Chapter 2

BACKGROUND INFORMATION ON THE SELECTED PLANTS
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Abstract

South African medicinal plants were selected based on information of their traditional medicinal use (traditional healers) in treating symptoms of listeriosis (diseases caused by \textit{L. monocytogenes} infection) and also based on a literature review. The plants selected were \textit{Aloe arborescences}, \textit{Acacia karroo}, \textit{Artmesia afra}, \textit{Clivia miniata}, \textit{Eucomis autumnalis}, \textit{Datura stramonium}, \textit{Drimia altissima}, \textit{Gomphocarpus fruticosus}, \textit{Heteromorpha arborscens}, \textit{Tulbaghia violaceae}, \textit{Senecio inonartus}, \textit{Ziziphus mucronata} and \textit{Plectranthus ecklonii}. The medicinal use, phytochemistry and distribution of each plant are described.
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2.1 Introduction

South Africa still utilises a large selection of medicines that are derived from plants and their extracts (Van Wyk et al., 1997; Taylor & Van Staden, 2001). In the past and the present herbal medicine has become a topic of augmented global importance, having strong influence on both world health and international trade (Stafford et al., 2005).

2.2 Plants selected for the present study

Thirteen medicinal plants were collected from Gauteng, northern and eastern Free State, South Africa. Different parts of the plants for example, leaves, stem, bark, roots were collected. The symptoms of listeriosis is gastro-enteritis, severe headaches, pulsating fever, nausea, vomiting, stiffness of the neck and back, septicaemia, and abortion. Traditional healers were asked for their treatment they use when patients complain and show these symptoms. The questionnaire (Appendix 3, page 134) was used to get information from the traditional healers. The healers mentioned vernacular name. An effort was made to go with the healers to find out the plants they use. Herbarium specimens were made which assisted to find out the scientific names. The plant species collected were based on information received from experienced traditional healers and elderly indigenous people who are experts on traditional medicine. The selection of these plants were also based on information culled from literature. The samples were taken to the HGWJ Schweickerdt herbarium of the University of Pretoria for identification. The herbarium specimens are preserved in the aforesaid herbarium (Table 2.1).
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Table 2.1 Voucher specimen numbers of the selected plants used for the present study.

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Voucher Specimen number</th>
<th>Plant part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia karroo Hayne</td>
<td>MN15</td>
<td>Leaves</td>
</tr>
<tr>
<td>Aloe arborescens Mill.var. natalensis Berger</td>
<td>MN 5</td>
<td>Leaves</td>
</tr>
<tr>
<td>Artemisia afra Jacq.</td>
<td>MN 7</td>
<td>Leaves</td>
</tr>
<tr>
<td>Clivia miniata Reg.</td>
<td>MN 3</td>
<td>Whole plant</td>
</tr>
<tr>
<td>Datura stramonium L.</td>
<td>MN 8</td>
<td>Leaves</td>
</tr>
<tr>
<td>Drimia altissima (L.f.) Ker Gawl</td>
<td>MN 14</td>
<td>Roots</td>
</tr>
<tr>
<td>Eucomis autumnalis (Mill.) Chitt.</td>
<td>MN 11</td>
<td>Bulb</td>
</tr>
<tr>
<td>Gomphocarpus fruticosus (L) W.T. Aiton</td>
<td>MN 1</td>
<td>Leaves</td>
</tr>
<tr>
<td>Heteromorpha arborescens (Spreng) Cham. &amp;. Schldtl.</td>
<td>MN 4</td>
<td>Stem</td>
</tr>
<tr>
<td>Plectranthus ecklonii Benth.</td>
<td>PRU 96396</td>
<td>Leaves</td>
</tr>
<tr>
<td>Senecio inonartus DC</td>
<td>MN 9</td>
<td>Leaves</td>
</tr>
<tr>
<td>Stem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tulbaghia violaceae Harv.</td>
<td>MN 2</td>
<td>Leaves</td>
</tr>
<tr>
<td>Ziziphus mucronata Wild.</td>
<td>MN 10</td>
<td>Leaves</td>
</tr>
</tbody>
</table>

The detailed descriptions of the selected plants for the present study are as follows:

