Are plants used for skin care in South Africa fully explored?

Namrita Lall*, Navneet Kishore

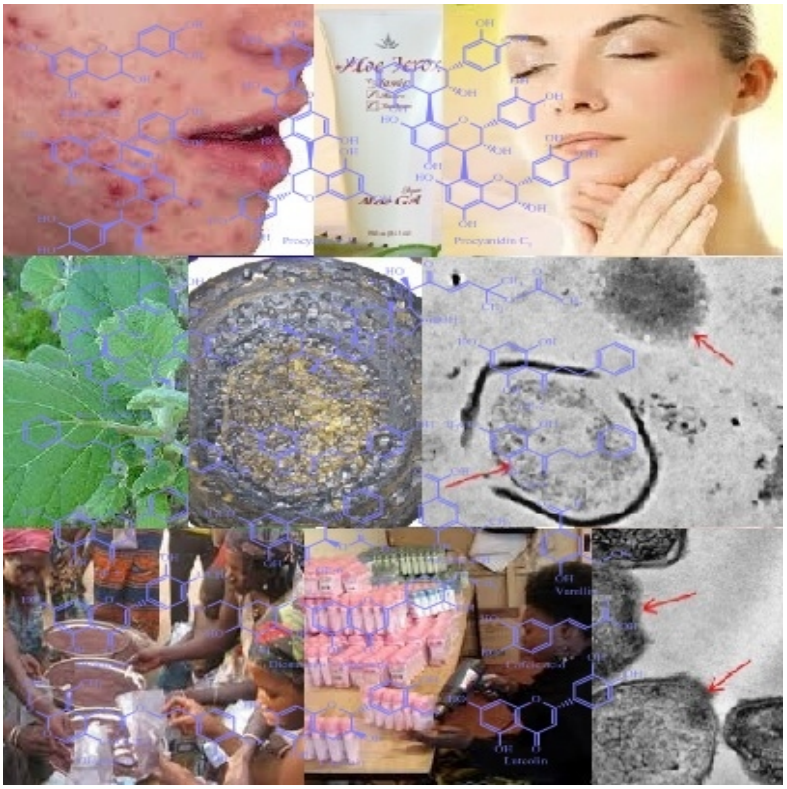
Department of Plant Science, Plant Science Complex, University of Pretoria, Pretoria-0002, South Africa

Corresponding Author: Prof. Namrita Lall
Department of Plant Science,
Plant Sciences Complex, University of Pretoria,
Pretoria-0002, South Africa
E-mail: namrita.lall@up.ac.za
Phone: 012-420-2524; Fax: +27-12-420-6668

Co-author: Dr. Navneet Kishore
Department of Plant Science,
Plant Sciences Complex, University of Pretoria,
Pretoria-0002, South Africa
E-mail: kishore.navneet6@gmail.com
Phone: +27-12-420-6995

Graphical Abstract

Scientific validation of South African medicinal plants used traditionally for skin care and their pharmacological properties associated with treating skin conditions.



Contents

---

1. Introduction

Skin is the largest organ in the body which protects the internal environment from the external one and adds to our beauty too. Beauty is a quality that gives pleasure to the senses, which is desired by many humans. In general terms skin diseases account for approximately 34% of all the diseases encountered worldwide (Abbasi et al., 2010). They affect people of all ages and constitute a major concern for medical consultation. Skin diseases currently exist as a major health burden in both developed and undeveloped countries. According to the World Health Organization (WHO), burns have also been a serious public health problem due to the global increase in burn mortality rates. In South Africa, over 19,500 fire-related deaths are reported annually and they rank among the 15 leading causes of death among youngsters (5-29 years). However, mortality rate for skin diseases is relatively low, often persistent and are difficult to treat (WHO 2012). There are many different ways to protect our skin. The usage of natural ingredients for skin care is very popular today. Medicinal plants have been found to play a major role in the treatment of various skin disorders and these species have been used in many countries around the world where they contribute significantly towards the health care for skin (De Wet et al., 2013). Moreover, the extensive use of medicinal plants to treat dermatological conditions in traditional system of whole southern Africa has been recently reported (Mabona et al., 2013).

The search for natural remedies for skin care is on-going worldwide. A review by Vermaak et al. (2011) focused on the importance of seeds oil from six species used in the preparation of cosmetics, also mentioned the traditional and other medicinal usage of seed

oils. An article by Mabona et al. (2013) focussed on the dermatological applications of about 47 southern African medicinal plants. The authors had mainly mentioned the antimicrobial effects of plants against skin pathogens. Chen et al. (2012) summarised very systematically the medicinal and cosmetic relevance of the *Aloe ferox*, a fully explored plant of South Africa which is also used in cosmetic herbal formulations. A document from Brendler and Denzil (2011) unpublished work, provided a list of African cosmetic species and their usage. Reports by other researchers such as Mukul et al. (2011); Gupta et al. (2011); Preetha and Karthika (2009); Gediya et al. (2009); Jain et al. (2010); Shivanand et al. (2009), focussed on the significance of Indian herbs and spices used in maintaining and enhancing human beauty as well as popularity of these herbs in cosmetics. Chaudhari et al. (2011) reviewed common types of plants used for skin care and concluded that the oxidative stress is one of the major mechanisms for skin aging and dermatological conditions.

These publications do not cover relevant significant scientific information regarding South African plants used for skin care. The need for review of the plants species grown in South Africa should focus on gaps in our understanding of traditional uses and *in-vitro* studies such as, pharmacological studies, toxicity profiling, pre-clinical and clinical trials. Previous review reported by Chen et al. (2012); Van Wyk and Gericke (2000) were directed at phytochemical aspects and few pharmacological activities of the species. Hence, an attempt was made to update the complete information on traditional uses, phytochemical aspects, toxicity and pharmacological activities of the species, which can aid for future research to be taken on the respective species by synthetic chemists, phytochemists, pharmacologists, clinicians, scientists and toxicologists etc. The review highlighted the traditional formulations made from the species for skin care (Table 1), in addition to this, different biological activities and toxicological studies have been reported on various extracts of different plant parts (Table 2).

There is growing interest in the health benefits of plants grown in South Africa with regard to skin care. In line with this, there is an increasing numbers of published articles

claiming that plant or plant derived actives may function as candidate for skin care. However, it is unclear which plant extract/active can work effectively. Therefore, to test this all available literature were reviewed with an intention of capturing what biological and/or phytochemical studies have been performed on those extracts. The present review focused on the ethnopharmacological aspects of 117 plant species used traditionally in South Africa for skin care belonging to 57 families and 101 genera, which are applied topically or taken orally in the traditional healing system of the South African population. Disorders treated, include abscesses, acne, burns, boils, incisions, ringworm, rashes, shingles, sores, wounds and warts. But such knowledge of medicinal plants is limited to specific localities in rural area. In other words, only a few people from local areas have information on the use of these medicinal plants. These species are still not fully investigated scientifically and a few are completely unexplored.

The main aims of the present review are as follows:

- Which species are used traditionally for skin care by people of South Africa?
- Which species have been explored scientifically? Either for the identification of bioactive compounds or for pharmacological applications
- What types of activities are associated with the species which have already been studied scientifically?
- How many species are still unexplored scientifically for skin care?
- A critical assessment of the existing information available in the literature on the pharmacological activity and traditional usage of plants grown in South Africa for skin care
- Based on existing knowledge about the species, what are the perspectives and directions for future research and potential applications

2. Plants as natural source for skin care

There has been a very long history in human civilization of the usage of natural ingredients; such as herbs, roots, essential oils and flowers for skin care. Egyptians, were the first to use the whipped ostrich eggs, olive oil, resin mixed with milk for the treatment of variety of skin conditions from ancient time. Nowadays, the most common examples of natural skin care ingredients include palm oil, sesame seed oil, linseed, jojoba oil, sandalwood, witch hazel, tea tree oil, chamomile and many more (Pandey et al., 2010). The use of bioactive extracts or phytochemicals from a variety of botanicals accomplish two functions; firstly they serve as cosmetics for the care of the body and secondly the botanical ingredients influence the biological functions of the skin, providing the nutrients necessary for a healthy skin (Dureja et al., 2005). Generally botanical products are a rich source of vitamins, antioxidants, various oils, essential oils, hydrocolloids, proteins, terpenoids and other bioactive molecules. The use of herbal medicines by communities of African descent is estimated to be 75% by the World Health Organization (Dubey et al., 2004).

3. Abundance of active constituents are the backbone of phyto-derived products

Plant extracts mainly added to herbal preparations for their topical use, are associated with several antimicrobial properties including anti-inflammatory and antioxidant properties. These antioxidant botanicals are generally classified into three categories depending upon the nature of their constituents, namely carotenoids, flavonoids and polyphenols. Carotenoids are structurally related to vitamin A and constitute various retinols like retinoic acid. The flavonoids, in addition to their antioxidant action also impart UV protection and have metal chelating properties (Glaser, 2004). However, whole herbal extracts consist of numerous compounds that together, provide better effects on the skin with regard to antioxidant, anti-inflammatory, emollient, melanin-inhibiting, antimutagenic and anti-aging properties.

Apart from the above, herbal extracts have also been shown to exhibit antifungal and antileishmanial properties. An ointment made from bark of *Calodendrum capense* (L.f.) Thunb. (Cape Chestnut) and a lotion made from leaves of *Warburgia salutaris* (Bertol. f.)

Chiov. (Pepper-bark tree) are used to treat fungal infections. Several other species such as *Croton sylvaticus* Hochst. (Woodland croton), *Terminalia sericea* Burch. ex DC. (Silver terminalia), *Withania somnifera* L. (Winter cherry) and *Zantedeschia aethiopica* Spreng. (White arum lily) exhibited antifungal activities (Fernandes et al., 2008; Mokoka et al., 2010). All these have attracted major attention of research scientists and clinicians because of the increasing incidence of fungal infections; leading to skin disorders. Likewise, fatty acids have been shown to have beneficial effects when applied onto the skin. In addition, the oils are also used as a carrier for other active ingredients. The presence of certain fatty acids has also proved to enhance skin permeation of co-administered molecules (Vermaak et al., 2011). Additionally, flavonoids, in the form of crude plant extracts, have long been utilised for their anti-inflammatory capacity in the cosmetic industry (Kim et al., 2004). There are various types of phyto-constituents that play a significant role in the improvement of skin smoothness and for protection from other skin problems.

However, phenolics rich plants species are candidates used for prevention of harmful effects of UV radiation on the skin. Also, the high concentration of plant peptides protects the peptide bonds of the skin proteins. The proteins, absorbing lipids, and nucleotides are also used as the skin's natural sun blockers (Anitha, 2012). There are a lot of different types of sunscreen products like oils, gels, creams, lotions which are made from mixture of different species, which provide adequate protection from harmful UV rays. Seed oils are ideally suited to satisfy this need due to the presence of fatty acids which have been shown to have beneficial effects when applied onto the skin (Vermaak et al., 2011; Welford et al., 2008). Sesame oil is one of the most efficient oils with 30% resistance of UV rays, while other oils resist about 20%. Most of the taxa listed in table 1 are not fully explored specially with regard to the identification of bioactive compounds, a few are totally unexplored. Phytochemical investigation of these plants is still warranted.

4. Plants grown in South Africa, a potential source for new preparation with beneficial effects on the skin

The majority of people in Africa use plant based traditional medicines for their health care. Nowadays in rural areas of South Africa 'Natural cosmetic products, are more frequently bought from herbal shops, but in a few cases they are still prepared at home, especially those for burns or skin inflammation. The use of medicinal plants to treat dermatological conditions has been observed in whole southern Africa as traditional medicine to treat skin diseases recently (Mabona et al., 2013). It is of great interest to know whether plant formulations used for skin care traditionally in South Africa may be part of modern formulations. South Africa, which has a history of traditional healing, has around 30,000 flowering plant species (Louw et al., 2002; Van Wyk and Viljoen, 2011), and accounts for almost 10% of the world's higher plant species (Van Wyk and Gericke, 2000). Therefore, significant research and development opportunities exist to discover the novel and useful biological with regard to skin care potential (Street and Prinsloo, 2013).

The oil of some popular South African plants *viz.* African oil palm (*Elaeis guineensis* Jacq), Baobab (*Adansonia digitata* L.), Cape Mahogany (*Trichilia emetica* Vahl.), False Sandalwood (*Ximenia Americana* L.), Manketti (*Schinziophyton rautanenii* Schinz), Marula (*Sclerocarya birrea* Sond.), Sesame (*Sesamum indicum* L.) and Wild Watermelon (*Citrullus lanatus* Thunb.) have been frequently used in cosmetic formulations due to moisturizerising effect. In addition to this, there are other popular South African plants such as Bitter Aloe (*Aloe ferox* Mill.), Rooibos tea (*Aspalathus linearis* (Burm.f.) R.Dahlgren), Cape Chestnut (*Calodendrum capense* (L.f.) Thunb.), Honeybush tea (*Cyclopia intermedia* E. Mey.), White milkwood (*Sideroxylon inerme* L.) and Blue mountain sage (*Salvia stenophylla* Burch. ex Benth) which are regularly used in various skin creams for anti-aging, anti-acne, anti-wrinkle and for skin-hyperpigmentation problems. An ointment made from cape chestnut is used for the treating those who suffers from psoriasis, skin cracking, sagging and eczema.

It continues a long-standing healthcare system intimately linked to traditional health care system which serves as the primary source of healthcare in South Africa (Makunga et al., 2004) including skin disorders (Van Wyk et al., 2008). Research on traditional species, like *Adansonia digitata* L. (Baobab), *Aspalathus linearis* Burm. f. (Rooibos tea), *Elaeis guineensis* Jacq (African oil palm), *Kigelia africana* (Lam.) Benth. (Sausage tree), *Trichilia emetica* Vahl. (Natal Mahogany), *Schinziophyton rautanenii* Schinz (Mongongo tree), *Sclerocarya birrea* Sond. (Marula), *Warburgia salutaris* (Bertol. f.) Chiov. (Pepper-bark tree) using multi-dimensional approaches originating from national and international, focused on South Africa has led to the development of several plant-derived products for skin care (Kiken and Cohen, 2002). Scientific evidence demonstrated that species such as *Aloe ferox* Mill. (Bitter Aloe), *Aspalathus linearis* Burm. f. (Rooibos tea), *Calendula officinalis* L. (Pot marigold), *Crocus sativus* L. (Saffron), *Kigelia africana* (Lam.) Benth. (Sausage tree), *Eriocephalus punctulatus* L. (Wild rosemary), *Greyia flanaganii* Bolus (Kei bottlebrush), *Sideroxylon inerme* L. (White milkwood) etc. possess significant biological properties and can actively restore, heal and protect the skin (Chen et al., 2012; Marnewick et al., 2005).

A detailed description of the traditional usage, relevant pharmacological activities and phytochemical constituents of a few most popular and researched taxa of South Africa are as follows:

4.1. *Aloe ferox* Mill.

Aloe ferox commonly known as the bitter aloe or Cape aloe is a variable species indigenous to the Cape coastal region of South Africa (Van Wyk et al., 2009). Traditionally the leaves and roots are applied topically or taken internally to treat dermatitis, acne and other skin diseases such as skin cancer, burns and psoriasis (Loots et al., 2007). It is also used in small doses as a ‘‘blood purifier’’ in cases of acne and recently the inner leaf parenchyma has become popular ingredient in skin care products. Aloe gel can be added to various cosmetic products such as cleansers, moisturisers, shampoos, suntan lotions, and sunburn screens. Aloesin showed promising activity as a pigmentation-altering agent for cosmetic or

therapeutic applications (Yagi and Takeo, 2003). The phytochemical literature survey of *A. ferox* revealed that it contains chromones, anthraquinones, antrhrones, anthrone-*C*-glycosides and other phenolic compounds (Chen et al., 2012).

4.2. *Aspalathus linearis* (Burm.f.) R. Dahlgren

Aspalathus linearis (Rooibos tea) is a herbal tea that grows in Cape Province. The tea has been said to have many functions for example, it helps to increase appetite, improve bowel movement and control mental condition (Nakano et al., 1997). During pregnancy African women takes rooibos to relieve heartburn, as an iron supplement, for colic relief for infants etc. Rooibos is well known for its antioxidant activity which also relates to its hepato-protective properties (Breiter et al., 2011). Rooibos contains unique phenolic compounds, namely, aspalathin, a dihydrochalcone *C*-glucoside and aspalalinin, a cyclic dihydrochalcone along with many other compounds, also abundant in flavonoids particularly, aspalathin, isoorientin, nothofagin, quercetin and isoquercitrin etc. (Kazuno et al., 2005; Street and Prinsloo, 2013).

4.3. *Calodendrum capense* (L.f.) Thunb.

The plant *Calodendrum* precisely devoted as a beautiful tree, also known as Cape Chestnut tree is a member of the family Rutaceae (Leistner, 2000). Traditionally the bark is used as an ingredient of skin ointment (Van Wyk and Gericke, 2000). Seeds are crushed and boiled to obtain oil that is suitable for making soap. Seeds oil is extracted from Cape Chestnut also known as Yangu oil (Ramoroka and Mapunya, 2006). This oil has natural UV protection, high content of fatty acids (especially linoleic) and antioxidants. It is very popular for African hair and skin care. Main fatty acids present in oil are palmitic, oleic, linoleic and stearic acid. The leaves and bark also used as a facial mask, in soap preparations and for skin-hyperpigmentation problem (Mapunya et al., 2012).

4.4. *Citrullus lanatus* Thunb.

Citrullus lanatus (Cucurbitaceae) commonly called water melon is widely distributed, but naturally occurs in South Africa, Namibia, Botswana, Zimbabwe, Mozambique, Zambia

and Malawi (Lucky et al., 2012). It is an excellent source of vitamin A, B and C. Pink watermelon is also a source of the arginine, carotenoids, lycopenes, carbohydrate, sodium, magnesium, potassium and water. Traditionally *Citrullus lanatus* is in use as energy source, act as antioxidant and is used to treat enlarged liver and jaundice (Yativ et al., 2010). The seed contains 20-40% oil and fatty oil in the seed (Hassan et al., 2011), the main fatty acids are linoleic, oleic, palmitic and stearic acids. Citrullus seed oil is also known to contain traces of linolenic, myristic, and lauric acids and both the oil and the fatty acid contents are stable after 6 months in storage (Jarret and Levy, 2012). Due to the presence of fatty acids and carotenoids it is also used for making soap. Face masks made from the fruit are used as a cosmetic for delicate skins.

4.5. *Elaeis guineensis* Jacq.

Elaeis guineensis (Oil palm) is a perennial plant and is measured to be the most productive oil crop with 42.41 million metric tonnes production in 2008 to 2009 contributing to 36% of total world oil production (Tahir et al., 2012). In traditional medicine, the leaf of the plant is squeezed and the juice thus obtained is placed on wounds to promote healing (Sasidharan et al., 2012). The leaf extract and juice from young petioles are applied to fresh wounds. The fruit mesocarp oil and palm kernel oil are administered as a poison antidote and used externally with several other herbs as a lotion to treat skin diseases. Major fatty acids are linoleic, palmitic, linolenic acids with trace amounts of oleic, stearic, arachidic, myristic, lauric, palmitoleic and margaric acids. The fruit husk is used in the preparation of soaps which is used to treat skin infections and is also used in cosmetics and personal care products, these palm oil ingredients are used in the formulation of skin care and makeup products (Sasidharan et al., 2010).

4.6. *Eriocephalus africanus* L.

Eriocephalus africanus (Asteraceae) is a common, fragrant woody shrub that occurs in specific localities in the Western Cape and Karoo regions of South Africa. It is also called as Cape snowbush or Rosemary. The infusions of leaves are used in treating inflammation

and other dermal complications (Philander, 2011). It has been reported that rosemary stimulated and improved circulation throughout the body; it increased the blood supply to the skin, which is thought to help restore a youthful glow. It has been also stated that Rosemary promotes hair growth (Njenga et al., 2005). The rosemary oil is therefore completely natural and used for aromatherapy, cosmetic and perfume.

