

**AUTHORS:**

Matthew C. Achilonu¹
Xolile V. Ngubane¹
S'busiso M. Nkosi¹
Phwe C. Jiyane¹

AFFILIATION:

¹Technology Station in Chemicals,
Mangosuthu University of
Technology, South Africa

CORRESPONDENCE TO:

Matthew Achilonu

EMAIL:

mcachilonu@yahoo.co.uk

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Phytochemicals, bioactivity, and ethnopharmacological potential of selected indigenous plants

The coastal regions of Africa are endowed with indigenous wild fruit plants rich in nutritional and medicinal phytochemicals and micronutrients. South African wild fruit plants complement the diet and health needs of rural poor households by providing vital dietary nutrients and remedies for various health concerns, and alleviating food insecurity. Milk plum, Natal plum, wild custard apple, and wild medlar medicinal plants are found mainly in the coastal provinces of South Africa. Studies have established that these plants are good sources of vitamins, essential elements, and bioactive phytochemicals such as flavonoids, phenolic acids, and terpenoids, which demonstrate significant antioxidant, antimicrobial and anti-inflammatory activities. The plants studied possess anti-epileptic, antiparasitic, and snake antivenom qualities. Here we highlight the views of different reports on ethnopharmacological relevance, phytochemistry, and bioactivity of the selected South African indigenous medicinal plants. We found a research gap in the phytochemical composition and phytopharmacological activity evaluation of *Carissa macrocarpa* and *Englerophytum magalismontanum*.

Significance:

South African indigenous medicinal plants augment the dietary and other health needs of the rural populace. The phytochemistry and phytopharmacological activities of *C. macrocarpa* and *E. magalismontanum* have been only partially studied, hence the need for further studies to examine their worth and possible use in cosmetic product enrichment.

Introduction

Africa is endowed with indigenous fruit plants rich in beneficial phytonutrients.¹ The fruits are the most popular part of the fruit-bearing plants and they appeal to the young, the old, and the ill as they are a useful source of essential metals and bioactive phytochemicals such as polyphenolics, vitamin C, and beta-carotene (provitamin A).¹ The minerals are building blocks for teeth, blood, muscle, and bone, and are essential in brain cell development.² Daily consumption of a reasonable quantity of fruits substantially reduces the risk of contracting severe respiratory infections and long-lasting diarrhoea, while inadequacy of these in children's diets results in stunted growth and poor academic ability.²

The rural populace of South Africa utilises traditional medicine and medicinal plants to augment their nutrition and in treating ailments such as skin cancer, tuberculosis, diarrhoea, malaria, fever, diabetes, gastritis, smallpox, chickenpox, snakebites, and erectile dysfunction.³⁻¹⁰ However, wasteful harvesting practices threaten the existence of these indigenous plants. This threat is exacerbated by periodic droughts and wildfires. These medicinal plants include milk plum (*Englerophytum magalismontanum*), Natal plum (*Carissa macrocarpa*), wild custard apple (*Annona senegalensis*), and wild medlar (*Vangueria infausta*). They are ubiquitous in the Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Northern Cape, and North West Provinces.^{11,12}

Reports reveal that approximately 80% of the South African population uses indigenous plants to meet their primary healthcare needs.^{2,6,13} This finding is congruent with a worldwide growing acceptance of traditional medicines, and hence the safe use of herbal concoctions has also become a medical issue.¹³ Information on indigenous medicinal plants is therefore necessary to enhance their phytopharmacological value and utilisation.

This review summarises different opinions and research findings on the ethnopharmacological uses, phytochemical constituents, and bioactivities of the four selected South African medicinal plants, thus highlighting their importance in addressing the nutritional and medicinal needs of rural communities. We recommend their sustainable harvesting/preservation as well as further exploratory studies of their potential utilisation as food and cosmetics enrichment sources.

