Journal of Medicinal Plants Research Vol. 5(9), pp. 1606-1612, 4 May, 2011
Available online at http://www.academicjournals.org/JMPR
ISSN 1996-0875 ©2011 Academic Journals

Full Length Research Paper

Curtisia dentata: Ethnopharmacological application

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Accepted 8 February, 2011

Ethnopharmacology is now being integrated into the mainstream medicine all over the world including South Africa due to the increasing popularity of medicinal plants in the treatment of various infections. Several plants have been used in various communities for the treatment of various diseases. *Curtisia dentata* a medicinal plant is among the most commonly used medicinal plants in South Africa; the plant is used in the treatment of diarrhea amongst other diseases. There is dearth in information in its antimicrobial potentials as well as phytochemical and toxicological profiles. Investigation of antimicrobial potentials of *C. dentata* will lead to the discovery of chemical substances that can possibly be used in the development of novel chemotherapeutic agents for the treatment of infections such as diarrhea, candidiasis and other microbial infections.

Key words: Ethnopharmacology, South Africa, *Curtisia dentata,* diarrhea, toxicology, medicinal trade market.

INTRODUCTION

Ethnopharmacology, the science of application of indigenous or local medicinal remedies including plants for treatment of diseases (Gurib-Fakim, 2006; Pande et al., 2008) has been the mainstay of traditional medicines of the entire world and currently been integrated into mainstream medicine. Different catalogues including *De Materia Medica, Historia Plantarum, Species Plantarum* have been variously published in attempt to provide scientific information on the medicinal uses of plants (Gurib-Fakim, 2006). A medicinal plant is a plant whose parts including leaves, roots, rhizomes, stems, barks, flowers, fruits, grains or seeds roots are employed in the control or treatment of a disease condition and therefore contains chemical components that are medically active. These non-nutrient plant chemical compounds or bioactive components often referred to as phytochemicals or phytoconstituents are responsible for protecting the plant against microbial infections or infestations by pests (Pieters and Vlietinck, 2005; Gurib-Fakim, 2006; Doughari et al., 2009). Consequently, medicinal plants are potential sources of new compounds of therapeutic value and as sources of lead compounds in drug development (Matu and van Staden, 2003).

Humans have discovered the secret of exploiting these phytoconstituents in the control of various health ailments through the use of plants for medicinal purposes. The use of traditional medicinal plants dates back since antiquity (Gurib-Fakim, 2006; Egwaikhide and Gimba, 2007) and the types of plants and methods of application vary from locality to locality. It has been reported that 80% of rural dwellers all over the world especially in Africa rely on plants as means of treating various diseases (Bodeker and Kronenberg, 2002; Matu and van Staden, 2003; Gurib-Fakim, 2006; Upadhyay et al., 2007). Logistics and beaurocracy associated with modern health, inadequate facilities, limited access to formal and adequate health services, high cost of antibiotics and other drugs, and inaccessibility has forced the underprivileged communities to continue depending on traditional plants as their sources of medicines (Matu and van Staden, 2003). Consequently, a single plant may be used for the treatment of various disease conditions depending on the community.

Several ailments including fever, asthma, constipation, esophageal cancer and hypertension have been treated

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with traditional medicinal plants (Cousins and Huffman, 2002; Saganuwan, 2010). The plants are applied in different forms such as poultices, concoctions of different plant mixtures, infusions as teas or tinctures or as component mixtures in porridges and soups administered in different ways including oral, nasal (smoking, snoffing or steaming), topical (lotions, oils or creams), bathing or rectal (enemas) (Gurib-Fakim, 2006). Despite the widespread application of plants in traditional medicines and their rapidly increasing popularity even among urban dwellers as well as the educated class, scientific analyses of the purported benefits of many plants are still scant. The increasing acceptability is not unconnected with the increasing inefficacy of many modern drugs used for the control of many infections such as typhoid fever, gonorrhea, and tuberculosis. The development of resistance by several bacteria to various antibiotics (WHO, 1996) has forced the scientific, medical, research and the academic community to delve into investigating alternative sources of treatments to these recalcitrant bacteria.

