

A narrative review of nutritional, medicinal, and ethnopharmacological properties of *Grewia occidentalis* L.

Alfred Maroyi

Department of Biotechnology and Biological Sciences, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa; Phone/Fax: 0027406022322

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Abstract

Fruits of *Grewia occidentalis* L. are edible, and various organs of the species are used in traditional medicine. This study explores the traditional medicinal knowledge and assesses the nutritional and ethnopharmacological properties of *G. occidentalis*. This study is based on literature obtained from scientific databases such as SpringerLink, PubMed, Scopus, Web of Science, Google Scholar, ScienceDirect, and SciELO, as well as literature obtained from pre-electronic sources such as books, book chapters, and other scientific publications obtained from the university library. This research showed that the fruit flesh and skin of *G. occidentalis* are a good source of energy, classic nutrients, and minerals. The crude extracts of *G. occidentalis* are used as ethnoveterinary medicine and as traditional medicine against bladder ailments, to induce labour, impotence, infertility, respiratory infections, sexually transmitted infections, sores and wounds. The species is characterized by saponins, flavonoids, tannins, phenols, cardenolides, terpenoids, and phlobatannins. The crude extracts of *G. occidentalis* leaves, roots, shoots, and twigs, and phytochemical compounds isolated from the species demonstrated antibacterial, anticonococcal, antifungal, anti-HIV, anti-inflammatory, antioxidant, mutagenicity, and uterotonic activities. There is a need to undertake detailed nutritional, phytochemical, pharmacological, and toxicological evaluations of *G. occidentalis* aimed at correlating its traditional uses as food and herbal medicine with its nutritional and ethnopharmacological properties.

Keywords: *Grewia occidentalis*, Malvaceae, materia medica, southern Africa, Tiliaceae, traditional ecological knowledge.

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Corresponding author: Alfred Maroyi

Email: amaroyi@ufh.ac.za

Department of Biotechnology and Biological Sciences, University of Fort Hare.

Introduction

Grewia occidentalis L. (Figure 1) is a shrub or small tree belonging to the Malvaceae family, or the mallows. The genus *Grewia* L. belongs to the Malvaceae family as opposed to its previous association with the Tiliaceae family (Bayer and Kubitzki, 2003; Heywood, 2007; APG III, 2009). Evidence from molecular analysis resulted in the expansion of the family Malvaceae to include other traditional families such as Tiliaceae, Sterculiaceae and Bombacaceae (Bayer and Kubitzki, 2003; Heywood, 2007; APG III, 2009). The family Malvaceae consists of about 244 genera and 4225 species, which are mostly herbs or shrubs but also trees and lianas (Simpson, 2010; Christenhusz and Byng, 2016). The genus *Grewia* is pantropical in distribution, recorded in Africa, Asia, and Australia (Leistner, 2000). The genus *Grewia* consists of approximately 323 recognized species of trees, shrubs, and lianas (Bayer and Kubitzki, 2003; Karimi and Hanes, 2024; POWO, 2026), with 207 species recorded in Africa, with 80 of these species endemic to Madagascar (Karimi and Hanes, 2024; POWO, 2026). The genus name *Grewia* is in honour of Nehemiah Grew (1641 - 1712), an English botanist, physician, author, and microscopist, who is considered to be

among the founders of plant anatomy as a branch of scientific research (Palmer and Pitman, 1972; Venter and Venter, 2015; Schmidt et al., 2017). The species name *occidentalis* is derived from a Latin word, “occidental,” which means “from the west” (Palmer and Pitman, 1972; Venter and Venter, 2015; Schmidt et al., 2017). The synonyms of *G. occidentalis* include *G. chirindae* Baker f., *G. microphylla* Weim., *G. obtusifolia* Eckl. & Zeyh., *G. rudatisii* Burret, *G. seringeana* Hanonbis, *G. trinervis* E. Mey. and *G. ulmifolia* Salisb. (Wild, 1963, 1984; Palgrave, 2002; Germishuizen and Meyer, 2003). The English common names of *G. occidentalis* include “assegai wood”, “cross berry”, “cross berry raisin”, “four corner”, “bow wood”, “button wood”, “dew berry”, “pink donkey berry” and “star flower” (Van Wyk and Van Wyk, 2007; Venter, 2012; Thomas and Grant, 2013; Bredenkamp, 2019). *Grewia occidentalis* is a variable species and it is divided into two infraspecifics, that is, varieties, namely *G. occidentalis* var. *occidentalis* occurring in Eswatini, Mozambique, Zimbabwe and South Africa (Wild, 1963, 1984; Bandiera et al., 2007; Burrows et al., 2018; Govaerts et al., 2021), and *G. occidentalis* var. *littoralis* Wild, which is a semi-prostrate shrub confined to coastal and sand dunes in Mozambique (Palgrave, 2002).

