

# Plants Used for Cosmetics in the Eastern Cape Province of South Africa: A Case Study of Skin Care

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## ABSTRACT

Cosmetology is the science of change of appearance and has been practiced since ancient times. In South Africa, especially Eastern Cape, the concept of using plants for beautification finds its origin in the traditional medicine literature. Moreover, herbal extract as a whole or part thereof has been used since time immemorial for various ailments of the skin, hair, and for overall appearance. Recently, the interest of consumers in the use of herbal cosmetics has been stimulated by the decline of faith in modern cosmetic products based on the beliefs that herbal cosmetics contain natural ingredients that are less dangerous to the skin and thereby superior to synthetic cosmetics and the reference to successful historical use by different cultures. A number of South African plants have been evaluated for their cosmetic potential. In this article, we reviewed 105 plant species used by the people of Eastern Cape Province for various cosmetic purposes with a majority of them used for skin care (70 species) and dental care (6 species). These plants are distributed in 59 families with the Asteraceae being the most represented with 9 species, followed by Fabaceae (7 species), Asphodelaceae (5 species), Lamiaceae (4 species), Apocynaceae (3 species), Hyacinthaceae (3 species), and other families with two to one species each. The results of the studies conducted confirmed the potential of the Eastern Cape medicinal plants in cosmetic products and identified a number of promising species for further investigation as plant-based cosmetic agents.

**Key words:** Cosmetics, Eastern Cape, herbal cosmetics, plants, skin care, South Africa

## INTRODUCTION

Beauty plays an important role in our day-to-day life. It is a very important source of inspiration in all areas of lives, thus providing pleasure or deep satisfaction to the sensations. Some are born with natural beauty while others are made beautiful esthetically. The word “beauty” is not associated with females only as is often thought, but males also used cosmetic products. According to the European Directive 93/95/EEC (European Commission), cosmetic products are referred to as “any substances or preparation intended for application to any external surface of the human body (epidermis, hair system, nails, lips, and external genital organs) or teeth including the mucosa membranes of the oral cavity with a view exclusively or mainly to cleaning, perfuming, or protecting them, changing their appearance and/or correcting body odour, and keeping them in good conditions.”<sup>[1]</sup> Currently, cosmeceutical industry is gaining popularity nowadays, as many cosmetic products are now being supplemented with natural ingredients. The term “natural” denotes as any element of the physical universe that is made by nature or found in nature. Sources of natural ingredients include water, land, mineral, fruits, flowers, leaves, and herbs.<sup>[2]</sup>

Plants have been the main source of all cosmetics since time immemorial, before the use of chemical-based cosmetics. Humans, indeed still, prefer using plant extracts for various cosmetic purposes. They used plant extracts for cleansing, beauty, health, well-being, and social status indicator. At present, there is an increased demand for herbal cosmetic products. This could be due to the perception that chemical-based cosmetics are dangerous to the skin and an increased awareness among consumer for herbal products triggered the request for natural products and natural extracts in cosmetic preparation. Herbal cosmetics are formulated, using different cosmetic ingredients to form the base in which one or more herbal ingredients are used to do magical wonders to an individual's skin as well as other parts of the body. Herbal cosmetics are also prepared in various types of formulation to ease of use. The formulations including ointments, creams, emulsions, powder solutions, and compacts can be employed based on the need. The legal requirement and regulatory procedures for herbal cosmetics are the same as that for chemical ingredients or moieties used in cosmetic formulations.<sup>[3-5]</sup> However, the significant growing interest in herbal cosmetic products has produced new opportunities in cosmeceutical market. This emerging pattern shift in cosmeceutical market continues to be driven by the growing demand for herbal products which is increasingly fascinating among young and elderly people worldwide.

In South Africa, most people prefer herbal products for their personal care to improve their beauty as these products supply the body with nutrients as they are devoid of synthetic chemicals and reported to have relatively fewer side effects.<sup>[6]</sup> In the Eastern Cape Province, herbal

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cosmetic products are more frequently bought from herbal shops, but in a few cases, they are still prepared at home, especially those used for skin care. Despite enormous advertising campaigns for new and improved cosmetic products, Xhosa men and women still prefer to use certain traditional vegetable and mineral cosmetics (imbhola yesiXhosa) for beauty, health, well-being, and as social status indicators in the Eastern Cape today. In line with this, it is worth reviewing the knowledge and usage of plants used in the Eastern Cape Province for various cosmetic purposes.

The search for plant products used in cosmetics is ongoing worldwide. A review by Chen *et al.*<sup>[7]</sup> reported the medicinal and cosmetic relevance of *Aloe ferox*, a fully explored plant in South Africa used in the herbal cosmetic formulation. An article from Vermaak *et al.*<sup>[8]</sup> also reported the importance of seed oil from six species used in the preparation of cosmetics. In this study, we focused on a comprehensive review of plants traditionally used for various cosmetic purposes in the Eastern Cape Province with a view to helping researchers and government agencies to prevent possible extinction of these plants. This study also provides guidance for future research on the scientifically underexploited plants.

## MATERIALS AND METHODS

Ethnobotanical information regarding all 105 plant species was obtained through a comprehensive literature survey from Google Scholar, ScienceDirect, PubMed, Web of Science, and Library Search. All the available relevant data from medicinal plants were collated from literature review articles together with several relevant books (e.g., Hutchings *et al.*, 1996; Van Wyk *et al.*, 2009; Watt and BreyerBrandwijk, 1962). One hundred and seventy journals were retrieved, although emphasis was laid on the plants used in various cosmetic products when keywords such as scientific name of the plants and cosmetics were typed in.

## RESULTS AND DISCUSSION

Table 1 shows a more in-depth analysis of the specific plants used by the people of Eastern Cape for various cosmetics purposes such as skin care, dental care, hair care, and perfume care. Based on available information, over 105 plant species were identified as being used for cosmetic purposes applied topically or as a paste or infusion, traditionally by the people of Eastern Cape province of South African. Surprisingly, few of these plants have been scientifically investigated for cosmetic or pharmacological potential.

### Skin care

The skin is one of the largest organs in the body, protecting the body from external or internal environmental factors. It plays a very significant role in terms of protection, thermoregulation, percutaneous adsorption, and sensory activities.<sup>[67]</sup> The skin comprises dermis, epidermis, and subcutaneous layers. The dermis is the layer of skin beneath which cushions the body from stress and strain while the epidermis (outermost layer of the skin) forms the waterproof, protective wrap over the body's surface. The subcutaneous layers attach the skin to underlying bone and muscle as well as supplying it with blood vessels and nerves. The acidic sebaceous secretions and surface structure of the skin are very aggressive toward many pathogens.<sup>[48]</sup> This is based on the fact that the rich blood and lymphatic supply of the dermis ensure that both specific and nonspecific immune responses can be quickly recruited against pathogens, thereby preventing them from attacking the skin. However, studies have also indicated that skins defense system may compromise if the surface is penetrated through injury, thereby enabling pathogens to invade the skin.<sup>[68]</sup>

Natural remedies have been used for years for the treatment of various skin conditions and a wide variety of dermatological disorders including

inflammation, dermatitis, phototoxicity, and psoriasis. Although they are generally accepted by patients, their scientific investigation in respect to skin conditions is very limited. The natural remedies are very promising, but their true effects are unknown, so further investigations must be performed to assess clinical benefit.

### Pharmacological activities with regard to skin care ethnobotanicals

Based on the ethnobotanical literature, 105 plant species are reportedly used traditionally by the people of Eastern Cape Province, South Africa, for various cosmetic purposes [Table 1]. Many of them have been reported to show activities which are directly associated with skin care. Activities such as wound healing, antioxidant, antityrosinase, and anti-inflammatory are reportedly common among the selected plant species listed in Table 1. Table 2 gives an overview of the pharmacological properties of species associated with treating skin conditions which are scientifically explored but needs further scientific explorations.

