

A Synthesis And Review Of Medicinal Uses, Phytochemistry And Pharmacological Properties Of Herbs In South Africa

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Abstract: Medicinal herbs are an important component of the indigenous pharmacopoeia in South Africa. This study was aimed at providing a critical review of the medicinal uses, phytochemistry and pharmacological properties of South African herbs. Documented information on the medicinal uses, phytochemistry and pharmacological properties of South African herbs was collected from several online sources such as PubMed, Embase, Google Scholar, Science Direct, Medline and SciFinder. In addition, complementary information was obtained from pre-electronic sources such as books, theses and scientific articles obtained from the University library. This study showed that South African herbs are mainly used as protective and love charm, ethnoveterinary medicine, and traditional medicine for cancer, fever, gastro-intestinal problems, headache, malaria, pain, respiratory problems, skin problems, sexually transmitted infections, sores, urinary problems and wounds. Phytochemical compounds identified from the species include alkaloids, anthocyanidins, anthraquinones, coumarins, essential oils, fatty acids, flavonoids, glycosides, homoisoflavanones, lactic acid, lactones, phenols, proanthocyanidins, saponins, steroids, tannins and terpenoids. Pharmacological research revealed that the crude extracts and compounds isolated from some of the documented species demonstrated numerous biological activities.

Keywords: Ethnopharmacology, indigenous pharmacopoeia, medicinal plants, pharmacological properties, phytochemistry, South African herbs, traditional knowledge

1. INTRODUCTION

Medicinal herbs (that is, woody and non-woody plants) are part of the indigenous pharmacopoeia that ensures the primary healthcare of millions of the South African population. Research by Van Wyk et al. [1] revealed that medicinal plants including herbs are an important component of the daily lives of many people and an important part of the South African cultural heritage. Similarly, Mander et al. [2] argued that 72% of the Black African population in South Africa is reliant on medicinal plants, accounting for 26.6 million people in the country. These consumers are from a diverse range of age categories, education levels, religions and occupations [2]. Research done by Van Wyk et al. [1] showed that 50% of pharmaceutical drugs and health products in clinical use in the world are derived from natural products isolated from plants. Therefore, research into medicinal uses, phytochemistry and pharmacological properties of South African herbs offers tremendous potential for developing new pharmaceutical health products and drugs. The ongoing screening of ethnopharmacological properties of South African herbs generated active principles that have great potential in the fight against several global health problems [3-7]. This study therefore, was aimed at reviewing the medicinal uses, phytochemistry and pharmacological properties of South African herbs. It is hoped that this information will highlight the important medicinal and ethnopharmacological properties of South African herbs and provide the necessary baseline data required for future research on this category of species. Literature studies revealed that there is increasing demand for traditional medicines South Africa and future use of such health promoting products must be embedded within efficacy, safe, affordable pharmaceutical products.

2 MATERIALS AND METHODS

A systematic search for medicinal uses, phytochemistry and pharmacological properties of South African herbs was undertaken using a variety ethnobotanical and ethnopharmacological books and other ethnobotanical pre-electronic sources such as book chapters, journal articles and scientific publications obtained from the University library. The major criteria used for selecting the species documented in this study include the following: i. herbs, that is, non-woody or woody sub-shrubs, ii. species categorized as important medicinal plants in South Africa [1,8-10], and iii. commercially important medicinal plants in local, regional and international markets [5,7,11-17]. All publications that could be accessed with any information on the medicinal uses, phytochemistry and pharmacological properties of South African herbs were considered useful. Botanical and family names of the documented species were confirmed using The Plant List managed by the Royal Botanic Gardens, Kew and the Missouri Botanical Garden (<http://www.theplantlist.org/>).

