leaves	Decoction applied to treat sores	Smith (1895)
<i>Aspilia natalensis</i> (Sond.) Wild, Asteraceae	Wild creeping sunflower	Leaves	Leaf paste or infusion applied to treat sores	Hutchings (1996)
<i>Aster bakeranus</i> Burt Davy ex C. A. Sm., Asteraceae	Uhloshana	Roots	Lotion applied to treat sores	Hutchings (1996) and Shale et al. (1999)
<i>Athrixia phyllicoides</i> DC., Asteraceae	Bushman's tea	Whole plant	Plant infusion applied to treat sores	Hutchings (1996) and Padayachee (2011)
<i>Boophane disticha</i> (L.f.) Herb., Amaryllidaceae	Tumbleweed, veld fan or windball	Bulbs	Applied topically to treat sores	Watt and Breyer-Brandwijk (1962), Bruce (1975), Rabe and Van Staden (1997), Shale et al. (1999) and Van Wyk et al. (2000)
<i>Cardiospermum halicacabum</i> L., Sapindaceae	Balloon vine or love in a puff	Leaves	Warm water leaf infusion applied to treat sores	Gerstner (1938), Hutchings (1996), Girish et al. (2008), Viji and Murugesan (2010) and Deepan et al. (2012)
<i>Centaurea benedicta</i> (L.) L., Asteraceae	Holy thistle	Whole plant	Applied topically to treat ulcers	Van Wyk et al. (2000)
<i>Chironia baccifera</i> L., Gentianaceae	Christmas berry	Whole plant	Applied topically to treat sores	Laidler (1928), Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Thring et al. (2007)
<i>Cissampelos capensis</i> Thunb., Menispermaceae	Davidjies	Rhizomes, roots and leaves	Paste applied to treat sores and ulcers	Van Wyk et al. (2000) and Babajide et al. (2010)
<i>Cnicus benedictus</i> L., Asteraceae	Holy thistle	Whole plant	Paste applied to treat ulcers	Bruneton (1995), Van Wyk et al. (2000) and Szabó et al. (2009)
<i>Crinum macowanii</i> Baker, Amaryllidaceae	River lily or veld lily	Bulbs and leaves	Applied topically to treat sores	Smith (1996), Rabe and Van Staden (1997) and Van Wyk et al. (2000)
<i>Dicoma anomala</i> Sond., Asteraceae	Fever bush or stomach bush	Charred root, stems and leaves	Paste applied topically to treat ulcers and sores	Boily and Van Puyvelde (1986) and Hutchings (1996)
<i>Dioscorea dregeana</i> T.Durand & Schinz., Dioscoreaceae	Wild yam	Large fresh tubers	Decoction applied topically to treat sores and cuts	Watt and Breyer-Brandwijk (1962), Pujol (1990), Kelmanson et al. (2000) and Van Wyk et al. (2000)
<i>Eriospermum abyssinicum</i> Baker, Eriosepmaeae	Cotton-seed lily	Leaves	Ointment applied to treat ulcers	Von Koenen (1996)
<i>Erythrina lysistemon</i> Hutch., Fabaceae	Common coral tree or lucky bean tree	Bark	Applied as poultice or powdered burnt bark to treat sores	Coates Palgrave (1977), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000), Takahashi et al. (2004), More et al. (2008) and Van Wyk et al. (2011)
<i>Graderia scabra</i> (L.f.) Benth., Orobanchaceae	Pink ground-bells	Roots	Paste applied to treat sores	Hutchings (1996)
<i>Haemanthus coccineus</i> L., Amaryllidaceae	Paintbrush lily or blood Flower	Leaves	Applied topically to treat ulcers	Von Koenen (1996)
<i>Harpagophytum procumbens</i> DC. ex Meisn., Pedaliaceae	Devil's claw or grapple plant	Roots	Ointment applied to treat sores and ulcers	Watt and Breyer-Brandwijk (1962) and Van Wyk et al. (2000)
<i>Helichrysum foetidum</i> (L.) Moench, Asteraceae	Yellow everlasting	Leaves	Applied topically to treat sceptic sores	Gerstner (1938), Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Lourens et al. (2004)
<i>Hibiscus surattensis</i> L., Malvaceae	Wild sour	Pounded leaf and stalk	Ointment applied to treat sores	Hutchings (1996)
<i>Ilex mitis</i> Radlk., Aquifoliaceae	Cape holly, African holly or waterboom	Ground bark	Paste or decoction applied to treat sores	Hutchings (1996) and Van Wyk et al. (2011)
<i>Ipomoea crassipes</i> Hook., Convolvulaceae	One-day flower	Ground plant parts	Paste applied topically to treat sores	Hutchings (1996)
<i>Jasminum fluminense</i> Vell., Oleaceae	Wild jasmine	Leaves and young shoots	Applied topically to treat ulcers	Von Koenen (1996)
<i>Jatropha zeyheri</i> Sond., Euphorbiaceae	Verfbol	Rhizomes or sap	Applied topically to treat sores	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Luseba et al. (2007) and Van Wyk et al. (2009)
<i>Kigelia africana</i> (Lam.) Benth., Bignoniaceae	Sausage tree	Fruit	Applied topically to treat ulcers and sores	Watt and Breyer-Brandwijk (1962), Coates Palgrave (1977), Hutchings (1996), Van Wyk et al. (2000), Shai et al. (2008) and Van Wyk et al. (2011)
<i>Lantana rugosa</i> Thunb., Verbenaceae	Bird's brandy	Leaf, stem and ripe fruits	Paste applied to treat festering sores	Smith (1895), Roberts (1990), Hutchings (1996), Kelmanson et al. (2000) and Suliman et al. (2010)
<i>Leontonyx angustifolius</i> DC., Asteraceae	Beetbossie	Ointment	Applied topically to treat ulcers	Watt and Breyer-Brandwijk (1962) and Lourens et al. (2008)
<i>Melianthus comosus</i> Vahl., Melianthaceae	Honey Flower	Leaves, leaf juice	Leaf poultice and leaf decoction applied to treat sores	Smith (1895), Gerstner (1938), Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Kelmanson et al. (2000)
<i>Melianthus major</i> L., Melianthaceae	Giant honey flower	Leaves	Leaf poultice or leaf decoction applied to treat sores	Van Wyk et al. (2009) and Srividya and Sumithra (2010)
<i>Opuntia ficus-indica</i> (L.) Mill., Cactaceae	Prickly pear or barbary fig	Leaves	Applied topically to treat ulcers	Smith (1996) and Von Koenen (1996)
<i>Osmitopsis asteriscoides</i> Cass., Asteraceae	Mountain daisy or bellis	Leaves	Applied topically to treat cuts	Van Wyk et al. (2000) and Viljoen et al. (2003)

Table 2 (continued)

Botanical name/family	Common name	Parts used	Use	References
<i>Phyllanthus reticulatus</i> Lodd., Euphorbiaceae	Potato bush or roast potato plant	Leaves	Powered leaf applied topically to treat sores	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Ram et al. (2004)
<i>Priva cordifolia</i> Druce, Verbenaceae	Heart-leaf velvet bur or heart-leaf priva	Ground seeds	Applied topically to treat sores	Hutchings (1996)
<i>Psidium guajava</i> L., Myrtaceae	Guava	Leaves	Infusions applied topically to treat ulcers	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Van Wyk et al. (2000), Gutiérrez et al. (2008), Abubakar (2009) and Van Wyk et al. (2011)
<i>Ricinus communis</i> L., Euphorbiaceae	Caster bean tree	Leaf, burnt-pulverized seeds and bark	Applied as poultice to treat sores	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Van Wyk et al. (2000), Luseba et al. (2007) and Malik et al. (2011)
<i>Sarcostemma viminale</i> (L.) R.Br., Asclepiadaceae	Caustic bush or rapunzel plant	Whole plant	Latex applied to treat ulcers	Von Koenen (1996) and Luseba et al. (2007)
<i>Scadoxus puniceus</i> (L.) Friis & Nordal, Amaryllidaceae	Red paintbrush or paintbrush Lily	Bulbs and roots	Decoction applied topically to treat ulcers and sores	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Van Wyk et al. (2000)
<i>Scilla natalensis</i> Planch., Hyacinthaceae	Blue squill or wild squill	Bulb	Applied topically to treat sores	Roberts (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000) and Ghuman and Cooposamy (2011)
<i>Securidaca longepedunculata</i> Fresen., Polygalaceae	Violet tree	Leaves and bark	Ointment applied to treat sores	Hutchings (1996) and Van Wyk et al. (2000)
<i>Senecio concolor</i> DC., Asteraceae	Idambiso or ibohlololo	Leaves	Paste applied to treat cuts and sores	Smith (1895)
<i>Senecio serratuloides</i> DC., Asteraceae	Two day cure	Leaves and stems	Applied topically to treat cuts	Pujol (1990), Bhat and Jacobs (1995), Hutchings (1996) and Kelmanson et al. (2000)
<i>Sonchus oleraceus</i> L., Asteraceae	Milk thistle sowthistle or smooth sow thistle	Whole plant	Ointment applied to treat sores	Watt and Breyer-Brandwijk (1962) and Jimoh et al. (2011)
<i>Solanum giganteum</i> Jacq., Solanaceae	Healing-leaf tree, red bitter-apple, red bitter- berry, thorny bug-tree	Leaves	Ointment applied to treat festering sores	Watt and Breyer-Brandwijk (1962) and Hutchings (1996)
<i>Solanum nigrum</i> L., Solanaceae	Black nightshade	Whole plant	Applied topically to treat ulcers	Von Koenen (1996) and Malik et al. (2011)
<i>Turbina oblongata</i> (E.Mey. ex Choisy) A.Meeuse, Convolvulaceae	Ubhoqo	Leaves	Applied topically to treat sores	Pujol (1990) and Hutchings (1996)
<i>Ximenia caffra</i> Sond., Olacaceae	Large sourplum	Roots	Applied topically to treat septic sores	Von Koenen (1996), Fabry et al. (1998) and Van Wyk et al. (2011)
<i>Xysmalobium undulatum</i> R.Br., Apocynaceae	Milk bush, milkwort, uzura or wild cotton,	Roots	Powder applied topically to treat sores	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000) and Buwa and Van Staden (2006)
<i>Zantedeschia aethiopica</i> (L.) Spreng., Araceae	Arum lily or calla lily	Leaves	Leaf applied topically to treat sores	Watt and Breyer-Brandwijk (1962), Rood (1994), Van Wyk et al. (2000) and Nielsen et al. (2012)
<i>Zanthoxylum capense</i> Harv., Rutaceae	Small knobwood	Leaves	Applied topically to treat sores	Bryant (1996), Hutchings (1996) and Buwa and Van Staden (2006)
<i>Ziziphus mucronata</i> Willd., Rhamnaceae	Buffalo-thorn	Leaves, roots and bark	Decoction applied topically to treat sores	Watt and Breyer-Brandwijk (1962), Rood (1994), Hutchings (1996), Rabe and Van Staden (1997), Luseba et al. (2007), Van Wyk et al. (2000) and Van Wyk et al. (2011)

treatment thereof. As a result of age related anatomical, physiological, behavioural and environmental factors, both the very young and elderly are considered to be more prone to skin diseases (Laube, 2004; Tomson and Sterling, 2007).

Another factor of concern with respect to dermatological infections is the impact from occupational sources. The prevalence of skin ailments is estimated to be as high as 34% of all occupational diseases, worldwide (Njoroge and Bussmann, 2007; Abbasi et al., 2010). Occupational skin diseases are generally related to the long periods of exposure to chemicals, water and sun. Workers may present with skin diseases or conditions such as eczema, urticaria, sunburn or skin cancer (Fowler, 1998). Many of the lower income workers, such as miners or farming labourers in South Africa are thus prone to skin diseases of occupational origin. Eczema is estimated to be the most common skin disorder diagnosed in the South African population (Hartshorne, 2003). It is thus not surprising that some medicinal plants are dedicated to the treatment of skin irritations (Table 4). Also, plants used traditionally may be applied for other non-specified ailments (Table 5), as well as burns (Table 6), contusions (Table 7) and skin growths (Table 8).

## 5. Infections of the skin

Skin infections may be attributed to a variety of microbes, either being viral, parasitic, bacterial or fungal in nature. In addition to this, when the integrity of the skin is compromised (by injury or any other external or internal factor), many characteristic diseases either inflammatory or non-inflammatory may result, and these may range from mild skin rashes, dermatitis (eczema), psoriasis, acute erythema, vitiligo to burns and deep wounds (Bannister et al., 2000; Van Hees and Naafs, 2001). Bacterial pathogens that may cause infections on the skin include; *Staphylococci* and *Streptococci* (impetigo and open wound infections), *Pseudomonas aeruginosa* (furunculosis and open wound infection), *Mycobacterium leprae* (leprosy), *Corynebacterium minutissimum* and *Corynebacterium diphtheriae* (erythrasma), *Pasteurella multocida* (cellulitis), *Bartonella henselae* (cellulitis), *Propionibacterium acnes* (acne vulgaris) and *Borrelia burgdorferi* (erythema chronicum migrans), to name a few of the most frequently encountered organisms (Bannister et al., 2000; Van Hees and Naafs, 2001; Weideman, 2005; Weckesser et al., 2007).

