Cissampelos capensis L.f. (Menispermaceae): Review of its medicinal uses, phytochemical and pharmacological properties

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ABSTRACT

Cissampelos capensis L.f. is a perennial climber widely used as a traditional medicine in South Africa. This study was aimed at providing a critical review of medicinal uses, phytochemical and pharmacological properties of C. capensis. Documented information on the pharmacological properties, phytochemistry and medicinal uses of C. capensis was collected from several online sources such as Scopus, Google Scholar, PubMed and Science Direct, and pre-electronic sources such as book chapters, books, journal articles and scientific publications obtained from the university library. This study revealed that leaf, rhizome and root infusions and decoctions of C. capensis are mainly used as a blood purifier, and traditional medicines for respiratory problems, ulcers, sores and wounds, skin and stomach cancers, snakebite, sexually transmitted infections, skin diseases, diabetes and gastrointestinal problems. Phytochemical compounds identified from the species include alkaloids, essential oils, flavonoids, phenolics, saponins and tannins. Pharmacological research revealed that C. capensis extracts and compounds isolated from the species have anthelmintic, antibacterial, antifungal, antidiabetic, antimalarial, hepatotoxicity, spermatozoa and cytotoxicity activities. Documentation of the medicinal uses, phytochemistry and pharmacological properties of C. capensis is vital as this information provides baseline data required for future research and development of health-promoting and pharmaceutical products. There is a need for extensive toxicological evaluations of crude extracts and compounds isolated from the species since C. capensis contains potentially toxic compounds.

INTRODUCTION

Cissampelos capensis L.f. is a perennial climber belonging to the Menispermaceae family. The genus Cissampelos L. is represented in southern Africa by four species, namely C. capensis, C. hirta Klotzsch, C. mucronata A. Rich. and C. torulosa E. Mey. ex Harv. (Wet and Wyk, 2008). Synonyms of C. capensis include Antizoma capensis (L.f.) Diels, Antizoma capensis (L.f.) Diels var. pulverulenta (Harv.) Diels, Cissampelos fruticosa L.f. and Cissampelos humilis Poir. (Botha, 1980; Germishuizen and Meyer, 2003).

Cissampelos capensis is an evergreen, dioecious, sprawling or climber with twining stems and can grow up to two meters in height (Germishuizen and Meyer, 2003). The stems grow from a woody root stock below the ground, and the plant supports itself by twining around the stems of other plants. The leaves are arranged spirally, heart-shaped and sometimes rounded, bright green in color, with...
entire to slightly undulating leaf margins. The inflorescence is axillary, umbel-like cyme, usually solitary or clustered. The male inflorescence is usually solitary or paired while female inflorescence is usually arranged in a short false raceme. *Cissampelos capensis* has been recorded in sandy slopes, among rocks and scrub of the Northern, Western and Eastern Cape provinces in South Africa and northwards into Namibia at an altitude ranging from sea level to 1900 m above sea level (Botha, 1980; Germishuizen and Meyer, 2003).

Rhizome and roots of *C. capensis* are sold as traditional medicines in informal herbal medicine markets in the Eastern Cape and Western Cape provinces in South Africa (Dold and Cocks, 2002; Philander et al., 2014). In Cape Town in South Africa, *C. capensis* is sold as herbal medicine in combination with *Alepidea longifolia* E. Mey., *Glycyrrhiza glabra* L., *Stoebe fusca* (L.) Thunb. and *Tulbaghia violacea* Harv. (Zonyane et al., 2013). The compound cissampeline isolated from *C. capensis*, which is characterized by sedative, anti-spasmodic and anti-tumour properties has potential for commercialization as a vital source of pharmaceutical products (George et al., 2001).