In addition, the increase of opportunistic infections especially with Acquired Immune Deficiency Syndrome (AIDS) patients and individuals on immunosuppressive chemotherapy, toxicity of many antifungal and antiviral drugs has further underlined the need of searching for more new drug substances (Maregesi et al., 2008). Just as in several other parts of the world, medicinal plants are an integral part of African culture. In South Africa, 21st century drug therapy is used side-by-side with traditional African medicines to heal the sick (van Wyk et al., 1997). In their separate studies on six South African urban centers of a total population of over 1.5 million, Hirschowitz and De Castro (1995) and Mander (1998) reported that 70% of this population visits a traditional healer on an average of three times a year. The country is also endowed with a very rich biodiversity of natural plant resources (van Wyk et al., 1997; McGaw and Eloff, 2008; van Wyk, 2008) useful as medicinal plants. These plants span an estimated 147 plant families amongst which the Fabaceae, Asteraceae, Euphorbiaceae, Rubiaceae and Orchidaceae families are the most popular within the Zulu, Sotho and Xhosa ethnomedicine (Hutchings et al., 1996).

The most commonly preferred plant part, the stem bark, accounts for approximately 27% of market produce traded annually in KwaZulu–Natal (Mander, 1998). Common medicinal plants employed as local health remedies include *Sutherlandia frutescens* (for flu, as blood purifier and all-purpose tonic) (van Wyk et al., 1997; Mncwangi and Viljoen, 2007), *Bridelia micrantha* (Euphorbiaceae, for diarrhoea, stomach ache, sore eyes), *Combretum molle* (Combretaceae, for fever, abdominal pains, convulsion, worm infections), *Combretum coffrum* (Combretaceae, for conjunctivitis) and *Terminalia sericea* (for Cough, diarrhoea, skin and wound infections) (Bessong et al., 2004; McGaw and Eloff, 2008). Members of the Cornaceae family have been subject of extensive phytochemical and pharmacological research (Lee et al., 2000). There are reports of various compounds including flavonoids, phenolic compounds and terpenoids isolated from one of the Cornaceae family, *Cornus controversa* (Lee et al., 2000). Antimicrobial and antihelminthic activities of some members of this family have also been reported. Dulger and Gonuz (2004) reported activity of the ethanol extracts of *Cornus mas* against *Pseudomonas aeruginosa, Proteus vulgaris* and *Micrococcus luteus*.

The genus "*Curtisia"* of the Cornaceae family was first named by the botanist William Curtis. The species name *"dentata"* is simply coined from the Latin version "toothed", referring to the slightly serrated margins of its leaves. Previous reports indicate that the plant is potent against some pathogenic bacteria, fungi and some parasites. Enwerem et al. (2001) has earlier reported the antihelminthic activity of betulinic acid, a chemical compound isolated from *C. dentata* against *Caenorhabditis elegans,* a free-living nematode, at a concentration of 500 µg/mℓ after 7 days of incubation. Despite reports on some members of the Cornaceae family, there is dearth in information on the phytochemical, pharmacological and biological investigations of *C. dentata*. This paper thus provides botanical information and highlights the pharmacological potentials of *C. dentata.*

