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REVIEW ARTICLE

An overview of medicinal uses, phytochemical and pharmacological properties of *Terminalia brownii* Fresen.

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Abstract

Terminalia brownii Fresen. is a shrub or small tree widely used in traditional medicine in tropical Africa. This study critically reviewed the medicinal uses, phytochemical and pharmacological properties of *T. brownii*. Literature was collected from multiple internet sources as well as non-electronic sources which included book chapters, books, scientific reports and journal articles obtained from the University library. This study revealed that *T. brownii* is used as ethnoveterinary medicine and traditional medicines against respiratory infections, gastro-intestinal problems, malaria, jaundice, colic, diabetes, gastric ulcers, intestinal problems, liver problems, rheumatism, yellow fever, skin diseases, wounds, fever and typhoid. Phytochemical research identified carboxylic acid, chromone derivatives, ellagic acid derivatives, ellagitannins, fatty acids, fatty alcohols, flavonoids, geranylated chalcones, keto acids, phenols, phytosterols, steroids, stilbens, triterpenoids and triterpene glucosides from the bark, flowers, leaves, roots, stem bark and stem wood of *T. brownii*. Ethnopharmacological research revealed that the phytochemical compounds isolated from *T. brownii* and the crude extracts of the species demonstrated antibacterial, antimycobacterial, antifungal, antidiarrheal, antimycoplasmal, antidiabetic, anti-inflammatory, antioxidant, antiplasmodial, antinociceptive, antiulcer, anti-pyretic, hepatoprotective and cytotoxicity activities. *T. brownii* has become an important medicinal plant species in tropical Africa. Therefore, the full potential of the species as a medicinal plant should be explored by assessing the toxicity, safety, mechanisms of action *in vivo* and clinical research of the crude extracts and phytochemical compounds isolated from the species. Future ethnopharmacological studies should also examine the combinational effects of *T. brownii* extracts with other medicinal plants as the species is widely used in synergistic therapy.

Keywords: Combretaceae; indigenous knowledge; *Materia medica; Terminalia brownii;* traditional medicine

Introduction

Terminalia brownii Fresen. is a deciduous shrub or small tree belonging to the Combretaceae family commonly known as the white mangrove, Indian almond or bush willow family. The Combretaceae family consists of about 530 species distributed in 10 genera (1-3). *T. brownii* is a multi-purpose tree support livelihoods of local communities in developing countries through several ecosystem goods and services such as timber, traditional medicines, firewood, charcoal, fodder, mulch and cultural services (4-6). The wood of *T. brownii* is strong, hard, durable, resistant to fungi, boring insects and termites, easy to saw and work and widely used for construction, joinery, furniture, fence posts, animal enclosures, canoes, utensils, tool handles, carvings, beehives and sticks (7, 8). *T. brownii* is an important source of firewood and charcoal throughout the distributional range of the species as the wood burns slowly with intense heat (7, 8). The smoke of burning wood and bark of *T. brownii* is used as body and hair perfume (8). The fruits of *T. brownii* are edible, although they are bitter and its leaves, branches and twigs are browsed by game and livestock (8). The bark, fruits and roots of *T. brownii* are important sources of tannin and dye, used for tanning hides (7, 8). *T. brownii* is an attractive tree that is popular in private gardens, tolerating frost and moderate drought and widely as an ornamental or shade plant (4, 8). *T. brownii* is an integral part of the agroforestry system used for intercropping purposes with different agricultural crops doing well under its canopy (4, 9, 10), thus improving the soil physicochemical properties, enhancing soil fertility, providing shelter and habitat to other species and reducing environmental degradation (11).

Today, in informal herbal medicine markets throughout tropical Africa, the bark, roots, seeds, stems and stem bark of *T. brownii* are widely sold as medicinal ingredients for various human and animal ailments (8, 12). Similarly, several *Terminalia* species (Table 1) are used as sources of traditional medicines in tropical Africa. It is therefore, within this context that the current study was undertaken aimed at reviewing the medicinal uses, phytochemical and pharmacological properties of *T. brownii.*

Materials and methods

A systematic review of the medicinal uses, phytochemical and pharmacological properties of *T. brownii* was conducted following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. The literature search involved using different electronic databases such as Web of Science (https://

Table 1. *Terminalia* species used as sources of traditional medicines in tropical Africa

Species	Country or region	Reference
T. avicennioides Guill. & Perr.	West Africa	(13, 14)
T. bellirica (Gaertn.) Roxb.	Mauritius	(15)
T. bentzoë (L.) L.f.	Mauritius and Réunion	(16, 17)
T. brachystemma Welw. ex Hiern	Angola, Mozambique, Zambia and Zimbabwe	(16, 18-20)
T. engleri Gere & Boatwr.	West Africa	(10, 16, 20)
T. ivorensis A.Chev.	Cameroon, Ghana, Ivory Coast, Liberia, Nigeria and Sierra Leone	(10, 20)
T. kaiseriana F.Hoffm.	Tanzania	(10, 20, 22)
T. kilimandscharica Engl.	Kenya	(4, 9, 10, 23)
T. laxiflora Engl. & Diels	Burkina Faso, Central African Republic (CAR), Guinea, Ivory Coast, Kenya, Mali, Nigeria, Senegal, South Sudan, Sudan and Togo	(10, 13, 16, 20, 24)
T. macroptera Guill. & Perr.	Burkina Faso, CAR, Ivory Coast and Nigeria	(10, 13, 16, 20, 21)
T. mantaly H.Perrier	Madagascar	(20)
T. mollis M.A.Lawson	Benin, Cameroon, Democratic Republic of Congo (DRC), Kenya, Mozambique, Namibia, Nigeria, Rwanda, Tanzania, Uganda and Zambia	(9, 10, 20, 23)
T. myrtifolia (M.A.Lawson) Gere & Boatwr.	Mozambique and Tanzania	(4, 10, 16, 19, 20, 26)
T. orbicularis Engl. & Diels	Kenya	(9, 23, 27)
T. phanerophlebia Engl. & Diels	South Africa	(19)
T. prunioides M.A.Lawson	Angola, Botswana, Kenya, Namibia, Somalia, South Africa, Zambia and Zimbabwe	(4, 9, 20, 23)
T. sambesiaca Engl. & Diels	East and southern Africa	(10, 16, 20)
T. schimperiana Hochst.	CAR, Ethiopia, Guinea, Niger, Nigeria, Sierra Leone, Tanzania and Uganda	(10, 13, 16, 20, 28, 29)
T. sericea Burch. ex DC.	Botswana, DRC, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe	(10, 16, 18, 20, 30)
T. spinosa Engl.	Ethiopia, Kenya, Somalia and Tanzania	(4, 9, 10, 20, 23, 24, 31)
T. stenostachya Engl. & Diels	Malawi, Mozambique, Tanzania and Zimbabwe	(10, 16, 18, 20)
T. superba Engl. & Diels	Cameroon, DRC, Gabon, Ghana, Ivory Coast, Kenya, Nigeria, Sierra Leone, Somalia and Tanzania	(4, 10, 9, 13, 16, 27, 32)
T. tetraptera (Wickens) Gere & Boatwr.	Kenya	(4, 23)

www.webofknowledge.com), Scopus® (http://www.scopus.com/), SpringerLink® (https://link.springer.com/), Google Scholar (https://scholar.google.com/), SciELO (https://search.scielo.org/), PubMed® (https://pubmed.ncbi.nlm.nih.gov/) and ScienceDirect® (https://www.sciencedirect.com/search) and non-electronic sources such as books, book chapters, journal articles, dissertations and thesis obtained from the University library. The electronic search utilized specific keywords such as "*Terminalia brownii*", English common name "red pod terminalia", "biological activities of *Terminalia brownii*", "pharmacological properties of *Terminalia brownii*", "ethnobotany of *Terminalia brownii*", "medicinal uses of *Terminalia brownii*", "phytochemistry of *Terminalia brownii*" and "traditional uses of *Terminalia brownii*". The study inclusion criteria focused on studies that explored the medicinal uses, phytochemical and pharmacological properties of *T. brownii*. Exclusions were made for articles that did not address these issues as well as scientific papers published as abstracts only. The number of articles appraised for full inclusion in the study amounted to 87 (Fig. 1) published from 1961 to 2025, a long period to capture literature on the medicinal uses, phytochemical and pharmacological properties of *T. brownii.*

Species description

The genus *Terminalia* consists of about 190 species and is cosmopolitan in distribution, recorded across the tropical areas of Asia, Africa, America and extending into the subtropical regions of the Pacific Islands and Australia (33-36). The genus *Terminalia* comprises trees, shrubs and lianas, characterized by the leaves which are simple, without scales, that are alternate, spirally arranged or sometimes opposite or nearly opposite and are usually terminal or crowded towards the ends of the branches and sometimes on short shoots (33, 37). The leaves of some *Terminalia* species are petiolate or subsessile, usually entire but occasionally subcrenate, often with some pellucid dots or glands on either side of the leaf near the base or on the petiole (4). The flowers are bisexual or male or female on the same or different trees, usually borne in lax spikes (4, 37). The flowers are small, lacking petals and the fruit is one-seeded with two wings which are joined at the top and bottom (37). The bark, leaf and fruit characters are widely used to differentiate and identify the *Terminalia* species (38, 39). The genus name *Terminalia* is derived from the Latin word "*terminus*" which means "end", in reference to the leaves that are borne in whorls close to ends of the shoots, branchlets and branches (10, 37). The specific name "*brownii*" is in honour of Robert Brown (12 December 1773 – 10 June 1858), a prominent Scottish botanist and plant collector (40). Several synonyms are associated with the scientific name *T. brownii,* see Table 2. The English common name of *T. brownii* is "red pod terminalia" (4, 8, 10).