*Cissampelos capensis* is included in the book “medicinal plants of South Africa”, a photographic guide to the most commonly used plant medicines in the country, including their botany, main traditional uses and active ingredients (Wyk et al., 2013). *Cissampelos capensis* is also included in two monographs focusing on poisonous plants, “mind-altering and poisonous plants of the world” and “poisonous plants of South Africa” (Wyk et al., 2005; Wink and Wyk, 2008).

In these two monographs, (Wyk et al., 2005; Wink and Wyk, 2008) provide necessary information about the poisonous ingredients, the pharmacological effects and associated symptoms of human and animal poisoning as a result of ingesting documented plant species. It is, therefore, within this context that this review was undertaken aimed at reviewing the ethnomedicinal uses, phytochemical and pharmacological properties of *C. capensis* to provide baseline data required in evaluating the therapeutic potential of the species.

**MATERIALS AND METHODS**

Results of the current study are based on a literature search on the phytochemistry, pharmacological properties and medicinal uses of *C. capensis* using information derived from several internet databases. The databases included Scopus, Google Scholar, PubMed and Science Direct. Other sources of information used included pre-electronic sources such as journal articles, theses, books, book chapters and other scientific articles obtained from the university library.

**RESULTS AND DISCUSSION**

**Medicinal uses of *Cissampelos capensis***

The leaf, rhizome and root infusions and decoctions of *C. capensis* are mainly used as a blood purifier, and traditional medicines for respiratory problems, ulcers, sores and wounds, skin and stomach cancers, snakebite, sexually transmitted infections, skin diseases, diabetes and gastrointestinal problems (Table 1, Figure 1). Other medicinal applications supported by at least five literature reports include the use of leaves, rhizomes and roots as colic, protective charm and purgative, and traditional medicine against bladder problems, blood pressure, fever, glandular and gravel swelling, menstrual problems and pregnancy problems (Table 1).

The roots of *C. capensis* are taken as a brandy tincture or mixed with roots of *Pentzia incana* (Thunb.) Kuntze and *Pentzia globosa* Less. As traditional medicine for erysipelas (Watt and Breyer-Brandwijk, 1962; Wet and Wyk, 2008).

![Figure 1: Medicinal applications of Cissampelos capensis derived from literature records.](image)

**Phytochemistry of *Cissampelos capensis***

Several alkaloids and flavonoids (Table 2) have been identified from the aerial parts, leaves, roots and stems of *C. capensis*. (Babajide et al., 2010, 2015) also identified essential oils, phenolics, saponins and tannins from aerial parts and roots of *C. capensis* and research by (Watt and Breyer-Brandwijk, 1962) showed that the alkaloid cissampeline characterizes *C. capensis*. Some of these phytochemical compounds identified from the species may be responsible for the biological activities exhibited by *C. capensis.*
| Medicinal use          | Parts used                                      | References                                                                                           |
|-----------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Appetite stimulant    | Roots                                          | (Koenen, 2001; Wyk et al, 2008)                                                                    |
| Backache              | Roots                                          | (Hulley and Wyk, 2019)                                                                               |
| Biliary complaints    | Rhizome                                         | (Philander, 2011; Shalaweh et al., 2015b)                                                            |
| Bladder problems      | Roots                                          | (Wyk et al., 2008; Semwal et al., 2014)                                                             |
| Blood pressure        | Rhizome and roots                               | (Wyk et al., 2008; Semwal et al., 2014)                                                             |
| Blood purification    | Rhizome and roots                               | (Wet and Wyk, 2008; Wyk and Gericke, 2018)                                                          |
| Colic                 | Roots                                          | (Watt and Breyer-Brandwijk, 1962; Babajide et al, 2010)                                             |
| Diabetes              | Leaves, rhizome and roots                       | (Wet and Wyk, 2008; van de Venter et al., 2008)                                                       |
| Diuretic              | Rhizome                                         | (Wet et al., 2011; Shalaweh et al., 2015b)                                                            |
| Emetic                | Rhizome and roots                               | (Wyk et al., 2005; Semwal et al., 2014)                                                              |
| Epilepsy              | Roots                                          | (Hulley and Wyk, 2019)                                                                               |
| Erysipelas            | Roots taken as a brandy tincture or mixed with roots of Pentzia incana (Thunb.) Kuntze and Pentzia globosa Less. | (Watt and Breyer-Brandwijk, 1962; Wet and Wyk, 2008)                                             |
| Fever                 | Rhizome and roots                               | (Shalaweh et al., 2015a,b)                                                                          |
| Gallstones            | Roots                                          | (Wet and Wyk, 2008; Oyen, 2008)                                                                      |
| Gastro-intestinal problems (cholera, diarrhoea, flatulence, gastroenteritis, stomach ache and stomach problems) | Leaves and roots | (Watt and Breyer-Brandwijk, 1962; Wet and Wyk, 2008)                                               |
| Glandular and gravel swelling | Roots                                      | (Wet and Wyk, 2008; Wyk and Gericke, 2018)                                                          |
| Headache              | Rhizome                                         | (Wet and Wyk, 2008; Hulley and Wyk, 2019)                                                            |
| Heart problems        | Roots                                          | (Semwal et al., 2014; Alves et al., 2017)                                                             |
| Infertility           | Rhizome                                         | (Shalaweh et al., 2015a,b)                                                                          |
| Influenza             | Roots mixed root with those of Agathosma betulina (Berquis) Pillans | (Wet and Wyk, 2008; Wyk et al., 2008)                                                                |
| Kidney problems       | Roots                                          | (Hulley and Wyk, 2019)                                                                               |
| Menstrual problems    | Roots                                          | (Shalaweh et al., 2015a,b)                                                                          |