#### Antioxidant activity

The free radicals are species capable of independent existence that contains one or more unpaired electrons in their outer shells. They are produced in living systems as a part of the normal physiological process.<sup>[69]</sup> They are also formed exogenously when reacting with various biomolecules present in the skin, thereby playing an important role in skin disorders.<sup>[10,70]</sup> These radicals can be controlled naturally by various useful compounds known as antioxidants. Antioxidants generally are substances or radical scavengers that when present in low concentrations delay or prevent free radicals by inhibiting various oxidizing chain reactions.<sup>[10]</sup>

Plants are a very important source of natural antioxidants. Several scientific reports have indicated that plants contain a large variety of secondary metabolites (phytochemicals) that have antioxidant property.<sup>[71]</sup> Phytochemicals include flavonoids, tocopherols (delta > gamma > beta > alpha), carotenoids, phenols, beta-carotene, lycopene, sesamol, gossypol, anthocyanins, catechins, ellagic acid, lutein, resveratrol, cinnamic acids, benzoic acids, folic acid, ascorbic acid, and tocotrienols. These phytochemicals produced by plants are known as natural antioxidants or phytochemical antioxidants.<sup>[71]</sup> They are very effective in scavenging free radical formation, thereby promoting their decomposition and suppressing disorders. Studies also indicated that some phytochemical compounds such as plant phenolics prevent or inhibit the propagation of oxidative chain reactions, thus repairing the oxidative damage done to the body's cells.<sup>[2]</sup> However, it should be noted that antioxidant activity of plants varies according to the molecular structures of the compounds presence in the plant. This is as a result of the fact that molecular structures of individual compounds present in the plant extracts are the most important factor determining the antioxidant activity of a compound or plant.<sup>[72]</sup> Table 2 shows some of the Eastern Cape plant species reported to exhibit antioxidant activity. Despite the fact that the antioxidant activity of some plants has been investigated, numerous plants still lack comprehensive scientific data to validate the pharmacological effects of the medicinal plants and their respective bioactive compounds.

#### Antityrosinase activity

Melanin plays a very significant role in humans. It is a pigment that is responsible for the color of the eyes, hair, and skin in humans.<sup>[73]</sup> It performs an important function in protecting the skin against ultraviolet (UV) light damage by absorbing UV radiation and removing reactive oxygen species.<sup>[74,75]</sup> Melanin is secreted or produced by the melanocytes cells, which are circulated in the basal layer of the dermis, through a physiological process called

**Table 1:** List of medicinal plants used in the Eastern Cape Province for cosmetic purposes

Scientific name	Family	Local name (Xhosa)	Cosmeceutical significance	Other ethnobotanical uses	Reference
<i>Acokanthera oppositifolia</i> (Lam.) Codd	Apocynaceae	Intlungunyembe	Leaf pulp is applied into wounds, and as a dressing to swollen part	Root decoctions are used to treat tapeworm and aerial part of the plant are used to treat snakebite, headaches, abdominal pains, and convulsions	[9,10]
<i>Acacia karroo</i> Hayne	Fabaceae	Umnga	Bark/leaves are used to treat bumps on skin, boil, and thrush	Bark and leaf decoctions are used to treat diarrhea	[11,12]
<i>Aristea ecklonii</i> Baker*	Iridaceae	Umhushuza	The whole plant is applied topically to treat shingles	The whole plant is used to treat syphilis, coughs, and fever	[9,13]
<i>Artemisia afra</i> Jacq. ex Willd	Asteraceae	Umhloniyane	Leaves are used for body washes and as decoctions to treat acne and boils	Roots/stems are used to treat diabetes, cough, and fever	[9,14]
<i>Albizia adianthifolia</i> (Schumach.) W.Wight var.	Fabaceae	Umhlandlothi	The bark is used to improve skin beauty and as well as treat eczema	The bark is used to treat acne and eye inflammation	[15]
<i>Alepidea amatymbica</i> (Eckl. and Zeyh)*	Apiaceae	Umvuthuza	Decoction of the roots is used to treat pimples, lice on all hairy parts including head and armpits	The roots decoction is used to treat colds, coughs, rheumatism, wounds, and to wash divining bones	[15]
<i>Aloe arborescens</i> Mill.	Xanthorrhoeaceae	Ikalene	Leaves are topically applied to treat wounds, burns, and various skin ailments	The leaves powdered are used for the protection of storms	[16,17]
<i>Aloe ferox</i> Mill.	Asphodelaceae	Ikhala	Sap from the leaves is applied directly to treat skin irritation, bruises, and eczema	Leaf sap is applied for wound healing and constipation	[17,18]
<i>Asparagus africanus</i> Lam.	Asparagaceae	Ubumhlope/Umathunga	The aerial part of the plant is used by women to stimulate the growth of the hair	The root extract is applied externally for chronic gout	[19]
<i>Athrixia phyllicoides</i> DC.	Asteraceae	N/A	The plant infusion is used to treat sores and boils	The leaves decoction is used for coughs	[9,20]
<i>Bauhinia bowkeri</i> Harv.	Fabaceae	Umdlndlovu	Leaves and bark are used for steaming and bathing	The leaves and barks of the plant are used for inducing vomiting	[21]
<i>Bulbine asphodeloides</i> (L.) Spreng*	Asphodelaceae	Uyakayakane/Intelezi	The leaves or leaf gel is applied into wounds, itches, burns, sunburns, rough skin, and insects' bites	Leaf/tuber decoction is used to treat dysentery and diarrhea	[15]
<i>Bulbine latifolia</i> * (L.f.) Roem. et Schult.	Asphodelaceae	Ibhucu	The leaf sap is applied directly to treat wound, burns, eczema rashes, and itches	The roots are used, taken orally to quell vomiting and diarrhea	[16,22,23]
<i>Bulbine frutescens</i> (L.) Willd.	Asphodelaceae	N/A	Fresh leaf juice is used for cracked lips, slimy leaves is applied typically to wound and rash	Decoctions of the fresh leaf are taken for coughs, colds and arthritis,	[10,24]
<i>Bowiea volubilis</i> Ex Hook.f. subsp. <i>Volubilis</i> *	Hyacinthaceae	Umagaqana	The bulb is used for painkilling effect in skin	The bulbs are used for bladder problems, barrenness, and to facilitate delivery	[15]
<i>Carpobrotus dimidiatus</i> (Haw.) L. Bolus	Mesembryanthemaceae	N/A	The leaf juice is used as an ointment and used for dressing wounds and burns	The leaf juice of the plant is used for the treatment of diarrhea and dysentery	[10]
<i>Carpobrotus edulis</i> (L.) Bolus	Mesembryanthemaceae	Igcukuma	The leaf juice/pulp is used as a lotion for eczema and improvement of skin condition	The leaf juice is directly applied to treat tooth thrush, diarrhea, dysentery, and mouth infection	[25]

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Scientific name	Family	Local name (Xhosa)	Cosmeceutical significance	Other ethnobotanical uses	Reference
<i>Calodendrum capense</i> (L.f.) Thunb	Rutaceae	Umbaba/Umsitshana	The bark of the plant is used as an ingredient for skin ointments	The leaves are used for killing insect and the seed oil of the plant is used in making soap	[10,26]
<i>Cassipourea flanaganii</i> (Schinz) Alston.	Rhizophoraceae	Umemezi	The bark of the leaf is applied to the face to enhance the beauty of the young women and also used for skin lightning and complexion	N/A	[11]
<i>Centella asiatica</i> (L.) Urban	Apiaceae	N/A	The leaves are used as tinctures for wound and acnes	The leaves are used to treat leprosy, dermatitis, and bronchitis,	[27,28]
<i>Centaurea benedicta</i> (L.) L*	Asteraceae	N/A	The whole plant is applied topically for wound and ulcers	The plants are used to promote lactations	[25]
<i>Cheilanthes viridis</i> (Forssk.) Sw.*	Pteridaceae	N/A	The whole plant is used to treat burns, wound, and sores	N/A	[29]
<i>Citrullus lanatus</i> (Thunb.) Matsum. and Nakai	Cucurbitaceae	Uinxoxozi	The flesh of fruits is used as an ingredient in lotions used to treat sunburns	The fruit of the plant is used for the treatment of jaundice, kidney and bladder infection	[10,30]
<i>Cissampelos capensis</i> L.*	Menispermaceae	Umayisake	The root/leaf is used as paste for wound, ulcer, boils, and skin cancer	The roots of the plant are used for the treatment of diabetes and tuberculosis	[31,32]
<i>Cissampelos torulosa</i> E.Mey. Ex	Menispermaceae	Isitorhom	Roots are chewed for toothache	The root is used for treatment of fever, arthritis, obesity, and dysentery	[33]
<i>Clausena anisata</i> (Willd) Hook.f. ex Benth.	Rutaceae	Umnukandiba/Umtuto	Crushed leaves are applied externally as an antiseptic for wounds and sores	The essential oils of the plant are used as repellent and insecticidal activities	[10]
<i>Clematis brachiata</i> Thunb	Ranunculaceae	Ityolo	The root is cooked with salt and used as a remedy for thrush	A tea made of the leaves are used for the treatment of headaches, coughs and colds, and chest ailments	[33]
<i>Clerodendrum glabrum</i> E.Mey. var.	Verbenaceae	Umqwaqwanam	Decoctions of leaves are used for treating wounds	The roots and leaves decoction are used to treat snake bites and diarrhea	[10]
<i>Cotyledon orbiculata</i> Forssk.	Crassulaceae	Imphewula	The leaf juice is applied topically for boils, corns, and warts	Warmed leaf juice is used as drops for toothache	[33]
<i>Crinum moorei</i> Hook.F	Amaryllidaceae	N/A	The bulbs of the plant are used to treat infected sores and acne	The bulbs are used for the treatment of urinary tract infections and body swelling	[9,34]
<i>Croton sylvaticus</i> Hochst.	Euphorbiaceae	Umfeze/Umagwaqane	Finely ground bark is used for healing bleeding gums	The bark of the plant is used for the treatment of intestinal disorders and rheumatism	[35,36]
<i>Curtisia dentata</i> (Burm.f.) C.A. Smith.	Corticaceae	Umlahlani	The decoction of the root is used for pimples, itches, rashes, and acnes.	The bark of the plant is used to treat stomach ailments, diarrhea, and as a blood purifier and aphrodisiac	[10]