Description and distribution of *Curtisia dentata*

C. dentata (Cornaceae or dogwood family) or assegai (English common name) is a traditional medicinal plant that has been employed in the treatment of diarrhea and related stomach ailments in South Africa (Notten, 2004). *C. dentata is* locally named in South Africa as - the Zulu Assegai- because of the 'African spear' traditionally made from this tree's strong wood. In Southern Africa the common names include, assegaai (Afrikaans); uSirayi, umGxina (Xhosa), umLahleni (Xhosa, Zulu), uMagunda, uMaginda, umBese, umPhephelelangeni (Zulu), iliNcayi, isiNwati (Stwanee), modula-tshwene (Northern Sotho), musangwe, mufhefhera (Venda) and modula-shtwene (Pede) (Notten, 2004; Shai et al., 2008). Of the 15 plant genera found in the Cornaceae family, only the *Curtisia* genera are found in Africa (Shai et al., 2008). The plant is an attractive medium-sized tree with bark dark and fissured in square patches; young branches covered in dense rusty brown hairs. The plant, when young is velvety to the touch and bronze-gold in colour. The leaves are smooth glossy and opposite, ovate to broadly elliptic, up to 10 cm in length. The leaf surface is leathery, shiny dark green above, light green and covered in woolly hairs with conspicuous venation below; covered in dense rusty brown hairs with a sharply pointed apex and strongly margined toothing. The flowers are small,

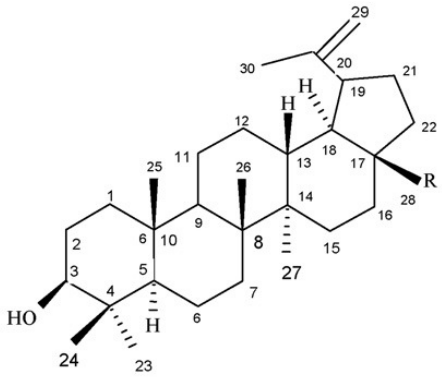
Figure 1. *Curtisia dentata* full plant.

inconspicuous and odourless occurring in branched terminal heads, up to 12 cm long, cream, covered in soft, light grey hairs. *C. dentata* fruits are small rounded to oval fleshy bitter berries about 10 mm in diameter, white, turning red when ripe and crowned with the calyx remains. The wood is tough, hard, heavy, fine-grained, dull red, used in the past for furniture, rafters and flooring. *C. dentata* is a very decorative tree, even when small (Figure 1) and is usually cultivated from the seed (Notten, 2004).

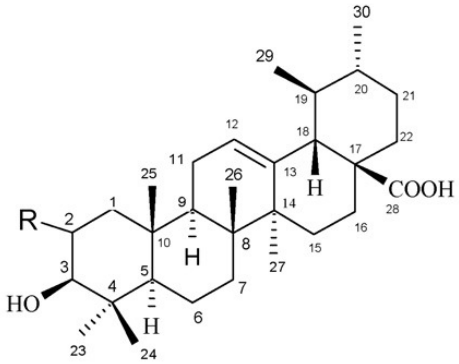
The plant has a worldwide distribution and especially on mountains, evergreen forests and along the margins of forests and grasslands (Notten, 2004). 'Assegai tree' as it is commonly called, grows in the forests of South Africa and Swaziland, ranging from sea level to 1800 m elevation, and from Cape Town in the south to Limpopo province in the north. In deep Afromontane forest *C. dentata* grows into a tall tree, but on open mountain slopes and by the coast, the plant remains a small bushy tree. In Southern Africa in general, *C. dentata* is found in Zimbabwe, Mozambique, South Africa (Limpopo, Mpumalanga, KwaZulu-Natal, Eastern and Western Cape Provinces) and Swaziland (Shai et al., 2008). The plant, been in decline in some areas as its bark is highly valued for traditional medicine.

Medicinal properties and antimicrobial potentials of *Curtisia dentata*

C. dentata has been employed in the treatment of various ailments. The stem bark is used by Southern African cultures as an aphrodisiac, a blood purifier and as treatment against various stomach ailments and diarrhea (Pujol, 2000). In the Eastern Cape Province of South Africa the local populations use the bark to treat



Lupeol (**1**)	R = CH_3
Betulinic acid (**2**)	R = COOH



Ursolic acid (**3**)	R = H
2α-hydroxyursolic acid (**4**)	R = αOH

Figure 2. Structures of some chemical compounds isolated from leaf extracts of *Curtisia dentata* (Shai et al., 2008).

heart-water in cattle (Dold and Cocks, 2001). Traditional herbal practitioners use this species in special mixtures because it is scarce and endangered. *C. dentata* is also used for the treatment of pimples (Shai et al., 2009a; Dold and Cocks, 2001). The ethanol and aqueous extracts of the plant have been reported to exhibit antibacterial activity against *Bacillus subtilis* (McGaw et al., 2000).

