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Ethnomedicinal uses, phytochemistry and pharmacological properties of *Elytropappus rhinocerotis*

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Abstract

Elytropappus rhinocerotis is a small perennial shrub widely used as traditional medicine in South Africa. This study is aimed at providing a critical review of the botany, medicinal uses, phytochemistry and pharmacological properties of *E. rhinocerotis*. Documented information on the botany, medicinal uses, phytochemistry and pharmacological properties of *E. rhinocerotis* was collected from several online sources which included BMC, Scopus, SciFinder, Google Scholar, Science Direct, Elsevier, Pubmed and Web of Science. Additional information on the botany, medicinal uses, phytochemistry and pharmacological properties of *E. rhinocerotis* was gathered from pre-electronic sources such as book chapters, books, journal articles and scientific publications sourced from the University library. This study showed that the leaves, roots, stems and twigs of *E. rhinocerotis* are mainly used as appetite stimulant and tonic, and traditional medicines for high blood pressure, backache, convulsions, foot perspiration and odour, respiratory problems, sores and wounds, bladder problems, kidney problems, vermifuge, diabetes, fever, painful hands and feet, influenza, ulcers, cancer and stomach cancer and stomach problems. Phytochemical compounds identified from the aerial parts and leaves of *E. rhinocerotis* include coumarins, essential oils, flavonoids, labdane diterpenes, phenolic acids, alkaloids, cardiac glycosides, flavonoids, saponins, tannins and triterpene steroids. Pharmacological research revealed that *E. rhinocerotis* extracts and compounds isolated from the species have antibacterial, antimycobacterial, antifungal, anticonvulsant, anti-inflammatory, antioxidant and immunotoxicity activities. Future research should focus on evaluating the phytochemical, pharmacological and toxicological properties of *E. rhinocerotis* crude extracts as well as compounds isolated from the species.

Keywords: Asteraceae, *Elytropappus rhinocerotis*, ethnopharmacology, herbal medicine, indigenous pharmacopeia

INTRODUCTION

Medicinal plants collected from the wild and in some cases managed in home gardens have always been the principal sources of traditional medicines in developing countries. The World Health Organization estimates that up to 80% of the people in both rural and urban communities in the developing countries still depend on medicinal plants to fulfil their primary healthcare needs.[1] Recent data suggest that the use of traditional medicines in developing countries is substantially lower than 80% and is on the decline.[2-6] Van Andel and Carvalheiro[7] argued that the use of traditional medicines in developing countries and factors underlying people's decision to use traditional medicines are poorly documented. Research by Van Andel and Carvalheiro[7] revealed that frequent use of self-collected, home-prepared herbal medicines, and illnesses and associated traditional knowledge influenced the use of traditional medicines rather than poverty or limited access to modern health care facilities as often reported in literature. Medicinal plants and their derivatives represent more than 50% of all pharmaceutical drugs in clinical use in the world and higher plants contribute no less than 25% to the total.[8] Medicinal plants are an important aspect of the daily lives of many people and an important part of the South African cultural heritage.[9] Medicinal plants are now receiving significant attention globally, with a number of international and local herbal medicine practitioners actively exploring the botanical resources of tropical Africa with the intention of screening medicinal plants for pharmaceutically active compounds. Piwowarski et al.[10] argued that research into underutilized traditional herbs that are presently not incorporated into orthodox medicine is a promising strategy which may lead to the development of future innovative and sustainable pharmaceutical drugs. Evaluation of phytochemistry and pharmacological properties of traditional medicines is important in medicinal plant research and indigenous knowledge systems. Validating the correlations of ethnomedicinal uses, bioactive compounds, biological and pharmacological effects will help to maintain options of using herbal medicines, particularly as their use is growing because of their moderate costs and also increasing faith in traditional herbal medicines. It is within this context that this review was undertaken aimed at reviewing the Ethnomedicinal uses, phytochemistry and pharmacological properties of *Elytropappus rhinocerotis* (L.f.) Less. so as to provide baseline data required in evaluating the therapeutic potential of the species. Moreover, *E. rhinocerotis* is one of the valuable medicinal plant species in South Africa, and the species is included in the book "medicinal plants of South Africa," a photographic guide to the most commonly used herbal medicines in the country, including its botany, major medicinal applications and active phytochemical compounds.[9] Research by Van Wyk[11] showed that the leaves and stems of *E. rhinocerotis* have commercial potential as sources of health products such as appetite stimulant, bitter tonic, dyspepsia, indigestion, stomach cancer, ulcers and fumigant against influenza in South Africa. The leaves and stems of *E. rhinocerotis* are sold in informal herbal medicine markets in the Eastern Cape and Western Cape provinces of South Africa.[12,13]