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Scientific name	Family	Local name (Xhosa)	Cosmeceutical significance	Other ethnobotanical uses	Reference
<i>Cucumis hirsutus</i> Sond.	Cucurbitaceae	N/A	Leaves and roots are used for inflammation	The leaf and root decoctions of the plant are used for diarrhea	[10,37]
<i>Datura stramonium</i> L.	Solanaceae	Umhlavuthwa/Ibhudabhutha	The leaves are used to treat wounds, sores, swellings, boils, and abscesses	The leaves are used for the treatment of asthma, arthritis, and gastrointestinal disorder	[23,38]
<i>Dalbergia obovata</i> E.Mey*	Fabaceae	Umlungulu	The stem mixed with water used for sore mouths in infants	The ash of the plant is used in snuff	[33]
<i>Diospyros lycioides</i> Desf.	Ebenaceae	Umbhongisa	The decoctions of bark and root are used to treat inflammation	Decoctions of bark/ root are used for dysentery	[22]
<i>Dodonaea viscosa</i> Jacq var. <i>angustifolia</i> (L.f) Benth.	Sapindaceae	N/A	The twigs are chewed to clean the teeth while the plant is gargled for oral thrush	The concoction of the root is used for cold and influenza	[39,40]
<i>Elephantorrhiza elephantina</i> (Burch.) Skeels.	Fabaceae	Intolwane	Roots and rhizomes infusions are applied topically for acne, wounds, and burns	The root is used as a remedy for dysentery and diarrhea	[41,42]
<i>Eriocephalus africanus</i> L.	Asteraceae	N/A	The essential oil of the plant is used for skin care	Leaf decoctions are used for menstruation, swelling, and gynecological problems	[10,24]
<i>Erythrina lysistemon</i> Hutch.	Fabaceae	Umsintsi	Barks are applied as poultice or powdered burnt bark for open wounds and sores	The aerial plant part is used for arthritis	[43]
<i>Eucomis autumnalis</i> (Mill.) Chitt*	Hyacinthaceae	Umathunga	Bulbs are applied to improve beauty and treat wounds and ulcer caused by STI	The bulb is used for healing of fractures	[15]
<i>Euphorbia ingens</i> E.Mey. ex Boiss.*	Euphorbiaceae	Umlonhlo	Stem and milky fluid are applied on skin rash, postinflammatory spots	The bulbs are used to promote healing without hyperpigmentation	[15]
<i>Ficus natalensis</i> Hochst.	Moraceae	Umqgeqe/Umgwenyenzinja	Leaves are used as poultices for wounds and boils	Bark is used during pregnancy to ensure easy childbirth and the leaf decoction are used to treat various stomach disorders	[44,45]
<i>Foeniculum vulgare</i> Mill.	Umbelliferae	N/A	The natural light green dye obtained from leaves of the plant is used as a fragrance component	The whole plant part is used as a milk stimulant in pregnant women, arthritis and fever	[10]
<i>Gerbera piloselloides</i> (L.) Cass*	Asteraceae	Umsa	Root infusion is applied on postinflammatory spots, pimples	Root infusion is used for wound hyperpigmentation	[15]
<i>Greyia flanaganii</i> Bolus	Greyiaceae	Usinga/Lwamaxhegokazi	Leaves are used to treat skin ailment	The bark infusion is used to treat diarrhea	[10,17,46]
<i>Grewia occidentalis</i> L.	Malvaceae	Umqqabaza	Bark soaked in water for wound dressing	Bark is used to expedite child delivery	[9,47]
<i>Gunnera perpensa</i> L.	Gunneraceae	Iphuzi lomlambo, Ighobo	Decoctions of leaf, root, and rhizome is used for wound dressing	Decoction of the entire plant is used for rheumatic fever, infertility, and to ease childbirth	[48]

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Scientific name	Family	Local name (Xhosa)	Cosmeceutical significance	Other ethnobotanical uses	Reference
<i>Gnidia anthylloides</i> (L.f.) Gilg*	Thymelaeaceae	Intozwane	Root burnt or ground is applied on wounds and burns	Bark is used for snake bites, toothaches, and earaches	[15]
<i>Gnidia capitata</i> L.f.	Thymelaeaceae	Umsila	Root burnt or ground is applied on wounds, rashes, fractures, snake bites, and sore throat	The leaves are ground to a snuff, smoked and used to treat stomach-ache and earache	[15]
<i>Harpephyllum caffrum</i> Bernh. ex Krauss	Anacardiaceae	Ingwenye	Bark topically applied on acne and eczema	Powdered burnt bark is used to treat sprain	[25,45]
<i>Halleria lucida</i> L.	Scrophulariaceae	N/A	The whole plant part is used to treat skin complaints	The whole plant part is used to relieve earache	[9,49]
<i>Helichrysum odoratissimum</i> (L.) Sweet.	Asteraceae	Imphepho	Leaf decoctions are used for pimples	Leaves are widely used to treat coughs and colds	[10]
<i>Helichrysum petiolare</i> Hilliard and B.L. Burt*	Asteraceae	Imphepho	Decoction of the leaves is used to improve skin texture and beauty and to treat wounds	The leaves are to make an infusion to treat asthma, chest problems, and high blood pressure	[15]
<i>Helichrysum nudifolium</i> (L.) Less.*	Asteraceae	Indlebe	Leaves and twig powder is topically applied to improve skin beauty	Roots and leaves are used as traditional medicine to treat chest complaints	[15]
<i>Hydnora africana</i> (Thumb)	Hydnoraceae	Umavumbuka	The dried fruiting body with a little water is applied to treat acne and other skin blemishes	Plant dried powdered raw is used to treat diarrhea, dysentery, and kidney problems	[47]
<i>Hypoxis hemerocallidea</i> Fisch. C.A.Mey. and Ave-Lall.	Hypoxidaceae	Inongwe	The ground corm is applied directly to treat pimples and improvement of beauty	Weak infusions and decoctions of the corm are used to treat tuberculosis and cancer	[11]
<i>Ilex mitis</i> (L.) Radlk	Aquifoliaceae	Umduma	The ground bark decoction is used to treat skin rashes and sores on the face	The stem bark is used for the treatment of rheumatism and fever	[48]
<i>Kniphofia drepanophylla</i> Baker.	Asphodelaceae	Ixonyi	Ground rhizomes is used to treat ringworm, wounds, pimples, acne, and eczema	Infusion of the root is used to treat tuberculosis	[15]
<i>Leonotis leonurus</i> (L.) R.Br.	Lamiaceae	Umfincafincane/ Umunyamunya	The leaves and stems decoction are applied topically to treat skin ailments, itching, boils, and eczema	The whole plant part of is used for swollen glands, fever, arthritis, and mouth ulcers	[10,50,51]
<i>Lippia javanica</i> (Burm.f.) Spreng	Verbenaceae	Inzinziniba	The leaves and roots infusion of the plant are applied directly to treat various skin disorders such as heat rash and scabies	The leaves and roots infusion of the plant is used for the treatment of malaria, influenza, and measles	[22,50]
<i>Leucosidea sericea</i> Eckl. and Zeyh.	Rosaceae	Isidwadwa/Umyityi	Leaves used as paste to treat acne	The paste made from the crushed leaves used to treat ophthalmia	[10]
<i>Macaranga capensis</i> (Baill.) Benth. ex Sim	Euphorbiaceae	Umpumelelo	The bark decoction is used for pimples, wounds eczema, and acne	The root decoction is drunk for the treatment of mental illness	[15]
<i>Malva parviflora</i> L.	Malvaceae	Umajikanelanga/Ijongilanga	Decoctions of roots or leaves are used as a hair rinse to remove dandruff and to soften hair	The leaves are used to treat stomach pains and inflammation	[52-54]

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Table 1: Contd...