Shai et al. (2009a) reported the activity of acetone extracts of leaves, twigs and stem barks of the plant against *E. coli*, *S. aureus*, *P. aerugenosa*, *E. faecalis* as well as *C. albicans* as well as inhibition of motility in some parasitic and free living nematodes (Shai et al., 2008; 2009a, b).

Chemical constituents

There is paucity of reports of phytochemical, pharmacological and biological investigations of *C. dentata* probably due to its scarce nature. Other members of the Cornaceae family such as *Cornus controversa* however, have been subjects of extensive phytochemical and pharmacological research with various flavonoids, phenolic compounds and terpenoids being reported (Lee et al., 2000). For the first time however, Doughari et al. (2010a) reported the presence of tannins, flavonoids (Figure 2), saponins, anthraquinones, steroids and glycosides in various extracts of the plant (Doughari et al., 2010a). The isolation of four antibacterial and antifungal triterpenoids through bioactivity guided fractionation and bioautogram studies was also for the first time reported by Shai et al. (2007; 2008). Their study revealed that the leaf extracts of the plant contained a greater number of antifungal compounds including lupeol, betulinic acid, ursolic acid and 2-alpha-hydroxyursolic acid (Figure 2). Several of these compounds displayed common R_f values in thin layer chromatography. Betulinic acid, ursolic acid and 2- alpha-hydroxyursolic acid

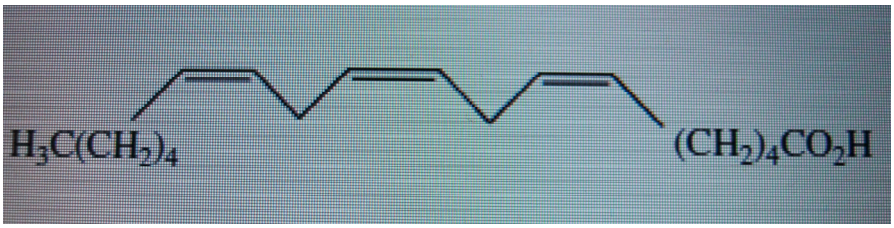


Figure 3. Structure of linoleic acid.