T. brownii (Fig. 2) is a deciduous shrub or small tree growing up to 15 m in height (8). The bole is characterized by low-branching, crown umbrella-shaped, with spreading branches, densely shady with somewhat drooping foliage (Fig. 2A). The bark surface is rough and fissured, greyish black to dark brown in colour and the inner bark is thick, fibrous and dull red brown in colour. The twigs of *T. brownii* are initially hairy and becoming glabrous with age. The leaves are spirally arranged, simple with entire margins (Fig. 2B), crowded at the ends of branches and turn red before falling. The leaves are elliptic to obovate in shape, base rounded to cuneate, apex obtuse to acute, sometimes slightly acuminate, papery or thin-leathery, glaborous or hairy beneath with waxy edges. The inflorescence of *T. brownii* is short and hairy, occurring in axillary spikes. The flowers are bisexual or male, regular, whitish or creamy

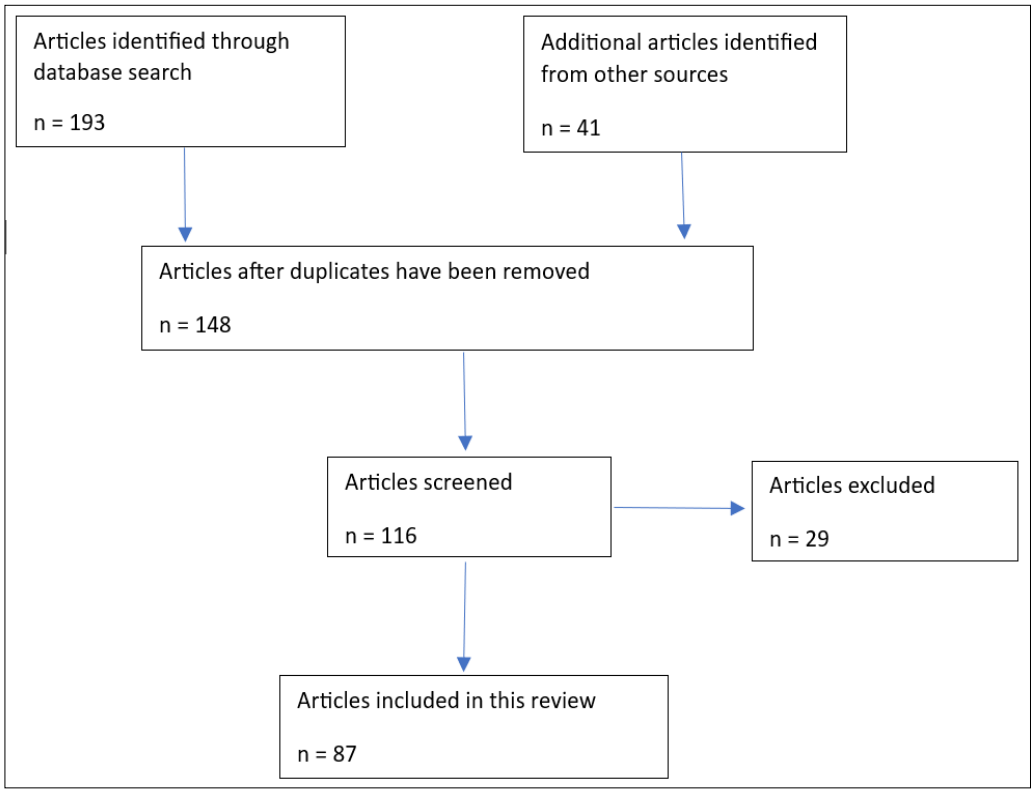

Fig. 1. PRISMA flow diagram presenting the systematic review undertaken in this study.

Table 2. List of synonyms associated with the scientific name *Terminalia brownii*

Synonym	Type of synonym	Reference
Myrobalanus brownii (Fresen.) Kuntze	Homotyoic	(41-43)
T. brownii Fresen. var. *albertensis* Bagsh. & Baker f.	Heterotypic	(41-43)
T. brownii Fresen. var. *gallaensis* Engl. ex Diels	Heterotypic	(41-43)
T. brownii Fresen. var. *stenocarpa* Fiori	Heterotypic	(41-43)
T. confertifolia Steud. ex A.Rich.	Heterotypic	(41)
T. cycloptera R.Br.	Heterotypic	(41)
T. hemignosta Steud. ex A.Rich.	Heterotypic	(41)
T. *semLikiensis* De Wild.	Heterotypic	(41)

green in colour, unpleasantly scented and pollinated by insects. The fruit is an ellipsoid winged nut (Fig. 2C), glabrous, reddish purple in colour and indehiscent with a single seed. *Terminalia brownii* has been recorded in Cameroon, Central African Republic (CAR), Chad, Nigeria, Somalia, Ethiopia, Djibouti, Eritrea, the Democratic Republic of Congo (DRC), Yemen, Kenya, South Sudan, Sudan, Tanzania and Uganda (4, 8, 10, 41-45) (Fig. 3). *T. brownii* has been recorded in woodland, bushland, grassland, rocky outcrops, in deep sandy soils, well drained loamy soils, dry rocky soils above streams or near rivers in dry areas at altitudes up to 2000 m above sea level (8).

Fig. 2. *Terminalia brownii*: A) entire plant, B) branch showing leaf shape and C) branch showing leaves and fruits (photos: O Weber).

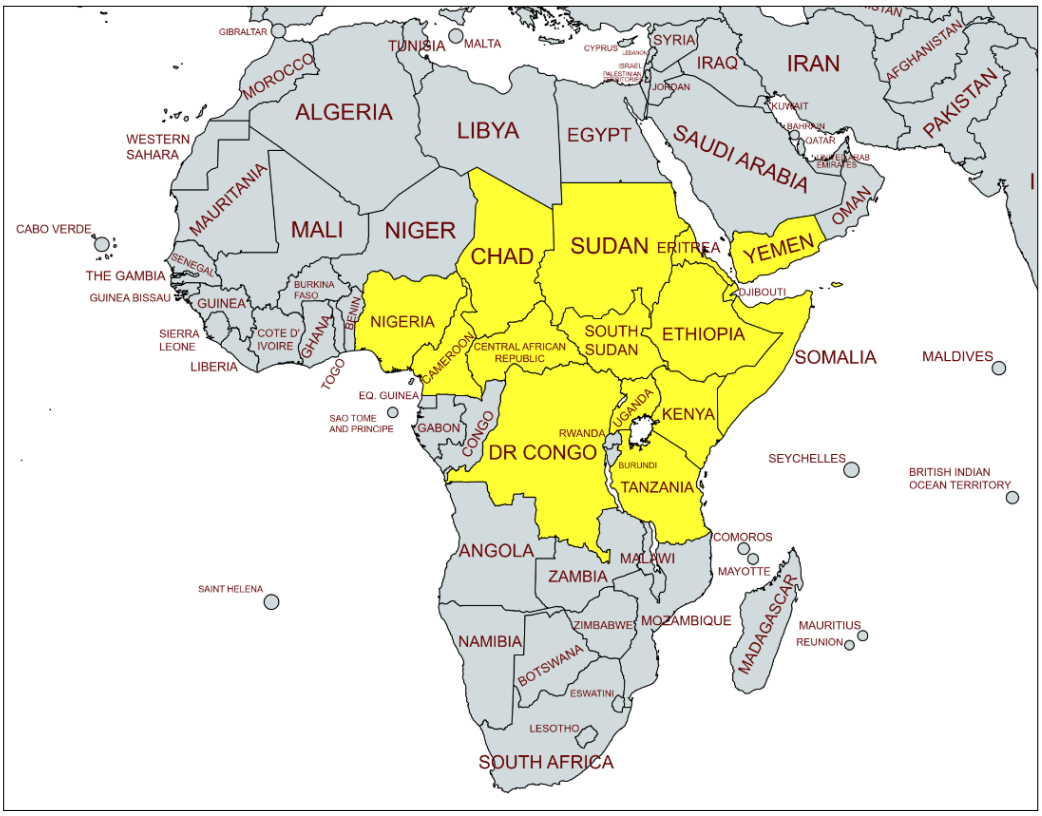

Fig. 3. Distribution of *Terminalia brownii* in tropical Africa and Yemen.

Medicinal uses of *Terminalia brownii*

T. brownii is used as a source of traditional medicines in Nigeria, Ethiopia, Djibouti, Eritrea, DRC, Kenya, South Sudan, Sudan and Tanzania, that is, 9 countries (60.0 %) of the 15 countries (Fig. 3) where the species is indigenous (Table 3). In tropical Africa, the bark, leaves, roots, stems, stem bark, stems, seeds, branches, trunks, twigs, wood or bast fibre of *T. brownii* are used as traditional medicines to treat or manage 67 human and animal diseases or ailments. The main ailments and diseases treated by *T. brownii* extracts (Fig. 4) include its use as ethnoveterinary medicine and traditional medicine for respiratory infections, gastro-intestinal problems, malaria, jaundice, colic, diabetes, gastric ulcers, intestinal problems, liver problems, rheumatism, yellow fever, skin diseases, wounds, fever and typhoid. Research showed that in the pastoral communities in Nigeria, Kenya, South Sudan, Sudan, Tanzania and Uganda, the bark and leaves of *T. brownii* are widely used as ethnoveterinary medicine for worms, babesiosis, conjunctivitis, tick borne, diarrhoea, East Coast fever, heart water, red water, sweating sickness and tuberculosis (3, 8, 46-49).

In Kenya, the roots of *T. brownii* are mixed with the bark of *Leucas calostachys* Oliv. (Lamiaceae) and *Maerua decumbens* (Brongn.) DeWolf (Capparaceae) and *Vachelia xanthophloea* (Benth.) P J H Hurter (Fabaceae) leaves of *Bersama abyssinica* Fresen. (Francoaceae) and roots of *Vepris nobilis* (Delile) Mziray (Rutaceae) as traditional medicines against amoebiasis (23, 50, 51). The bark of *T. brownii* is mixed with roots of *L. calostachys, Olea europaea* L. (Oleaceae), *V. xanthophloea* and *Zanthoxylum asiaticum* (L.) Appelhans (Rutaceae) as remedy for arthritis (23, 50, 51) while the bark is mixed with bark of *Ficus thonningii* Blume (Moraceae) and *Olea europaea* L. subsp. *africana* (Mill.) P S Green (Oleaceae) and *V. xanthophloea* as remedy for cancer (23, 50, 51). The bark of *T. brownii* is mixed with roots of *M. decumbens* and *Carissa spinarum* L. (Apocynaceae) as remedy for diabetes while leaf juice is mixed with juice of apical leaves of *Coleus barbatus* (Andrews) Benth. ex G Don (Lamiaceae) as remedy for eye problems (50). The root powder decoction of *T. brownii* is taken orally mixed with *Rumex usambarensis* (Engl.) Dammer (Polygonaceae) and *Warburgia ugandensis* Sprague (Canellaceae) as remedy for gum bleeding while the root powder decoction is taken orally mixed with *W. ugandensis* and *Azadirachta indica* A Juss (Meliaceae) as remedy for tonsillitis (52). The bark of *T. brownii* is mixed with tubers of *Rhoicissus tridentata* (L.f.) Wild & R B Drumm. (Vitaceae), bark of *L. calostachys* and *Jasminum fluminense* Vell. (Oleaceae) as remedy for heartburn (50). In Ethiopia, the leaves of *T. brownii* are mixed with root and bark of *Nicotiana tabacum* L. (Solanaceae) as remedy for anthrax (53) while the bark is mixed with that of *Croton macrostachyus* Hochst. ex Delile (Euphorbiaceae) as traditional medicine for jaundice and liver disease (54).

Phytochemistry of *Terminalia brownii*

Qualitative and quantitative phytochemical analyses of *T. brownii* bark, flowers, leaves, roots, stem bark and stem wood revealed the presence of carboxylic acid, chromone derivatives, ellagic acid derivatives, ellagitannins, fatty acids, fatty alcohols, flavonoids, geranylated chalcones, keto acids, phenols, phytosterols, steroids, stilbens, triterpenoids and triterpene glucosides (84 - 99) (Table 4). Some of the phytochemical compounds isolated from the extracts of *T. brownii* exhibited antibacterial (85, 87, 93, 98), antimycobacterial (91), antifungal (85, 87, 92, 98), antimycoplasmal (86, 87) and antinociceptive (100) activities (Table 5).