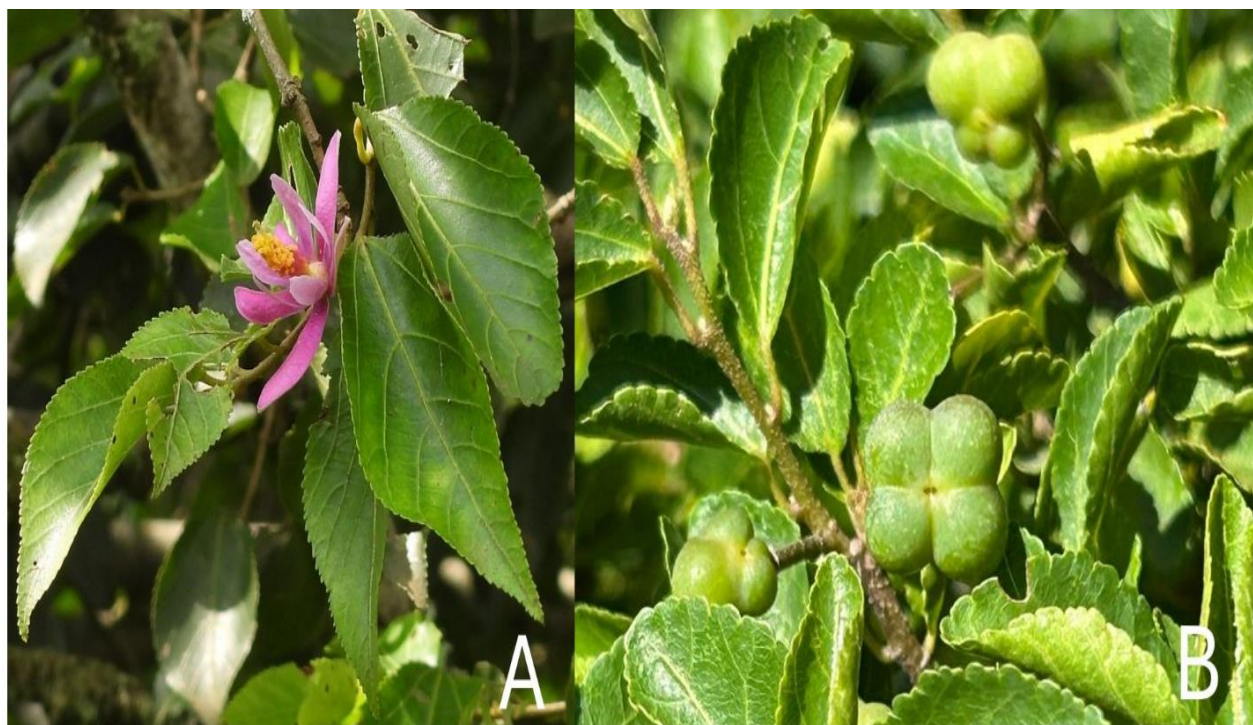


Figure 1: *Grewia occidentalis*: A: branch showing leaves and flower, and B: branch showing leaves and fruits (photos: A = R Johnstone, B = P Earlam)

Grewia occidentalis is an evergreen to semi-deciduous multi-stemmed shrub or small tree with a tangled crown, and can grow to a height of 10 metres (Venter and Venter, 2015). *Grewia occidentalis* sometimes occurs as a climber in closed evergreen forest and has a tendency to scramble. The bark of *G. occidentalis* is smooth and grey to grey-brown in colour. Leaves of *G. occidentalis* are simple and alternate, lanceolate to ovate in shape, light green and thinly textured but smooth, with three prominent veins from the leaf base (Venter and Venter, 2015). The leaves sometimes have sparse hairs on both surfaces, and the whole leaf margins are finely scalloped (Venter, 2012). The flowers of *G. occidentalis* are pink to dark mauve in colour, showing yellow stamens in a central mass, occurring in clusters and situated opposite the leaves. The fruit of *G. occidentalis* is reddish brown in colour, a slightly fleshy and shiny drupe when mature, four-lobed and characteristically square in shape, with each lobe containing a single seed (Venter, 2012). *Grewia occidentalis* has been recorded in a variety of habitats such as mountain slopes, rocky outcrops, termitaria, thornveld, forest margins, open woodland, bushveld, thicket, wooded grassland, arid highlands, arid Karoo, riverine bush, riverine fringes, coastal dune bush and evergreen montane

forests (Goldblatt and Manning, 2000; Manning and Goldblatt, 2012; Thomas and Grant, 2013). *Grewia occidentalis* has been recorded in Eswatini, Lesotho, Mozambique, South Africa and Zimbabwe at an altitude ranging from sea level to 2075 m above sea level (Drummond, 1975; Germishuizen and Meyer, 2003; Da Silva et al., 2004; Mapaura and Timberlake, 2004; Loffler and Loffler, 2005; Van Wyk, 2008; Retief and Meyer, 2017; Darbyshire et al., 2019; Hyde et al., 2026) (Figure 2).

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Figure 2: Distribution of *Grewia occidentalis* in Southern Africa (drawn by the author using the MapChart programme)

The wood of *G. occidentalis* is moderately heavy, hard and fine-grained, and has traditionally been used for assegai handles and to make bows and walking sticks (Palgrave, 2002; Venter, 2012). The branches and bark contain gum and tannin, and are tough, strong, and fibrous, and are used to make string or rope (Watt and Breyer-Brandwijk, 1962; Roberts and Roberts, 2017). The ripe fruits are eaten by birds, animals, and humans, often collected and dried for later use (Mabogo, 1990; Venter and Venter, 2015; Roberts and Roberts, 2017; Magwede et al., 2019; Van Wijk et al.,