4.7. *Eriocephalus punctulatus* L.

Eriocephalus punctulatus (Asteraceae), also known as the Cape chamomile grows on the north-east slopes of the Drakensberge mountain range in the province free state of South Africa (Philander, 2011). Nowadays, commercial Cape chamomile oil due to its pleasant odour, is being used as a fragrance in cosmetics and toiletries; it is increasingly employed in aromatherapy (Kamatou et al., 2011). The blue colour of the commercial Cape chamomile oil is associated by the presence of azulene derivatives in the oil, which are formed by the decomposition of proazulenes during steam distillation. From literature reports very few components have been identified in Cape chamomile oil. 2-Methylbutyl isobutyrate, 2-methylpropyl isobutyrate, *p*-cymene, α-pinene, 2-methylbutyl isovalerate and 3-methylbutyl isobutyrate were found to be the main components.

4.8. *Greyia flanaganii* Bolus

Greyia flanaganii is an evergreen, rare endemic southern African plant species, one of three closely related species of the family Greyiaceae. In 1998 it was the Tree of the Year. This plant is very frost tolerant. It remains evergreen even in areas exposed to frost in winter (Steyn et al., 1987). It has been reported that the ethanol leaf extract exhibited significant anti-tyrosinase activity with the fifty percent inhibitory concentration (IC_{50}) of 32.62 µg/ml when tyrosine was used as a substrate. The total extract also showed significant inhibition of melanin production at 6.25 µg/ml and low levels of cytotoxicity with IC_{50} < 400 µg/ml. Isolated compounds showed good radical scavenging activity and low toxicity of the cells with reduction of melanin content of the cells (Mapunya et al., 2011).

The compounds isolated from the plant were (3S)-4-hydroxyphenethyl 3-hydroxy-5-phenylpentanoate, 2',4',6'-trihydroxy-dihydrochalcone, 2',6',4-trihydroxy-4'-methoxydihydro-chalcone, 2',6'-dihydroxy-4'-methoxydihydrochalcone, 5,7- dihydroxyflavanone [(2S)-pinocembrin], 2',6'-dihydroxy-4',4-dimethoxy dihydrochalcone and (2R,3R)-3,5,7-trihydroxy-3-O-acetylflavanone. Compound 2',4',6'-trihydroxydihydrochalcone exhibited significant antityrosinase activity exhibiting the fifty per cent inhibitory concentration of (IC_{50}) 69.15 μM (Mapunya et al., 2011).

4.9. *Olea europaea* L. subsp. *africana* (Mill.) P.S. Green

The olive tree *Olea europaea* is a member of the family Oleaceae, have been widely used in folk medicine and cultivated for oil production (Bianco et al., 1993). It is applied topically to treat skin damage, such as contact dermatitis, atopic dermatitis, eczema including severe hand and foot eczema, psoriasis, thermal and radiation burns, other types of skin inflammation and aging (Aburjai and Natsheh, 2003). Oleuropein, the main constituent of olive leaf extract, is a complex phenol present in large quantities in olive tree leaves, inhibited platelet-activating factor activity, enhanced nitric oxide production by mouse macrophages and decreased inflammatory mediator production (Mourtzinos et al., 2007). Olive oil contains fatty acids, triglycerides, tocopherols, squalene, carotenoids, sterols, polyphenols, chlorophylls, β-sitosterol, tocopherol, volatile and flavour compounds. Olive leaves also contain flavonoids (apigenin, kaempferol, luteolin) as well as phenolic compounds (caffeic acid, tyrosol, hydroxytytrosol). Since ancient time people have been using olive oil as skin and hair conditioner in cosmetics (Alvarez and Rodriguez, 2000).

4.10. *Pelargonium graveolens* L'Her.

The technical and scientific knowledge is limited for *Pelargonium graveolens* (Geraniaceae), (Hsouna and Hamdi, 2013). Some scientific studies showed the presence of constituents belonging mainly to the groups of essential oils, phenolics and flavonoids (Rao et al., 2002). Geranium oil is used as cleansing for over-oily skin, for acne and for eczema. It

is a very important component of high grade perfumes due to its strong rose-like odour (Parameswaran et al., 2000).

4.11. *Schinziophyton rautanenii* Schinz

Schinziophyton rautanenii (Euphorbiaceae), is known as mungongo in Zambia and manketti in many other African countries. It is found growing in a rough band across the subtropical latitudes of southern Africa including the Limpopo Province of South Africa. The seed oil from the species consists mainly of fatty acids including linoleic, oleic, palmitic, linolenic, and erucic acids, with lesser quantities of myristic and myristoleoic acids. In addition, it is rich in vitamin E (565 mg/100 g of the kernel) which provides excellent oxidative stability and a long shelf life (Juliani et al. 2007; Chivandi et al. 2008). Additionally, the presence of Vitamin E, linoleic and eleostearic acids renders the oil useful for skin protection and hydration, which may assist with reduction of inflammation and promotion of cellular repair and tissue generation (Zimba et al., 2005). Skin supplementation with anti-oxidants may play an important role in the reduction of photo damage and photo aging due to free-radical oxidative stress (Saral et al., 2002).

4.12. *Sclerocarya birrea* Sond.

Sclerocarya birrea (Anacardiaceae) is a Savannah tree commonly known as Marula, an important ethnomedicinal plant. The oil of marula contains oleic, linoleic and palmitic acid. Recent studies on the oil from *Sclerocarya birrea* kernels showed a high oxidative stability even during deep frying due to its fatty acid and tocopherol composition (Mariod et al., 2010). Women in the Limpopo region of South Africa use the oil to massage babies and as body lotion for face, feet and hands. Local populations in southern Africa, particularly in South Africa, have been using marula oil for several years to protect against dry and cracking skin, and as a shampoo for dry, damaged and fragile hair (Hein et al., 2009). Like many other fixed oils, marula oil is rich in monounsaturated fatty acids which make the oil very stable (Zimba et al., 2005). Marula oil has been shown to improve skin hydration and smoothness as well as to reduce skin redness (Gruenwald, 2006). Clinical tests (including skin hydration,

'transepidermal water loss' and 'increase in skin smoothness') to determine its potential in cosmetic formulations have been completed with moderate success (Houghton, 1999).

4.13. *Sesamum indicum* L.

Sesamum indicum (Sesame) is grown extensively in tropical and subtropical areas, is an important oilseed crop, being cultivated in the tropics and the temperate zone of the world. Defatted sesame meal is rich in protein (40-50%), and it may be an excellent protein source. It is one of the oldest oil crops and is widely cultivated in Asia and Africa (Ali et al., 2007). The sesame seed oil is rich in oleic acid and linoleic acid (Zhang et al., 2013; Bandyopadhyay and Ghosh 2002). In the tissues beneath the skin, this oil neutralizes oxygen radicals. It penetrates into the skin quickly and enters the blood stream through the capillaries (Anilkumar et al., 2010). The oil is useful in the industrial preparation for skin conditioning agents, moisturizers and bath oils products etc. Sesame seed has higher oil content (around 50%) than most of the known oil seeds (Warra, 2012).

4.14. *Sideroxylon inerme* L.

Sideroxylon inerme or white milkwood is an evergreen Southern African coastal tree, is one of South Africa's 'Protected Trees'. This is the only member of the *Sideroxylon* genus in Southern Africa (VanWyk et al., 1997). Traditionally it is used plant for skin-lightening purposes in South African tribes by Zulus and Xhosas. The bark is used for several medicinal purposes in the form of a paste, the bark also widely used as a skin lightener, particularly in KwaZulu-Natal province of South Africa (VanWyk and Gerick, 2000). Methanol and acetone extracts from the stem bark of *S. inerme* was found to exhibited significant inhibition of monophenolase activity with IC_{50} values of 63 µg/ml and 82 µg/ml, respectively. The methanol extract also exhibited 37% reduction of melanin content at a concentration of 6.2 µg/ml in melanocytes without being significantly toxic to the cells. Two active compounds, epigallocatechin gallate and procyanidin B1 has been isolated from the stem bark of *S. inerme*, exhibited with IC_{50} values against monophenolase of 30 µg/ml and >200 µg/ml, respectively. The compound epigallocatechin gallate exhibited a greater anti-tyrosinase

activity than arbutin. Both compounds also exhibited antioxidant activities with a fifty percent effective concentration (EC_{50} values) of 1.33 µg/ml and 1.68 µg/ml, respectively (Momtaz et al., 2008).

4.15. *Ximenia Americana* L.

Ximenia americana (Olacaceae) is a thorny bush-forming shrub or small tree of southern Africa (Maikai et al. 2010). The roots are traditionally used to treat skin problems, leprotic ulcers, mouth ulcers, haemorrhoids, abdominal pains, dysentery and venereal disease. The oil from the seed is used as an emollient, conditioner, skin softener and hair oil as well as included as an ingredient in lipsticks and lubricants (Maikai et al., 2010). Analysis of the seed oil revealed that the major components were found to be oleic, hexacos-17-enoic (ximenic), linoleic, linolenic and stearic acids together with smaller quantities of triacont-21-enoic (lumequic), octadec-11-en-9-ynoic (ximenynic), arachidonic, erucic, and nervonic acids. Fatty acids with more than 22 carbon atoms are rarely found naturally. Ximenia oil contains very long chain fatty acids with up to 40 carbon atoms. Studies on ximenynic acid (Ximenoil®) have revealed improvement in blood circulation. The greatest effect increased by 50% was seen after 60 min especially on cellulitic areas where blood perfusion is usually very low (Olabissi et al., 2011).

Table 1 depicts about 117 plant species grown in South Africa including the aforesaid ones which are applied topically or taken orally, traditionally by the South African population in several localities for inflammation, wound healing, as dressing for swollen parts, for cleaning wounds, treatment of sores, burns, eczema, boils, leprosy, as a blood cleanser, for cracked lips or skin, for fractures, for sprains and skin diseases caused by microorganisms (Dweck, 2011). A few plant species used in plant-based formulation have been scientifically proven with regard to skin care potential, but the majority of plant species used traditionally to treat various skin disorders has not been scientifically validated and therefore, need special attention for further investigations. **Table 1** depicts the taxa of South Africa (few are grown or cultivated), for their medicinal and skin care usage.

Table 1: Ethnobotanical usage of plants from South Africa for skin care

Scientific name	Common name	Family	Local and ethnobotanical uses	Cosmeceutical relevance's	References
Acacia erioloba E.Mey.*	Camel thorn, Kameeldoring (Afr.)	Fabaceae	Pods are used to treat coughs, Herpes zoster and gonorrhoea	Wood ash is used for skin infections	Von Koenen (1996); Chinsembu et al., 2011
Acokanthera oppositifolia (Lam.) Codd	Bushman's Poison, Boesmansgif (Afr.)	Apocynaceae	Aerial plant parts are used to treat headaches, abdominal pains, convulsions, pain, snake-bite; and root decoctions are used to treat tapeworm	Leaf/root pulp is rubbed into wounds, and also applied as a dressing to swollen parts	Watt and Breyer (1962); Hutchings (1996)
Adansonia digitata L.	Baobab, Kremetartboom (Afr.)	Malvaceae	Whole plant is used as diaphoretic, diuretic, astringent, emollient and has antiarrhythmic properties	The entire plant part is used for inflammation and aging related disorders	Caluwe et al., 2010
Agapanthus campanulatus Leighton*	Bell agapanthus, Bloulelie (Afr.)	Agapanthaceae	A lotion made from crushed roots are used to bathe new-born babies to make them strong	Leaves are used against blemishes	Duncan (1998)
Agathosma betulina (Berg.) Pillans	Boegoe, Bergboegoe (Afr.)	Rutaceae	The whole plant part is used as a diuretic, a liniment, a cough remedy, to treat kidney and urinary tract infections, prostatitis, rheumatism, cholera and other stomach ailments	The plant is mixed with vinegar and is used to clean wounds and in cosmetics to keep the skin soft and moist in dry climates	Van Wyk et al. (1997); Watt and Breyer (1962); Simpson (1998)
Agathosma crenulata (L.) Pillans*	Oval-leaf buchu, Anysboegoe (Afr.)	Rutaceae	Leaves are used to treat stomach complaints, worms, indigestion, kidney and bladder ailments	Leaf decoctions are used for bath and for cleaning wounds	Van Rooyen and Steyn (1999); Goldblatt and Manning (2000)
Aloe aculeata Pole-Evans	Red hot poker aloe	Aloaceae	Leaves are used to treat various skin ailments	Leaves are used for skin blemishes	Mapunya et al. (2012)
Aloe arborescens Mill.	Krantz aloe, Kransaalwyn (Afr.)	Aloaceae	Powdered leaves are used for protection against storms and leaf decoctions are used for childbirth	Leaves are used to treat burn wounds and abrasions	Mapunya et al. (2012)
Aloe ferox Mill.	Bitter Aloe, Bergaalwyn (Afr.)	Aloaceae	Sap from the leaves is used as a laxative and for arthritis	Leaf sap is used for wound healing	Mapunya et al. (2012)
Aloe greatheadii Schonland	Spotted aloe, Transvaalaalwyn (Afr.)	Aloaceae	The sap of the plant is used to treat arthritis, skin cancer, burns, eczema, digestive problems, high blood pressure and diabetes	The bitter sap of the leaves is used to treat wounds, sores and burns	Van Wyk and Malan (1988); Van Wyk and Smith (1996)

Aloe pretoriensis Pole-Evans	Pretoria Aloe	Aloaceae	Sap is used to treat arthritis and skin irritations	The sap of the leaves is used for skin blemishes	Mapunya et al. (2012)
Aloe sessiliflora Pole-Evans	Bottle-brush aloe	Aloaceae	The whole plant is used to treat vomiting, bronchitis, asthma, jaundice and ulcers	Leaves are used to treat skin diseases	Mapunya et al. (2012)
Aloe vera (L.) Burm.f.	True Aloe, Barbados Aloe	Aloaceae	The sap of the plant is used for multipurpose skin treatments	The gel from leaves is used as a remedy for minor burns, scrapes and for sunburn	Mapunya et al. (2012)
Anacardium occidentale L.*	Cashew nut	Anacardiaceae	Fruit-bark juice is used to treat warts, cancerous ulcers, dysentery, fever, leucoderma, piles and tumours	Old leaves are applied to the skin as a poultice for burns and other skin diseases	Okoye et al. (2009)
Antidesma venosum E. Mey. ex Tul.*	Tassle Berry, Tasselbessie (Afr.)	Phyllanthaceae	Root-bark is used for dysentery, it is chewed to treat snakebite; root decoctions are used to treat abdominal pains and malaria	Powdered bark is used for wound dressing	Gerstner (1938); Palgrave (2002)
Aristea ecklonii Baker.*	Blue stars, Blousterre (Afr.)	Iridaceae	The whole plant used to treat fevers, coughs and syphilis	The whole plant is applied topically for shingles	Hutchings et al. (1996); Ngwenya et al. (2003)
Artemisia afra Jacq. ex Willd.	African wormwood, Wilde-als (Afr.)	Asteraceae	Roots/stems/leaves are used to treat coughs, whooping cough, fever, loss of appetite, headache, diabetes and intestinal worms	Roots, stems and leaves are used for body washes	Van Wyk et al. (1997); Watt and Breyer (1962)
Aspalathus linearis (Burm.f.) R.Dahlgren	Rooibos tea, Bossietee (Afr.)	Fabaceae	The whole plant is used for increasing appetite, for improving bowel movement and for controlling mental conditions	The aerial plant part is used for anti-ageing and for eczema	Jackson (1990); Van Wyk and Gericke (2000)
Asparagus africanus Lam.	African asparagus	Asparagaceae	The aerial plant part is used to treat headache, backache, stomach pain and for child birth. The root extract is applied externally for chronic gout	The aerial plant part is used by women to stimulate hair growth	Lohdip and Tyonande (2005)
Athrixia phylicoides DC.	Bushman's tea, Boesmanstee (Afr.)	Asteraceae	The leaf decoction is used to treat coughs, colds and as a gargle for throat infections and voice loss	Plant infusions are used as blood cleansers, and to treat sores and boils	Hutchings (1996)
Ballota africana (L.) Benth.*	Cape horehound, Kattekruie (Afr.)	Lamiaceae	The whole plant part is used for colds, influenza, asthma, bronchitis, hoarseness, heart trouble, hysteria, insomnia,	The leaf decoction is applied externally to treat sores	Codd (1985); Van Wyk et al. (1997)

			typhoid fever, headaches and liver problems		
Bauhinia bowkeri Harv.	Kei White Bauhinia, Keibeesklou (Afr.)	Fabaceae	Leaves and bark are used to induce vomiting	Leaves and bark are used for steaming and bathing	Ndawonde et al. (2007)
Bauhinia petersiana Bolle	Kalahari White Bauhinia	Fabaceae	Roots are used for treating infertility in females, dysmenorrhea and diarrhoea	Leaves mixed with salt are used to heal wounds.	Ahmed et al. (2012)
Bauhinia variegata L.	Orchid tree, Camel's Foot Tree and Mountain-ebony	Fabaceae	The leaves are frequently used for coughs, asthma, abdominal distension, diarrhoea and as a gargle for sore throats	Bark decoction is used for skin diseases and is helpful in managing skin discoloration	Kirtikar and Basu (1975); Ahmed et al. (2012)
Becium obovatum E. Mey. ex Benth.*	Cat's whiskers, Katsnor (Afr.)	Lamiaceae	Roots and leaves are administered as enemas to treat stomach ailments as well as for abdominal pains	Pounded roots and leaf infusions in warm water are applied for inflammations	Pooley (1998); Fawole et al. (2009)
Boophane disticha (L.f.) Herb.*	Century plant, Seerooglelie (Afr.)	Amaryllidaceae	Bulbs are used to treat hysteria in young women; and fresh leaves are used to treat wound	Bulbs are used to treat wounds and are applied to boils and abscesses	Van Wyk et al., (1997); Van Wyk and Malan (1988)
Bulbine frutescens (L.) Willd.	Snake flower, Geelkatstert (Afr.)	Asphodelaceae	Fresh leaf decoctions are taken for coughs, colds, arthritis, insect bites and for improving wound healing	Fresh leaf juice is used for burns, cracked lips and acne	Dyson (1998); Joffe (1993)
Calendula officinalis L.	Pot marigold	Asteraceae	Leaf decoctions are used to treat fevers, cancer and for menstruation problem	Tinctures and balms made from the flowers are applied to the skin to heal wounds and damaged skin	Mozherenkov and Shubina (1976); Muley et al. (2009)
Calodendrum capense (L.f.) Thunb.	Cape Chestnut, Wildekastaiing (Afr.)	Rutaceae	Leaves are used to kill insects. Seed oil is used for making soap	The bark is used as an ingredient for skin ointments	Leistner (2000); Palmer and Pitman (1972)
Carpobrotus dimidiatus (Haw.) L. Bolus*	Natal sour fig, Natalse strandvy (Afr.)	Mesembryanthe-maceae	The leaf juice is used as a gargle for sore throats, digestive troubles, diarrhoea and dysentery	Leaf juice is used for dressing burns and as an ointment	Fox and Norwood (1982); Joffe (2003)
Carpobrotus edulis (L.) L.Bolus	Sour fig, Cape fig, Hottentotsvy (Afr.)	Mesembryanthe-maceae	The leaf is used to treat diarrhoea, dysentery, stomach cramps, diphtheria, mouth infections, ulcers, toothache and is also used as an astringent	The leaf juice is used as a lotion for burns, bruises, scrape, cuts, sunburn, eczema, dermatitis and other skin conditions	Germishuizen and Meyer (2003); Roberts (1990)
Centella asiatica (L.) Urban	Udingu (Afr.)	Apiaceae	The leaves are used to treat anaemia, dermatitis, bronchitis,	Plant extract is applied for wound healing,	Zainol et al. (2003); Cheng

