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REVIEW ARTICLE

# Plant species used in the treatment of diabetes by South African traditional healers: An inventory

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## Abstract

The indigenous people of southern Africa have a long history of traditional plant usage for medicinal purposes, with about 4,000 taxa being so employed. Traditional medicines continue to play a significant role in the treatment of life-threatening diseases such as malaria, tuberculosis, diabetes and AIDS in the developing world, although no adequate scientific evidence has been documented in support of their healing properties. The primary goal of this paper is to summarize information on some of the plant species used by traditional healers for the treatment of diabetes in South Africa. The information obtained is from published literature as well as personal communication with various traditional healers and herbalists from different areas. In total, the information of 32 plant species, representing 20 families, traditionally used by healers in the treatment of diabetes, has been discussed, of which 14 are currently being investigated for their hypoglycemic activity by various scientists at the University of Pretoria.

**Keywords:** Diabetes; herbalists; plants; South Africa; traditional healers

**Abbreviations:** E – English; A – Afrikaans; Z – Zulu; V – Venda; K – Khoi; Xh – Xhosa; Ts – Tswana; Sd – Swati; Sh – Shona; So – Sotho; Sp – Spanish; Ki – Kikuyu; Th – Tshonga; NS – North Sotho

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## Introduction

Most African countries are undergoing a demographic transition and are increasingly coming under western influences, leading to the adoption of a cosmopolitan lifestyle and a western food culture, thus giving rise to an increase in the consumption of fat, sugar and salt. Rural African societies have maintained their traditional diet. However, an increase in nutritional deficiencies has occurred which appears to be related to drought, poverty, war and socioeconomic deprivation rather than culture or religion. These lifestyle changes and a rapid increase in the urban population of Africa have led to an increase in nutritional deficiencies and, subsequently, a rise in the occurrence of diabetes mellitus (Mbanya & Gwangwa, 1997).

Diabetes mellitus is a common endocrine disorder, and affects more than 100 million people worldwide (World Health Organization, 1994). It is recognized as being a syndrome, a collection of disorders that have hyperglycemia and glucose intolerance as hallmark, due

either to insulin deficiency or to impaired effectiveness of insulin's action, or a combination of both.

Ethnopharmacological studies can contribute greatly to modern medicine, and can lead to the discovery of many novel and useful drugs, although the modern and traditional uses may be entirely different (Holmstedt & Bruhn, 1995). The identification of biologically active compounds needs to be interpreted in the light of the traditional use and preparation of the plant (Holmstedt & Bruhn, 1995). This should comprise a chemical and pharmacological evaluation of the traditional drug preparation in order to establish dose–effect relationships for the quantitative use of the remedy.

The use of plants as medicine goes back to early man. Certainly, the great civilizations of the ancient Chinese, Indians, and Egyptians provided written evidence of man's ingenuity in utilizing plants for the treatment of a wide variety of diseases.

It was not until the nineteenth century that man began to isolate the active compounds of medicinal plants, and one particular landmark was the discovery

of quinine from *Cinchona* bark by the French scientists Caventou and Pelletier. Such discoveries led to an interest in plants from the New World and expeditions scoured the almost impenetrable jungles in the quest for new medicines (Phillipson, 2001).

Prior to World War II, a series of natural products isolated from higher plants became clinical agents and a number are still in use today, such as morphine, codeine, digoxin, atropine, and hyoscyne. The antibiotic era dawned during and after World War II, with the discovery of the antibacterial effects of a whole series of natural products isolated from species of *Penicillium*, *Cephalosporium*, and *Streptomyces*. In the post-war years there were relatively few discoveries of new drugs from higher plants. Despite the discoveries of reserpine and vincristine, the impact of phytochemistry on new drug development waned and inevitably the innovative pharmaceutical industry turned to synthetic chemicals (Phillipson, 2001). During recent years, the attention of the pharmaceutical industry has switched once more to the natural world and this is illustrated by the development of three clinical drugs: taxol, etoposide, and artemisinin (Phillipson, 1999).

## Ethnobotany in South Africa

The indigenous people of southern Africa have a long history of traditional plant usage for medicinal purposes, with about 4,000 taxa being so employed. The trade in medicinal plants is an important part of the regional economy with over 700 plant species being reported as traded (Mander, 1998). In South Africa, it is estimated that there are 27 million consumers of traditional medicine (Mulholland & Drewes, 2004).

The value of trade in ethnomedicinal plants in KwaZulu-Natal alone was estimated to be worth R60 million in 1998. Most households spend between 4% and 8% of their annual income on traditional medicinal services. In addition, in KwaZulu-Natal, between 20,000 and 30,000 people derive an income from trading indigenous plants (Mulholland & Drewes, 2004).

The use of plants in traditional medicine finds its natural expression and further development in primary healthcare. Current estimates suggest that in many developing countries a large proportion of the population relies heavily on traditional practitioners and medicinal plants to meet primary healthcare needs. Although modern medicine may be available in these countries, herbal medicine has often maintained popularity for historical and cultural reasons. Traditional medicines also continue to play a significant role in the treatment of life-threatening diseases such as malaria, tuberculosis and AIDS in the developing world, although no adequate scientific evidence has been documented in support of their healing properties.

The primary goal of this paper is to summarize information on some of the plants used by traditional healers and herbalists for the treatment of diabetes in South Africa. The information obtained is from published literature as well as personal communication with various traditional healers from different areas. The traditional healers and herbalists interviewed were recommended by health-care professionals and local community workers active in the respective areas. Plant material was authenticated by M. Nel and A.E. van Wyk at the H.G.W.J. Schweickert Herbarium, University of Pretoria, where voucher specimens are being kept. In total, the information of 32 plant species representing 20 families traditionally used by healers in the treatment of diabetes is discussed.

## Plant material

### *Elaeodendron transvaalense*

*Elaeodendron transvaalense* (Burt Davy) R.H. Archer (Celastraceae); common names: Transvaal saffronwood (English (E)), Transvaalsafraan (Afrikaans (A)), ingwavuma (Zulu (Z)), mukuvhazwivhi (Venda (V)). Plant parts used: bark.

### Description

This is a shrub or small multi-branched tree, usually around 5 m tall but may reach 10 m or more. The bark is smooth and has a characteristic pale, gray color. Tufts of leaves are crowded on the ends of rigid shoots. The leaves are oblong in shape with a firm texture and conspicuous venation on the upper and lower surfaces. The leaf margin is sometimes toothed. Small and inconspicuous greenish flowers are produced in summer, followed by oblong, yellow to dark orange, edible berry-like fruits (Coates Palgrave, 1984). The species is widely distributed in the northeastern parts of South Africa. It occurs along the coastal parts of KwaZulu-Natal and in Mpumalanga, Gauteng, and Limpopo.

### Medicinal use

An infusion of the bark is taken as a stomach cleanser and used as an enema for stomach aches and fever and to treat intestinal cramps and diarrhea. The leaves are chewed and the juices swallowed for a sore throat (Van Wyk et al., 2005). A teaspoon of powdered bark is boiled in water and no more than two cups are taken per day (Pujol, 1990). The powdered bark may also be licked from the palm of the hand, and washed down with a small amount of water. The bark is known to be toxic so the dosage should be carefully controlled. The species is used for the treatment of diabetes by local herbalists and traditional healers in the Venda region, Limpopo (Emmanuel Tshikalange, University of Pretoria, personal communication).

### Phytochemistry/bioactivity

The beneficial effects of the bark have been ascribed to its high tannin content (Frost, 1941). A phenolic compound, elaeocyanidin, has been isolated from both *Elaeodendron transvaalense* and *Elaeodendron croceum* (Thunb.) DC. (Drewes & Mashimbye, 1993). The latter species also contains gallotannins and ouratea proanthocyanidin A, and it is likely that these or similar compounds will be present in *E. transvaalense*, together with the reported triterpenoids (Drewes & Mashimbye, 1993). Tannins are sometimes used for their astringent and antidiarrheal properties (Bruneton, 1995). The activity for stomach ailments by *E. transvaalense* and *E. croceum* bark can at least partly be explained by the presence of these phenolic compounds and tannins (Van Wyk et al., 2005).

### *Euclea undulata*

*Euclea undulata* Thunb. (Ebenaceae); common names: guarrie (Khoi (K)), common guarri (E), gewone ghwarrie (A) umgwali (Xhosa (Xh)) mokoerekoere (Tswana (Ts)); gwanxe, inkunzane; umshekizane; umbophanyamazane (Z); inhlangula (Swati (Sd)), chizuzu (Shona (Sh)), mokwere kwere (Sotho (So)). Plant parts used: roots.

### Description

A dense, erect, twiggy, evergreen dioecious shrub or small tree. The leaves are alternate or arranged in pseudowhorls, crowded at the ends of the branches. The leaves are small, obovate to narrow elliptic, leathery, yellowish green to dark green or blue-green above and paler green below, sometimes rusty-brown due to glands dotted over the surface. The flowers are small and whitish in auxiliary raceme-like sprays up to 2 cm long. The fruit is spherical, thinly fleshed, reddish brown becoming black when mature (Coates Palgrave, 1984). The species occurs widespread on rocky slopes in all provinces except the Free State; *Euclea undulata* var. *undulata* occurs from Worcester in the Western Cape Province to Komga in the Eastern Cape while *Euclea undulata* var. *myrtina* (small leaved guarrie) is found in Namibia, Limpopo and into KwaZulu-Natal, Mpumalanga and Swaziland.