3 RESULTS AND DISCUSSION

2.1 Medicinal uses

Medicinal uses of 15 herbs from different provinces of South Africa are listed in Table 1. The different plant parts such as bulbs, flowers, leaf latex, leaf sap, leaves, roots, stems and whole plants have been used in the treatment of a variety of disease conditions. The species are mainly used as protective and love charm, ethnoveterinary medicine, and traditional medicine for cancer, fever, gastro-intestinal problems, headache, malaria, pain, respiratory problems, skin problems, sexually transmitted infections, sores, urinary problems and wounds (Table 1; Fig. 1). The preparation methods, uses and application of these species are well documented in the common ethnobotanical literature [1,8-10,18-20]. All the species documented in this study are traded as herbal medicines in local, regional and international markets (Table 2) generating economic opportunities for vulnerable groups living

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in peri-urban, rural, and marginalized areas of South Africa [7,11-17].

TABLE 1
MEDICINAL USES OF SOUTH AFRICAN HERBS

Species and family	Common name	Medicinal uses	References	Plant part	Other uses	References
Boophone disticha (L.f.) Herb., Amaryllidaceae	Poison bulb	Bulb used as emetic, hallucinogen, protective charm, purgative and used as ethnoveterinary medicine and used for abdominal pain, bladder pains, cancer, dizziness, eye problems, headache, insomnia, malaria, pain, respiratory problems (asthma, chest pains and dyspnoea), skin problems (abscesses, boils, bruises, burns and rashes), stomachache, swellings, uterus problems and wounds	[1,8]	flower	protective charm and ethnoveterinary medicine, and used for backache, biliousness, bladder problems, blood disorders, bone fractures, cough, fever, gastro-intestinal problems (abdominal distension, diarrhoea, flatulence and stomach ache), kidney problems, lumbago, nausea, respiratory problems, sexually transmitted infections (syphilis and venereal diseases), urinary diseases and during pregnancy to facilitate delivery	[18]
Bowiea volubilis Harv. ex Hook. f., Hyacinthaceae	Climbing potato	Bulb used as abortifacient, anthelmintic, emetic, love and protective charm, purgative, used during pregnancy or childbirth, and used for ascites, backache, bladder pains, constipation, ear and eye problems, gastro-intestinal, haemorrhoids, headache, impotence, infertility, jaundice, oedema, pains, scrofula, skin diseases (rashes, sores and warts), swellings, urinary problems, venereal diseases and wounds	[1,8,15,19]	River pumpkin	Rhizome used as anthelmintic, colic, galactagogue and ethnoveterinary medicine, and used for abdominal pains, bladder problems, bleeding stomach, cancer, colds, dysmenorrhoea, earache, endometritis, gastro-intestinal problems (constipation and stomach pains), headache, impotence, infertility, kidney problems, poor appetite, psoriasis, pulmonary problems, rheumatic fever, scabies, sexually transmitted infections (gonorrhoea and syphilis), sores, swellings, ulcers, urinary infections and wounds, also used as an ingredient in herbal concoction known as inembe* and isihlambezo# taken to ensure an easy childbirth or augment or induce labour	[1,5,8,9,18,19]
Bulbine frutescens (L.) Willd., Asphodelaceae	Bulbine and burn jelly plant	Leaf gel, leaves and roots used against convulsions, human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS), Kaposi sarcoma, mouth ulcers, skin diseases (boils, burns, candidiasis, chicken pox, cracked lips, eczema, herpes, rashes and ringworm), urinary tract infections and wounds	[1,7]	Most fragrant helichrysum	Leaves used as anthelmintic, colic, fumigant, insect and parasite repellent, laxative, perfume, protective charm, ritual incense, and used for abdominal pain, backache, conjunctivitis, convulsions, cramps, diabetes, fever, headache, heart problems, high blood pressure, inflammation, insanity, insomnia, kidney problems, menstrual pain, nervous disorders, postpartum bleeding, prostrate problems, respiratory problems (chest pains, colds, cough, flu and tuberculosis), skin infections (acne, eczema, pimples, scabies and skin ulcers), sterility, stomach problems, stroke, tension, toothache, urinary problems and wounds (burns and infections)	[1,5,8]
Clivia miniata (Lindl.) Regel, Amaryllidaceae	Bush lily	Roots and whole plant used as protective charm, and used against fever, infertility, pain, snakebite, urinary problems, wounds, also used as an ingredient in herbal concoction known as inembe* and isihlambezo# taken to ensure an easy childbirth or augment or induce labour	[1,7,9,18]	Hoodia gordonii (Masson) Sweet ex Decne, Apocynaceae	Stem used as functional food, to suppress hunger and thirst, and used medicinally as a stomachic and for treatment of haemorrhoids, tuberculosis, diabetes, indigestion, hypertension and stomach ache	[1,7]
Dicoma capensis Less., Asteraceae	Fever bush	Leaves used as diuretic and tonic, and used against back pain, bladder problems, cancer, diabetes, diaphoretic, expel retained placenta, febrile conditions, fever, gastro-intestinal problems (constipation, diarrhoea, flatulence and stomach problems), haemorrhoids, high blood pressure, kidney problems, liver problems, nausea, respiratory problems (asthma, colds, cough, influenza and tuberculosis) and rheumatism	[1,8]	Mentha longifolia (L.) Huds., Lamiaceae	Leaves, roots and stems used against fever, flatulence, headache, hysteria, indigestion, menstrual problems, respiratory problems (asthma, bronchial ailments, colds and cough), swollen glands, urinary tract infections and wounds, also	[7-9]
Eucomis	Pineapple	Bulb used as colic, enema,	[1,8,10]			