**Table 3**  
Southern African medicinal plants used to treat skin inflammation.

Botanical name/family	Common name	Parts used	Use	References
<i>Acokanthera oppositifolia</i> (Lam.) Codd., Apocynaceae	Bushmans arrow poison	Powdered leaf	Topical	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Nielsen et al. (2012)
<i>Boophane disticha</i> (L.f.) Herb., Amaryllidaceae	Tumbleweed, veld fan or windball	Bulbs	Topical	Watt and Breyer-Brandwijk (1962), Bruce (1975), Rabe and Van Staden (1997), Shale et al. (1999) and Van Wyk et al. (2000)
<i>Cassine transvaalensis</i> Celastraceae	Saffronwood	Bark	Infusion	Von Koenen (1996), Van Wyk et al. (2000) and Steenkamp et al. (2007)
<i>Cinnamomum camphora</i> (L.) J.Presl, Lauraceae	Camphor tree	Essential oil	Topical	Grieve (1967) and Van Wyk et al. (2000)
<i>Cotyledon orbiculata</i> Forssk, Crassulaceae	Pig's ear	Leaf and leaf juice	Apply juice topically for warts removal, or place the hot leaf directly to the swollen part of the body	Watt and Breyer-Brandwijk (1962), Rood (1994), Bhat and Jacobs (1995), Felhaber (1997) and Van Wyk et al. (2000)
<i>Dodonaea angustifolia</i> L.f., Sapindaceae	Sand olive	Tips of twigs	For inflammation	Van Wyk (2008b)
<i>Galenia africana</i> L., Aizoaceae	Yellowbush	Leaf	For inflammation	Van Wyk (2008b)
<i>Glycyrrhiza glabra</i> L., Fabaceae	Liquorice root	Rhizomes and roots	Topical	Bruneton (1995), Van Wyk et al. (2000) and Motsei et al. (2003)
<i>Hibiscus surattensis</i> L., Malvaceae	Wild sour	Pounded leaf and stalk	Ointment	Hutchings (1996)
<i>Kigelia africana</i> (Lam.) Benth., Bignoniaceae	Sausage tree	Fruit	Topical	Watt and Breyer-Brandwijk (1962), Coates Palgrave (1977), Hutchings (1996), Van Wyk et al. (2000), Shai et al. (2008) and Van Wyk et al. (2011)
<i>Malva parviflora</i> L. Malvaceae	Small mallow	Leaf	Hot leaf poultice	Watt and Breyer-Brandwijk (1962), Grierson and Afolayan (1999), Von Koenen (1996) and Tadege et al. (2005)
<i>Melianthus comosus</i> Vahl., Melianthaceae	Honey Flower	Leaves, leaf juice	Leaf poultice and leaf decoction. The leaf juice or paste is applied frequently for the treatment of wounds.	Smith (1895), Gerstner (1938), Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Kelmanson et al. (2000)
<i>Nymphaea caerulea</i> Savigny, Nymphaeaceae	Blue water lily	Leaves and stems	Poultice	Von Koenen (1996)
<i>Osmitopsis asteriscoides</i> Cass., Asteraceae	Mountain daisy or bellis	Leaves	Topical	Van Wyk et al. (2000) and Viljoen et al. (2003)
<i>Ozoroa engleri</i> R.Fern. & A.Fern., Anacardiaceae	White resin tree	Bark, roots and leaves	Topical	Pooley (1993) and Hutchings (1996)
<i>Pentanisia prunelloides</i> Walp., Rubiaceae	Wild verbena	Roots	Applied topically	Van Wyk et al. (2000) and Yff et al. (2002)
<i>Phytolacca americana</i> L., Phytolaccaceae	Ink berry or pigeon berry	Leaves	Paste applied topically	Hutchings (1996)
<i>Senecio serratuloides</i> DC., Asteraceae	Two day cure	Leaves and stems	Topical	Pujol (1990), Bhat and Jacobs (1995), Hutchings (1996) and Kelmanson et al. (2000)
<i>Withania somnifera</i> (L.) Dunal, Solanaceae	Poison gooseberry or winter cherry	Leaves and berries	Ointment	Watt and Breyer-Brandwijk (1962), Boily and Van Puyvelde (1986), Pujol (1990), Hutchings (1996), Van Wyk et al. (2000), Malik et al. (2011) and Saadabi and Moglad (2011)
<i>Ziziphus mucronata</i> Willd., Rhamnaceae	Buffalo-thorn	Leaves, roots and bark	Decoction applied topically	Watt and Breyer-Brandwijk (1962), Rood (1994), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000), Luseba et al. (2007) and Van Wyk et al. (2011)

Yeasts and dermatophytes are typical fungal infections associated with the skin. Dermatophytosis is an infection of the keratinized tissue that is hair, nails and the skin, and is commonly known as ringworm or tinea and is referred to as onychomycosis when the finger nails are infected. Dermatophyte causing infections are mainly typical of the three genera: *Microsporum*, *Trichophyton* and *Epidermophyton* (Beneke et al., 1984; Van Hees and Naafs, 2001; Tadege, 2004). Candidiasis caused by *Candida albicans*, is a yeast infection of the mucous membrane often occurring in adipose, immunocompromised and diabetic patients (Weckesser et al., 2007). When burns occur, the skin loses its protective epithelial layer and since *C. albicans* forms part of the opportunistic skin flora, the wounds may become prone to infection by the yeast (Naidoo and Cooposamy, 2011).

### 5.1. Antimicrobial properties of medicinal plants against skin relevant pathogens

The traditional use of southern African medicinal plants for the treatment of skin infections is extensive, as can be observed in Table 9. While numerous antimicrobial studies have addressed the efficacies of plant species used to treat a plethora of diseases, relatively

few studies of southern African relevance have addressed the antimicrobial efficacies of plant species against pathogens associated with acne and superficial skin fungal infections. The majority of the plant species noted in Table 9 have been incorporated into some antimicrobial studies, against pathogens such as, *Staphylococci* species, *P. aeruginosa* and *C. albicans* using either disc-diffusion and/or the minimum inhibitory concentration assays, however, limited attention has been given to other skin relevant pathogens.

While many southern African medicinal plants are traditionally used to treat fungal skin infections such as tinea, the correlation between skin infections and pathogens such as *Microsporum canis*, *Trichophyton mentagrophytes* and *Epidermophyton floccosum*, species have been addressed in only a few antimicrobial studies such as Masoko et al. (2005), Masoko et al. (2007); Shai et al. (2008) and Ghuman and Cooposamy (2011). The treatment of dermatophytes have been addressed in other medicinal plant studies further afield than South Africa, where plant extracts were observed to possess antifungal effects (Ali-Shtayeh and Gheib, 1999; Webster et al., 2008; Mutai et al., 2009; Sule et al., 2010; Bhadauria and Kumar, 2011; Beatriz et al., 2012). Dermatophytes have also been addressed in other *in vitro* studies involving the essential oil of *Eucalyptus pauciflora*



**Table 4**  
Southern African medicinal plants used to treat skin irritations.

Botanical name/family	Common name	Parts used	Use	References
<i>Acokanthera oblongifolia</i> Benth. & Hook.f., Apocynaceae	Poison bush	Roots	Applied topically to relieve itching	Palmer and Pitman (1972), Hutchings (1996) and McGaw et al. (2000)
<i>Albizia adianthifolia</i> W.Wight, Fabaceae	Flat crown	Bark and roots	Lotion applied to treat eczema	Boily and Van Puyvelde (1986) and Bryant (1996), Hutchings (1996) and Van Wyk et al. (2011)
<i>Aloe ferox</i> Mill., Xanthorrhoeaceae	Bitter aloe	Leaf sap, leaves and roots	Sap applied topically to treat skin irritation, psoriasis, skin cancer and eczema	Watt and Breyer-Brandwijk (1962), Bruce (1975), Van Wyk et al. (2000) and Jia et al. (2008)
<i>Arctopus echinatus</i> L., Apiaceae	Bear's foot.	Roots	Infusion applied to treat skin irritation	Watt and Breyer-Brandwijk (1962), Van Wyk et al. (2000) and Magee et al. (2007)
<i>Aspalathus linearis</i> (Burm.f.) R.Dahlgren, Fabaceae	Rooibos tea	Leaves	Applied topically to treat eczema	Van Wyk et al. (2000) and Joubert et al. (2008)
<i>Bulbine frutescens</i> (L.) Willd., Asphodelaceae	Burn jelly plant	Slimy leaves	Applied topically to treat skin rash and relieve itchiness	Rabe and Van Staden (1997), Van Wyk et al. (2000) and Ghuman and Cooposamy (2011)
<i>Carpobrotus edulis</i> (L.) N.E.Br., Aizoaceae	Sour fig	Leaf juice and pulp	Juice directly applied to skin to treat eczema	Watt and Breyer-Brandwijk (1962), Rood (1994), Van Wyk et al. (2000) and Van der Watt and Pretorius (2001)
<i>Cassine transvaalensis</i> Celastraceae	Saffronwood	Bark	Infusion applied to treat skin rash	Von Koenen (1996), Van Wyk et al. (2000) and Steenkamp et al. (2007)
<i>Chenopodium ambrosioides</i> Bert. ex Steud., Chenopodiaceae	Worm salt	Whole plant	Decoction applied to treat eczema	Boily and Van Puyvelde (1986) and Hutchings (1996)
<i>Diospyros mespiliformis</i> Hochst. ex A.DC., Ebenaceae	African ebony	Roots and leaves	Decoction applied to treat skin rash	Von Koenen (1996), Van Wyk et al. (2011), Dangoggo et al. (2012) and Shagal et al. (2012)
<i>Dodonaea angustifolia</i> L.f., Sapindaceae	Sand olive	Leaves and tips of twigs	Decoction applied topically as an antipruritic	Watt and Breyer-Brandwijk (1962), Rood (1994), Smith (1996), Van Wyk et al. (2000) and Teffo et al. (2010)
<i>Euclea divinorum</i> Hiern, Ebenaceae	Magic guarri	Roots and leaves	Applied topically to treat skin rash	Smith (1996), Von Koenen (1996), Geyid et al. (2005) and More et al. (2008)
<i>Glycyrrhiza glabra</i> L., Fabaceae	Liquorice root	Rhizomes and roots	Applied topically as an antipruritic	Bruneton (1995), Van Wyk et al. (2000) and Motsei et al. (2003)
<i>Guibourtia coleosperma</i> (Benth.) J.Léonard, Fabaceae	African rosewood	Roots	Applied topically to treat Superficial skin scratches	Von Koenen (1996)
<i>Gunnera perpensa</i> L., Gunneraceae	River pumpkin	Roots	Infusion applied to treat psoriasis	Hutchings (1996), Felhaber (1997) and Buwa and Van Staden (2006)
<i>Harpephyllum caffrum</i> Bernh. ex Krauss, Anacardiaceae	Wild plum	Bark	Applied topically to treat eczema	Pujol (1990), Van Wyk et al. (2000), Buwa and Van Staden (2006) and Van Wyk et al. (2011)
<i>Hibiscus surattensis</i> L., Malvaceae	Wild sour	Pounded leaf and stalk	Ointment applied to treat skin irritation	Hutchings (1996)
<i>Ilex mitis</i> Radlk, Aquifoliaceae	Cape holly, African holly or waterboom	Ground bark	Paste or decoction applied to treat skin rash	Hutchings (1996) and Van Wyk et al. (2011)
<i>Leonotis leonurus</i> (L.) R.Br., Lamiaceae	Wild dagga or lion's tail	Leaves and stems	Decoction applied topically to treat eczema and relieve itchiness	Mabogo (1990), Roberts (1990) and Pooley (1993)
<i>Matricaria nigellifolia</i> DC., Asteraceae	Staggers weed	Leaves	Leaf infusion applied to treat skin rash	Hutchings (1996)
<i>Melia azedarach</i> L., Meliaceae	China berry tree, bead-tree or cape lilac	Leaf, flower, bark and root	Ointment applied to treat eczema	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Khan et al. (2001) and Sen and Batra (2012)
<i>Nymphaea caerulea</i> Savigny, Nymphaeaceae	Blue water lily	Leaves and stems	Poultice applied to treat skin rash	Von Koenen (1996)
<i>Opuntia ficus-indica</i> (L.) Mill., Cactaceae	Prickly pear or barbary fig	Leaves	Applied topically to treat skin rash	Smith (1996) and Von Koenen (1996)
<i>Phyllanthus reticulatus</i> Lodd., Euphorbiaceae	Potato bush or roast potato plant	Leaves	Powered leaf applied topically to treat skin irritations	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Ram et al. (2004)
<i>Plantago afra</i> L., Plantaginaceae	Ribwort plantain, black psyllium or flea-seed plant	Leaves	Ointment applied to relieve itchiness	Hutchings (1996)
<i>Rauvolfia caffra</i> Sond., Apocynaceae	Quinine Tree	Bark	Applied topically to treat urticaria and other skin rashes	Gerstner (1938), Bryant (1996), Hutchings (1996) and McGaw et al. (2000)
<i>Rumex lanceolatus</i> Thunb., Polygonaceae	Common dock	Leaves	Applied topically to treat tumours	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996) and Van Wyk et al. (2000)
<i>Samolus valerandi</i> L., Primulaceae	Brook weed	Not given	Skin rash	Van Wyk (2008b)
<i>Scadoxus puniceus</i> (L.) Friis & Nordal, Amaryllidaceae	Red paintbrush or paintbrush Lily	Bulbs and roots	Decoction applied topically to treat skin allergic reaction	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Van Wyk et al. (2000)
<i>Spermacoce natalensis</i> Hochst., Rubiaceae	Insulansala	Roots	Applied topically to treat febrile rash	Bryant (1996) and Hutchings (1996)
<i>Trichilia emetica</i> Vahl, Meliaceae	Natal Mahogany	Leaves or fruits	Poultice applied to treat eczema	Adeniji et al. (1998), Germanò et al. (2005), Geyid et al. (2005), Shai et al. (2008), Komane et al. (2011) and Van Wyk et al. (2011)