2.2.1 Acacia karroo Hayne

*Acacia karroo* is a member of the *Fabaceae* family. It is commonly known as sweet thorn. In the different South African languages it is known by different names in Zulu it is known as
“umungu” and in Xhosa “umnga”, “mookana” in Pedi (Northern Sotho). Its trunk is made up of “rough bark, which is dark brown in colour. The branches have many pairs of white large spines. The small round yellow flowers give the plant its distinct character (Figure 2.1) A. karroo is used medicinally to treat diarrhoea, colds, dysentery, conjunctivitis and haemorrhage. The gum from A. karroo has been used medicinally as emollients and as pharmaceutical aids such as emulsifiers, stabilisers of suspensions and additives for solid formulations. The gum has also been used to treat mouth ulcers (van Wyk et al., 1997; van Wyk & Gericke 2000). In the previous study (Katerere & Eloff, 2004) A. karroo was found to have antibacterial activity against Escherichia coli and Staphylococcus aureus. Compounds which have been isolated from the heartwood (stem) of A. karroo, are (2'S,3'R)-3,10-dihydroxy-9-O-(6'-hydroxy-7'-O-methyl-2'-hydroxy-methylidihydrobenzofuran-3-yl)dibenz-[b,d]-pyran-6-one and its 10-O-methyl analogue; 8-O-methylepiprosopin-4β-ol; 8-methoxyfustin; and 7,8,3,4'-tetrahydroxy-3'-methoxyflavone (Malan & Swartz, 1995). The compound, 7,8,3,4'-tetrahydroxy-3'-methoxyflavone has been reported to have antioxidant and antimutagenic activities (Chung et al., 1999). The compound has also been reported to have antibacterial activity against the Gram positive bacteria such as Bacillus cereus, Staphylococcus aureus, Enterococcus faecalis and Gram negative bacterium, Escherichia coli (Wang et al., 1989; Teffo et al., 2010). The phenolic acids, cinnamic, caffeic, p-coumaric, ferulic acids and chlorogenic acids from fresh fruit and vegetables have been reported to have antilisterial activity (Wen et al. 2003). The phenolic acids were also found to be bactericidal against L. monocytogenes. These compounds have similar structures to other phenolics compounds that have been isolated from A. karroo such as acaciabiuronic acid (DNP, 2010). The leaves were used for the present study.

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The genus *Acacia* is found in the dry regions of Africa (Katerere & Eloff, 2004; Dube et al., 2001), Australia, India and America (Arias et al., 2004). *A. karroo* is widely distributed in South Africa (Van Wyk et al., 1997) and is found in all the nine provinces.

![Acacia karroo](image)

**Figure 2.1** *Acacia karroo* a tree with the golden-yellow round flowers (Courtesy: Van Wyk et al., 1997)

### 2.2.2 *Aloe arborescens* Mill. var. *natalensis* Berger

*A. arborescens* is a member of the family *Asphodelaceae*. It has long fleshy dull green leaves that have spines along the edges (Figure 2.2). The plant is medicinally used to treat wound and burns. *A. arborescens* has been reported to be used during pregnancy to ease labour (Grace et al., 2008). The plant has been reported to have antibacterial, anti-inflammatory anti-ulcer and anticancer activities (Van Wyk & Gericke, 2000; Jia et al., 2008). The compounds aloenin, aloenin B, 10-hydroxyaloin A, aloin A and B, and aloe-emodin have been isolated from the leaves of *A. arborescens*. Aloenin has been reported to have purgative and laxative activity (Park et al., 1998). *A. arborescens* has been found to be effective in wound healing. The species

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has also been found to have antibacterial activity against *Staphylococcus aureus*, *Klebsiella pneumonia*, and *Escherichia coli* (Jia et al., 2008). The leaves were used for the present study.

**Distribution of *A. arborescens***

*A. arborescens* is widely distributed in the eastern parts of South Africa especially in the Eastern Cape and some parts of Western Cape and KwaZulu-Natal. It is a popular garden plants found in most gardens in South Africa.