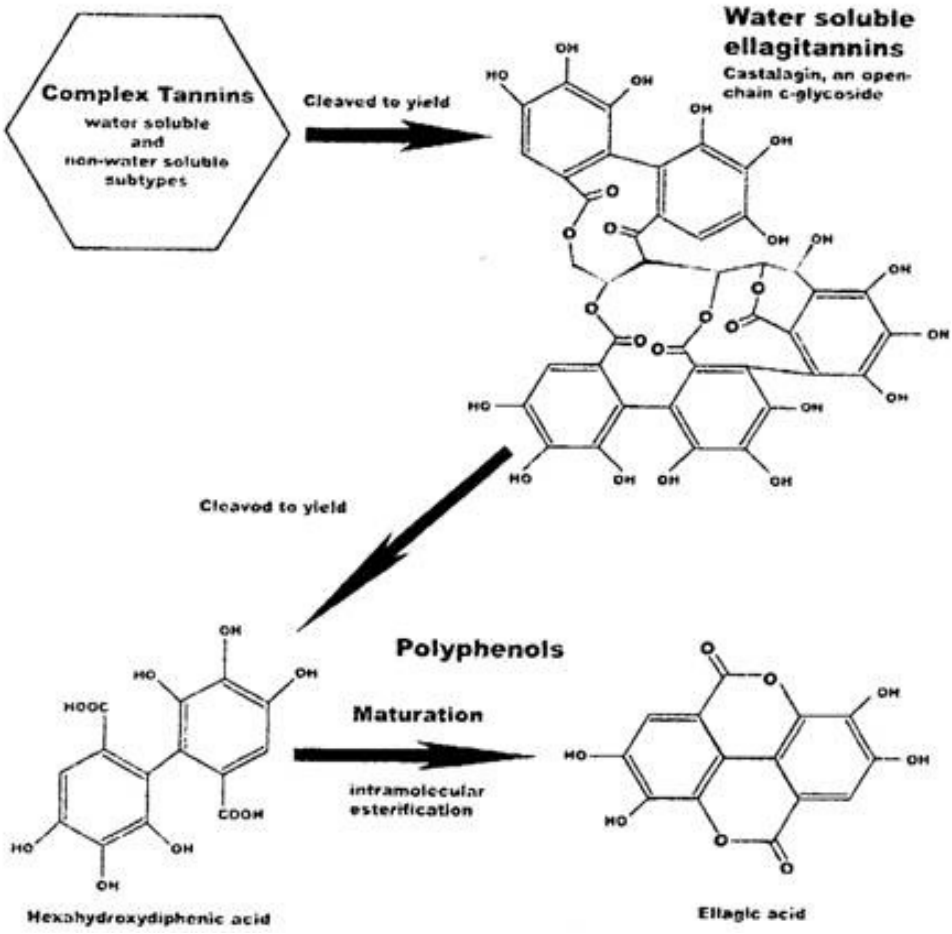


Figure 4. Structure of some ellagitannins found in extracts of *Curtisia dentata* (Barron, 2001).

appreciably inhibited fungal growth with minimum inhibitory concentration (MIC) values ranging from 8 to 63 µg/ml.

The study provided information on the antimicrobial compounds of this species, as well as a preliminary rationale for the use in traditional South African medicine. Another study by Breuer et al. (1978) also reported the presence of the fatty acid linoleic acid ($C_{17}H_{31}COOH$) - an unsaturated fatty acid (Figure 2), considered essential to the human diet, responsible for cell development and regulation of cellular metabolism. *C. dentata* also contains ellagitannins (complex tannins) (Figures 3, 4 and 5) which are hydrolysable tannins (yielding polyphenols) mainly glucose esters of hexahydroxydiphenic acid and its congeners (Bate-smithi et al., 1975; Barron, 2001).

Challenges of trade and harvesting to *Curtisia dentata* sustainability

In South Africa there is an increase in demand for

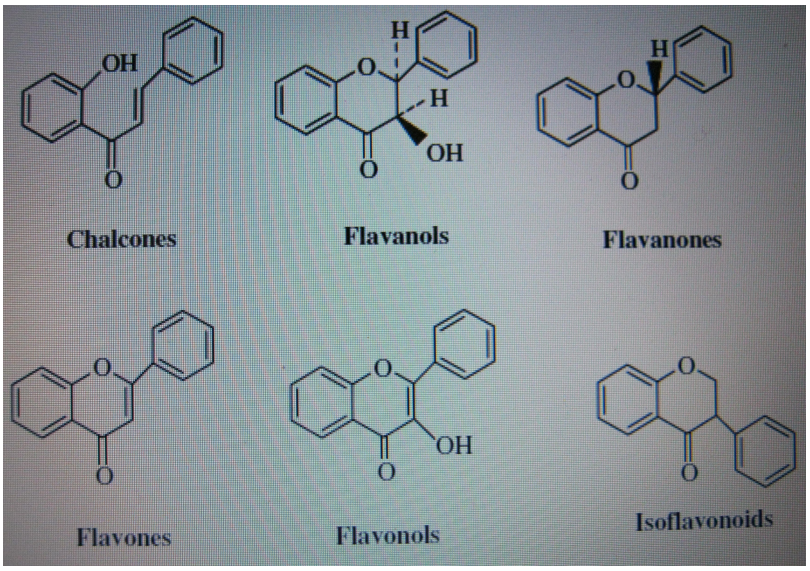


Figure 5. Basic structures of some flavonoids.