Scientific name	Family	Local name (Xhosa)	Cosmeceutical significance	Other ethnobotanical uses	Reference
<i>Melianthus comosus</i> L.	Melanthaceae	Ubuhlungu/Bemamb	The decoction of leaf and poultices are widely used to treat septic wounds and sores	The decoctions of the leaf are used to treat bruises, backache, rheumatic joints, and snakebite	[10,55]
<i>Melianthus major</i> L.	Melanthaceae	Ubuhlungubemamba/ Ubutyayi	The leaf poultice and leaf decoction are used to treat septic wounds, sores and bruises	The leaves are used for the treatment of cancer and rheumatism	[42,53,54]
<i>Mentha longifolia</i> (L.)	Lamiaceae	Inixina/Inzinziniba	Leaves are applied topically to treat wounds	Leaves are used as a general health tonic and also for respiratory problems	[54]
<i>Miscanthus capensis</i> (Nees) Andersson*	Poaceae	Umpumelelo	Decoction of the bark is used for pimples, wounds eczema, and acne	N/A	[15]
<i>Olea europaea</i> L subsp. <i>africana</i> (Mill.) P.S.Green.	Oleaceae	Umnquma	The leaves are used for herpes sores/ulcers, eye infection, and skin disorder	Bark is used to treat strokes, heart disease, and palpitations	[54,56]
<i>Pelargonium sidoides</i> DC.	Geraniaceae	Umsangela	The entire plant part is used for various skin disorders	The plant is used to treat coughs, sore throats, diarrhea, and gonorrhoea	[10,47]
<i>Pentanisia prunelloides</i> (Klotzsch ex Eckl. and Zeyh.) Walp.	Rubiaceae	Itshamlilo	The root decoctions are applied topically to treat burns and swelling	Root decoctions are taken orally for rheumatism, heartburn, fever, toothache, and snake bite	[25]
<i>Plumbago auriculata</i> Lam.	Plumbaginaceae	Umabophe	The powdered roots/leaves are applied to treat warts, rashes, acne, and pimples	It is taken as a snuff for headaches	[15]
<i>Protea repens</i> (L.) L.	Proteaceae	N/A	Leaves are used for inflammation	Syrup made from the nectar is used for the treatment of diabetes	[47]
<i>Protea simplex</i> E. Phillips	Proteaceae	N/A	The entire part of the plant are used for inflammation	Root and barks infusions are used for dysentery and stomach pains	[9]
<i>Protorhus longifolia</i> (Bernh.) Engl*	Anacardiaceae	Ikhubalo	The decoction of the bark is used for wounds, cuts, bruise and graze ringworm, acne, and eczema	The ground up bark, though somewhat poisonous, is used as "red muti"	[15,50]
<i>Rothmannia capensis</i> Thunb	Rubiaceae	Ibolo	The warm fruit juice of the plant is applied to wounds and burns for speedy recovery of the healing process	Powdered roots are used for the treatment of leprosy and rheumatism	[9,57,58]
<i>Rapanea melanophloeo</i> (L.) Mez.*	Myrsinaceae	Umaphipha	The powdered bark of the plant is used as a facial cosmetic paste to protect against evil	The bark is burnt as incense in preparation for ritual	[11]
<i>Rauvolfia caffra</i> Sond.	Apocynaceae	Umjelo/Umthundisa	Bark infusions are used for skin rashes	The bark and latex is used for the treatments of diarrhea and related stomach ailments	[9,10]
<i>Rumex lanceolatus</i> Thunb*	Rubiaceae	Dolonyana	Roots/leaves are topically applied to treat abscesses, boils, and bruises	Roots/leaves is topically applied to treat cancerous tumors	[15]

Contd...

**Table 1:** Contd...

Scientific name	Family	Local name (Xhosa)	Cosmeceutical significance	Other ethnobotanical uses	Reference
<i>Salvia stenophylla</i> Burch. ex Benth	Lamiaceae	N/A	A poultice of the leaves are used for wounds and sores	The leaves of the plant are used to soothe digestive problems, colds, coughs, and chest congestion	[59]
<i>Sansevieria hyacinthoides</i> (L.) Druce	Asparagaceae	Isikholokotho	The decoction of the leaf is used topically for the treatment of swellings, burns, and wounds	The leaves are used for the treatment of stomach disorders, ear infections, and toothache	[10]
<i>Sarcophyte sanguinea</i> Sparrm. subsp. sanguinea	Balanophoraceae	Umavumbuka	The dried fruiting body with a little water is applied to treat acne and other skin blemishes	Whole plant decoction is drunk to treat cancer	[11]
<i>Scadoxus puniceus</i> (L.) Friis and Nordal	Amaryllidaceae	Inkuphulwana	Decoction of the bulbs and roots is applied topically for wound and ulcer	Bulbs and roots are used to treat coughs and gastrointestinal	[9,25]
<i>Scilla natalensis</i> Planch	Hyacinthaceae	N/A	Ointments from fresh bulbs of the plant are used externally to treat boils and sores	Decoctions of the bulb are taken as enemas for female infertility and to enhance male potency and libido	[26,60]
<i>Scabiosa columbaria</i> L.*	Dipsacaceae	Makgha	Powdered leaves/roots from the plant are mixed with oil or animal fat for treatment of wounds bruises and cuts	Ointment of charred roots applied to venereal sores	[15]
<i>Senecio speciosus</i> *	Asteraceae	Ustukumbini	Decoction of the leaves or stem is made into paste is applied to treat swellings, cuts, burns, and sores	The stem or leaves decoction are used to treat inflamed gums	[15]
<i>Sideroxylon inerme</i> L. subsp. <i>Inerme</i>	Sapotaceae	Umqwashu	Bark is used to lighten the skin	Traditionally, the bark of the plant is used for treatment of skin diseases	[10,23]
<i>Siphonochilus aethiopicus</i> Schweif.	Zingiberaceae	N/A	The leaves are used to treat oral thrush	The leaves are used to treat candida infections	[33]
<i>Solanum incanum</i> L. Ruiz and Pav.	Solanaceae	Umthuma	The leaves and roots are topically applied to treat wounds, furuncles, and ringworm. The root infusions and pounded fruits of the plant are also applied externally or rubbed into scarifications	Pounded seeds are mixed with pulped fruits to massage aching ears	[61]
<i>Spirostachys africana</i> Sond.*	Euphorbiaceae	Umthombothi	The fragrant wood of the plant is powdered and mixed with a little water for smearing the face of infants	The bark is used to treat stomach pains	[11]
<i>Sutherlandia frutescens</i> (L.) R.Br.	Fabaceae	Umnwele	Leaf decoctions are used for washing wounds	Leaves' decoctions are used for the treatment of diabetes, rheumatoid arthritis, and dysentery	[10,62]
<i>Syzygium cordatum</i> Hochst.ex C.Krauss.*	Myrtaceae	Umswi	The bark paste is topically applied to treat blisters, pimples, inflammations, acne, and eczema	The whole plant is used for the treatment of respiratory ailments and tuberculosis	[15,23]
<i>Tecomaria capensis</i> (Thunb.) Spach	Bignoniaceae	Umsilingi/Icakatha	Bark infusion is used to treat inflammation	The infusion of bark is used to relieve pain, sleeplessness, and as antipyretic	[9]

Contd...

Table 1: Contd...

Scientific name	Family	Local name (Xhosa)	Cosmeceutical significance	Other ethnobotanical uses	Reference
<i>Tetradenia riparia</i> (Hochst)	Lamiaceae	Iboza	Leaf infusions are used to treat mouth ulcers	Inhaling the crushed leaves of the plant relieves headaches	[33]
<i>Trichilia emetica</i> Vahl.	Meliaceae	Umkhuhlu	Leaves or fruits of the plant are used as poultices to treat bruises and eczema	Powdered roots of the plant are used against ascaris stomachache, and dysmenorrhea	[45,63]
<i>Trichilia dregeana</i> Sond.	Meliaceae	Umkhuhlu	The seeds are used as a body ointment and hair oil	The aerial plant part used as a stomach cleanser and to treat kidney problems, leprosy, and sleeplessness	[9,10]
<i>Tulbaghia alliacea</i> (L.f.) Thunb.*	Alliaceae	Itswele	The bulb is used to treat boils, wounds, pimples, eczema, and herpes	The bulb infusion is taken orally to treat fever	[15]
<i>Valeriana capensis</i> Thunb*	Valerianaceae	Umvuthuza	Roots are used topically to treat cuts and wounds	The whole plant is used for asthma, insomnia, hysteria, and nervous disorders	[10,23]
<i>Vernonia natalensis</i> Sch.Bip. ex Walp	Valerianaceae	Umthi/Wezulu	The decoctions of root/leaf are used to treat boils	The whole plant is used to treat malaria and for pain and kidney problem	[9,23]
<i>Warburgia salutaris</i> (Bertol. F.) Chiov.	Canellaceae	N/A	The bark is topically applied to treat various skin complaints	Bark decoctions are used to treat constipation, diarrhea, and snake bite	[14,64]
<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Ubuvimba/Ubushwa	Ointment from leaves and berries are used to treat cuts, wounds, abscesses, and inflammation	Leaf decoction is used to treat hemorrhoids and rheumatism	[9,38]
<i>Xysmalobium undulatum</i> (L.) Aiton F.	Apocynaceae	Nwachaba/Ishongwane	Roots' powder is applied topically to treat cuts and wounds	The entire plant part is used to treat typhoid fever, malaria, and skin diseases	[12,14,65]
<i>Zantedeschia aethiopica</i> Spreng*	Araceae	Mtebe/Inyibiba	Leaves are topically applied to treat sores	Fresh leaves and rhizomes are used for headache	[10,47]
<i>Zanthoxylum capense</i> Harv	Rutaceae	Lsifutho	The leaves are topically applied to treat sores	N/A	[9,14,66]
<i>Ziziphus mucronata</i> Willd	Rhamnaceae	Uinphafa	Leaf/root/bark decoctions are applied to treat boils and swellings	The decoction of bark and roots are used to treat respiratory infections, chest problems, and gastrointestinal complaints	[10,25,45]

\*: Scientific investigation with regards to cosmeceutical usage required. No pharmacological activity with regards to cosmeceutical usage available in literature.