Botanical profile of *Elytropappus rhinocerotis*

The genus *Elytropappus* Cass. which belongs to the Asteraceae family, tribe Gnaphaliea derives its name from the Greek words "*elytron*", meaning sheath and "*pappos*" meaning down or fluff, in reference to the small cup-like rim around the base of the feathery pappus.[14] The genus

Elytropappus consists of about ten species confined to the Cape Floristic Region of South Africa.[15,16] The species name *rhinocerotis* refers to the association with the rhinoceros (Diceros bicornis), probably the black rhino which occurred in the Cape region before the colonial times.[14] The English common names of the species include "rhinoceros bush" and "rhenoster bush", as the species is an important component of the Renosterveld vegetation type confined to the south-western Cape of South Africa. In some literature sources, this species is listed as a synonym of *Dicerothamnus rhinocerotis* (L.f.) Koekemoer but strictly speaking this name is invalid until it is published in a recognized scientific journal.[14] The synonyms associated with the name *E. rhinocerotis* include *E. cernuus* (Thunb.) Fourc., *Helichrysum rhinocerotis* Steud., *Seriphium adpressum* DC., *S. cernuum* (Thunb.) Pers., *S. rhinocerotis* (L.f.) Pers., *Stoebe adpressa* (DC.) DC. ex Harv., *S. cernua* Thunb., *S. cupressina* Rchb. ex DC. and *S. rhinocerotis* L.f.[17]

Elytropappus rhinocerotis is a single-stemmed perennial, erect and bushy shrub which can grow up to about 2 metres in height.[14-16] The old branches are gnarled and the bark is smooth and grey in colour. Older branches are bare of leaves but bear many thin, whip-like twigs which are held erect and covered with tiny and triangular leaves, tightly grouped and pressed to the stem. In between the leaves a layer of fine white hairs is visible, giving a woolly appearance and giving the plant a greyish appearance. The small and inconspicuous flowerheads are borne towards the ends of the twigs containing several tiny purple flowers. The seeds are tiny and are wind-dispersed by means of a feathery pappus. *Elytropappus rhinocerotis* has been recorded in dry shale and sandstone slopes and flats in southern Namibia to the Eastern Cape, Northern Cape and Western Cape provinces in South Africa at an altitude ranging from 200 m to 1900 m above sea level.[15-17]

Medicinal uses of *Elytropappus rhinocerotis*

The leaves, roots, stems and twigs of *E. rhinocerotis* are mainly used as appetite stimulant and tonic, and traditional medicines for high blood pressure, backache, convulsions, foot perspiration and odour, respiratory problems, sores and wounds, bladder problems, kidney problems, vermifuge, diabetes, fever, painful hands and feet, influenza, ulcers, cancer and stomach cancer and stomach problems (Table 1, Figure 1). The leaves and stems of *E. rhinocerotis* are mixed with those of *Diosma oppositifolia* L. as appetite stimulant and traditional medicine for indigestion, stomach cancer and problems.[18] Similarly, the leaves of *E. rhinocerotis* are mixed with tubers of *Kedrostis nana* (Lam.) Cogn. var. *nana* and used as a contraceptive.[19]