2019). The leaves of *G. occidentalis* are used as leafy vegetables in Eswatini (Loffler and Loffler, 2005) and South Africa (Leingme, 1981; Mabogo, 1990; Steyn et al., 2001; Bvenura and Afolayan, 2015; Magwede et al., 2019; Mokganya and Tshisikhawe, 2019). In South Africa, the fruits of *G. occidentalis* are used to produce a traditional alcoholic beverage or drink (Venter, 2012; Bultosa et al., 2020; Motlhanka et al., 2018, 2020; Molapisi et al., 2024). The leaves of *G. occidentalis* are browsed by game and livestock (Venter, 2012; Van Wyk and Van Wyk, 2013) and

have potential as browse and supplemental forage in regions of southern Africa characterized by poor-quality grasses (Meso et al., 2025). *Grewia occidentalis* is an attractive, frost- and drought-resistant garden or ornamental plant with seeds that germinate easily, grow fast in good soil, and in well-watered gardens (Thomas and Grant, 2013). In the Eastern Cape province in South Africa, *G. occidentalis* is tolerated or managed in home gardens as a multipurpose plant species used as an ornamental plant and also an important source of edible fruits and herbal medicines (Maroyi, 2022a).

Grewia occidentalis is widely used in traditional medicine in Southern Africa, and the species is included in the book “Medicinal and magical plants of southern Africa: An annotated checklist” (Arnold et al., 2002). The roots of *G. occidentalis* are an ingredient of a herbal concoction known as “*isihlambezo*,” used to facilitate, augment, or induce labour, and as postnatal medication to expel the afterbirth, and also administered to animals to expel the placenta and to treat endometritis (Watt and Breyer-Brandwijk, 1962; Veale et al., 1992; Varga and Veale, 1997; Maroyi, 2016). The “*isihlambezo*” ingredients include roots of *G. occidentalis*, *Callilepis laureola* DC. (roots), *Agapanthus africanus* (L.) Hoffmann (roots), *Clivia miniata* (Lindl.) Verschaff (leaves), *Combretum erythrophyllum* (Burch.) Sond. (roots), *Gomphocarpus fruticosus* (L.) W.T. Aiton (roots), *Crinum* spp. (bulb), *Gunnera perpensa* L. (rhizomes), *Pentanisia prunelloides* (Klotzsch ex Eckl. & Zeyh.) Walp. (roots), *Gymnanthemum corymbosum* (Thunb.) H. Rob. (roots), *Rhoicissus tridentata* (L.f.) Wild & R.B. Drumm. subsp. *cuneifolia* (Eckl. & Zeyh.) Urton (roots), *Typha capensis* (Rohrb.) N.E.Br. (rhizome) and *Scadoxus puniceus* (L.) Friis & Nordal (bulb) (Watt and Breyer-Brandwijk, 1962; Veale et al., 1992; Varga and Veale, 1997; Maroyi, 2016, 2019, 2025). It is therefore, within this context, that this study was undertaken, aimed at reviewing the nutritional, medicinal, and ethnopharmacological properties of *G. occidentalis*.

Materials and methods

This review critically examined the nutritional, medicinal, and ethnopharmacological properties of *G. occidentalis*. Comprehensive data were systematically compiled in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Figure 3). The literature studies documenting nutritional, medicinal and ethnopharmacological properties of *G. occidentalis* were conducted from November 2025 to May 2026 through databases such as ScienceDirect (<https://www.sciencedirect.com/search>), PubMed (<https://pubmed.ncbi.nlm.nih.gov/>), Google Scholar (<https://scholar.google.com/>), Scopus (<http://www.scopus.com/>), Web of Science (<https://www.webofknowledge.com/>), SpringerLink (<https://link.springer.com/>) and SciELO (<https://search.scielo.org/>). The pre-electronic sources, which included books, book chapters, journal articles, dissertations, and theses obtained from the University library, were also used. The search strategy involved using keywords: “*Grewia occidentalis*”, English common names “assegai wood”, “cross berry”, “cross berry raisin”, “four corner”, “bow wood”, “button wood”, “dew berry”, “pink donkey berry,” and “star flower”. An additional search was also conducted using the keywords “nutritional properties of *Grewia occidentalis*”, “biological activities of *Grewia occidentalis*”, “pharmacological properties of *Grewia occidentalis*”, “ethnobotany of *Grewia occidentalis*”, “medicinal uses of *Grewia occidentalis*”, “phytochemistry of *Grewia occidentalis*” and “traditional uses of *Grewia occidentalis*”. The selection process was designed to include a wide range of scientific publications focusing on the nutritional, medicinal uses, and ethnopharmacological properties of *G. occidentalis*. The search covered publications from 1939 to 2026, a long period to capture literature on the nutritional, medicinal, and ethnopharmacological properties of *G. occidentalis*. Literature sources excluded from this review are those articles that are partially accessed, that is, accessed as abstracts only, and also published or unpublished ethnobotanical, nutritional, or ethnopharmacological surveys lacking information on medicinal uses, nutritional and/or ethnopharmacological properties of *G. occidentalis*.