**Table 5**  
Southern African medicinal plants used to treat unspecified skin ailments.

Botanical name/family	Common name	Parts used	Use	References
<i>Albizia adianthifolia</i> W.Wight, Fabaceae	Flat crown	Bark and roots	Lotion	Boily and Van Puyvelde (1986), Bryant (1996), Hutchings (1996) and Van Wyk et al. (2011)
<i>Aloe arborescens</i> Mill., Xanthorrhoeaceae	Krantz aloe	Leaves	Topical	Van Wyk et al. (2000), Jia et al. (2008) and Ghuman and Coopoosamy (2011)
<i>Celosia trigyna</i> L., Amaranthaceae	Woolflower	Leaves	Paste	Watt and Breyer-Brandwijk (1962) and Hutchings (1996)
<i>Cissampelos capensis</i> Thunb. Menispermaceae	Davidjies	Rhizomes, roots and leaves	Paste applied to treat snakebites	Van Wyk et al. (2000) and Babajide et al. (2010)
<i>Dichrostachys cinerea</i> (L.) Wight & Arn., Fabaceae	Sickle bush	Bark	Topical	Hutchings (1996) and Eisa et al. (2000)
<i>Glycyrrhiza glabra</i> L., Fabaceae	Liquorice root	Rhizomes and roots	Applied topically to treat insect bites	Bruneton (1995), Van Wyk et al. (2000) and Motsei et al. (2003)
<i>Halleria lucida</i> L., Scrophulariaceae	White olive	Unspecified parts	Topical	Pooley (1993), Hutchings (1996) and Adedapo et al. (2008)
<i>Leonotis leonurus</i> (L.) R.Br., Lamiaceae	Wild dagga or lion's tail	Leaves and stems	Decoction applied topically	Mabogo (1990), Roberts (1990) and Pooley (1993)
<i>Lippia javanica</i> Spreng., Verbenaceae	Lemon bush or fever tea	Leaves and roots	Paste	Gelfand et al. (1895), Hutchings (1996) and Samie et al. (2005)
<i>Lobostemon fruticosus</i> H.Buek, Boraginaceae	Pajama bush	Leaves and twigs	Ointment	Smith (1895), Watt and Breyer-Brandwijk (1962), Rood (1994) and Van Wyk et al. (2000)
<i>Melia azedarach</i> L., Meliaceae	China berry tree, bead-tree or cape lilac	Leaf, flower, bark and root	Ointment	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Khan et al. (2001) and Sen and Batra (2012)
<i>Thespesia acutiloba</i> (Baker f.) Exell & Mendonça, Malvaceae	Wild tulip tree	Bark	Topical	Jenkins (1987) and Hutchings (1996)
<i>Vernonia adoensis</i> Sch.Bip. ex Walp., Asteraceae	Inyathelo	Flowers	Topical	Pujol (1990), Hutchings (1996) and Chitemerere and Mukanganyama (2011)
<i>Viscum capense</i> L.f., Santalaceae	Cape mistletoe	Whole plant	Topical	Hutchings (1996) and Amabeoku et al. (1998)
<i>Warburgia salutaris</i> (Bertol.f.) Chiov., Canellaceae	Pepper-bark tree or fever tree	Bark	Topical	Hutchings (1996) and Rabe and Van Staden (1997)

and garlic plant *Allium sativum* which both proved to possess considerable antifungal properties against a broad-spectrum range of pathogenic fungi, particularly those associated with superficial fungal infections (Shahi et al., 2000; Reuter et al., 2010). The essential oil of *Ocimum basilicum* has also been reported to have antifungal properties against *T. mentagrophytes* (Dikshit and Husain, 1984).

*P. acnes* is an important skin bacterial pathogen responsible for the chronic inflammatory disease of the sebaceous glands and hair follicles of the skin. The infection usually results in acne vulgaris, a skin condition common, but not exclusive to teenagers and has considerable psychological impact (Magin et al., 2006). Similar to the dermatophytes, it has been rarely addressed in southern Africa with respect to medicinal plant studies. The *in vitro* antimicrobial and anti-inflammatory properties of medicinal plants against *P. acnes* have been investigated in a number of studies abroad (Chomnawang et al., 2005; Kim et al., 2007, 2008; Tsai et al., 2010; Balakrishnan et al., 2011). Furthermore, the relevance of *P. acnes* has also been detailed in a review on the traditional uses, phytochemistry and pharmacology of *Psidium guajava* (Gutiérrez et al., 2008), yet little attention has been given to this pathogen when investigating southern African plants.

Some *Brevibacterium* spp. are implicated in producing the odour associated with foul-smelling feet. These micro-organisms have been rarely addressed in correlation with the antimicrobial properties of medicinal plants. One study was found, where the *in vitro* investigation of *Brevibacterium* spp. was undertaken on the antibacterial activities for the essential oil and methanol extracts of *Ziziphora persica*, a Turkish folk medicinal plant used for various ailments including wound healing (Öztürk and Ercisli, 2006). The discovery of medicinal plants that have antimicrobial properties against these pathogens may pilot future more natural treatment alternatives for foot odour.

## 6. Plant parts used to treat skin diseases

Not surprisingly, it was found that the leaves are the most frequently used part of the plant, accounting for 43% (Fig. 2.). Many other indigenous communities worldwide, utilize mostly leaves for the preparation of traditional medicines. This was congruent with

results obtained from other countries such as India, whereby leaves account for 50% of the plant parts used by Kani tribes in the Tirunelveli hills of Western Ghats (Ayyanar and Ignacimuthu, 2011). Roots are the second most frequently used part of the plant (22%) for the treatment of skin diseases. This choice is less surprising considering difficulties encountered with unsustainable harvesting and plant destruction. Following this category is bark (11%), whole plant (7%), unspecified parts (5%) and fruits, rhizomes, bulb and flowers, which all account for less than 5%.

## 7. Method of preparation and mode of administration

According to the recorded ethnobotanical literature (Watt and Breyer-Brandwijk, 1962; Hutchings, 1996; Von Koenen, 1996; Felhaber, 1997; Rabe and Van Staden, 1997; Van Wyk et al., 2000, 2009), medicinal plants used for the treatment of skin ailments may be administered as a powder (leaves, root or wood powder), paste, plant juice, ointment, poultice/compress, leaf extract and decoction or infusion. Mostly, the plants are prepared in an aqueous solution, as the traditional healers or lay people do not usually have access to lipophilic solvents. When organic solvents are required for preparation, alcohols such as ethanol are usually sought for extraction processes, as these are relatively inexpensive and freely available (Louw et al., 2002). Many preparations are poorly described (unspecified, 47%), whereas other preparations such as pastes (12%) and decoctions or infusions (19%) have been described in detail within the readily available ethnobotanical literature (Tables 1–9, Fig. 3). A decoction refers to the process of boiling any plant material in water or any other solvent, with the aim of extracting active substances. The liquid can then be used to cleanse wounds, and act as an antiseptic or applied to skin rashes. The preparation of infusions involves submerging the plant material in boiled or cold water for a specified period, which is then strained before use (Von Koenen, 1996). This formulation is relatively simple and easy to prepare, hence it is the most frequently used.

The use of ointments and plant poultices account for 8% of the preparations. Usually, a heated mass of plant material is used in the form of a dressing, as either a cold or hot compress and applied

**Table 6**  
Southern African medicinal plants used to treat burns.

Botanical name/family	Common name	Parts used	Use	References
<i>Aloe arborescens</i> Mill., Xanthorrhoeaceae	Krantz aloe	Leaves	Topical	Van Wyk et al. (2000), Jia et al. (2008) and Ghuman and Cooposamy (2011)
<i>Aloe ferox</i> Mill., Xanthorrhoeaceae	Bitter aloe	Leaf sap, leaves and roots	Sap applied directly	Watt and Breyer-Brandwijk (1962), Bruce (1975), Van Wyk et al. (2000) and Jia et al. (2008)
<i>Bridelia micrantha</i> (Hochst.) Baill., Euphorbiaceae	Coastal golden leaf	Bark	Decoction	Mabogo (1990), Hutchings (1996), Samie et al. (2005), Adefuye et al. (2011) and Van Wyk et al. (2011)
<i>Bulbine frutescens</i> (L.) Willd., Asphodelaceae	Burn jelly plant	Slimy leaves	Topical	Rabe and Van Staden (1997), Van Wyk et al. (2000) and Ghuman and Cooposamy (2011)
<i>Bulbine natalensis</i> Baker, Xanthorrhoeaceae	Ibhucu	Leaves, roots and leave sap	Applied directly to skin	Watt and Breyer-Brandwijk (1962), Pujol (1990), Rood (1994), Van Wyk et al. (2000) and Ghuman and Cooposamy (2011)
<i>Carpobrotus edulis</i> (L.) N.E.Br., Aizoaceae	Sour fig	Leaf juice and pulp	Juice directly applied to skin	Watt and Breyer-Brandwijk (1962), Rood (1994), Van Wyk et al. (2000) and Van der Watt and Pretorius (2001)
<i>Elephantorrhiza elephantina</i> (Burch.) Skeels, Fabaceae	Eland's bean or elephant's root	Roots and rhizomes	Infusion applied topically, the root powder is sprinkled onto wounds and burns	Pujol (1990), Van Wyk et al. (2009) and Mathabe et al. (2006)
<i>Gnidia kraussiana</i> Meisn., Thymelaeaceae	Yellow heads	Roots	Paste	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Saadabi and Moglad (2011)
<i>Heeria argentea</i> (Thunb.) Meisn., Anacardiaceae	Kliphout (gom) or klipes Gum	Not given	mixed with sweet oil for burns	Van Wyk (2008b)
<i>Jatropha zeyheri</i> Sond., Euphorbiaceae	Verfbol	Rhizomes or sap	Topical	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Luseba et al. (2007) and Van Wyk et al. (2009)
<i>Mohria caffrorum</i> (L.) Desv., Anemiaceae	Parsley fern	Powdered leaf (aromatic)	Ointment for burns and scalds	Van Wyk (2008b)
<i>Momordica balsamina</i> L., Cucurbitaceae	Balsam apple or african cucumber	Mashed fruit	Poultice and seeds in oil	Gerstner (1938), Hutchings (1996) and Saadabi and Moglad (2011)
<i>Myrothamnus flabellifolius</i> Welw., Myrothamnaceae	Resurrection plant	Leaves and twigs	Dried powdered leaves applied topically	Von Koenen (1996) and Van Wyk et al. (2000)
<i>Pentanisia prunelloides</i> Walp., Rubiaceae	Wild verbena	Roots	Applied topically	Van Wyk et al. (2000) and Yff et al. (2002)
<i>Phyllanthus reticulatus</i> Lodd., Euphorbiaceae	Potato bush or roast potato plant	Leaves	Powered leaf applied topically	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Ram et al. (2004)
<i>Pteronia onobromoides</i> DC., Asteraceae	Boegoebossie	Leaves	Powdered leaf mixed with fat for burns and sunburn	Van Wyk (2008b)
<i>Rothmannia capensis</i> Thunb., Rubiaceae	Candlewood	Sap from fruit	Topical	Arnold and Gulumian (1984), Hutchings (1996) and Steenkamp et al. (2007)
<i>Senecio latifolius</i> DC., Asteraceae	Dan's cabbage, groundsel or ragwort	Leaves	Paste	Smith (1895)
<i>Senecio serratuloides</i> DC., Asteraceae	Two day cure	Leaves and stems	Topical	Pujol (1990), Bhat and Jacobs (1995), Hutchings (1996) and Kelmanson et al. (2000)
<i>Senna italica</i> Mill., Fabaceae	Wild senna	Roots	Topical	Hutchings (1996) and Dabai et al. (2012)

directly to the affected area (Hutchings, 1996; Van Wyk et al., 2000). Plant powder (4%) and leaf sap or juice (2%), are less frequently used preparations adopted for skin disease management.

These preparations are applied topically and at times, orally. The available ethnobotanical literature (Watt and Breyer-Brandwijk, 1962; Hutchings, 1996; Von Koenen, 1996; Felhaber, 1997; Rabe and Van Staden, 1997; Van Wyk et al., 2000, 2009) have reported that topical or direct application is the most common route used for

treating skin infections, as this ensures quick and direct contact of the specific plant compounds to the site of action. Some skin infections are found to be deep within the skin layers. These infections mainly occur in the hair follicles creating boils which are situated in the innermost layer of the skin. The benefits of the plants used can only be seen when the plant preparations are able to permeate the surface of the skin and treat the core root of the infection (Goswami et al., 2008). The permeability of plant preparations is rather unnecessary

**Table 7**  
Southern African medicinal plants used to treat contusions.

Botanical name/family	Common name	Parts used	Use	References
<i>Agathosma betulina</i> (P.J.Bergius) Pillans, Rutaceae	Buchu	Bachu vinegar with leaf	Infusion/tincture applied to treat bruises	Watt and Breyer-Brandwijk (1962), Smith (1996), Van Wyk et al. (2000) and Moolla (2005)
<i>Aloe ferox</i> Mill., Xanthorrhoeaceae	Bitter aloe	Leaf sap, leaves and roots	Sap applied topically to treat bruises	Watt and Breyer-Brandwijk (1962), Bruce (1975), Van Wyk et al. (2000) and Jia et al. (2008)
<i>Diospyros mespiliformis</i> Hochst. ex A.DC., Ebenaceae	African ebony	Roots and leaves	Decoction applied to treat scars and bruises	Von Koenen (1996), Van Wyk et al. (2011), Dangoggo et al. (2012) and Shagal et al. (2012)
<i>Rumex lanceolatus</i> Thunb., Polygonaceae	Common dock	Leaves	Applied topically to treat bruises	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996) and Van Wyk et al. (2000)
<i>Sarcostemma viminalis</i> (L.) R.Br., Asclepiadaceae	Caustic bush or rapunzel plant	Whole plant	Latex applied to treat skin lesions	Von Koenen (1996) and Luseba et al. (2007)
<i>Trichilia emetica</i> Vahl, Meliaceae	Natal Mahogany	Leaves or fruits	Poultice applied to treat bruises	Adeniji et al. (1998), Germanò et al. (2005), Geyid et al. (2005), Shai et al. (2008), Komane et al. (2011) and Van Wyk et al. (2011)

**Table 8**  
Southern African medicinal plants used to treat skin growths.

Botanical name/family	Common name	Parts used	Use	References
<i>Catharanthus roseus</i> G.Don, Apocynaceae	Madagascar periwinkle	Flowers milky sap	Applied topically	Roberts (1990), Hutchings (1996) and Govindasamy and Srinivasan (2012)
<i>Cotyledon orbiculata</i> Forssk, Crassulaceae	Pig's ear	Leaf and leaf juice	Juice applied topically for the removal of corns and warts	Watt and Breyer-Brandwijk (1962), Rood (1994), Bhat and Jacobs (1995), Felhaber (1997) and Van Wyk et al. (2000)
<i>Ficus natalensis</i> Hochst., Moraceae	Natal fig	Leaves	Hot compress	Hutchings (1996), Rabe and Van Staden (1997) and Van Wyk et al. (2011)
<i>Opuntia ficus-indica</i> (L.) Mill., Cactaceae	Prickly pear or barbary fig	Leaves	Applied topically	Smith (1996) and Von Koenen (1996)
<i>Opuntia vulgaris</i> Mill., Cactaceae	Drooping prickly pear	Plant juice	Applied topically	Smith (1996) and Von Koenen (1996)
<i>Solanum capense</i> L., Solanaceae	Nightshade	Squashed berries	Applied topically	Von Koenen (1996)
<i>Viscum capense</i> L.f., Santalaceae	Cape mistletoe	Whole plant	Applied topically	Hutchings (1996) and Amabeoku et al. (1998)

when treating superficial skin conditions like urticaria, skin irritation or sunburn, in which case antipruritic, skin calming agents or protective skin barrier applications such as pastes may be sought to manage such conditions. It is therefore pivotal to understand the permeability of compounds in medicinal plants which are expected to act on the skin, including their suitability for the intended therapeutic effects.