Table 1: Medicinal uses of *Elytropappus rhinocerotis*

Medicinal use	Parts used	References
Appetite stimulant	Leaves and roots	Van Wyk et al.[9]; Bergh[14]; Van Wyk and Gericke[19]; Knowles[20]; Thring and Weitz[21]; Pool et al.[22]; Mshengu[23]; Ticha et al.[24]; Mzindle[25]; Hulley et al.[26]; Thinyane and Maroyi[27]
Appetite stimulant	Leaves and stems mixed with those of *Diosma oppositifolia* L.	Davids et al.[18]
Backache	Leaves and stems	Hulley et al.[26]; Van Wyk et al.[28]; Nortje and Van Wyk[29]
Bladder problems	Leaves	Thring and Weitz[21]; Hulley et al.[26]; Scott et al.[30]; Iyamu[31]
Cancer and stomach cancer	Leaves and roots	Bergh[14]; Van Wyk and Gericke[19]; Knowles[20]; Thring and Weitz[21]; Pool et al.[22]; Mshengu[23]; Ticha et al.[24]; Mzindle[25]; Hulley et al.[26]; Thinyane and Maroyi[27]; Scott et al.[30]; De Beer and Van Wyk[32]; Hulley and Van Wyk[33]
Contraceptive	Leaves mixed with tubers of *Kedrostis nana* (Lam.) Cogn. var. *nana*	Van Wyk and Gericke[19]
Convulsions	Leaves	Thring and Weitz[21]; Ticha et al.[24]; Hulley et al.[26]; Iyamu[31]
Diabetes	Leaves and stems	Davids et al.[18]; Thring and Weitz[21]; Nortje and Van Wyk[29]; Hulley and Van Wyk[33]; Afolayan and Sunmonu[34]
Earache	Leaves	Hulley and Van Wyk[33]
Fever	Leaves and stems	Bergh[14]; Davids et al.[18]; Thring and Weitz[21]; Mshengu[23]; Ticha et al.[24]; Mzindle[25]; Hulley et al.[26]; Iyamu[31]; Hulley and Van Wyk[33]
Flatulence	Leaves	Nortje and Van Wyk[29]
Foot perspiration and odour	Leaves	Bergh[14]; Hulley et al.[26]; Nortje and Van Wyk[29]
Headache	Leaves	Thring and Weitz[21]
Heart problems	Leaves	Thring and Weitz[21]
High blood pressure	Leaves and stems	Davids et al.[18]; Balogun and Ashafa[35]
Infertility	Leaves	Hulley and Van Wyk[33]
Influenza	Leaves and twigs	Van Wyk et al.[9]; Bergh[14]; Van Wyk and Gericke[19]; Knowles[20];

Medicinal use	Parts used	References
		Thring and Weitz[21]; Mshengu[23]; Hulley et al.[26]; Nortje and Van Wyk[29]; Hulley and Van Wyk[33]; Van Wyk[36]; Van Wyk et al.[28]; Van Wyk and Gorelik[37]
Indigestion	Leaves and stems mixed with those of *D. oppositifolia* L.	Davids et al.[18]
Inflammation	Stems	Davids et al.[18]
Insect repellent	Leaves	Hulley and Van Wyk[33]
Kidney problems	Leaves	Thring and Weitz[21]; Hulley et al.[26]; Scott et al.[30]; Iyamu[31]
Painful hands and feet	Leaves	Hulley et al.[26]; Nortje and Van Wyk[29]; Hulley and Van Wyk[33]; Van Wyk et al.[28]; Philander[38]
Respiratory problems (asthma, colds, coughs and tuberculosis)	Leaves	Hulley et al.[26]; Hulley and Van Wyk[33]; Van Wyk et al.[28]
Rheumatism	Leaves	Nortje and Van Wyk[29]
Ringworm	Leaves	Hulley and Van Wyk[33]
Sores and wounds	Leaves	Thring and Weitz[21]; Nortje and Van Wyk[29]; Hulley and Van Wyk[33]
Stomach cancer and problems	Leaves and stems mixed with those of *D. oppositifolia* L.	Davids et al.[18]
Stomach problems (diarrhoea, digestive, dysentery, dyspepsia and indigestion	Leaves, roots, stems and twigs	Van Wyk et al.[9]; Bergh[14]; Davids et al.[18]; Van Wyk and Gericke[19]; Knowles[20]; Thring and Weitz[21]; Pool et al.[22]; Mshengu[23]; Ticha et al.[24]; Mzindle[25]; Hulley et al.[26]; Thinyane and Maroyi[27]; Scott et al.[30]; De Beer and Van Wyk[32]; Hulley and Van Wyk[33]; Van Wyk[36]; Van Wyk and Gorelik[37]; Philander[38]; Dekker et al.[39]
Tonic	Leaves	Van Wyk et al.[9]; Knowles[20]; Pool et al.[22]; Mshengu[23]; Ticha et al.[24]; Mzindle[25]; Scott et al.[30]; Hulley and Van Wyk[33]; Van Wyk and Gorelik[37]
Ulcers	Leaves and roots	Van Wyk et al.[9]; Van Wyk and Gericke[19]; Knowles[20]; Thring and Weitz[21]; Pool et al.[22]; Mshengu[23]; Ticha et al.[24]; Mzindle[25]; Hulley et al.[26]; Thinyane and Maroyi[27]; Scott et al.[30]; De Beer and Van Wyk[32]
Vermifuge	Leaves and twigs	Thring and Weitz[21]; Van Wyk[36]; Van Wyk and Gorelik[37]; Philander[38]