Continued on next page
| Medicinal use                                      | Parts used                          | References                                      |
|--------------------------------------------------|-------------------------------------|------------------------------------------------|
| Pain                                             | Rhizome and roots                   | (Wet and Wyk, 2008; Hulley and Wyk, 2019)       |
| Pregnancy problems                               | Roots                               | (Wet and Wyk, 2008; Babajide et al., 2015)      |
| Protective charm                                 | Rhizome and roots                   | (Wet and Wyk, 2008; Oyen, 2008)                 |
| Purgative                                        | Rhizome                             | (Wet and Wyk, 2008; Semwal et al., 2014)       |
| Respiratory problems                             | Rhizome and roots                   | (Wet and Wyk, 2008; Wyk and Gericke, 2018)     |
| Sedative                                         | Rhizome                             | (Wet and Wyk, 2008; Wyk and Gericke, 2018)     |
| Sexually transmitted infections                  | Leaves, rhizomes and roots          | (Watt and Breyer-Brandwijk, 1962; Wet and Wyk, 2008) |
| Skin and stomach cancers                         | Rhizome and roots                   | (Wet and Wyk, 2008; Oyen, 2008)                 |
| Skin diseases (boils, measles, rashes and ringworm) | Leaves, rhizomes and roots         | (Watt and Breyer-Brandwijk, 1962; Wet and Wyk, 2008) |
| Snakebite                                        | Leaves, rhizomes and roots          | (Wet and Wyk, 2008; Hulley and Wyk, 2019)       |
| Sores and wounds                                  | Leaves, rhizomes and roots          | (Watt and Breyer-Brandwijk, 1962; Wet and Wyk, 2008) |
| Stimulates body energy                            | Roots                               | (Afolayan and Mbaebie, 2010; Philander, 2011)  |
| Tonic                                            | Roots                               | (Hulley and Wyk, 2019)                          |
| Toothache                                        | Roots                               | (Wet and Wyk, 2008; Wyk et al., 2008)           |
| Ulcers                                           | Leaves, rhizomes and roots          | (Watt and Breyer-Brandwijk, 1962; Wet and Wyk, 2008) |
| Weight loss                                       | Roots                               | (Afolayan and Mbaebie, 2010; Semwal et al., 2014) |
| Ethnoveterinary medicine (skin problems and wounds)| Roots                          | (Kambizi, 2016)                                 |
Pharmacological properties of *Cissampelos capensis*

The following pharmacological activities have been documented from the leaves and roots of *C. capensis* and phytochemical compounds isolated from the species: anthelmintic, antibacterial, antifungal, antidiabetic, antimalarial, hepatotoxicity, spermatozooa, cytotoxicity and toxicity activities.