			asthma, cholera, constipation, diarrhoea, dysentery, epilepsy, hypertension, jaundice, leucorrhoea, nervous disorders and smallpox	related skin infections and poultices are used to treat closed fractures and sprains	and Koo (2000)
Cheilanthes viridis (Forssk.) Sw.*	Green cliffbrake	Pteridaceae	The whole plant part is used for wound	The whole plant part is used to treat sores	Kelmanson et al. (2000)
Chenopodium ambrosioides L.	Sweet pigweed	Chenopodiaceae	The entire plant is used for flatulence, influenza, typhoid fever and pneumonia	Plant decoctions are used to treat eczema and wounds	Pesewu et al. (2008); Hutchings (1996)
Cissampelos capensis L.*	Dawidjieswortel (Afr.)	Menispermaceae	Roots are used for snakebite, diabetes, syphilis, tuberculosis, stomach and skin cancers	Rhizomes/roots/leaf paste are used for boils, wounds, ulcers and sores	Van Wyk et al. (2000); Babajide et al. (2010); Wet et al. (2011)
Citrullus lanatus (Thunb.) Matsum. & Nakai	Wild watermelon, Bitterboela (Afr.)	Cucurbitaceae	The fruit is used to treat enlarged livers, jaundice, for kidneys and bladder infection and for high blood pressure	The flesh of fruits is used as an ingredient of sun lotions and other cosmetics	Laghetti and Hammer (2007); Raimondo et al. (2009)
Clausena anisata (Willd) Hook.f. ex Benth.	Mkomavikali Nukamdida (Afr.)	Rutaceae	A decoction of leaves/roots is used to treat gastro-intestinal disorders and sore throats	Crushed leaves are applied externally as an antiseptic for wounds, sores and burns	Clarkson et al. (2004); Hutchings et al. (1996)
Clerodendrum glabrum E.Mey. var. glabrum*	Tinderwood, Tontelhout (Afr.)	Verbenaceae	The roots are used to treat the snakebites and leaves decoctions are used to treat diarrhoea	Decoctions of leaves are used for treating wounds	Van Wyk et al., (2007)
Crinum moorei Hook. f.	Natal lily, Boslelie (Afr.)	Amaryllidaceae	The bulbs are used for urinary tract infections and to treat body swelling	Bulbs are used as blood cleansers and to treat infected sores and acne	Fawole et al. (2010); Hutchings et al. (1996)
Crocus sativus L.	Saffron	Iridaceae	Used to treat dysentery, enlargement of the liver, urological infections, coughs, stomach disorders and asthma	The whole plant is used for skin blemishes	Assimopoulou et al. (2005); Sariri et al. (2011)
Croton sylvaticus Hochst.*	woodland croton, Boskoorsbessie (Afr.)	Euphorbiaceae	Bark is used to treat rheumatism and intestinal disorders	Leaves are made into a poultice to treat pleurisy	Lans (2007); Schmidt et al. (2002)
Cucumis hirsutus Sond.	Volunteer cucumber	Cucurbitaceae	Leaf and root decoctions are used for diarrhoea	Leaves and roots are used for inflammation	Hutchings et al. (1996); Fawole et al. (2009)

Cyclopia intermedia E. Mey.	Honeybush tea	Fabaceae	Leaf decoctions are used as a diuretic, to treat diarrhoea, menstruation cycles, uterus and prostate cancer	Leaf decoctions are used to wash wounds and burns	McKay and Blumberg (2007); Marnewick et al. (2005)
Cyperus textilis Thunb.*	Basket grass, Kooigoed (Afr.)	Cyperaceae	The plant is used for making baskets and mats	Rhizomes are used for skin ailments	Nadkarni (1976); Smith (1966)
Datura stramonium L.	Thorn apple	Solanaceae	The leaves are used to treat gastrointestinal problems, asthma, arthritis, headaches, sprains, haemorrhoids and tumours	The leaves are used to treat wounds, sores, swellings, boils, abscesses, bruises and inflammation	van Wyk et al., 2000
Dicoma anomala Sond.	Fever bush, Koorsbossie (Afr.)	Asteraceae	Root decoctions are used to treat diarrhoea, dysentery and intestinal worms	Root decoctions are used for sores and wounds	Retief and Herman (1997); Pooley (1998)
Diospyros lycioides Desf.	Monkey plum, Bloubos (Afr.)	Ebenaceae	Bark/root decoctions are used for dysentery	Bark and root decoctions are used for inflammation	Van Wyk and Van Wyk (1997)
Detarium microcarpum Guill. & Perr.*	Sweet detar, Sweet dattock (Afr.)	Fabaceae	The bark/leaves/root decoctions are used to treat rheumatism, venereal diseases, urogenital infections, diarrhoea, dysentery, intestinal worms, malaria and for painful menstruation	Fresh bark or leaves are applied to wounds to prevent and to cure infections	Abreu et al. (1998); Pooley (1998)
Diospyros mespiliformis Hochst. ex A.DC.	African ebony, Jakkalsbessie (Afr.)	Ebenaceae	Leaf decoctions are used for whooping cough, fever, malaria, leprosy and dermatomycoses	Leaves are used for skin infections and wounds	Mohamed et al. (2009)
Ekebergia capensis Sparrm.*	Cape ash, Essenhout (Afr.)	Meliaceae	Root decoctions are used for headaches and chronic coughs; bark is used to cure dysentery and the leaves are used for intestinal worms	Bark infusion is used for boils, acne and abscesses	Pujol (1990); Van Wyk et al. (2011); Ndukui et al. (2012)
Elaeis guineensis Jacq	African oil palm	Arecaceae	Leaves are used for headaches, gonorrhoea, menorrhagia and bronchitis	The leaf extract is applied on fresh wounds and fruit mesocarp oil is used externally as a lotion to treat skin disease	Sasidharan et al. (2010)
Elephantorrhiza elephantina	Elephant's root, Leerbossie	Fabaceae	Roots are used for dysentery, diarrhoea, intestinal disorders,	Underground parts are used to treat sunburn and	Van Wyk et al., 1997

(Burch.) Skeels	(Afr.)		haemorrhoids and for syphilis	root infusion is used to treat acne	
Embelia ruminate (E.Mey. ex A.Dc.) Mez*	False black pepper	Myrsinaceae	Leaves are used as an anti-anthelmintic	Leaf paste is used to treat open wounds and for leprosy related infections	Kumaraswamy et al. (2007)
Eriocephalus africanus L.	Wild Rosemary, Wilderoosmaryn (Afr.)	Asteraceae	Leaf decoctions are used for dropsy, coughs, delayed menstruation, swelling and for gynaecological problems	The yellow oil is used for skin care and is an important constituent of cosmetics products	Gericke et al. (1997); Dyson (1998)
Eriocephalus punctulatus L.	Wild rosemary, Kapokbos (Afr.)	Asteraceae	Leaves are used for the urinary infections and for stomach diseases	Oil has anti-allergic and anti-septic properties and is used in aromatherapy	Sandasi et al. (2011)
Erythrina lysistemon Hutch.	Common coral tree, Gewone (Afr.)	Fabaceae	The aerial plant part is used for arthritis and to relieve earache, root decoctions are used for sprains	Bark is applied as a poultice to treat sores, wounds and abscesses	Pillay et al. (2001)
Eucalyptus camaldulensis Dehnh.	Rostrata gum, Rooibloekom (Afr.)	Myrtaceae	The aerial plant part is used for colds and influenza, the oil is used as an antiseptic	Bark infusion is used to treat pimples	Mabona et al. (2013); Hutchings (1996)
Ficus natalensis Hochst.*	Natal Fig	Moraceae	Leaf decoctions are used to treat various stomach disorders. Bark is used during pregnancy to ensure easy childbirth. Roots are administrated for blood purification	Leaves are used as poultices for wounds and boils	Gerstner (1941); Pujol (1990); Corrigan et al. (2011)
Foeniculum vulgare Mill.	Wild Fennel, Bobbejaanvinkel (Afr.)	Umbelliferae	The whole plant part is used for arthritis, fever, gastric-intestinal complaints, diarrhoea and as a milk stimulant in pregnant women	Seed and root decoctions are used as a blood cleanser	Watt and Breyer (1962); Van Wyk et al. (1997)
Galenia africana L.*	Yellow Bush, Brakkraalbossie (Afr.)	Aizoaceae	The whole plant part is used to treat venereal sores, asthma, coughs, wounds, eye infections and skin diseases	A lotion made from the plant decoction are used for inflammation and for skin diseases	Van der Lugt et al. (1992)
Grewia occidentalis L.*	Cross-berry, Kruisbessie (Afr.)	Malvaceae	Bark is used to facilitate child delivery and for bladder ailments	Small twigs and leaf infusion are used for wounds	Grierson and Afolayan (1999)
Greyia flanaganii Bolus	Kei bottlebrush, Kei baakhout (Afr.)	Greyiaceae	An infusion of the powdered bark is used to treat diarrhoea	No traditional usage for skin recorded	Mapunya et al. (2011)

Gunnera perpensa L.	River pumpkin, Wilde ramenas (Afr.)	Gunneraceae	A aqueous decoction of the entire plant is used for rheumatic fever, infertility in women and to ease childbirth	Root, rhizome, leaf decoctions are used for dressing wounds and to treat psoriasis	Van Wyk et al. (2009); Mabona et al. (2013)
Halleria lucida L.	Tree Fuchsia, Notsung (Afr.)	Scrophulariaceae	The whole plant part is used for to relieve earache	The whole plant part is used topically for various skin diseases	Pooley (1993); Hutchings (1996)
Harpagophytum procumbens (Burch.) DC. ex Meisn.	Devil's claw, Duivelsklou (Afr.)	Pedaliaceae	The whole plant part is used as an anti-rheumatic, laxative, sedative, to treat coughs, diarrhoea, diabetes, bleeding gums, gonorrhoea	Plant infusions help to heal ulcers, boils, skin lesions and wounds, also used for blood purification	Neuwinger (2000); Powell (2001)
Harpephyllum caffrum Bernh. ex Krauss	Wild plum, Wildepruim (Afr.)	Anacardiaceae	Powdered burnt bark is used to treat sprains	Bark is applied externally to treat acne and eczema. Bark is applied in the form of facial saunas and skin washes	Pujol (1990); Van Wyk et al. (2011); Van Wyk et al. (2000)
Helichrysum odoratissimum L.*	Imphepho, Kooigoed (Afr.)	Asteraceae	Leaves and stems are widely used for insomnia, coughs and colds	Leaf decoctions are used for pimples	Hutchings (1996)
Hyaenanche globosa (Gaertn.) Lamb. & Vahl	Hyaena-poison, Gifboom (Afr.)	Euphorbiaceae	Fruits and seeds are used to poison carcasses with the purpose of destroying hyenas	--	Momtaz et al. (2010) Momtaz et al. (2008)
Hypericum perforatum L.	Goatweed, Johanneskruid (Afr.)	Hypericaceae	The aerial plant part is used as a popular remedy for depression, anxiety and inflammation	Aerial parts are applied externally to treat wounds	Savikin et al. (2007); Van Wyk et al. (2000)
Ilex mitis (L.) Radlk.*	Cape holly, Waterboom (Afr.)	Aquifoliaceae	Stem bark is used to treat fever and rheumatism	Ground bark decoction is used for skin rashes and sores on the face	Mabona et al. (2013)
Kigelia africana (Lam.) Benth.	Sausage tree, Worsboom (Afr.)	Bignoniaceae	Bark is administrated for dysentery, rheumatism, diarrhoea and for the treatment of impotence, syphilis, toothache and rheumatism	Bark decoctions are externally applied to treat sores and acne	Mabona et al. (2013); Iwu (1986); Gabriel and Olubunmi (2009)
Leonotis leonurus (L.) R.Br.	Wild dagga, Duiwelstabak (Afr.)	Lamiaceae	The whole plant part is used for fever, arthritis, swollen glands, mouth ulcers	The whole plant part is used to treat boils, eczema, skin ailments and for itching	Frum (2006)
Leucosidea sericea Eckl. & Zeyh.	Oldwood, Ouhout (Afr.)	Rosaceae	The paste made from the crushed leaves used to treat ophthalmia	--	Van Wyk et al. (1997)

Lippia javanica (Burm.f.) Spreng	Lemon Bush, Lemoenbossie (Afr.)	Verbenaceae	Plant infusion is used to treat coughs, colds, bronchial problems, malaria, influenza and measles	Plant infusion is applied to treat various skin disorders such as heat rash and scabies	Van Wyk et al. (1997); Van Wyket al. (2000); Pooley (1998)
Malva parviflora L.	Cheeseweed, Kasieblaar (Afr.)	Malvaceae	Leaves are used to treat stomach pains, decoctions of roots or leaves are used as a hair rinse to remove dandruff and to soften hair	Leaf paste combined with other plant species are used to treat wounds and abscesses	Smith (1895); Watt and Breyer (1962)
Melianthus comosus L.	Honey Flower	Melianthaceae	Leaf decoctions are used to treat bruises, backache, rheumatic joints and snakebite	Leaf poultices and decoctions are widely used to treat septic wounds and sores	Van Wyk et al. (1997)
Melianthus major L.	Giant honey flower	Melianthaceae	Leaves are used to treat cancer, rheumatism and ringworm	Leaf infusion are applied to septic wounds, pimples, sores and bruises	Philander (2011); Van Wyk et al. (2009)
Mentha longifolia (L.) Huds.	Wild mint, Balderjan (Afr.)	Lamiaceae	Leaves are used as a general health tonic, for respiratory problems and urinary tract infections	Leaves are applied topically to treat wounds	Philander (2011)
Olea europaea L. subsp. *africana* (Mill.) P.S.Green	Wild olive, Olienhout (Afr.)	Oleaceae	Bark is used to treat strokes, heart disease, palpitations and to lower blood pressure	Leaves and bark are used for eye infections and for skin disorders	Philander (2011)
Oncosiphon suffruticosum L.*	Stinkkruid, Wurmkruid (Afr.)	Asteraceae	An infusion of the aerial part of plant is taken orally to treat stomach pains, colds, influenza, intestinal worms, typhoid fever and rheumatic fever	A poultice of the leaves is applied for inflammation and scorpion stings	Van Wyk (2008); Van Wyk et al. (2009)
Osmitopsis asteriscoides (P.J. Bergius) Less.*	Mountain daisy, Belsbossie (Afr.)	Asteraceae	Leaves are used for fever, colds, dyspepsia, pain, paralysis and to reduce swelling	The dried plant is used externally for inflammation, cuts and swelling	Van Wyk et al. (1997)
Pelargonium cucullatum (L) L'Her.	Wilde malva	Geraniaceae	The entire plant part used to treat diarrhoea and for the relief of earache	The entire plant part is used as an antiseptic dressing for open sores or wounds	Van der Walt (1977)
Pelargonium graveolens L'Her.	Rose-scented pelargonium	Geraniaceae	The entire plant part used as a diuretic, for depression and respiratory disorders	The entire plant part is used to treat acne and dermatitis	Van der Walt and Vorster (1988)
Pelargonium luridum Andr.	Umsongelo (Afr.)	Geraniaceae	A root infusion is used to treat backache, abdominal pains	The leaf decoctions is used to treat skin sores	Van Wyk et al. (1997); Watt

			in infants, to reduce fever, diarrhoea and dysentery		and Breyer (1962)
Pelargonium sidoides DC.	Kalwerbossie (Afr.)	Geraniaceae	The plant is used to treat coughs, sore throats, respiratory ailments, diarrhoea and gonorrhoea	The entire plant part is used for various skin disorders	Watt and Breyer (1962)
Pentanisia prunelloides (Klotzsch ex Eckl. & Zeyh.) Walp.	Wild verbena, Sooibrandbossie (Afr.)	Rubiaceae	Root decoctions are taken orally for vomiting, rheumatism, heartburn, tuberculosis, fever, toothache and snakebite	Root decoctions are applied externally for burns and for swellings	Pooley (1998); van Wyk et al. (2000); van Wyk et al. (1997)
Polystichum pungens Roth*	Shield ferns	Dryopteridaceae	A decoction obtained from the rhizomes is used to treat intestinal worms and is also used for respiratory problems, as a general anthelmintic	Powdered dried fronds are sprinkled on wounds. The fresh fronds are applied as a poultice	Jacobsen (1983)
Protea repens L.	Common sugarbush, Suikerbos (Afr.)	Proteaceae	Syrup made from the nectar is used to treat diabetes	Leaves are used for inflammation	Watt and Breyer (1962)
Protea simplex E. Phillips	Common sugarbush, Suikerbos (Afr.)	Proteaceae	Root and bark infusions are used for dysentery, diarrhoea and stomach pains	The entire plant part are used for inflammation	Hutchings et al. (1996)
Rauvolfia caffra Sond.	Quinine tree, Kinaboom (Afr.)	Apocynaceae	The bark and latex is used to treat coughs, diarrhoea and other stomach ailments	Bark infusion are used for wounds and skin rashes	Gerstner (1938); Hutchings (1996)
Rothmannia capensis Thunb.*	Wild gardenia, Wildekatjiepiering (Afr.)	Rubiaceae	Powdered roots are used for treating leprosy and rheumatism. Sap from the fruit is applied topically for burns and wounds	Warm fruit juice is applied to wounds and burns to speed up the healing process	Arnold and Gulumian (1984); Mabona et al. (2013)
Salvia stenophylla Burch. ex Benth	Blue mountain sage	Lamiaceae	Leaves are used to soothe digestive problems, colds, coughs, chest congestion and to relieve breathing issues	A poultice of the leaves are used for wounds and sores	Kamatou et al. (2005)
Sansevieria hyacinthoides (L.) Druce	Devil's tongue, Snake tongue	Asparagaceae	The leaves are used to treat ear infections, toothache, haemorrhoids, ulcers, intestinal worms, stomach disorders and diarrhoea	Leaf decoctions are used topically for burns, wounds and swellings	Ribeiro et al. (2010); Watt and Breyer (1962)
Scadoxus puniceus (L.) Friis &	Snake lily, Rooikwas (Afr.),	Amaryllidaceae	Bulbs and roots are used to treat coughs, gastro-intestinal	Leaves are applied to sores and ulcers to aid	Watt and Breyer (1962); Van