N/A: Not available

melanogenesis (melanin production).<sup>[75,76]</sup> The melanocyte cells produce two types of melanin pigments: eumelanin (black or brown) and pheomelanin (red or yellow). Nevertheless, the color of human skin and hair is determined by the type and distribution of melanin pigment produced. In general, people from different racial groups have more or less the same number of melanocyte cells; hence, the type of melanin produced depends on the functioning of the melanocytes, for example, people that are dark in complexion (darker skin) are genetically programmed to constantly produce higher levels of melanin than those with light skin.<sup>[75,77,78]</sup> This is as a result of the melanosome (organelles within the melanocyte cells) size and grouping. The melanosomes in terms of pigmentation are

smaller and grouped in clumps in the light skin while they are larger single organelle in dark skin.

Tyrosinase, also known as polyphenol oxidase, is an important enzyme that is responsible for the production of melanin.<sup>[79]</sup> Overactivity of tyrosinase leads to overproduction of melanin (hyperpigmentation of the skin) and the abnormal biosynthesis of melanin pigments are responsible for skin disorders such as melisma and freckles.<sup>[80]</sup> Several compounds or chemicals have been reported to inhibit the catalytic activity of tyrosinase and disrupt the synthesis of melanin pigments.<sup>[81]</sup> Many of these compounds have a tyrosinase-inhibiting activity, leading to the decrease of total melanin production. Compounds such as kojic acid and arbutin have been reported

**Table 2:** List of plants screened for skin care products

Plant name	Pharmacological studies investigated	Plant source/part used	Solvents used	References
<i>Acokanthera oppositifolia</i> (Lam.) Codd	Antioxidant and anti-inflammatory	Stem	Methanol	[87,88]
<i>Acacia karroo</i> Hayne	Antioxidant and anti-inflammatory	Stem bark, root	Aqueous, methanol	[89]
<i>Artemisia afra</i> Jacq. ex Willd	Antioxidant	Whole plant	Ethanol	[90,91]
<i>Albizia adianthifolia</i> (Schumach.) W.Wight var.	Antioxidant	Stem bark	Ethyl acetate	[92]
<i>Aloe arborescens</i> Mill.	Antioxidant, antityrosinase, melanogenesis, and anti-inflammatory	Leaves	Ethanol	[17,46,93]
<i>Aloe ferox</i> Mill.	Antioxidant, antityrosinase, anti-inflammatory	Leaves	Methanol, ethanol	[17,34,82]
<i>Athrixia phyllicoides</i> DC	Antioxidant	Aerial	Aqueous	[94]
<i>Bauhinia bowkeri</i> Harv.	Antioxidant and anti-inflammatory	Leaves	Acetone	[95]
<i>Burbine latifolia</i>	Antioxidant	Leaves	Aqueous	[96]
<i>Burbine frustecens</i> (L.) Willd	Antioxidant	Leaves	Aqueous	[97]
<i>Bowiea volubilis</i> Ex Hook.f. subsp.	Antioxidant and anti-inflammatory	Bulb, leaves	Petroleum ether, dichloromethane, 70% ethanol and aqueous	[15,84]
<i>Volubilis</i>	Antioxidant and anti-inflammatory	Leaves	Petroleum ether, dichloromethane, ethanol, and methanol	[37]
<i>Carpobrotus dimidiatus</i> (Haw.) L. Bolus	Antioxidant	Leaves	Aqueous	[98]
<i>Carpobrotus edulis</i> (L.) Bolus	Antityrosinase and melanogenesis	Leaves	Ethanol	[17]
<i>Cassipourea flanaganii</i> (Schinz) Alston.	Antityrosinase	Leaves	Methanol	[99]
<i>Centella asiatica</i> (L.) Urban	Antioxidant and anti-inflammatory	Leaves, aerial part	Aqueous	[100,102]
<i>Citrullis lanatus</i> (Thunb.) Matsum. and Nakai	Antioxidant and anti-inflammatory	Fruit	Methanol	[101,103]
<i>Clausena anisata</i> (Willd) Hook. f. ex Benth.	Antioxidant and anti-inflammatory	Leaves	Essential oil, ethanol	[104,105]
<i>Clerodendrum glabrum</i> E. Meyvar.	Antioxidant and anti-inflammatory	Root, stem, bark and fruits	Methanol, ethanol	[106,107]
<i>Cotyledon orbiculata</i> Forssk.	Anti-inflammatory and antioxidant	Leaves	Methanol	[46,108]
<i>Crinum moorei</i> Hook. F	Antioxidant and anti-inflammatory	Bulbs	Methanol	[34]
<i>Croton sylvaticus</i> Hochst	Antioxidant and anti-inflammatory	Leaves	Aqueous, methanol	[60]
<i>Curtisia dentate</i> (Burm.f.) C.A. Smith.	Antioxidant and anti-inflammatory	Stem bark	Acetone	[109]
<i>Cucumis hirsutus</i> Sond	Anti-inflammatory	Leaves	Petroleum ether	[37]
<i>Diospyros lycioide</i> Desf	Antioxidant	Leaves	Ethanol	[37]
<i>Dodonaea viscosa</i> Jacq	Anti-inflammatory and antioxidant	Leaves	Ethanol	[46,110]
<i>Elephantorrhiza elephantine</i> (Burch.) Skeels.	Antioxidant and anti-inflammatory	Root	Aqueous	[111,112]
<i>Eriocephalus africanus</i> L.	Antioxidant and anti-inflammatory	Leaves, aerial part	Aqueous, essential oil	[113]
<i>Erythrina lysistemon</i> Hutch.	Antioxidant and anti-inflammatory	Leaves	Ethanol, ethyl acetate and methanol	[43,114]
<i>Ficus natalensis</i> Hochst.	Antioxidant	Leaves	Methanol, dichloromethane	[115]
<i>Foeniculum vulgare</i> Mill.	Antioxidant	Seed	Aqueous, ethanol	[116,117]
<i>Greyia flanaganii</i> Bolus	Antioxidant and anti-inflammatory	Leaves	Ethanol	[17]
<i>Grewia occidentalis</i> L	Anti-inflammatory and antioxidant	Root	Petroleum ether	[58,118]
<i>Gunnera perpensa</i> L.	Antioxidant and anti-inflammatory	Rhizome	Ethanol, methanol	[119,120]
<i>Gnidia capitata</i> (L.f)	Antioxidant and anti-inflammatory	Root	Ethyl acetate, dichloromethane, hexane, and methanol	[15]
<i>Harpephyllum caffrum</i> Bernh. ex Krauss	Antioxidant	Stem bark	Methanol, dichloromethane	[121]
<i>Halleria lucida</i> L	Antioxidant	Leaf	Methanol	[49]

Contd...

Table 2: Contd...