## 8. Combined preparations used to treat skin afflictions

Another aspect sorely neglected in the investigation of plants used to treat skin infections is the investigation of pharmacological interactions between plants which are used in combination. The therapeutic value of synergistic interactions has been known since antiquity and the African cultural healing system still relies on this principle in the belief that combination therapy may enhance efficacy. Without adequate validation of these combination therapies, the ethnopharmacological information obtained will remain unchallenged. A number of plant combinations used to treat various skin diseases (Table 10) have been reported (Smith, 1895; Hutchings, 1996; Felhaber, 1997), yet very few studies have been conducted to validate these claims. Some of the plants used in combination are also used individually to treat skin ailments. However, some plant species such *Acorus calamus*, *Cyathula natalensis*, *Cyanella lutea*, *Hypoxis latifolia*, *Momordica foetida*, *Pittosporum viridiflorum* and *Vernonia natalensis* which are reportedly used in the combinations do not have any known dermatological relevance when used independently. Some plant species for e.g. *P. viridiflorum* and *V. natalensis* are traditionally used to alleviate fever (Hutchings, 1996; Van Wyk et al., 2009), a symptom very often present in bacterial infections. Hence, inclusion of these plants in a combination may be for the treatment of other additional symptoms.

Some antimicrobial combination studies focusing on medicinal plants from South African origin such as, *Salvia chamaelaeagnea* combined with *L. leonurus*, *A. afra* with *Eucalyptus globulus* and *Hypoxis hemerocallidea* with *Merwillia plumbea* (Kamatou et al., 2006; Suliman et al., 2010; Ncube et al., 2012), have been undertaken, however, specific attention has not been given to skin relevant pathogens such as *P. acnes*, *M. canis*, *T. mentagrophytes*, and *E. floccosum*, which have dermatological importance.

The use of allopathic antimicrobial agents together with plant extracts has become a major concern for medical practitioners. With skin infections, typically being difficult to treat, the possible lack of compliance to allopathic drugs by patients may be problematic. As patients find that infections are not readily cured, more and more natural remedies are being sought and in some cases the co-administration may prove to have adverse effects. The use of traditional medicines together with conventional medicines is usually not recommended, as the interactions may prove to decrease or increase the pharmacological and toxicology effects of the respective components (Weideman, 2005). Van Vuuren and Viljoen (2011) highlighted a number of plants used in combination with conventional drugs for a variety of ailments. The review also highlighted the antagonistic interaction of ciprofloxacin with

*Melaleuca alternifolia* (tea tree oil which is traditionally used to treat a variety of skin ailments) against *Staphylococcus aureus*. It is therefore important to understand and investigate the pharmacological effects of plants when combined with conventional drugs for the treatment of skin ailments in order to recognize both favourable and unfavourable combinations.

## 9. Pharmaceutical applications

There are a vast number of pharmaceutical products used to treat skin diseases, mainly being topical applications such as creams, ointments, gels and lotions. The use of petroleum jelly and mineral oil as moisturisers is widely sought and relied on by many communities in Africa. This, however, plays a vital role in the precipitation of skin ailments. Skin irritation and aggravation of existing inflammatory conditions, are common side effects as these formulations tend to occlude the pores of sweat ducts and also precipitate any trapped microbial infections due to the unfavourable humid and warm conditions (Van Hees and Naafs, 2001). As an alternative, ointments or creams are usually the formulations of choice. Ointments are said to be the ideal emollients with greater penetration and adherence to the skin, suitable for skin conditions such as chronic eczema, psoriasis and severe cases of fungal infections. While creams are suitable for wet or acutely inflamed lesions, ointments are usually preferred for chronic, dry or lichenified lesions (Van Hees and Naafs, 2001; Goswami et al., 2008).

While looking at the numerous pharmaceutical skin formulations available, it can be observed that there is an increased prevalence of multi-drug resistance to pathologic micro-organisms, as well as undesired adverse effects, such as burning sensations, stinging, photo-hypersensitivity, skin irritation and more severe anaphylactic shock (Van Hees and Naafs, 2001; Gibbon, 2008; Alviano and Alviano, 2009). The development of modern medicine relies greatly on plant bio-active compounds, with almost 25% of the prescribed drugs used worldwide derived from plants. About 252 commercial drugs are considered basic and essential drugs by the WHO, of which 11% are of plant origin and the synthetic drugs, obtained from natural precursors (Weideman, 2005; Ayyanar and Ignacimuthu, 2011). Therefore the development of new products (where special attention has been given to natural products with dermatological relevance) can lead to potentially effective agents, which may be additionally less expensive and therefore affordable to the majority of the economically underprivileged communities (Alviano and Alviano, 2009).

## 10. Toxicity effects of medicinal plants used to treat skin ailments

Plants used for therapeutic purposes are normally assumed to be safe and free of toxicity. This is mainly due to the long term usage of medicinal plants for the treatment of diseases based on basic knowledge accumulated and shared from generation to generation over many centuries. However, recent scientific studies have highlighted



**Table 9**

Southern African plants used to treat infections of the skin.

Botanical name/family	Common name	Parts used	Use	References
<i>Achyranthes aspera</i> L., Amaranthaceae	Devil's horsehip	Roots	Ointment applied topically to treat boils and abscesses	Perumal Samy et al. (1998) and Hutchings (1996)
<i>Aristea ecklonii</i> Baker, Iridaceae	Blue stars	Whole plant	Applied topically to treat shingles	Ngwenya et al. (2003)
<i>Artemisia afra</i> Jacq. ex Willd., Asteraceae	Wormwood	Leaves	Decoction applied on acne and boils	Smith (1895), Hutchings (1996) and Rabe and Van Staden (1997)
<i>Athrixia phyllicoides</i> DC., Asteraceae	Bushman's tea	Whole plant	Plant infusion applied on boils	Hutchings (1996) and Padayachee (2011)
<i>Boophane disticha</i> (L.f.) Herb., Amaryllidaceae	Tumbleweed, veld fan or windball	Bulbs	Applied topically to treat boils	Watt and Breyer-Brandwijk (1962), Bruce (1975), Rabe and Van Staden (1997), Shale et al. (1999), Van Wyk et al. (2000) and Van Wyk (2008a)
<i>Bulbine frutescens</i> (L.) Willd., Asphodelaceae	Burn jelly plant, cat's tail or snake flower	Slimy leaves	Applied topically to treat ringworm infections	Rabe and Van Staden (1997), Van Wyk et al. (2000) and Ghuman and Cooposamy (2011)
<i>Capparis tomentosa</i> Lam., Capparaceae	Woolly caper bush	Roots	Paste applied topically to treat leprosy	Hutchings (1996) and Buwa and Van Staden (2006)
<i>Celosia trigyna</i> L., Amaranthaceae	Woolflower	Leaves	Paste applied on boils	Watt and Breyer-Brandwijk (1962) and Hutchings (1996)
<i>Centella asiatica</i> (L.) Urb., Apiaceae	Pennywort	Leaves	Tinctures used to treat leprosy and acne	Boiteau et al. (1949), Smith (1996), Von Koenen (1996), Van Wyk et al. (2000), Jagtap et al. (2009), Ullah et al. (2009), Dash et al. (2011) and Malik et al. (2011)
<i>Chironia baccifera</i> L., Gentianaceae	Christmas berry	Whole plant	Applied topically to treat leprosy, boils and acne	Laidler (1928), Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Thring et al. (2007)
<i>Cinnamomum camphora</i> (L.) J.Presl., Lauraceae	Camphor tree or camphorwood	Essential oil	Applied topically as an antiseptic	Grieve (1967) and Van Wyk et al. (2000)
<i>Cissampelos capensis</i> Thunb., Menispermaceae	Davidjies	Rhizomes, roots and leaves	Paste applied on boils	Van Wyk et al. (2000) and Babajide et al. (2010)
<i>Cotyledon orbiculata</i> L., Crassulaceae	Pig's ear	Leaf and leaf juice	Hot leaf placed directly to the boils	Watt and Breyer-Brandwijk (1962), Rood (1994), Bhat and Jacobs (1995), Felhaber (1997) and Van Wyk et al. (2000)
<i>Crinum macowanii</i> Baker, Amaryllidaceae	River lily or veld lily	Bulbs and leaves	Applied topically to treat boils and acne	Smith (1996), Rabe and Van Staden (1997) and Van Wyk et al. (2000)
<i>Cucumis myriocarpus</i> Naudin, Cucurbitaceae	Paddy melon, prickly paddy melon	Raw fruit	Applied topically to treat boils	Watt and Breyer-Brandwijk (1962) and Hutchings (1996)
<i>Datura stramonium</i> L., Solanaceae	Jimson weed or datura	Leaves	Skin patch placed onto boils and abscesses	Watt and Breyer-Brandwijk (1962), Bruneton (1995), Rabe and Van Staden (1997), Van Wyk et al. (2000), Priya et al. (2002) and Saadabi and Moglad (2011)
<i>Dichrostachys cinerea</i> (L.) Wight & Arn., Fabaceae	Sickle bush	Bark	Applied topically to treat abscesses	Hutchings (1996) and Eisa et al. (2000)
<i>Dicoma anomala</i> Sond., Asteraceae	Fever bush or stomach bush	Charred root, stems and leaves	Paste applied on ringworm infections	Boily and Van Puyvelde (1986) and Hutchings (1996)
<i>Diospyros mespiliformis</i> Hochst. ex A.DC., Ebenaceae	African ebony or jackal-berry	Roots and leaves	Decoction applied on ringworm infections	Von Koenen (1996), Van Wyk et al. (2011), Dangoggo et al. (2012) and Shagal et al. (2012)
<i>Dodonaea angustifolia</i> L.f., Sapindaceae	Sand olive	Leaves and tips of twigs	Decoction applied topically to treat boils	Watt and Breyer-Brandwijk (1962), Rood (1994), Smith (1996), Van Wyk et al. (2000) and Teffo et al. (2010)
<i>Ekebergia capensis</i> Sparrm., Meliaceae	Cape ash or Dogplum	Bark	Infusion applied on abscesses, boils and acne	Pujol (1990), Rabe and Van Staden (1997), Van Wyk et al. (2000) and Van Wyk et al. (2011)
<i>Elephantorrhiza elephantina</i> (Burch.) Skeels, Fabaceae	Eland's bean or elephant's root	Roots and rhizomes	Infusion applied topically to treat acne	Pujol (1990), Van Wyk et al. (2009) and Mathabe et al. (2006)
<i>Embelia ruminata</i> (E.Mey. ex A.DC.) Mez, Myrsinaceae	Vidanga	Leaves	Leaf paste applied directly to treat leprosy	Kumara Swamy et al. (2007)
<i>Eriospermum abyssinicum</i> Baker, Eriosepmaeae	Cotton-seed lily	Leaves	Ointment applied on boils	Von Koenen (1996)
<i>Erythrina lysistemon</i> Hutch., Fabaceae	Common coral tree or lucky bean tree	Bark	Applied as poultice or powdered burnt bark for abscesses	Coates Palgrave (1977), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000), Takahashi et al. (2004), More et al. (2008) and Van Wyk et al. (2011)
<i>Eucalyptus camaldulensis</i> Dehnh., Myrtaceae	River red gum	Bark	Used to wash pimples	Hutchings (1996), Babayi et al. (2004), Ayepola and Adeniyi (2008) and Musa et al. (2011)
<i>Ficus natalensis</i> Hochst., Moraceae	Natal fig	Leaves	Hot compress placed onto boils	Hutchings (1996), Rabe and Van Staden (1997) and Van Wyk et al. (2011)
<i>Ficus sur</i> Forssk., Moraceae	Broom cluster fig	Bark	Applied as a Compress on boils	Palmer and Pitman (1972) and Hutchings (1996)
<i>Gnidia kraussiana</i> Meisn., Thymelaeaceae	Yellow heads	Roots	Paste applied on boils	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Saadabi and Moglad (2011)
<i>Harpagophytum procumbens</i> DC. ex Meisn., Pedaliaceae	Devil's claw or grapple plant	Roots	Ointment applied on boils	Watt and Breyer-Brandwijk (1962) and Van Wyk et al. (2000)
<i>Harpephyllum caffrum</i> Bernh. ex Krauss, Anacardiaceae	Wild plum	Bark	Applied topically to treat acne	Pujol (1990), Van Wyk et al. (2000), Buwa and Van Staden (2006) and Van Wyk et al. (2011)
<i>Helichrysum odoratissimum</i> (L.) Sweet, Asteraceae	Imphepho	Leaves	Ointment applied onto pimples	Hutchings and Johnson (1986), Hutchings (1996) and Lourens et al. (2004)
<i>Jasminum fluminense</i> Vell., Oleaceae	Wild jasmine	Leaves and young shoots	Applied topically onto boils	Von Koenen (1996)