![Figure 2.2 Aloe arborescens](image)

**Figure 2.2 Aloe arborescens** (Courtesy: Van Wyk et al., 1997)

### 2.2.3 *Artemisia afra* Jacq.

*A. afra* belongs to the family *Asteraceae*. It is known as African wormwood. In Zulu and Xhosa it is known as “umhlonyanae”, and “lengana” in Sotho and Tswana. *A. afra* is a perennial shrub with greyish-green leaves (Figure 2.3), and yellow flowers. The leaves are medicinally used to treat coughs, fever, colds, influenza and blocked nasal passages. The plant has antimicrobial and anti-oxidative properties (Van Wyk et al., 1997; Van Wyk & Gericke, 2000).
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The methanol extract of *A. afra* has been found to have antibacterial activity against *S. aureus* and *Bacillus subtilis* (Rabe and Van Staden, 1997). The compounds isolated from *A. afra* which have been reported to have antimicrobial properties are: 1,8-cineole, α-thujone, β-thujone, camphor and borneol (Van Wyk et al., 1997; Mangena and Muyima, 1999). These compounds have been isolated from the leaves. The 1,8-cineole, α-thujone, β-thujone isolated from *A. afra* have been found to have broad antibacterial activities against a number of bacteria such as *Salmonella enteritidis, S. typhi, S. newport, Bacillus subtilis, Micrococcus luteus,* etc. (Mangena and Muyima, 2009). Dichloromethane, water and ethanol extracts of *A. afra* extracts have been found to have antibacterial activity against *Bacillus cereus, E.coli, Klebsiella pneumonia, S. aureus* and *Mycobacterium aurum* respectively (Buwa and Afolayan, 2009). The leaves were used for this study.

**Distribution of *A. afra***

*A. afra* is a widely distributed, common species in South Africa. It is distributed as far as north as tropical east Africa through to Ethiopia.

![Artemisia afra](image)

**Figure 2.3 Artemisia afra** (Courtesy: Van Wyk et al., 1997)
2.2.4 *Clivia miniata* Reg.

*C. miniata* belongs to the family *Amaryllidaceae*. It is a perennial tuberous rhizomatous plant that does not require exposure to sunlight to grow. It is commonly known as bush lily or orange lily. In Zulu it is known as “umayime.” It usually bears orange flowers that develop from the same point of the stalk (Figure 2.4). The rhizome (underground stem) is medicinally used to treat fever and to relieve pain while the whole plant is used in childbirth. Roots and leaves are taken by South African women during pregnancy and childbirth (Louw *et al*., 2002). Compounds such as lycorine, clivacetine, clivonine, cliviasine and clividine have been isolated from *C. miniata*. Lycorine, clivonine and cliviasine have been isolated from the rhizome. Clivacetine and clividine have been isolated from the whole plant. Lycorine has been found to be a respiratory stimulant and has been reported to have antitumour, antiviral and antifungal activity (Van Wyk *et al*., 1997; Pieters and Vlietinck, 2005). The whole plant was used for this study.

**Distribution of *C. miniata***

*C. miniata* is found on the eastern coastal line of South Africa, in the Eastern Cape and KwaZulu-Natal provinces (Van Wyk *et al*., 1997).
2.2.1.5 *Datura stramonium* L.

*D. stramonium* belongs to family *Solanaceae*. The plant is commonly known as the thorn apple. In Zulu it is known as “iloyi”. It is has white or purplish tubular flowers and four–locular–fruit capsules which have brown, kidney shape seeds (Figure 2.5) (Van Wyk *et al.*, 1997). The leaves of *D. stramonium* are medicinally used to relieve asthma, rheumatism, gout, boils, abscesses, sore throat, tonsillitis and respiratory difficulties. Methanol extract of *D. stramonium* has been found to be active against *Bacillus subtilis* (Rabe and Van Staden, 1997). In previous study (Mdee *et al.*, 2009) *D. stramonium* was found to have antifungal activity against several tested fungi such as *Aspergillus niger*, *A. parasiticus*, etc. Tropane has been isolated from *Datura* species (Rao and Ravishankar, 2002). *D. stramonium* has been reported to contain lubumin, hydroxylubimin, germacrenediol and small amounts of capsidiol (Stoessl *et al.*, 1976). Atropine and scopolamine are the two major compounds isolated from *D. stramonium*. The compounds have been isolated from the aerial parts of the plant. It has been reported that scopolamine has
analgesic, anti-inflammatory and antispasmodic activities.