plant-derived medicines which has created a trade in indigenous plants estimated to be worth approximately R270 million per annum (Dold and Cocks, 2002). This demand has resulted in more than 700 plant species being actively traded for medicinal purposes throughout the country. Consequently, there is an intensive harvesting of wild material which has posed a serious threat to biodiversity in the region. With the increasing harvesting pressures on traditional supply areas, there is a growing shortage in supply of the popular medicinal plant species (van Wyk, 2008). One such affected plants just like most African medicinal plants, is *C. dentata.* The plant is in high demand with a high price in South Africa. It is among the ten most commonly sold plant species in the Eastern Cape Region of South Africa and among the sixty most frequently traded plants. Because the plant is scarce and endangered, traditional medicine practitioners use it in special herbal mixtures (Cunningham, 1988). Due to heavy trading the plant has become vulnerable, scarce and in decline, therefore making it conservation dependent (Dold and Cocks, 2002).

The stem bark of the plant is a common feature in the traditional medicinal trade in South African herbal markets. Because of the need to conserve the plant species, the government enlisted it among the 'nationally protected trees' (Pilot State of the Forest Report, 2005). This therefore calls for stricter management measures to ensure its conservation.

Challenges on research and ethnopharmacological applications of *Curtisia dentata*

African medicinal plant resources are under the threat of extinction. This is as a result of over-exploitation due to excessive utilization, commercialisation, habitat destruction and other natural and man-made destructive influences. Deliberate targeted conservation measures must be taken in order to ensure their continued availability. The establishment of medicinal botanical gardens, herbarium and farms should be vigorously pursued in this respect. With the increasing relevance the world including researchers and scientists are giving to traditional medicinal plants, and with the global increase in incidence of multidrug resistance by microorganisms to antimicrobial agents, it is very pertinent that medicinal plants should be adequately studied and conserved. The significance of *C. dentata* in the treatment of various infections including diarrhea if properly investigated will go a long way in curbing the high incidences of these infections especially diarrhea, which is currently ravaging the African continent. Currently 2 to 3 billion incidences of diarrhea and 3 to 5 million deaths from the disease is said to occur annually in the developing countries (WHO, 1996; Sanchez and Holmgren, 2005; Doughari et al., 2010b) including South Africa (Lin et al., 2002).

The fact that the plant is used in the treatment of diarrhea calls for the investigation of its antimicrobial activities against diarrhea causing bacteria such as *Escherichia coli, Shigella dysenterie, Salmonella* spp and other related bacteria.

Phytochemical and toxicity studies of this plant should also be carried out, to enable identification of active chemical constituents and cautions to be issued of dangerous practices or its toxic effects. The high demand of *C. dentata* in the South African medicinal trade market and the dearth in information on its antimicrobial potentials as well as phytochemical and toxicological profiles calls for more vigorous research in this area as well as stricter conservation measures.

ACKNOWLEDGEMENT

The study was supported by Cape Peninsula University of Technology, Cape Town South Africa through the University Research Fund RP03.

REFERENCES

Barron J (2001). Ellagic Acid and Red Raspberries, the truth about ellagic acid. The Barron Report. 10(3). Available at http://www.jonbarron.org/baseline-health-program/09-01-2001.php. Accessed on 24th September, 2010.

Bate-smithi EC, Ferguson K, Hutson K, Jensen SR, Nielsen BJ, Swain T (1975). Phytochemical interrelationships in the Cornaceae. Biochem. Syst. Ecol., 3: 79-89.

Bessong PO, Obi CL, Igumbor E, Andreola M, Litvak S (2004). *In vitro* activity of three selected South African medicinal plants against human immunodeficiency virus type 1 reverse transcriptase. Afr. J. Biotechnol., 3(10): 555-559.

Bodeker G, Kronenberg FA (2002). Public health agenda for traditional, complementary, and alternative medicine. Am. J. Pub. Health, 92: 1582-1591.