Plant name	Pharmacological studies investigated	Plant source/part used	Solvents used	References
<i>Helichrysum odoratissimum</i> (L.) Sweet.	Antioxidant	Leaves, stems	Ethanol	[122]
<i>Hydnora africana</i> (Thunb)	Antioxidant	Leaves	Aqueous, acetone, and methanol	[123]
<i>Hypoxis hemerocallidea</i> Fisch. C.A.Mey. and Ave-Lall.	Antioxidant	Corm	Methanol	[15]
<i>Ilex mitis</i> (L.) Radlk	Antioxidant, antityrosinase	Leaves, stem bark	Methanol	[99,124]
<i>Kniphofia drepanophylla</i>	Antioxidant	Rhizome	Methanol	[15]
<i>Leonotis leonurus</i> (L.) R.Br.	Antioxidant and antityrosinase	Leaves	Aqueous, methanol	[60]
<i>Lippia javanica</i> (Burm.f.) Spreng	Antioxidant and antityrosinase	Leaves	Aqueous, ethyl acetate	[60,125,126]
<i>Leucosidea sericea</i> Eckl. and Zeyh.	Antioxidant and antityrosinase	Leaves	Ethanol, petroleum ether	[46,127]
<i>Melianthus comosus</i> L.	Antioxidant and antityrosinase	Leaves	Methanol	[60]
<i>Melianthus major</i> L.	Antioxidant	Leaves	Petroleum ether, ethyl acetate, and methanol leave	[53]
<i>Mentha longifolia</i> (L.)	Antioxidant and antityrosinase	Leaves	Essential oil	[128,129]
<i>Olea europaea</i> L. subsp. <i>africana</i> (Mill.) P.S.Green	Antioxidant	Olive leaf	Methanol	[130]
<i>Pelargonium sidoides</i> DC	Antioxidant	Leaves	Ethanol	[131]
<i>Pentania prunelloides</i> (Klotzsch ex Eckl. and Zeyh.) Walp	Antioxidant and anti-inflammatory	Rhizome	Hexane, aqueous, methanol, and ethanol	[111,132]
<i>Plumbago auriculata</i> Lam.	Anti-inflammatory and antioxidant	Leaves	Acetone, ethanol, and dichloromethane	[133,134]
<i>Protea repens</i> (L.) L.	Anti-inflammatory			[37]
<i>Protea simplex</i> E. Phillips	Anti-inflammatory	leaves, bark	Petroleum ether	[37]
<i>Rauvolfia caffra</i> Sond	Antioxidant	Root	Aqueous ethanol	[135]
<i>Salvia stenophylla</i> Burch. Ex Benth	Antioxidant and antityrosinase	Aerial part	Methanol	[59]
<i>Sansevieria hyacinthoides</i> (L.) Druce	Antioxidant	Root	Methanol	[136,137]
<i>Scadoxus puniceus</i> (L.) Friis and Nordal	Antioxidant	Bulb	Ethyl acetate	[138]
<i>Scilla natalensis</i> Planch	Antioxidant and anti-tyrosinase	Bulbs, leaves	Methanol, aqueous	[60]
<i>Sideroxylon inerme</i> L. subsp. <i>inerme</i>	Antioxidant, antityrosinase, and melanogenesis	Stem bark	Methanol	[139]
<i>Solanum incanum</i> L. Ruiz and Pav.	Antioxidant	Fruit	Methanol	[61]
<i>Sutherlandia frutescens</i> (L.) R.Br.	Antioxidant and antityrosinase	Aerial part	Methanol	[140,141]
<i>Tecoma capensis</i> (Thunb.) Spach	Anti-tyrosinase	Leaves	Methanol	[142]
<i>Trichilia emetica</i> Vahl.	Antioxidant and antityrosinase	Leaves	Aqueous, ethanol, and methanol	[143,144]
<i>Vernonia natalensis</i> Sch.Bip. ex Walp	Anti-inflammatory	Leaves	Aqueous, ethanol	[37]
<i>Warburgia salutaris</i> (Bertol. f.) Chiov.	Antioxidant and antityrosinase	Bark	Ethanol	[145]
<i>Withania somnifera</i> (L.) Dunal	Anti-tyrosinase and antioxidant	Root	Aqueous	[146,147]
<i>Xysmalobium undulatum</i> (L.) Aiton f.	Antioxidant	Aerial	Methanol	[148]
<i>Zanthoxylum capense</i> Harv	Antioxidant and anti-inflammatory	Leaves	Acetone	[134]
<i>Ziziphus mucronata</i> Willd	Antioxidant	Leaves	Methanol	[149]

to inhibit the catalytic activity of tyrosinase.<sup>[81]</sup> Several studies have also indicated that plants are very important tyrosinase inhibitors, which are used for depigmentation or for the disorder of hyperpigmentation of the skin. Many Eastern Cape medicinal plants have been investigated for their antityrosinase activity, and some of these have shown good antityrosinase activity [Table 2]. These plants among others include *Aloe arborescens*, *A. ferox*, *Calodendrum capense*, *Cassipourea flanaganii*, *Leonotis leonurus*, *Lippia javanica*, and *Melianthus comosus*. They have been reported to possess antityrosinase properties due to their action on tyrosinase enzyme to stop the production of melanin.<sup>[15,44,82]</sup>

### Anti-inflammatory activity

Inflammation is the response of the organism to invasion by pathogens such as bacteria, parasite, or viruses. The inflammatory response is a critical protective reaction to irritation, injury, or infection. The typical clinical signs of inflammation include redness, heat swelling, loss of function, and pain.<sup>[83]</sup> However, inflammation of the skin can be categorized as either acute or chronic. Acute inflammation results from exposure to UV radiation or from contact with chemical irritants, while chronic inflammation occurs as a result of a sustained immune cell-mediated inflammatory response within the skin itself. There are various number of nuclear transcription factors that are responsible for

the regulatory functions of the inflammatory response. Transcription factors include interleukin-1 (IL-1), IL-2, IL-6, IL-8, and tumor necrosis factor- $\alpha$ .

Many ethnobotanicals have previously been assessed using the different assays, with many of them showing significant anti-inflammatory activity. The structural and functional diversity of secondary metabolites (phytochemicals) in most plants has shown unique opportunities for the development of new chemotherapeutic agents for many inflammatory diseases. Some of the Eastern Cape plant species used for various skin care have been identified to possess anti-inflammatory effect [Table 2]. These plants include *Acokanthera oppositifolia*, *Acacia karroo*, *Bowiea volubilis*, *Dodonaea viscosa*, *Elephantorrhiza elephantina*, *Erythrina lysistemon*, *Greyia flanaganii*, *Grewia occidentalis*, *Pelargonium sidoides*, and *Protea simplex* reported to inhibit inflammatory enzyme.<sup>[46,49,84]</sup>

### Wound healing

Wounds generally occur due to physical injuries that result in an opening or breaking of the skin. It can also occur as a result of thermal, chemical, and microbial assault on the skin. Wounds must be sterilized to avoid colonization by skin bacteria which can cause an infection. However, wound healing is a natural process that has the capacity to heal on its own; for fast healing, there is a need for appropriate treatment of damaged tissue.<sup>[85]</sup>

Medicinal plants have served as agents of wound healing since ancient times.<sup>[86]</sup> Many of the plants used by the people of Eastern Cape for such purposes include *Centaurea benedicta*, *A. arborescens*, *Carpobrotus dimidiatus*, *Ficus natalensis*, *Gnidia anthylloides*, *Kniphofia drepanophylla*, and *Xysmalobium undulatum* [Table 1]. There are also many herbal formulations which are used for wound treatment. For example, lotion made from the infusion of *Calendula officinalis* flowers in olive oil is used for treating sunburn, bed sores, and skin degeneration conditions. Therefore, some of the plant's species mentioned in Tables 1 and 2 may be exploited for the formulation of herbal cosmetics used for wound treatment.

## Ethnobotanically usage of plants from Eastern Cape for cosmetic potentials

A comprehensive description of the traditional usage, pharmacological activities, and phytochemical constituents of selected plants used by the people of the Eastern Cape Province for various cosmetic purposes are as follows:

### *Acokanthera oppositifolia* (Lam.) Codd

*A. oppositifolia* (Apocynaceae) is an evergreen shrub or small tree with white latex. Locally, it is commonly known as iNtlungunyembe in Xhosa and inhlungunyembe in Zulu, and it is broadly distributed in South Africa (Eastern Cape, KwaZulu-Natal, and Gauteng). Traditionally, the leaf pulp is applied into wounds and as a dressing to swollen part. The leaves are used in the form of a snuff to treat headaches or as a treatment for snake bites and in infusions for abdominal pains and convulsions.<sup>[87]</sup> The stems of the plant are chewed to relieve a toothache. The methanol and acetone extracts of *A. oppositifolia* have been reported to exhibit antioxidant, anti-inflammatory, and analgesic activities.<sup>[87,88]</sup> Four active compounds, lup-20 (29)-en-3  $\beta$ -O-(3'- $\beta$ -hydroxy) palmitate (1), a triterpene; lupeol (2), a cardiac glycoside; acovenoside A (3), and a sterol;  $\beta$ -sitosterol (4) isolated from seed of *A. oppositifolia*, exhibited strong antimicrobial activity.<sup>[150]</sup> The compound lup-20 (29)-en-3  $\beta$ -O-(3'- $\beta$ -hydroxy) palmitate exhibited antibacterial activity against *Pseudomonas aeruginosa* with minimum inhibitory concentration (MIC) values of 7.81  $\mu$ g/ml. However, lupeol also reported to exhibit remarkable

antimicrobial activity against methicillin-resistant *Staphylococcus aureus*, *Aspergillus fumigatus*, and *Candida albicans* with MIC values of 3.9, 0.24, and 3.9  $\mu$ g/ml, respectively. On the other hand, acovenoside A was reported to inhibit the growth of *Escherichia coli* with MIC values of 0.98  $\mu$ g/ml.<sup>[150]</sup> The observed activities of these compounds isolated from *A. oppositifolia* could probably be the reason why the plant is used for cosmetics by the people of Eastern Cape.