**Distribution of *D. stramonium***

*D. stramonium* is widely distributed in South Africa and is found in all the provinces.

![Figure 2.5 D. stramonium (Courtesy: Van Wyk et al., 1997)](image)

**2.2.6 Drimia altissima (L.f.) Ker Gawl**

*D. altissima* belongs to the family *Hyacinthaceae*. Species of *Drimia* have large underground bulbs, strap-shaped leaves (Figure 2.6) and long thin flowering stalks. The bulbs and leaves are medicinally used as expectorants (promoting secretion, liquefaction or expulsion of the sputum from the respiratory passages), emetics, diuretic and as a heart tonic, to treat fever, bladder and uterus disease (Van Wyk *et al.*, 1997; Louw *et al.*, 2002). The compound 3-O-α-L-Rhamnopyranoside has been isolated from *D. altissima* (DNP, 2010). Bufadienolides and cardioactive C-24 steroids have been isolated from *D. altissima* (Krenn & Kopp, 1998).
Bufadienolides have been isolated from the bulb. In the previous study *D. altissima* was tested for antibacterial activity against methicillin resistant *S. aureus* and was found to have low activity against the pathogen (Heyman *et al.*, 2009). The roots and leaves were used for this study.

**Distribution of *D. altissima***

*D. altissima* is widely distributed in South Africa particularly in the region of summer-rainfall region (Crouch *et al.*, 2006).

![Drimia altissima bulbs and leaves](image1)

**Figure 2.6** *Drimia altissima* (a) bulbs and (b) leaves

### 2.2.7 *Eucomis autumnalis* (Mill.) Chitt.

*E. autumnalis* belongs to the family *Hyacinthaceae*. This bulbous plant is commonly known as the pineapple flower. In Zulu and Xhosa it is known as “umathunga.” It consists of a number of small yellowish-green flowers that are attached to the centrally located stalk (Figure
2.7). The bulb is medicinally used for fever, stomach ache, colic, urinary diseases, diarrhoea, syphilis, easing of childbirth, etc. (Van Wyk, 2008). *E. autumnalis* has been reported to treat chest complaints, coughing and tuberculosis (McGaw et al., 2008). Methanol extract of *E. autumnalis* has been found to have antibacterial activity against *B. subtilis* (Rabe and Van Staden, 1997). *E. autumnalis* serves as an enema for low back pain, fever, colic and urinary diseases (Louw et al., 2002). The compounds previously isolated from the bulb of *E. autumnalis* are eucomanalin, autumnariol and eucosterol (Van Wyk et al., 1997; Van Wyk & Gericke, 2000). The bulb was used for this study.

**Distribution of *E. autumnalis***

*E. autumnalis* is widely distributed along the eastern parts of South Africa (Van Wyk et al., 1997). It is predominantly found in the following provinces the Free State, KwaZulu-Natal, Eastern Cape, Mpumalanga, and Gauteng.

![Eucomis autumnalis](image1.jpg)  
(a)  

![Eucomis autumnalis bulb](image2.jpg)  
(b)  

**Figure 2.7** *Eucomis autumnalis* (a) flowers and leaves and (b) bulb (Courtesy: Van Wyk et al., 1997)
2.2. 8 *Gomphocarpus fruticosus* (L.) Aiton

*G. fruticosus*, formerly known as *Asclepias fruticosa* belongs to the family *Asclepiadaceae*. The plant is a small shrub of about 2 meters in height with slender stems and leaves attached opposite to each other. The yellowish-green flowers are borne in swinging clusters. Large round–shaped seed pods are attached to the stem (Figure 2.8). The leaves are used medicinally to treat headaches, stomach pain, tuberculosis and as an emetic. In the previous study quercetin glycosides, rutin and kaempferol and isorhamenin were isolated from *G. fruticosus* (Heneidak et al., 2006). Other compounds gomphoside, gomphacil, afroside, 5,6-didehydroafroside have been isolated from *G. fruticosus*. Gomphacil and afroside have been isolated from the leaves. Gomphoside is a cardiotonic agent (van Wyk et al., 1997; van Wyk & Gericke, 2000). The leaves were used for the present study.

**Distribution of *G. fruticosus***

It is widely distributed in all parts of South Africa.