### Medicinal use

The plant is an old-fashioned Cape remedy for heart disease and the powdered bark is a Southern Sotho headache remedy. An infusion of the root bark is said to be a purgative. It is also reported that the root is used in South Africa as a remedy for toothache and other pains (Watt & Breyer-Brandwijk, 1962). Leaf preparations are taken orally in the Western Cape to treat diarrhea and disorders of the stomach, and as a gargle to relieve tonsillitis. Elsewhere in the country root infusions are used as enemata or as an ingredient of *inembe* (medication taken

regularly during pregnancy to ensure a trouble-free confinement). Root preparations are used to induce emesis or purgation (South African National Biodiversity Institute et al., 2005). Herbalists and traditional healers in the Venda region, Limpopo, make use of *Euclea undulata* to treat diabetes (Tshikalange, personal communication).

### Phytochemistry/bioactivity

Studies on the phytochemistry of *Euclea* species have identified triterpenoids and aliphatics in the branches and leaves (Costa et al., 1978) and naphthoquinones in root, stem and fruit (Van der Vyver & Gerritsma, 1973, 1974). In the *Euclea undulata* Herba study, the naphthoquinones 7-methyl-juglone and diospyrin were isolated from the roots, and isodiospyrin from the fruits of *Euclea undulata* var. *myrtina*. Stems appeared to be devoid of naphthoquinones. The leaves were not included in the latter survey. Chemical tests indicated the presence, in leaves and stems, of tannins, saponins and reducing sugars, but not of alkaloids or anthraquinones or cardiac glycosides. Bark is reported to contain 3.26% tannin (South African National Biodiversity Institute et al., 2005).

*In vitro* antimicrobial activity against *Staphylococcus aureus* was demonstrated by aqueous extracts prepared from dried leaf material at a concentration of 40 mg/mL. This result, together with the demonstrated presence of tannins in the leaves of this species, supports its use as an anti-diarrheal and for the relief of tonsillitis. No activity against *Pseudomonas aeruginosa*, *Candida albicans*, or *Mycobacterium smegmatis* was found in preliminary tests (South African National Biodiversity Institute et al., 2005). According to Van Wyk et al. (2005) the active ingredients of *Euclea undulata* roots are the two naphthoquinones, diospyrin, and 7-methyl-juglone.

As both anti-diarrheal and purgative actions are reported for this species, dosage and method of preparation require standardization. Its use as an anti-diarrheal by pregnant women and children is not recommended.

### *Euclea natalensis*

*Euclea natalensis* A.DC. (Ebenaceae); common names: Natal guarri (E), Natalghwarrie (A) mutanqule (V). Plant parts used: bark and root (Van Wyk & Van Wyk, 1997).

### Description

A shrub or small to medium-sized tree with a somewhat spreading crown. The leaves are elliptic to obovate-oblong, tough and leathery, glossy dark green above and densely covered with pale rusty woolly hairs below. The flowers are borne in dense, branched, auxiliary heads, are small greenish white to cream in color and sweetly scented. The fruit is a spherical berry, red becoming black when mature (Van Wyk & Van Wyk, 1997). It occurs from coastal dune bush to about 1,000 m above sea level in a

variety of habitats from dry arid areas to open woodland and riverine fringes. It is also common among rocks and on koppies (hillocks) (Coates Palgrave, 1984).

#### Medicinal use

An infusion of *Euclea natalensis* is used by the Zulu people as a purgative and for abdominal complaints, but is liable to produce emesis. The plant is thought to be poisonous but is an ingredient in a Zulu scrofula remedy (Watt & Breyer-Brandwijk, 1962). Among the Shangaan the charred and powdered root is applied to skin lesions in leprosy and taken internally for ancylostomiasis. The Tonga apply the powdered root for the relief of toothache and headache (Watt & Breyer-Brandwijk, 1962). Van Wyk and Van Wyk (1997) also report medicinal usage and that the twigs are used for toothbrushes. In the Venda region *Euclea natalensis* is used to treat diabetes by herbalists and traditional healers (Tshikalange, personal communication).

#### Phytochemistry/bioactivity

According to the literature, the following compounds were isolated from *Euclea natalensis*: natalenone (Ferreira et al., 1977); diospyrin, 7-methyl-juglone, euclein (Van der Vyver & Gerritsma, 1974; Lall & Meyer, 1999, 2001); isodiospyrin, mamegaquinones, BN-quinones, 8,8-dihydroxy-4,40 dimethoxy-6,6-dimethyl-2,2-binaphthyl-1,1-quinone (Tannock, 1973) and 4,8-dihydroxy-6-methyl-1-tetralone (Khan, 1985). According to Lall and Meyer (2001), the naphthoquinones present in *Euclea natalensis* inhibit the bacteria *Mycobacterium tuberculosis*.

#### *Lannea edulis*

*Lannea edulis* (Sond.) Engl. (Anacardiaceae); common names: wild grape (E), wildedruif (A), pheho (Ts), muporotso (V), mutshutsuhgwa (V). Plant parts used: bark of the woody underground rootstock.

#### Description

A small shrublet of up to 1 m in height, with short, leafy branches developing from an underground rootstock. The compound leaves are densely hairy, particularly on the lower side. Small yellowish flowers are borne in erect clusters, followed by numerous small red to purplish-black fleshy berries (Van Wyk & Malan, 1988). It is widely distributed in the grassland areas of the summer rainfall region of South Africa (Van Wyk et al., 2005).

#### Medicinal use

Decoctions or infusions of the root bark are used to treat diarrhea. Leaf poultices or leaf infusions are sometimes applied externally to treat sore eyes, boils, and abscesses (Van Wyk et al., 2005). Herbalists and traditional healers

in Venda use *Lannea edulis* to treat diabetes (Tshikalange, personal communication).

#### Phytochemistry/bioactivity

Nothing appears to be known about the chemistry or bioactivity of *Lannea edulis* but the bark is likely to be rich in phenolic compounds and tannins (Van Wyk et al., 2005).

#### *Spirostachys africanus*

*Spirostachys africanus* Sond. (Euphorbiaceae); common names: tamboti (E), tambotie (A) muonze (V). Plant parts used: bark.

#### Description

A medium-sized deciduous tree with a rounded crown and yellow or reddish autumn colors. It contains a milky latex and the sexes are separated on the same plant. The flowers are very small and are produced in the axils of distinctive reddish bracts in slender catkin-like spikes (Coates Palgrave, 1984). The bark is dark gray to blackish and cracked in a grid like pattern. It is found in the Bushveld, usually at low altitude, on heavy soils along rivers and streams.

#### Medicinal use

Inhalation of the smoke causes headache and nausea, and food directly exposed to the smoke is said to be poisonous. The latex is toxic and may cause skin irritation (Van Wyk & Van Wyk, 1997). No evidence was found in the literature that the above mentioned plant is used by the Venda traditional healers for diabetes, although this appears to be the case (Tshikalange, personal communication).

#### Phytochemistry/bioactivity

The latex from the wood of tamboti contains diterpenes, such as stachenone, stacenol and other structurally related acid metabolites and diosphenols (Van Wyk et al., 2002).

#### *Schkuhria pinnata*

*Schkuhria pinnata* (Lam.) Cabrera (Asteraceae); common names: dwarf marigold (E), kleinkakiebos (A) canchalagua, escobilla, vassourinha, (Spain (Sp)) gakuinini (Kikuyu (Ki)). Plant parts used: whole plant.

#### Description

*Schkuhria pinnata* is a small, herbaceous plant, which was introduced from the mountainous regions of South America (Taylor, 2006). It is a common highly branched annual herb up to 60 cm tall with a deep and finely divided leaf. Flowerheads are borne in branched,



flat-topped inflorescences. The disc and ray florets are yellow. This common weed was first recorded in South Africa in 1898, when British soldiers introduced it with imported fodder for their horses (Bromilow, 1995). It occurs on cultivated lands, gardens, along roadsides, in overgrazed grasslands and wastelands (Grabandt, 1985). In South America it grows in remote places, in valleys and on slopes at 2,000 to 3,000 m above sea level (Taylor, 2006).

#### Medicinal use

Andean healers recommended its use as a way to improve and support healthy looking skin. Topically it has been used as a skin tonic, for blackheads, pimples, eye wash, wound wash, insect bites, and swellings (Taylor, 2006). Traditionally, a mild bitter tonic is prepared which is used as a blood cleanser and kidney tonic. *Schkuhria pinnata* is also used for leprosy, swelling, respiratory problems, bronchitis, fever, throat problems, as an aphrodisiac, for menstrual problems, stomach problems, headache, as a strong anti-spasmodic. Furthermore, it is said to be excellent for hypertension and nervousness, for diarrhea, venereal disease, as a diuretic, and for the treatment of diabetes. It is used to promote and support normal metabolism and blood cleansing, which can also lead to overall improvement of the skin as it is regarded as tonic for both the liver and kidneys (Taylor, 2006).