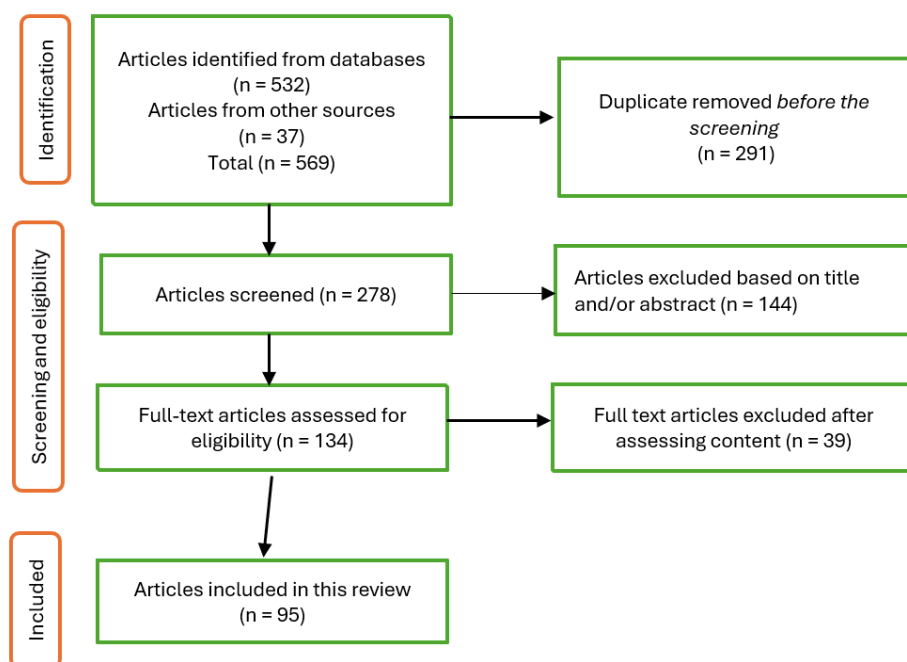


Figure 3: Flow diagram showing identification and screening of articles used in this review

Results and discussion

Medicinal uses of *Grewia occidentalis*

Several researchers listed medicinal uses of *G. occidentalis* in Eswatini, Lesotho and South Africa (Tables 1 and 2), that is, 60% of the countries where the species is indigenous. Herbal medicines prepared from the bark, leaves, roots, root bark, stems, twigs and wood of *G. occidentalis* are used for treating and managing 33 human and animal diseases and ailments in Southern Africa. The main ailments and diseases treated by *G. occidentalis* extracts include its use as ethnoveterinary medicine and as traditional medicine against bladder ailments, inducing labour, impotence, infertility, respiratory infections, sexually transmitted infections, sores and wounds (Figure 4). *Grewia occidentalis* is often used in combination with *Rhoicissus digitata* (L.f.) Gilg & M. Brandt, *Bridelia cathartica*

G.Bertol., *Crotalaria monteiroi* Taub. ex Baker f., *Commiphora neglecta* I.Verd. and *Garcinia livingstonei* T. Anderson as traditional medicine for blood cleansing, infertility, menstrual problems, and premature birth (De Wet and Ngubane, 2014; Maroyi, 2018; Ramulondi et al., 2022). The bark of *G. occidentalis* is mixed with the bark of *Ficus sycomorus* L. and *Cassia abbreviata* Oliv. as a remedy for diabetes mellitus (Muthaphuli, 2016; Semenya and Maroyi, 2019a). The bark and twigs of *G. occidentalis* are mixed with leaves of *Centella asiatica* (L.) Urb. as a remedy for ear problems, scratches, wounds, insect and tick bites (Roberts and Roberts, 2017). The leaves of *G. occidentalis* are mixed with sap of *Aloe ferox* Mill. and leaves of *Zanthoxylum capense* (Thunb.) Harv. and *Olea europaea* L. subsp. *africana* (Mill.) P.S.Green as ethnoveterinary medicine against gallsickness in stock (Dold and Cocks, 2001; Selogatwe et al., 2021).