Breuer B, Stuhlfauth T, Fuck H, Huber H (1987). Fatty acids of some cornaceae, hydrangeaceae, Aquifoliaceae, hamamelidaceae and styracaceae. Phytochem., 26(5):1441-1445.

Cousins D, Huffman MA (2002). Medicinal properties in the diet of Gorillas: an ethno-pharmacological evaluation. Afr. St. Monographs, 23(2): 65-89.

Cunningham AB (1988). An investigation of the herbal medicine trade in Natal/KwaZulu. Investigational Report No. 29. Institute of Natural Resources, University of Natal, Pietermaritzburg, South Africa.

Dold AP, Cocks ML (2002). The trade in medicinal plants in the Eastern Cape Province, South Africa. South Afr. J. Sci., 98: 589-597.

Dold AP, Cocks ML (2001). Traditional veterinary medicine in the Alice district of the Eastern Cape Province, South Africa. South Afr. J. Sci., 97: 375-379.

Doughari JH, Ndakidemi PA, Human IS, Benade S (2010a). Antimicrobial susceptibility profile and effect of stem bark extracts of *Curtisia dentata* on multi-drug resistant verotoxic *Escherichia coli* and *Acinetobacter* spp. isolates obtained from water and wastewater samples. Conference Abstracts, International Conference on Antimicrobial Research (ICAR), 2010, Valladolid, Spain.

Doughari JH, Ndakidemi PA, Human IS, Benade S (2010b). Verocytotoxic diarrhogenic bacteria and food and water contamination in developing countries: a challenge to the scientific and health community. Rev. Infect., 1(4): 197-201.

Doughari JH, Ndakidemi PA, Human IS, Benade S (2009). Phytochemicals as chemotherapeutic agents and antioxidants: possible solution to the control of antibiotic resistant verocytotoxin producing bacteria. J. Med. Plants Res., 3(11): 839-848.

Dulger B, Gonuz A (2004). Antimicrobial activity of some Turkish medicinal plants. J. Biol. Sci., 7: 1559-1562.

Egwaikhide PA, Gimba CE (2007). Analysis of the phytochemical content and anti-microbial activity of *Plectranthus glandulosis* whole plant. Middle-East J. Sci. Res., 2(3-4): 135-138.

Enwerem NM, Okogun JJ, Wambebe CO, Okorie DA. Akah PA (2001). Anthelmintic activity of the stem bark extracts of *Berlina grandiflora* and one of its active principles, Betulinic acid. Phytomed., 8: 112-114.

Gurib-Fakim A (2006). Medicinal plants: Traditions of yesterday and drugs of tomorrow. Mol. Aspects Med., 27: 1-93.

Hirschowitz R, De Castro J (1995). In A National Household Survey of Health Inequalities in South Africa, Community Agency for Social Enquiry, Durban, 6: 63-76.

Hutchings A, Scott AH, Lewis G, Cunningham AB (1996). Zulu Medicinal Plants: An Inventory. University of Natal Press, Pietermaritzburg.

Lee D, Kang SJ, Lee SH, Ro J, Lee K, Kinghorn AD (2000). Phenolic compounds from the leaves of *Cornus controversa*. Phytochem., 83: 405-407.

Lin J, Puckree T, Mvelase TP (2002). Anti-diarrhoeal evaluation of some medicinal plants used by Zulu traditional healers. J. Ethnopharmacol., 79: 53-56.

Mander M (1998). Marketing of Indigenous Medicinal Plants in South Africa. A case Study in KwaZulu-Natal. Food and Agriculture Organization, Rome.

Maregesi SM, Pieters L, Ngassapa OD, Apers S, Vingerhoets R, Cos P, Vanden Berghec DA, Vlietinck AJ (2008). Screening of some Tanzanian medicinal plants from Bunda district for antibacterial, antifungal and antiviral activities. J. Ethnopharmacol., 119: 58-66.