Nordal			problems, febrile colds, asthma, leprosy, sprains and bruises	healing and act as an antiseptic	Wyk et al. (2000)
Schinziophyton rautanenii Schinz	Mongongo tree	Euphorbiaceae	The aerial plant part is used for skin diseases	The seed oil is used as a skin cleanser and moisturizer	Juliani et al. (2007); Vermaak et al. (2011)
Scilla natalensis Planch.	Wild squill, Blouberglelie (Afr.)	Hyacinthaceae	Ash from burnt plants and bulbs are used in powdered form to rub on cuts and scratches, over sprains and fractures	Ointments from fresh bulbs are used externally to treat various skin ailments like boils and sores	Leistner (2000); Frum (2006)
Sclerocarya birrea Sond.	Marula	Anacardiaceae	Leaves/stem/bark is widely used to treat stomach illnesses	The leaves are used to treat acne and other skin conditions	Njume et al. (2011); Eloff (2001)
Senecio serratuloides DC.*	Umaphozisa Umkhuthelo (Afr.)	Asteraceae	The aerial part of the plant is used to treat internal and external sores and gonorrhoea	The aerial plant part of the plant is used for sores, burns and as a blood purifier	van Wyk et al. (2009); Wet et al. (2012)
Sesamum indicum L.	Sesame	Pedaliaceae	Seeds are used for cholera, diarrhoea, dysentery and respiratory infections	Seed powder is used for ulcers and bleeding piles	Kapoor (2001)
Sideroxylon inerme L.	White milkwood, Melkbessie (Afr.)	Sapotaceae	The bark is traditionally used for skin diseases	Bark is widely used as a skin lightener	Van Wyk and Gerick (2000)
Siphonochilus aethiopicus Schweif.*	Natal ginger, Wildegemmer (Afr.)	Zingiberaceae	Rhizomes and roots are chewed to treat asthma, hysteria, colds and coughs	Leaf extracts are used for skin depigmentation	Hutchings (1996); Van Wyk et al. (1997)
Solanum incanum L.	Bitter Apple	Solanaceae	The aerial part of the plant is used as tooth antiseptic and for toothache	The aerial plant part of the plant is used for various skin diseases	Al-Fatimi et al. (2007)
Sutherlandia frutescens (L.) R.Br.	Cancer bush, Hoenderbelletjie (Afr.)	Fabaceae	The aerial plant part is used to treat chicken pox, rheumatoid arthritis, dysentery and inflammation	Leaf decoctions are used for washing wounds	Van Wyk et al. (1997) Jackson (1990)
Tecomaria capensis (Thunb.) Spach	Cape honeysuckle, Malangula (Afr.)	Bignoniaceae	Bark infusion is used as an antidiarrheal, to relieve pain, sleeplessness, and antipyretic	Bark infusion is used to treat inflammation	Hutchings et al. (1996)
Terminalia sericea Burch. ex DC.	Silver terminalia, Vaalboom (Afr.)	Combretaceae	Leaf and root infusion is taken for the treatment of diarrhoea and stomach aches	Leaves are used as an antibiotic for wounds	Van Wyk et al. (1997)
Trichilia dregeana Sond.	Cape mahogany, rooiessenhout (Afr.)	Meliaceae	The aerial plant part used as a stomach cleanser and to treat kidney problems, leprosy and sleeplessness	The aerial plant part are used as a blood cleanser	Hutchings et al. (1996); Pooley (1993)

Trichilia emetica Vahl.	Natal Mahogany	Meliaceae	Powder of the grounded roots is used against ascaris stomachache and dysmenorrhoea	Leaves or fruits are used as poultices for bruises and eczema	Van Wyk et al. (2011); Diallo et al. (2003)
Valeriana capensis Thunb.*	Cape Valerian, Wildebalderjan (Afr.)	Valerianaceae	The whole plant is used for asthma, insomnia, hysteria and nervous disorders	Roots are used topically to treat cuts and wounds	Hutchings (1996); Van Wyk and Gericke (2000)
Vernonia natalensis Sch.Bip. ex Walp*	Silver Vernonia, Ihlambihloshana (Afr.)	Asteraceae	The whole plant is used to treat malaria and for pain and kidneys	Root/leaf decoctions are used to treat boils	Hutchings (1996); Van Wyk and Gericke (2000)
Viscum capense L.f.*	Cape mistle toe, Lidjiestee (Afr.)	Viscaceae	The whole plant is used to treat epilepsy, asthma, bronchitis and warts	Whole plant is applied externally to treat warts and other skin disorders	Watt and Breyer (1962)
Warburgia salutaris (Bertol. f.) Chiov.	Pepper-bark tree, Peperbasboom (Afr.)	Canellaceae	Bark decoctions are used in abdominal pains, constipation, diarrhoea, irritation, pneumonia, blood disorders, rheumatism and snake bite	Leaf and stalk lotion is used to treat sores and skin irritations	Hutchings (1996); Maroyi (2013)
Watsonia tabularis L.*	Bugle lily	Iridaceae	Corms are used to treat diarrhoea	Corms are used for inflammation	Hutchings et al (1996)
Withania somnifera L.	Winter cherry, Koorshout (Afr.)	Solanaceae	Leaf decoction, infusion or tincture are applied for inflammation, haemorrhoids, rheumatism	Leaves are used to heal open as well as septic and inflamed wounds	Van Wyk et al. (1997)
Ximenia americana L.	False sandalwood	Olacaceae	Stem bark is used to treat fever, stiffness, sore throats, asthma, headaches, abdominal pains, dysentery, inflamed joints and mouth ulcers	Crushed roots and sap are applied to rashes, ringworm and skin ulcers	Maikai et al. (2007); Ogunleye and Ibitoye (2003)
Xysmalobium undulatum (L.) Aiton f.	Milk bush, Melkbos (Afr.)	Apocynaceae	The entire plant part is widely used as an anti-diarrhoeal, to treat malaria, typhoid fever and skin diseases	Powdered root is used to treat wounds and abscesses	Watt (1935); Van Wyk et al. (1997)
Zantedeschia aethiopica Spreng.*	White arum lily, Wit varkoor (Afr.)	Araceae	Fresh leaves and rhizomes are used for the treatment of headaches	Leaves are applied directly to the skin to treat wounds, boils and sores	Watt and Breyer (1962)
Ziziphus mucronata Willd	Buffalo thorn, Blinkblaar-wag-n-bietjie (Afr.)	Rhamnaceae	Bark and roots decoctions are used to treat snake bite, body pains, respiratory infections, chest problems, gastrointestinal complaints, diarrhoea and dysentery	Leaf/root/bark decoctions are applied to treat boils, sores and swellings	Watt and Breyer (1962); Van Wyk et al. (2000); Van Wyk et al. (2011)

*Scientific validation of the ethnobotanical and cosmeceutical usage required. No scientific pharmacological data available in the literature.

5. Activities attributed to skin-care ethnobotanicals

In accordance with the ethnobotanical studies, the selected 117 plant species grown in South Africa are used traditionally for the treatment of several ailments including various skin disorders. They showed activities like wound healing, antioxidant, anti-inflammatory and anti-tyrosinase activities which are directly associated with skin care. **Table 2** depicts the pharmacological properties of species associated with treating skin conditions and toxicological relevance, which are explored scientifically but do require further explorations.

5.1. *Antioxidant activity*

Free radical formation is controlled naturally by various beneficial compounds known as antioxidants. Antioxidants are radical scavengers which provide protection to the human body against free radicals by inhibiting various oxidizing chain reactions. Reactive oxygen species (ROS) generated exogenously react with various biomolecules present in the skin and play important role in skin disorders (Yamakoshi et al., 2003; Singh and Agarwal, 2009). Ultraviolet radiation from sunlight is the most common exogenous factor and is harmful to the skin. The continuous exposure to various environmental factors lead to alterations in the connective tissue due to the formation of lipid peroxides, enzymes and reactive oxygen species, which results in various skin disorders (Kaur et al., 2006).

Plant extracts contain numerous naturally occurring compounds which are useful as antioxidants, range from alpha tocopherol and beta carotene to phenolic compounds (Mohamed et al., 2006). Natural antioxidants are effective in preventing free radical formation by scavenging them or promoting their decomposition and suppressing disorders. Some compounds inhibit the initiation or propagation of oxidative chain reactions, thus preventing or repairing oxidative damage done to the body's cells by oxygen (Velioglu et al., 1998). Antioxidants derived from natural sources have attracted much interest in herbal preparations for skin disorders. Most of the species listed in **Table** 2 exhibited good antioxidant activity in various assays.

5.2. *Anti-inflammatory activity*

Many environmental factors cause injuries and inflammation of the skin, especially sun light is an important factor for skin disorders such as skin cancer (Katiyar, 2005). Highly reactive oxygen species produced by several enzymatic and non-enzymatic mechanisms in the skin, due to the effect of sunburn. Skin inflammation is either acute or chronic. Acute inflammation results from exposure to UV radiation or from contact with chemical irritants while chronic inflammation results from a sustained immune cell mediated inflammatory response within the skin itself. Typical clinical signs of inflammation include redness, heat and swelling which are due to vascular alterations in the area of injury (Safayhi et al., 1992). This inflammation is long lasting and can cause significant and serious tissue destruction. A number of nuclear transcription factors are responsible for many of the regulatory functions of the inflammatory response such as interleukin-1 (IL-1), interleukin-2 (IL-2), interleukin-6 (IL-6), interleukin-8 (IL-8) and tumour necrosis factor (TNF-α).

The structural and functional diversity of phytochemicals showed unique opportunities for the development of chemotherapeutic agents for many inflammatory targets. Flavonoids such as quercetin have been shown to inhibit both phospholipase A2 and lipoxygenase enzymes which results in the inhibition of pro-inflammatory prostaglandins and leukotrienes. Many ethnobotanicals have a history of traditional use for the treatment of inflammation. A few taxa listed in **Table 2**, have been evaluated for anti-inflammatory activity and some of these showed good activity in various assays.

5.3. *Anti-tyrosinase activity*

Melanin is a pigment that is responsible for the colour of eyes, hair and skin in humans. The pigment is secreted and produced, through a physiological process called melanogenesis, by the melanocytes cells, which are distributed in the basal layer of the dermis. There are two types of melanin pigments that can be produced by the melanocyte cells, eumelanin which is black or brown, and pheomelanin which is red or yellow and

alkaline soluble. The colour of human skin and hair is determined by the type and distribution of melanin pigment. Each individual of the different racial groups have more or less the same number of melanocyte cells, thus the type of melanin produced depends on the functioning of the melanocytes *i.e.* people with darker skin are genetically programmed to constantly produce higher levels of melanin (Mapunya et al., 2011). It is formed through a series of oxidative reactions involving the amino acid tyrosine in the presence of the enzyme tyrosinase, the key enzyme in melanin biosynthesis (Halder et al., 2004).

The role of melanin is to protect the skin against UV light damage by absorbing UV sunlight and removing the reactive oxygen species. Over-activity of tyrosinase, the key enzyme in melanin biosynthesis, leads to the overproduction of melanin. There are several noteworthy tyrosinase inhibitors obtained from natural sources reported in literature which are used for depigmentation or for the disorder of hyperpigmentation of the skin. There is a variety of plant species that are used traditionally for the treatment of different skin problems. Different parts of these particular plants have been powdered and are used as face masks to remove spots and have also been used for skin lightening purposes. A few taxa listed in **Table 2**, have been evaluated for the anti-tyrosinase activity and some of these have showed good anti-tyrosinase activity. Further research on the promising plants in clinical studies will be required in order to prove their potential for skin-care formulations.

5.4. *Wound treatment*

Wounds are physical injuries which result from the opening or breaking of the skin that may cause disturbances in the normal skin anatomy and function. Wounds may also be produced by chemical, thermal, microbial or immunological assault on the skin tissue. The cellular and biochemical complex involved in treating wounds is a process of structural and functional integrity with the recovery of strength of the injured tissue. Although wound healing is a natural process that has the ability to heal on its own, for rapid healing there is a need for proper treatment for damaged tissue (Rupesh et al., 2011).

Many formulations/plant extracts/plant-derived compounds are being used for wound treatment. For example lotion made from the infusion of *Calendula officinalis* flowers in olive oil is used for skin regeneration, sunburn, bed sores and other inflammatory conditions. A preparation made from Rosemary and *Calendula* sold with the name "Paul Penders Rosemary and Calendula Cleansing Milkwork" are effective in removing surface dirt and impurities form skin. Another cream made form 22 herbs including *Calendula* with the trade name "*Levens*ESSENTIE Gold®" is used for soft and remarkably clear skin. "Kaircin" is a natural antioxidant cream made from *Crocus Sativus* under the brand name "Mother Herbs" helps to nourish skin, removes imperfections and acts against the ageing due to its anti-oxidant properties. Oil made from *Eriocephalus punctulatus* available as "Cape Camomile" contains significant amount of azulene, a known anti-inflammatory agent. Another preparation "Derma Gel Treatment" made from *Aloe ferox*, *Eriocephalus punctulatus* and *Lippia javanica* are used for the Soothing, hydrating and purifying all skin types. "Sausage Tree Cream" made from *Africana Kigelia*, is specially formulated for the treatment of skin cancer (Solar Keratoses), also effective in the treatment of psoriasis, eczema and other skin irritations. "Blue Mountain Sage" is an aromatherapy essential oil made from leaves of *Salvia stenophylla* by traditional South African methods are used to treat various skin ailments. "Elemis Maximum Moisture Day Cream", "African Botanics Pure Marula Oil" and Dr Jackson's Face Oil contains *Sclerocarya birrea* as an ingredient, claims to protect skin from cold weather, improve elasticity and reduce redness and fine lines. A formulation made by South African company from the taxa *Aspalathus linearis* under the trade name Annique®, claims retaining the beauty and vitality of skin. Annique® Products are the triple gold winner of the International Inventions Exhibition in Geneva; promote the repair mechanisms in a natural way (Kumar et al., 2007). Plant based materials are used as first aid-antiseptic coagulants and for the purpose of wound washing by South African peoples at various localities. Almost all the plants discussed in this paper are used for the treatment of wounds.

There is a possibility that some of those mentioned in table 1 and table 2 may lead to the finding of novel formulations with wound healing activity.

6. Scientifically explored plants: further exploration needed

Most of the plant species in South Africa which are used in herbal preparation for skin care and need further attention are listed in **Table 2**. These plants exhibited promising activities associated with skin ailments. Crude extracts from all the plant species which are evaluated for antioxidant, anti-inflammatory, anti-tyrosinase and wound healing activities, showed good activity in various bioassays. However, only limited scientific information has been reported for some of the species while for others no activity has been reported. Most of these species are indigenous to South Africa except, for a few that are cultivated.

There are 35 species out of the 117 which are totally unexplored, but are frequently used in the traditional system by various communities in South Africa. Therefore, these plant species need to be studied with priority. Additionally, the pharmacological properties of plant species namely, *Aloe aculeata*, *Aloe arborescens*, *Aloe ferox*, *Aloe pretoriensis*, *Aloe sessiliflora*, *Aloe vera*, *Artemisia afra*, *Calodendrum capense*, *Greyia flanaganii, Harpephyllum caffrum*, *Hyaenanche globosa*, *Leucosidea sericea*, *Sclerocarya birrea*, *Sideroxylon inerme* and *Ximenia americana* have been explored scientifically by our research group for skin hyperpigmentation problems. All plant species were investigated for their effect on tyrosinase using both L-tyrosine and L-DOPA as substrates by the standard methods (Momtaz et al., 2010; Mapunya et al. 2011; More et al., 2012). Kojic acid was used as a control drug. Final concentrations of the extract samples ranged from 3.91-500 μg/ml and Kojic acid (positive control) ranged from 3.125-400 μg/ml respectively. Antioxidant activities of these species and purified compounds were investigated using the 1,2-diphenyl-2-picrylhydrazyl (DPPH) antioxidant assay. The inhibition of tyrosinase activity relative to the inhibition of its activity at the transcriptional level was also studied by the determination of the degree of expression of mRNAs for this gene by using extract of *Sideroxylon inerme*-

treated cells (B16F10) and semi-quantitative RT-PCR. The taxa *Sclerocarya birrea*, *Greyia flanaganii* and *Sideroxylon inerme*, which showed good anti-tyrosinase activity were explored further for other pharmacological properties and for the identification of bioactive compounds.

These results *i.e.* significant tyrosinase inhibition activity, antioxidant, antibacterial activity and low toxicity as well as the presence of active phytoconstituents provides *in vitro* evidence that these plants may have strong potential for their usage for skin care. An additional five species have recently exhibited excellent pharmacological and cosmetic relevance in different bioassays (unpublished result) and are under clinical trials for skin hyperpigmentation and for the evaluation of their sun-protection factor.

Based on scientific data, species such as *Greyia flanaganii* (Greyiaceae), *Halleria lucida* (Scrophulariaceae), *Athrixia phylicoides* (Asteraceae), *Leucosidea sericea* (Rosaceae), *Trichilia emetica* (Meliaceae), *Warburgia salutaris* (Canellaceae), *Bauhinia species* (Fabaceae), *Crinum moorei* (Amaryllidaceae), *Harpephyllum caffrum* (Anacardiaceae), *Leonotis leonurus* (Lamiaceae), *Melianthus species* (Melianthaceae), *Mentha longifolia* (Lamiaceae), *Pelargonium cucullatum* (Geraniaceae), *Ziziphus mucronata* (Rhamnaceae) etc. showed promising and significant pharmacological activities, hence it should be worth exploring the potential of these plants in clinical studies which can be very helpful to take these plants to possible product level. A number of species such as African oil palm (*Elaeis guineensis*), Baobab (*Adansonia digitata*), Bitter Aloe (*Aloe ferox*), Blue Mountainsage (*Salvia stenophylla*), Cape Camomile (*Eriocephalus punctulatus*), Cape Mahogany (*Trichilia emetica*) False Sandalwood (*Ximenia Americana*), Kei Bottle Brush (*Greyia flanaganii*), Linseed oil (*Linum usitatissimum*), Manketti Tree (*Schinziophyton rautanenii*), Marula (*Sclerocarya birrea*), Rooibos Tea (*Aspalathus linearis*), Sesame oil (*Sesamum indicum*), White Milk Wood (*Sideroxylon inerme*), Wild Rosemary (*Eriocephalus africanus*), Wild Watermelon (*Citrullus lanatus*), Honeybush tea (*Cyclopia intermedia*) etc. are already one of

the ingredients of the skin care products. It will be worth exploring various relevant pharmacological activities such as antioxidant, anti-inflammatory, anti tyrosinase and wound healing activity in order to substantiate the potential usage of these products.

The toxicity of a number of species species as mentioned in table 2 such as *Aloe arborescens* (Aloaceae), *Artemisia afra* (Asteraceae), *Bauhinia species* (Fabaceae), *Harpephyllum caffrum* (Anacardiaceae), *Leucosidea sericea* (Rosaceae), *Sclerocarya birrea* (Anacardiaceae) etc. should be researched with caution as moderate toxicity was already observed in toxicity analysis conducted previously. One can conduct further additional different toxicity analysis of these plants before considering them for potential product development. The particular constituents responsible for the toxicity of the species needs to be identified. In addition, the target tissue (s) and mechanism (s) of toxicity deserve further investigations.

7. Scientifically unexplored plants: specific research needs

Almost 35 plant species marked as asterisk (*) in table 1 are totally unexplored scientifically with regard to skin care applications. These species are already being used traditionally for treating skin conditions, hence need special attention with regard to exploring for their possible potential for usage for skin care. The taxa should be studied scientifically to investigate their potential for skin care, as these plants have never been explored for antioxidant, anti-inflammatory, anti tyrosinase and wound healing activity. The data provided here in, should help provide a practical base for further scientific research on these species. The chemical and pharmacological properties of these species should be further investigated to understand their traditional use and to identify leading compounds for skin-care valuable products.