Table 1. Monotherapeutic applications of *Grewia occidentalis*

Medicinal use	Parts used and preparation	Country	Reference
Bladder ailments	Rootbark	South Africa	Schmidt et al., 2017; Gerstner, 1939; Hutchings, 1989; Hutchings et al., 1996; Mulholland et al., 2002; Grace et al., 2003; Steenkamp et al., 2005; Cumes et al., 2009; Mulaudzi, 2012; Lall and Kishore, 2014; Pitso and Lebesse, 2014; Gulumian et al., 2018; Cock et al., 2021; Chakale et al., 2025; Matlala et al., 2025
Boils	Roots or wood	Lesotho	Jacot Guillarmod, 1971; Hutchings et al., 1996; Moffett, 2010
Charm and rituals	Stems or wood	Lesotho and South Africa	Moteetee and Van Wyk, 2011; Tshikalange et al., 2016; Moteetee, 2017; Moteetee et al., 2019
Cosmetic (hair shampoo)	Bark	South Africa	Venter, 2012; Thomas and Grant, 2013; Pitso and Lebesse, 2014; Chakale et al., 2025
Ease childbirth and hasten labour.	Leaves, roots and twigs	South Africa	Bryant, 1966; Palmer and Pitman, 1972; Hutchings, 1989; Mabogo, 1990; Hutchings et al., 1996; Mulholland et al., 2002; Palgrave, 2002; Steenkamp et al., 2005; Turner, 2008; Cumes et al., 2009; Venter, 2012; Abdillahi and Van Staden, 2013; Thomas and Grant, 2013; Bhat, 2014; Lall and Kishore, 2014; Roberts and Roberts, 2017; Schmidt et al., 2017; Gulumian et al., 2018; Sagbo and Mbeng, 2018; Brahmi et al., 2025
Impotence	Leaves, roots and twigs	Eswatini and South Africa	Palmer and Pitman, 1972; Bhat, 2014; Mabogo, 1990; Palgrave, 2002; Turner, 2008; Venter, 2012; Thomas and Grant, 2013; Bhat, 2014; Roberts and Roberts, 2017; Gulumian et al., 2018; Mhlongo and Van Wyk, 2019; Matlala et al., 2025
Infertility	Leaves, roots and twigs	Eswatini and South Africa	Palmer and Pitman, 1972; Mabogo, 1990; Palgrave, 2002; Steenkamp, 2003; Amusan, 2008; Turner, 2008; Quattrocchi, 2012; Venter, 2012; Abdillahi and Van Staden, 2013; Thomas and Grant, 2013; Roberts and Roberts, 2017; Gulumian et al., 2018; Ngubane et al., 2024; Brahmi et al., 2025; Matlala et al., 2025
Postpartum	Leaves, roots and twigs	South Africa	Roberts and Roberts, 2017
Respiratory infections (sore-throat and tuberculosis)	Roots	South Africa	Semenya and Maroyi, 2018, 2019b-d, 2020; Matlala et al., 2025
Sexually transmitted infections (syphilis and venereal diseases)	Leaves or roots	South Africa	Mabogo, 1990; Mulaudzi et al., 2011, 2013; Mulaudzi, 2012; Papo et al., 2022; Chakale et al., 2024
Sores and wounds	Bark, leaves, roots, twigs or wood	Eswatini, Lesotho and South Africa	Watt and Breyer-Brandwijk, 1962; Jacot Guillarmod, 1971; Palmer and Pitman, 1972; Hutchings, 1989; Hutchings et al., 1996; Grierson and Afolayan, 1999a,b; Afolayan et al., 2002; Palgrave, 2002; Grace et al., 2003; Steenkamp et al., 2005; Turner, 2008; Cumes et al., 2009; Moffett, 2010; Venter, 2012; Mabona and Van Vuuren, 2013; Thomas and Grant, 2013; Lall and Kishore, 2014; Pitso and Lebesse, 2014; Venter and Venter, 2015; Maroyi, 2022b; Roberts and Roberts, 2017; Schmidt et al., 2017; Mokganya and Tshisikhawe, 2019; Gulumian et al., 2018; Mhlongo and Van Wyk, 2019; Sagbo and Mbeng, 2019; Chakale et al., 2025; Fisher et al., 2025; Matlala et al., 2025
Tonic	Roots	South Africa	Mhlongo and Van Wyk, 2019
Toothbrush	Stems	South Africa	Chakale et al., 2025
Ethnoveterinary medicine (anthelmintics, fertility, gallsickness, heartwater and wounds)	Bark, leaves and twigs	South Africa	Hutchings, 1989; Hutchings et al., 1996; McGaw and Eloff, 2008; Soyelu and Masika, 2009; Maphosa and Masika, 2010; Maroyi, 2017, 2022b; Khunoana and McGaw, 2020; McGaw et al., 2020; Mthi et al., 2016, 2020, 2023; Selogatwe et al., 2021; Mhlongo et al., 2024

Table 2 Medicinal uses of *Grewia occidentalis* in combination with other species

Medicinal use	Parts used and preparation	Reference
Blood cleansing, infertility, menstrual problems and premature birth	Roots mixed with those of <i>Rhoicissus digitata</i> (L.f.) Gilg & M. Brandt, <i>Bridelia cathartica</i> G.Bertol., <i>Crotalaria monteiri</i> Taub. ex Baker f., <i>Commiphora neglecta</i> I.Verd. and <i>Garcinia livingstonei</i> T. Anderson	De Wet and Ngubane, 2014; Maroyi, 2018; Ramulondi et al., 2022
Diabetes mellitus	Bark mixed with bark of <i>Ficus sycomorus</i> L. and <i>Cassia abbreviata</i> Oliv.	Muthaphuli, 2016; Semanya and Maroyi, 2019a
Ear problems	Bark and twigs which are mixed with leaves of <i>Centella asiatica</i> (L.) Urb.	Roberts and Roberts, 2017
Insect and tick bites	Bark and twigs which are mixed with leaves of <i>C. asiatica</i>	Roberts and Roberts, 2017
Scratches and wounds	Bark and twigs which are mixed with leaves of <i>C. asiatica</i>	Roberts and Roberts, 2017
Gallsickness in stock	Leaves mixed with sap of <i>Aloe ferox</i> Mill. and leaves of <i>Zanthoxylum capense</i> (Thunb.) Harv. and <i>Olea europaea</i> L. subsp. <i>africana</i> (Mill.) P.S.Green	Dold and Cocks, 2001; Selogatwe et al., 2021