(continued on next page)

Table 9 (continued)

Botanical name/family	Common name	Parts used	Use	References
<i>Jatropha curcas</i> L., Euphorbiaceae	Purging nut	Rhizomes	Applied topically onto boils	Perumal Samy et al. (1998) and Van Wyk et al. (2000)
<i>Jatropha zeyheri</i> Sond., Euphorbiaceae	Verfbol	Rhizomes or sap	Applied topically onto boils	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Luseba et al. (2007) and Van Wyk et al. (2009)
<i>Kigelia africana</i> (Lam.) Benth., Bignoniaceae	Sausage tree	Fruit	Applied topically to treat abscesses	Watt and Breyer-Brandwijk (1962), Coates Palgrave (1977), Hutchings (1996), Van Wyk et al. (2000), Shai et al. (2008) and Van Wyk et al. (2011)
<i>Lannea edulis</i> (Sond.) Engl., Anacardiaceae	Wild grape	Bark	Applied topically to treat boils and abscesses	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Van Wyk et al. (2000)
<i>Leonotis leonurus</i> (L.) R.Br., Lamiales	Wild dagga or lion's tail	Leaves and stems	Decoction applied topically to treat boils	Mabogo (1990), Roberts (1990) and Pooley (1993)
<i>Ochna serrulata</i> (Hochst.) Walp., Ochnaceae	Small-leaved plane or carnival bush	Roots	Decoction applied topically to treat gangrene infections	Bryant (1996) and Hutchings (1996)
<i>Opuntia ficus-indica</i> (L.) Mill., Cactaceae	Prickly pear or barbary fig	Leaves	Applied topically to treat furuncles	Smith (1996) and Von Koenen (1996)
<i>Pelargonium alchemilloides</i> (L.) L'Hr., Geraniaceae	Wilde malva or garden geranium	Leaves	Leaf paste applied to treat abscesses	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Shale et al. (1999)
<i>Pellaea calomelanos</i> Link, Adiantaceae	Hard fern	Leaves and rhizomes	Decoction or infusions applied topically to treat boils and abscesses	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996), Van Wyk et al. (2000) and Braithwaite et al. (2008)
<i>Plantago afra</i> L., Plantaginaceae	Ribwort plantain, black psyllium or flea-seed plant	Leaves	Ointment applied to treat pustules and furuncles	Hutchings (1996)
<i>Psidium guajava</i> L., Myrtaceae	Guava	Leaves	Infusions applied topically to treat boils	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Van Wyk et al. (2000), Gutiérrez et al. (2008), Abubakar (2009), Van Wyk et al. (2011)
<i>Rauvolfia caffra</i> Sond., Apocynaceae	Quinine tree	Bark	Applied topically to treat measles	Gerstner (1938), Bryant (1996), Hutchings (1996) and McGaw et al. (2000)
<i>Ricinus communis</i> L., Euphorbiaceae	Caster bean tree	Leaf, burnt-pulverized seeds and bark	Applied as poultice to treat boils	Watt and Breyer-Brandwijk (1962), Hutchings (1996), Van Wyk et al. (2000), Luseba et al. (2007) and Malik et al. (2011)
<i>Rumex lanceolatus</i> Thunb., Polygonaceae	Common dock	Leaves	Applied topically to treat abscesses and boils	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996) and Van Wyk et al. (2000)
<i>Scilla natalensis</i> Planch., Hyacinthaceae	Blue squill or wild squill	Bulb	Applied topically to treat boils	Roberts (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000), Ghuman and Cooposamy (2011)
<i>Senna italica</i> Mill., Fabaceae	Wild senna	Roots	Applied topically to treat furuncles	Hutchings (1996) and Dabai et al. (2012)
<i>Solanum capense</i> L., Solanaceae	Nightshade	Squashed berries	Applied topically to treat ringworm infections	Von Koenen (1996)
<i>Solanum hermannii</i> Dunal, Solanaceae	Devil's apple	Fruit sap, leaf paste and roots	Leaf paste or ointment applied to treat boils and non-specific skin infections	Watt and Breyer-Brandwijk (1962) and Hutchings (1996)
<i>Solanum incanum</i> L., Solanaceae	Bark weed, thorn apple or bitter apple	Leaves and roots	Applied topically to treat furuncles and ringworm infections	Gerstner (1938), Hutchings (1996), Von Koenen (1996) and Hamza et al. (2006)
<i>Solanum nigrum</i> L., Solanaceae	Black nightshade	Whole plant	Applied topically to treat septic pimples, furuncles, and ringworm infections	Von Koenen (1996) and Malik et al. (2011)
<i>Solanum panduriforme</i> Drège ex Dunal, Solanaceae	Bitter apple	Sap	Applied topically to treat non-specific skin infections	Hutchings (1996) and More et al. (2008)
<i>Solanum tomentosum</i> L., Solanaceae	Slang apple	Fruit	Applied topically to treat non-specific skin infections	Batten and Bokelmann (1966), Hutchings (1996) and Aliero and Afolayan (2006)
<i>Stephania abyssinica</i> Walp., Menispermaceae	Umbamba	Powdered roots	Decoction applied topically to treat boils	Watt and Breyer-Brandwijk (1962), Hutchings (1996) and Geid et al. (2005)
<i>Terminalia sericea</i> Burch. ex DC., Combretaceae	Silver cluster-leaf or silver <i>Terminalia</i>	Root sap or bark	Applied topically to treat leprosy	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000) and Moshi and Mbwambo (2005)
<i>Turbina oblongata</i> (E.Mey. ex Choisy) A.Meeuse, Convolvulaceae	Ubhoqo	Leaves	Applied topically to treat abscesses	Pujol (1990) and Hutchings (1996)
<i>Tylecodon wallichii</i> Harv. Toelken, Crassulaceae	krimpsiekbos	Not given	Poultice for abscesses	Van Wyk (2008b)
<i>Vernonia adoensis</i> Sch.Bip. ex Walp., Asteraceae	Inyathelo	Flowers	Applied topically to treat scabies	Pujol (1990), Hutchings (1996) and Chitemerere and Mukanganyama (2011)
<i>Withania somnifera</i> (L.) Dunal, Solanaceae	Poison gooseberry or winter cherry	Leaves and berries	Ointment applied to treat abscesses	Watt and Breyer-Brandwijk (1962), Boily and Van Puyvelde (1986), Pujol (1990), Hutchings (1996), Van Wyk et al. (2000), Malik et al. (2011) and Saadabi and Moglad (2011)

Table 9 (continued)

Botanical name/family	Common name	Parts used	Use	References
<i>Xysmalobium undulatum</i> R.Br. Apocynaceae	Milk bush, milkwort, uzura or wild cotton,	Roots	Powder applied topically to treat abscesses	Watt and Breyer-Brandwijk (1962), Pujol (1990), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000) and Buwa and Van Staden (2006)
<i>Zantedeschia aethiopica</i> (L.) Spreng., Araceae	Arum lily or calla lily	Leaves	Leaf applied directly to treat boils	Watt and Breyer-Brandwijk (1962), Rood (1994), Van Wyk et al. (2000) and Nielsen et al. (2012)
<i>Ziziphus mucronata</i> Willd., Rhamnaceae	Buffalo-thorn	Leaves, roots and bark	Decoction applied topically to treat boils	Watt and Breyer-Brandwijk (1962), Rood (1994), Hutchings (1996), Rabe and Van Staden (1997), Van Wyk et al. (2000), Luseba et al. (2007) and Van Wyk et al. (2011)

the toxic, mutagenic and carcinogenic effects of many plants used as traditional medicine (Fennell et al., 2004). Medicinal plants used to treat skin ailments are known to produce adverse effects such as allergic reactions, phyto dermatitis, and a high risk of photosensitization. The evidence based review on botanicals in dermatology by Reuter et al. (2010) identifies certain medicinal plants which have been used for dermatological purposes, which have also reported toxic effects. These include *Euphorbia helioscopia*, *Citrus bergamia*, *Matricaria recutita*, *Inula helenium* and *Tanacetum parthenium*. An ethnopharmacological study by Fennell et al. (2004) identified over 50 African medicinal plants which were screened for their safety and efficacy through analysing their pharmacological and toxicology effects. The toxic effects of the plants were investigated using the Ames test (*in vitro* bacterial and mammalian cells assay), micronucleus test (white blood cell chromosomes) and comet test (DNA damage). Amongst these, are medicinal plants used in South Africa for the treatment of skin infections such as; *Boopane disticha*, *Catharanthus roseus*, *Crinum macowanii*, *K. africana*, *Ochna serrulata*, *S. natalensis*, *T. emetica* and *Z. mucronata*, which were found to have some level of toxicity. Skin irritation tests done on mice models with *A. ferox* and *Aloe arborescens* showed no adverse effects on both damaged and healthy skin (Jia et al., 2008). A study by Ahmed et al. (2012) also investigated the cytotoxicity effects of four South African *Bauhinia* species against Vero cell lines, where *Bauhinia petersiana* was noted as one of the least toxic plants. In a study by Steenkamp and Gouws (2006), which investigated the cytotoxicity effects of South African medicinal plants, it was identified that *C. asiatica* and *Cnicus benedictus* did not exhibit any cytotoxic effects against cancer cell lines. Since the toxicity of some medicinal plants may result in the mutagenicity of cells, it is essential that the effects of medicinal plants be investigated for these adverse effects. A study by Verschaeve and Van Staden (2008), investigated the antimutagenic effects of South African plants, including species with dermatological relevance such as *B. disticha*, *C. macowanii*, *Harpephyllum caffrum*, *Acokanthera oblongifolia*, *C. roseus*, *X. undulatum*, *A. afra*, *Senecio serratuloides*, *K. africana*, *W. salutaris*, *Dioscorea dregeana*, *Euclea divinorum*, *R. communis*, *Ekebergia capensis*, *T. emetica*, *O. serrulata*, *Z. mucronata* and *D. stramonium*.

Mapunya et al. (2012) highlighted the toxicity effects of *H. caffrum* and *A. arborescens* against melanocytes, when examining these plants as skin-lighteners. *Sideroxylon inerme*, another plant used for skin-lightening purposes has been reported to have toxicity effects against melanocytes (Momtaz et al., 2008). Studies such as these provide some insight into plants used to treat hyperpigmentation of the skin. The use of plants as topical agents for cosmetic, skin-lightening potential and other traditional applications have not been discussed here. Only medicinal plants were the focus of this review. However, such studies should not be neglected as they play a significant role in the cultural applications of plants to the skin.

## 11. Phytochemistry investigations

Due to the increasing resistance of pathogens to conventional antimicrobial agents, plant compounds are of interest as antiseptics, and alternative antimicrobial substances (Weckesser et al., 2007; Ayyanar and Ignacimuthu, 2011). To fully comprehend the pharmacological properties of medicinal plants it is important to understand the phytochemistry of such plants. A review by George et al. (2001) revealed that by 2001, about 350 species of the 3000 South African plants used for medicinal purposes had been investigated for their phytochemical properties. Interest in bio-prospecting and development of new treatment alternatives has inspired research in this field, however, the elucidation of new phytochemicals is timely and expensive (George et al., 2001). A number of phytochemical studies have since been extensively dedicated to investigating medicinal plants and these also highlight plants used for dermatological purposes. Phytochemistry studies by Van der Watt and Pretorius (2001), Louw et al. (2002), Fennell et al. (2004) and Gutiérrez et al. (2008) have highlighted medicinal plants used to treat skin ailments including *B. disticha*, *C. edulis*, *Erythrina lysistemon*, *K. africana*, *P. guajava* and *W. salutaris*. The phytochemistry of medicinal plants such as *Agathosma betulina*, *A. linearis*, *A. afra*, *Athrixia phylloides*, *Dicoma anomala*, *Dodonaea angustifolia*, *L. javanica*, *Mentha longifolia*, *R. cafra*, *Scadoxus puniceus*, *Solanum incanum*, *Z. mucronata*, has also been addressed in a number

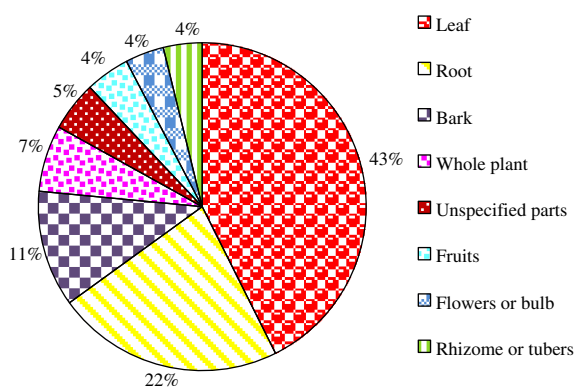


Fig. 2. Plant parts used to treat skin infections in southern Africa.

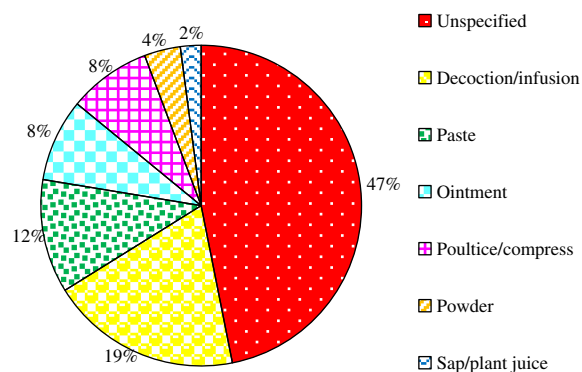


Fig. 3. Modes of administration of medicinal plants used to treat skin infections in southern Africa.