Table 2: Relevant pharmacological activities of plants grown in South Africa, which are used for skin care

Plant name	Pharmacological studies			Toxicity	Reference
	Anti-oxidant activity	Anti-inflammatory activity	Anti-tyrosinase activity		
Acokanthera oppositifolia	The methanol extract of stem ABTS assay: 99% inhibition at 0.08 mg/mL DPPH assay: 70% inhibition at 0.1 mg/mL	*	*	**	Adedapo et al. (2008a)
Adansonia digitata	Butanol extract of leaves FTC assay; 78% inhibition of lipid peroxidation at 500 µg/mL	Water extract of fruit pulp Cytokine analysis: decrease of cytokine IL-8 at 70 µg/mL	*	The methanol leaf extract MTT toxicity assay: IC_{50}; 70 µg/mL on Vero monkey kidney cells	Selvarani and Hudson (2009); Oloyede et al. (2010)
Agathosma betulina	Methanol : dichloromethane (1:1) extract of leaves DPPH assay: IC_{50}; >100 µg/mL ABTS assay: IC_{50}; 37.75 µg/mL	The essential oil of aerial parts The 5-lipoxygenase assay: IC_{50}; 50.37 µg/mL	*	Methanol : Dichloromethane (1:1) extract of leaves MTT toxicity assay: IC_{50}; 100 µg/mL on Graham cells	Moolla and Viljoen (2008); Street and Prinsloo (2013)
Aloe aculeata	*	*	The ethanol leaf extract Anti-tyrosinase assay: 31% tyrosinase inhibition at 500 µg/mL	**	Mapunya et al. (2011)
A. arborescens	*	*	NA	The ethanol leaf extract MTT toxicity assay: nontoxic up to 25 µg/mL on melanocyte cells	Mapunya et al. (2011)
Aloe ferox	50% methanol extract of the leaves DPPH assay: IC_{50}; 10.45 mg/mL	Petroleum ether extract of leaves Cyclooxygenase assay: 100% COX-1 inhibition at 0.25 µg/mL	The ethanol leaf extract Anti-tyrosinase assay: 60% tyrosinase inhibition at 500 µg/mL	**	Kambizi et al. (2007); Fawole et al. (2010)

		49.3% COX-2 inhibition at 0.25 µg/mL			
Aloe greatheadii	Leaf gel extract (LGE) and 95% aqueous ethanol leaf gel extract (ELGE) ORAC assay: LGE, 59 µmol of Trolox equivalent (TE)/g ELGE, 83 µmol of TE/g FRAP assay: LGE; 2.63 µmol/g ELGE; 8.98 µmol of/g	*	*	**	Botes et al. (2008)
Aloe pretoriensis	*	*	The ethanol leaf extract Anti-tyrosinase assay: 17% tyrosinase inhibition at 500 µg/mL	**	Mapunya et al. (2011)
Aloe sessiliflora	*	*	The ethanol leaf extract Anti-tyrosinase assay: 13% tyrosinase inhibition at 500 µg/mL	**	Mapunya et al. (2011)
Aloe vera	*	*	NA	**	Mapunya et al. (2011)
Artemisia afra	Ethanol extract of aerial parts DPPH assay: IC_{50}; 22.2 µg/mL	*	*	The ethanol extract of aerial part MTT toxicity assay: IC_{50} 16.95 µg/mL on McCoy fibroblast cell line	Burits et al. (2001); More et al. (2012)
Aspalathus linearis	The ethanol leaf extract ORAC assay: 1402 µmol of TE/g	The aqueous extract of tea (16 mg/mL) *In vivo* analysis in wister rats: after 4 week SOD increased	The ethanol leaf extract Anti-tyrosinase assay: 7% tyrosinase inhibition at 500 µg/mL	Methanol extract of aerial part Cytotoxicity of H_2O_2: no toxicity of H_2O_2 on mouse leukemic cells at 11.25 mg/mL	Momtaz et al. (2008); Marnewick et al. (2005 & 2011)
Asparagus africanus	*	Methanol root extract Rat paw oedema test: 22.3% inhibition of oedema in mice at dose of 250 mg/kg (44% at 500 mg/kg)	*	Aqueous ethanol extract of whole plant Acute toxicity assay: LD_{50}; 1264.9 mg/kg in Swiss albino mice	Hassan et al. (2012); Hassan et al. (2008)

Athrixia phylicoides	Aqueous extract of aerial part TEAC assay: TEAC content 0.269	*	*	Water extract of aerial part Brine shrimp mortality assay: LC_{50}; >1000 µg/mL	Beer et al. (2011); McGaw et al. (2007); Joubert et al. (2008)
Bauhinia bowkeri	Acidified 70% acetone leaf extract DPPH assay: IC_{50}; 19.53 µg/mL ABTS assay: IC_{50}; 14.50 µg/mL	The acetone leaf extract Cyclooxygenase assay: 41.70-71.34% COX-1 inhibition; Ranged from 65-250 µg/mL	*	The acetone extract of leaf MTT toxicity assay: not toxic up to 25 mg/mL using the Vero African green monkey kidney cell line	Ahmed et al. (2012)
Bauhinia petersiana	Acidified 70% acetone leaf extract DPPH assay: IC_{50}; 43.29 µg/mL ABTS assay: IC_{50}; 17.19 µg/mL	The acetone leaf extract Cyclooxygenase assay: 41.70-71.34% COX-1 inhibition; Ranged from 65-250 µg/mL	*	The acetone extract of leaf MTT toxicity assay: not toxic up to 25 mg/mL using the Vero African green monkey kidney cell line	Ahmed et al. (2012)
Bauhinia variegata	Acidified 70% acetone leaf extract DPPH assay: IC_{50}; 123.60 µg/mL ABTS assay: IC_{50}; 9.24 µg/mL	The acetone leaf extract Cyclooxygenase assay: 41.70-71.34% COX-1 inhibition; Ranged from 65-250 µg/mL	*	The acetone extract of leaf MTT toxicity assay: not toxic up to 25 mg/mL using the Vero African green monkey kidney cell line	Ahmed et al. (2012); Sawhney et al. (2011)
Bulbine frutescens	The water extract of leaf DPPH scavenging activity: Ranged from 0.19-0.34 mg/mL	*	*	**	Abegaz et al. (2002); Pather et al. (2011)
Calendula officinalis	Ethyl acetate fraction of methanol extract of leaves DPPH assay: IC_{50}; 0.20 µg/mL	Ethyl acetate fraction of methanol extract of leaves TPA assay: 84 % inhibition of (TPA)-induced inflammation (1 μg/ear) in mice with an ID_{50} value of 0.05-0.20 mg/ear	*	Aqueous extract of flower Acute toxicity assay: Nontoxic up to 5.0g/kg in mice	Muley et al. (2009)
Calodendrum capense	*	*	NA	*	Mapunya et al. (2011)

Carpobrotus edulis	Aqueous leaf extract DPPH assay: IC_{50}; 0.018 mg/mL ABTS assay: IC_{50}; 0.016 mg/mL Ethanol leaf extract DPPH assay: IC_{50}; 0.022 mg/mL ABTS assay: IC_{50}; 0.05 mg/mL	*	*	**	Martins et al. (2011); Omoruyi et al. (2012); Ibtissem et al. (2012)
Centella asiatica	Aqueous leaf extract DPPH assay: IC_{50}; 31.25 µg/mL	Aqueous extract of aerial part Rat paw oedema test: 46.31 % inhibition of Oedema at 100 mg/kg dose in rats	*	**	Rahman et al. (2013); George et al. (2009); Pittella et al. (2009)
Chenopodium ambrosioides	The oil from aerial part ABTS assay: IC_{50}; 3000 µg/mL	The ethanol extract of aerial part Ear-oedema assay: inhibition of ear oedema at 1% in cream	*	**	Kumar et al. (2007); Grassi et al. (2013)
Citrullus lanatus	The methanol fruit extract ABTS assay: IC_{50}; 23 mg/100g DPPH assay: IC_{50}; 32 mg/100g	Cucurbitacin E (CE) an isolated compound Cyclooxygenase assay: IC_{50} values of CE on COX-1 and COX-2 were 90 and 69 µM, respectively	*	**	Reddy et al. (2010); Abdelwahab et al. (2011)
Clausena anisata	The essential oil of leaf BHT assay: EC_{50}; 6.53 mg/L	The ethanol leaf extract Mice-paw oedema test: 71% inhibition at 450 mg/kg	*	The ethanol leaf extract Acute toxicity assay: LD_{50}; 393.7 mg/kg in albino rats	Goudoum et al. (2009); Frum (2006); Okokon et al. (2012)
Crinum moorei	The 50% Methanol extract of bulbs DPPH assay: IC_{50}; 5.06 µg/mL	The 50% Methanol extract of bulbs Cyclooxygenase assay: 95.6 % COX-1 inhibition at 21.5 µg/mL 71.6% COX-2 inhibition at 21.5 µg/mL	*	**	Fawole et al. (2010)
Crocus sativus	Methanol extract of flowers DPPH assay: IC_{50}; 1 mg/mL	The ethanol extract of stigma and petals Xylene-induced ear edema assay: 20% inhibition	Methanol extract of flowers Anti-tyrosinase assay: 10.7-28.2%	The ethanol extract of stigmas Acute toxicity assay: LD_{50}; 3.4 g/kg in mice	Sariri et al. (2011)

		at 0.32 g/kg	tyrosinase inhibition ranged from 50-1000 µg/mL		
Cucumis hirsutus	*	Petroleum ether extract of leaves Cyclooxygenase assay: 91.5 % COX-1 inhibition at 250 µg/mL 80.3% COX-2 inhibition at 250 µg/mL	*	**	Fawole et al. (2009)
Cyclopia intermedia	Ethanol/Acetone extract of processed tea TBARS assay: 63% inhibition of lipid peroxidation nmol MDA/mg protein: 3.50	*	*	Aqueous leaf extract *Salmonella typhimurium* assay: reduced mutagenesis significantly at 5%	McKay and Blumberg (2007)
Datura stramonium	Aqueous/methanol fruits extract DPPH assay: IC_{50}; >100 ppm	Aqueous and methanol extract of leaf and fruit The 5-lipoxygenase assay: IC_{50}; > 100ppm	*	**	Kumar et al. (2008); Frum (2006)
Dicoma anomala	NA	*	*	**	Steenkamp et al. (2004)
Diospyros lycioides	*	The ethanol leaf extract Cyclooxygenase assay: 90% COX-1 inhibition at 250 µg/mL 72% COX-2 inhibition at 250 µg/mL	*	**	Fawole et al. (2009)
Diospyros mespiliformis	Methanol fruits extract ABTS assay: 157.50 µmol/100g	*	*	**	Lamien-Meda et al. (2008)
Elaeis guineensis	Methanol, water and acetone extract of ripe fruits DPPH scavenging activity: Ranged from 4.41 to 6.05 g/L	*	*	**	Neo et al. (2008); Sasidharan et al. (2010)

Elephantorrhiza elephantine	*	Aqueous root extract Rat oedema assay: 93.7% inhibition at 50 mg/kg	*	Water extract of root Acute toxicity assay: Nontoxic in rats up to 1600 mg/kg body weight	Maphosa et al. (2009)
Eriocephalus africanus	Acetone leaf extract DPPH assay: IC_{50}; 47.2 µg/mL	Essential oil of aerial part The 5-lipoxygenase assay: 5-LOX IC_{50}; 32.8 µg/mL	* *	**	Njenga and Viljoen (2006)
Eriocephalus punctulatus	Acetone extract of leaf displayed DPPH scavenging activity ranged from 21.5 to 79 µg/mL	Essential oil of aerial part The 5-lipoxygenase assay: 5-LOX IC_{50}; 62 µg/mL	*	**	Njenga and Viljoen (2006)
Erythrina lysistemon	The leaf methanol extract DPPH assay: IC_{50}; 86 µg/mL	Ethanol and ethyl acetate extract Cyclooxygenase assay: 78-98% COX-1 inhibition at 500 µg/mL	*	**	Juma and Majinda (2005); Pillay et al. (2001)
Eucalyptus camaldulensis	The essential oil from aerial part DPPH scavenging activity: Ranged from 1.75-12.62 mg/mL	*	*	**	Siramon and Ohtani (2007); Miguel (2010)
Foeniculum vulgare	The water and ethanol seed extracts DPPH assay: water and methanol extract; 47.49% and 36.46% of decrease of DPPH at 250 µg, respectively	*	*	**	Adhikari et al. (2008); Oktay et al. (2003)
Greyia flanaganii	Leaf ethanol extract DPPH assay: IC_{50}; 22.01 µg/mL	*	The ethanol leaf extract Anti-tyrosinase assay: IC_{50}; 32.62 µg/mL using L-tyrosine as substrate	The ethanol leaf extract XTT assay: IC_{50}; ≥ 400 µg/mL	Mapunya et al. (2011)
Gunnera perpensa	The methanol rhizome extract DPPH assay: IC_{50}; 16 mg/L	Aqueous extract of rhizome inhibited Oedema assay: 59.2 % inhibition at 150 mg/kg	*	The methanol extract of rhizome Brine shrimp lethality test: LC_{50}; 137.62 mg/mL	Simelane et al. (2010); Nkomo et al. (2010)

Halleria lucida	The methanol leaf extract DPPH assay: IC_{50}; 8.49 µg/mL	*	*	**	Adedapo et al. (2008b); Frum et al. (2007)
Harpagophytum procumbens	The ethanol root extract FRAT assay: 47.87 % inhibition at 200 µg/mL	An aqueous extract of root Paw-edema test in rats: reduction from 7.6 mm to 6.6 mm at 800 mg/kg dose for 3 days	*	The ethanol root extract Acute toxicity assay: LD_{50}; 13.5 g/kg body weight	Georgiev et al. (2012); Brien et al. (2006)
Harpephyllum caffrum	The methanol and dichloromethane extract of stem bark DPPH scavenging activity: Ranged from 4.26 to 6.92 µg/mL	*	*	Water-methanol (1:3) leaf extract MTT toxicity assay: LC_{50}; 50 µg/mL on human keratinocyte cells	Moyo et al. (2010)
Hyaenanche globosa	The fruits ethanol extract (F.E.) TBARS assay: mean value obtained 170.7 µmol/L in treated 'Hela' cells by F.E.	*	Ethanol extract of fruit, leaves and root Anti-tyrosinase assay: fruit extract; 90.4% tyrosinase inhibition at 200 µg/mL Leaf extract; 87% tyrosinase inhibition at 200 µg/mL Root extract; 86.8% tyrosinase inhibition at 200 µg/mL	The ethanol fruit extract MTT assay: IC_{50}; 37.7 µg/mL using the HeLa cells	Momtaz et al. (2010)
Hypericum perforatum	The ethanol extract of aerial part DPPH assay: IC_{50}; 21 µg dwb/mL	Ethanol extract of aerial part Rat paw oedema assay: ED_{50}; 47.55 mg/kg	*	**	Savikin et al. (2007); Silva et al. (2005)
Kigelia africana	The water extract of leaf TBARS assay: 0.67 mg/mL	The stem bark ethanol extract Paw-oedema assay: 90% inhibition of oedema at 200 mg/kg dose after 6h	*	The methanol leaf extract Acute toxicity test: safe up to dose of 3000 mg/kg in swiss albino mice	Jackson et al. (2000); Picerno et al. (2005); Olalye & Rocha (2007)
Leonotis leonurus	Aqueous extract from leaves DPPH assay: IC_{50}; 34.21 ppm	The methanol extract of leaves The 5-lipoxygenase assay: IC_{50}; >100 ppm	*	**	Frum (2006)

Leucosidea sericea	The ethanol leaf extract DPPH assay: IC_{50}; 2.01 µg/mL	Petroleum ether extract of leaves Cyclooxygenase assay: IC_{50}; 0.06 and 12.66 µg/mL for COX-1 and COX-2	*	The ethanol leaf extract In vitro cytotoxicity assay: EC_{50}; 55.50 µg/mL in B16-F10 mouse melanocytes	Sharma et al. (2013); Aremu et al. (2010)
Lippia javanica	The ethyl acetate leaf extract ORAC assay: 908.00 µM TE/10 mg	The aqueous leaf extract The 5-lipoxygenase assay: IC_{50}; >100 ppm	*	**	Olivier et al. (2010); Pretorius (2010); Frum (2006)
Malva parviflora	The methanol leaves extract ABTS assay: 84 % inhibition at 0.2 mg/mL	*	*	**	Adedapo and Ofuegbe (2013); Farhan et al. (2012)
Melianthus comosus	The methanol extract of leaves DPPH assay: IC_{50}; 5.60 ppm	The methanol extract of leaf The 5-lipoxygenase assay: IC_{50}; 55.05 ppm	*	**	Frum (2006)
Melianthus major	Petroleum ether, ethyl acetate and methanol leaves extracts DPPH assay: IC_{50}; 28.08, 52.21 and 4.48 µg/mL, respectively	*	*	**	Srividya et al. (2010)
Mentha longifolia	Ethanol-water extract of aerial part DPPH assay: IC_{50}; 12.6 µg/mL	*	*	**	Ebrahimzadeh et al. (2010)
Olea europaea	Olive leaf methanol extract TEAC assay: 1.58 mM	*	*	**	Benavente-Garcia et al. (2000)
Pelargonium cucullatum	The methanol leaf extract DPPH assay: IC_{50}; 40.18 µg/mL	*	*	**	Saraswathi et al. (2011)
P. graveolens	The dichloromethane extract of leaves and stem DPPH scavenging activity: Ranged from 0.19 to 0.39 mg/mL	*	*	**	Cavar and Maksimovic (2012)

P. luridum	NA	*	*	**	Saraswathi et al. (2011)
P. sidoides	NA	*	*	**	Saraswathi et al. (2011)
Pentanisia prunelloides	*	The ethanol leaf extract Cyclooxygenase assay: 88% COX-1 inhibition at 0.1 mg/mL	*	The ethanol leaf extract MTT assay: No toxicity observed on monkey kidney cells up to 31.25 µg/mL	Yff et al. (2002)
Protea repens	*	NA	*	**	Fawole et al. (2009)
Protea simplex	*	Petroleum ether leaf extract Cyclooxygenase assay: 100% COX-1 inhibition at 250 µg/mL 72% COX-2 inhibition at 250 µg/mL	*	**	Fawole et al. (2009)
Rauvolfia caffra	Aqueous ethanol extracts of root DPPH assay: 80% inhibition at 0.05 mg/mL	*	*	Ethanol extract of root Brine shrimp lethality test: LC_{50}; 47.9 µg/mL	Erasto et al. (2011)
Salvia stenophylla	The methanol extract of aerial part DPPH assay: IC_{50}; 15.30 µg/mL	The methanol extract of aerial part The 5-lipoxygenase assay: IC_{50}; >100 ppm	*	The methanol extract of aerial part MTT toxicity assay: IC_{50}; 21.67 µg/mL on Graham cells	Kamatou et al. (2005)
Sansevieria hyacinthoides	The methanol leaf extract DPPH assay: 85.68% inhibition at 1000 µg/mL	*	*	The methanol leaf extract MTT toxicity assay: 92.2% cell viability at 125 µg/mL on HepG2 liver cell line	Aliero et al. (2008); Philip et al. (2011 & 2012)
Scadoxus puniceus	Ethyl acetate extract of root ABTS assay: below 50% inhibition at 0.125 mg/mL DPPH assay: below 50% inhibition at 0.125 mg/mL	The water extract of bulbs Cyclooxygenase assay: ~70% COX-1 inhibition at 2 mg/mL	*	**	Adewusi and Steenkamp (2011)
Scilla natalensis	Methanol and water extract of bulbs DPPH assay: IC_{50}; >100 ppm	Aqueous leaf extract 5-lipoxygenase assay: IC_{50}; >100 ppm	*	**	Frum (2006)

Sclerocarya birrea	Methanol extract of bark and leaves DPPH assay: IC_{50}; 5.60 µg/mL	Methanol bark extract Rat paw oedema test: significant reduction at 50-500 mg/kg	NA	Methanol stem bark extract Brine shrimp lethality assay: LD_{50}; < 5000 mg/kg body weight	Ojewole et al. (2010); Moyo et al. (2010)
Sesamum indicum	The ethanol extract of seed DPPH assay: IC_{50}; 87 µg/mL	*	*	**	Hu et al. (2004); Hsu et al. (2012)
Sideroxylon inerme	The methanol extract of stem bark DPPH assay: EC_{50}; 1.54 µg/mL	*	Methanol extract of stem bark Anti-tyrosinase assay: inhibition of monophenolase at 25µg/mL Melanogenesis assay: 37% reduction of melanin content at 6.2 µg/mL	Methanol extract of bark XTT assay: IC_{50}; 100 µg/mL in $B_{16}F_{10}$ mouse melanocyte cells	Momtaz et al. (2008)
Solanum incanum	NA	*	*	The methanol fruit extract Neutral red uptake assay: IC_{50}; 35 µg/mL using FL-cells	Al-Fatimi et al. (2007)
Sutherlandia frutescens	Ethyl acetate extract of aerial part DPPH assay: 82% inhibition at 0.5 mg/mL	Aqueous extract of aerial plant part Rat paw oedema test: significant reduction at 800 mg/kg	*	**	Katerere and Eloff (2005); Ojewole (2004)
Tecomaria capensis	*	Methanol leaves extract Paw oedema assay: significant reduction of paw oedema ranged from 100-500 mg/kg	*	The ethanol leaf extract Acute toxicity assay: Single dose safe up to 2000 mg/kg in female albino rats	Saini and Singhal (2012); Jothi et al. (2012)
Terminalia sericea	Acetone extract of stem bark DPPH assay: 93.96% inhibition at 0.2 mg/mL	*	*	**	Nkobole et al. (2011); Mochizuki and Hasegawa (2007)
Trichilia dregeana	Leaves and twigs methanol extract	An ethyl acetate leaf extract			Amoo et al. (2012)