**Anthelmintic activities**

(Ayers et al., 2007) evaluated the anthelmintic activities of aporphine alkaloids, (S)-dicentrine and (S)-neolitsine isolated from the aerial parts of *C. capensis* using an in vitro assay using *Haemonchus contortus* with ivermectin as a positive control. The compounds (S)-dicentrine and (S)-neolitsine exhibited activities with EC_{90} values (concentration at which 90% loss of larval motility observed) of 6.3 μg/mL and 6.4 μM/mL, respectively which were higher than the potent control with an EC_{90} value of 0.2 μM/mL. The compounds were evaluated for in vivo activities in Swiss Webster mice using *Heligmosomoides polygyrus*. At a concentration of 25.0 mg/kg, the compound (S)-dicentrine exhibited 67.0% reduction in worm count when the mice were dosed orally 40.0% when dosed intramuscularly against 99.0% reduction exhibited by the positive control (Ayers et al., 2007).

**Antibacterial activities**

(Babajide et al., 2010, 2015) evaluated antibacterial activities of aqueous, dichloromethane, ethyl acetate, n-hexane and methanol extracts of *C. capensis* aerial parts and roots against *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus* and *Staphylococcus aureus* (MRSA) ATCC 43300, gentamycin-methicillin-resistant *Staphylococcus aureus* (GMRSA) ATCC 33592 and *Staphylococcus epidermidis* ATCC 2223 with ciprofloxacin as the positive control. The extracts showed activities with minimum inhibitory concentration (MIC) values ranging from 0.3 mg/mL to >16.0 mg/mL in comparison to MIC values of 0.3 μg/mL to 1.3 μg/mL exhibited by the positive control (Mabona et al., 2013).

**Antifungal activities**

(Babajide et al., 2010, 2015) evaluated antifungal activities of aqueous, dichloromethane, ethyl acetate, n-hexane and methanol extracts of *C. capensis* aerial parts and roots against *Candida albicans*, *Candida eropiralis* and *Aspergillus niger* using the disc diffusion assay with fluconazole (120 μg/mL) as a positive control. All extracts except for dichloromethane extract exhibited activities against tested pathogens with a zone of inhibition ranging from 14.0 mm to 38.0 mm in comparison to 39.0 mm to 53.0 mm exhibited by the positive control (Babajide et al., 2010, 2015). (Babajide et al., 2015) also evaluated the antifungal activities of the compounds 5,6-dehydro-4,5-dihydroxy-1,3,6-trimethoxy-17-methylmorphinan-7-one, 1,2-methylenedioxy-3-hydroxy-9,10-dimethoxyaporphine, 5,6-didehydro-4-hydroxy-3,6-dimethoxy-17-methylmorphinan-7-one, 3,7,8,3′-tetratetra methoxy-6-C-methyl-5,4′-dihydroxylavone (6-C-methyl quercetin 3,3′,7,8-tetramethyl ether), 5,7,8-trihydroxy-2′,5′-dimethoxy-3′,4′-methylenedioxyisoflavone and 3-methoxy-6-C-methyl-3′,4′,5,7,8-penta hydroxyflavone (6-C-methyl quercetin-3-methyl ether) isolated from *C. capensis* using the disc diffusion assay.