Data sources

The major databases explored for this review were Web of Science, PubMed, Google Scholar, and Scopus. The key search words for each plant were ethnopharmacological uses, phytochemicals, and biological activities of the plant. Articles included in the study constitute those that were published in English with a focus on the four plants of interest. Primary consideration was on peer-reviewed articles, although some relevant non-peer-reviewed quality publications from government bodies were considered. The search covered the period from 2000 to 2021. The record identification process followed is presented in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram (Figure 1).

Indigenous medicinal plants

Communities worldwide commonly use therapeutic herbs and plants to treat various health conditions. The widespread usage of multipurpose South African indigenous plants could therefore be attributed to their being ubiquitous and affordable.

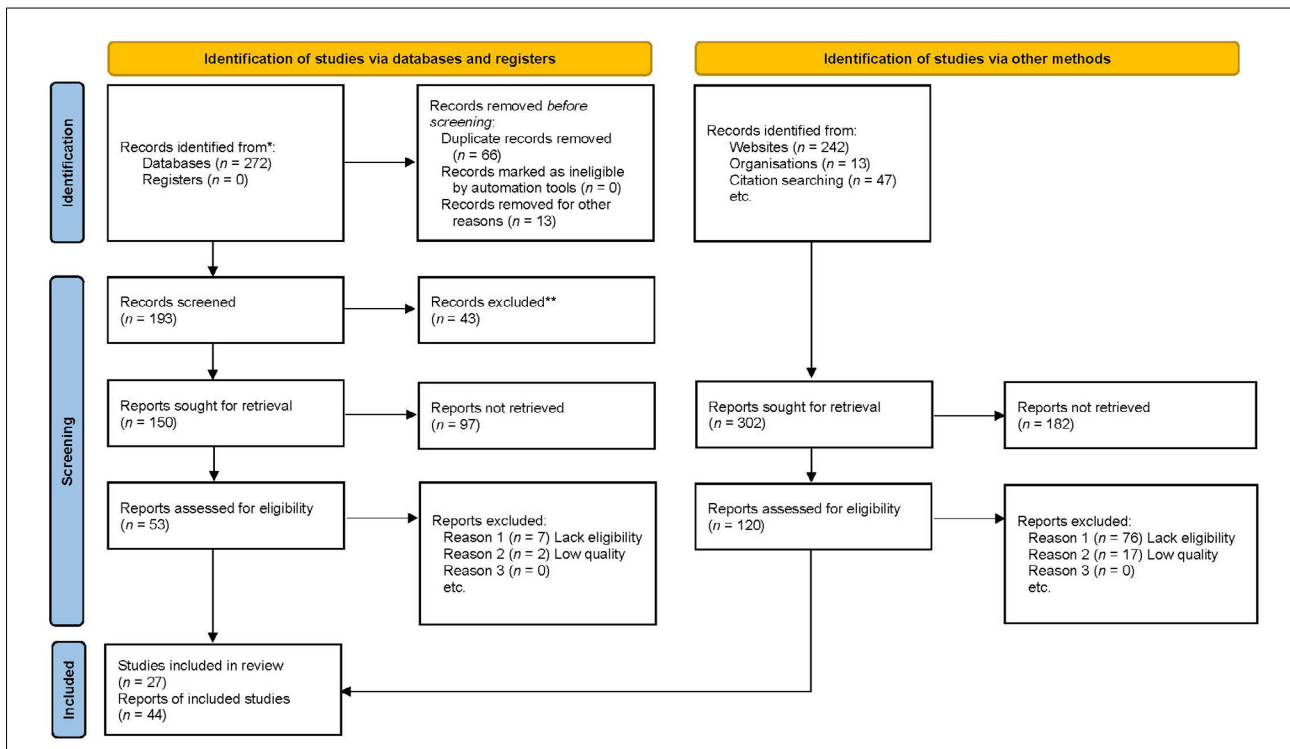


Figure 1: PRISMA diagram on the phytochemicals, bioactivities, and ethnopharmacological uses of selected medicinal plants.

Descriptions of the indigenous plants with their phytochemical and bioactive profiles are provided below and summarised in Tables 1 and 2.