It is considered to be anti-diarrheal and anti-emetic. Antiseptic leaf decoctions are used for wounds and fever. Mixed with maternal milk, it is used as an anti-emetic for infants. Leaf decoctions are also used in antipyretic baths and in poultices for migraine and as a tea for pain and swelling. Brazilians add the root to a bath when "cleaning their blood". They apply strained leaf juice for eye ailments and to infected wounds (erysipelas). A tea can be made by steeping one or more teaspoons per cup. *Schkuhria pinnata* is used by traditional healers and herbalists in the Ga-Rankuwa area, Gauteng to treat diabetes (Sr. Lia Matibe, Medical University of South Africa, personal communication).

The common names escobilla, chanchalagu and vasourina are used for the description of concoctions of two different plant species from two separate families, *Schkuhria pinnata* and *Scoparia dulcis* L. In the literature it is not clear exactly which concoction from which plant is used for which specific ailment and if both are used for all the above mentioned ailments (Taylor, 2006).

According to Watt and Breyer-Brandwijk (1962), the powdered leaf of *Schkuhria pinnata* is swallowed with water as a remedy for malaria, influenza and for colds. The Kikuyu name implies "one with quinine", probably due to the bitter taste. It plays a significant role in the treatment of malaria in Central Kenya.

#### *Pteronia divaricata*

*Pteronia divaricata* (P.J. Bergius) Less. (Asteraceae); common names: geel gombos, geelknopbos, spalkpenbos (A). Plant parts used: whole plant.

#### Description

A twiggy, dense shrublet up to 1 m tall. The leaves are round, elliptic and velvety. Six or seven large yellow disc flower heads are clustered at the ends of the branchlets, flowering from September to November. It occurs on sandy and rocky soils from Namibia to Hopetown (Manning & Goldblatt, 2000).

#### Medicinal use

In the literature, no evidence was obtained of the medicinal uses of *Pteronia divaricata*, although some *Pteronia* species are toxic to livestock, e.g., *Pteronia pallens* L.f. (Van Wyk et al., 2000) and others do have medicinal value such as *Pteronia camphorata* (L.) L., *P. onobromoides* DC., and *P. stricta* Aiton (Watt & Breyer-Brandwijk, 1962). *Pteronia divaricata* is used to treat diabetes in the Clanwilliam area, Western Cape (Peter Maltz, traditional health practitioner, Kommetjie, Western Cape, personal communication).

#### *Ziziphus mucronata*

*Ziziphus mucronata* Willd. (Rhamnaceae); common names: buffalo-thorn (E) blinkblaarwag-'n-bietjie (A) mokgalo (North Sotho (NS)); Ts umphafa (Xh, Z) umlahlankosi (Z). Plant parts used: leaves.

#### Description

A small shrub to medium-sized tree. The leaves are ovate to broadly ovate, glossy dark green above and the lower surface slightly hairy. The base is markedly asymmetric and the margin finely toothed over the upper two-thirds. The stipules are spinescent, one hooked, the other straight, or the plant is unarmed. Flowers are in axillary clusters and are small, yellowish green. The fruit is a sub-globose drupe, shiny reddish to yellow brown (Van Wyk & Van Wyk, 1997). These trees occur in a wide variety of habitats throughout South Africa.

#### Medicinal use

According to Coates Palgrave (1984) it is used as a remedy for pain, as a poultice for the treatment of boils and other skin infections as well as for the treatment of tubercular gland swellings. It is also used by sufferers from dysentery and lumbago. The Zulu use it for the relief of chest pains and coughs (Coates Palgrave, 1984; Van Wyk & Van Wyk 1997). Warm infusions of the root, bark or leaves are taken orally as tea or decoctions are used topically to treat sores, boils and swelling (Van Wyk

et al., 2005). According to Mushtaq et al. (2007), 4-5 fresh *Ziziphus jujube* Miller leaves are plucked and washed and chewed daily by diabetics in the Attock district of Pakistan to lower blood glucose levels. According to a local herbalist in the Pilanesberg area (Grace Masuku, Saulsport, personal communication), a tea is prepared from the leaves of *Ziziphus mucronata* combined with powdered material from *Viscum* species for the treatment of diabetes.

### Phytochemistry/bioactivity

Several alkaloids, commonly referred to as peptide alkaloids are known from *Ziziphus* species such as mucronine D (Van Wyk et al., 2005). The alkaloid franguloline, is a strong sedative. It is structurally closely related to some of the alkaloids extracted from *Z. mucronata* (Van Wyk et al., 2005).

### *Aloe ferox*

*Aloe ferox* Mill. (Asphodelaceae); common names: bitter aloe (E); bitteraalwyn, Kaapse aalwyn (A); umhlaba (Xh, Z, So). Plant parts used: leaves.

### Description

*Aloe ferox* is a robust single-stemmed plant between 2 and 5 m tall. The leaves are broad and fleshy, usually a dull to grayish green with brown spines on the edges as well as on the upper and lower surfaces. The inflorescence is a raceme with bright orange-red flowers (Van Wyk & Smith, 1996). It is a widely distributed *Aloe* species occurring from the Western to the Eastern Cape provinces as well as in southern KwaZulu-Natal and the extreme southeastern parts of the Free State. It occurs in a wide range of habitats varying from mountain slopes, rocky ridges and flat open plains (Van Wyk & Smith, 1996).

### Medicinal use

An important commercial laxative but it is also used for arthritis, eczema, conjunctivitis (Watt & Breyer-Brandwijk, 1962; Bruce, 1975), hypertension and stress (Pujol, 1990). According to Van Wyk et al. (2005) a small crystal of the crude drug, about twice the size of a match head, is taken orally as a laxative, and half the dose for arthritis. The fresh bitter sap is instilled directly for conjunctivitis and sinusitis. *Aloe ferox* is also used to treat diabetes according to a well-known South African herbalist (Margaret Roberts, DeWildt, personal communication).

### Phytochemistry/bioactivity

The main purgative ingredient is anthrone C-glucoside alon (= barbalion). The wound healing properties of aloe gel are ascribed to glycoproteins. Anthraquinone derivatives act as stimulant laxatives (Bruneton, 1995).

### *Warburgia salutaris*

*Warburgia salutaris* (G.Bertol.) Chiov. (Canellaceae); common names: pepperbark tree (E); peperbasboom (A); isibhaha, amazwecehlalabayo (Z); mulanga, manaka (V); shibaha (Ts). Plant parts used: stem bark.

### Description

A slender tree between 5 and 10 m tall. The bark is rough and a rich brown color with yellow corky lenticels (Venter & Venter, 1996; Coates Palgrave, 2002). The leaves are simple and alternately arranged, elliptic to lanceolate, a dark glossy green above and a pale dull green below. The bisexual flowers can be green or white and are solitary or in flower-heads or cymes. The ten stamens are joined together to form a tube in the centre of the flower, enveloping the ovary and most of the style. The fruit is a spherical berry that turns black when mature (Coates Palgrave, 1984). It occurs in evergreen forests and wooded ravines in the northeastern areas of southern Africa (Coates Palgrave, 1984).

### Medicinal use

*Warburgia* is one of the most important medicinal plant species in southern Africa. The inner bark is reddish, bitter and peppery and has a variety of applications. It is used to treat common colds, to open sinuses, for chest complaints as well as against malaria (Coates Palgrave, 1984). According to Van Wyk and Gericke (2000) it is also used as a natural antibiotic, for venereal diseases, abdominal pain, constipation, the treatment of cancer, rheumatism, and stomach ulcers. Powdered bark decoctions and infusions are taken orally against malaria. It is also applied externally to cuts as well as on the temples for headache (Van Wyk & Gericke, 2000). It is ground and snuffed to open sinuses, chewed or smoked and inhaled for chest complaints (Coates Palgrave, 1984). It is also used to treat diabetes (Roberts, personal communication).

### Phytochemistry/bioactivity

The bark contains numerous drimane sesquiterpenoids, such as warburganal and polygodial, as well as tannins and mannitol (Watt & Breyer-Brandwijk, 1962; Van Wyk & Gericke, 2000). Warburganal and polygodial both show profound anti-candidal activity (Van Wyk & Gericke, 2000). Polygodial is potentially useful in clinical medicine as an adjustment to treatment with antibiotics and antifungals which have poor membrane permeability (Iwu, 1993). Mannitol is used against dyspepsia and as a diuretic (Bruneton, 1995). According to Hutchings et al. (1996) drimenin has insect antifeedant properties and also shows antibacterial and anti-ulcer activity (Van Wyk et al., 2005). Potential antifungal activity was exhibited by an isolated sesquiterpenoid dialdehyde (Hutchings et al.,

1996). Muzigadial, another sesquiterpenoid, is according to Rabe and Van Staden (1997, 2000) responsible for the antibacterial activity.

### *Momordica balsamina*

*Momordica balsamina* L. (Cucurbitaceae); common names: balsam pear (E), laloentjie (A), mohodu (So), nkaka (Tshonga (Th)). Plant parts used: fruit.