### *Aloe ferox* Mill.

*A. ferox* (Asphodelaceae) is a tall single-stemmed aloe which is found in Cape coastal region of South Africa.<sup>[55]</sup> It is locally known as bitter aloe or red aloe (English); bitteraalwyn and bergaalwyn (Afrikaans); inhlaba (Zulu); and iKhala (Xhosa). Traditionally, the plant (leaves or roots) is applied locally or taken internally to treat skin-related diseases such as skin cancer, burn, psoriasis, dermatitis, and acne.<sup>[151]</sup> The gel-like flesh from the inside of the leaves is used as ingredients in cosmetic products and is reported to have wound healing properties. Studies have also indicated that Aloe gel can be added to several cosmetic products, for example, "Schweden bitters" which is found in many pharmacies contains bitter aloe.<sup>[152]</sup> Aloe preparations are considered to be safe to use, but some adverse effects such as hypersensitivity have been reported lately.<sup>[153]</sup> The biological activities such as antioxidant, antibacterial, anti-inflammatory, and antiviral activities of this species have been widely reported.<sup>[82,153]</sup> These activities of this plant are attributed to the presence of various chemical components.<sup>[153]</sup> Numerous classes of compounds such as anthraquinones, anthrone-c-glycosides, chromones, and phenolics have been isolated from *A. ferox*.<sup>[154,155]</sup>

### *Bulbine latifolia* (L.f.) Roem. et Schult.

*Bulbine latifolia* (previously *Bulbine natalensis*) is one of the largest species in the genus Asphodelaceae. It is commonly called geelkopieva or rooiwortel in Afrikaans denoting the red flesh of its root, but the true Xhosa name is ibucu or incelwane. *B. latifolia* is widely dispersed in the southeastern parts of South Africa. It is widely spread in the Eastern Cape Province and often found in dry river valleys and rocky gorges. Traditionally, powdered tuber of the plant is mixed with a little water to make a yellow cosmetic paste which is applied to the face by men and women in the Eastern Cape Province.<sup>[11]</sup> The leaf sap is being used by traditional healers to treat wounds, burns, eczema, rashes, and itches. Lazarus reported the antioxidant activity and toxicity of aqueous extract of *B. latifolia*. The extract exhibited strong reducing power which was even greater than the standard antioxidant butylated hydroxyanisole at the highest concentration (5 mg/ml) investigated and high level of toxicity with LC<sub>50</sub> of 4.30 mg/ml was also observed. The anthraquinone; knipholone has been isolated from *B. latifolia* extracts.<sup>[96]</sup>

### *Bauhinia bowkeri* Harv.

*Bauhinia bowkeri* is a tall, graceful shrub with arching stems belonging to the family Fabaceae. The plant is commonly known as Kei Bauhinia, Kei White Bauhinia (English), Keibeeskou (Afrikaans), and umDlandlovu (Xhosa). *B. bowkeri* is a rare prevalent of the thicket or valley Bushveld region in the Eastern Cape Province of South Africa. The plant occurs along the Mbashe River margin between Umtata and Butterworth. Traditionally, the plant is used to induce vomiting and also used for steaming and bathing.<sup>[121]</sup> Acidified 70% acetone leaf extract from *B. bowkeri* was found to inhibit 2,2-Diphenyl-1-picrylhydrazyl and 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) radical scavenging activity with IC<sub>50</sub> values of 19.53 and 14.50  $\mu$ g/ml, respectively. The cytotoxicity assay of acetone leaf extract on the Vero African green monkey kidney cell lines showed no toxicity up to 25 mg/ml.<sup>[95]</sup>

### *Cassipourea flanaganii* (Schinz) Alston

*C. flanaganii* (Rhizophoraceae) is a small uncommon tree found in the forest between King Williams's Town (Eastern Cape) and Southern KwaZulu-Natal. It is commonly called Cape Onionwood (English), Kaapse Uiehout (Afrikaans), and Umemezi (Xhosa). In traditional medicine, the bark of *C. flanaganii* is mixed with a little water to make a light brown paste that is applied to the face to improve the beauty of women most especially young women. The plant is also used to lighten and improve skin complexion, particularly by the people of Eastern Cape Province.<sup>[11]</sup> The methanol extract of *C. flanaganii* was reported to inhibit tyrosinase enzyme between the ranged of 29% and 74% with a higher total phenolic content of 49.45 mg/g. The extract also showed photo-protective effect with sun protection factor values above 15.<sup>[99]</sup>

### *Clausena anisata* (Willd) Hook.f. ex Benth.

*Clausena anisata* is a deciduous shrub or small tree, belonging to the Rutaceae family. It is locally referred to as Mkomavikali or Nukamdida (Afrikaans), Horsewood (English), Umnukelambiba (Zulu), and Umtuto (Xhosa). The plant is the only representative of the *Clausena* genus in tropical Africa and found in forests and forest margins, riverine thickets, and Bushveld in the Eastern Cape Province of South Africa.<sup>[156]</sup> Various parts of the plant are used in traditional medicine for the treatment of numerous disorders and infections including diabetes, fever, indigestion, cough, hemorrhoids, hypotension, hypertension, heart failure, pneumonia, headache, whooping cough, malaria, venereal diseases, sinusitis, wounds, burn, and mouth infections.<sup>[9]</sup> The leaves, fruits, and stem bark of the plant have been reported as rich in aromatic essential oils. These oils have been implicated in the repellent and insecticidal activities of *C. anisata* against a number of pests. Several lines of studies have also been conducted on the chemical composition of essential oil from *C. anisate*.<sup>[157-159]</sup> The composition of the oils determined from these studies include E-ocimene, Z-ocimene, gamma-terpinene, germacrene D,  $\gamma$ -terpinene, and germacrene-B.<sup>[158]</sup> The plant and its compound have also been reported for various biological activities such as anti-inflammatory, immunomodulatory, anticoagulant, antiplasmodial, and analgesic.<sup>[104]</sup>

### *Dalbergia obovata* E. Mey.

*Dalbergia obovata* is a climber with charmingly dense clusters of sweet-smelling flowers belonging to the family Fabaceae. It is locally called climbing flat bean (English); bobbejaankoudoring, rankplatboontjie (Afrikaans); isibandhlube, (Zulu); and umzungulu (Xhosa). It occurs in coastal and riverine forest and forest margins as well as wooded slopes and deciduous woodland. This plant is prevalent in the former Transkei and KwaZulu-Natal and is located from the Eastern Cape to Southern Mozambique. Traditionally, it is used as a paste, and the powdered stem of the plant is mixed with water for sore mouths in infants.<sup>[33]</sup> The aqueous leaves extract of *D. obovata* exhibited poor activity against several bacteria strains such as *Streptococcus mutans*, *Streptococcus sanguis*, *Lactobacillus acidophilus*, and *Porphyromonas gingivalis* with MIC values of 1.50, 4.00, 8.00, and 8.00 mg/ml, respectively.<sup>[33]</sup> However, there has not been any scientific fact about its cosmeceutical efficacy in literature.

### *Elephantorrhiza elephantina* (Burch.) Skeels

*Elephantorrhiza elephantina* (Fabaceae) belongs to the member of a small and purely African genus represented by nine species on the continent.<sup>[160]</sup> The word "Elephantorrhiza" means "elephant root" and is originated on the large underground stem which is common to many members of this genus.<sup>[161]</sup> It is locally known as elephant's root, eland's wattle (English); baswortel, olifantswortel (Afrikaans.); mupangara (Shona); mositsane (Sotho, Tswana); and intolwane (Xhosa,

Zulu). *E. elephantina* is usually widespread, frequently gregarious, and forming huge patches in hot and dry areas in grasslands and open scrub and found in many Southern Africa countries such as Namibia, Zimbabwe, Swaziland, Mozambique, and South Africa.<sup>[161]</sup> *E. elephantina* is a very important plant resource in Southern Africa, where its root is being used in the formulation of commercial herbal medicine for skin ailments, diarrhea, antioxidant, perforated ulcers, and prostrate hypertrophy in South Africa.<sup>[162]</sup> Locally, the root and rhizome of the plant are taken orally as decoction mixed with *Pentanisia prunelloides* to treat eczema, fever, and HIV/AIDS opportunistic diseases.<sup>[163-165]</sup> Biological activities of *E. elephantina* reported in the literature include anthelmintic,<sup>[18,166]</sup> antibacterial,<sup>[41,167]</sup> antifungal,<sup>[167]</sup> anti-inflammatory and antinociceptive,<sup>[112]</sup> antiplasmodial,<sup>[168]</sup> and antioxidant<sup>[111]</sup> activities. Aaku *et al.*<sup>[169]</sup> reported isolated compounds from n-butanol rhizome extracts of *E. elephantina*. The compounds such as dihydrokaempferol 1, (-)-catechin 2, kaempferol 3, ethyl gallate 4, gallic acid 5, 2-(3,4-dihydroxyphenyl) ethanol 6, 4-hydroxybenzoic acid 7, ethyl-1-O- $\beta$ -D-galactopyranoside 8, and quercetin 3-O- $\beta$ -D-glucopyranoside 9.