Wild custard apple (*Annona senegalensis*)

Annona senegalensis, belonging to the Annonaceae family, is a fruit plant that is native to South Africa, specifically found in the KwaZulu-Natal, Limpopo, and Mpumalanga Provinces.^{1,8} The English name is wild custard apple, while indigenous names are *isiphofu*, *mamense*, *mokamanawe*, *mokokole*, *motlepe*, *muembe*, *muyembe*, *umhlalajuba*, *umphofu*, *umthofa*, and *wildesuikerappel*. The plant is also found in Botswana, Lesotho, Mozambique, and Eswatini. This annual plant bears fleshy and lumpy fruits that are either ovoid or globose in shape.¹ The unripe fruit is green on the outside but turns yellowish-orange when ripe. The edible white pulp has a characteristic pleasant pineapple-like taste. The seeds are many, cylindrical, oblong, and orange-brown in colour.¹

As a multipurpose plant, *A. senegalensis* is used traditionally as food and as a concoction to treat many diseases. In folk medicine, reports reveal that the leaves, stem bark, and root bark are used in treating various health disorders^{1,14-21} (Table 1). One report notes that the leaves of the plant are locally used to protect cereals against weevil attacks.¹⁴

A plethora of studies have reported the phytochemical profiles and bioactivities of *A. senegalensis*, highlighting their significant health benefits^{4,7,8,15,21-23}, as presented in Table 2. The investigations of the leaves, twigs, and stem-bark extracts revealed a substantial constituent of bioactive phytochemicals. The studies established that extracts of the leaves and the stem bark were laden with polyphenols and phenolic acids²⁴, hence, their exhibition of significant antioxidant and hepatoprotective activities²⁵.

Agbo'Saga et al.²⁶ noted that a crude extract from the leaf exhibited dose-dependent effectiveness against breast cancer cells. The anticancer activity was attributed to the linalool^{20,26}, amongst other phytoconstituents (citronellal, geranial, citronellol) of the leaf²⁷. Rutin, epi-catechin, and quercetin glycoside isolated from the crude leaf extract displayed significant parasitic activity against *Onchocerca ochengi*²⁸, while kaurenoic acids (root-bark extract)²⁹ and 3-carene (fruit extract) showed strong antibacterial activities against tested strains^{20,30}. The stem bark diethyl ether fraction (containing benzenediol, butylated hydroxytoluene,

hexadecanoic acid, oleic acid, octadecanoic acid, octadecandienal pentadecane, tetratriacontane, and squalene) demonstrated strong antimicrobial activity.³¹ The bioactive phytochemicals and bioactivities^{20,27-33} of *A. senegalensis* are listed in Table 2.

The cytotoxicity of *A. senegalensis* parts was also investigated. The highest cytotoxicity (93%) was demonstrated by the crude oil extract of the leaf, administered at a dose of 50 ppm in the brine shrimp lethality bioassay.³⁴ Conversely, the phytochemical fractions obtained on further purification of the crude oil fraction caused a lower lethality (49%) in the brine shrimp larvae at the same concentration of 50 ppm. Caryophyllene oxide was identified as the major compound in the lower cytotoxic fraction. However, conducting a similar test with a pure caryophyllene oxide compound showed no toxicity on the target substrate. It was concluded that caryophyllene oxide works most effectively in synergy with other phytochemicals.³⁴ An *in vitro* test reported that the leaf, stem bark, and root bark of *A. senegalensis* water/methanol extracts administered at 10 mg/mL demonstrated significant activity on *Trypanosoma evansi* by inhibiting its motility.³⁵ Endophytes are endosymbionts that enhance the growth of the host by improving the medicinal plant's nutrient acquisition, resistance to pathogens, repugnance to insects and herbivores, and tolerance ability over abiotic stresses, for example, drought.³⁵⁻³⁷ The methanol extract of *A. senegalensis* leaves showed dose-dependent activity against the malarial parasite *Plasmodium berghei*.¹⁵ However, the hexane and chloroform fractions from the leaf methanolic extract caused more mortality in the immature mosquito vectors.³⁸ The aqueous extract of *A. senegalensis* leaves exhibited drug detoxification possibilities.³⁹ A study recorded that the diethyl ether fraction of the stem bark exhibited significant antimicrobial activity against *Escherichia coli*, *Salmonella enteritidis*, and *Shigella dysenteriae*.²² Another investigation established that the crude methanolic extract from the stem bark of the plant demonstrated a minimum inhibitory concentration (MIC) at a dose of 100 mg/mL against *Shigella* species and *E. coli* strain and repressed *Salmonella typhi* growth at 50 mg/mL.^{40,41} The root-bark methanolic extract was reported to detoxify snake venom and stimulate a reduction in hyperthermia.⁴²