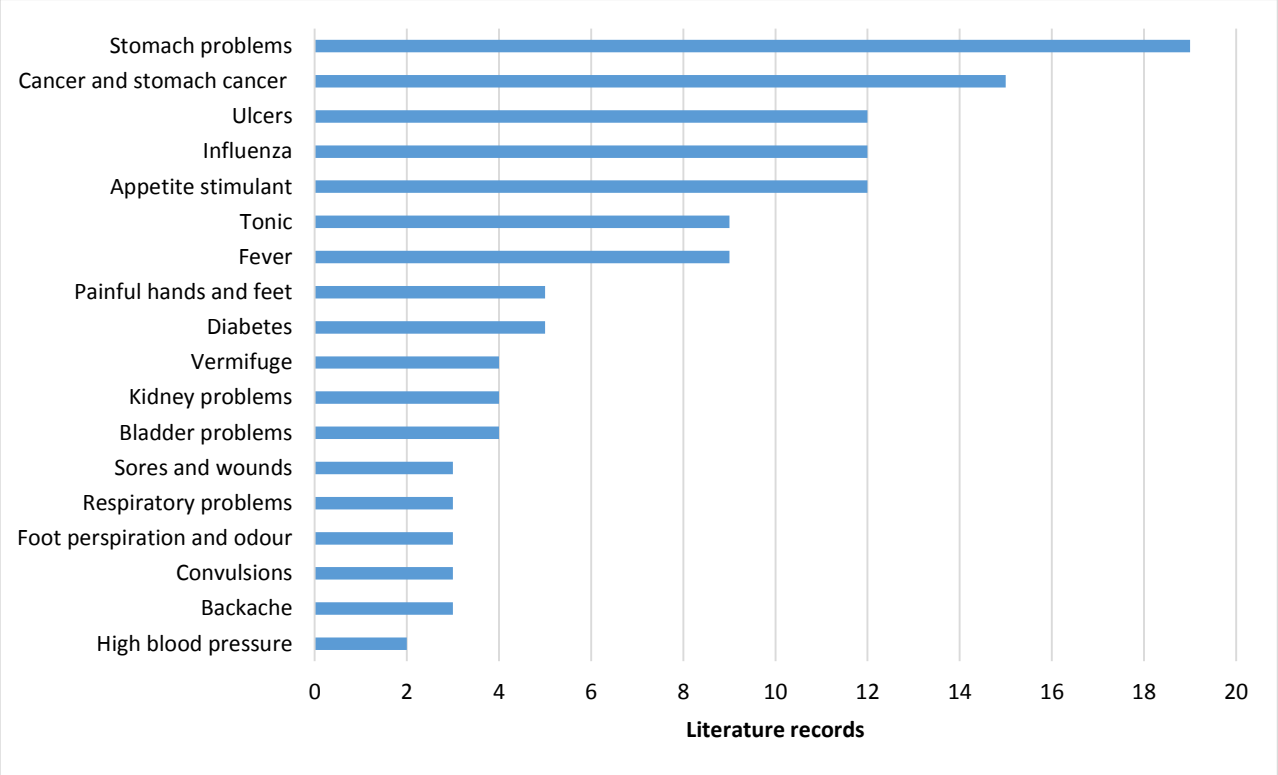

Figure 1. Medicinal applications of *Elytropappus rhinocerotis* derived from literature records