![Figure 2.8 Gomphocarpus fruticosus](Courtesy: Van Wyk et al. 1997)
2.2.1.9 *Heteromorpha arborescens* (Spreng) Cham. &. Schltldl

*H. arborescens* belongs to the family *Apiaceae*. The plant is commonly known as parsley tree. In Zulu and Xhosa it is known as “umbangandlala” and “mkatlala” in Sotho. It is a woody shrub or small tree approximately 15 metres in height. The bark is scale–like and is easily peels off. The flowers are yellow and the flower stalks arise from the same point. The bark and leaves (Figure 2.9) are medicinally used to treat headaches, fever, asthma, coughs, dysentery, infertility, abdominal pains and colic (Van Wyk *et al*., 1997; Lundgaard *et al*., 2008). The compounds falcarindiol, germacrene D, asacirin, sabinene and α-pinene have been isolated from *H. arborescens*. Falcarindiol has been isolated from the roots. Germacrene D, asacirin, sabinene and α-pinene have been isolated from the leaves. Falcarindol has been reported to have antifungal, antibacterial and analgesic activity (van Wyk *et al*., 1997; van Wyk & Gericke, 2000). Falcarindol has been reported to inhibit cyclooxygenase-1 (COX-1) (Lundgaard *et al*., 2008). *H. arborescens* has been reported to have antibacterial activity against Gram positive bacteria such as *Staphylococcus aureus*, *S. epidermidis*, *Bacillus subtilis*, *Micrococcus kristinae* and *Streptococcus faecalis* (Nkomo and Kambizi, 2009). The stem and the leaves were used for this study.

**Distribution of *H. arborescens***

*H. arborescens* is extensively distributed in South Africa.
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Figure 2.9 *Heteromorpha arborescens* (a) bark (b) leaves and flowers (Courtesy: Van Wyk *et al.*, 1997)

2.2.10 *Plectranthus ecklonii* Benth.

*Plectranthus ecklonii* belongs to the family *Lamiaceae*. *P. ecklonii* is a shrub (Figure 2.10) which grows to about 2 metres tall growing best in a semi shade. *Plectranthus* species including *P. ecklonii* are traditionally used to treat stomachaches, nausea, vomiting and meningitis (Lukhoba *et al.*, 2006). The leaves of *P. ecklonii* are used to treat skin infections. *P. ecklonii* has been reported to be traditionally used for its anti-inflammatory and antifungal properties (Figueiredo *et al.*, 2010). The aqueous extract of *P. ecklonii* has been reported to have antibacterial activity against *Streptococcus mutans* and *Streptococcus sobrinus*. In addition *P. ecklonii* also inhibited the formation of the biofilm of the two bacteria. The *P. ecklonii* extract further inhibited the glucosyltransferase and hence the extract may be used in the prevention of dental caries. The main compound present in *P. ecklonii* said to be responsible for this action is rosmarinic acid (Figueiredo *et al.*, 2010). Other species of *Plectranthus* such as *P. laxiflorus* and *P. madagascariensis* have been reported to be used in South Africa for the treatment of tuberculosis.
related diseases (McGaw et al., 2008). Ecklonoquinone A and B have been previously isolated from *P. ecklonii* (DNP, 2010). Other compounds that have been previously isolated from *P. ecklonii* are: 11-hydroxy-19-(methyl-buten-2-oyloxy)-abienta-5,7,9(11),13-tetraene-12-one), 11-hydroxy-2α-(3,4dihydroxy-benzoyloxy)abieta-5,7,9(11),13-tetraene-12-one) and 7α-formyloxy-6β,12-dihydroxy-abieta-8,12-diene-11,14-dione (Van Zyl et al., 2007). These compounds were isolated from the leaves and were reported to have antiplasmodial activity (Van Zyl et al., 2007). The constituents of *Plectranthus* plants mainly diterpenoids have been found to have antimycobacterial activity (Rijo et al., 2010). Other compounds that have been previously isolated from *P. ecklonii* are cirsimaritin, ladanein and salvigenin (Grayer et al., 2010). Parviflorn D and F have been isolated from *P. ecklonii* and have been found to have antibacterial activity against *Mycobacterium tuberculosis* and *L. monocytogenes* (Nyila et al., 2009). The leaves were used for this study.