Merwillia plumbea (Lindl.) Speta, Hyacinthaceae	Blue hyacinth, blue squill and wild squill	Bulb used as aphrodisiac, enema, purgative and used as ethnoveterinary medicine, and used for boils, fractures, infertility, sores and wounds, sprains, tumours, and also taken to ensure an easy childbirth or augment or induce labour	[1,7-9]
Pelargonium sidioides DC., Geraniaceae	Black pelargonium	Roots used as anthelmintic, colic, immune stimulant, general tonic, and used as ethnoveterinary medicine, and used against gastro-intestinal problems (diarrhoea, dysentery, gastritis and stomach problems), gonorrhoea, hepatic disorders, menstrual complaints, prolapsed rectum, respiratory problems (bronchitis, cough and tuberculosis), skin pimples and wounds	[7-9]
Pentanisia prunelloides (Klotzsch ex Eckl. & Zeyh.) Walp., Rubiaceae	Wild verbena	Leaves and roots used as emetic, poison antidote, protective charm, purgative, tonic, and used as ethnoveterinary medicine, and used against bladder problems, breast cancer, burns, diabetes, dysmenorrhoea, fever, gastro-intestinal problems (constipation, diarrhoea, dysentery and stomach problems), haemorrhoids, headache, heartburn, heart problems, internal tumour, kidney problems, pain, palpitations, respiratory problems (chest pains, colds, cough, influenza and tuberculosis), retained placenta, rheumatism, schizophrenia, sexually transmitted infections (syphilis and venereal diseases), skin infections (boils, eczema, itching, infection, inflammation, pimples, rash and shingles), snakebite, sores and wounds, sprains, swellings, toothache and ulcers	[1,8,18-20]
Sceletium tortuosum (L.) N.E.Br., Aizoaceae	Sceletium	Whole plant used as hypnotic, sedative, neurological and psychiatric disorders	[1,7]
Xysmalobium undulatum (L.) Aiton f., Apocynaceae	Uzara	Roots used as colic, against diarrhoea, dysentery, dysmenorrhoea, headache, indigestion, oedema, sores and wounds	[1,7]

erythrophyllum (Burch.) Sond. (roots), Crinum spp. (bulb), Gomphocarpus fruticosus (L.) W.T. Aiton (roots), G. perpensa (rhizomes), Gymnanthemum corymbosum (Thunb.) H. Rob. (roots), Pentanisia prunelloides (Klotzsch) Walp. (roots), Rhoicissus tridentata subsp. cuneifolia (roots), Scadoxus puniceus (bulb), and Typha capensis (Rohrb.) N.E.Br. (rhizome).