Phytochemistry and biological activities of *Elytropappus rhinocerotis*

Several phytochemical compounds (Table 2) have been identified from the aerial parts and leaves of *E. rhinocerotis*, and these compounds include coumarins, essential oils, flavonoids, labdane diterpenes and phenolic acids.[24,26,39-41] Scott et al.[30] and Iyamu[31] identified alkaloids, cardiac glycosides, flavonoids, saponins, tannins and triterpene steroids from the leaves of *E. rhinocerotis*. The following biological activities have been reported from the aerial parts and leaf extracts of *E. rhinocerotis* and compounds isolated from the species: antibacterial,[26,30] antimycobacterial,[24] antifungal,[20,26,42] anticonvulsant,[31] anti-inflammatory,[25,39] antioxidant[25] and immunotoxicity[22] activities.

Table 2: Phytochemical composition of *Elytropappus rhinocerotis*

Phytochemical	Value	Plant part	Reference
(+)-13-epilabdanolic acid	-	Aerial parts	Hulley et al.[26]; Mshengu et al.[41]
(+)-(8R,13R)-labdan-8,15-diol	-	Aerial parts	Hulley et al.[26]; Mshengu et al.[41]
(+)-ent-labdanolic acid	-	Aerial parts	Hulley et al.[26]; Mshengu et al.[41]
(+)-methyl 13-epilabdanolate	-	Aerial parts	Hulley et al.[26]; Mshengu et al.[41]
(–)-Spathulenol (%)	1.7 – 37.8	Aerial parts	Hulley et al.[26]
1,8-Cineole (%)	0.6 – 12.3	Aerial parts	Hulley et al.[26]
4',5,7-trihydroxyflavone	-	Aerial parts	Mshengu et al.[41]
5,7-dihydroxy-4'-methoxyflavone	-	Aerial parts	Mshengu et al.[41]
5,7-dihydroxy-4',6-dimethoxyflavone	-	Aerial parts	Mshengu et al.[41]
6,7-dimethoxycoumarin	-	Aerial parts	Mshengu et al.[41]
Benzoic acid	-	Leaves	Proksch et al.[40]
β-Bourbonene (%)	0.9 – 9.1	Aerial parts	Hulley et al.[26]
Cirsimaritin	-	Leaves	Proksch et al.[40]
Damascone (%)	2.6 – 3.8	Aerial parts	Hulley et al.[26]
Dodedalactone (%)	2.7 – 4.4	Aerial parts	Hulley et al.[26]
ent-labd-13-en-8β-hydroxy-15-oic acid	-	Aerial parts	Hulley et al.[26]
Eupafolin	-	Leaves	Proksch et al.[40]
Ferulic acid	-	Leaves	Proksch et al.[40]
Germacrene A (%)	3.9 - 15.6	Aerial parts	Hulley et al.[26]
Hispidulin	-	Leaves	Proksch et al.[40]
Humulane-1,6-dien-3-ol (%)	1.1 - 2.6	Aerial parts	Hulley et al.[26]
Hydroxybenzoic acid	-	Leaves	Proksch et al.[40]
Kaempferol 3-methyl ether	-	Aerial parts	Mshengu et al.[41]
Ledol (%)	2.4 – 5.0	Aerial parts	Hulley et al.[26]
Linalool oxide (%)	3.4	Aerial parts	Hulley et al.[26]
Longipinonol (%)	1.1 - 3.5	Aerial parts	Hulley et al.[26]
p-coumaric acid	-	Leaves	Proksch et al.[40]
Pinocarveol (%)	1.0	Aerial parts	Hulley et al.[26]
Protocatechuic acid	-	Leaves	Proksch et al.[40]
Quercetin	-	Leaves	Proksch et al.[40]
Rhinocerotinoic acid	-	Aerial parts	Hulley et al.[26]; Dekker et al.[39]
(S)-4',5-dihydroxy-7-methoxyflavanone	-	Leaves	Ticha et al.[24]
(S)-4',5-dihydroxy-3',7-dimethoxyflavanone	-	Leaves	Ticha et al.[24]
Santolina alcohol (%)	1.4 – 4.4	Aerial parts	Hulley et al.[26]
Sclareoloxide (%)	1.2 – 6.0	Aerial parts	Hulley et al.[26]
Silphiperfol− 6-en-5-one (%)	4.5 – 26.8	Aerial parts	Hulley et al.[26]
Sinapic acid	-	Leaves	Proksch et al.[40]
Terpinen-4-ol (%)	9.2 – 24.3	Aerial parts	Hulley et al.[26]
Veratric acid	-	Leaves	Proksch et al.[40]
Viridiflorol (%)	0.3 – 100.0	Aerial parts	Hulley et al.[26]
α-Ylangene (%)	5.0	Aerial parts	Hulley et al.[26]