	DPPH assay: 95.8% inhibition at 100 µg/mL	Cyclooxygenase assay: 81% COX-2 inhibition at 100 µg/mL	*	**	Eldeen et al., 2005
Trichilia emetica	The methanol leaf extract DPPH assay: IC_{50}; 17.9 µg/mL	Ethanol and aqueous leaf extracts Cyclooxygenase assay: Inhibited prostaglandin synthesis 22% and 89% at a conc. of 5mg/ml, respectively	*	Aqueous root extract MTT reduction assay: IC_{50}; >1000 mg/mL	Komane et al. (2011); Germano et al. (2006)
Warburgia salutaris	The ethanol extract of bark DPPH assay: IC_{50}; 6.59 µg/mL	Ethanol bark extract 5-lipoxygenase assay: IC_{50}; 32.11 ppm	*	**	Kuglerova et al. (2011)
Withania somnifera	*	Root powder (0.7 & 1.4 g/kg body weight/ day). 30 days treatment; decrease in lipid peroxidation	*	**	Singh et al. (2010); Tong et al. (2011)
Ximenia americana	The methanol extract of stem bark DPPH assay: RC_{50}; 82.5 µg/mL	Ethanol-water extract of root bark Rat oedema test: 12% inhibition at 10 mg/kg	NA	Aqueous ethanol root bark extract Acute toxicity assay: LD_{50}; 345 mg/kg of body weight in mice	Maikai et al. (2010); Olabissi et al. (2011)
Xysmalobium undulatum	The methanol extract of aerial part ABTS assay: 50% inhibition at 0.125 mg/mL	*	*	**	Steenkamp et al. (2004)
Ziziphus mucronata	The methanol leaf extract ABTS assay: IC_{50}; 8.12 µg/mL	*	*	**	Kwape and Chaturvedi (2012)

FRAP = Ferric reducing antioxidant power; FRAT = Ferric-reducing antioxidant power test; DPPH = 2,2-diphenylpicrylhydrazyl; ABTS = 3-ethylbenzothiazoline-6-sulfonate assays; BHT = Butyl hydroxyl toluene; TE/g = Trolox equivalent per gram; TEAC = Trolox equivalent antioxidant capacity; ROS = Reactive oxygen species; SOD = Super oxide dismutase; TBARS = Thio-barbituric acid reactive substance; iNOS = Inducible nitric oxide synthase expression; AEAC = Ascorbic acid Equivalent Antioxidant Content; MTT = 3-[4,5-dimethyl-2-thiazol-yl]-2,5-diphenyl-2H-tetrazolium bromide; LD_{50} = Lethal Dose; MIC = Minimum Inhibitory Concentration; NA = Not active; *yet to be done **Not found

8. Conclusion

The present study identified several plant species and their usage for skin care. Despite of the widespread use of plants from South Africa for skin-care, there are a very limited number of scientific studies and no clinical trials published. It is time to increase the number of scientific studies and to begin to conduct clinical studies with preparations from these taxa. Furthermore, the mechanism of action by which plant extracts and their active compounds need to be studied. In addition, the new uses of 35 species were presented. Further exploration of these preparations may lead to the discovery of novel skin care products. The ethnobotanical study showed that the use of traditional plants for skin care is still prevalent in the community especially, in the villages. The preservation of local culture, the practice of traditional medicinal plant species themselves represent important strategies for sustenance of popular knowledge of plants in the local systems of skin care.

Acknowledgement

The authors sincerely acknowledge the University of Pretoria, and National Research Foundation, South Africa for financial support.

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.

Abdelwahab, S.I., Hassan, L.E.A., Sirat, H.M., Yagi, S.M.A., Koko, W.S., Mohan, S., Taha, M.M.E., Ahmad, S., Chuen, C.S., Narrima, P., Rais, M.M., Hadi, A.H.A., 2011. Anti-inflammatory activities of cucurbitacin E isolated from *Citrullus lanatus*: Role of reactive nitrogen species and cyclooxygenase enzyme inhibition. Fitoterapia 82, 1190-1197.

Abegaz, B.M., Bezabih, M., Msuta, T., Brun, R., Menche, D., Muhlbacher, J., Bringmann, G., 2002. Gaboroquinones A and B and 4*β*-*O*-Demethylknipholone-4*β*-*O*-*α*-D-glucopyranoside, Phenylanthraquinones from the roots of *Bulbine frutescens*. Journal of Natural Products 65, 1117-1121.

Abreu, P.M., Rosa, V.S., Araujo, E.M., Canda, A.B., Kayser, O., Bindseil, K.-U., Siems, K., Seemann, A., 1998. Phytochemical analysis and antimicrobial evaluation of *Detarium microcarpum* bark extracts. Pharmaceutical and Pharmacological Letters 8, 107-109.

Aburjai, T., Natsheh, F.M., 2003. Plants used in cosmetics. Phytotherapy Research 17, 987-1000.

Adedapo, A.A., Jimoh, F.O., Afolayan, A.J., Masika, P.J., 2008a. Antioxidant activities and phenolic contents of the methanol extracts of the stems of *Acokanthera oppositifolia* and *Adenia gummifera.* BMC Complementary and Alternative Medicine 8, 54.

Adedapo, A.A., Jimoh, F.O., Koduru, S., Masika, P.J., Afolayan, A.J., 2008b. Evaluation of the medicinal potential of the methanol extracts of the leaves and stems of *Halleria lucida*. Bioresource Technology 99, 4158-4163.

Adedapo, A.A., Ofuegbe, S.O., 2013. Anti-Inflammatory and analgesic activities of soft drink leaf extract of *Phyllanthus amarus* in some laboratory animals. British Biotechnology Journal 3, 183-196.

Adewusi, E.A., Steenkamp, V., 2011. *In vitro* screening for acetylcholinesterase inhibition and antioxidant activity of medicinal plants from southern Africa. Asian Pacific Journal of Tropical Medicine 829-835.

Adhikari, A., Devkota, H.P., Takano, A., Masuda, K., Nakane, T., Basnet, P., Skalko-Basnet, N., 2008. Screening of Nepalese crude drugs traditionally used to treat hyperpigmentation: in vitro tyrosinase inhibition. International Journal of Cosmetic Science 30, 353-360.

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.

Al-Fatimi, M., Wurster, M., Schroder, G., Lindequist, U., 2007. Antioxidant, antimicrobial and cytotoxic activities of selected medicinal plants from Yemen. Journal of Ethnopharmacology 111, 657-666.

Ali, G.M., Yasumoto, S., Seki-Katsuta, M., 2007. Assessment of genetic diversity in sesame (*Sesamum indicum* L.) detected by amplified fragment length polymorphism markers. Electronic Journal of Biotechnology 10, 12-23.

Aliero, A.A., Jimoh, F.O., Afolayan, A.J., 2008. Antioxidant and antibacterial properties of *Sansevieria hyacinthoides*. International Journal of Pure and Applied Sciences 3, 103-110.

Alvarez, A.M.R., Rodriguez, M.L.G., 2000. Lipids in pharmaceutical and cosmetic preparations. Grasasy Aceites 51, 74-96.

Amoo, S.O., Aremu, A.O., Moyo, M., Van Staden, J., 2012. Antioxidant and acetylcholinesterase-inhibitory properties of long-term stored medicinal plants. BMC Complementary and Alternative Medicine 12, 87.

Anilkumar, K.R., Pal, A., Khanum, F., Bawa, A.S., 2010. Nutritional, medicinal and industrial uses of sesame (*Sesamum indicum* L.), seeds-an overview. Agriculturae Conspectus Scientificus 75, 159-168.

Anitha, T., 2012. Medicinal plants used in skin protection. Asian Journal of Pharmaceutical and Clinical Research, 5, 35-38.

Aremu, A.O., Fawole, O.A., Chukwujekwu, J.C., Light, M.E., Finnie, J.F. Van Staden J., 2010. *In vitro* antimicrobial, anthelmintic and cyclooxygenase-inhibitory activities and phytochemical analysis of *Leucosidea sericea*. Journal of Ethnopharmacology 131, 22-27.

Arnold, H.J., Gulumian, M., 1984. Pharmacopoeia of traditional medicine in Venda. Journal of Ethnopharmacology 12, 35-74.

Assimopoulou, A.N., Sinakos, Z., Papageorgiou, V.P., 2005. Radical scavenging activity of *Crocus sativus* L. extract and its bioactive constituents. Phytotherapy Research 19, 997-1000.

Babajide, O.J., Mabusela, W.T., Green, I.R., Ameer, F., Weitz, F., Iwuoha, E.I., 2010. Phytochemical screening and biological activity studies of five South African indigenous medicinal plants. Journal of Medicinal Plants Research 2, 1924-1932.

Bandyopadhyay, K., Ghosh, S., 2002. Preparation and characterization of papain-modified sesame (*Sesamum indicum* L.) protein isolates. Journal of Agriculture and Food Chemistry 50, 6854-6857.

Beer, D., Joubert, E., Malherbe, C.J., Brand, D.J., 2011. Use of countercurrent chromatography during isolation of 6-hydroxyluteolin-7-O-β-glucoside, a major antioxidant of *Athrixia phylicoides*. Journal of Chromatography A 1218, 6179-6186.

Benavente-Garcia, O., Castillo, J., Lorente, J., Ortuno, A., Rio, J.A.D., 2000. Antioxidant activity of phenolics extracted from *Olea europaea* L. leaves. Food Chemistry 68, 457-462.

Bianco, A., Scalzo, R., Scarpati, M.L., 1993. Isolation of cornoside from *Olea europaea* and its transformation in to halleridone. Phytochemistry 32, 455-457.

Botes, L., Westhuizen, F.H., Loots, D.T., 2008. Phytochemical contents and antioxidant capacities of two *Aloe greatheadii* var. *davyana* extracts. Molecules 13, 2169-2180.

Breiter, T., Laue, C., Kressel, G., Groll, S., Engelhardt, U.H., Hahn, A., 2011. Bioavailability and antioxidant potential of rooibos favonoids in humans following the consumption of different rooibos formulations. Food Chemistry 128, 338-347.

Brien, S., Lewith, G.T., Mc Gregor, G., 2006. Devil's claw (*Harpagophytum procumbens*) as a treatment for osteoarthritis: A review of efficacy and safety. The Journal of Alternative and Complementary Medicine 12, 981-993.

Burits, M., Asres, K., Bucar, F., 2001. The antioxidant activity of the essential oils of *Artemisia afra*, *Artemisia abyssinica* and *Juniperus procera*. Phytotherapy Research 15, 103-108.

Caluwe, E.D., Halamova, K., Damme, P.V., 2010. *Adansonia digitata* L -A review of traditional uses, phytochemistry and pharmacology. Afrika focus 23, 11-51.

Cavar, S., Maksimovic, M., 2012. Antioxidant activity of essential oils? and aqueous extract? of *Pelargonium graveolens* L'Her. Food Control 23, 263-267.

Chaudhari, P.M., Kawade, P.V., Funne, S.M., 2011.Cosmeceuticals-A review. International Journal of Pharmacy & Technology 3, 774-798.

Chen, W., Wyk, B.-E., Vermaak, I., Viljoen, A.M., 2012. Cape aloes- A review of the phytochemistry, pharmacology and commercialisation of *Aloe ferox*. Phytochemistry Letters 5, 1-12.

Cheng, C.L., Koo, M.W.L., 2000. Effects of *Cassia auriculata* on ethanol induced gastric mucosal lesions in rats. Life Science 67, 2647-2653.

Chinsembu, K.C., Hedimbi, M., Mukaru, W.C., 2011. Putative medicinal properties of plants from the Kavango region, Namibia. Journal of Medicinal Plants Research 5, 6787-6797.

Chivandi, E., Davidson, B.C., Erlwanger, K.H., 2008. A comparison of the lipid and fatty acid profiles from the kernels of the fruit (nuts) of *Ximenia caffra* and *Ricinodendron rautanenii* from Zimbabwe. Industrial Crops and Products 27, 29-32.

Clarkson, C., Maharaj, V.J., Crouch, N.R., Grace, O.M., Pillay, P., Matsabisa, M.G., Bhagwandin, N., Smith, P.J., Folb, P.I., 2004. In vitro antiplasmodial activity of medicinal plants native to or naturalised in South Africa. Journal of Ethnopharmacology 92, 177-191.

Codd, L.E., 1985. The genus *Ballota.* Flora of Southern Africa 28, 48-50.

Corrigan, B.M., Van Wyk, B-E., Geldenhuys, C.J., Jardine, J.M., 2011. Ethnobotanical plant uses in the KwaNibela Peninsula, St Lucia, South Africa. South African Journal of Botany 77, 346-359.

De Wet, H., Nciki, S., van Vuuren, S.F., 2013. Medicinal plants used for the treatment of various skin disorders by a rural community in northern Maputaland, South Africa Journal of Ethnobiology and Ethnomedicine 9:51.

Diallo, D., Paulsen, B.S., Liljeback, T.H.A., Michaelsen, T.E., 2003. The malian medicinal plant *Trichilia emetica*; studies on polysaccharides with complement fixing ability. Journal of Ethnopharmacology 84, 279-287.

Dubey, N.K., Kumar, R., Tripathi, P., 2004. Global promotion of herbal medicine: India's opportunity. Current Science 86, 37-41.

Duncan, G., 1998. Grow *Agapanthus*, A guide to the species, cultivation and propagation of the genus *Agapanthus*, National Botanical Institute, Trident Press, Cape Town.

Dureja, H., Kaushik, D., Gupta, M., Kumar, V., Lather, V., 2005. Cosmeceuticals: An emerging concept. Indian Journal of Pharmacology 37, 155-159.

Dweck, A.C., 2011. A data base: Article for cosmetics and toiletries magazine ethnobotanical plants from Africa part two, Research Director, Peter Black Medicare Ltd. White Horse Business Park, Aintree Avenue, Wiltshire, UK BA14 0XB.

Dyson, A., 1998. Discovering indigenous healing plants of the herb and fragrance gardens at Kirstenbosch National Botanical Garden. NBI, Cape Town.

Ebrahimzadeh, M.A., Nabavi, S.M., Nabavi, S.F., 2010. Antioxidant and antihemolytic activities of *Mentha longifolia*. Pharmacologyonline 2, 464-471.

Eldeen, I.M., Elgorashi, E.E., van Staden, J., 2005. Antibacterial, anti-inflammatory, anti-cholinesterase and mutagenic effects of extracts obtained from some trees used in South African traditional medicine. Journal of Ethnopharmacology 102, 457-464.

Eloff, J.N., 2001. Antibacterial activity of Marula (*Sclerocarya birrea* (A. rich) Hochst. subsp. *caffra* (Sond.) Kokwaro) (Anacardiaceae) bark and leaves. Journal of Ethnopharmacology 76, 305-308.

Erasto, P., Mbwambo, Z.H., Nondo, R.S.O., Lall, N., Lubschagne, A., 2011. Antimycobacterial, antioxidant activity and toxicity of extracts from the roots of *Rauvolfia vomitoria* and *R. caffra*. Spatula DD 1, 73-80.

Farhan, H., Rammal, H., Hijazi, A., Hamad, H., Daher, A., Reda, M., Badran, B., 2012. *In vitro* antioxidant activity of ethanolic and aquous extracts from crude Malva parviflora L. grown in Lebanon. Asian Journal of Pharmaceutical and Clinical Research 5, 234-238.

Fawole, O.A., Amoo, S.O., Ndhlala, A.R., Light, M.E., Finnie, J.F., Van Staden, J., 2010. Anti-inflammatory, anticholinesterase, antioxidant and phytochemical properties of medicinal plants used for pain-related ailments in South Africa. Journal of Ethnopharmacology, 127, 235-241.

Fawole, O.A., Ndhlala, A.R., Amoo, S.O., Finnie, J.F., Van Staden, J., 2009. Anti-inflammatory and phytochemical properties of twelve medicinal plants used for treating gastro-intestinal ailments in South Africa. Journal of Ethnopharmacology 123, 237-243.

Fernandes, L., van Rensburg, C.E.J., Hoosen, A.A., Steenkamp, V., 2008. In vitro activity of medicinal plants of the Venda region, South Africa, against *Trichomonas vaginalis*. South African Journal of Epidemiology Infection 23, 26-28.

Fox, F.W., Norwood, Y.M.E., 1982. Food from the veld, edible wild plants of southern Africa. Delta Books, Johannesburg.

Frum, Y., 2006. *In vitro* 5-lipoxygenase and anti-oxidant activities of South African medicinal plants commonly used topically for skin diseases, MSc. Dissertation, University of the Witwatersrand, Johannesburg.

Frum, Y., Viljoen, A.M., Van Heerden, F.R., 2007. Verbascoside and luteolin-5-O-β-D-glucoside isolated from *Halleria lucida* L. exhibit antagonistic anti-oxidant properties *in vitro*. South African Journal of Botany 73, 583-587.

Gabriel, O.A., Olubunmi, A., 2009. Comprehensive scientific demystification of *Kigelia africana*: A review. African Journal of Pure and Applied Chemistry 3,158-164.

George, M., Joseph, L., Ramaswamy., 2009. Anti-allerigic, anti-pruritic, and anti-inflammatory activities of *Centella asiatica* extracts. African Journal of Traditional, Complementary and Alternative Medicine 6, 554-559.

Georgiev, M.I., Alipieva, K., Orhan, I.E., 2012. Cholinesterases inhibitory and antioxidant activities of *Harpagophytum procumbens* from *in vitro* systems. Phytotherapy Research 26, 313-316.

Gericke, N., Van Oudtshoorn, B., Van Wyk, B., 1997. Medicinal Plants of South Africa Briza. Pretoria.

Germano, M.P., D'Angelo, V.D., Biasini, T., Sanogo, R., De Pasquale, R., Catania, S., 2006. Evaluation of the antioxidant properties and bioavailability of free and bound phenolic acids from *Trichilia emetica* Vahl. Journal of Ethnopharmacology 105, 368-373.

Germishuizen, G., Meyer, N.L., 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14, National Botanical Institute, Pretoria.

Gerstner, J., 1938. A preliminary checklist of Zulu names of plants with short notes. Bantu Studies, 12, 215-236.

Gerstner, J., 1941. A preliminary checklist of Zulu names of plants with short notes?. Bantu Studies 15, 277-383.

Glaser, D.A., 2004. Anti-aging products and cosmeceuticals. Facial Plastic Surgery Clinics of North America 12, 363-372.

Goldblatt, P., Manning, J., 2000. Cape plants, a conspectus of the Cape flora of South Africa Strelitzia 9. National Botanical Institute, Pretoria & Missouri Botanical Garden, Missouri.

Goudoum, A., Tinkeu, L.S.N., Ngassoum, M.B., Mbofung, C.M., 2009. Antioxidant activities of essential oils of *Clausena anisata* (Rutaceae) and *Plectranthus glandulosus* (Labiateae), plants used against stored grain insects in North Cameroon. International Journal of Biological and Chemical Sciences 3, 567-577.