Pharmacological properties of *Terminalia brownii*

Several pharmacological activities of *T. brownii* crude extracts have been reported in literature justifying some of its ethnomedicinal uses. Some of the listed pharmacological activities (Table 6) may not relate directly to the ethnomedicinal uses of *T. brownii* but may provide some insight into its potential therapeutic value and bioactive properties. A wide range of pharmacological activities that have been reported include antibacterial (58, 85, 89, 93, 101-106),

Table 3. Medicinal uses of *Terminalia brownii*

Medicinal use	Plant part used	Country	Reference
Mono-therapeutic applications			
Abortifacient	Leaf decoction taken orally	Kenya	(8, 46)
Allergic reactions	Root decoction applied topically	Kenya	(8, 46)
Anthelmintic	Bark decoctions taken orally	Kenya	(8, 48)
Body swellings	Bark and stem decoctions taken orally	Ethiopia	(8, 55)
Cancer	Not specified	Kenya	(56)
Cleaning teeth	Seed decoction applied topically	Ethiopia	(57)
Colic	Bark or leaf chewed, or decoction taken orally	Kenya and Tanzania	(8, 58, 59)
Contraceptive	Leaf decoction taken orally	Kenya	(46)
Diabetes	Bark, leaf or stem bark decoction taken orally	Eritrea, Kenya and Sudan	(56,60-62)
Endometritis	Bark, root, stem, branch or trunk decoctions taken orally	DRC	(20, 58)
Epilepsy	Bark, branch, stem bark or trunk decoction taken orally	Kenya	(8, 20, 58)
Eye problems	Bark, leaf or stem bark decoctions applied topically	Kenya	(7, 8, 46, 56, 63)
Fever and typhoid	Bark or leaf decoctions taken orally	Ethiopia and Kenya	(4, 10, 48, 56, 64)
Gastric ulcers	Bark, branch, leaf, stem bark or trunk decoction taken orally	Kenya and Tanzania	(20, 58, 65)
Gastro-intestinal problems (constipation, diarrhoea, indigestion and stomachache)	Bark, branch, leaf, root, stem, stem bark or trunk decoction taken orally	Ethiopia, Kenya and Tanzania	(8, 10, 20, 56, 58, 63,66-69)
Hair cream	Seed decoction applied topically	Ethiopia	(57)
Heartburn	Leaf decoctions taken orally	Tanzania	(58)
Hysteria	Branch, stem bark or trunk decoction taken orally	Kenya	(20, 58)
Intestinal problems (colitis and worms)	Branch, stem bark or trunk decoction taken orally	Ethiopia and Kenya	(20, 46, 58, 70)
Jaundice	Bark, stem or stem bark decoction taken orally	Djibouti, Ethiopia, Kenya and Sudan	(8,20,22,50,58,59 ,62,63,70-72)
Kidney problems	Bark decoction taken orally	Kenya	(46)
Leukorrhoea	Bark, root, stem, branch or trunk decoctions taken orally	DRC	(20, 58)
Liver problems (cirrhosis and hepatitis)	Bark, leaf or stem decoction taken orally	Ethiopia and Kenya	(20, 22, 58,71)
Malaria	Bark, branch, leaf, stem bark or twig decoction taken orally	Djibouti, Eritrea and Kenya	(8,20,46,56,58,61 ,63,73,74)
Menstrual problems	Branch, stem bark or trunk decoction taken orally	Kenya	(20, 58)
Mosquito repellant	Stems burnt	Ethiopia	(75)
Pain	Leaf decoction taken orally	Ethiopia	(67)
Respiratory infections (asthma, colds, cough, influenza, pneumonia and tuberculosis)	Bark, leaf, root, stem, stem bark or wood decoction or infusion taken orally	Eritrea, Kenya, Nigeria, Sudan and Tanzania	(4,7,8,10,20,47,4 8,56,58,61-63,68,76,77)
Rheumatism	Root or stem bark decoction applied topically	Kenya and Sudan	(62, 78)
Sexually transmitted infections (gonorrhoea and syphilis)	Bark, root, stem, branch or trunk decoctions taken orally	DRC	(8, 20, 58)
Skin diseases (dermatitis and ringworm)	Leaf or stem bark decoction applied topically	Eritrea and Kenya	(8, 46, 61)
Snake bite	Bark decoction applied topically	Ethiopia	(64)
Tonsillitis	Root powder decoction taken orally	Kenya	(79)
Toothache	Root powder decoction applied topically	Kenya	(56, 79)
Urino-genital problems	Bark, root, stem, branch or trunk decoctions taken orally	DRC	(8, 20, 58)
Wounds	Bark, leaf or stem bark decoction applied topically	Eritrea, Ethiopia and Sudan	(61,62,80,81,82)
Yellow fever	Bark, bast fibre, leaf, root, stem or stem bark decoction applied topically	Ethiopia and Kenya	(4,8,10,20,22,58, 65,68,71)
Ethnoveterinary medicine (anthelmintic, babesiosis, conjunctivitis, tick borne, diarrhoea, East Coast fever, heart water, red water, sweating sickness and tuberculosis)	Bark or leaves	Kenya, Nigeria, South Sudan, Sudan, Tanzania and Uganda	(8,46-49)
Used in combination with other species			
Amoebiasis	Roots mixed with bark of *Leucas calostachys* Oliv. (Lamiaceae) and *Maerua decumbens* (Brongn.) DeWolf (Capparaceae) and *Vachelia xanthophloea* (Benth.) P.J.H.Hurter (Fabaceae), leaves of *Bersama abyssinica* Fresen. (Francoaceae) and roots of *Vepris nobilis* (Delile) Mziray (Rutaceae)	Kenya	(23, 50, 51)
Anthrax	Leaf mixed with root and bark of *Nicotiana tabacum* L. (Solanaceae)	Ethiopia	(81)
Arthritis	Bark mixed with roots of *L. calostachys, Olea europaea* L. (Oleaceae), *V. xanthophloea* and *Zanthoxylum asiaticum* (L.) Appelhans (Rutaceae)	Kenya	(23, 50, 51)
Cancer	Bark mixed with bark of *Ficus thonningii* Blume (Moraceae) and *Olea europaea* L. subsp. *africana* (Mill.) P.S.Green (Oleaceae) and *V. xanthophloea*	Kenya	(23, 50, 51)
Diabetes	Bark mixed with roots of *M. decumbens* and *Carissa spinarum* L. (Apocynaceae)	Kenya	(50)
Eye problems	Leaf juice mixed with juice of apical leaves of *Coleus barbatus* (Andrews) Benth. ex G.Don (Lamiaceae)	Kenya	(50)
Gum bleeding	Root powder decoction taken orally mixed with *Rumex usambarensis* (Engl.) Dammer (Polygonaceae) and *Warburgia ugandensis* Sprague (Canellaceae)	Kenya	(79)
Heartburn	Bark mixed with tubers of *Rhoicissus tridentata* (L.f.) Wild &R.B.Drumm. (Vitaceae), bark of *L. calostachys* and *Jasminum fluminense* Vell. (Oleaceae)	Kenya	(50)
Jaundice	Bark mixed with that of *Croton macrostachyus* Hochst. ex Delile (Euphorbiaceae)	Ethiopia	(83)
Liver disease	Bark mixed with that of *C. macrostachyus*	Ethiopia	(83)
Tonsillitis	Root powder decoction taken orally mixed with *W. ugandensis* and *Azadirachta indica* A.Juss (Meliaceae)	Kenya	(79)

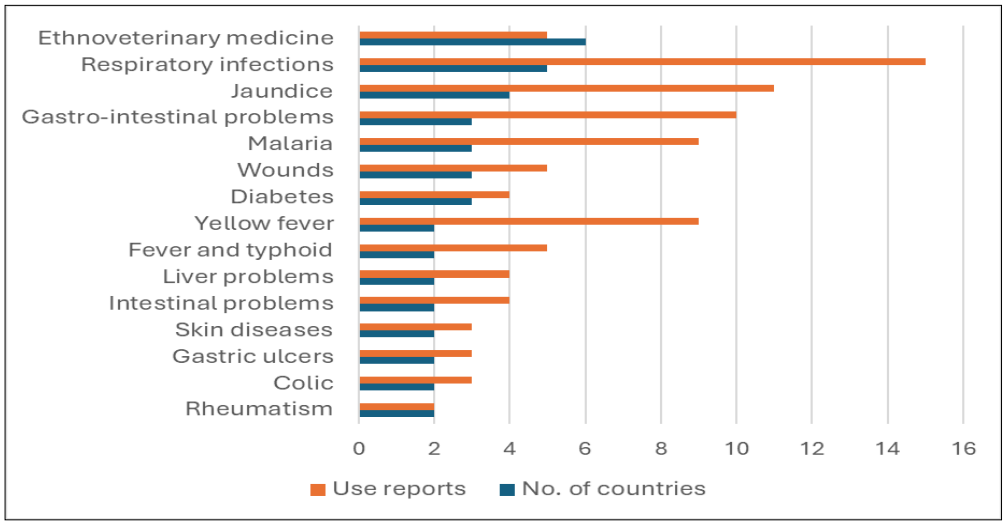

Fig. 4. Main diseases and ailments treated and managed by *Terminalia brownii* in tropical Africa.

Table 4. Phytochemical composition of *Terminalia brownii*

Chemical compound	Formula	Plant part	Reference
1,18-octadec-9-ene-dioate	$C_{18}H_{32}O_4$	Stem bark	(91)
1,2,3-tri-O-galloyol-β-D-glucose	$C_{27}H_{24}O_{18}$	Leaves	(92)
1,2,3,6-tetra-O-galloyl-β-D-glucose	$C_{34}H_{28}O_{22}$	Leaves	(92)
1,2,4-tri-O-galloyl-8,9-dideoxynonose	$C_{30}H_{30}O_{18}$	Flowers and stem bark	(98)
1,3-di-galloyl-β-D-glucose	$C_{20}H_{20}O_{14}$	Leaves	(92)
1,4,7-tri-O-galloyl hept-6-deoxyheptose	$C_{28}H_{26}O_{18}$	Flowers and stem bark	(98)
1,6-di-galloyl-β-D-glucose	$C_{20}H_{20}O_{14}$	Leaves	(92)
2',6',4-trihydroxy-3'-methoxy-4-O-prenyloxy chalcone	$C_{25}H_{28}O_6$	Leaves	(99)
3-O-β-D-glucopyranosyl-β-sitosterol	$C_{35}H_{60}O_6$	Stem bark	(87)
3β,24-O-ethylidenyl-2α,19α-dihydroxyolean-12-en-28-oic acid	$C_{32}H_{50}O_6$	Stem bark	(87)
3*β*,24-*O*-ethylidenyl-2*α*,19*α*-dihydroxyolean-12-en-28-oic acid	$C_{32}H_{50}O_5$	Stem bark	(86)
3,3',4',5-tetrahydroxy-7-methoxyflavone	$C_{16}H_{12}O_7$	Flowers and stem bark	(98)
3,3´-di-O-methylellagic acid	$C_{16}H_{10}O_8$	Stem bark	(87)
3,3´,4-tri-O-methylellagic acid	$C_{17}H_{12}O_8$	Stem bark	(87)
3,4,6-tri-O-galloyol-β-D-glucose	$C_{27}H_{24}O_{18}$	Leaves	(92)
3-O-methylellagic acid	$C_{15}H_8O_8$	Stem bark	(87)
3-O-methyl-4-(α-L-rhamnopyranosyl)ellagic acid	$C_{21}H_{18}O_{12}$	Stem bark	(87)
3,4,3'-tri-O-methylellagic acid	$C_{17}H_{12}O_8$	Bark	(94)
4-(α-L-rhamnopyranosyl)ellagic acid	$C_{20}H_{16}O_{12}$	Stem bark	(87)
4-O-(3",4"-di-O-galloyl-α-L-rhamnopyranosyl)ellagic acid	$C_{19}H_{14}O_{12}$	Stem bark	(87)
4-O-(3'',4''-di-O-galloyl-a-L-rhamnopyranosyl)ellagic acid	$C_{34}H_{24}O_{20}$	Stem bark	(93)
5,6-dihydroxy-3',4',7-trimethoxy flavone	$C_{18}H_{16}O_7$	Stem wood	(88)
23-galloyl arjungenin	$C_{37}H_{56}O_{12}$	Flowers and stem bark	(98)
23-galloyl arjunic acid	$C_{37}H_{54}O_{10}$	Stem bark	(87)
23-galloyl arjunolic acid	$C_{37}H_{52}O_{10}$	Stem bark	(86)
28-O-β-D-glucopyranosyl-2,3,6-trihydroxy-23-galloylolean-12-dien-28-oate	$C_{50}H_{64}O_{19}$	Flowers and stem bark	(98)
β-amyrine	$C_{30}H_{50}O$	Stem bark	(91)
Apigenin	$C_{15}H_{10}O_5$	Leaves	(92)
Arjunic acid	$C_{30}H_{48}O_5$	Stem bark	(87)
Arjungenin	$C_{30}H_{48}O_6$	Stem bark	(85, 87)
Arjunglucoside I	$C_{36}H_{58}O_{11}$	Flowers and stem bark	(87, 98)
Asiatic acid	$C_{30}H_{48}0_5$	Stem wood	(88)
Behenic acid	$C_{22}H_{44}O_2$	Stem bark	(91)
Betulinic acid	$C_{30}H_{48}O_3$	Stem bark	(85, 91)
Caffeic acid	$C_9H_8O_4$	Leaves	(96)
Campesterol	$C_{28}H_{48}O$	Stem bark	(97)
Catechol	$C_6H_6O_2$	Leaves	(96)
Chebulinic acid	$C_{41}H_{32}O_{27}$	Leaves	(92)
Chromone	$C_9H_6O_2$	Stem wood	(88)
Cinnamic acid	$C_9H_8O_2$	Leaves	(96)
Corilagin	$C_{27}H_{22}O_{18}$	Leaves and roots	(91, 92)
Diellagilactone	$C_{28}H_{10}O_{16}$	Stem bark	(86, 87)
Dihydroactinidiolide	$C_{11}H_{16}O_2$	Stem bark	(95)
Di-methyl ellagic acid glucoside	$C_{22}H_{20}O_{13}$	Leaves	(92)
Dotriacontanol	$C_{32}H_{66}O$	Stem bark	(91)
Ellagic acid	$C_{14}H_6O_8$	Bark, roots and stem bark	(88, 89,91,93-95)
Ellagitannin	$C_7H_6O_5$	Leaves	(92)
Ellagic acid 4-O-α-L-rhamnopyranoside	$C_{21}H_{18}O_{12}$	Bark	(94)