A study evaluated the leaf ethanolic extract efficacy as an antimalarial remedy and found the extract to show moderate inhibitory effect on

Plasmodium falciparum and *Plasmodium yoelii* malaria parasite strains, as well as cytotoxicity towards leukaemia cell lines.²¹ The methanol, hexane, chloroform, and ethyl acetate extracts of the *A. senegalensis* leaves demonstrated significant ($p < 0.001$) toxicity against *Aedes aegypti* larvae, which transmits yellow fever, dengue fever, Chikungunya, and Zika fever.⁴³ However, the efficacy of the solvent extract fractions was dose-dependent, and the most effective was the hexane extract at a LC_{50} of 379.3 mg/L, that is, at a lethal concentration causing 50% death. Recent evaluations of oral toxicity of *A. senegalensis* extracts indicated that a lethal oral dose (LD_{50}) of about 5 g/kg body weight (b.w.) of the plant parts extract administered to mice did not cause acute toxicity or motility in the mice.⁴⁴ Another study confirmed that a mixture of aqueous root extracts of *A. senegalensis* and *Asparagus africanus* was given orally at a dose of about 12 800 mg/kg b.w. of mice and did not cause mortality in the experimental mice. However, the mice displayed mild signs of drowsiness, inactivity, and loss of appetite.⁴⁵

Natal plum (*Carissa macrocarpa*)

The Natal plum belongs to the family Apocynaceae. The plant is indigenous to the province of KwaZulu-Natal and widely distributed along the coastal areas of the Eastern Cape, as well as inland in the Free State and Limpopo Provinces.¹ The plant's common name is Natal plum, and the indigenous names are *amatungula*, *noemnoem*, *umbethankunzi*, and *ditokolo*.⁴⁰ White star-shaped flowers and protective Y-shaped thorns characterise this twig-like evergreen medicinal shrub. The fruit of *C. macrocarpa* is small, ovoid, and oozes delicious flavour. The sweetish and slightly sour cherry-red ripe fruit contains numerous small, flat, brown seeds. The fruits are used in the preparation of salads, cakes, puddings, ice-cream, pies, tarts, and sweet jelly⁴⁶, with the leaves used to treat diarrhoea in livestock. According to the South African National Research Council, all of the parts of the plant are used in treating infections such as sexually transmitted ailments and coughs.¹