The compounds exhibited activities against the tested pathogens with a zone of inhibition ranging from 10.0 mm to 41.0 mm (Babajide et al., 2015). (Mabona et al., 2013) evaluated the antibacterial activities of aqueous and dichloromethane: methanol (1:1) extracts of leaves of *C. capensis* using the microtitre plate dilution technique against dermatologically relevant pathogens such as *Brevibacillus Agri* ATCC 51663, *Propionibacterium acnes* ATCC 11827, *Pseudomonas aeruginosa* ATCC 27858, *Staphylococcus aureus* ATCC 25923, methicillin-resistant *Staphylococcus aureus* (MRSA) ATCC 43300, gentamycin-methicillin-resistant *Staphylococcus aureus* (GMRSA) ATCC 33592 and *Staphylococcus epidermidis* ATCC 2223 with ciprofloxacin as the positive control. The extracts showed activities with minimum inhibitory concentration (MIC) values ranging from 0.3 mg/mL to >16.0 mg/mL in comparison to MIC values of 0.3 μg/mL to 1.3 μg/mL exhibited by the positive control (Mabona et al., 2013).
Table 2: Phytochemical compounds identified from Cissampelos capensis.

| Phytochemical compound                                                                 | Plant part                        | Reference                                      |
|--------------------------------------------------------------------------------------|-----------------------------------|------------------------------------------------|
| 5,6-dehydro-4,5-dihydroxy-1,3,6-trimethoxy-17-methylmorphinan-7-one                  | Aerial parts and roots            | (Babajide et al., 2015)                        |
| 1,2-methylenedioxy-3-hydroxy-9,10-dimethoxyaporphine                                | Aerial parts and roots            | (Babajide et al., 2015)                        |
| 5,6-didehydro-4-hydroxy-3,6-dimethoxy-17-methylmorphinan-7-one                      | Aerial parts and roots            | (Babajide et al., 2015)                        |
| 3,7,8,3’-tetramethoxy-6-C-methyl-5,4’-dihydroxyflavone (6-C-methylquercetin           | Aerial parts and roots            | (Babajide et al., 2015)                        |
| 5,6-didehydro-4-hydroxy-3,6-dimethoxy-17-methylmorphinan-7-one                      | Aerial parts and roots            | (Babajide et al., 2015)                        |
| 3,7,8-trihydroxy-2’,5’-dimethoxy-3’,4’-methylenedioxyisoflavanone                    | Aerial parts and roots            | (Babajide et al., 2015)                        |
| 3-methoxy-6-C-methyl-3’,4’,5,7,8-pentahydroxyflavone (6-C-                            | Aerial parts and roots            | (Babajide et al., 2015)                        |
| methanol (1:1) extracts of leaves of C. capensis using the microtitre plate dilution technique against dermatologically relevant pathogens such as Candida albicans ATCC 10231, Microsporum canis ATCC 36299 and Trichophyton mentagrophytes ATCC 9533 with amphotericin B as the positive control. The extracts showed activities with MIC values ranging from 1.0 mg/ml to 8.0 mg/ml in comparison to MIC value of 1.3 μg/ml to 25.0 μg/ml exhibited by the positive control (Mabona et al., 2013).

Antidiabetic activities

(van de Venter et al., 2008) evaluated the antidiabetic activities of aqueous and organic extracts of C. capensis leaves against Chang liver, C2C12 muscle and 3T3-L1 adipose cells using a glucose utilisation assay with one μM insulin for C2C12 and 3T3-L1 cells and 1 μM metformin for Chang liver cells as positive controls. The extracts exhibited activities with negligible toxicity (van de Venter et al., 2008).

Antimalarial activities

(Zyl et al., 2009) evaluated the antimalarial activities of methanol extracts of C. capensis rhizome against a chloroquine-resistant Plasmodium falciparum strain using the [3H]-hypoxanthine incorporation assay. The extract exhibited activities at a concentration of less than 5 μg/ml (Zyl et al., 2009).