Ellagic acid xylopyranoside	$C_{19}H_{14}O_{12}$	Roots	(89)
Flavellagic acid ester	$C_{14}H_6O_9$	Stem wood	(88)
Friedelin	$C_{30}H_{50}O$	Stem bark	(91)
Gallic acid	$C_7H_6O_5$	Bark, leaves and roots	(89, 92, 94)
Gallagic acid dilactone	$C_{28}H_{10}O_{16}$	Stem wood	(90)
Gallotanin	$C_7H_6O_5$	Leaves	(92)
Gallo-ellagitannin	$C_{20}H_{20}O_{14}$	Leaves	(92)
Galloyl ellagitannin	$C_{20}H_{20}O_{13}$	Leaves	(92)
Genipin	$C_{11}H_{14}O_5$	Leaves	(92)
Genkwanin	$C_{16}H_{12}O_5$	Leaves	(92)
Hexacosanoic acid	$C_{26}H_{52}O_2$	Stem bark	(91)
Hexadecanoic acid	$C_{16}H_{32}O_2$	Stem bark	(97)
Kaempferol-4'-sulfate	$C_{15}H_{10}O_9S$	Leaves	(92)
Leucodelphinidin	$C_{15}H_{14}O_8$	Stem bark	(95)
Levulinic acid	$C_5H_80_3$	Leaves	(96)
Linoleic acid	$C_{18}H_{32}O_2$	Stem bark	(97)
Luteolin-7-O-glucoside	$C_{21}H_{20}O_{11}$	Leaves	(92)
Maslinic acid	$C_{30}H_{48}O_4$	Stem wood	(88)
Methyl 3,4,5-trihydroxybenzoate	$C_8H_8O_5$	Leaves	(92)
Methyl ellagic acid xyloside	$C_{20}H_{16}O_{12}$	Roots	(89)
Methyl-(S)-flavogallonate	$C_{22}H_{12}O_{13}$	Leaves, roots and stem wood	(89, 90, 92)
Methyl galate	$C_8H_8O_5$	Leaves	(92, 96)
Miltiodiol	$C_{19}H_{22}O_3$	Stem bark	(95)
Monogalloylglucose	$C_{13}H_{16}O_{10}$	Roots	(89)
Monogynol A	$C_{30}H_{52}O_2$	Stem bark	(85)
Myricetin-3-rhamnoside	$C_{21}H_{20}O_{12}$	Leaves	(92)
Naringenin 4'-methoxy-7-arabinoside	$C_{17}H_{16}O_5$	Stem wood	(88)
Octacosanol	$C_{28}H_{58}O$	Stem bark	(91)
Octacosanoic acid	$C_{28}H_{56}O_2$	Stem bark	(91)
Octadecanoic acid	$C_{18}H_{36}O_2$	Stem bark	(97)
Papyriogenin D	$C_{30}H_{44}O_4$	Stem bark	(95)
Protocatechuic acid	$C_7H_6O_4$	Leaves	(92)
α,β-punicalagin	$C_{48}H_{28}O_{30}$	Bark	(94)
Pyrogallol	$C_6H_6O_3$	Leaves	(96)
Quercetin	$C_{15}H_{10}O_7$	Flowers, leaves and stem bark	(96, 98)
Quercetin 7-β-O-diglycoside	$C_{27}H_{30}O_{17}$	Stem wood	(88, 90)
Quercetin 7-O-galloyl glycoside	$C_{28}H_{24}O_{16}$	Stem wood	(88)
Quinic acid	$C_7H_{12}O_6$	Leaves	(96)
Resveratrol	$C_{14}H_{12}O_3$	Stem wood	(88)
Cis/trans-resveratrol-3-O-β-galloyl-glucoside	$C_{27}H_{26}O_{12}$	Stem wood	(88, 90)
Rhamnetin-3-O-(2,3,6-trigalloyl)-β-D-glucopyranoside	$C_{43}H_{34}O_{24}$	Flowers and stem bark	(98)
Sericic acid	$C_{30}H_{48}O_6$	Leaves and stem bark	(87, 92)
Sericoside	$C_{36}H_{58}O_{11}$	Flowers and stem bark	(87, 98)
Sitostenone	$C_{29}H_{48}O$	Stem bark	(91)
β-sitosterol	$C_{29}H_{50}O$	Stem bark	(85, 91, 97)
Squalene	$C_{30}H_{50}$	Stem bark	(97)
Stearic acid	$C_{18}H_{36}O_2$	Stem bark	(91)
Stigmast-4-en-3-one	$C_{29}H_{48}O$	Stem bark	(91)
5α-stigmastan-3,6-dione	$C_{29}H_{48}O_2$	Stem bark	(91)
Stigmasterol	$C_{29}H_{48}O$	Leaves and stem bark	(85, 91, 97)
α,β-terchebulin	$C_{48}H_{28}O_{30}$	Bark	(94)
Terflavin B	$C_{34}H_{24}O_{22}$	Leaves	(92)
Termiglaucescin	$C_{43}H_{62}O_{15}$	Flowers and stem bark	(98)
Terminalianone	$C_{17}H_{13}O_5$	Bark	(84)
Tertracosanoic acid	$C_{24}H_{48}O_2$	Stem bark	(91)
Tomentosic acid	$C_{30}H_{48}O_6$	Stem bark	(87)
Triacontanol	$C_{30}H_{62}O$	Stem bark	(91)

Table 5. Summary of pharmacological activities of phytochemical compounds isolated from *Terminalia brownii*

Activity tested	Extract	Plant part	Model	Effect	Reference
***In vitro* studies**					
Antibacterial	1,2,4-tri-O-galloyl-8,9-dideoxynonose	Flowers (F) and stem bark (SB)	Agar diffusion	Showed activities against *Staphylococcus aureus* (*Sa*) with inhibition zone of 10.0 mm, *Escherichia coli* (*Ec*) (12.5 mm) and *Pseudomonas aeruginosa* (*Pa*) (13.0 mm)	(98)
	1,4,7-tri-Ogalloyl hept-6-deoxyheptose			Showed activities against *Sa* with inhibition zone of 10.0 mm, *Ec* (16.5 mm) and *Pa* (9.5 mm)	
	3,3',4',5- tetrahydroxy-7-methoxyflavone			Showed activities against *Sa* with inhibition zone of 10.5 mm, *Ec* (9.5 mm) and *Pa* (11.5 mm)	
	3,3',4',5,7-pentahydroxyflavone			Showed activities against *Sa* with inhibition zone of 8.8 mm, *Ec* (10.5 mm) and *Pa* (9.5 mm)	
	4-O-(3",4"-di-O-galloyl-α-L-rhamnopyranosyl)ellagic acid	SB	Microdilution	Showed activities against *Pa* with half maximal inhibitory concentration (IC_{50}) value of 8.8 µg/mL	(87)
			Microplate bioassay	Showed activities against *Flavobacterium columnare* (*Fc*) with minimum inhibition concentration (MIC) value of 10.0 µg/mL and IC_{50} value of 31.0 µg/mL	(93)
	23-galloyl arjungenin	F and SB	Agar diffusion	Showed activities against *Sa* with inhibition zone of 12.3 mm, *Ec* (9.3 mm) and *Pa* (9.5 mm)	(98)
	28-O-β-D-glucopyranosyl-2,3,6-trihydroxy-23-galloylolean-12-dien-28-oate	F and SB		Showed activities against *Sa* with inhibition zone of 10.5 mm, *Ec* (12.8 mm) and *Pa* (11.8 mm)	
	Arjungenin	SB	Microdilution	Showed activities against *Ralstonia solanacearum* (*Rs*) with MIC value of 200.0 µg/mL	(85)
	Betulinic acid			Showed activities against *Streptomyces ipomoeae* (*Si*) and *Rs* with MIC value of 50.0 µg/mL and 100.0 µg/mL, respectively	
	Arjunglucoside-I	F and SB	Agar diffusion	Showed activities against *Sa* with inhibition zone of 12.5 mm, *Ec* (10.5 mm) and *Pa* (10.0 mm)	(98)
	Diellagic lactone	SB	Microdilution	Showed activities against *Pa* with IC_{50} value of 8.4 µg/mL	(87)
	Ellagic acid		Microplate bioassay	Showed activities against *Fc* with MIC value of 6.0 µg/mL	(93)
	Rhamnetin-3-O-(2,3,6-trigalloyl)-β-D-glucopyranoside	F and SB	Agar diffusion	Showed activities against *Sa* with inhibition zone of 11.5 mm, *Ec* (10.5 mm) and *Pa* (8.0 mm)	(98)
	Sericoside	F and SB	Agar diffusion	Showed activities against *Sa* with inhibition zone of 10.8 mm and 8.5 mm against *Ec* and *Pa*	(98)
	β-sitosterol	SB	Microdilution	Showed activities against *Rs* with MIC value of 100.0 µg/mL	(85)
	Termiglaucescin	F and SB	Agar diffusion	Showed activities against *Sa* with inhibition zone of 10.5 mm, *Ec* (10.5 mm) and *Pa* (10.8 mm)	(98)
Antimycobacterial	Corilagin	SB	Microdilution	Showed activities against *Mycobacterium smegmatis* (*Ms*) with MIC value of 1000.0 µg/mL	(91)
	Ellagic acid, β-sitosterol and stigmasterol			Showed activities against *Ms* with MIC value of 500.0 µg/mL	
	Friedelin, sitostenone and triacontanol			Showed activities against *Ms* with MIC value of 250.0 µg/mL	