The phytochemical composition of *C. macrocarpa* has not been thoroughly studied. However, some investigations have recorded that Natal plum parts are richly endowed with bioactive polyphenolics, vitamin C, and cardiac healthy fatty acids.^{2,47-51} The studies also noted that the fruit is rich in essential metals such as Mg, Ca, P, Fe, Zn, Mn, Cu, Se, Cr, and Ni⁴⁷, and thus contributes significantly to the consumer's dietary needs for micronutrients and bioactive phytochemicals.^{33,47} Zn, in particular, featured prominently as one of the key essential metals in combating the COVID-19 global pandemic.⁵² Mg is an essential element for cellular metabolism, protein digestion, Ca absorption, muscle growth, parathyroid hormone release, and proper functioning of the nervous system.⁵³ Conversely, Mg deficiency in the body results in low vitamin activity and poor Ca absorption, which contributes to immune compromise, and accelerates ageing of the skin because of free radicals and uncontrollable movement of muscle twitching/tremor/spasm/cramps.^{53,54} Ca improves muscle contraction and blood clotting, as well as controls the passage of nutrients through cell walls, and reduces insomnia. A deficiency in dietary Ca causes absorption of Ca from the bones, resulting in the bones becoming weak and brittle.⁵⁴ This condition is known as osteoporosis. K acts as a buffer that prevents acidity change in body fluids.⁵⁵ Fe assists in the formation of blood and in the transportation of oxygen and carbon dioxide in the body tissues. Fe deficiency causes anaemia and impaired learning and behavioural changes in children.⁵⁴ Zn boosts hair growth, and promotes functioning of taste, touch and smell sense organs while contributing to the proper metabolism of carbohydrates and protein. Mn assists in carrying oxygen from the lungs to other organs in the body. In this way, Mn acts as an enzyme metabolic reaction activator necessary for food metabolism. Deficiency in Mn results in growth retardation and abnormal loss of weight, while Co facilitates vitamin B12 metabolism.⁵⁴ Dietary intake of fibre reduces serum cholesterol and contributes to several other health benefits.⁵⁴ A recent study reported that incorporation of *C. macrocarpa* fruit into mango fruit pulp affords functional food possessing better-quality dietary phytochemical content and nutritional value.⁵⁶

In consideration of the utilisation of *C. macrocarpa* as an agricultural resource, crude phenolic and terpenoid extracts of the leaves, administered at a concentration of 10 mg/mL, demonstrated significant

in vitro inhibition of *Aphis fabae* (a devastating bean pest). Accordingly, the leaf extracts can act as a natural pesticide alternative to petroleum-based synthetic pesticides.⁵⁷ The phytochemical constituents of essential oils from different parts of *C. macrocarpa* and their antimicrobial activities were investigated. The results showed pentadecanal and tetradecan-1-ol as the main compounds in the essential oils from the fresh leaves.⁵⁸ The fruit essential oils contained nerolidol (a naturally occurring sesquiterpene alcohol extensively used in cosmetics and detergents) and caryophyllene oxide. The essential oils from the stem possessed linalool and hexahydrofarnesyl acetone, and the flower essential oils showed the presence of benzyl benzoate, which is used in treating lice and in repelling insects. The essential oils exhibited significant antimicrobial activities, which presented the plant oil as a potential source of antimicrobial compounds.⁵⁸

An earlier study of the *C. macrocarpa* phytoconstituent profile reported pentacyclic oleanane triterpenes isolated from the fruits. The oleanane triterpenes included amyirin, methyl oleanolate, oleanolic acid, and hydroxyolean-11-en-28,13 β -olide, whereas ursolic acid was obtained from the leaves. The oleanane triterpenes and the ursolic acid demonstrated good antibacterial activity against bacterial strains (*Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *E. coli*, *Staphylococcus saprophyticus*, *Staphylococcus aureus*, and *Enterococcus faecium*) at MICs ranging from 0.06 mg/mL to 1.0 mg/mL.⁵

Wild medlar (*Vangueria infausta*)

The *Vangueria infausta* from the Rubiaceae family is known by the common name wild medlar. Its local names are *wildemispel*, *mmilo*, *muzwilu*, *mavelo*, *umviyo*, *umtulwa*, *mothwanye*, *umvile*, and *amantulwane*. The plant is indigenous to southern Africa. In South Africa, it is widely distributed in the KwaZulu-Natal, Eastern Cape, Free State, Gauteng, Limpopo, and North West Provinces.¹

The fruit of *V. infausta* is round and dark green when unripe and light brown when ripe. The ripe fruit is about 20–50 mm in diameter with soft and fleshy pulp. The orange pulp that contains roughly five seeds is slightly astringent and sweet-sour-bitter in taste. The flesh is usually eaten fresh and occasionally cooked. The fresh pulp, as a tradition, is processed into juice, jam, marmalade, puddings, and porridge, or sundried for storage.⁵⁶

Diverse parts of *V. infausta* are used in the traditional treatment of various kinds of diseases and health disorders, as summarised in Table 1.