Antibacterial activities

Scott et al.[30] evaluated antibacterial activities of the aqueous extracts of aerial parts of *E. rhinocerotis* against *Mycobacterium smegmatis*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* using the disk diffusion assay with ciprofloxacin (50 µg/ml) as a positive control. The extract exhibited activities against *Staphylococcus aureus* with zone of inhibition of 13 mm which was much lower than 27 mm exhibited by the positive control.[30] Hulley et al.[26] evaluated antibacterial activities of the water and methanol-dichloromethane extracts of aerial parts of *E. rhinocerotis*, essential oil, compounds (+)-13-epilabdanolic acid and ent-labd-13-en-8β-hydroxy-15-oic acid isolated from the species against *Brevibacterium agri*, *Brevibacterium epidermidis*, *Brevibacterium linens*, *Staphylococcus aureus* and *Staphylococcus epidermidis* using the microtitre plate method with ciprofloxacin, zinc oxide and zinc sulphate as positive controls. The crude extract, essential oil and the compounds exhibited activities with minimum inhibitory concentration (MIC) values ranging from 0.003 mg/mL to >8.0 mg/mL.[26]

Antimycobacterial activities

Ticha et al.[24] evaluated the antimycobacterial activities of the compounds (S)-4',5-dihydroxy-7-methoxyflavanone and (S)-4',5-dihydroxy-3',7-dimethoxyflavanone isolated from the leaves of *E. rhinocerotis* against *Mycobacterium tuberculosis* (H37Rv) using the using BACTEC susceptibility testing over a seven day period with isoniazid and rifampicin as positive controls. The compounds exhibited weak activities.[24]

Antifungal activities

Knowles[20] evaluated antifungal activities of leaf methanol extracts of *E. rhinocerotis* alone or combined with kresoxim-methyl against *Botrytis cinerea* using radial growth assay. At concentrations of 25% and 50% (w/v), the extract showed the best inhibitory effects in combination with kresoxim-methyl at concentrations of 0.25% and 0.5%. Knowles[20] evaluated the dose rates that produce synergistic reactions for combinations of leaf methanol extracts of *E. rhinocerotis* and kresoxim-methyl against *Botrytis cinerea* in an apple bioassay. The extract showed synergistic effects with complete inhibition of *Botrytis cinerea* infection in mixtures at 0.19%.[20] Fielding et al.[42] evaluated antifungal activities of leaf methanol extracts of *E. rhinocerotis* alone or combined with kresoxim-methyl against Botrytis cinerea using radial growth assay. Synergistic interactions between the plant extracts and the kresoxim-methyl fungicide were also tested during a seven day incubation period with radial growth assays. In the absence of kresoxim-methyl, the extract at 500 mg/mL produced 62.0% inhibitory effects while kresoxim-methyl in combination with the extract optimal antifungal activities at 250.0 mg/mL and 500.0 mg/mL with 74.4% to 88.1% inhibitory effects, respectively. The extract showed weak antifungal activities *in vivo*, exhibiting synergistic effects at 1.95 mg/mL, 3.91 mg/mL and 7.81 mg/mL.[42] Hulley et al.[26] evaluated antifungal activities of the water and methanol-dichloromethane extracts of aerial parts of *E. rhinocerotis* and essential oil isolated from the species against *Trichophyton mentagrophytes* using the microtitre plate method with amphotericin B as a positive control. The crude extract and essential oil exhibited activities with MIC values ranging from 0.01 mg/mL to >8.0 mg/mL.[26]