#### Description

Balsam pear is a perennial creeping herb with slender stems, lobed leaves and tendrils for attachment. The solitary trumpet yellow flowers are followed by pointed fruits that turn orange to red when mature. The edible seeds have bright red arils that are also considered to be edible. Leaves and young fruit are cooked and used as vegetables (Van Wyk & Gericke, 2000). Commonly found in tree savannas in sandy soils (Van Rooyen, 2001).

#### Medicinal use

*Momordica balsamina* is said to be effective in treating diabetes (Van Wyk & Gericke, 2000; Van Rooyen, 2001). Although it is used as an anti-diabetic, careful tests do not support this use. It has some hypoglycemic action when tested in rabbits, however, there is no definite assurance of insulin-like properties (BioNatural *Momordica balsamina*, 2006). *Momordica balsamina* emits a strong unpleasant smell when bruised (Watt & Breyer-Brandwijk, 1962). A liniment, made by infusing the fruit (minus the seed) in olive oil or almond oil, is used as an application to chapped hands, burns and hemorrhoids and the mashed fruit is used as a poultice. An extract has been administered for the relief of dropsy. The plant is much used in West Africa as a medicine in both man and horse, particularly as a bitter stomachic, as a wash for fever and for yaws, and as a purgative (Watt & Breyer-Brandwijk, 1962). The fruit pulp, mixed with oil, is used as an antiphlogistic dressing. The root is used as an ingredient in an aphrodisiac or with the seeds and fruit as an abortifacient and in the treatment of urethral discharge. Among the Pedi the fruit is believed to be deadly poisonous and this view is supported by the report that a few drachms of it, given to a dog, is fatal, death being due to violent vomiting and purging (Watt & Breyer-Brandwijk, 1962). The Shangaan prepare tea from the leaves as a blood purifier and for liver deficiencies. In dry seasons, postnatal mothers eat the leaves to stimulate milk production (*Momordica balsamina*, 2006). One small cup of fresh *Momordica charantia* L. fruit juice daily is used to lower blood glucose levels in the Attock district in Pakistan. It is also taken in the form of a tea for various other ailments (Mushtaq et al., 2007).

### Phytochemistry/bioactivity

*Momordica balsamina* contains a bitter principle, momordocin and two resin acids. The plant also contains a highly aromatic volatile oil, a fixed oil, carotene, a resin and two alkaloids, one of which is a saponin. Momordocin is an amaroid obtained as a crystalline powder. A leaf extract has shown positive antibiotic properties to the pathogens against which it has been tested. An infusion of the plant has shown mild, but inconsistent, anti-malarial effects hence the use of this plant by the Portuguese for “paludismo” or sometimes referred to as “yellow fever tree sickness” (Mushtaq et al., 2007).

### *Kedrostis nana*

*Kedrostis nana* (Lam.) Cogn (Cucurbitaceae); common names: ystervarkpatat (A). Plant parts used: underground tuber.

#### Description

A tuberous climber with annual stems that attach to their support by tendrils. The leaves are alternate, lobed and shining dark green (Manning & Goldblatt, 2000). It has a strong odor of carbon bisulphide (Watt & Breyer-Brandwijk, 1962). The greenish-yellow flowers are unisexual and borne on separate plants during February and March. The male flowers are in short clusters whereas the female flowers are solitary. The flowers are followed by fleshy, yellow-orange fruit (Manning & Goldblatt, 2000). *Kedrostis nana* is frequently found among bushes at low altitudes, especially near the sea from the Western Cape to KwaZulu-Natal (Manning & Goldblatt, 2000).

#### Medicinal use

The tuber is used as a cleansing emetic, and as a laxative. An infusion mixed with honey is taken for hemorrhoids. Infusions are used for diabetes and cancer, and used in low doses for diarrhea. A decoction of baked tuber, combined with *Dicerotheramnus rhinocerotis* (L.f.) Koekemoer is taken as a contraceptive (Rood, 1994) and it may have an abortifacient action, since *Kedrostis gijef* (J.F.Gmel.) C. Jeffrey has been reported to cause abortion in goats (Hutchings et al., 1996). *Kedrostis nana* has been found experimentally to produce a severe type of irritant poisoning in sheep and rabbits. The runners and roots are poisonous to sheep and rabbits, producing nausea, vomiting and diarrhea, and death after large doses from respiratory paralysis. The early colonists of the Cape used the roots of *Kedrostis nana* var. *latiloba* as an emetic, and an infusion in wine or brandy was used as a purgative (Watt & Breyer-Brandwijk, 1962).



***Artemisia afra***

*Artemisia afra* Jacq. Ex. Willd. (Asteraceae); common names: umhlonyane (Xh, Z) lengana (So, Ts), als, wildeals (A), African wormwood (E). Plant parts used: leaves.

**Description**

A highly aromatic, perennial, erect shrub of up to 2 m in height. The leaves are finely divided and have a silver-grayish green color due to the presence of fine hairs. The flowers are inconspicuous, yellow, and borne at the ends of branches in globose capitula (Hilliard, 1977). It occurs widespread in all provinces of South Africa, with the exception of the Northern Cape, also in Lesotho, Swaziland, and northwards into tropical Africa, usually in mountain habitats along forest margins and stream-sides (Hilliard, 1977).

**Medicinal use**

*Artemisia afra* is one of the most widely used traditional medicines in South Africa, mainly used for the treatment of coughs, croup, whooping cough, influenza, fever, diabetes, gastro-intestinal disorders and intestinal worms. It is also used as an inhalation for the relief of headache and nasal congestion, or as a lotion to treat hemorrhoids (Van Wyk et al., 2005). In traditional practice a fresh leaf is inserted into the nostril to relieve nasal congestion or placed in boiling water as a steam bath for menstrual pain or after child birth. Warmed leaves may be applied externally as a poultice to relieve inflammation and aqueous infusions are administered per rectum or applied as a lotion to treat hemorrhoids (South African National Biodiversity Institute et al., 2006a). *Artemisia afra* is used mainly as an aqueous decoction or infusion applied externally or taken orally. The extremely bitter taste can be masked by the addition of sugar or honey. An infusion may be made with two tablespoons full (7 g) of dried ground herb to which 1 L of boiling water is added. If fresh leaves are being used four tablespoons of freshly chopped leaves are infused in 1 L of boiling water. Fresh leaves may be added to boiling water and the vapors inhaled (South African National Biodiversity Institute et al., 2006a).

**Phytochemistry/bioactivity**

Microchemical tests indicated the presence of tannins and saponins but not of alkaloids or cardiac, cyanogenic or anthraquinone glycosides. Studies done by Silbernagel et al. (1990) identified the triterpenes  $\sigma$ - and  $\beta$ -amyrin and friedelin as well as the alkanes ceryl cerotate and *n*-nonacosane in the leaves of South African collections of *Artemisia afra*. The investigation of leaf exudate flavonoids revealed the presence of two luteolin methyl ethers (Wollenweber et al., 1989). Jakupovic et al. (1988) analyzed the sesquiterpene lactones of *Artemisia* and 10 guaianolides and 5 glaucolides were detected. Analyses

of the essential oils obtained from the leaves have demonstrated considerable variation in oil composition. The major components of the oil appear to be  $\alpha$ - and  $\beta$ -thujone, 1,8-cineole, camphor and  $\alpha$ -pinene (Graven et al., 1992). Also present are terpenoids of the eudesmadien and germacratien types as well as coumarins and acetylenes (Van Wyk et al., 2005).

Antihistaminic and narcotic analgesic effects have been reported following preliminary tests (Hutchings et al., 1996; Van Wyk et al., 2005). The volatile oil, which contains mainly 1,8-cineole,  $\alpha$ -thujone,  $\beta$ -thujone, camphor, and boreol, has antimicrobial and anti-oxidative properties (Graven et al., 1992). Anti-malaria assays done on dried aerial parts of Tanzanian plants showed weak activity against *Plasmodium falciparum*. Fresh ethanol leaf extracts showed no activity against Leuk-L1210 and Sarcoma-WM256(IM) lines (Charlson, 1980). According to Watt and Breyer-Brandwijk (1962), *Artemisia afra* has been used to keep urine free from sugar in the case of diabetes mellitus.

***Catharanthus roseus***

*Catharanthus roseus* (L.) G. Don (Apocynaceae); common names: Madagascar periwinkle (E); kanniedood (A); isisushlungu (Z). Plant parts used: aerial parts.

**Description**

A semi-woody evergreen perennial herb up to 900 mm in height. The leaves are opposite and a glossy dark green, with a prominent white midrib. The five petaled flowers are up to 40 mm in diameter and vary from pink to white. The flowers are tubular, with a slender corolla tube. Periwinkles are commonly grown in South African gardens, but originate from Madagascar and have become naturalized in tropical and sub-tropical regions of the world (Van Wyk et al., 2005).