Reports on the phytochemical investigations of *V. infausta* plant parts available to us during this review were limited. However, the accessed papers reported the identification of the presence of flavonoids, tannins, coumarins, lignans, phenolic acids, saponins, fatty acids, terpenoids, and anthraquinones in different parts of the *V. infausta* plant extracts.^{58,59} The phytochemicals isolated from the extracts are listed in Table 2.

The biological activities of *V. infausta* have been extensively investigated, relative to its phytochemistry. The reviewed literature shows that all parts of the plant have exhibited both antimalarial⁶⁰ and antifungal activities⁶⁰⁻⁶². Inhibitory activities of leaf extracts against seven pathogenic fungi were observed with acetone and dichloromethane (DCM) extracts at a MIC of 0.32 mg/mL.³⁶ An indole alkaloid, morindolide, isolated from the leaf displayed good antimalarial activity at $IC_{50} = 107.1 \pm 0.6 \mu\text{M}$.⁶⁰ The hexane, DCM, acetone, and methanol extracts of *V. infausta* leaves demonstrated inhibitory activities against *Enterococcus faecalis* at a low MIC value of 0.02 mg/mL.⁶⁰ The DCM extract of *V. infausta* root exhibited high inhibitory effects on the *Leishmania* protozoan with an IC_{50} value of 4.51 $\mu\text{g/mL}$,⁶³ a significant antiparasitic activity at IC_{50} of 1.84 $\mu\text{g/mL}$, and a selectivity index of 25 against *Plasmodium falciparum*.⁶⁴ The report resonated with earlier findings, which identified chloroform extracts from the *V. infausta* root bark that markedly inhibited the activities of two *Plasmodium falciparum* strains at IC_{50} s of 3.8 $\mu\text{g/mL}$ and 4.50 $\mu\text{g/mL}$.⁶⁴ The hexane, DCM, acetone, and methanol extracts of *V. infausta* leaves demonstrated inhibitory activities against *Enterococcus faecalis* at a low MIC value of 0.02 mg/mL.⁶⁵

Table 1: Ethnopharmacological uses of the various parts of the four plants under review

Plant	Fruit	Leaf	Stem	Root	References
<i>Annona senegalensis</i>	The ripe fruit is eaten raw.	Treats pneumonia, yellow fever, tuberculosis, smallpox, toothache, fever, asthma, bronchitis, anxiety, dysentery, constipation, high blood pressure, rheumatism, and female infertility. Insecticide and anthelmintic.	Remedy for worms, diarrhoea, gastroenteritis, venereal diseases, snakebites, toothache, respiratory infections, leukaemia, and skin cancer, and seals cuts and wounds.	Treats gastritis, stomachaches, diarrhoea, snakebites, male sexual impotence, tuberculosis, and diabetes. Antidote for necrotising toxins.	1,15–21
<i>Carissa macrocarpa</i>	Processed into a salad, cake, pudding, ice-cream, pies, tarts, and sweet jelly. Treats hepatitis and HIV infection.	Treats diarrhoea in animals.	Treats cough and venereal infections.	Treats diarrhoea, toothache, respiratory infection, and sores.	1,46
<i>Vangueria infausta</i>	Eaten or processed into juice, marmalade (jam), puddings, and porridge, or dried for storage.	Protective charm against sorcery. Treats dermatitis, malaria, pleurisy, headaches, abscesses, and swelling.	Treats malaria, syphilis, and haemorrhoids.	Treats pneumonia, fever, coughs, chest ailments, gastrointestinal disorders, epilepsy, measles, inflammation, stomach ulcers, headaches, hernias, malaria, asthma, blood pressure problems, diarrhoea, skin blisters, menstrual problems, vaginal discharge, infertility, male virility, candidiasis, helminthic concerns, snakebites, and nervous system disorders, and is a snake repellent.	3,5,56
<i>Englerophytum magalimontanum</i>	Processed into syrup, jelly, jam, vinegar, and wine (<i>mampoer</i>).	Treats epilepsy	Remedy for diabetes mellitus, pain, and rheumatoid arthritis.	Treats Alzheimer's disease, inflammation, rheumatism, abdominal pain, and wounds.	6,13,67