Grassi, L.T., Malheiros, A., Meyre-Silva, C., Buss, Z.S., Monguilhott, E.D., Frode, T.S., daSilva, K.A.B.S., Souza, M.M., 2013. From popular use to pharmacological validation: A study of the anti-inflammatory, anti-nociceptive and healing effects of *Chenopodium ambrosioides* extract. Journal of Ethnopharmacology 145, 127-138.

Grierson, D.S., Afolayan, A.J., 1999. An ethnobotanical study of plants used for the treatment of wounds in the Eastern Cape, South Africa. Journal of Ethnopharmacology 67, 327-332.

Gruenwald, J., 2006. Anti-aging nutraceuticals. Food Science and Technology 20, 50-51.

Gupta, C., Goyal, S., Gupta, S., 2011. Cosmeceuticals: Beauty behind plants. Journal of Pharmacy Research 4, 56-57.

Halder, R.M., Richards, M.D., Richards, G.M., 2004. Topical agents used in the management of hyperpigmentation. Skin Therapy Letter 9, 1-3.

Hassan, H.S., Ahmadu, A.A., Hassan, A.S., 2008. Analgesic and anti-inflammatory activities of *Asparagus africanus* root extract. African Journal of Traditional, Complementary and Alternative Medicine 5, 27-31.

Hassan, H.S., Sule, M.I., Musa, A.M., Musa, K.Y., Abubakar, M.S., Hassan, A.S., 2012. Antiiinflammatory activity of crude saponin extracts from five Nigerian medicinal plants. African Journal of Traditional, Complementary and Alternative Medicine 9, 250-255.

Hassan, L.E.A., Sirat, H.M., Yagi, S.M.A., Koko, W.S., Abdelwahab, S.I., 2011. *In vitro* Antimicrobial activities of chloroformic, hexane and ethanolic extracts of *Citrullus lanatus* var. *citroides* (Wild melon). Journal of Medicinal Plants Research 5, 1338-1344.

Hein, A.J., Wicker, C.M., Palmer, C.F., 2009. Natural butters reconstituted by transesterification with glycerine and its use in cosmetic applications. Patent US 2009/0285876 A1.

Houghton, C., 1999. New natural oils and their properties. Anglia Oils Ltd., Bulk Speciality Division, Norfolk.

Hsouna, A.B., Hamdi, N., 2013. Phytochemical composition and antimicrobial activities of the essential oils and organic extracts from pelargonium graveolens growing in Tunisia. Hsouna and Hamdi Lipids in Health and Disease 11, 167-173.

Hsu, D.-Z., Chu, P.-Y., Li, M.-Y., 2012. Sesame seed (*Sesamum indicum* L.) extracts and their anti-inflammatory effect. ACS Symposium Series DOI: 10.1021/bk-2012-1093.ch019.

Hu, Q., Xu, J., Chen, S., Yang, F., 2004. Antioxidant activity of extracts of black sesame seed (*Sesamum indicum* L.) by supercritical carbon dioxide extraction. Journal of Agriculture and Food Chemistry 52, 943-947.

Hutchings, A., 1996. Zulu Medicinal Plants. University of Natal Press. Pietermaritzburg.

Hutchings, A., Scott, A.H., Lewis, G., Cunningham, A.B., 1996. Zulu Medicinal Plants. University of Natal Press, Pietermaritzburg.

Ibtissem, B., Abdelly, C., Sfar, S., 2012. Antioxidant and antibacterial properties of *Mesembryanthemum crystallinum* and *Carpobrotus edulis* extracts. Advances in Chemical Engineering and Science 2, 359-365.

Iwu, M.M., 1986. African Ethnomedicine. Second ed. SNAAP Press, Enugu, Nigeria 173.

Jackson, S.J., Houghton, P.J., Retsas, S., Photiou, A., 2000. *In vitro* cytotoxicity of Norviburtinal and Isopinnatal from *Kigelia pinnata* against cancer cell lines. Planta Medica 66, 758-761.

Jackson, W.P.U., 1990. Origins and meanings of names of South African plant genera. U.C.T. Printing Dept., Cape Town.

Jacobsen, W.B.G., 1983. The ferns and fern allies of Southern Africa. Butterworths, South Africa, pp. 284, 446, 448, 449.

Jain, A., Dubey, S., Gupta, A., Kannojia, P., Tomar, V., 2010. Potential of herbs as cosmeceuticals. International Journal of Research in Ayurveda & Pharmacy 1, 71-77.

Jarret, R.L., Levy, I.J., 2012. Oil and fatty acid contents in seed of *Citrullus lanatus* schrad. Journal of Agriculture and Food Chemistry 60, 5199-5204.

Joffe, P., 1993. The gardener's guide to South African plants. Table Mountain Publishers, Cape Town.

Joffe, P., 2003. *Creative gardening with indigenous plants.* Briza Publications, Pretoria.

Jothi, E.T., Nithya, P.D., Lakshmi, N.V., Chand, V.G., Babu, P.S., 2012. *In vitro* anti inflammatory activity of *Tecomaria Capensis* (Thunb) leaves of different extracts. Current Pharma Research 2, 524-526.

Joubert, E., Gelderblom, W.C.A., Louw, A., de Beer, D., 2008. South African herbal teas: *Aspalathus linearis*, *Cyclopia* spp. and *Athrixia phylicoides*-A review. Journal of Ethnopharmacology 119, 376-412.

Juliani, H.R., Koroch, A.R., Simon, J.E., Wamulwange, C., 2007. Mungongo cold pressed oil (*Schinziophyton rautanenii*): A new natural product with potential cosmetic applications. Acta Horticulturae 756, 407-412.

Juma, B.F., Majinda, R.R.T., 2005. Three new compounds from *Erythrina lysistemon* and their antimicrobial, radical scavenging activities and their brine shrimp lethality. 11th NAPRECA Symposium Book of Proceedings, Antananarivo, Madagascar Pages 97-109, August 9-12.

Kamatou, G.P.P., Vermaak, I., Viljoen, A.M., 2011. An updated review of *Adansonia digitata*: A commercially important African tree. South African Journal of Botany 77, 908-919.

Kamatou, G.P.P., Viljoen, A.M., Gono-Bwalya, A.B., van Zyl, R.L., van Vuuren, S.F., Lourens, A.C.U., Baser, K.H.C., Demirci, B., Lindsey, K.L., van Staden, J., Steenkamp, P., 2005. The *in vitro* pharmacological activities and a chemical investigation of three South African *Salvia* species. Journal of Ethnopharmacology 102, 382-390.

Kambizi, L., Goosen, B.M., Taylor, M.B., Afolayan, A.J., 2007. Anti-viral effects of aqueous extracts of *Aloe ferox* and *Withania somnifera* on herpes simplex virus type 1 in cell culture. South African Journal of Science 103, 359-360.

Kapoor, L.D., 2001. Hand Book of Ayurvedic Medicinal Plants, Herbal Reference Library Edition. CRC Press, New York.

Katerere, D.R., Eloff, J.N., 2005. Antibacterial and antioxidant activity of *Sutherlandia frutescens* (Fabaceae), a reputed anti-HIV/AIDS phytomedicine. Phytotherapy Research 19, 779-781.

Katiyar, C., Gupta, A., Kanjilal S, Katiyar S, 2012. Drug discovery from plant sources: An integrated approach. Ayurveda 33, 10-19.

Katiyar, S.K., 2005. Silymarin and skin cancer prevention: Anti-inflammatory, antioxidant and immunomodulatory effects (Reiev). International Journal of Oncology 26, 139-176.

Kaur, G., Jabbar, Z., Athar, M., Alam, M.S., 2006. *Punica granatum* (pomegranate) flower extract possesses potent antioxidant activity and abrogates Fe-NTA induced hepatotoxicity in mice. Food and Chemical Toxicolgy 44, 984-993.

Kazuno, S., Yanagida, M., Shindo, N., Murayama, K., 2005. Mass spectrometric identification and quantification of glycosyl flavonoids, including dihydrochalcones with neutral loss scan mode. Analytical Biochemistry 347, 182-192.

Kelmanson, J.E., Jager, A.K., van Staden, J., 2000. Zulu medicinal plants with antibacterial activity. Journal of Ethnopharmacology 69, 241-246.

Kiken, D.A., Cohen, D.E., 2002. Contact dermatitis to botanical extracts. American Journal of Contact Dermatitis 13, 148-152.

Kim, H.P., Son, K.H., Chang, H.W., Kang, S.S., 2004. Anti-inflammatory plant flavonoids and cellular action mechanisms. Journal of Pharmacological Sciences 96, 229-245.

Kirtikar, K.R., Basu, B.D., 1975. Indian Medicinal Plants, Vol. II, Periodical Experts, New Delhi, 2nd Ed.

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.

Kuglerova, M., Tesarova, H., Grade, J.T., Halamova, K., Wanyana-Maganyi, O., Damme, P.V., Kokoska, L., 2011. Antimicrobial and antioxidative effects of Ugandan medicinal barks. African Journal of Biotechnology 10, 3628-3632.

Kumar, B., Govindarajan, M., Pusphagandan ,R., 2007. Ethanopharmacological approaches to wound healing-Exploring medicinal plants of India. Journal of Ethanopharmacology 114, 103-113.

Kumar, P.S., Sucheta, S., Deepa, V.S., Selvamani, P., Latha, S., 2008. Antioxidant activity in some selected Indian medicinal plants. African Journal of Biotechnology 7, 1826-1828.

Kumaraswamy, H.M., Krishna, V., Shankar murthy, K., Rahiman, A.B., Mankani, K.L., Mahadevan, K.M., Harish, B.G., Naika, R.H., 2007. Wound healing activity of embelin isolated from the ethanol extract of leaves of *Embelia ribes* Burm. Journal of Ethnopharmacology 109, 529-534.

Kwape, T.E., Chaturvedi, P., Antiooxidant activities of leaf extracts of *Ziziphus mucronata.* International Journal of Food, Agriculture and Veterinary Sciences 2, 62-69.

Laghetti, G., Hammer, K., 2007. The Corsican citron melon [*Citrullus lanatus* (Thunb.) Matsumura & Nakai subsp. *lanatus* var. *citroides* (Bailey) Mansf. ex Greb.] a traditional and neglected crop. *Genetic Resources and Crop Evolution* 54, 913-916.

Lamien-Meda, A., Lamien, C.E., Compaore, M.M.Y., Meda, R.N.T., Kiendrebeogo, M., Zeba, B., Millogo, J.F., Nacoulma, O.G., 2008. Polyphenol content and antioxidant activity of fourteen wild edible fruits from Burkina Faso. Molecules 13, 581-594.

Lans, C., 2007. Comparison of plants used for skin and stomach problems in Trinidad and Tobago with Asian ethnomedicine. Journal of Ethnobiology and Ethnomedicine 3, 3.

Leistner, O.A., 2000. Seed plants of southern Africa: families and genera, Strelitzia 10, National Botanical Institute, Pretoria.

Lohdip, A.M., Tyonande, T.T., 2005. Analysis of *Asparagus africanus* (LAM) for some hair growth-stimulating elements. ChemClass Journal 2, 93-94.

Loots, D.T., Westhuizen, F.H., Botes, L., 2007. *Aloe ferox* leaf gel phytochemical content, antioxidant capacity, and possible health benefits. Journal of Agriculture and Food Chemistry 55, 6891-6896.

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.

Lucky, O.O., John, U.O., Kate, I.E., Peter, O.O., Jude, O.E., 2012. Quantitative determination, Metal analysis and Antiulcer evaluation of Methanol seeds extract of *Citrullus lanatu*s Thunb (Cucurbitaceae) in Rats. Asian Pacific Journal of Tropical Disease S804-S808.

Mabona, U., Viljoen, A., Shikanga, E., Marston, A., Van Vuuren, S., 2013. Antimicrobial activity of southern African medicinal plants with dermatological relevance: From an ethnopharmcological screening approach, to combination studies and the isolation of a bioactive compound. Journal of Ethnopharmacology 148, 45-55.

Maikai, V.A., Kobo, P.I., Maikai, B.V.O., 2010. Antioxidant properties of *Ximenia americana*. African Journal of Biotechnology 9, 7744-7746.

Maikai, V.A., Nok, A.J., Alawa, C.B.I., Adaudi, A.O., 2007. The effect of *Ximenia americana* in mice experimentally infected with *Trypanosoma congolense*. International Journal of Bioscience 2, 48-52.

Makunga, N.P., Philander, L.E., Smith, M., 2008. Current perspectives on an emerging formal natural products sector in South Africa. Journal of Ethnopharmacology 119, 365-375.

Maphosa, V., Masika, P.J., Moyo, B., 2009. Investigation of the anti-inflammatory and antinociceptive activities of *Elephantorrhiza elephantine* (Burch.) Skeels root extract in male rats. African Journal of Biotechnology 8, 7068-7072.

Mapunya, M.B., Hussein, A.A., Rodriguez, B., Lall, N., 2011. Tyrosinase activity of *Greyia flanaganii* (Bolus) constituents. Phytomedicine 18, 1006-1012.

Mapunya, M.B., Nikolova, R.V., Lall, N., 2012. Melanogenesis and antityrosinase activity of selected South African plants. Evidence Based Complement Alternative Medicine, Article ID 374017, P6.

Mariod, A.A., Matthaus, B., Idris, Y.M.A., Abdelwahab, S.I., 2010. Fatty acids, tocopherols, phenolics and the antimicrobial effect of *Sclerocarya birrea* kernels with different harvesting dates. Journal of the American Oil Chemists Society 87, 377-384.

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.

Marnewick, J.L., Rautenbach, F., Venter, I., Neethling, H., Blackhurst, D.M., Wolmarans, P., Macharia, M., 2011. Effects of rooibos (*Aspalathus linearis*) on oxidative stress and biochemical parameters in adults at risk for cardiovascular disease. Journal of Ethnopharmacology 133, 46-52.

Maroyi, A., 2013. *Warburgia salutaris* (Bertol. f.) Chiov.: A multi-use ethnomedicinal plant species. Journal of Medicinal Plants Research 7, 53-60.

Martins, A., Vasas, A., Viveiros, M., Molnar, J., Hohmann, J., Amaral, L., 2011. Antibacterial properties of compounds isolated from *Carpobrotus edulis*. International Journal of Antimicrobial Agents 37, 438-444.

McGaw, L.J., Steenkamp, V., Eloff, J.N., 2007. Evaluation of *Athrixia* bush tea for cytotoxicity, antioxidant activity, caffeine content and presence of pyrrolizidine alkaloids. Journal of Ethnopharmacology 110, 16-22.

McKay, D.L., Blumberg, J.B., 2007. A Review of the Bioactivity of South African Herbal Teas: Rooibos (*Aspalathus linearis*) and Honeybush (*Cyclopia intermedia*). Phytotherapy Research 21, 1-16.

Miguel, M.G., 2010. Antioxidant and anti-inflammatory activities of essential oils: A Short Review. Molecules 15, 9252-9287.

Mochizuki, M., Hasegawa, N., 2007. Anti-inflammatory effect of extract of *Terminalia sericea* roots in an experimental model of colitis. Journal of Health Science 53, 329-331.

Mohamed, I.E., El-Nur, B.E., Choudhary, M.I., Khan, S.N., 2009. Bioactive Natural Products from Two Sudanese Medicinal Plants *Diospyros mespiliformis* and *Croton zambesicus*. Records of Natural Products 3, 198-203.

Mokoka, T. A., McGaw, L. J., Eloff, J. N., 2010. Antifungal efficacy of ten selected South African plant species against *Cryptococcus neoformans*. Pharmaceutical Biology 48, 397-404.

Momtaz, S., Lall, N., Basson, A., 2008b. Inhibitory activities of mushroom tyrosine and DOPA oxidation by plant extracts. South African Journal of Botany 74, 577-582.

Momtaz, S., Mapunya, B.M., Houghton , P.J., Edgerly, C., Hussein, A., Naidoo, S., Lall, N., 2008a. 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.

Momtaz. S., Lall, N., Hussein, A., Ostad, S.N., Abdollahi, M., 2010. Investigation of the possible biological activities of a poisonous South African plant; *Hyaenanche globosa* (Euphorbiaceae). Pharmacognosy Magazine 6, 34-41.

Moolla, A., Viljoen, A.M., 2008. 'Buchu'-*Agathosma betulina* and *Agathosma crenulata* (Rutaceae): A review. Journal of Ethnopharmacology 119, 413-419.

More, G., Lall, N., Hussein, A., Tshikalange, T.E., 2012. Antimicrobial constituents of *Artemisia afra* Jacq. exWilld. against periodontal pathogens. Evidence-Based Complementary and Alternative Medicine Article ID 252758, 7p.

Mourtzinos, I., Salta, F., Yannakopoulou, K., Chiou, A., Karathanos, V.T., 2007. Encapsulation of olive leaf extract in β-Cyclodextrin. Journal of Agriculture and Food Chemistry 55, 8088-8094.

Moyo, M., Ndhlala, A.R., Finnie, J.F. Van Staden, J., 2010. Phenolic composition, antioxidant and acetylcholinesterase inhibitory activities of *Sclerocarya birrea* and *Harpephyllum caffrum* (Anacardiaceae) extracts. Food Chemistry 123, 69-76.

Mozherenkov, V.P., Shubina, L.F., 1976. Treatment of chronic conjunctivitis with *Calendula*. Medicinska Sestra 35, 33-34.

Mukul, S., Surabhi, K., Atul, N., 2011. Cosmeceutical for the skin: An overview. Asian Journal of Pharmaceutical and Clinical Research 4, 1-6.

Muley, B.P., Khadabadi, S.S., Banarase, N.B., 2009. Phytochemical constituents and pharmacological activities of *Calendula officinalis* Linn (Asteraceae): A Review. Tropical Journal of Pharmaceutical Research 8, 455-465.

Nadkarni, K.M., 1976. Indian Materia Medica, (2 vol) Popular Prakashan Publications. Ltd., Bombay.

Nakano, M., Nakashima, H., Itoh, Y., 1997. Anti-human immunodeficiency virus activity of oligosaccharides from Rooibos tea (*Aspalathus linearis*) extracts in vitro. Leukemia 11, 128-130.

Ndawonde, B.G., Zobolo, A.M., Dlamini, E.T., Siebert, S.J., 2007. A survey of plants sold by traders at Zululand muthi markets, with a view to selecting popular plant species for propagation in communal gardens. African Journal of Range and Forage Science 42, 103-107.

Ndukui, J.G., Muwonge, H., Sembajwe, L.F., 2012. Aphrodisiac potential and phytochemical profile of *Ekebergia capensis* (Cape ash) in male albino rats, Spatula DD 2, 237-243.

Neo, Y.P., Ariffin, A., Tan, C.P., Tan, Y.A., 2008. Determination of oil palm fruit phenolic compounds and their antioxidant activities using spectrophotometric methods. International Journal Food Science and Technology 43, 1832-1837.

Neuwinger, H.D., 2000. African traditional medicine, a dictionary of plant use and applications. Medpharm Scientific Publishers, Stuttgart.

Ngwenya, M.A., Koopman, A., Williams, R., 2003. Zulu Botanical Knowledge: An Introduction. National Botanical Institute, Durban.

Njenga, E.W., Viljoen, A.M., 2006. In vitro 5-lipoxygenase inhibition and anti-oxidant activity of *Eriocephalus* L. (Asteraceae) species. South African Journal of Botany 72, 637-641.

Njenga, E.W., Vuuren, S.F., Viljoen, A.M., 2005. Antimicrobial activity of *Eriocephalus* L species. South African Journal of Botany 71, 81-87.

Njume, C., Afolayan, A.J., Green, E., Ndip, R.N., 2011. Volatile compounds in the stem bark of *Sclerocarya birrea* (Anacardiaceae) possess antimicrobial activity against drug-resistant strains of Helicobacter pylori. International Journal of Antimicrobial Agents 38, 319-324.