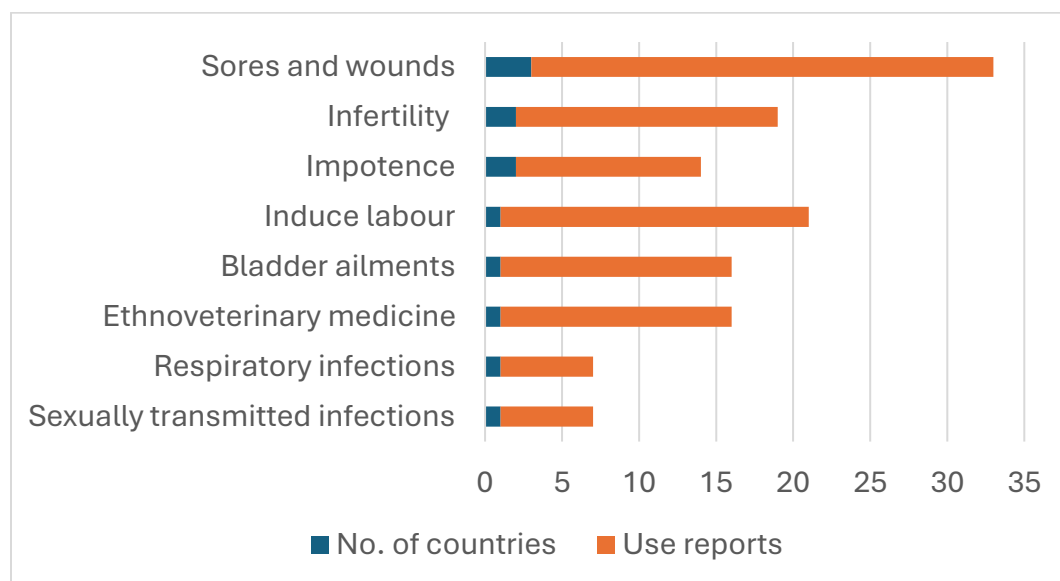


Figure 4: Medicinal uses of *Grewia occidentalis* in southern Africa

Nutritional and phytochemistry of *Grewia occidentalis*

Several researchers, such as Wehmeyer (1986), Steyn et al. (2001), Wilson and Downs (2012), and Mthi et al. (2016), investigated the nutritional properties of *G. occidentalis* (Table 3). Analyses of the nutritional properties of the

leaves, fruit flesh, and skin (Table 3) show that *G. occidentalis* is a good source of energy, classic nutrients, and minerals. The phytochemical compounds identified from the bark and wood of *G. occidentalis* include coniferaldehyde ((E)-4-hydroxy-3-methoxy-cinnamaldehyde), oleanonic acid, sinapaldehyde ((E)-4-hydroxy-3,5-

dimethoxycinnamaldehyde), and syringaldehyde (4-hydroxy-3,5-dimethoxybenzaldehyde) (Mulholland et al., 2002). Mudau et al. (2022) identified saponins, flavonoids, tannins, phenols, cardenolides, terpenoids, and

phlobatannins from the leaves of *G. occidentalis*. Some of these phytochemical compounds may be responsible for the pharmacological activities associated with *G. occidentalis*.

Table 3 Nutritional and phytochemistry of *Grewia occidentalis*

Nutrient or element	Value	Plant part	Reference
Ash (g/100g)	2.5 - 12.7	Fruits or leaves	Wehmeyer, 1986; Mthi et al., 2016
Calcium (mg/100g)	183.0	Fruits or leaves	Wehmeyer, 1986; Steyn et al., 2001
Carbohydrates (g/100g)	57.4	Fruits	Wehmeyer, 1986
Copper (mg/100g)	1.0 - 10.0	Fruits or leaves	Wehmeyer, 1986; Mthi et al., 2016
Energy (kj/100g)	1080.0	Fruits	Wehmeyer, 1986
Fat (g/100g)	1.4 – 2.6	Fruits	Wehmeyer, 1986; Wilson and Downs, 2012
Fibre (g/100g)	14.4 – 32.8	Fruits or leaves	Wehmeyer, 1986; Mthi et al., 2016
Iron (%)	187.5	Leaves	Mthi et al., 2016
Magnesium (mg/100g)	130.0	Fruits or leaves	Wehmeyer, 1986; Steyn et al., 2001
Manganese (%)	96.0	Leaves	Mthi et al., 2016
Moisture (g/100g)	12.6	Fruits	Wehmeyer, 1986
Phosphorus (mg/100g)	76.0	Fruits or leaves	Wehmeyer, 1986; Steyn et al., 2001
Potassium (mg/100g)	579.0	Fruits or leaves	Wehmeyer, 1986; Steyn et al., 2001
Protein (g/100g)	2.6 – 6.0	Fruits or leaves	Wehmeyer, 1986; Wilson and Downs, 2012; Mthi et al., 2016
Sodium (mg/100g)	78.0	Fruits or leaves	Wehmeyer, 1986; Steyn et al., 2001
Sulphur (%)	0.18	Leaves	Ravhuhali et al., 2023
Vitamin C (mg/100g)	18.4	Fruits or leaves	Wehmeyer, 1986; Steyn et al., 2001
Zinc (mg/100g)	1.1	Fruits or leaves	Wehmeyer, 1986; Steyn et al., 2001

Pharmacological properties of *Grewia occidentalis*

The following biological activities have been reported from the leaves, roots, shoots and twigs of *G. occidentalis* as well as phytochemical compounds isolated from the species: antibacterial (Grierson et al., 1999a; Pretorius et al., 2003; Mulaudzi et al., 2011; Mulaudzi, 2012; Lall et al., 2018; Papo et al., 2022), antigonococcal (Mulaudzi et al., 2011; Mulaudzi, 2012), antifungal (Mulaudzi et al., 2011; Mulaudzi, 2012; Papo et al., 2022), anti-HIV (Mulaudzi et al., 2011; Mulaudzi, 2012), anti-inflammatory (Mulaudzi, 2012; Mulaudzi et al., 2013), antioxidant (Steenkamp et al., 2005; Moustafa et al., 2014), mutagenicity (Ngubane et al., 2024) and uterotonic (Mulholland et al., 2002) activities.