Antifungal	1,2,4-tri-O-galloyl-8,9-dideoxynonose	F and SB	Agar diffusion	Showed activities against *Candida albicans* (*Cl*) with inhibition zone of 12.5 mm	(98)
	1,4,7-tri-Ogalloyl hept-6-deoxyheptose			Showed activities against *Cl* with inhibition zone of 12.5 mm	
	3,3',4',5- tetrahydroxy-7-methoxyflavone			Showed activities against *Cl* with inhibition zone of 12.8 mm	
	3,3',4',5,7-pentahydroxyflavone			Showed activities against *Cl* with inhibition zone of 11.8 mm	
	3-O-methylellagic acid	SB	Microdilution	Showed activities against *Candida glabrata* (*Cg*) and *Cryptococcus neoformans* (*Cn*) with IC_{50} values of 2.7 µg/mL and 18.0 µg/mL, respectively	(87)
	4-O-(3",4"-di-O-galloyl-α-L-rhamnopyranosyl)ellagic acid			Showed activities against *Cg* with IC_{50} value of 0.6 µg/mL, *Candida krusei* (*Ck*) (4.3 µg/mL), *Cl* (15.0 µg/mL) and *Cn* (4.7 µg/mL)	
	23-galloyl arjungenin	F and SB	Agar diffusion	Showed activities against *Cl* with inhibition zone of 5.5 mm	(98)
	28-O-β-D-glucopyranosyl-2,3,6-trihydroxy-23-galloyloleán-12-dien-28-oate			Showed activities against *Cl* with inhibition zone of 14.0 mm	
	Apigenin	Roots (R)	Microdilution	Showed activities against *Cl* and *Cg* with MIC values of 500.0 µg/mL and 125.0 µg/mL against *Candida parapsilosis* (*Cp*)	(92)
	Arjungenin	SB		Showed activities against *Alternaria* spp. with MIC value of 100.0 µg/mL, *Aspergillus niger* (*An*) (100.0 µg/mL) and *Fusarium solani* (*Fs*) (200.0 µg/mL)	(85)
	Arjunglucoside-I	F and SB	Agar diffusion	Showed activities against *Cl* with inhibition zone of 15.0 mm	(98)
	Arjunic acid	SB	Microdilution	Showed activities against *Cn* with IC_{50} values of 14.5 µg/mL	(87)
	Betulinic acid	SB		Showed activities against *An* with MIC value of 50.0 µg/mL, *Fs* (100.0 µg/mL) and *Rhizopus stolonifer* (*Rt*) (100.0 µg/mL)	(85)
	Corilagin	R		Showed activities against *Candida tropicalis* (*Ct*) with MIC value of 500.0 µg/mL	(92)
	Diellagic lactone	SB		Showed activities against *Cg* with IC_{50} value of 0.32 µg/mL, *Ck* (1.7 µg/mL), *Cl* (19.4 µg/mL) and *Cn* (7.6 µg/mL)	(87)
	Diellagic lactone	SB		Showed activities against *Cg* with IC_{50} value of 0.32 µg/mL	
	Ellagic acid, friedelin and luteolin	R		Showed activities against *Cp* and *Cg* with MIC values of 500.0 µg/mL	(92)
	Quercetin	R		Showed activities against *Cl* and *Cg* with MIC values of 250.0 µg/mL	
	Rhamnetin-3-O-(2,3,6-trigalloyl)-β-D-glucopyranoside	F and SB	Agar diffusion	Showed activities against *Cl* with inhibition zone of 11.5 mm	(98)
	Sericoside			Showed activities against *Cl* with inhibition zone of 13.0 mm	
	β-sitosterol	SB	Microdilution	Showed activities against *An* with MIC value of 100.0 µg/mL, *Fs* (100.0 µg/mL) and *Rt* (200.0 µg/mL)	(85)
	Stigmasterol			Showed activities against *An* with MIC value of 100.0 µg/mL, *Fusarium oxysporum* (200.0 µg/mL) and *Fs* (200.0 µg/mL)	
	Sitosterol	R	Microdilution	Showed activities against *Cp* and *Cg* with MIC values of 125.0 µg/mL and 250.0 µg/mL, respectively	(92)
	Stigmasterol	R	Microdilution	Showed activities against *Cg* with MIC values of 500.0 µg/mL	(92)
	Termiglaucescin	F and SB	Agar diffusion	Showed activities against *Cl* with inhibition zone of 16.0 mm	(98)
Antiplasmodial	4-O-(3",4"-di-O-galloyl-α-L-rhamnopyranosyl)ellagic acid	SB	Parasitic lactate dehydrogenase (pLDH) assay	Showed activities against chloroquine sensitive (D6) and chloroquine resistant (W2) strains of *Plasmodium falciparum* (*Pf*) with IC_{50} value of 4.7 µg/mL	(87)
				Showed activities against *Pf* D6 and W2 with IC_{50} values of 2.76 µg/mL and 4.5 µg/mL, respectively	
	23-galloylarjunolic acid			Showed activities against *Pf* W2 with IC_{50} value of 2.76 µg/mL	(86)
***In vivo* studies**					
Antinociceptive	Lectins	Leaves and seeds	Abdominal writhing and hotplate assays in rates	Lectins exhibited activities, reducing abdominal pain and prolonging latency time in the hotplate assay	(100)

Abbreviations: An = Aspergillus niger; *Cl* = *Candida albicans*; *Cg* = *Candida glabrata*; *Ck* = *Candida krusei; Cn* = *Candida neoformans*; *Cp* = *Candida parapsilosis*; *Ct* = *Candida tropicalis*; *Ec* = *Escherichia coli*; F = flowers; *Fc* = *Flavobacterium columnare; Fs* = *Fusarium solani;* IC_{50} = half maximal inhibitory concentration; MIC = minimum inhibitory concentration; *Pa* = *Pseudomonas aeruginosa; Pf* = *Plasmodium falciparum*; R = roots; *Rs* = *Ralstonia solanacearum; Rt* = *Rhizopus stolonifer; Sa* = *Staphylococcus aureus*; SB = stem bark; *Si* = *Streptomyces ipomoeae*

Table 6. Summary of pharmacological activities of extracts from different parts of *Terminalia brownii*

Activity tested	Extract	Plant part	Model	Effect	Reference
***In vitro* studies**					
Antibacterial	Aqueous (Aq)	Roots (R)	Disc diffusion	Showed activities against *Pseudomonas aeruginosa* (*Pa*) with inhibition zone of 12.0 mm, *Staphylococcus aureus* (*Sa*) (14.0 mm), *Klebsiella pneumoniae* (*Kp*) (6.0 mm), *Bacillus anthracis* (*Ba*) (13.0 mm) and *Bacillus cereus* (*Bc*) (6.5 mm)	(58)
	Dichloromethane (DCM)			Showed activities against *Pa* with inhibition zone of 4.5 mm, *Sa* (7.0 mm), *Proteus mirabilis* (*Pm*) (12.5 mm), *Escherichia coli* (*Ec*) (5.0 mm), *Kp* (1.0 mm) and *Ba* (7.5 mm)	
	DC: methanol (MeOH)			Showed activities against *Sa* with inhibition zone of 11.5 mm, *Pm* (13.0 mm) and *Bc* (5.5 mm)	
	MeOH			Showed activities against *Sa* with inhibition zone of 12.7 mm, *Pa* (9.0 mm), *Pm* (13.5 mm), *Ec* (5.0 mm), *Ba* (12.0 mm) and *Bc* (4.5 mm)	
	Petroleum ether (PE)			Showed activities against *Pa* with inhibition zone of 4.5 mm, *Sa* (3.0 mm), *Kp* (2.3 mm), *Ba* (5.5 mm), *Ec* (2.5 mm) and *Pm* (11.7 mm)	
	Aq	Stem bark (SB)		Showed activities against *Pa* with inhibition zone of 8.7 mm, *Sa* (11.3 mm), *Kp* (9.3 mm), *Ba* (13.0 mm) and *Bc* (7.3 mm)	
	DCM			Showed activities against *Pa* with inhibition zone of 5.0 mm, *Pm* (3.0 mm) and *Ba* (4.3 mm)	
	DCM: MeOH			Showed activities against *Sa* with inhibition zone of 7.3 mm, *Pm* (7.3 mm), *Ec* (6.0 mm) and *Ba* (4.7 mm)	
	MeOH			Showed activities against *Sa* with inhibition zone of 10.3 mm, *Kp* (7.3 mm), *Ba* (13.3 mm) and *Bc* (7.3 mm)	
	Aq	Stem wood (SW)		Showed activities against *Pa* with inhibition zone of 9.3 mm, *Sa* (12.0 mm), *Kp* (6.7 mm), *Ba* (11.7 mm) and *Bc* (7.0 mm)	
	DCM			Showed activities against *Pa* with inhibition zone of 4.3 mm, *Salmonella typhi* (*St*) (3.7 mm), *Ec* (7.3 mm) and *Ba* (3.3 mm)	
	DCM: MeOH			Showed activities against *Sa* with inhibition zone of 12.0 mm, *Bc* (8.0 mm), *Ec* (8.3 mm) and *Ba* (14.7 mm)	
	MeOH			Showed activities against *Sa* with inhibition zone of 13.3 mm, *Ba* (15.5 mm) and *Bc* (11.5 mm)	
	Aq	Bark (B)	Agar diffusion	Showed activities against *Ec* with inhibition zone of 11.7 mm, *Bs* (12.8 mm) and *Sa* (17.0 mm)	(101)
	Aq	Leaves (L)		Showed activities against *Ec* with inhibition zone of 10.3 mm, *Bs* (9.0 mm) and *Sa* (18.0 mm)	
	Ethyl acetate (EA)	SB	Disc diffusion	Showed activities against *Ralstonia solanacearum* (*Rs*) and *Streptomyces ipomoeae* (*Si*) with inhibition zone of 15.0 mm to 18.6 mm, respectively	(85)
	Hexane (HEX)			Showed activities against *Rs* and *Si* with inhibition zone of 12.4 mm to 13.2 mm, respectively	
	MeOH			Showed activities against *Rs* and *Si* with inhibition zone of 9.1 mm to 9.8 mm, respectively	
	Ethanol (EtOH)	B	Microdilution	Showed activities against *Cutibacterium acne* (*Ca*) with minimum inhibition concentration (MIC) value of 2.0 mg/mL	(102)
	MeOH			Showed activities against *Ca* with MIC value of 0.5 mg/mL	
	EtOH and MeOH	Wood (W)		Showed activities against *Ca* with MIC value of 4.0 mg/mL	
	EtOH	L	Disc-diffusion	Showed activities against *Salmonella* spp. (Sl) with MIC value of 4.0 mg/mL	(103)
	Chloroform (TCM)	SB	Microplate bioassay	Showed activities against *Flavobacterium columnare* (*Fc*) with MIC value of 100.0 µg/mL	(93)
	MeOH: water (H_2O)			Showed activities against *Edwardsiella ictaluri* (*Ei*) with MIC (100.0 µg/mL) and half maximal inhibitory concentration (IC_{50}) value (90.0 µg/mL) and MIC value of 10.0 µg/mL and IC_{50} of 38.0 against *Fc*	
	HEX : MeOH : H_2O			Showed activities against *Ei* with MIC value of 100.0 µg/mL	
	EtOH	B		Showed activities against *Porphyromonas gingivalis* (*Pg*) with MIC value of 0.5 mg/mL	(104)
	MeOH			Showed activities against *Pg* with MIC value of 1.0 mg/mL	
	EtOH	W		Showed activities against *Pg* with MIC value of 2.0 mg/mL	
	MeOH			Showed activities against *Pg* with MIC value of 0.5 mg/mL	
	Aq	R	Microdilution	Showed activities with MIC values of 78.12 µg/mL against *Sa* and 39.06 µg/mL against *Pa*, *Micrococcus luteus* (*ML*) and *Staphylococcus epidermidis* (*Se*)	(89)
	Acetone (ACE)			Showed activities against *Sa, Se* and *ML* with MIC value of 39.06 µg/mL and 312.5 µg/mL against *Pa*	
	EA			Showed activities with MIC values of 39.06 µg/mL against *Sa* and *ML*, 78.126 µg/mL against *Se* and 156.25 µg/mL against *Pa*	
	EtOH	SB		Showed activities with MIC values of 156.25 µg/mL and 312.5 µg/mL against *ML* and *Sa*, respectively	
	EA	SW		Showed activities with MIC values of 156.25 µg/mL and 312.5 µg/mL against *ML* and *Pa*, respectively	
	EtOH	R	Agar diffusion	Showed activities against *Ec, Pa* and *Sa* with inhibition zone of 15.0 mm, 20.0 mm and 25.0 mm, respectively	(105)
	DCM: MeOH	Flowers (F)	Microdilution	Showed activities with MIC values of 1.25 mg/mL to 9.25 mg/mL and 1.11 mg/mL to 7.5 mg/mL against *Ec* and *Pa*, respectively	(98)