### *Foeniculum vulgare* Mill.

*Foeniculum vulgare* Mill (Apiaceae) is a biennial medicinal and aromatic plant with height of up to 2.5 m with hollow stems. It is commonly called wild fennel (English) and Bobbejaancinkel (Afrikaans). It is usually grown in vegetable and herb garden and found in the Northern, Eastern, and Western provinces of South Africa. Traditionally, the aerial parts of the plant are widely used as galactagogues for improving the milk flow of breastfeeding mothers.<sup>[170,171]</sup> In addition to its medicinal uses, the natural light green dye obtained from leaves of *F. vulgare* is used as a fragrance component in cosmetic products and as a food colorant.<sup>[172]</sup> Reports from literature have indicated that *F. vulgare* extracts effectively inhibited numerous infectious disorder of bacterial, fungal, or viral origins.<sup>[173,174]</sup> *F. vulgare* extracts have been reported to exhibited strong antioxidant, antitumor, chemopreventive, cytoprotective, hepatoprotective, hypoglycemic, and estrogenic activities.<sup>[117,175]</sup>

### *Hypoxis hemerocallidea* Fisch., C.A.Mey. and Ave-Lall.

*Hypoxis hemerocallidea* is a beautiful tuberous perennial plant with strap-like leaves and yellow star-shaped flowers belonging to the family Hypoxidaceae. It is locally called yellow start (English) sterblom (Afrikaans); lotsane (S Sotho); iNkomfe (Zulu); and inongwe (Zulu). The plant is usually found in open grassland and woodland and is widely distributed in the eastern summer rainfall provinces such as Eastern Cape, Free State, KwaZulu-Natal, Mpumalanga, Gauteng, and Limpopo. The tuber of *H. hemerocallidea* is used traditionally to treat kidney problem and high blood pressure and more lately as a commercial product (Moducare™) to treat immune system disorders. In addition, the dried rhizome of the plant is applied by women as a paste to treat acne and conceal pimple.<sup>[111]</sup> The leaves and corms of the plant have been reported to possess antioxidant, anticonvulsant, and antibacterial activities.<sup>[176]</sup> The aqueous extract (50–800 mg/kg) of the plant was also found to possess anti-inflammatory and antidiabetic activities when treated with rodents induced with a rat hind paw edema (0.5 mg/kg) and streptozotocin (90 mg/kg), respectively.<sup>[177]</sup> The activities of this plant are attributed to its main bioactive compounds such as hypoxoside, aglycone derivative, and rooperol.<sup>[178]</sup>

### *Ilex mitis* (L.) Radik.

*Ilex mitis* (Aquifoliaceae) is a tall, dense evergreen tree with almost white bark. The plant is locally known as Cape holly, wild holly (English); waterboom and waterhount (Afrikaans); iPhuphuma (Zulu); and

umDuma (Xhosa). It is widely distributed in South Africa, growing on the banks of rivers stream, and moist spots in woods and forests. Ethnobotanically, the bark of the plant is used as pastes or decoction applied to treat skin rash.<sup>[179]</sup> A study by Thibane *et al.*<sup>[99]</sup> investigated the antityrosinase activity of *I. mitis* methanolic leaf extract, where the ability of the extract to inhibit the tyrosinase activity ranged between 29% and 74% and total phenolic content of 44.15 mg GAE/g.

#### *Pentania prunelloides* (Klotzsch ex Eckl. and Zeyh.)

*Pentania prunelloides* is an erect perennial herb, with stout hairy stems, belonging to the family Rubiaceae. It is locally known as wild verbena and broad-leaved Pentania (English); Sooiibrandbossie (Afrikaans.); and Icimamlilo (Zulu). It is found in grassland throughout Southern Africa, from Eastern Cape (South Africa) to Tanzania. Traditionally, the root decoctions of the plant are taken orally and also applied externally for burns, swellings, and toothache. From the literature report, the plant has been indicated to possess anti-inflammatory, antioxidant, antibacterial, and nongenotoxic activities.<sup>[60,111]</sup> The phytochemical analysis of the extracts of *P. prunelloides* was reported to be tannins, terpenoids, alkaloids, saponins, flavonoids, and cardiac glycosides.<sup>[180]</sup> The compounds isolated from the plant are acetylated, nonacetylated, and tormentic acid.

#### *Rumex lanceolatus* Thumb.

*Rumex lanceolatus* is a perennial plant with a long taproot, belongs to the Polygonaceae family. The plant's common names include the common dock (English); Gladdetongblaar (Afrikaans.); Idolo Lenkonyane (Zulu); and Idolonyana (Xhosa). It is not endemic to South Africa, but it is widely distributed within South Africa most especially in the Eastern, Western, and Northern Cape Provinces. The leaves of the plant are applied typically to treat tumors rash skin.<sup>[181,182]</sup> No scientific validation of its cosmeceutical usage has been reported to date despite its usage by the people of Eastern Cape.

#### *Sideroxylon inerme* L.

*Sideroxylon inerme* is a small-to-medium evergreen Southern African coastal tree that belongs to the Sapotaceae family. It is one of South Africa's protected trees and reported to be the only member of the *Sideroxylon* genus in Southern Africa.<sup>[22]</sup> Locally, the plant is called white milkwood (English); witmelkhout and melkbessie (Afrikaans.); aMasethole (Xhosa); and aMasethole-amhlope and uMakhwela-fingqane (Zulu). Traditionally, the bark of the plant is used in the form of a paste by most Zulus and Xhosas tribes for skin-lightening purposes.<sup>[23]</sup> Lall and Kishore<sup>[10]</sup> reported that methanol and acetone extracts from the stem bark of *S. inerme* and were found to inhibit monophenolase activity with IC<sub>50</sub> values of 63 and 82 µg/ml, respectively. The methanol extract (6.2 µg/ml) also exhibited 37% reduction of melanin content with no significant toxicity to the cells. The compounds (epigallocatechin gallate and procyanidin B1) isolated from the stem bark of *S. inerme* were found to exhibit monophenolase activity with IC<sub>50</sub> values of 30 and >200 µg/ml, respectively.

#### *Solanum incanum* L. Ruiz and Pav.

*Solanum incanum* is an herb or soft-wooded species of nightshade that belongs to the family Solanaceae. The common names include thorn apple, bitter apple, bitter ball, and bitter tomato (English) and umthuma (Xhosa). The plant is distributed throughout Africa. Traditionally, the root and leaves' infusion of the plant is applied topically to treat furuncles and ringworm infections. The infusions of the root and pounded fruits of the plant are also applied externally or rubbed into scarifications, leaf sap is also used for washing painful areas, and ash of burnt plants is mixed with fat and applied externally. From literature, it has been reported that methanol extract of *S. incanum*

showed broad-spectrum antifungal activities and low level of cytotoxicity toward human fetal liver cells at IC<sub>50</sub> of 35 µg/ml.<sup>[61]</sup> The aqueous fruit extract of the plant showed antibacterial activity against *Bacillus subtilis*, *Micrococcus flavus*, and *P. aeruginosa*.<sup>[61]</sup> The compounds isolated from *S. incacum* fruits include the alkaloids solasodine and solamargine and the steroidal sapogenins diosgenin and yamogenin.

## CONCLUSION

The cosmetic industry is growing rapidly and apart from traditionally documented applications; some modern trials have also proven the utility of herbs in personal care products. In Eastern Cape Province, the number of people using herbal cosmetics has been rising steadily over the past two decades. This high prevalence deserves special attention toward the use of the medicinal plant for various cosmetic products. Out of the 105 identified medicinal plants traditionally used in the Eastern Cape for the cosmetic purposes, only seventy have been documented scientifically. Considering the rich cultural traditions of plant use and the high prevalence of cosmetic usage in South Africa, more investigations should be encouraged to validate the cosmeceutical usage of the identified plants as claimed by the traditional healers.

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## Conflicts of interest

There are no conflicts of interest.

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