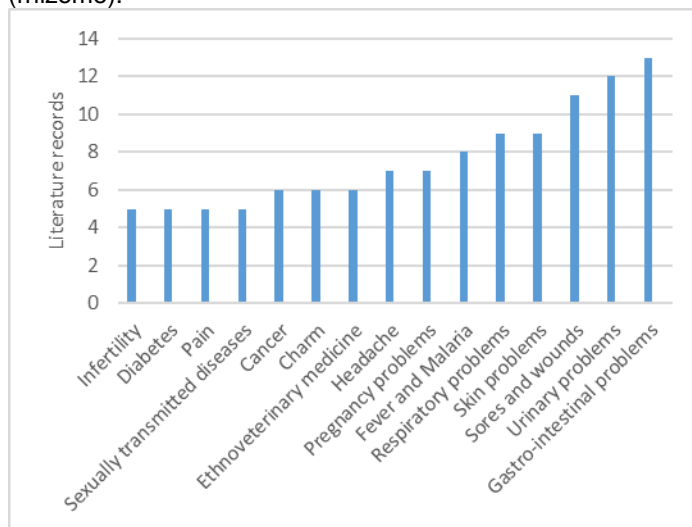


Fig. 1: Medicinal uses of South African herbs based on literature records

TABLE 2
SOUTH AFRICAN HERBS TRADED IN LOCAL, REGIONAL AND INTERNATIONAL MARKETS

Species and family	Countries involved in trade	References
B. disticha	Bulb traded in Eswatini, Lesotho, Malawi and South Africa	[7,11,13,14,16,17]
B. volubilis	Bulb traded in Eswatini, South Africa and Zimbabwe	[7,11-17]
B. frutescens	Bulb is traded in South Africa	[7,13,16]
C. miniata	Bulb and whole plant traded in South Africa	[7,11-13,15,17]
D. capensis	Traded in South Africa	[7]
E. autumnalis	Bulb traded in Eswatini and South Africa	[7,11-13,15,17]
G. perpensa	Roots traded in South Africa	[7,11-16]
H. odoratissimum	Leaves and stems traded in South Africa	[7,11,13,14,16]
H. gordonii	Traded in Botswana, Namibia and South Africa.	[5,7]
M. longifolia	Leaves and stems traded in Egypt and South Africa	[7,16]
M. plumbea	Traded in South Africa	[7,15,17]
P. sidioides	Traded in Lesotho and South Africa	[5,7]
P. prunelloides	Roots traded in South Africa	[7,11,13,14]
S. tortuosum	Traded in South Africa.	[5,7]
X. undulatum	Traded in Namibia, South Africa and Zimbabwe.	[5,7,13,14]

Inembe* is a herbal concoction prepared from the roots of Cyphostemma natalitium (Szyszyl.) J.J.M. Van der Merwe, Gunnera perpensa L., Rhoicissus tridentata subsp. cuneifolia (Eckl. & Zeyh.) Urton and Triumphetta rhomboidea Jacq. Isihlambezo# is a herbal concoction prepared from Agapanthus africanus (L.) Hoffmans (roots), Callilepis laureola DC. (roots), Clivia miniata (Lindl.) Bosse (leaves), Combretum

2.2 Phytochemistry and pharmacological properties of South African herbs

Table 3 provides a summary of chemical constituents and pharmacological activities of herbs used in South African traditional medicine. Phytochemical compounds identified from the species include alkaloids, anthocyanidins, anthraquinones, coumarins, essential oils, fatty acids, flavonoids, glycosides, homoisoflavanones, lactic acid, lactones, phenols, proanthocyanidins, saponins, steroids, tannins and terpenoids (Tables 3). Some of these phytochemical compounds may be responsible for the pharmacological properties exhibited by the documented species.