Nkobole, N., Houghton, P.J., Hussein, A. Lall, N., 2011. Antidiabetic activity of *Terminalia sericea* Burch. ex DC constituents. Natural Product Communications 6, 3.

Nkomo, M., Nkeh-Chungag, B.N., Kambizi, L., Ndebia, E.J., Iputo, J.E., 2010. Anti-nociceptive and anti-inflammatory properties of *Gunnera perpensa* (Gunneraceae) African Journal Pharmacy and Pharmacology 4, 263-269.

Ogunleye, D.S., Ibitoye, S.F., 2003. Studies of antimicrobial activity and chemical constituents of *Ximenia americana*. Tropical Journal of Pharmaceutical Research 2, 239-241.

Ojewole, J.A.O., 2004. Analgesic, antiinflammatory and hypoglycemic effects of *Sutherlandia frutescens* R. BR. (variety Incana E. MEY.) [Fabaceae] shoot aqueous extract. Method and Findings in Experimental and Clinical Pharmacology 26, 409-416.

Ojewole, J.A.O., Mawoza, T., Chiwororo, W.D.H., Owira, P.M.O., 2010. *Sclerocarya birrea* (A. Rich) Hochst. ['Marula'] (Anacardiaceae): A review of its phytochemistry, pharmacology and toxicology and its ethnomedicinal uses. Phytotherapy Research 24, 633-639.

Okokon, J.E., Udoh, A.E., Andrew, U.E., Amazu, L.U., 2012. Antiinflammatory and antipyretic activities of *Clausena anisata.* Molecular & Clinical Pharmacology 3, 47-54.

Okoye, E.I., Onyekwelli, A.O., Ohwoavworhua, F.O., Kunle, O.O., 2009. Comparative study of some mechanical and release properties of paracetamol tablets formulated with cashew tree gum, povidone and gelatin as binders. African Journal of Biotechnology 8, 3970-3973.

Oktay, M., Gulcin, I., Kufrevioglu, O.I., 2003. Determination of in vitro antioxidant activity of fennel (*Foeniculum vulgare*) seed extracts. Lebensmittel-Wissenschaft U-Technology 36, 263-271.

Olabissi, O.A., Moussa, O., Moustapha, O., Edgard, Z.F., Eleonore, K., Marius, L., Pierre, G.I., 2011. Acute toxicity and anti-inflammatory activity of aqueous ethanol extract of root bark of *Ximenia americana* L. (Olacaceae). African Journal Pharmacy and Pharmacology 5, 806-811.

Olalye, M.T., Rocha, J.B.T., 2007. Commonly used tropical medicinal plants exhibit distinct *in vitro* antioxidant activities against hepatotoxins in rat liver. Experimental and Toxicological Pathology 58, 433-438.

Olivier, D.K., Shikanga, E.A., Combrinck, S., Krause, R.W.M., Regnier, T., Dlamini, T.P., 2010. Phenylethanoid glycosides from *Lippia javanica*. South African Journal of Botany 76, 58-63.

Oloyede, G.K., Onocha, P.A., Soyinka, J., Oguntokun, O., Thonda, E., 2010. Phytochemical screening, antimicrobial and antioxidant activities of four Nigerian medicinal plants. Annals of Biological Research 1, 114-120.

Omoruyi, B.E., Bradley, G., Afolayan, A.J., 2012. Antioxidant and phytochemical properties of *Carpobrotus edulis* (L.) bolus leaf used for the management of common infections in HIV/AIDS patients in Eastern Cape Province. BMC Complementary and Alternative Medicine 12, 215.

Palgrave, K.C., 2002. Trees of Southern Africa, In: Moll EJ, Ed. Cape Town: Struik Publishers.

Palmer, E., Pitman, N., 1972. Trees of Southern Africa, A.A. Balkema, Cape Town.

Pandey, S., Meshya, N., Viral, D., 2010. Herbs play an important role in the field of cosmetics. International Journal of PharmTech Research 2, 632-639.

Parameswaran, T.N., Kalra, A., Mehta, V.K., Radhakrishnan, K., 2000. Chemical control of tip burn and blight of scented geranium (*Pelargonium graveolens*) caused by *Colletotrichum gloeosporioides* under South Indian hill conditions. Journal of Medicinal and Aromatic Plant Science 22, 666-668.

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.

Pesewu, G.A., Cutler, R.R., Humber, D.P., 2008. Antibacterial activity of plants used in traditional medicines of Ghana with particular reference to MRSA. Journal of Ethnopharmacology 116, 102-111.

Philander, L.A., 2011. An ethnobotany of Western Cape Rasta bush medicine. Journal of Ethnopharmacology 138, 578-594.

Philip, D., Kaleena, P.K., Valivittan, K., 2011. *In vitro* cytotoxicity and anticancer activity of *Sansevieria roxburghiana*. International Journal of Current Pharmaceutical Research 3, 71-73.

Philip, D., Kaleena, P.K., Valivittan, K., 2012. Antioxidant potential of *Sansevieria roxburghiana* Schult. and Schult. F. Asian Journal of Pharmaceutical and Clinical Research 5, 166-169.

Picerno, P., Autore, G., Marzocco, S., Meloni, M., Sanogo, R., Aquino, R.P., 2005. Anti-inflammatory activity of verbinoside from *Kigelia africana* and evaluation of cutaneous irritation in cell cultures and reconstituted human epidermis. Journal of Natural Products 68, 1610-1614.

Pillay, C.C.N., Jager, 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.

Pittella, F., Dutra, R.C., Junior, D.D., Lopes, M.T.P., Barbosa, N.R., 2009. Antioxidant and cytotoxic activities of *Centella asiatica* (L) Urb. International Journal of Molecular Science 10, 3713-3721.

Pooley, E., 1993. The complete guide to trees of Natal, Zululand and Transkei, Natal Flora Publication Trust, p 240-245.

Pooley, E., 1998. A field guide to wild flowers of KwaZulu-Natal and the Eastern Region. Natal Flora Publications Trust, Durban.

Powell, E., 2001. Devil's claw, protective measures to ensure the sustainable use of *Harpagophytum procumbens*, one of South Africa's most valuable medicinal plants. Veld and Flora 87, 4:157.

Preetha, J.P., Karthika, K., 2009. Cosmeceuticals-An evolution. International Journal of Chemical and Technology Research 1, 1217-1223.

Pretorius, C., 2010. Antioxidant properties of *Lippia javanica* (Burm.f.) Spreng. M.Sc. Dissertation in Pharmaceutical Chemistry at the Potchefstroom Campus of the North-West University.

Pujol, J., 1990. Nature Africa: the herbalist handbook. Jean Pujol Natural Healers Foundation, Durban.

Rahman, M., Hossain, S., Rahaman, A., Fatima, N., Nahar, T., Uddin, B., Basunia, M.A., 2013. Antioxidant activity of *Centella asiatica* (Linn.) Urban: Impact of extraction solvent polarity. Journal of Pharmacognosy and Phytochemistry 1, 27-32.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helm, N.A., Turner, R.C., Kamundi, D.A., Manyama, P.A., 2009. Red List of South African plants, Strelitzia 25, South African National Biodiversity Institute, Pretoria.

Ramoroka, R., Mapunya, T.G., 2006. Personal Communication.

Rao, B.R., Kaul, P.N., Syamasundar, K.V., Ramesh, S., 2002. Water soluble fractions of rose-scented geranium (*Pelargonium species*) essential oil. Bioresource Technology 84, 243-246.

Reddy, C.V.K., Sreeramulu, D., Raghunath, M., 2010. Antioxidant activity of fresh and dry fruits commonly consumed in India. Food Research International 43, 285-288.

Retief, E., Herman, P.P.J., 1997. Plants of the northern provinces of South Africa: Keys and diagnostic characters. *Strelitzia* 6, National Botanical Institute, Pretoria.

Ribeiro, A., Romeiras, M.M., Tavares, J., Faria, M.T., 2010. Ethnobotanical survey in Canhane village, district of Massingir, Mozambique: medicinal plants and traditional knowledge. Journal of Ethnobiology and Ethnomedicine 6, 33.

Roberts, M., 1990. Indigenous healing plants. Southern Book Publishers, Halfway House, South Afirca.

Rupesh, T., Nitika, J., Raghvendra, P., Sardul, S., 2011. Practices in wound healing studies of plants. Evidence-Based complementary and Alternative medicine Article ID 438056.

Safayhi, H., Mack, T., Sabieraj, J., Anazodo, M.I., Subramanian, L.R., Ammon, H.P., 1992. Mechanism of anti-inflammatory actions of curcumine and boswellic acids. Journal of Pharmacology and Experimental Therapeutics 261, 1143-1146.

Saini, N.K., Singhal, M., 2012. Anti-inflammatory, analgesic and antipyretic activity of methanolic *Tecomaria capensis* leaves extract. Asian Pacific Journal of Tropical Biomedicine 2, 870-874.

Sandasi, M., Kamatou, G. P.P., Viljoen, A.M., 2011. Chemotaxonomic evidence suggests that *Eriocephalus tenuifolius* is the source of Cape chamomile oil and not *Eriocephalus punctulatus*. Biochemical Systematics and Ecology 39, 328-338.

Saral, Y., Uyar, B., Ayar, A., Nazirogly, M., 2002. Protective effects of topical alpha-tocopherol acetate on UVB irradiation in guinea pigs: importance of free radicals. Physiological Research 51, 285-290.

Saraswathi, J., Venkatesh, K., Baburao, N., Hilal, M.H., Rani, A.R., 2011. Phytopharmacological importance of *Pelargonium* species. Journal of Medicinal Plants Research 5, 2587-2598.

Sariri, R., Sabbaghzadeh, R., Poumohamad, F., 2011. *In-vitro* antioxidant and anti-tyrosinase activity of methanol extracts from *Crocus sativus* flowers. Pharmacologyonline 3, 1-11.

Sasidharan, S., Nilawatyi, R., Xavier, R., Latha, L.Y., Amala, R., 2010. Wound healing potential of *Elaeis guineensis* leaves in an infected albino rat model. Molecules 15, 3186-3199.

Sasidharan, S., Nilawatyi, R., Xavier, R., Latha, L.Y., Amala, R., 2012. Wound healing potential of *Elaeis guineensis* Jacq leaves in an infected albino rat model. Molecules 15, 3186-3199.

Savikin, K., Dobric, S., Tadic, V., Zdunic, G., 2007. Anti-inflammatory activity of ethanol extracts of *Hypericum perforatum* L., *H. barbatum* Jacq., *H. hirsutum* L., *H. richeri* Vill. and *H. androsaemum* L. in rats. Phytotherapy Research 21, 176-180.

Sawhney, S.S., Mir, M.A., Kumar, S., 2011. Phytochemical screening and antioxidant properties of *Bauhinia variegata* (bark). Journal of Pharmaceutical Science and Technology 3, 645-650.

Schmidt, E., Lotter, M., McCleland, W., 2002. Trees and shrubs of Mpumalanga and Kruger National Park. Jacana, Johannesburg.

Selvarani, V., Hudson, J.B., 2009. Multiple inflammatory and antiviral activities in *Adansonia digitata* (Baobab) leaves, fruits and seeds. Journal of Medicinal Plants Research 3, 576-582.

Sharma, R., Kishore, N., Hussein, A., Lall, N., 2014. The potential of *Leucosidea sericea* against *Propionibacterium acnes*. Phytochemistry Letters 7, 124-129.

Shivanand, P., Nilam, M., Viral, D., 2010. Herbs play an important role in the field of cosmetics. International Journal of PharmTech Research 2, 632-639.

Silva, B.A., Ferreres, F., Malva, J.O., Dias, A.C.P., 2005. Phytochemical and antioxidant characterization of *Hypericum perforatum* alcoholic extracts. Food Chemistry 90, 157-167.

Simelane, M.B.C., Lawal, O.A., Djarova, T.G., Opoku, A.R., 2010. *In vitro* antioxidant and cytotoxic activity of *Gunnera perpensa* L. (Gunneraceae) from South Africa. Journal of Medicinal Plants Research 4, 2181-2188.

Simpson, D., 1998. Buchu-South Africa's amazing herbal remedy. Scott. Med J 43, 189-191.

Singh, G., Sharma, P.K., Dudhe, R., Singh, S., 2010. Biological activities of *Withania somnifera*. Annals of Biological Research 1, 56-63.

Singh, R.P., Agarwal, R., 2009. Cosmeceuticals and Silibinin. Clinics in Dermatology 27, 479-484.

Siramon, P., Ohtani, Y., 2007. Anti-oxidative and antiradical activities of *Eucalyptus camaldulensis* leaf oils from Thailand. Journal of Wood Science 53, 498-504.

Smith, A., 1895. A contribution to the South African material medica, Third ed. Lovedale, South Africa.

Smith, C.A., 1966. Common names of South African plants. Memoirs of the Botanical Survey of South Africa No. 35. Department of Agricultural Technical Services, Pretoria.

Srividya, A.R., Sumithra, G.S., 2010. Antioxidant, antimicrobial and cytotoxic property of *Melianthus major* leaves. Journal of Global Pharma Technology 2, 94-97.

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 95, 353-357.

Steyn, E.M.A., Robbertse, P.J., Van Wyk, A.E., 1987. Floral development in *Greyia flanaganii* with notes on inflorescence initiation and sympodial branching. South African Journal of Botany 53, 194-201.

Street, R.A., Prinsloo, G., 2013. Commercially important medicinal plants of South Africa: A review. Journal of Chemistry 2013, 1-16.

Tahir, N.I., Shaari, K., Abas, F., Parveez, G.K.A., Ishak, Z., Ramli, U.S., 2012. Characterization of apigenin and luteolin derivatives from oil palm (*Elaeis guineensis* Jacq.) leaf using LC-ESI-MS/MS. Journal of Agriculture and Food Chemistry 60, 11201-11210.

Tong, X., Zhang, H., Timmermann, B.N., 2011. Chlorinated withanolides from *Withania somnifera*. Phytochemistry Letters 4, 411-414.

Van der Lugt, J.J., Schultz, R.A., Fourie, N., Hon, L.J., Jordaan, P., Labuschagne, L., 1992. *Galenia africana* L. poisoning in sheep and goats: hepatic and cardiac changes. Journal of Veterinary Research 59, 323-333.

Van der Walt, J.J.A., 1977. Pelargoniums of Southern Africa. Purnell, Cape Town.

Van der Walt, J.J.A., Vorster, P.J., 1988. *Pelargoniums of Southern Africa*, Vol. 3. National Botanical Gardens: Cape Town.

Van Rooyen, G., Steyn, H., 1999. Cederberg, Clanwilliam and Bieudow Valley. South African *Wild Flower Guide* 10. Botanical Society of South Africa, Cape Town.

Van Wyk, B., Malan, S., 1988. Field guide to the wild flowers of Witwatersrand and Pretoria region. Struik, Cape Town.

Van Wyk, B., Smith, G., 1996. Guide to the aloes of South Africa. Briza Publications, Pretoria.

Van Wyk, B., Van Wyk, P., 1997. Field guide to trees of southern Africa. Struik, Cape Town.

Van Wyk, B., Van Wyk, P., Van Wyk, B.E., 2011. Photo guide to trees of Southern Africa. Briza, South Africa.

Van Wyk, B.E., 2008. A review of Khoi-San and Cape Dutch medical ethnobotany. Journal of Ethnopharmacology 119, 331-341.

Van Wyk, B.-E., De Wet, H., Van Heerden, F.R., 2008. An ethnobotanical survey of medicinal plants in south-eastern Karoo, South Africa. South African Journal of Botany 74, 696-704.

Van Wyk, B.E., Gericke, N., 2000. People's plants, A guide to useful plants of Southern Africa. p. 218-219, Briza, Pretoria, South Africa.

Van Wyk, B.E., van Oudtshoom, B., Gericke, N., 2000. Medicinal plants of South Africa 2nd ed. Pretoria: Briza Publication; p. 146.

Van Wyk, B.E., Van Oudtshoorn, B., Gericke, N., 1997. Medicinal plants of South Africa. Briza Publications, Pretoria, South Africa.

Van Wyk, B.E., Van Oudtshoorn, B., Gericke, N., 2009. Medicinal plants of South Africa, Second edition, Briza Publications, Pretoria.

Van Wyk, B.-E., Viljoen, A., 2011. Special issue on Economic Botany, South African Journal of Botany 77, 809-1012.

Velioglu, Y.S., Mazza, G., Gao, L., Oomah, B.D., 1998. Antioxidant activity and total phenolics in selected fruits, vegetables, and grain products. Journal of Agricultural and Food Chemistry 46, 4113-4117.

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.

Von Koenen, E.M., 1996. Medicinal Poisonous and Edible Plants in Namibia. Klaus Hess, Windhoek and Gottingen.

Warra, A.A., 2012. Sesame (*Sesamum Indicum* L.) seed oil methods of extraction and its prospects in cosmetic industry: A review. Bayero Journal of Pure and Applied Sciences 4, 164-168.

Watt, J.M., 1935. The uses and actions of *Xysmalobium undulatum* R.Br. South African Journal of Medicine and Science I, September.

Watt, J.M., Breyer, B.M.G., 1962. The medicinal and poisonous plants of Southern and Eastern Africa, 2nd ed. Livingstone, London.

Welford, L., Jara, M.E.A., Gericke. N., 2008. HerbalGram 79 includes articles on The Painted Desert: Tree of Life: The Use of Marula Oil in Southern Africa, American Botanical Council, HerbalGram 79, 32-41.

Wet, H., van Heerden, F.R., van Wyk, B.E., 2011. Alkaloidal variation in *Cissampelos Capensis* (Menispermaceae). Molecules 16, 3001-3009.

Wet, H.D., Nzama, V.N., Van Vuuren, S.F., 2012. Medicinal plants used for the treatment of sexually transmitted infections by lay people in northern Maputaland, KwaZulu-Natal Province, South Africa. South African Journal of Botany 78, 12-20.

WHO, 2012. http://www.who.int/violence_injury_prevention/other_injury/burns/en/ Violence and injury prevention.

Yagi, A., Takeo, S., 2003. Anti-inflammatory constituents, aloesin and aloemannan in *Aloe* species and effects of tanshinon VI in Salvia miltiorrhiza on heart. Yakugaku Zasshi 123, 517-532.

Yamakoshi, J., Otsuka, F., Sano, A., Tokutake, S., Saito, M., Kikuchi, M., Kubota, Y., 2003. Lightening effect on ultraviolet-induced pigmentation of guinea pig skin by oral administration of a Proanthocyanidin rich extract from grape seeds. Pigment Cell Research 16, 629-638.

Yativ, M., Harary, I., Wolf, S., 2010. Sucrose accumulation in watermelon fruits: Genetic variation and biochemical analysis. Journal of Plant Physiology 167, 589-596.

Yff, B.T.S., Lindsey, K.L., Taylor, M.B., Erasmus, D.G., Jager, A.K., 2002. The pharmacological screening of *Pentanisia prunelloides* and the isolation of the antibacterial compound palmitic acid. Journal of Ethnopharmacology 79, 101-107.

Zainol, M.K., Abd-Hamid, A., Yusof, S., Muse, R., 2003. Antioxidative activity and total phenolic compounds of leaf, root and petiole of four accessions of *Centella asiatica* (L.) Urban. Food Chemistry 81, 575-581.

Zhang, H., Miao, H., Wang, L., Qu, L., Liu, H., Wang, Q., Yue, M., 2013. Genome sequencing of the important oilseed crop *Sesamum indicum* L. Genome Biology 14, 401-409.

Zimba, N., Wren, S., Stucki, A., 2005. Three major tree nut oils of southern central Africa: their uses and future as commercial base oils. International Journal of Aromatherapy 15, 177-182.