**Table 10**  
Plant combinations used in southern Africa for the treatment of skin ailments.

Combination	Parts used	Medicinal uses	Administration	Reference
<i>Pelargonium alchemilloides</i> + <i>Malva parviflora</i>	Leaves	Wounds and abscesses	Paste	Smith (1895)
<i>Cyanella lutea</i> + <i>Leontonyx angustifolius</i>	Unspecified parts	Boils, carbuncles and abscesses	Ointment	Smith (1895) and Watt and Breyer-Brandwijk (1962)
<i>Cyanella lutea</i> + <i>Leontonyx angustifolius</i> + <i>Galenia africana</i> + <i>Lobostemon fruticosus</i> + <i>Melianthus major</i>	Unspecified parts	Dressing to wounds	Ointment	Smith (1895) and Watt and Breyer-Brandwijk (1962)
<i>Combretum kraussii</i> + <i>Terminalia sericea</i>	Roots	Wounds	Mixed and applied topically	Hutchings (1996)
<i>Momordica foetida</i> + <i>Pittosporum viridiflorum</i> + <i>Vernonia natalensis</i>	Roots or leaves	Boils	Decoctions	Watt and Breyer-Brandwijk (1962) and Hutchings (1996)
<i>Trichilia emetica</i> + <i>Cyathula natalensis</i>	Stem fruit, seeds	Leprosy	Ointment	Hutchings (1996)
<i>Warburgia salutaris</i> + <i>Hibiscus surattensis</i>	Leaves and stalk	Anti-inflammatory, sores and skin irritation	Lotion	Hutchings (1996)
<i>Elephantorrhiza elephantina</i> + <i>Dicoma anomala</i>	Tubers	Acne	Externally	Felhaber (1997)
<i>Elephantorrhiza elephantina</i> + <i>Pentanisia prunelloides</i>	Tubers	Eczema	Externally	Felhaber (1997)
<i>Pentanisia prunelloides</i> + <i>Dicoma anomala</i>	Tubers	Insect and sting bites	Externally	Felhaber (1997)
<i>Pentanisia prunelloides</i> + <i>Dicoma anomala</i> + <i>Hypoxis latifolia</i>	Tubers, bulbs	Insect and sting bites	Taken orally	Felhaber (1997)
<i>Gunnera perpensa</i> + <i>Cassine transvaalensis</i>	Rhizomes, bark	Psoriasis	Taken orally	Felhaber (1997)
<i>Pentanisia prunelloides</i> + <i>Jatropha zeyheri</i> + <i>Warburgia salutaris</i>	Tubers, roots, bark	Cuts, bruises, blisters and burns	Taken orally	Felhaber (1997)
<i>Warburgia salutaris</i> + <i>Cassine transvaalensis</i> + <i>Acorus calamus</i>	Bark, rhizomes	Cold sores and shingles	Taken orally	Felhaber (1997)

of studies (Joubert et al., 2008; McGaw et al., 2008; Moolla and Viljoen, 2008). Aremu, 2009 and Abbasi et al., 2010 also examined the phytochemistry of medicinal plants used to treat skin ailments (*A. oppositifolia*, *C. orbiculata*, *Achyranthes aspera*, *D. stramonium*, *R. communis*). A review by Van Vuuren (2008) highlighted some phytochemistry studies where plants traditionally used to treat skin ailments (*A. ferox*, *Helichrysum* spp., *G. perpensa* and *T. sericea*) were found to possess antimicrobially active chemical compounds. While the phytochemistry of many medicinal plants have been analysed, some plants still lack comprehensive scientific data to validate the pharmacological effects of their respective chemical constituents on the skin.

## 12. Recommendations and conclusions

As a contribution to the on-going search for alternative, available and affordable treatments to common skin infections in southern Africa, it is necessary to advocate intense scientific research on plants used for skin diseases and other cultural applications. It is clear that the pharmacological effects of plants used for skin ailments can be either beneficial or detrimental and requires a thorough scientific investigation of the phytochemistry, toxicity and other pharmacological activities. It is also recommended that plants are not only screened for antimicrobial properties against neglected pathogens (e.g. *P. acnes*, *M. canis*, *T. mentagrophytes* and *E. floccosum*), but also studies on the isolated compounds be subjected to these pathogens of specific dermatological relevance. The impact on the use of traditional medicines for the treatment of acne vulgaris can further pilot safer alternatives compared to the existing conventional treatments such as retinoids which are very aggressive and have severe side effects from photosensitivity reactions to teratogenic effects on unborn babies. The toxicology effects of plants are important aspects that need to be addressed, as the main aim for studying indigenous plants is to find safer, good quality and effective alternatives to the mainstream allopathic medications which are costly and very often require prolonged treatment regimens. The use of plant combinations to treat skin diseases needs to be addressed. In addition to this, the combination of medicinal plants with conventional medicines to treat specific skin conditions also needs attention. Many herbal preparations are used in combination with conventional drugs. The scientific validation on the efficacy of such combinations (synergistic or antagonistic effects) can lead to new directives and insight for on-going scientific research

which aims at integrating the indigenous treatments to mainstream medicine (Weideman, 2005). Attention to these aspects should lead to new directives for commercialization and provide insight towards the understanding of some neglected plant species.

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## References

- Abbasi, A.M., Khan, M.A., Ahmad, M., Zafar, M., Jahan, S., Sultana, S., 2010. Ethnopharmacological application of medicinal plants to cure skin diseases and in folk cosmetics among the tribal communities of North-West Frontier Province, Pakistan. *Journal of Ethnopharmacology* 128, 322–335.
- Abubakar, E.L.-M.M., 2009. The use of *Psidium guajava* Linn. in treating wound, skin and soft tissue infections. *Scientific Research and Essay* 4, 605–611.
- Adedapo, A.A., Jimoh, F.O., Koduru, S., Masika, P.J., Afolayan, A.J., 2008. Evaluation of the medicinal potentials of the methanol extracts of the leaves and stems of *Halleria lucida*. *Bioresource Technology* 99, 4158–4163.
- Adefuye, A.O., Samie, A., Ndip, R.N., 2011. *In-vitro* evaluation of the antimicrobial activity of extracts of *Bridelia micrantha* on selected bacterial pathogens. *Journal of Medicinal Plants Research* 5, 5116–5122.
- Adeniji, K.O., Amusan, O.O.G., Dlamini, P.S., Enow-Orock, E.G., Gamedze, S.T., Gbile, Z.O., Langa, A.D., Makhubu, L.P., Mahunnah, R.L.A., Mshana, R.N., Sofowora, A., Vilane, M.J., 1998. Traditional medicine and pharmacopoeia contribution to ethnobotanical and florist studies in Swaziland. Organisation of African Unity/ Scientific, Technical and Research Commission, Lagos. ISBN:978-2453-66-3.
- Ahmed, A.S., Elgorashi, E.E., Moodley, N., McGaw, L.J., Naidoo, V., Eloff, J.N., 2012. The antimicrobial, antioxidative, anti-inflammatory activity and cytotoxicity of different fractions of four South African *Bauhinia* species used traditionally to treat diarrhoea. *Journal of Ethnopharmacology* 143, 826–839.
- Aliero, A.A., Afolayan, A.J., 2006. Antimicrobial activity of *Solanum tomentosum*. *African Journal of Biotechnology* 5, 369–372.
- Ali-Shtayeh, M.S., Gheib, S.I.A., 1999. Antifungal activity of plant extracts against dermatophytes. *Mycoses* 42, 665–672.
- Alviano, D.S., Alviano, C.S., 2009. Plant extracts: search for new alternatives to treat microbial diseases. *Current Pharmaceutical Biotechnology* 10, 106–121.
- Amabeoku, G.J., Leng, M.J., Syce, J.A., 1998. Antimicrobial and anticonvulsant activities of *Viscum capense*. *Journal of Ethnopharmacology* 61, 237–241.
- Aremu, A.O., 2009. Pharmacology and Phytochemistry of South African Plants used as Anthelmintics. (MSc thesis) University of KwaZulu-Natal.
- Arnold, H.J., Gulumian, M., 1984. Pharmacopoeia of traditional medicine in Venda. *Journal of Ethnopharmacology* 12, 35–74.
- Ashafa, A.O.T., Afolayan, A.J., 2009. Assessment of the antimicrobial activity of the root extracts from *Chrysocoma ciliata* L. *African Journal of Microbiology Research* 3, 700–703.
- Ayepola, O.O., Adeniyi, B.A., 2008. The antibacterial activity of leaf extracts of *Eucalyptus camaldulensis* (Myrtaceae). *Journal of Applied Sciences Research* 4, 1410–1413.