**Distribution of *P. ecklonii***

*P. ecklonii* is widely distributed in South Africa, Australia, New Zealand, Mexico and the United States.

![Figure 2.10 Shrubs of *P. ecklonii* with leaves and purple flowers.](image)
2.2.11 Senecio inornatus DC

*S. inornatus* belongs to the family *Asteraceae*. The plant is an herb with an upright stem. The leaves and stem are medicinally used to treat various illnesses such as chest pains, headaches, swellings, burns and sores. *S. inornatus* has been reported as one of the plants that is used in South Africa for the treatment of respiratory or chest complaints and coughing (McGaw *et al.*, 2008). *Senecio* species are characterised by the presence of macrocyclic pyrrolizidine alkaloids such as toxic senecionine and the non-toxic platyphylline. Senecionine has been isolated from the aerial parts of the plant. Senecionine has been reported to have antineoplastic activity (van Wyk *et al.*, 1997). The leaves were used for this study.

**Distribution of *S. inornatus***

The plant is widely distributed in South Africa especially in the eastern part of the country (Brand *et al.*, 2009).

2.2.12 Tulbaghia violacea Harv.

*T. violacea* belongs to the family *Alliaceae*. The plant is commonly known as wild garlic. In Zulu is known as “ishaqa”. *T. violacea* is a bulbous plant with long leaves arising from the fleshy base. The purple flowers occur in groups at the tip of a thin stalk (Figure 2.11). The plant is characterised by a strong smell of garlic when damaged (Van Wyk *et al.*, 1997). The leaves and bulbs are medicinally used to treat fever, colds, asthma, tuberculosis (Van Wyk,
Alliin is the main sulphur-containing compound of the whole plant. The bulb of *T. violacea* has been previously (Buwa & Afolayan, 2009) found to have antibacterial activity against *Escherichia coli*, *Bacillus cereus* and *Staphylococcus aureus*. The compounds, Bis[(methylthio)methyl] disulfide, Bis[(methylthio)methyl] disulfide 2,2-Dioxide, Bis[(methylthio)methyl] disulfide 4-Oxide and marasmine have been previously isolated from *T. violacea* (DNP, 2010). The leaves were used for this study.

**Distribution of *T. violacea***

*T. violacea* is found mainly in the Eastern Cape and the southern parts of KwaZulu-Natal province.

![Tulbaghia violacea with purple flowers](image)

*Figure 2.11* *Tulbaghia violacea* with purple flowers (Courtesy: Van Wyk et al. 1997)

**2.2.13 *Ziziphus mucronata* Wild.**

*Ziziphus mucronata* belongs to the family *Rhannaceae*. It is commonly known as buffalo-
thorn. In Zulu it is known as “umhlakaniso”, “umphafa” in Xhosa, “mokgalo” in Tswana and Pedi. It has a greyish-brown bark and sharp thorns are found on the twigs. The fruits are small round berries (Figure 2.12). The bark or leaves are medicinally used to treat coughs, chest problems, and diarrhoea, sore and glandular swellings. Decoctions of roots and leaves are applied externally to boils, sores and glandular swellings (Van Wyk et al., 1997; Van Wyk and Gericke, 2000). In previous study *Z. mucronata* was found to possess antibacterial activity against *Enterococcus faecalis* and *Staphylococcus aureus* (MacGaw et al., 2007). Also in another study methanol extracts of *Z. mucronata* have been found to have antibacterial activity against *B. subtilis*, *S. aureus* and *S. epidermis* (Rabe and Van Staden, 1997). Mucronine D and sanjoinine compounds have been isolated from the stem bark of *Z. mucronata* (Van Wyk et al., 1997; Van Wyk and Gericke, 2000). The leaves were used for the present study.

**Distribution of *Z. mucronata***

*Z. mucronata* is widely distributed in South Africa with the exception of the Western Cape province (van Wyk et al., 1997).
2.3 References


Plectrantus ecklonii leaves on the viability, glucosyltransferase activity and biofilm formation of Streptococcus sobrinus and Streptococcus mutans. Food Chemistry 119, 664-668.


plant tissues of *Catharanthus roseus* and hyoscyamine and scopolamine in root tissues of *Datura stramonium* by thin layer chromatography. Phytochemical Analysis 3, 117-121.


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