Table 2: Phytochemical profiles and bioactivity potentials of the plants under review

Plant	Phytochemicals	Bioactivity	References
<i>Annona senegalensis</i>	Triterpenes, alkaloids, steroids, carbohydrates, and phenolic compounds were detected. Kaurenoic acid, carene, linalool, roemerine, aporphine alkaloid, germacrene d, terpinen-4-ol, citronellal, geranial, citronellol, thymol, carvacrol, catechol, N-hexadecanoic acid, octadecanoic acid, oleic acid and linoleic acid were isolated.	Exhibited antioxidant, antimicrobial, antidiarrhoeal, anti-inflammatory, antiparasitic, anticonvulsant, antimalarial, antitrypanosomal, antivenom, and antinociceptive activities. Cytotoxic against <i>Shigella</i> species, <i>Escherichia coli</i> , <i>Salmonella typhi</i> , <i>Plasmodium falciparum</i> , <i>Plasmodium yoelii</i> bacterial strains, and <i>Aegypti</i> larvae.	4,7,8,15,21–23,27–33
<i>Carissa macrocarpa</i>	Vitamin C, cyanidin derivatives, pentadecanal, tetradecan-1-ol, nerolidol, caryophyllene oxide, linalool, hexahydrofarnesyl acetone, benzyl benzoate, ursane, and fatty acids were present.	Antimicrobial and cytotoxic against <i>Aphis fabae</i> Scopoli strain. Active against <i>Klebsiella pneumoniae</i> , <i>Pseudomonas aeruginosa</i> , <i>Escherichia coli</i> , <i>Staphylococcus saprophyticus</i> , <i>Staphylococcus aureus</i> , and <i>Enterococcus faecium</i> bacterial strains.	5,33,47–51,54–58
<i>Vangueria infausta</i>	Polyphenols, lignans, phenolic acids, saponins, fatty acids, terpenoids, and anthraquinones were detected, while octanoic acid, hexanoic acid, hexanoate derivatives, octanoate derivatives, hexahydroxy-biflavone, apigenin-7-O-rutinoside, daidzein, dihydrokaempferol, quercetin derivatives, epiafzelechin, epicatechin, genistein, luteolin derivatives, methylcylohex-1-ene, morindolide, friedelin, tomentosolic acid, vangerolic acid were isolated.	Exhibited antibacterial and antifungal activities. Cytotoxic against <i>Aspergillus niger</i> , <i>Aspergillus parasiticus</i> , <i>Colletotricum gloeosporioides</i> , <i>Penicillium janthinellum</i> , <i>Penicillium expansum</i> , <i>Trichoderma harzianum</i> and <i>Fusarium oxysporum</i> fungal strains; and <i>Plasmodium falciparum</i> and <i>Leishmania donovani</i> parasites.	36,58–66,70,71
<i>Englerophytum magalimontanum</i>	Vitamin C, Al, Ca, Fe, K, Mg, Mn, P, Pb, Se, and Zn minerals were detected.	Exhibited anti-inflammatory and antimicrobial activities. Cytotoxic against <i>Actinomyces naeslundii</i> , <i>Actinomyces israelii</i> , <i>Porphyromonas gingivalis</i> , <i>Prevotella intermedia</i> and <i>Streptococcus mutans</i> microorganisms.	68,69

The cause of health conditions such as inflammatory and arthritic ailments (spondylitis, osteoarthritis, and rheumatoid arthritis) is related to protein denaturation. Therefore, any substance that could prevent or limit protein denaturation will consequently contribute to the prevention of inflammation and arthritic conditions of the body and skin. An investigation of *V. infausta* proved that this wild plant showed significant anti-inflammatory activity from different phytochemical extracts of the plant parts on a substrate⁶⁶, thus proving its health benefit.