Antimycobacterial	ACE	L	Disc diffusion	Showed activities against *Mycobacterium smegmatis* (*Ms*) with MIC value of 2500.0 µg/mL	(91)
	EA	R		Showed activities against *Ms* with MIC value of 2500.0 µg/mL	
	ACE			Showed activities against *Ms* with MIC value of 2500.0 µg/mL	
	ACE	L		Showed activities against *Ms* with MIC value of 2500.0 µg/mL	(107)
	Aq	R		Showed activities against *Candida albicans* (*Cl*) and *Cryptococcus neoformans* (*Cn*) with inhibition zone of 6.0 mm and 8.5 mm, respectively	(58)
	DCM			Showed activities against *Cl* with inhibition zone of 2.0 mm	
	DCM: MeOH			Showed activities against *Cl* and *Cn* with inhibition zone of 12.0 mm and 5.5 mm, respectively	
	MeOH			Showed activities against *Cl* and *Cn* with inhibition zone of 8.0 mm and 7.0 mm, respectively	
	PE	SB		Showed activities against *Cl* with inhibition zone of 2.5 mm	
	Aq			Showed activities against *Cl* and *Cn* with inhibition zone of 10.7 mm and 11.7 mm, respectively	
	DCM: MeOH			Showed activities against *Cl* and *Cn* with inhibition zone of 5.3 mm and 4.7 mm, respectively	
	MeOH			Showed activities against *Cl* and *Cn* with inhibition zone of 10.0 mm and 6.5 mm, respectively	
	Aq	SW		Showed activities against *Cl* and *Cn* neoformans with inhibition zone of 12.3 mm and 9.7 mm, respectively	
	DCM			Showed activities against *Cl* with inhibition zone of 3.0 mm	
	DCM: MeOH			Showed activities against *Cl* and *Cn* with inhibition zone of 13.3 mm and 8.3 mm, respectively	
	MeOH			Showed activities against *Cl* and *Cn* with inhibition zone of 14.3 mm and 10.3 mm, respectively	
Antifungal	EA	SB		Showed activities against *Alternaria* spp. (*Al*) with inhibition zone of 13.1 mm, *Aspergillus niger* (*An*) (15.5 mm), *Fusarium oxysporum* (*Fo*) (5.7 mm), *Fusarium solani* (*Fs*) (10.8 mm) and *Rhizopus stolonifer* (*Rt*) (5.9 mm)	(85)
	HEX			Showed activities against *Al*. with inhibition zone of 9.0 mm, *An* (10.1 mm), *Fo* (5.0 mm), *Fs* (6.2 mm) and *Rs* (5.0 mm)	
	MeOH			Showed activities against *Al* with inhibition zone of 5.0 mm, *An* (6.5 mm), *Fs* (6.2 mm) and *Rs* (5.0 mm)	
	EtOH	R		Showed activities against *Cl* with inhibition zone of 15.0 mm	(105)
	Aq	SB and W	Agar diffusion	Showed activities against *An* and *Aspergillus flavus* (Af) with inhibition zone of 14.0 mm and 20.0 mm against *Gibberella moniliformis* (*Gm*) and *Nattrassia mangiferae* (*Nm*)	(88)
	EA	SB and W		Showed activities against *An* and *Af* with MIC value of 500.0 µg/mL and 250.0 µg/mL against *Nm* and *Fusarium verticillioides* (*Fv*)	(90)
	EA	L	Microdilution	Showed activities against *Candida parapsilosis* (*Cp*) and *Cl* with MIC values of 312.0 µg/mL and 625.0 µg/mL, respectively	(92)
	ACE			Showed activities against *Cp, Cl* and *Candida glabrata* (*Cg*) with MIC value of 312.0 µg/mL and 625.0 µg/mL against *Candida tropicalis* (*Ct*)	
	Aq			Showed activities against *Cp, Cl* and *Cg* with MIC value of 625.0 µg/mL	
	MeOH			Showed activities against *Cp* and *Cg* with MIC value of 625.0 µg/mL	
	MeOH	SB		Showed activities against *Cg* with MIC value of 312.0 µg/mL	
	EA	SW		Showed activities against *Cg* with MIC values of 625.0 µg/mL	
	Aq	SW		Showed activities against *Cp* and *Cg* with MIC value of 625.0 µg/mL	
	EA	R		Showed activities against *Cl* and *Cg* with MIC value of 625.0 µg/mL	
	Aq	R		Showed activities against *Cl* and *Cg* with MIC value of 625.0 µg/mL	
	MeOH	R		Showed activities against *Cg* with MIC value of 312.0 µg/mL	
	EA	RB		Showed activities against *Cg* with MIC value of 625.0 µg/mL	
	Aq	SW		Showed activities against *Cp* and *Cg* with MIC value of 625.0 µg/mL	
Antimycoplasmal	ACE	L	Two-fold serial microplate dilution	Showed activities against *Mycoplasma mycoides* subsp. *mycoides* (*Mm*) with MIC value of 420.0 µg/mL	(108)

Antidiabetic	Butanol	SB	α-amylase inhibition assay	Showed activities with IC_{50} value of 84.7 µg/mL	(109)
	TCM			Showed activities with IC_{50} value of 63.4 µg/mL	
Antioxidant	EtOH	B	1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging assay	Showed activities with IC_{50} value of 5.89 µg/mL	(102)
	MeOH			Showed activities with IC_{50} value of 3.85 µg/mL	
	EtOH	W		Showed activities with IC_{50} value of 5.19 µg/mL	
	MeOH			Showed activities with IC_{50} value of 4.97 µg/mL	
	EtOH	R		Extract demonstrated moderate antioxidant activities	(105)
	ACE			Extract demonstrated activities with IC_{50} value of 36.8 µg/mL	
	MeOH			Extract demonstrated activities with IC_{50} value of 72.3 µg/mL	
	EA			Extract demonstrated activities with IC_{50} value of 71.2 µg/mL	
	Aq	B		Extract demonstrated activities with IC_{50} value of 93.2 µg/mL	(113)
	ACE			Extract demonstrated activities with IC_{50} value of 44.8 µg/mL	
	MeOH		2′-azinobis (3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS)	Extract demonstrated activities with IC_{50} value of 34.3 µg/mL	
	EA			Extract demonstrated activities with IC_{50} value of 57.8 µg/mL	
	Aq			Extract demonstrated activities with IC_{50} value of 40.6 µg/mL	
Antiplasmodial	Aq	SB	Parasitic lactate dehydrogenase (pLDH) assay	Showed activities against chloroquine sensitive (D6) and chloroquine resistant (W2) strains of *Plasmodium falciparum* (*Pf*) with IC_{50} value of 27.4 µg/mL and 47.1 µg/mL, respectively	(86)
	Aq			Demonstrated activities against chloroquine sensitive (*Pf* 3D7) and multidrug resistant (*Pf* Dd2) strains exhibiting IC_{50} values of 1.1 µg/mL	(95)
	EtOH			Demonstrated activities against *Pf* 3D7 and *Pf* Dd2 exhibiting IC_{50} values of 1.0 µg/mL and 2.2 µg/mL, respectively	
	EA			Demonstrated activities against *Pf* 3D7 and *Pf* Dd2 exhibiting IC_{50} values of 10.6 µg/mL and 6.3 µg/mL, respectively	
	DCM	L	[G^3-H] hypoxanthine incorporation assay	Demonstrated activities against *Pf* exhibiting IC_{50} value of 13.7 µg/mL	(74)
	EA			Demonstrated activities against *Pf* exhibiting IC_{50} value of 7.5 µg/mL	
	Aq			Demonstrated activities against D6 and W2 of *Pf* with IC_{50} values ranging from 3.3 µg/mL to 5.9 µg/mL	(114)
	DCM			Demonstrated activities against D6 and W2 of *Pf* with IC_{50} values ranging from 4.3 µg/mL to 7.1 µg/mL	
	MeOH			Demonstrated activities against D6 and W2 of *Pf* with IC_{50} values ranging from 41.2 µg/mL to 47.3 µg/mL	
Cytotoxicity	PE	SW	Brine shrimp lethality assay	Showed activities with median lethal concentration (LC_{50}) value of 13.0 µg/mL	(58)
	DCM	SB		Showed activities with LC_{50} value of 36.1 µg/mL	
	DCM	SW		Showed activities with LC_{50} value of 13.5 µg/mL	
	DCM: MeOH	SB		Showed activities with LC_{50} value of 70.3 µg/mL	
	DCM: MeOH	SW		Showed activities with LC_{50} value of 2.6 µg/mL	
	MeOH	SB		Showed activities with LC_{50} value of 88.1 µg/mL	
	MeOH	SW		Showed activities with LC_{50} value of 14.9 µg/mL	
	Aq	SB		Showed activities with LC_{50} value of 68.6 µg/mL	
	ACE	L	3-(4,5-dimethylthiazole-2-yl)-2,5-diphynyltetrazolium bromide (MTT) assay	Showed activities against the African green monkey kidney (Vero) cell line exhibiting LC_{50} value of 23.8 µg/mL	(108)
	MeOH		MTT	Demonstrated activities by exhibiting median cytotoxic concentration (CTC_{50}) value of 0.4 mg/mL against HepG2 human hepatoma cancer cells	(112)
	EtOH		MTT	Demonstrated activities against the human diploid embryonic lung cell line (MRC-5) by exhibiting IC_{50} value of 83.1 µg/mL	(74)
	Aq		SRB protein stain assay	Showed activities against human breast cancer cells (MCF-7), human colon cancer cells (HCT 116) and human liver cancer cells (HEPG-2)	(96)
	EA, HEX and TCM		SRB	Showed activities against MCF-7, HCT 116 and HEPG-2	
***In vivo* studies**					
Antidiabetic	Aq and EA	SB	Normoglycemic, streptozotocin-induced diabetic and oral glucose challenged mice model	Showed significant body glucose level reduction in all the three animal models	(109)
Antidiarrheal	EA, Aq, HEX and MeOH	L	Castor oil-induced diarrhea model in rats	Extract inhibited and reduced wet and total defecation and also reduced the castor oil-induced intestinal motility, weight and volume of intestinal contents	(110)