TABLE 3
CHEMICAL CONSTITUENTS AND PHARMACOLOGICAL
ACTIVITIES OF HERBS USED IN SOUTH AFRICAN
TRADITIONAL MEDICINE

Species	Known chemical constituents	Pharmacological activity	References	
B. disticha	1-O-acetylbuphanamine, 3-O-methylcrinamidine, 6-hydroxycrinamine, acetovanillone, acetylnerbowdine, buphacetine, buphanamine, buphanidine, buphanisine, chelidonic acid, crinamidine, crinine, distichamine, fatty acids, flavonoids, furfuraldehyde, ipuranol, laevulose, lycorine, nerbowdine, pentatriacontane, phenolics, phytosterol and undulatine	Age-related dementia, analgesic, anticancer, antidepressant, anti-inflammatory, antimicrobial, anti-mutagenic, antioxidant, hallucinogenic, narcotic, hypotensive and vasodilatory	[21-23]	
B. volubilis	Rich in cardiac glycosides such as bovogenin A, bovoruboside, scillirubroside, scilliglaucoside, scillicyanoside and scillipheoside	Anti-inflammatory and antimicrobial	[21,24-26]	
B. frutescens	3,8-dihydroxy-1-methylanthraquinone-2-carboxylic acid, 4'-O-demethylknipholone-4'-O-β-D-glucopyranoside, 4-O-methyleleutherol, 6',8-O-dimethylknipholone, 8-hydroxy-6-methylxanthone-1-carboxylic acid, aloemodin, gaboroquinone A and B, joziknipholone A and B, knipholone, knipholone anthrone, sodium entknipholone 6'-O-sulfate, sodium 4'-O-demethylknipholone 6'-O-sulfate and sodium 4'-O-demethylknipholone-4'-β-D-glucopyranoside 6'-O-sulfate	Anti-cancer, antibacterial, anti-inflammatory, antioxidant, anti-plasmodial, anti-trypanosomal, antiviral and cutaneous wound healing	[27,28]	
C. miniata	α-amino adipic acid, α- and γ-aminobutyric acid, β-aminoisobutyric acid, alanine, allo-isoleucine, asparagine, aspartic acid, caranine, clivacetine, clivatine, cliviahaksine, clivialine, cliviamartine, cliviasindhine, cliviasine, cliviasyaline, clividine, clivimine, clivojuline,	Antioxidant, cytotoxicity, neuroprotective and uterotonic	[29-31]	
D. capensis	clivonidine, clivonine, glutamic acid, glutamine, glycine, haemanthamine, hippeastrine, histidine, isoleucine, leusine, lycorine, lysine, miniatine, ornithine, phenylalanine, proline, serine, threonine, tryptophan, tyrosine and valine	Eudesmanolides, flavonoids, germacranolides, lactones, melampolides, saponins, steroids and terpenoids	[32-33]	
E. autumnalis	Autumnariol, benzopyrones autumnariol, eucosterol, and homoisoflavanones	1,1'-biphenyl-4,4'-diacetic acid, 2-methyl-6-(3-methyl-2-butenyl)benzo-1,4-quinone, 3-hydroxy-2-methyl-5-(3-methyl-2-butenyl)benzo-1,4-quinone, 3,3',4'-tri-O-methyl ellagic acid lactone, 6-hydroxy-8-methyl-2,2-dimethyl-2H-benzopyran, alkaloids, cardiac glycosides, ellagic acid lactone, flavonoids, flavonols, lactic acid, p-hydroxy-benzaldehyde, phenols, proanthocyanidins, pyrogallol, rans-phyt-2-enol, saponins, steroids, succinic acid, tannins, trimethyl ether, Z-methyl lespedezate, Z-venusol, 7,8-dihydroxy-6-(hydroxymethyl)-3-[(Z)-(4-hydroxyphenyl)methylidene]tetrahydro-4aH-pyrano[2,3-b][1,4]dioxin-2-one	Anti-inflammatory and antioxidant, antiplasmodial and cytotoxicity	[21,24,28]
G. perpensa	3,5-dihydroxy-6,7,8-trimethoxy flavone, 3-O-methylquercetin and 3',4',3,5-tetrahydroxy-7-methoxyflavone, helichrysetin and essential oils	Acetylcholin esterase (AChE) enzyme inhibition, anthelmintic, antibacterial, antifungal, antinociceptive, anti-inflammatory, antioxidant, antitumour, lactogenic, and uterotonic	[34-36]	
H. odoratissimum	Oxypregnane, pregnane and steroidal glycosides	Antibacterial, antimycobacterial, antifungal, anti-inflammatory, antioxidant, hepatoprotection, hypoglycemic and cytotoxicity	[37-39]	
H. gordonii	Essential oils, phenolics, flavonoids, phenolic acids, cinnamates, ceramides, sesquiterpenes, terpenes and terpenoids	Antidepressant, anti-diabetic and anti-obesity anticancer, anthemolytic	[40,41]	
M. longifolia		Antimicrobial, antioxidant, antimutagenic, antinociceptive, anti-inflammatory	[42,43]	