Matu EN, van Staden J (2003). Antibacterial and anti-inflammatory activities of some plants used for medicinal purposes in Kenya. J. Ethnopharmacol., 87: 35-41.

McGaw LJ, Eloff JN (2008). Ethnoveterinary use of Southern African plants and scientific evaluation of their medicinal properties. J. Ethnopharmacol., 119(3): 559-574.

McGaw LJ, Jager AK, van Staden J (2000). Antibacterial, anthelmintic and anti-amoebic activity in South African medicinal plants. J. Ethnopharmacol., 72: 247-263.

Mncwangi N, Viljoen A (2007). Indigenous South African medicinal plants part 3: *Sutherlandia frutescens* (Cancer bush/'Kankerbos'). South Afr. Pharm. J., 3: 49.

Notten A (2004). *Curtisia dentata* (Burm.f.) C.A.Sm. South African National Biodiversity Institute's plant information website. Available at: http://www.plantzafrica.com/. Accessed on the 28th September, 2010.

Pande VV, Shastri KV, Khadse CD, Tekade AR, Tankar AN, Jain BB (2008). Assessment of indigenous knowledge of medicinal plants from Vidarbha region of Maharashtra. International J. Green Pharm., 2(2): 69-71.

Pieters L, Vlietinck AJ (2005). Bioguided isolation of pharmacologically active plant components, still a valuable strategy for the finding of new lead compounds? J. Ethnopharmacol., 100: 57-60.

Pilot State of the Forest Report (2005). A Pilot Report to Test the National Criteria and Indicators. Prepared by the Institute of Natural resources for the department of Water Affairs and Forestry. Investigation report Number 253. South Africa. Available at http://www2.dwaf.gov.za/dwaf/cmsdocs/4111State%20of%20the%20forest%20Report%202005.pdf. Accessed on 24th September, 2010.

Pujol J (2000). Nature Africa: The Herbalist Handbook: African Flora, Medicinal Plants. Natural Healers Foundation, Durban.

Saganuwan AS (2010). Some medicinal plants of Arabian Peninsula. Afri. J. Microbiol., 4(9): 766-788.

Sanchez J, Holmgren J (2005). Virulence factors, pathogenesis and vaccine protection in cholera and ETEC diarrhea. Curr. Opin. Immunol., 17: 388-398.

Shai LJ (2007). Characterization of compounds from *Curtisia dentata* (Cornaceae) active against *Candida albicans*. PhD Thesis, Department of Paraclinical Sciences, University of Pretoria, South Africa.

Shai LJ, McGaw LJ, Aderogba MA, Mdee LK, Eloff JN (2008). Four pentacyclic triterpenoids with antifungal and antibacterial activity from *Curtisia dentata* (Burm.f) C.A. Sm. leaves. J. Ethnopharmacol., 119: 238-244.

Shai LJ, McGaw LJ, Eloff JN (2009a). Extracts of the leaves and twigs of the threatened tree *Curtisia dentata* (Cornaceae are more active against *Candida albicans* and other microorganisms than the stem bark extract. South Afr. J. Bot., 75: 363-366.

Shai LJ, Bizimenyera ES, Bagla V, McGaw LJ, Eloff JN (2009b). *Curtisia dentata* (Cornaceae) leaf extracts and isolated compounds inhibit motility of parasitic and free-living nematodes. Onderstepoort. J. Vet. Res., 76(2): 249-256.

Upadhyay PB, Roy S, Kumar A (2007). Traditional uses of medicinal plants among the rural communities of Churu district in the Thar Desert, India. J. Ethnopharmacol., 113: 387-399.

Van Wyk BE (2008). A broad review of commercially important southern African medicinal plants. J. Ethnopharmacol., 119: 342-355.

Van Wyk BE, van Oudtshoorn B, Gericke N (1997). Medicinal Plants of South Africa. Briza Publications, Pretoria.

WHO Scientific working Group (1996). Resistance to antimicrobial agents. Bull. W.H.O., 71: 335-336.