Anti-inflammatory	MeOH	B	Carrageenan-induced edema in rats	Extract reduced the carrageenan-induced paw edema by between 1.6 % to 20.4 %	(111)
Antinociceptive	MeOH	B	Rat paw edema, writhing and formalin-induced pain tests	Extract demonstrated activities by reducing the formalin-induced pain in both early and late phases by reducing the paw licking time	(116)
Antioxidant	MeOH	L	Endogenous antioxidant enzyme levels in excised livers of rats	Extract demonstrated antioxidant activities	(112)
Antiplasmodial	Aq and MeOH	B	4-day suppressive test	Extract demonstrated inhibition of parasitemia in a dose-dependent manner	(115)
	Aq	L		Demonstrated activities exhibiting parasitemia suppression of 9.5 %	(114)
	DCM	L		Demonstrated activities exhibiting parasitemia suppression of 9.9 %	
	MeOH	L		Demonstrated activities exhibiting parasitemia suppression of 11.1 %	
Anti-pyretic	MeOH	B	Steam-distilled turpentine-induced pyrexia in rats	Extracts demonstrated activities by reducing the rectal temperatures after extract administration	(117)
Hepatoprotective	MeOH	L	Carbon tetrachloride-induced hepatotoxicity assay	Extract demonstrated hepatoprotective activities	(112)

Abbreviations: Al = *Alternaria* spp.; ACE = acetone; *Af* = *Aspergillus flavus;* An = Aspergillus niger; Aq = aqueous; *As* = *Aspergillus* spp.; B = bark; *Ba* = *Bacillus anthracis*; *Bc* = *Bacillus cereus*; *Bs* = *Bacillus subtilis*; *Ca* = *Cutibacterium acnes; Cl* = *Candida albicans*; *Cg* = *Candida glabrata*; *Cn* = *Candida neoformans*; *Cp* = *Candida parapsilosis*; *Ct* = *Candida tropicalis*; DCM = dichloromethane; EA = ethyl acetate; *Ei* = *Edwardsiella ictaluri; Ec* = *Escherichia coli*; EtOH = ethanol; F = flowers; *Fc* = *Flavobacterium columnare;* Fo = Fusarium oxysporum; *Fs* = *Fusarium solani; Fv* = *Fusarium verticillioides*; *Gm* = *Gibberella moniliformis;* H_2O = water; HEX = hexane; *Kp* = *Klebsiella pneumoniae*; L = leaves; MeOH = methanol; MIC = minimum inhibitory concentration; *ML* = *Micrococcus luteus; Mm* = *Mycoplasma mycoides* subsp. *mycoides; Ms* = *Mycobacterium smegmatis; Nm* = *Nattrassia mangiferae; Pa* = *Pseudomonas aeruginosa;* PE = petroleum ether; *Pf* = *Plasmodium falciparum*; *Pg* = *Porphyromonas gingivalis; Pm* = *Proteus mirabilis*; R = roots; *Rs* = *Ralstonia solanacearum; Rt* = *Rhizopus stolonifer; Sa* = *Staphylococcus aureus*; SB = stem bark; *Se* = *Staphylococcus epidermidis*; *Si* = *Streptomyces ipomoeae; Sl* = *Salmonella* spp.; *St* = *Salmonella typhi*; SW = stem wood; TCM = chloroform; W = wood

antimycobacterial (91, 107), antifungal (58, 85, 88, 90, 92, 105), antimycoplasmal (108), antidiabetic (109, 110), anti-inflammatory (111), antioxidant (102, 105, 112, 113), antiplasmodial (74, 87, 95, 114, 115), antinociceptive (116), anti-pyretic (117), hepatoprotective (112) and cytotoxicity (58, 74, 96, 108, 112) activities (Table 6).

Antibacterial activities

The antibacterial activities of the aqueous, petroleum ether, methanol, dichloromethane:methanol (1:1) extracts of *T. brownii* wood, stem bark and roots against *Pseudomonas aeruginosa, Staphylococcus aureus, Klebsiella pneumoniae, Bacillus anthracis, Escherichia coli, Proteus mirabilis, Salmonella typhi* and *Bacillus cereus* using the disc diffusion assay with gentamicin as a positive control (58). The extracts demonstrated activities against the tested pathogens exhibiting inhibition zone ranging from 3.0 mm to 13.3 mm (58). The antibacterial activities of aqueous extracts of *T. brownii* bark and leaves against *Escherichia coli, Staphylococcus aureus* and *Bacillus subtilis* using the agar diffusion method with tetracycline, streptomycin, sulphamethoxazole, cotrimoxazole and gentamicin as positive controls. The extracts demonstrated activities against the tested pathogens exhibiting inhibition zone ranging from 9.0 mm to 18.0 mm (101). The antibacterial activities of ethyl acetate, methanol and n-hexane extract of *T. brownii* stem bark against *Ralstonia solanacearum* and *Streptomyces ipomoeae* using the disc diffusion assay with streptocycline as a positive control. The extracts demonstrated activities against the tested pathogens exhibiting inhibition zone ranging from 9.1 mm to 18.6 mm (85). The antibacterial activities of the phytochemical compounds β-sitosterol, betulinic acid and arjungenin isolated from the stem bark of *T. brownii* against *Ralstonia solanacearum* and *Streptomyces ipomoeae* using the microdilution assay with streptocycline as a positive control. The phytochemical compounds demonstrated activities against the tested pathogens exhibiting minimum inhibition concentration (MIC) values ranging from 50.0 µg/mL to 200.0 µg/mL (85). The antibacterial activities of the phytochemical compounds 4-O-(3'',4''-di-O-galloyl-α-L-rhamnopyranosyl) ellagic acid and diellagic lactone isolated from the stem bark of *T. brownii* against *Pseudomonas aeruginosa* using the microdilution method with ciprofloxacin as a positive control. The phytochemical compounds demonstrated activities against the tested pathogen with half maximal inhibitory concentration (IC_{50}) values ranging from 8.4 µg/mL to 8.8 µg/mL (87). The antibacterial activities of 50 % ethanol and methanol extracts of *T. brownii* bark and wood against *Cutibacterium acnes* using the microdilution method with tetracycline hydrochloride as a positive control. The extracts demonstrated activities against the tested pathogen exhibiting MIC values ranging from 0.5 mg/mL to 4.0 mg/mL (102). The antibacterial activities of ethanol extracts of *T. brownii* leaves against Salmonella spp. using the disc-diffusion assay with ceftriaxone as a positive control. The extract demonstrated activities exhibiting MIC value of 4.0 mg/mL (103). The antibacterial activities of the crude, chloroform, methanol : water (70:30) and hexane: methanol: water extracts of *T. brownii* stem bark and the phyotochemical compounds ellagic acid and 4-O-(3'',4''-di-O-galloyl-a-L-rhamnopyranosyl) ellagic acid isolated from the species against *Edwardsiella ictaluri* and *Flavobacterium columnare* using the microplate bioassay with florfenicol and oxytetracycline as positive controls (93). The extracts and the phytochemical compounds demonstrated activities against the pathogens and exhibited MIC and IC_{50} values ranging from 6.0 µg/mL to 100.0 µg/mL (93). The antibacterial activities of 50 % ethanolic and methanolic and extracts of *T. brownii* bark and wood against *Porphyromonas gingivalis* using the microdilution assay method with chlorohexidine as a positive control (104). The extracts demonstrated activities against the tested pathogen exhibiting MIC values ranging from 0.5 mg/mL to 2.0 mg/mL (104). The antibacterial activities of water, methanol, ethyl acetate and chloroform extracts of *T. brownii* stem bark, roots and stem wood against *Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus epidermidis* and *Micrococcus luteus* using the microdilution assay with ampicillin, gentamycin, penicillin and tetracycline as positive controls. The

extracts demonstrated activities against the tested pathogens exhibiting MIC values ranging from 39.06 µg/mL to 312.5 µg/mL (89). The antibacterial activities of ethanol extract of *T. brownii* roots against *Pseudomonas aeruginosa, Staphylococcus aureus* and *Escherichia coli* using the agar diffusion bioassay with ampicillin and gentamycin as positive controls. The extract demonstrated activities against the tested pathogens exhibiting inhibition zone ranging from 15.0 mm to 25.0 mm (105). The antibacterial activities of dichloromethane:methanol (1:1) extract of *T. brownii* flowers against *Escherichia coli* and *Pseudomonas aeruginosa* using the microdilution method with amoxicillin as a positive control. The extract demonstrated activities against the tested pathogens exhibiting MIC values ranging from 1.1 mg/mL to 9.3 mg/mL (106). The antibacterial activities of the phytochemical compounds termiglaucescin, arjunglucoside-I, sericoside, 23-galloyl arjungenin, 28-O-β-D-glucopyranosyl-2,3,6-trihydroxy-23-galloylolean-12-dien-28-oate, 1,4,7-tri-O-galloyl hept-6-deoxyheptose, 1,2,4-tri-O-galloyl-8,9-dideoxynonose, rhamnetin-3-O-(2,3,6-trigalloyl)-β-D-glucopyranoside, 3,3',4',5-tetrahydroxy-7-methoxyflavone and 3,3',4',5,7-pentahydroxyflavone isolated from the flowers and stem bark of *T. brownii* against *Staphylococcus aureus, Escherichia coli* and *Pseudomonas aeruginosa* using agar diffusion method with amoxillin as a positive control (98). The phytochemical compounds demonstrated activities against the tested pathogens exhibiting inhibition zone ranging from 8.5 mm to 16.5 mm (98).

Antimycobacterial activities

The antimycobacterial activities of acetone extracts of *T. brownii* leaves against *Mycobacterium smegmatis* using the microdilution assay. The extract demonstrated activities exhibiting MIC value of 2500.0 µg/mL (107). The antimycobacterial activities of water, methanol, ethyl acetate, acetone, dichloromethane, hexane and chloroform extracts of *T. brownii* leaves, stem bark, roots, stem wood and fruits and phytochemical compounds ellagic acid, corilagin, friedelin, triacontanol, sitostenone, stigmasterol and β-sitosterol isolated from the species against *Mycobacterium smegmatis* using the microdilution assay with rifampicin as a positive control. The extracts and phytochemical compounds demonstrated activities against the tested pathogen exhibiting MIC values ranging from 250.0 µg/mL to 2500.0 µg/mL (91).