Milk plum (*Englerophytum magalismsontanum*)

The *Englerophytum magalismsontanum* plant family is Sapotaceae. The common name is milk plum, and local names are *stamvrug*, *mothatswa*, *munombelo*, *amanumbela*, and *umnumbela*.¹ It grows in the riverine forest suburbs of Gauteng, North West, Mpumalanga, Limpopo, and the northern part of KwaZulu-Natal.¹¹ The flesh of *E. magalismsontanum* berry fruit is ellipsoid to round. The fruit ripens to a bright red colour and contains sticky, milky latex. The edible fruit serves as a thirst quencher. During the harvest season, the fruit is processed into syrup, jelly, jam, wine, vinegar, and a strong alcoholic drink, known as *mampoer*.¹³ Indigenous people use powdered roots to treat rheumatism; concentrated juice treats abdominal pain, while a mixture of finely powdered roots and fruits cures epilepsy. A recent review paper documented *E. magalismsontanum* as one of the herbal plants that the local populace uses in the traditional treatment of diabetes mellitus.⁶⁷

Evaluation of the mineral composition of *E. magalismsontanum* fruit against 13 other selected indigenous wild southern African fruits, revealed the mineral content of *E. magalismsontanum* as 109 mg/kg Al, 410 mg/kg Ca, 27 mg/kg Fe, 8464 mg/kg K, 777 mg/kg Mg, 50 mg/kg Mn, 718 mg/kg P, 131 mg/kg Pb, 286 mg/kg Se and 25 mg/kg Zn.⁶⁸ Interestingly, Mg, Mn, Zn, and Se, which are known to be very beneficial minerals for human nutrition, are present in the fruit in significant amounts. These essential elements (Mg, Mn, Zn, and Se) are popular in nourishing and rejuvenating skin, particularly when incorporated into a product for topical application. Furthermore, the root is traditionally pulverised into powder and rubbed into incisions, to assist in healing.¹³

Research has revealed that *E. magalismsontanum* leaf extracts exhibit significant activity against acetylcholinesterase at a dose of 160 µg/mL. Extracts of different parts of the plant demonstrated strong activity in managing oxidative stress related diseases and ailments, such as Alzheimer's disease, inflammation, and pain.⁶ Furthermore, extracts from *E. magalismsontanum* parts exhibited significant antimicrobial activities against oral microorganisms such as *Actinomyces naeslundii* and *Actinomyces israelii*. The ethanol extract exhibited MIC values from 12.5 mg/mL to 6.3 mg/mL, while the cytotoxicity test showed an IC₅₀ value of about 98.8 mg/mL.⁶⁹

Conclusion

Our review and summary of the literature on four indigenous medicinal plants in South Africa indicate that different parts of the plants have long been used in folk medicines and other remedies, including as dietary supplements, based on traditional beliefs. The phytochemical composition and biological activity profile of three of the reviewed plants were sparsely studied; hence, not much was reported. However, this review indicates the presence of the bioactive phytochemicals flavonoids, tannins, coumarins, lignans, phenolic acids, saponins, fatty acids, terpenoids, and anthraquinones in these plants, which relate to the demonstration of strong antioxidant, anti-inflammatory, antiparasitic, anthelmintic, anticonvulsant, antimalarial, antitrypanosoma, antinociceptive and antivenom activities. The study reveals that there is sufficient evidence to promote the consumption of *V. infausta* and *A. senegalensis* to manage various ailments, especially in the era of the COVID-19 pandemic that undermines the immune system.

We therefore recommend intense research on the phytochemical composition and bioactivity profiles of *C. macrocarpa* and *E. magalismsontanum*. Such studies will improve their worth and facilitate their incorporation into communal medicaments such as cosmetics and other functional products.

Competing interests

We have no competing interests to declare.

Authors' contributions

M.C.A.: Conceptualisation; data collection; writing – initial draft. V.X.N. and S.M.N.: Revised the manuscript. C.P.J.: Reviewed the manuscript.

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