**Medicinal use**

The plant is traditionally used in South Africa for the treatment of diabetes and rheumatism (Watt & Breyer-Brandwijk, 1962). Alkaloid extracts of the aerial parts are used to treat various forms of cancer such as breast and uterine cancer and Hodgkin's and non-Hodgkin's lymphoma (Bruneton, 1995). An infusion of the leaf is used to treat diabetes, but even diluted mixtures can be extremely toxic. The two main alkaloids of the plant are used in combined chemotherapy and small doses are injected weekly or monthly (Van Wyk et al., 2005). According to Mushtaq et al. (2007), extracts obtained from fresh leaves are being used for diabetes in Pakistan. A small teaspoon is taken in the morning.

**Phytochemistry/bioactivity**

Various alkaloids such as catharanthine, leurosine and vindoline are responsible for the hypoglycemic effect.

The two binary indole alkaloids vincristine and vinblastine are used in cancer chemotherapy (Van Wyk et al., 2005). The binary alkaloids prevent cell division in the metaphase by binding to the protein tubulin and blocking its ability to polymerize into microtubules (Bruneton, 1995; Van Wyk et al., 2005).

### *Cnicus benedictus*

*Cnicus benedictus* L. (Asteraceae); common names: karmedik (A); holy thistle (E). Plant parts used: leaves.

### Description

An annual herb up to 70 cm tall with a rosette of basal leaves. The lance-shaped leaves are indented with spiny edges. Yellow flowers are borne in a terminal flower head surrounded by a circle of spiny bracts (Van Wyk et al., 2005). *Cnicus benedictus* is native to Europe and Asia, but was introduced to South Africa more than 150 years ago and is currently a widely distributed weed in the Cape as well as on the Highveld (Henderson & Anderson, 1966; Smith, 1966).

### Medicinal use

The plant is used as a cholagogue, stomachic and tonic (Bruneton, 1995). The recorded uses in South Africa include the use of brandy tinctures for internal cancers and for diabetes and arthritis (Watt & Breyer-Brandwijk, 1962, Smith, 1966 & Rood, 1994). This medicine is used as an aromatic bitter to stimulate the secretion of gastric juices and increase the appetite (Van Wyk et al., 2005). The use of *Cnicus benedictus* for bacterial infections, indigestion and flatulence as well as for viral infections has been investigated but the scientific evidence to substantiate its healing properties is still lacking. It is also used as a contraceptive, as an appetite stimulant, an astringent, for bleeding, as a blood purifier, for boils, colds as well as in the treatment of cancer, heart and liver ailments and malaria (Basch et al., 2006).

Boiling water is poured over 1.5 to 3 g of ground dried herb, steeped for 10 to 15 min to prepare a tea and taken three times daily (Basch et al., 2006). A cup of unsweetened infusion is taken half an hour before meals (Van Wyk et al., 2005).

### Phytochemistry/bioactivity

A bitter sesquiterpenoid lactone, cnicin, is probably the main active ingredient (Bruneton, 1995). Lignan lactones such as trachelogenin contribute to the bitterness of the plant. The plant also contains volatile oil with the terpenoids *p*-cymene, fenchone, and citral and the aromatic substances cinnamaldehyde and benzoic acid, all of which can contribute towards the pharmacological activity of the plant (Van Wyk et al., 2005).

### *Psidium guajava*

*Psidium guajava* L. (Myrtaceae); common names: guava (E) koejawel (A); ugwawa (Z). Plant parts used: leaves.

### Description

An evergreen shrub or small tree, 2 to 5 m tall (Henderson, 2001). The bark peels off in flakes, revealing the characteristic smooth trunk. The large, bronze turning to light green, ovate to oblong-elliptic leaves are borne opposite each other. The veins are conspicuously impressed above and raised below. Small white flowers with numerous stamens are produced in groups of 1-3 during October to December, followed by rounded or pear-shaped many-seeded berries. Guavas are an important commercial crop due to their delicious taste and high vitamin C content. The guava occurs naturally in tropical America up to Peru, but has become naturalized in many parts of the world. It is found as a weed in the warm subtropical areas of KwaZulu-Natal, Mpumalanga and Limpopo Province in South Africa (Van Wyk et al., 2005) and is currently classified as a category 2 invasive weed in South Africa.

### Medicinal use

Guava leaves are commonly used in South Africa as a remedy for diarrhea (Watt & Breyer-Brandwijk, 1962; Hutchings et al., 1996). The leaves are also used for several other ailments including diabetes, fever, cough, ulcers, boils and wounds (Watt & Breyer-Brandwijk, 1962; Hutchings et al., 1996). The main ethnotherapeutic use in Africa is said to be for malaria (Iwu, 1993). Crushed leaves are boiled in water and the infusion is either taken orally as a tea or as an enema (Hutchings et al., 1996). A common use in Pakistan is to make a hot water extract from dried guava leaves to reduce blood glucose levels in diabetes (Mushtaq et al., 2007).

### Phytochemistry/bioactivity

Numerous tannins and phenolic compounds have been identified from *Psidium guajava* of which the glycoside of ellagic acid, amritoside, is of particular importance. Other biologically interesting compounds are guajaverin and arabinopyroside of quercetin. The leaves contain essential oils and triterpenoids (Buckingham, 1996). Ellagic acid, a known intestinal astringent and haemostatic (Buckingham, 1996). Bruneton (1995) explains the therapeutic value of the plant against diarrhea and dysentery. The tannins are of value because of their vasoconstricting effects and their ability to form a protective layer on the skin and mucous membranes (Bruneton, 1995). These effects, together with proven antibacterial and antifungal activity, result in effective treatment of both internal and external infections (Bruneton, 1995). Quercetin contributes to the efficacy of the medicine, because of its known anti-oxidant with anticarcinogenic, anti-HIV and antibiotic effects (Buckingham, 1996).

### *Terminalia sericea*

*Terminalia sericea* Burch. ex. DC. (Combretaceae); common names: silver cluster-leaf (E); vaalboom (A); mogonono (T); moxonono (NS); mususu (Shona, V); amangwe (Z); mangwe (Ndebele). Plant parts used: stem bark.

#### Description

A small to medium-sized deciduous tree up to 8 m tall, with a single erect trunk and wide spreading canopy (Coates Palgrave, 1984; Van Wyk & Van Wyk, 1997; Van Wyk et al., 2000). The bark is thick, fibrous, dark gray and deeply longitudinally fissured. The leaves are clustered towards the ends of the branches, narrowly obovate-elliptic and densely covered with silky, silvery hairs (Van Wyk et al., 2000). Small pale cream flowers are borne in axillary spikes and have an unpleasant smell. The fruit is surrounded by two broad papery wings, and are pink to purplish red when mature (Van Wyk et al., 2000). These trees are normally found in the Bushveld, on deep sandy soils, often in dense stands (Van Wyk et al., 2000).

#### Medicinal use

Root decoctions are used as a traditional Tswana remedy for stomach disorders and diarrhea (Watt & Breyer-Brandwijk, 1962; Coates Palgrave, 1984; Hutchings et al., 1996). Decoctions of the roots, that have a very bitter taste, are taken to cure diarrhea, to relieve colic but are also used as an eye wash. Hot root infusions are used for the treatment of pneumonia (Coates Palgrave, 1984), whereas the bark is taken for diabetes (Watt & Breyer-Brandwijk, 1962). Decoctions and infusions are taken orally or applied externally. Ground bark eaten with maize meal is taken for diabetes (Van Wyk et al., 2005).

#### Phytochemistry/bioactivity

Several pentacyclic triterpenoids have been isolated from *Terminalia* species (Buckingham, 1996), of which sericic acid and an ester thereof, known as sericoside, are the main compounds in the roots (Bombardelli et al., 1974). The medicinal activity of the Combretaceae family is mainly ascribed to stilbenoids, triterpenoids, and saponins (Rogers, 1996). Triterpenoids and saponins are well known for their antimicrobial and anti-inflammatory activity. The antidiarrheal effects may be due to tannins (Bruneton, 1995).

### *Sutherlandia frutescens*

*Sutherlandia frutescens* (L.) R. Br. (Fabaceae); common names: kankerbos, gansies (A); cancer bush (E). Plant parts used: aerial parts.

#### Description

An attractive small shrub up to 1.2 m high. The compound leaves are grayish green, slightly to densely covered with hair giving it a silvery appearance. The characteristic red pea family flowers are followed by bubble, duck-shaped pods giving rise to the Afrikaans common name "gansies". *Sutherlandia frutescens* is a small genus consisting of five members, mainly restricted to southern Africa with representatives in South Africa, Botswana and Namibia where they are widely distributed in the dry areas of the Western and Northern Cape provinces, often in disturbed places.

#### Medicinal use

*Sutherlandia frutescens* is used internally for the treatment of cancer, gastric ailments, gynecological problems, rheumatism, edema and fevers and also as a bitter tonic or blood purifier. According to tradition and folklore the plant's uses include remedies for colds, influenza, chicken-pox, diabetes, varicose veins, piles, inflammation, liver problems, backache and rheumatism. Externally it is used to treat eye infections and wounds and as a douche for prolapse of the uterus.

Approximately 10 g ( $\pm$  3 tablespoons full) of dried ground herb is infused until cold with 1 L of boiling water, then strained and taken in half teacupful doses (90 mL) three times daily. Children 6-12 years are given 45 mL (South African National Biodiversity Institute et al., 2006b).