Anticonvulsant activities

Iyamu[31] evaluated the anticonvulsant activities of leaf methanol extracts of *E. rhinocerotis* by assessing the effects of the extract against seizures induced by pentylenetetrazole, picrotoxin, bicuculline, N-methyl-DL-aspartic acid and strychnine in experimental male albino mice. Tonic convulsions induced in mice by pentylenetetrazole (100 mg/kg, i.p), picrotoxin (20 mg/kg, i.p), bicuculline (30 mg/kg, i.p), N-methyl-DL-aspartic acid (500 mg/kg, i.p) and strychnine (2 mg/kg, i.p) were antagonized by an extract of 200 mg/kg, i.p to 400 mg/kg, i.p.[31]

Anti-inflammatory activities

Dekker et al.[39] evaluated the anti-inflammatory activities of the aerial parts of *E. rhinocerotis* and the compound rhinocerotinoic acid isolated from the species using the carrageenan-induced oedema test in male albino mice. The aerial part extracts showed considerable inhibition of carrageenan-induced oedema in rats while rhinocerotinoic acid (LD_{50} >300 mg/kg) caused a 50% inhibition of the carrageenan-induced oedema in non-adrenalectomized and adrenalectomized rats at a dose of 150 mg/kg.[39] Mzindle[25] evaluated anti-inflammatory activities of methanol and water leaf extracts of E. rhinocerotis using the lipoxygenase inhibitor screening assay with nordihydroguaiaretic acid as a positive control. The methanol and water extracts inhibited lipoxygenase enzyme by 22.4% and 103.8%, respectively, in comparison to 122% and 129% inhibition demonstrated by nordihydroguaiaretic acid, the control. Mzindle[25] also evaluated the wound healing activities of ethanol and water extracts of *E. rhinocerotis* using the scratch wound assay. The migration rate of the extracts ranged from 34.6% to 48.1% when compared to the untreated cells with a percentage migration rate of 24%.[25]

Antioxidant activities

Mzindle[25] evaluated antioxidant activities of methanol and water extracts of *E. rhinocerotis* using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging assay with rutin as a positive control. The extracts showed free radical scavenging abilities ranging from 24.9% to 95.4%, while rutin exhibited free radical scavenging abilities ranging from 27.4% to 95.3%.[25]

Immunotoxicity activities

Pool et al.[22] evaluated the immunotoxicity activities of leaf extracts of *E. rhinocerotis* on male mouse spleenocytes using cytokine ELISAs. Spleen cell cultures were prepared and exposed to varying concentrations of the extracts. The extracts exhibited immunomodulatory effects as exposure

of cell cultures to the extracts resulted in a decrease in both IL-4 and IFN-γ.[22]

Toxicity activities

Pool et al.[43] evaluated the toxicity activities of leaf extracts of *E. rhinocerotis* using *Vibrio fischeri* bioluminiscent, *Selenastrum capricornutum* growth inhibition, *Daphnia pulex* acute toxicity and *Poecilia reticulata* acute toxicity tests. The extract exhibited weak activities with half maximal effective concentration (EC_{50}) values against *Selenastrum capricornutum* and *Vibrio fischeri* ranging from 110 µg/ml to 390 µg/ml while the median lethal concentration (LC_{50}) values against *Daphnia pulex* and *Poecilia reticulata* ranged from 210 µg/ml to 340 µg/ml.[43]

CONCLUSION

The present review summarizes the ethnomedicinal uses, phytochemistry and pharmacological properties of the aerial parts, leaves, roots, stems and twigs of *E. rhinocerotis*. The historical traditional usage of *E. rhinocerotis* as traditional medicine in South Africa calls for detailed phytochemical and pharmacological studies aimed at correlating its documented ethnomedicinal uses with the phytochemical and pharmacological properties of the species. There is need for clinical and toxicological evaluations of both crude extracts and phytochemical compounds associated with *E. rhinocerotis*.

Conflict of interest

The author declares that he has no conflict of interest.

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