- Ayyanar, M., Ignacimuthu, S., 2011. Ethnobotanical survey of medicinal plants commonly used by Kani tribals in Tirunelveli hills of Western Ghats, India. *Journal of Ethnopharmacology* 134, 851–864.
- Babajide, O.J., Mabusele, W.T., Green, I.R., Ameer, F., Weitz, F., Iwuoha, E.L., 2010. Phytochemical screening and biological activity studies of five South African indigenous medicinal plants. *Journal of Medicinal Plants Research* 2, 1924–1932.
- Babayi, H., Kolo, I., Okogun, J.I., Ijah, U.J.J., 2004. The antimicrobial activities of methanolic extracts of *Eucalyptus camaldulensis* and *Terminalia catappa* against some pathogenic microorganisms. *Biokemistri* 16, 106–111.
- Balakrishnan, K.P., Narayanaswamy, N., Subba, P., Poornima, E.H., 2011. Antibacterial activity of certain medicinal plants against acne-inducing bacteria. *International Journal of Pharmaceutical and Biological Sciences* 2, 476–481.
- Bannister, B.A., Begg, N.T., Gillespie, S.H., 2000. *Infectious Diseases*, 2nd ed. Blackwell Science, Oxford, United Kingdom.
- Batten, A., Bokelmann, A., 1966. *Wild flowers of the Eastern Cape*. Books of Africa, Cape Town.
- Beatriz, P.M., Ezequiel, V.V., Azucena, O.C., Pilar, C.R., 2012. Antifungal activity of *Psidium guajava* organic extracts against dermatophytic fungi. *Journal of Medicinal Plants Research* 6, 5435–5438.
- Beneke, E.S., Rippon, J.W., Rogers, A.L., 1984. *Human Mycoses*, 8th ed. The Upjohn Company, United States.
- Bhadauria, S., Kumar, P., 2011. *In vitro* antimycotic activity of some medicinal plants against human pathogenic dermatophytes. *Indian Journal of Fundamental and Applied Life Sciences* 1, 1–10.
- Bhat, R.B., Jacobs, T.V., 1995. Traditional herbal medicine in Transkei. *Journal of Ethnopharmacology* 48, 7–12.
- Boily, Y., Van Puyvelde, L., 1986. Screening of medicinal plants of Rwanda (Central Africa) for antimicrobial activity. *Journal of Ethnopharmacology* 16, 1–13.
- Boiteau, P., Buzas, A., Lederer, E., Polonsky, J., 1949. Derivatives of *Centella* used against leprosy, chemical constitution of asiaticoside. *Nature* 163, 258–259.
- Braithwaite, M., Van Vuuren, S.F., Viljoen, A.M., 2008. Validation of smoke inhalation therapy to treat microbial infections. *Journal of Ethnopharmacology* 119, 501–506.
- Bruce, W.G.C., 1975. Medicinal properties in the *Aloe*. *Excelsa* 5, 57–68.
- Bruneton, J., 1995. *Pharmacognosy, Phytochemistry, Medicinal Plants*. Intercept, Hampshire.
- Bryant, A.T., 1996. *Zulu Medicine and Medicine-Men*. C. Struik, Cape Town.
- Buwa, L.V., Van Staden, J., 2006. Antibacterial and antifungal activity of traditional medicinal plants used against venereal diseases in South Africa. *Journal of Ethnopharmacology* 103, 139–142.
- Chitemerere, T.A., Mukanganyama, S., 2011. *In vitro* antibacterial activity of selected medicinal plants from Zimbabwe. *The African Journal of Plant Science and Biotechnology* 5, 1–7.
- Chomnawang, M.T., Surassmo, S., Nukoolkarn, V.S., Gritsanapan, W., 2005. Antimicrobial effects of Thai medicinal plants against acne-inducing bacteria. *Journal of Ethnopharmacology* 101, 330–333.
- Coates Palgrave, K., 1977. *Trees of Southern Africa*. Struik, Cape Town, South Africa.
- Dabai, Y.U., Kawo, A.H., Aliyu, R.M., 2012. Phytochemical screening and antibacterial activity of the leaf and root extracts of *Senna italica*. *African Journal of Pharmacy and Pharmacology* 6, 914–918.
- Dahanukar, S.A., Kulkarni, R.A., Rege, N.N., 2000. Pharmacology of medicinal plants and natural products. *Indian Journal of Pharmacology* 32, 81–118.
- Dangogga, S.M., Hassan, L.G., Sadiq, I.S., Manga, S.B., 2012. Phytochemical analysis and antibacterial screening of leaves of *Diospyros mespiliformis* and *Ziziphos spina-Christi*. *Journal of Chemical Engineering* 1, 31–37.
- Dash, B.K., Faruquee, H.M., Biswas, S.K., Alam, M.K., Sisir, S.M., Prodhon, U.K., 2011. Antibacterial and antifungal activities of several extracts of *Centella asiatica* L. against some human pathogenic microbes. *Life Sciences and Medicine Research* 35, 1–5.
- Deepan, T., Alekhy, V., Saravanakumar, P., Dhanaraju, M.D., 2012. Phytochemical and anti-microbial studies on the leaves extracts of *Cardiospermum halicacabum* Linn. *Advances in Biological Research* 6, 14–18.
- Dikshit, A., Husain, A., 1984. Antifungal action of some essential oils against animal pathogens. *Fitoterapia* 55, 171–176.
- Eisa, M.M., Almagboul, A.Z., Omer, M.E.A., Elegami, A.A., 2000. Antibacterial activity of *Dichrostachys cinerea*. *Fitoterapia* 71, 324–327.
- Fabry, W., Okemo, P.O., Ansorg, R., 1998. Antibacterial activity of East African medicinal plants. *Journal of Ethnopharmacology* 60, 79–84.
- Felhaber, T., 1997. *South African Traditional Healers' Primary Health Care Handbook*. Kagiso Publishers, Cape Town, South Africa.
- Fennell, C.W., Lindsey, K.L., McGaw, L.J., Sparg, S.G., Stafford, G.I., Elgorashi, E.E., Grace, O.M., Van Staden, J., 2004. Assessing African medicinal plants for efficacy and safety: pharmacological screening and toxicology. *Journal of Ethnopharmacology* 94, 205–217.
- Fowler, J.F., 1998. Current problems in dermatology. *Occupational Dermatology* 10, 213–244.
- Frum, Y., 2006. *In vitro* 5-lipoxygenase and anti-oxidant activities of South African medicinal plants commonly used topically for skin diseases. (MSc Thesis) University of the Witwatersrand.
- Gelfand, M., Mavi, S., Drummond, R.B., Ndemera, B., 1995. *The Traditional Medical Practitioner in Zimbabwe*. Mambo Press, Gweru, Zimbabwe.
- George, J., Laing, M.D., Drewes, S.E., 2001. Phytochemical research in South Africa. *South African Journal of Science* 97, 93–105.
- Germanò, M.P., Angelo, V.D., Sanogo, R., Catania, R., Alma, R., De Pasquale, G.B., 2005. Hepatoprotective and antibacterial effects of extracts from *Trichilia emetica* Vahl. (Meliaceae). *Journal of Ethnopharmacology* 96, 227–232.
- Gerstner, J., 1938. A preliminary checklist of Zulu names of plants with short notes. *Bantu Studies* 12, 321–342.
- Geyid, A., Abebe, D., Debella, A., Makonnen, Z., Aberera, F., Teka, F., Kebede, T., Urga, K., Yersaw, K., Biza, T., Mariam, B.H., Guta, M., 2005. Screening of some medicinal plants of Ethiopia for their anti-microbial properties and chemical profiles. *Journal of Ethnopharmacology* 97, 421–427.
- Ghuman, S., Coopoosamy, R.M., 2011. Crude sample preparation, extraction and *in vitro* screening for antimicrobial activity of selected wound healing medicinal plants in KwaZulu-Natal, South Africa: a review. *Journal of Medicinal Plants Research* 5, 3572–3576.
- Gibbon, J.C., 2008. *South African Medicines Formulary*, 8th ed. South African Medical Health and Medical Publishing Group, Cape Town.
- Girish, H.V., Sudarshana, M.S., Rati Rao, E., 2008. *In vitro* evaluation of the efficacy of leaf and its callus extracts of *Cardiospermum halicacabum* L. on important human pathogenic bacteria. *Advances in Biological Research* 2, 34–38.
- Goswami, J.P., Sharma, S., Gupta, G.D., Mustafa, A., Chaudhary, D., 2008. Topical preparations are used for the localized effects at the site of their application by virtue of drug penetration into the underlying layers of skin or mucous membranes. Available at: <http://www.pharmainfo.net/reviews/topical-drug-delivery-systems-review> (Accessed on: 11/01/2013).
- Govindasamy, C., Srinivasan, R., 2012. *In vitro* antibacterial activity and phytochemical analysis of *Catharanthus roseus* (Linn.) G. Don. *Asian Pacific Journal of Tropical Biomedicine* S155–S158.
- Grierson, D.S., Afolayan, A.J., 1999. Antibacterial activity of some indigenous plants used for the treatment of wounds in the Eastern Cape. *South African Journal of Ethnopharmacology* 66, 103–106.
- Grieve, M., 1967. *A Modern Herbal*. Hafner, London.
- Gulluce, M., Sahin, F., Sokmen, M., Ozer, H., Daferera, D., Sokmen, A., Polissiou, M., Adiguzel, A., Ozkan, H., 2007. Antimicrobial and antioxidant properties of the essential oils and methanol extract from *Mentha longifolia* L. ssp. *longifolia*. *Food Chemistry* 103, 1449–1456.
- Gutiérrez, R.M.P., Mitchell, S., Solis, R.V., 2008. *Psidium guajava*: a review of its traditional uses, phytochemistry and pharmacology. *Journal of Ethnopharmacology* 117, 1–27.
- Hamza, O.J., den Bout-Van, Van, den Beukel, C.J., Matee, M.I., Moshi, M.J., Mikx, F.H., Selemani, H.O., Mbwambo, Z.H., Van der Ven, A.J., Verweij, P.E., 2006. Antifungal activity of some Tanzanian plants used traditionally for the treatment of fungal infections. *Journal of Ethnopharmacology* 108, 124–132.
- Hartshorne, S.T., 2003. *Dermatological disorders in Johannesburg*, South Africa. *Clinical and Experimental Dermatology* 28, 661–665. <http://www.africanextracts.com/> (Accessed on: 11/01/2013). <http://www.elixirskincare.com/> (Accessed on: 11/01/2013).
- Hutchings, A., 1996. *Zulu Medicinal Plants*. University of Natal Press, Pietermaritzburg.
- Hutchings, A., Johnson, C.T., 1986. Glimpses of a Xhosa herbalist. *Veld and Flora* 72, 59–62.
- Jagtap, N.S., Khadabadi, S.S., Ghorpade, D.S., Banarase, N.B., Naphade, S.S., 2009. Antimicrobial and antifungal activity of *Centella asiatica* (L.) Urban, Umbelliferae. *Research Journal of Pharmacy and Technology* 2, 328–330.
- Jenkins, M.D., 1987. *Madagascar on Environmental Profile*. IUCN, Gland, Switzerland.
- Jia, Y., Zhao, G., Jia, J., 2008. The effects of *Aloe ferox* Miller and *Aloe arborescens* Miller on wound healing. *Journal of Ethnopharmacology* 120, 181–189.
- Jimoh, F.O., Adedapo, A.A., Afolayan, A.J., 2011. Comparison of the nutritive value, antioxidant and antibacterial activities of *Sonchus asper* and *Sonchus oleraceus*. *Records of National Products* 5, 29–42.
- Joubert, E., Gelderblom, W.C.A., Louw, A., De Beer, D., 2008. South African herbal teas: *Aspalathus linearis*, *Cyclopia* spp. and *Athrixia phylicoides*. *Journal of Ethnopharmacology* 119, 376–412.
- Kamatou, G.P.P., Viljoen, A.M., Van Vuuren, S.F., 2006. *In vitro* evidence of antimicrobial synergy between *Salvia chameleagnea* and *Leonotis leonurus*. *South African Journal of Botany* 72, 634–636.
- Kashikar, N.D., George, I., 2006. Antibacterial activity of *Cissus quadrangularis* Linn. *Indian Journal of Pharmaceutical Sciences* 68, 245–247.
- Kelmanson, J.E., Jäger, A.K., Van Staden, J., 2000. Zulu medicinal plants with antibacterial activity. *Journal of Ethnopharmacology* 69, 241–246.
- Khan, M.R., Kihara, M., Omoloso, A.D., 2001. Antimicrobial activity of *Horsfieldia helwigii* and *Melia azedarach*. *Fitoterapia* 72, 423–427.
- Kim, S.S., Hyun, C.G., Kim, J.Y., Lee, J., Park, D., 2007. Antibacterial effects of medicinal plants from Jeju Island against acne-inducing bacteria. *Journal of Applied Biological Chemistry* 50, 101–103.
- Kim, S.S., Baik, J.S., Oh, T.H., Yoon, W.J., Lee, N.H., Hyun, C.G., 2008. Biological activities of Korean *Citrus obovoides* and *Citrus natsudaoides* essential oils against acne-inducing bacteria. *Bioscience, Biotechnology, and Biochemistry* 72, 2507–2513.
- Komane, B.M., Olivier, E.I., Viljoen, A.M., 2011. *Trichilia emetica* (Meliaceae) – a review of traditional uses, biological activities and phytochemistry. *Phytochemistry Letters* 4, 1–9.
- Kumara Swamy, H.M., Krishna, V., Shankarmurthy, K., Abdul Rahman, B., Mankani, K.L., Mahadevan, K.M., Harish, B.G., Raja Naika, H., 2007. Wound healing activity of embelin isolated from the ethanol extract of leaves of *Embelia ribes* Burm. *Journal of Ethnopharmacology* 109, 529–534.
- Lagnika, L., Amoussa, M., Adjovi, A., Sanni, A., 2012. Antifungal, antibacterial and antioxidant properties of *Adansonia digitata* and *Vitex doniana* from Bénin pharmacopeia. *Journal of Pharmacognosy and Phytotherapy* 4, 44–52.
- Laidler, P.W., 1928. *The magic medicine of the Hottentots*, South Africa. *Journal of Science* 25, 433–447.
- Laube, S., 2004. Skin infections and ageing. *Ageing Research Reviews* 3, 69–89.
- Lourens, A.C.U., Reddy, D., Bas, K.H.C., Viljoen, A.M., Van Vuuren, S.F., 2004. *In vitro* biological activity and essential oil composition of four indigenous South African *Helichrysum* species. *Journal of Ethnopharmacology* 95, 253–258.