#### Phytochemistry/bioactivity

The plant is rich in amino acids and pinitol, but has small quantities of saponins and no alkaloids, according to current biosystematic and chemosystematic studies done (Van Wyk et al., 2005). The non-protein  $\alpha$ -amino acid canavanine has been detected in the seeds of the species (Bell et al., 1978). Studies using 50% ethanol extracts of the fresh flowers of *Sutherlandia frutescens* found no antitumor activity against CA-Lewis lung, Leuk-L 1210 or Sarcoma 180 solid tumors in mice. Similar extracts, assayed for cytotoxicity against CA-9KB cell lines, at a concentration of 2  $\mu$ g/mL, proved to be inactive (Charlson, 1980). *Sutherlandia frutescens* seeds contain canavanine that has according to Southon (1994) antitumorigenic properties and it is possible that this, or some other amino acid, is responsible for the reported benefits in treating cancer (Van Wyk et al., 2005). No *in vitro* antimicrobial activity against *Pseudomonas aeruginosa*, *Candida albicans* or *Mycobacterium smegmatis* was observed in the concentrations used for disc assays. Some activity was recorded against *Staphylococcus aureus* (South African National Biodiversity Institute et al., 2006b). The presence of pinitol, however, explains the traditional anti-diabetic use (Van Wyk et al., 2005).



***Bridelia micrantha***

*Bridelia micrantha* (Hochst.) Baill. (Euphorbiaceae); common names: coastal goldenleaf; mitzeerie/mzerie (E); wild coffee (E); bruinstinkhout (A); mitserie (A); incinci; isihlalamangewibi; isihlalamangwibi; umhlahle; umshonge; umhlalamagwababa; umhlalamgwababa; umhlalimakwaba; umhlalamkhwaba (Z). Plant parts used: stem bark.

**Description**

A medium to large deciduous tree with a spreading crown characterized by scattered bright red leaves, glossy dark green above but paler green below. The venation of the leaves is prominent in a herringbone pattern. The very small flowers are borne in axillary clusters and are yellowish green. Flowers are followed by small edible black berries (Van Wyk & Van Wyk, 1997). The bark is brown to gray, slightly flaking and rough in mature specimens (Coates Palgrave, 2002). It occurs in coastal, riverine, and swamp forest, usually in moist places (Van Wyk & Van Wyk, 1997).

**Medicinal use**

In southern Africa the stem bark is used as an expectorant, as a laxative, and in the therapy of diabetes (Iwu, 1993). Powdered bark is applied topically to burns, and reputedly enhances the rate of healing (Venter & Venter, 1996). The Venda people also use it to treat wound, burns, toothache and venereal diseases (Mabogo, 1990). According to Hutchings et al. (1996) the Zulu people take an infusion as an emetic.

**Phytochemistry/bioactivity**

The following compounds were isolated from *Bridelia micrantha* (Pegel & Rogers, 1968 cited in Hutchings et al., 1996): epifreidelinol, taraxol, gallic acid and ellagic acid. Gallic acid and ellagic acid seem to have antifungal and antiviral properties. Gallic and ellagic acid are antioxidants and were found to show cytotoxicity against cancer cells (Phytochemicals, 2007a, 2007b). Gallic acid is used as a remote astringent in cases of internal hemorrhage as well as in the treatment of albuminuria and diabetes.

***Sclerocarya birrea***

*Sclerocarya birrea* (A. Rich.) Hochst. (Anacardiaceae); common names: marula, cider tree (E); maroela (A); umganu (Z); morula (NS). Plant parts used: roots, bark, and leaves.

**Description**

A medium to large deciduous tree with an erect trunk and rounded, spreading crown. The leaves consist of 3 to 7 pairs of leaflets with a terminal one, dark green above and a paler bluish green below (Van Wyk & Van Wyk, 1997). The flowers are borne in small, oblong clusters.

Male and female flowers occur separately, usually but not always on separate trees, before the new leaves. The flowers are small, with red sepals and yellow petals. The rough bark is flaky, with a mottled appearance due to contrasting gray and pale brown patches (Van Wyk et al., 2005). A watery latex is present (Van Wyk et al., 2000). An almost spherical fleshy fruit is borne in late summer to mid winter, ripening to yellow after falling to the ground. The stone is hard with two to three openings plugged by lids. The tree is widely distributed throughout South Africa in bushveld and woodland (Van Wyk et al., 2005).

**Medicinal use**

*Sclerocarya birrea* is used for diarrhea, dysentery and unspecified stomach problems. It is also used to combat fever and in the treatment of malaria (Watt & Breyer-Brandwijk, 1962; Hutchings, 1989; Hutchings et al., 1996). Pujol (1990) reported that it is used as a general tonic, for indigestion and for the treatment of diabetes. Decoctions or leaf infusions are taken for diabetes (Iwu, 1993).

**Phytochemistry/bioactivity**

According to Galvez et al. (1993) the bark contains procyanidins whereas Watt and Breyer-Brandwijk (1962) and Iwu (1993) reported that it contains gallotannins, flavonoids and catechins. No detailed information has been documented. The antidiarrheal effects have been experimentally linked to the procyanidins (Galvez et al., 1993). Claims have also been made that it possesses hypoglycemic effects (Iwu, 1993).

***Brachylaena discolor***

*Brachylaena discolor* DC. (Asteraceae); common names: coast silver oak (E); kusvaalbos(A); muakawura, mupasa (Sh); iphahla, umpahla (Z). Plant parts used: leaves.

**Description**

An evergreen shrub or small tree usually 4 to 10 m in height. The bark is rough, dark gray to brownish-gray. The leathery leaves are lanceolate to obovate, dark green above and pale whitish below and covered with dense hairs. The leaf margin is entire or obscurely and irregularly toothed. The sexes are on different plants. The flower heads are grouped in terminal panicles with creamy-white individual flowers. The fruit is a small achene, tipped with a tuft of bristly hair (Coates Palgrave, 1984; Van Wyk & Van Wyk., 1997). It occurs in coastal woodland and bush as well as littoral scrub and on the margins of evergreen forests (Coates Palgrave, 1984).

**Medicinal use**

According to Watt and Breyer-Brandwijk (1962) this species is being used for diabetes and renal conditions as well as a tonic. Leaf infusions are used in the treatment of diabetes (Venter & Venter, 1996) as well as an



ingredient in a Zulu remedy for intestinal parasites and for round worms (Watt & Breyer-Brandwijk, 1962).

#### Phytochemistry/bioactivity

Onopordopicrin has been isolated from aerial parts of *Brachylaena discolor* (Hutchings et al., 1996). Cytotoxic, antibacterial, and antifungal activities have been reported for onopordopicrin (Lonergan et al., 1992).

#### *Brachylaena elliptica*

*Brachylaena elliptica* (Thunb.) DC. (Asteraceae); common names: bitterleaf (E); bitterblaar (A); isiduti (X); iphahle, uhlunguhlungu (Z). Plant parts used: leaves.

#### Description

A shrub or small tree up to 4 m tall with a light gray to brown bark that becomes rough with age. The leaves are lanceolate, elliptical to ovate, dark green above and white felted below. The leaf margin is irregularly toothed and often with 2 lobes near the apex giving the end of the leaf a 3-lobed effect. The creamy white flowers are born in terminal and axillary flowerheads. The fruit is a small achene, tipped with a tuft of bristly hair (Coates Palgrave, 1984; Van Wyk & Van Wyk, 1997). *Brachylaena elliptica* occurs in bushveld on rocky outcrops and along coastal margins (Van Wyk & Van Wyk, 1997).

#### Medicinal use

The leaves, which are extremely bitter tasting, are used medicinally (Van Wyk & Van Wyk, 1997) and valued by the Xhosa and Zulu as a treatment for diabetes. An infusion serves as a gargle and mouthwash (Coates Palgrave, 1984).

#### Phytochemistry/bioactivity

Watt and Breyer-Brandwijk (1962) state that a *Brachylaena elliptica* infusion is bitter, contains one or more glucosides, and probably no resin, and tests negative for alkaloids. It was also found that the leaf contains mucilage, tannin and a bitter ingredient which may be an alkaloid (Watt & Breyer-Brandwijk, 1962). Research has shown that infusions have no effect upon carbohydrate metabolism and little or no improvement in glycosuria or blood sugar percentages (Watt & Breyer-Brandwijk, 1962; Hutchings et al., 1996). The benefit derived from its local use as a gargle arises from the demulcent and astringent effects of the mucilage and the tannins, respectively (Watt & Breyer-Brandwijk, 1962).

#### *Brachylaena ilicifolia*

*Brachylaena ilicifolia* (Lam.) E. Phillips & Schweick. (Asteraceae); common names: small bitter leaf (E); fyn-bitterblaar (A). Plant parts used: leaves.

#### Description

A shrub or small tree between 3 and 4 m in height with a gray to brown bark. The leaves are often on short lateral branches, small, narrowly oblong, lanceolate to ovate, green above and covered with whitish-green hairs below. The leaf apex is rounded with a sharp spine-like tip, the margin is entire or with small teeth. The flower heads are thistle-like and the individual flowers are cream to yellow and grouped into a capitulum. The flowers give rise to a small achene with whitish bristly hairs (Coates Palgrave, 1984). *Brachylaena ilicifolia* occurs in bush, scrub forest and on rocky hillsides (Coates Palgrave, 1984).