M. plumbea	Cardiac glycosides, homoisoflavanones, saponins, gallic acid, ferulic acid, protocatechuic acid, caffeic acid and phenolic acids	, antioxidant, keratoprotective, hepatoprotective, anti-diarrheal, cholinesterase inhibitory, cytotoxicity, insecticidal and spasmolytic anticancer, antihelmintic, anti-inflammatory, antimicrobial, antioxidant and antischistosomal	[21,28]
P. sidoides	6-methoxy-7-(sulfoxy)-2H-1-benzopyran-2-one, 6,8-bis(sulfoxy)-7-methoxy-2H-1-benzopyran-2-one, coumarins, flavonoids, gallic acid-derivatives, hydroxycinnamic acid-derivatives, phenolic, oligo- and polymeric proanthocyanidins	Antibacterial, antimycobacterial, antifungal, antiviral, anticoagulant, antiparasitic and immunomodulatory	[44,45]
P. prunelloides	Alanine, alkaloids, alloisoleucine, α -aminobutyric acid, anthocyanidins, anthraquinones, arabinose, asparagine, aspartic acid, cardiac glycosides, diosgenin, (-)-epicatechin, epicatechin gallate, epigallocatechin gallate, flavonoids, glucuronic acid, hexoses, kaempferol, oleanolic acid, palmitic acid, quercetin, rhamnose, saponins, serine, steroids, tannins and terpenoids, tormentic acid and valine	Antibacterial, antimycobacterial, antifungal, antiviral, antidiabetic, anti-inflammatory, analgesic, antioxidant, uterotonic and cytotoxicity	[46-48]
S. tortuosum	Alkaloids, anthocyanin, anthraquinones, coumarins, glycosides, hordenine, mesembranol, mesembrine, mesembrenone, polyphenols, tannins and terpenes	Anti-inflammatory, antiHIV, antioxidant, cytoprotective and cytotoxicity	[49,50]
X. undulatum	Aglycone, allouzarigenin, allouzarin, alloxysmalogenin, alloxysmalorin, ascleposide, cardiac glycosides, coroglaucigenin, coroglaucigenin 3-O-glucoside, desglucouzarin, desglucoxysmalorin, pachygenol, pachygenol-3 β -O-glucoside, pregnenolone, β -sitosterol, smalogenin, uzarin, uzarigenin, uzaroside, xysmalogenin and xysmalorin	Antibacterial and hepatotoxicity	[51,52]

CONCLUSION

Significant research has been made in the past 100 years into the medicinal uses, phytochemistry and pharmacology of South African herbs. Detailed phytochemical and phytochemical studies, focusing on the mechanisms of action of their bioactive constituents aimed at illustrating the correlation between the medicinal uses and ethnopharmacological properties of the documented species should be the focus of future research on South African herbs. There is need for extensive in vitro and in vivo experiments and clinical trials.

CONFLICT OF INTEREST

No conflict of interest is associated with this work.

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