- Lourens, A.C.U., Viljoen, A.M., Van Heerden, F.R., 2008. South African *Helichrysum* species: a review of the traditional uses, biological activity and phytochemistry. *Journal of Ethnopharmacology* 119, 630–652.
- Louw, C.A.M., Regnier, T.J.C., Korsten, L., 2002. Medicinal bulbous plants of South Africa and their traditional relevance in the control of infectious diseases. *Journal of Ethnopharmacology* 82, 147–154.
- Luseba, D., Elgorashi, E.E., Ntloedibe, D.T., Van Staden, J., 2007. Antibacterial, anti-inflammatory and mutagenic effects of some medicinal plants used in South Africa for the treatment of wounds and retained placenta in livestock. *South African Journal of Botany* 73, 378–383.
- Mabogo, D.E.N., 1990. Ethnobotany of the Vhavenda. (MSc thesis) University of Pretoria.
- Magée, A.R., Van Wyk, B.E., Van Vuuren, S.F., 2007. Ethnobotany and antimicrobial activity of sieketros (*Arctopus* species). *South African Journal of Botany* 73, 159–162.
- Magin, P., Adams, J., Heading, G., Pond, D., Smith, W., 2006. Psychological sequelae of acne vulgaris. *Canadian Family Physician* 52, 978–979.
- Malik, F., Hussain, S., Mirza, T., Hameed, A., Ahmad, S., Riaz, H., Shah, P.A., Usmanghani, K., 2011. Screening for antimicrobial activity of thirty-three medicinal plants used in the traditional system of medicine in Pakistan. *Journal of Medicinal Plants Research* 5, 3052–3060.
- Mapunya, M.B., Nikolova, R.V., Lall, N., 2012. Melanogenesis and antityrosinase activity of selected South African plants. *Evidence-based Complementary and Alternative Medicine* 1–6.
- Marnewick, J., Joubert, E., Joseph, S., Swanevelder, S., Swart, P., Gelderblom, W., 2005. Inhibition of tumour promotion in mouse skin by extracts of rooibos (*Aspalathus linearis*) and honeybush (*Cyclopia intermedia*), unique South African herbal teas. *Cancer Letters* 224, 193–202.
- Masoko, P., Picard, J., Eloff, J.N., 2005. Antifungal activities of six South African *Terminalia* species (Combretaceae). *Journal of Ethnopharmacology* 99, 301–308.
- Masoko, P., Picard, J., Eloff, J.N., 2007. The antifungal activity of twenty-four southern African *Combretum* species (Combretaceae). *South African Journal of Botany* 73, 173–183.
- Mathabe, M.C., Nikolova, R.V., 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.
- McGaw, L.J., Jäger, A.K., Van Staden, J., 2000. Antibacterial, anthelmintic and antiamebic activity in South African medicinal plants. *Journal of Ethnopharmacology* 72, 247–263.
- McGaw, L.J., Lall, N., Meyer, J.J.M., Eloff, J.N., 2008. The potential of South African plants against *Mycobacterium* infections. *Journal of Ethnopharmacology* 119, 482–500.
- Mishra, G., Srivastava, S., Nagori, B.P., 2009. Extraction and evaluation of antimicrobial activity of *Cissus quadrangularis* Linnaeus. *Biological Forum - An International Journal* 1, 103–108.
- Momtaz, S., Mapunya, B.M., Houghton, P.J., Edgerly, C., Hussein, A., Naidoo, S., Lall, N., 2008. Tyrosinase inhibition by extracts and constituents of *Sideroxylon inerme* L. stem bark, used in South Africa for skin lightening. *Journal of Ethnopharmacology* 119, 507–512.
- Moolla, A., 2005. A Phytochemical and Pharmacological Investigation of Indigenous *Agathosma* Species. (MPharm Thesis) University of the Witwatersrand.
- Moolla, A., Viljoen, A.M., 2008. 'Buchu'-*Agathosma betulina* and *Agathosma crenulata* (Rutaceae): a review. *Journal of Ethnopharmacology* 119, 413–419.
- More, G., Tshikalange, T.E., Lall, N., Botha, F., Meyer, J.J.M., 2008. Antimicrobial activity of medicinal plants against oral microorganisms. *Journal of Ethnopharmacology* 119, 473–477.
- Moshi, M.J., Mbwambo, Z.H., 2005. Some pharmacological properties of extracts of *Terminalia sericea* roots. *Journal of Ethnopharmacology* 97, 43–47.
- Motsei, M.L., Lindsey, K.L., Van Staden, J., Jäger, A.K., 2003. Screening of traditionally used South African plants for antifungal activity against *Candida albicans*. *Journal of Ethnopharmacology* 86, 235–241.
- Murthy, L.K.N.C., Vanitha, A., Swamy, M.M., Ravishankar, G.A., 2003. Antioxidant and antimicrobial activity of *Cissus quadrangularis*. *Journal of Medicinal Food* 6, 99–105.
- Musa, D.A., Nwodo, F.O.C., Ojogbane, E., 2011. Phytochemical, antibacterial and toxicity studies of the aqueous extract of *Eucalyptus camaldulensis* Dehnh. *Asian Journal of Plant Science and Research* 1, 1–10.
- Mutai, C., Bii, C., Vagias, C., Abatis, D., Roussis, V., 2009. Antimicrobial activity of *Acacia mellifera* extracts and lupane triterpenes. *Journal of Ethnopharmacology* 123, 143–148.
- Naidoo, K.K., Cooposamy, R.M., 2011. A comparative analysis of two medicinal plants used to treat common skin conditions in South Africa. *African Journal of Pharmacy and Pharmacology* 5, 393–397.
- Ncube, B., Finnie, J.F., Van Staden, J., 2012. *In vitro* antimicrobial synergism within plant extract combinations from three South African medicinal bulbs. *Journal of Ethnopharmacology* 139, 81–89.
- Ngwenya, M.A., Koopman, A., Williams, R., 2003. Zulu Botanical Knowledge: An Introduction. National Botanical Institute, Durban.
- Nielsen, T.R.H., Kuete, V., Jäger, A.K., Meyer, J.J.M., Lall, N., 2012. Antimicrobial activity of selected South African medicinal plants. *BMC Complementary and Alternative Medicine* 12, 1–6.
- Njoroge, G.N., Bussmann, R.W., 2007. Ethnotherapeutic management of skin diseases among the Kikuyus of Central Kenya. *Journal of Ethnopharmacology* 111, 303–307.
- Olajuyigbe, O.O., Babalola, A.E., Afolayan, A.J., 2011. Antibacterial and phytochemical screening of crude ethanolic extracts of *Waltheria indica* Linn. *African Journal of Microbiology Research* 5, 3760–3764.
- Öztürk, S., Ercisli, S., 2006. The chemical composition of essential oil and *in vitro* antibacterial activities of essential oil and methanol extract of *Ziziphora persica* Bunge. *Journal of Ethnopharmacology* 106, 372–376.
- Padayachee, K., 2011. The Phytochemistry and Biological Activities of *Athrixia phyllicoides*. (MSc Thesis) University of the Witwatersrand.
- Palmer, E., Pitman, N., 1972. *Trees of Southern Africa*, vol. 3. Balkema, Cape Town.
- Pather, N., Viljoen, A.M., Kramer, B., 2011. A biochemical comparison of the *in vivo* effects of *Bulbine frutescens* and *Bulbine natalensis* on cutaneous wound healing. *Journal of Ethnopharmacology* 133, 364–370.
- Perumal Samy, R.P., Ignacimuthu, S., Sen, A., 1998. Screening of 34 Indian medicinal plants for antibacterial properties. *Journal of Ethnopharmacology* 62, 173–182.
- Pillay, C.C.N., Jäger, A.K., Mulholland, D.A., Van Staden, J., 2001. Cyclooxygenase inhibiting and anti-bacterial activities of South African *Erythrina* species. *Journal of Ethnopharmacology* 74, 231–237.
- Pooley, E., 1993. *The Complete Field Guide to Trees of Natal, Zululand and Transkei*. Natal Flora Publications Trust, Natal Herbarium, Durban.
- Priya, K.S., Gnanamani, A., Radhakrishnan, N., Babu, M., 2002. Healing potential of *Datura alba* on burn wounds in albino rats. *Journal of Ethnopharmacology* 83, 193–199.
- Pujol, J., 1990. *Nature Africa, The Herbalist Handbook*. Jean Pujol Natural Healers' Foundation, Durban.
- Rabe, T., Van Staden, J., 1997. Antibacterial activity of South African plants used for medicinal purposes. *Journal of Ethnopharmacology* 56, 81–87.
- Ram, A.J., Bhakshu, L.M., Raju, R.R.V., 2004. *In vitro* antimicrobial activity of certain medicinal plants from Eastern Ghats, India, used for skin diseases. *Journal of Ethnopharmacology* 90, 353–357.
- Reuter, J., Merfort, I., Schempp, C.M., 2010. Botanicals in dermatology, and evidence-based review. *American Journal of Clinical Dermatology* 11, 247–267.
- Roberts, M., 1990. *Indigenous Healing Plants*. Southern Book Publishers, Halfway House, South Africa.
- Rood, B., 1994. *Uit die Veldapteeke*. Tafelberg, Cape Town.
- Saadabi, A.M.A., Moglad, E.H., 2011. Experimental evaluation of certain Sudanese plants used in folkloric medicine for their antibacterial activity (*in-vitro* tests). *Journal of Applied Sciences Research* 7, 253–256.
- Saddique, Z., Naeem, I., Maimoona, A., 2010. A review of the antibacterial activity of *Hypericum perforatum* L. *Journal of Ethnopharmacology* 131, 511–521.
- Samie, A., Obi, C.L., Bessong, P.O., Lall, N., 2005. Activity profiles of fourteen selected medicinal plants from Rural Venda communities in South Africa against fifteen clinical bacterial species. *African Journal of Biotechnology* 4, 1443–1451.
- Shagal, M.H., Kubmarawa, D., Alim, H., 2012. Preliminary phytochemical investigation and antimicrobial evaluation of roots, stem-bark and leaves extracts of *Diospyros mespiliformis*. *International Research Journal of Biochemistry and Bioinformatics* 2, 011–015.
- Sen, A., Batra, A., 2012. Evaluation of antimicrobial activity of different solvent extracts of medicinal plant: *Melia azedarach* L. *International Journal of Current Pharmaceutical Research* 4, 67–73.
- Shahi, S.K., Shukla, A.C., Bajaj, A.K., Banerjee, U., Rimek, D., Midgely, G., Dikshit, A., 2000. Broad spectrum herbal therapy against superficial fungal infections. *Skin Pharmacology and Applied Skin Physiology* 13, 60–64.
- Shai, L.J., McGaw, L.J., Masoko, P., Eloff, J.N., 2008. Antifungal and antibacterial activity of seven traditionally used South African plant species active against *Candida albicans*. *South African Journal of Botany* 74, 677–684.
- Shale, T.L., Stirk, W.A., Van Staden, J., 1999. Screening of medicinal plants used in Lesotho for anti-bacterial and anti-inflammatory activity. *Journal of Ethnopharmacology* 67, 347–354.
- Smith, A., 1895. *A Contribution to The South Africa Material Medica*, 3rd ed. Lovedale, South Africa.
- Smith, C.A., 1996. *Common Names of South African plants*. *Memoirs of the Botanical Survey of South Africa*, 35th ed. Department of Agricultural Technical Services, Pretoria.
- Srividya, A.R., Sumithra, G.S., 2010. Antioxidant, antimicrobial and cytotoxic property of *Melanthus major* leaves. *Journal of Global Pharma Technology* 2, 94–97.
- Steenkamp, V., Gouws, M.C., 2006. Cytotoxicity of six South African medicinal plant extracts used in the treatment of cancer. *South African Journal of Botany* 72, 630–633.
- Steenkamp, V., Mathivha, E., Gouws, M.C., Van Rensburg, C.E.J., 2004. Studies on antibacterial, antioxidant and fibroblast growth stimulation of wound healing remedies from South Africa. *Journal of Ethnopharmacology* 9, 353–357.
- Steenkamp, V., Fernandes, A.C., Van Rensburg, C.E.J., 2007. Screening of Venda medicinal plants for antifungal activity against *Candida albicans*. *South African Journal of Botany* 73, 256–258.
- Street, R.A., Stirk, W.A., Van Staden, J., 2008. South African traditional medicinal plant trade-challenges in regulating quality, safety and efficacy. *Journal of Ethnopharmacology* 119, 705–710.
- Sule, W.F., Okonko, T.A., Joseph, T.A., Ojezele, M.O., Nwanze, J.C., Alii, J.A., Adewale, O.G., Ojezele, O.J., 2010. *In vitro* antifungal activity of *Senna alata* Linn. crude extract. *Research Journal of Biological Sciences* 5, 275–284.
- Suliman, S., Van Vuuren, S.F., Viljoen, A.M., 2010. Validating the *in vitro* antimicrobial activity of *Artemisia afra* in polyherbal combinations to treat respiratory infections. *South African Journal of Botany* 76, 655–661.
- Szabó, I., Pallag, A., Blidar, C.F., 2009. The antimicrobial activity of the *Cnicus benedictus* L. extracts. *Analele Universitatii din Oradea, Fascicula Biologie* XVI, 126–128.
- Tadeh, H., 2004. *Phytopharmaceutical Studies of Some Selected Medicinal Plants Locally used in the Treatment of Skin Disorders*. (MSc Thesis) Addis Ababa University.
- Tadeh, H., Mohammed, E., Asres, K., Gebre-Mariam, T., 2005. Antimicrobial activities of some selected traditional Ethiopian medicinal plants used in the treatment of skin disorders. *Journal of Ethnopharmacology* 100, 168–175.
- Takahashi, T., Kokubo, R., Sakaino, M., 2004. Antimicrobial activities of *Eucalyptus* leaf extracts and flavonoids from *Eucalyptus maculate*. *Letters in Applied Microbiology* 39, 60–64.

- Teffo, L.S., Aderogba, M.A., Eloff, J.N., 2010. Antibacterial and antioxidant activities of four kaempferol methyl ethers isolated from *Dodonaea viscosa* Jacq. var. *angustifolia* leaf extracts. *South African Journal of Botany* 76, 25–29.
- Thring, T.S.A., Springfield, E.P., Weitz, F.M., 2007. Antimicrobial activities of four plant species from the Southern Overberg region of South Africa. *African Journal of Biotechnology* 6, 1779–1784.
- Tomson, N., Sterling, J.C., 2007. Infections and infestations of the skin in children. *Paediatrics and Child Health* 17, 400–406.
- Tsai, T.H., Tsai, T.H., Wu, W.H., Tseng, J.T.-P., Tsai, P.J., 2010. *In vitro* antimicrobial and anti-inflammatory effects of herbs against *Propionibacterium acnes*. *Food Chemistry* 119, 964–968.
- Ullah, M.O., Sultana, S., Haque, A., Tasmin, S., 2009. Antimicrobial, cytotoxic and antioxidant activity of *Centella asiatica*. *European Journal of Scientific Research* 30, 260–264.
- Van der Watt, E., Pretorius, J.C., 2001. Purification and identification of active antibacterial components in *Carpobrotus edulis* L. *Journal of Ethnopharmacology* 76, 87–91.
- Van Hees, C., Naafs, B., 2001. Common Skin Diseases in Africa. An illustrated Guide.
- Van Vuuren, S.F., 2008. Antimicrobial activity of South African medicinal plants. *Journal of Ethnopharmacology* 119, 462–472.
- Van Vuuren, S.F., Viljoen, A.M., 2011. Plant-based antimicrobial studies-methods and approaches to study the interaction between natural products. *Planta Medica* 77, 1168–1182.
- Van Wyk, B.E., 2008a. A broad review of commercially important southern African medicinal plants. *Journal of Ethnopharmacology* 119, 342–355.
- Van Wyk, B.E., 2008b. A review of Khoi-San and Cape Dutch medical ethnobotany. *Journal of Ethnopharmacology* 119, 331–341.
- Van Wyk, B.E., Van Oudtshoorn, B., Gericke, N., 2000. Medicinal Plants of Southern Africa, 2nd ed. Briza, South Africa.
- Van Wyk, B.E., Van Oudtshoorn, B., Gericke, N., 2009. Medicinal Plants of South Africa. Briza, South Africa.
- Van Wyk, B., Van Wyk, P., Van Wyk, B.E., 2011. Photo Guide to Trees of Southern Africa. Briza, South Africa.
- Vermaak, I., Kamatou, G.P.P., Komane-Mofokeng, B., Viljoen, A.M., Beckett, K., 2011. African seed oils of commercial importance-cosmetic applications. *South African Journal of Botany* 77, 920–933.
- Verschaeve, L., Van Staden, J., 2008. Mutagenic and antimutagenic properties of extracts from South African traditional medicinal plants. *Journal of Ethnopharmacology* 119, 575–587.
- Viji, M., Murugesan, S., 2010. Phytochemical analysis and antibacterial activity of medicinal plant *Cardiospermum halicacabum* linn. *Journal of Phytology* 2, 68–77.
- Viljoen, A.M., Van Vuuren, S., Ernst, E., Klepser, M., Demirci, B., Baser, H., Van Wyk, B.E., 2003. *Osmitopsis asteriscoides* (Asteraceae) the antimicrobial activity and essential oil composition of a Cape-Dutch remedy. *Journal of Ethnopharmacology* 88, 137–143.
- Von Koenen, E., 1996. Heil-Gift-und, Essbare, *P. flenzen* in Namibia. Klaus Hees Verlag, Göttingen.
- Watt, J.M., Breyer-Brandwijk, M.G., 1962. The Medicinal and Poisonous Plants of Southern and Eastern Africa, 2nd ed. Livingstone, London.
- Webster, D., Taschereau, P., Belland, R.J., Sand, C., Rennie, R.P., 2008. Antifungal activity of medicinal plant extracts preliminary screening studies. *Journal of Ethnopharmacology* 115, 140–146.
- Weckesser, S., Engel, K., Simon-Haarhaus, B., Wittmer, A., Pelz, K., Schempp, C.M., 2007. Screening of plant extracts for antimicrobial activity against bacteria and yeast with dermatological relevance. *Phytochemistry* 14, 508–516.
- Weideman, L., 2005. An investigation into the antibacterial activities of medicinal plants traditionally used in the Eastern Cape to treat secondary skin infections associated with burn wounds. (MTEch Thesis) Nelson Mandela Metropolitan University.
- World Health Organisation (WHO), 2011. The world medicines situation traditional medicines: global situation, issues and challenges. Geneva. Available at: [http://www.who.int/medicines/areas/policy/world\\_medicines\\_situation/WMS\\_ch18\\_wTraditionalMed.pdf](http://www.who.int/medicines/areas/policy/world_medicines_situation/WMS_ch18_wTraditionalMed.pdf) (Accessed on: 11/01/2013).
- Yff, B.T.S., Lindsey, K.L., Taylor, M.B., Erasmus, D.G., Jäger, A.K., 2002. The pharmacological screening of *Pentanisia prunelloides* and the isolation of the antibacterial compound palmitic acid. *Journal of Ethnopharmacology* 79, 101–107.