Antibacterial activities

Grierson and Afolayan (1999a) evaluated the antibacterial activities of acetone, methanol and water extracts of *G. occidentalis* shoots against *Bacillus cereus*, *Bacillus pumilus*, *Bacillus subtilis*, *Micrococcus kristinae*, *Staphylococcus aureus*, *Enterobacter cloacae*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Serratia marcescens* using the agar diffusion method. The

methanol extract exhibited activities against all tested pathogens with minimum inhibitory concentration (MIC) values ranging from 1.0 mg/ml to 4.0 mg/ml (Grierson and Afolayan, 1999a). Pretorius et al. (2003) evaluated the antibacterial activities of crude extract of *G. occidentalis* leaves at a concentration of 50 mg/ml against *Clavibacter michiganense* pv. *michiganense*, *Agrobacterium tumefaciens*, *Erwinia carotovora* pv. *carotovora*, *Xanthomonas campestris* pv. *phaseoli* and *Pseudomonas solanacearum* using the agar diffusion method with dimethyl dodecyl ammonium chloride as a positive control. The extract exhibited activity against *Pseudomonas solanacearum* with an inhibition zone of 7.0 mm, which compared favourably with the inhibition zone of 12.0 mm exhibited by the positive control (Pretorius et al., 2003). Mulaudzi (2012) and Mulaudzi et al. (2011) evaluated the antibacterial activities of ethanol, dichloromethane, water and petroleum ether extracts of *G. occidentalis* roots against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Bacillus subtilis* using the microdilution method with neomycin (0.1 mg/ml) as a positive control. The extracts exhibited activities against the tested pathogens with the MIC values ranging from 0.8 mg/ml to >12.5

mg/ml (Mulaudzi, 2012; Mulaudzi et al., 2011). Lall et al. (2018) evaluated the antibacterial activities of the ethanol extract of *G. occidentalis* leaves against *Mycobacterium smegmatis*, *Mycobacterium tuberculosis*, and *Propionibacterium acnes* using the microdilution technique with ciprofloxacin and tetracycline as positive controls. The extract exhibited weak activity against tested pathogens, with MIC values ranging from 500.0 µg/mL to >1000.0 µg/mL, in comparison to MIC values of 0.3 µg/mL and 0.8 µg/mL exhibited by the positive controls ciprofloxacin and tetracycline, respectively (Lall et al., 2018). Papo et al. (2022) evaluated the antibacterial activities of aqueous and organic extracts of *G. occidentalis* leaves against *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Gardnerella vaginalis*, *Neisseria gonorrhoeae*, and *Staphylococcus epidermidis* using the micro-titre plate dilution method with ciprofloxacin as a positive control. The extracts demonstrated weak activities, exhibiting MIC values ranging from 0.8 mg/ml to 8.0 mg/ml (Papo et al., 2022).

Antigonococcal activities

Mulaudzi (2012) and Mulaudzi et al. (2011) evaluated the antigonococcal activities of ethanol, dichloromethane, and petroleum ether extracts of *G. occidentalis* roots against *Neisseria gonorrhoeae* through determination of clear zones of inhibition with ciprofloxacin as a positive control. The extracts exhibited moderate activities with percentage inhibition ranging from 44.0% to 53.0% (Mulaudzi, 2012; Mulaudzi et al., 2011).

Antifungal activities

Afolayan et al. (2002) evaluated the antifungal activities of acetone extracts of *G. occidentalis* leaves and twigs against *Alternaria alternata* and *Aspergillus niger* using the agar dilution assay. The extracts demonstrated weak fungicidal activities at concentrations of 10.0 mg/mL and 5.0 mg/mL (Afolayan et al., 2002). Mulaudzi (2012) and Mulaudzi et al. (2011) evaluated the antifungal activities of ethanol, dichloromethane, water, and petroleum ether extracts of *G. occidentalis* roots against *Candida albicans* using the microdilution method with amphotericin B as a positive control. The extracts exhibited activities against the tested pathogen with MIC and minimum fungicidal concentration (MFC) values ranging from 1.6 mg/ml to 6.3 mg/ml and 3.1 mg/ml to 6.3 mg/ml, respectively (Mulaudzi, 2012; Mulaudzi et al., 2011). Papo et al. (2022) evaluated the antifungal activities of organic and aqueous extracts of *G. occidentalis* leaves against *Candida albicans* using the micro-titre plate dilution method with ciprofloxacin as a positive control. The organic and aqueous extracts

demonstrated weak activities, exhibiting MIC values of 2.0 mg/ml and 4.0 mg/ml, respectively (Papo et al., 2022).

Anti-HIV activities

Mulaudzi (2012) and Mulaudzi et al. (2011) evaluated the anti-HIV activities of methanol and water extracts of *G. occidentalis* roots against a non-radioactive HIV-1 reverse transcriptase colorimetric ELISA kit with combivir and kaletra as positive controls. The extracts exhibited activities with an inhibition percentage of 55.0% at 1.0 mg/ml and half-maximal inhibitory concentration (IC₅₀) values ranging from 0.9 mg/ml to 0.1 mg/ml, which were comparable to IC₅₀ values of 0.06 mg/ml to 0.3 mg/ml exhibited by the positive control (Mulaudzi, 2012; Mulaudzi et al., 2011).