Hepatotoxicity activities

(Owumi et al., 2019) evaluated the hepatotoxicity activities of aqueous extracts of C. capensis stem bark against N-diethylnitrosamine-induced hepatic tumors in Wistar rats. The extract resulted in reduced tumor incidences and reversed fibrosis and hepatic stellate cells growth (Owumi et al., 2019).

Spermatozoa activities

(Shalaweh et al., 2015a) evaluated the spermatozoa activities of aqueous extracts of C. capensis by
assessing sperm motility, vitality, acrosome reaction, reactive oxygen species (ROS), capacitation, Annexin V binding, DNA fragmentation and mitochondrial membrane potential. The extract resulted in a dose-dependent increase in ROS, DNA fragmentation, capacitated and hyper activated spermatozoa (Shalaweh et al., 2015a). Similarly, (Shalaweh et al., 2015b) evaluated the spermatozoa activities of methanol fractions of C. capensis by assessing sperm motility, ROS, DNA-fragmentation, acrosome reaction and capacitation. The extract resulted in higher values for ROS, capacitation and hyper-activation (Shalaweh et al., 2015b).

**Cytotoxicity activities**

(Wet et al., 2009) evaluated cytotoxicity activities of crude alkaloidal extracts isolated from the leaves and rhizomes of C. capensis using MCF7 (breast), UACC62 (melanoma) and TK10 (renal) cancer cell lines with adriamycin and 5-fluorouracil as positive controls. The extracts exhibited weak activities with total growth inhibition (TGI) values ranging from 22.0 μg/ml to 50.0 μg/ml. The GI_{50} (concentration required for 50% inhibition of cell growth) values ranged from 12.5 μg/ml to 25.0 μg/ml (Wet et al., 2009).

**Toxicity activities**

(Babajide et al., 2010, 2015) evaluated the toxicity activities of aqueous, dichloromethane, ethyl acetate, n-hexane and methanol extracts of C. capensis aerial parts and roots using the brine shrimp lethality bioassay. All the extracts exhibited activities with half maximal lethal concentration (LC_{50}) values ranging from 0.3 μg/ml to 64.9 μg/ml (Babajide et al., 2010, 2015). (Babajide et al., 2015) also evaluated the toxicity activities of the compounds 5,6-dehydro-4,5-dihydroxy-1,3,6-trimethoxy-17-methylmorphinan-7-one, 1,2-methylenedioxy-3-hydroxy-9,10-dimethoxyaporphine, 5,6-didehydro-4-hydroxy-3,6-dimethoxy-17-methylmorphinan-7-one, 3,7,8,3'-tetramethoxy-6-C-methyl-5,4'-dihydroxyflavone (6-C-methylquercetin 3,3',7,8-tetramethyl ether), 5,7,8-trihydroxy-2',5'-dimethoxy-3',4'-methylenedioxyisoflavonane and 3-methoxy-6-C-methyl-3',4',5,7,8-pentahydroxyflavone (6-C-methylquercetin-3-methyl ether) isolated from C. capensis using the brine shrimp lethality bio assay. All compounds with the exception of 3-methoxy-6-C-methyl-3',4',5,7,8-pentahydroxyflavone (6-C-methylquercetin-3-methyl ether) exhibited activities with LC_{50} values ranging from 0.8 μg/ml to 320.7 μg/ml (Babajide et al., 2010, 2015).

**CONCLUSIONS**

Cissampelos capensis is a known poisonous plant and there is need for detailed clinical and toxicological evaluations of crude extracts and compounds isolated from the species. Although the leaves of C. capensis are known to be toxic to cattle, there is no information on human poisoning. Therefore, the widespread use of C. capensis in South Africa as traditional medicine suggest that the species is not taken at toxic dosages. But the use of C. capensis for the treatment of human diseases and ailments should be treated with caution and rigorous toxicological and clinical studies of the leaves, rhizomes, roots, stems and compounds isolated from the species are necessary.

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**Conflict of Interest**

The authors declare that they have no conflict of interest for this study.

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