#### Medicinal use

The leaves, which are intensely bitter, are used by Africans to treat diabetes (Coates Palgrave, 1984). It may be used in the same way as *Brachylaena elliptica* (Watt & Breyer-Brandwijk, 1962).

#### Phytochemistry/bioactivity

In the literature no information could be found on the phytochemistry or bioactivity of *Brachylaena ilicifolia*.

#### *Bulbine latifolia*

*Bulbine latifolia* (L.f.) Spreng. var. *latifolia* (Asphodelaceae); common names: broad-leaved bulbine (E); ibhucu (Z); rooiwortel, geelkopieva (A); incelwane (Xh). Plant parts used: fresh leaves and roots.

#### Description

A perennial with a tuberous root. The leaves are thick fleshy, bright green to yellow and arranged in a rosette. The inflorescence is borne on a long stem in a cluster consisting of yellow flowers. It occurs widespread in hot dry areas in the eastern and northern parts of South Africa (Pooley, 1998).

#### Medicinal use

The sap of *Bulbine* species is widely used for the treatment of wounds, burns, rashes, itches, ringworm, cracked lips (Watt & Breyer-Brandwijk, 1962; Rood, 1994; Pujol, 1990) and Herpes (Van Wyk et al., 2005). Root infusions of *Bulbine latifolia* are taken orally to quell vomiting and diarrhea (Pujol, 1990), convulsions, venereal diseases, diabetes, urinary complaints, rheumatism and blood disorders (Van Wyk et al., 2005; Pooley, 1998). Leaf sap is applied directly to the skin or in the form of a warm poultice. For internal use, an infusion of the roots or sometimes a brandy tincture is taken two or three times daily (Watt & Breyer-Brandwijk, 1962).

#### Phytochemistry/bioactivity

The stems and roots of *Bulbine* species contain anthraquinones such as chrysophanol and kinpholone (Van

Staden & Drewes, 1994; Van Wyk et al., 1995), but these compounds are probably of minor importance in the healing of wounds. Chrysophanol has antibacterial properties (Bruce, 1975). The healing effect is likely to be due to glycoproteins such as, aloctin A and B, in the leaf gel (Suzuki, 1981).

### *Carpobrotus edulis*

*Carpobrotus edulis* (L.) L. Bolus (Mesembryanthemaceae); common names: suurvy, perdevy, vyerank (A); gaukum (K); t'kobovy (Nama N) sour fig (E). Plant parts used: leaf juice and leaf pulp.

### Description

A creeping succulent perennial with mat to light green leaves often tinted red. The long leaves are slightly bent, tapered to the apex to give a more or less triangular shape. The large yellow flowers change to pink as they mature (Le Roux, 2005). The fragrant fruit contains a jellylike, sweet-sour pulp with a multitude of small, brown seeds (Van Wyk et al., 2005). Originally found in sandy, dry riverbeds along the coastlines of Namaqualand and south and eastwards along the coastline of the Western and Eastern Cape (Le Roux, 2005).

### Medicinal use

Juice from the leaves is gargled to treat throat and mouth infections (Rood, 1994). It is also taken orally for dysentery, digestive ailments, tuberculosis and as a diuretic and styptic (Watt & Breyer-Brandwijk, 1962). It is highly astringent and is applied externally to treat eczema, wounds and burns (Watt & Breyer-Brandwijk, 1962; Rood, 1994). It is also said to be effective against toothache, earache and oral and vaginal thrush. The fresh juice is taken orally or gargled whereas the leaf pulp is applied to the skin to treat wounds and infections (Watt & Breyer-Brandwijk, 1962; Rood, 1994). *Carpobrotus edulis* is being used for the treatment of diabetes mellitus traditionally in South Africa (Van Huyssteen, 2003).

### Phytochemistry/bioactivity

The beneficial medicinal effects are probably due to the presence of tannins. Tannins have the ability to form complexes with proteins, such as digestive enzymes and fungal or viral toxins. In addition to their anti-septic activity, tannins have a vasoconstricting effect and reduce fluid loss from wounds and burns, thereby enhancing tissue regeneration (Bruneton, 1995). The juice is said to be mildly antiseptic and highly astringent. The leaves also contain malic and citric acid (Watt & Breyer-Brandwijk, 1962).

### *Chironia baccifera*

*Chironia baccifera* L. (Gentianaceae); common names: aambeibossie, bitterbossie, agdaegeneesbossie,

perdebossie (A); Christmas berry, wild gentian (E). Plant parts used: whole plant.

### Description

A much branched shrublet between 0.5 and 1m tall. The stems are rigid, angled or narrowly winged. The narrow, thin or slightly fleshy leaves are semiclasped at the base with a hooked tip. Solitary pink flowers with conspicuous yellow anthers are borne terminally from August to February (Pooley, 1998). The flowers are followed by bright red berries when ripe (Van Wyk et al., 2005). This shrublet is found from the Cape Peninsula northwards to the Kamiesberg and eastwards into the Eastern Cape and KwaZulu-Natal. It usually grows in dry, sandy soils in the shade of other plants as well as in full sun (Van Wyk et al., 2005; Dyer et al. 1963).

### Medicinal use

*Chironia baccifera* was traditionally used by the Khoi as a purgative and for the treatment of boils (Watt & Breyer-Brandwijk, 1962). It is still used in traditional medicine as a purgative and for the treatment of hemorrhoids (Watt & Breyer-Brandwijk, 1962; Smith, 1966; Rood, 1994; Pooley, 1998). A decoction of the whole plant is taken as a blood purifier to treat acne, sores and boils (Van Wyk et al., 2005). Infusions may be used as a remedy for diarrhea, or for leprosy (Watt & Breyer-Brandwijk, 1962). According to Van Wyk and Gericke (2000), the plant is used as a bitter tonic and infusions and tinctures from the leaves and stems are used to treat diabetes. Decoctions, tinctures or infusions are taken, but the plant is potentially toxic and use should be controlled. Plant material is fried in butter and then applied externally to sores (Watt & Breyer-Brandwijk, 1962). Infusions are also applied to hemorrhoids (Van Wyk et al., 2005).

### Phytochemistry/bioactivity

The roots of *Chironia baccifera* contain various secoiridoids, of which gentiopicosid is the main component, together with small quantities of swertiamarine, chironoside and others (Wolfender et al., 1993). The bitter iridoids are known to stimulate appetite, but the compounds responsible for the healing properties appear to be unknown (Van Wyk et al., 2005).

### *Cissampelos capensis*

*Cissampelos capensis* L.f. (Menispermaceae); common names: dawidjiewortel (A). Plant parts used: rhizomes and roots.

### Description

A perennial climber with twining stems and rounded, bright green leaves (Botha, 1980). The plant supports itself by twining around the stems of other plants. The flowers, borne in clusters are small, hairy and greenish

and are followed by orange berries (Van Wyk et al., 2005). It is widely distributed in the western parts of South Africa (Van Wyk et al., 2005).

#### Medicinal use

A well known medicinal plant in the Western Cape which was traditionally used as a blood purifier for boils and syphilis, and also taken for bladder ailments, diarrhoea, colic and cholera (Watt & Breyer-Brandwijk, 1962). The Xhosa apply a paste of the leaves to wounds and sores (Watt & Breyer-Brandwijk, 1962). It is traditionally taken as a brandy tincture, as an infusion or decoction with *Pentzia incana* (Thunb.) Kuntze and *P. globosa* Less. and externally applied as a poultice (Watt & Breyer-Brandwijk, 1962). Fresh or dry rhizomes are chewed or taken directly as an infusion or tincture for diabetes (Van Wyk & Gericke, 2000).

#### Phytochemistry/bioactivity

A large number of biologically active alkaloids of the bis-benzyltetrahydroisoquinoline type have been isolated from several *Cissampelos* species, of which cissampareine is a typical example (Van Wyk et al., 2005). According to Watt & Breyer-Brandwijk (1962) the plant contains the alkaloid cissampeline. Sedative, antispasmodic and anti-tumor properties have been ascribed to Menispermaceae alkaloids (Buckingham, 1996; Bruneton, 1995).

#### *Harpagophytum procumbens*

*Harpagophytum procumbens* (Burch.) DC. ex. Meisn. (Pedaliaceae); common names: devil's claw, grapple plant (E); duiwelsklou (A); ghamaghoe (K). Plant parts used: secondary roots.

#### Description

A perennial plant with creeping, annual stems protruding from a fleshy corm. The leaves are blue-green on top and silver-gray underneath. The tubular flowers are a deep purple to pink with a yellow centre. The characteristic fruit has numerous "tentacles" with sharp, hooked thorns as well as two straight thorns on the upper surface (Van Rooyen, 2001). It occurs in sandy soils in the north-western parts of southern Africa as well as the dune veld of the Kgalagadi Transfrontier Park (Van Rooyen, 2001).