Anti-inflammatory activities

Mulaudzi (2012) and Mulaudzi et al. (2013) evaluated the anti-inflammatory activities of aqueous, dichloromethane, 80% ethanol, and petroleum ether extracts of *G. occidentalis* roots against the cyclooxygenase (COX-1 and COX-2) enzymes. The dichloromethane and petroleum ether extracts exhibited activities towards both COX-1 and COX-2 with percentage inhibition of at least 70.0% (Mulaudzi, 2012; Mulaudzi et al., 2013).

Antioxidant activities

Steenkamp et al. (2005) evaluated the antioxidant activities of aqueous and methanol extracts of *G. occidentalis* bark by assessing their ability to scavenge the hydroxyl radical (HO•) as measured by means of electron spin resonance spectrometry with the spin trap α -phenyl-N-tert-butyl nitrone. For water and methanol extracts, the hydroxyl radical scavenging activities were 58% and 78%, respectively (Steenkamp et al., 2005). Moustafa et al. (2014) evaluated the antioxidant activities of methanol extracts of *G. occidentalis* leaf using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay with ascorbic acid as a positive control. The extract exhibited free radical scavenging activities of 94.7% and a half-maximal effective concentration (EC₅₀) value of 11.9 µg/ml, which was comparable to the EC₅₀ value of 4.1 µg/ml exhibited by the positive control (Moustafa et al., 2014).

Uterotonic activities

Mulholland et al. (2002) evaluated the uterotonic activities of aqueous extract and an off-line supercritical extract of *G. occidentalis* using the uterine muscle tissue of a pregnant guinea pig. Research by Mulholland et al. (2002) revealed that the uterotonic activities exhibited by the species were due to the compounds oleanonic acid and coniferaldehyde ((E)-4-hydroxy-3-methoxycinnamaldehyde).

Mutagenicity and toxicity activities

Ngubane et al. (2024) evaluated the mutagenicity activities of the aqueous extract of *G. occidentalis* leaves against *Salmonella typhimurium* TA100 strain using the Ames test with 4-nitroquinoline oxide and sodium azide as positive controls. The extract demonstrated mutagenic activities (Ngubane et al., 2024). Similarly, Ngubane et al. (2024) evaluated the toxicity of aqueous extract of *G. occidentalis* leaves using the brine shrimp (*Artemia franciscana*) assay. The extract demonstrated toxic activity, causing 94% mortality of brine shrimp larvae after 24 hours (Ngubane et al., 2024).

Conclusion

The current study summarizes the nutritional, medicinal, and ethnopharmacological properties of *G. occidentalis*. The species is well-known for the provision of nutritional and health benefits to local communities in southern Africa. But presented ethnopharmacological information shows that there is not yet enough data correlating the medicinal applications of the species with its phytochemical and pharmacological properties. Therefore, detailed studies on phytochemical and pharmacological properties, toxicological evaluations, and *in vivo*, pre-clinical, and clinical research involving both extracts and compounds isolated from *G. occidentalis* are required.

Limitations

The current study is a systematic review which relies on a suite of literature sources. Therefore, the study is characterized by literature selection bias, exclusion of some literature sources, language restrictions, and reliance on the quality of past primary studies. Access and identification of literature sources focusing on nutritional, medicinal uses, and ethnopharmacological properties of *G. occidentalis* were a major challenge. Information provided in this study is based on available scientific sources identified through a systematic literature review, which is often susceptible to publication, analysis, and interpretation bias. In order to minimize these forms of bias and subjective decisions, credible literature sources associated with quality ethnobotanical studies and experimental techniques focusing on nutritional, medicinal, and ethnopharmacological evaluations of the species were selected and used in this study.

Recommendations

The outlook for *G. occidentalis* is promising, particularly as research continues to validate its food value and medicinal uses. Its potential contributions to nutritional,

pharmaceutical, nutraceutical, and/or functional sectors could expand significantly, provided future studies emphasize advanced phytochemical research, standardized quality, toxicology, evidence-based safety, and regulatory approvals involving the species. In ethnopharmacological research, there is a need for *in vitro*, *in vivo*, pre-clinical, and clinical studies, as these are the most convincing scientific methods of proving the safety and efficacy of plant-based therapies and natural products involving *G. occidentalis*.

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Author contributions

I am solely responsible for the conception and design of the research work, data collection, analysis, interpretation of the data, and writing of the manuscript.

Registration and protocol

The review was not registered, and a protocol was not prepared.

Competing interests

The author declares that there is no conflict of interest associated with this research.

List of abbreviations

COX-1 – cyclooxygenase-1 enzyme
 COX-2 – cyclooxygenase-2 enzyme
 DPPH - 2,2-diphenyl-1-picrylhydrazyl
 EC₅₀ - half maximal effective concentration
 HO• - hydroxyl radical
 IC₅₀ - half maximal inhibitory concentration
 MFC - minimum fungicidal concentration
 MIC - Minimum Inhibitory Concentration
 POWO - Plants of the World Online
 PRISMA - preferred reporting items for systematic reviews and meta-analyses

Availability of data, code, and other materials

All data generated or analyzed during this study are included in this article.

Author biography

Alfred Maroyi is a Professor of Botany in the Department of Biotechnology and Biological Sciences, University of Fort Hare

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