#### Medicinal use

*Harpagophytum procumbens* is an important medicinal plant, the corms and roots are used for ailments of the gallbladder and kidneys, diabetes, arteriosclerosis, osteoarthritis, rheumatism, ulcers, high blood pressure, and fever (Van Wyk & Gericke, 2000; Van Rooyen, 2001). Dried root infusions are taken as a cure for digestive disorders and as a tonic (Van Wyk et al., 2005). The fresh tuber is made into an ointment and applied to sores, ulcers, boils

and other skin lesions (Watt & Breyer-Brandwijk, 1962). An infusion of 1.5 g of powdered material in a cup of boiling water and strained, can be taken daily. Standardized extracts are available in the form of capsules, tablets, tinctures and ointments (Van Wyk et al., 2005).

#### Phytochemistry/bioactivity

According to Van Wyk et al. (2005) the roots are rich in sugars but also contain phytosterols, triterpenoids and flavonoids. The active ingredients in the roots are considered to be a cinnamic acid ester, harpagoside, harpagide (possibly a degradation product of harpagoside) and procumbide (Czygan & Krüger, 1977; Pourrat et al., 1986; Buckingham, 1996). According to Bruneton (1995), animal studies indicated slight analgesic and anti-arthritis effects. In Germany it is used in supportive therapy for degenerative disorders of the locomotor system, for lack of appetite and dyspeptic problems (Van Wyk et al., 2005). A recent clinical study indicated effectiveness in the treatment of acute low backache (Chrubasik et al., 1996).

#### *Hoodia currorii*

*Hoodia currorii* (Hook.) Decne. (Asclepiadaceae); common names: ghaap; khobab (K). Plant parts used: fleshy stem.

#### Description

Leafless succulent plants with thick fleshy erect stems with rows of small thorns. The disc-like, flesh-colored flowers smell strongly of decaying meat, attracting flies and blowflies for pollination (Van Wyk & Gericke, 2000). It occurs in the dry north-western parts of southern Africa.

#### Medicinal use

*Hoodia currorii* is eaten as a food, used as an appetite suppressant, to treat indigestion, hypertension, diabetes and stomach ache (Van Wyk & Gericke, 2000).

According to Von Koenen (2001) the plant is known as a diabetes remedy to the Damara people.

#### Phytochemistry

*Hoodia* species contains pregnane glycoside P57 that suppress hunger (Van Wyk & Wink, 2004).

#### *Nymphaea nouchali*

*Nymphaea nouchali* Burm.f. var. *caerulea* (Savigny) Verdc. (Nymphaeaceae); common names: Egyptian blue lily; sacred blue lily; blue water lily (E); blouwaterlelie, kaaimanblom (A); iZubu (Z). Plant parts used: seeds.

#### Description

A perennial hydrophyte with a tuberous rhizome anchored in the pond mud by spreading roots. It does

not have a true stem but the leaves are born on long leaf stalks that arise directly from the rhizome. The leaves are large, flat, and oval with smooth margins and a deep sinus where the petiole is attached. The showy, blue, bisexual flowers appear above the water at the tip of a sturdy stalk from September until April. Color variations may occur varying from white to mauve. Numerous blue-tipped bright yellow stamens occupy the centre of the flower. In Africa this species occurs from tropical to southern Africa where it is common. In South Africa it is found in waterbodies in the Highveld, Lowveld as well as in KwaZulu-Natal (Viljoen & Notten, 2002).

#### Medicinal use

The seeds of *Nymphaea nouchali* are used as a remedy for diabetes. An infusion of the root and stem is emollient and diuretic and is used in treating blenorragia and infections of the urinary passages. A decoction of the flower is said to be narcotic and an aphrodisiac, and the flowers have been used as a remedy for dysuria and for cough (Watt & Breyer-Brandwijk, 1962).

#### Phytochemistry/bioactivity

*Nymphaea nouchali* contains the alkaloids nuciferine and apomorphine. Recent studies have also shown it to have euphoric properties (Perry et al., 2002).

#### *Trigonella foenumgraecum*

*Trigonella foenumgraecum* L. (Fabaceae); common names: fenugreek; fenugrec (France (F)); fieno Greco (Italian (It)); alholva, feno-greco (Sp); helba (Arabic (Ar)); methi (Indian (In)). Plant parts used: seeds.

#### Description

A highly aromatic, erect, annual herb with trifoliate oblong-lanceolate leaflets. Yellowish flowers are borne in the leaf axil. The fruit is a long, narrow, sickle-like pod containing the brownish oblong seeds that are divided by a furrow into two unequal lobes (Suttie, 2007). Fenugreek is originally from the Mediterranean regions, northeastern Africa and western Asia (Van Wyk & Wink, 2004), but currently cultivated in India and neighboring countries as well as in France, Turkey, and China. Fenugreek grows on a wide range of well-drained soils (Suttie, 2007).

#### Phytochemistry/bioactivity

The seeds are rich in mucilage, mainly glactomannans, lipids, proteins, and protease inhibitors (Van Wyk & Wink, 2004). Steroidal saponin and the aglycone diosgenin and its epimer yamogenin are found in the seed oil of fenugreek whereas the alkaloid trigonelline was extracted from the seeds, and the steroidal peptide, foenugraecin, may contribute to the medicinal properties. Fenugreek also contains the furostanol glycosides trigofenosides A/G

(Van Wyk & Wink, 2004; Suttie, 2007). The saponins could be responsible for the observed antidiabetic, lipid and cholesterol lowering activities (Van Wyk & Wink, 2004).

#### Medicinal use

Fenugreek is an important medicinal plant and is used for the treatment of abdominal colic, bronchitis, cough, sprains, diabetes, asthma, emphysema, gastrointestinal troubles, constipation, fever, sterility as well as a treatment after child birth, and also as a digestive, an abortive, a purgative, a galactagogue, an emmenagogue, a stomachic, reconstituent, sedative for palpitations, icterus, an anthelmintic and an aphrodisiac (Suttie, 2007). For diabetes, an herbal mixture consisting of 5 g of *Tylophora hirsuta* Wight leaves, 25 g of *Trigonella foenum-graecum* seeds and 50 g of the aerial parts of *Fumaria indica* in water is used (Mushtaq et al., 2007).

#### *Vernonia oligocephala*

*Vernonia oligocephala* (DC.) Sch. Bip. ex Walp. (Asteraceae); common names: groenamara, bitterbossie (A); mofolotsane (SS); sefatsatse (Ts); ihlambihloshane (Z). Plant parts used: aerial parts.

#### Description

It is an erect, perennial, herbaceous plant up to 1 m tall. The stems develop from a woody rootstock. The elliptical leaves are pale green above and silver below due to the presence of a velvet hair cover. The dark pink flowerheads are grouped together on the branch tips (Van Wyk & Malan, 1988). *Vernonia oligocephala* is widespread throughout the grassland regions of South Africa (Van Wyk & Malan, 1988; Van Wyk et al., 2005).

#### Medicinal use

Infusions of *Vernonia oligocephala* are taken as stomach bitters to treat abdominal pains and colic. It is also used for the treatment of rheumatism, dysentery and diabetes (Watt & Breyer-Brandwijk, 1962; Pujol, 1990; Hutchings et al., 1996). Infusions are made of the leaves (Van Wyk et al., 2005).

#### Phytochemistry/bioactivity

Various sesquiterpenoid lactones have been isolated from *Vernonia* species (Buckingham, 1996), including germacranolides and glaucolides for example glaucolide A (Bohlman et al., 1984).

#### Conclusions

The trade in traditional medicines forms part of a multi-million rand economy in southern Africa (Cunningham, 1997), stimulated by high population growth, rapid urbanization, unemployment, and a high cultural value



of traditional medicines (Dold & Cocks, 2002). The trade is now greater than at any time in the past and is certainly the most complex resource-managing issue facing conservation agencies, healthcare professionals and resource users in South Africa (Dold & Cocks, 2002).

The popularity of herbal medicines has led to increasing concerns over their safety, quality and efficacy. In many countries the herbal medicine market is poorly regulated and products are neither registered nor controlled. There is a lack of detailed documentation on the use of medicinal plants in South Africa. The need to document traditional knowledge is a priority because the rapid pace of urbanization and aculturation in this country could easily lead to permanent loss of this knowledge (Van Wyk et al., 2005).

A study was conducted to look at mortality from traditional medicine of patients admitted at Ga-Rankua Hospital, South Africa. The results of this study have reinforced the concerns of the Medicines Control Council about the safety of some traditional medicines. Some medicinal plants species used by traditional healers in South Africa have shown a significant degree of toxicity, which obviously outweighs their benefits (South African Traditional Medicines Research Unit, 2005).

In the quest for discovering new hypoglycemic substances it is necessary to scientifically validate the claimed medicinal properties of traditional medicines. This inventory will assist researchers in the selection of plant species to evaluate for their hypoglycemic activities. This study also indicates the toxicity of some of the plant extracts where this information was available. The method of preparation and administration of medicines used by traditional healers is the starting point to design experimental protocols aimed at finding scientific evidence of efficacy and toxicity. The ability to produce safe, standardized medicinal plant products for further clinical evaluation is a major stumbling block in most countries wishing to enhance the quality of their traditional medicines (South African Traditional Medicines Research Unit, 2005).

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