Antifungal activities

The antifungal activities of the aqueous, petroleum ether, methanol, dichloromethane:methanol (1:1) extracts of *T. brownii* wood, stem bark and roots against *Candida albicans* and *Cryptococcus neoformans* using the disc diffusion assay with clotrimazole as a positive control. The extracts demonstrated activities against the tested pathogens exhibiting inhibition zone ranging from 3.0 mm to 11.7 mm (58). The antifungal activities of ethyl acetate, methanol and n-hexane extract of *T. brownii* stem bark against *Alternaria* spp., *Aspergillus niger, Fusarium oxysporum, Fusarium solani* and *Rhizopus stolonifer* using the disc diffusion assay with blitox as a positive control. The extracts demonstrated activities against the tested pathogens exhibiting inhibition zone ranging from 5.0 mm to 15.5 mm (85). The antifungal activities of the phytochemical compounds β-sitosterol, stigmasterol, betulinic acid and arjungenin isolated from the stem bark of *T. brownii* against *Alternaria* spp., *Aspergillus niger, Fusarium oxysporum, Fusarium solani* and *Rhizopus stolonifer* using the microdilution assay with blitox as a positive control. The extracts demonstrated activities against the tested pathogens exhibiting MIC values ranging from 50.0 µg/mL to 200.0 µg/mL (85). The antifungal activities of the phytochemical compound diellagic lactone isolated from the stem bark of *T. brownii* against *Candida glabrata* using microdilution assay. The phytochemical compound demonstrated activities exhibiting IC_{50} value of 0.3 µg/mL (86). The antifungal activities of the phytochemical compounds arjunic acid, 3-O-methylellagic acid, 4-O-(3'',4''-di-O-galloyl-α-L-rhamnopyranosyl) ellagic acid and diellagic lactone isolated from the stem bark of *T. brownii* against *Candida krusei, Candida albicans, Cryptococcus neoformans* and *Candida glabrata* using the microdilution method with amphotericin B as a positive control. The phytochemical compounds demonstrated activities against the tested pathogens with IC_{50} values ranging from 0.6 µg/mL to 18.0 µg/mL (87). The antifungal activities of aqueous extracts of *T. brownii* stem bark and wood against *Aspergillus niger, Aspergillus flavus, Gibberella moniliformis* and *Nattrassia mangiferae* using the agar diffusion bioassay. The extracts demonstrated activities against the pathogen exhibiting inhibition zones ranging from 14.0 mm to 20.0 mm (88). The antifungal activities of ethyl acetate, hexane, choloroform and aqueous extracts of *T. brownii* stem bark and wood against *Aspergillus niger, Aspergillus flavus, Nattrassia mangiferae* and *Fusarium verticillioides* using the microdilution method with amphotericin B as a positive control. The extract demonstrated activities against the tested pathogens exhibiting MIC values ranging from 250.0 µg/mL to 500.0 µg/mL (90). The antifungal activities of ethanol extract of *T. brownii* roots against *Candida albicans* using the agar diffusion bioassay. The extract demonstrated activities against the tested pathogen exhibiting inhibition zone of 15.0 mm (105). The antifungal activities of aqueous, methanol, ethyl acetate, acetone, dichloromethane and hexane extracts of *T. brownii* leaves, roots, stems, root bark, root wood, stem bark and stem wood and the phytochemical compounds apigenin, corilagin, ellagic acid, friedelin, luteolin, quercetin, sitosterol and stigmasterol isolated from the species against *Candida albicans, Candida glabrata, Candida tropicalis* and *Candida parapsilosis* using the microdilution method with amphotericin B as a positive control. The extracts demonstrated activities against the tested pathogens exhibiting MIC values ranging 125.0 µg/mL to 625.0 µg/mL (92). The antifungal activities of the phytochemical compounds termiglaucescin, arjunglucoside-I, sericoside, 23-galloyl arjungenin, 28-O-β-D-glucopyranosyl-2,3,6-trihydroxy-23-galloylolean-12-dien-28-oate, 1,4,7-tri-O-galloyl hept-6-deoxyheptose, 1,2,4-tri-O-galloyl-8,9-dideoxynonose, rhamnetin-3-O-(2,3,6-trigalloyl)-β-D-glucopyranoside, 3,3',4',5-tetrahydroxy-7-methoxyflavone and 3,3',4',5,7-pentahydroxyflavone isolated from the flowers and stem bark of *T. brownii* against *Candida albicans* using agar diffusion method with fluconazole as a positive control. The phytochemical compounds demonstrated activities against the tested pathogen exhibiting inhibition zone ranging from 5.5 mm to 16.5 mm (98).

Antidiarrheal activities

The *in vivo* antidiarrheal activities of the aqueous, 80 % hydromethanolic, n-hexane and ethyl acetate extracts of *T. brownii* leaves using the castor oil-induced diarrhea model in Swiss Albino mice. The extracts inhibited and reduced wet and total defecation and the extracts also reduced the castor oil-induced intestinal motility, weight and volume of intestinal contents (110).

Antimycoplasmal activities

The antimycoplasmal activities of acetone extracts of *T. brownii* leaves against *Mycoplasma mycoides* subsp. *mycoides* (T1/44 strains) using the two-fold serial microplate dilution. The extract demonstrated activities against the pathogen exhibiting MIC value of 420.0 µg/mL (108).

Antidiabetic activities

The *in vivo* antidiabetic activities of aqueous and ethyl acetate extracts of *T. brownii* stem bark in normoglycemic, streptozotocin-induced diabetic and oral glucose challenged mice. The extracts tested at dose levels of 250.0 mg/kg body weight, 500.0 mg/kg body weight and 750.0 mg/kg mg/kg body weight showed significant body glucose level reduction in all the three animal models (89). The antidiabetic activities of butanol and chloroform stem bark extracts of *T. brownii in vitro* α-amylase inhibition assay using the chromogenic 3,5-dinitrosalicylic acid method with acarbose as a positive control. The chloroform and butanol extracts demonstrated activities exhibiting IC_{50} value of 63.4 µg/mL and 84.7 µg/mL, respectively and these values were lower than IC_{50} value of 12.5 µg/mL exhibited by the positive control (109).

Anti-inflammatory activities

The *in vivo* anti-inflammatory activities of methanol extract of *T. brownii* bark on carrageenan-induced edema in Wistar albino rats with diclofenac as a positive control. The extract reduced the carrageenan-induced paw edema by between 1.6 % to 20.4 % which was comparable to 11.1 % to 25.3 % demonstrated by the positive control (111).

Antioxidant activities

The antioxidant activities of 50 % ethanol and methanol extracts of *T. brownii* bark and wood using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging assay with (+)-catechin as a positive control. The extracts demonstrated activities exhibiting IC_{50} values ranging from 3.9 µg/mL to 5.9 µg/mL (102). The *in vivo* antioxidant activities of 80 % methanol extract of *T. brownii* leaves by assessing the endogenous antioxidant enzyme levels in excised livers of female Wistar rats. The extract demonstrated antioxidant activities (112). The antioxidant activities of ethanol extract of *T. brownii* roots using the DPPH free radical scavenging assay with propyl gallate as a positive control. The extract demonstrated moderate antioxidant activities (105). The antioxidant activities of acetone, ethyl acetate, methanol and water extracts of *T. brownii* bark using the DPPH and 2'-azinobis (3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) assays. The extracts demonstrated activities against both ABTS and DPPH exhibiting IC_{50} values ranging from 34.3 µg/mL to 93.2 µg/mL (113).

Antiplasmodial activities

The antiplasmodial activities of the phytochemical compound 23-galloylarjunolic acid isolated from the stem bark of *T. brownii* against *Plasmodium falciparum* W2 strain using the pLDH assay with artemisinin and chloroquine as positive controls. The phytochemical compound demonstrated activities exhibiting IC_{50} value of 2.8 µg/mL (86). The antiplasmodial activities of the aqueous extract and the phytochemical compounds 23-galloylarjunic acid and 4-O-(3'',4''-di-O-galloyl-α-L-rhamnopyranosyl) ellagic acid isolated from the stem bark of *T. brownii* against chloroquine sensitive (D6) and chloroquine resistant (W2) strains of *Plasmodium falciparum* using the pLDH assay with artemisinin and chloroquine as positive controls. The extract and phytochemical compounds demonstrated activities exhibiting IC_{50} values ranging from 2.8 µg/mL to 47.1 µg/mL (87). The *in vivo* antiplasmodial activities of aqueous and 80 % methanol extracts of *T. brownii* bark in *Plasmodium berghei* infected mice using a 4-day suppressive test. The extracts demonstrated a significant inhibition of parasitemia in a dose-dependent manner (115). The *in vitro* antiplasmodial activities of aqueous, dichloromethane and methanol extracts of *T. brownii* leaves against chloroquine sensitive (D6) and chloroquine resistance (W2) strains of *Plasmodium falciparum* using the [G^3-H] hypoxanthine incorporation assay with chloroquine as a positive control. The extracts demonstrated activities against the strains with IC_{50} values ranging from 3.3 µg/mL to 47.3 µg/mL (114). The *in vivo* antiplasmodial activities of aqueous, dichloromethane and methanol extracts of *T. brownii* leaves by using the 4-day suppression test against *Plasmodium berghei* in male Swiss albino mice. The extracts demonstrated activities against the pathogen by exhibiting parasitemia suppression ranging from 9.5 % to 11.1 % (114). The *in vitro* antiplasmodial activities of aqueous, methanolic, ethanolic, ethyl acetate and hydroethanolic extracts of *T. brownii* stem bark against chloroquine sensitive (Pf3D7) and multidrug resistant (PfDd2) strains of *Plasmodium falciparum* using the pLDH assay with artemisinin and chloroquine as positive controls. The extract demonstrated activities exhibiting IC_{50} values ranging from 0.1 µg/mL to 10.6 µg/mL (95). The antiplasmodial activities of dichloromethane and ethyle acetate extracts of *T. brownii* leaves against chloroquine resistant strain FcB-1 of *Plasmodium falciparum* using the pLDH assay with artemisinin as a positive control. The dichloromethane and ethyl acetate extracts demonstrated activities exhibiting IC_{50} values of 13.7 µg/mL and 7.5 µg/mL, respectively (74).

Antinociceptive activities

The *in vivo* antinociceptive activities of the methanolic bark extract of *T. brownii* in Wistar rats by using the rat paw edema, writhing and formalin-induced pain tests with diclofenac as a positive control. The extracts demonstrated activities by reducing the formalin-induced pain in both early and late phases by reducing the paw licking time (116). The *in vivo* antinociceptive activities of lectins isolated from the leaves and seeds of *T. brownii* using the abdominal writhing and hotplate assays in male Swiss white mice. The lectins exhibited antinociceptive effects, reducing abdominal pain and prolonging latency time in the hotplate assay (100).

Antiulcer activities

The *in vivo* antiulcer activities of lectins isolated from the leaves and seeds of *T. brownii* using the abdominal writhing and hotplate assays in male Swiss white mice. The lectins demonstrated at least 33.4 % protection against ethanol-induced stomach ulceration (100).

Anti-pyretic activities

The *in vivo* anti-pyretic activities of the methanolic bark extract of *T. brownii* on steam-distilled turpentine-induced pyrexia in Wistar rats. The extracts demonstrated activities by reducing the rectal temperatures after extract administration (117).

Hepatoprotective activities

The hepatoprotective activities of 80 % methanol extract of *T. brownii* leaves against the carbon tetrachloride-induced hepatotoxicity in female Wistar rats. The extract demonstrated hepatoprotective activities (112).

Cytotoxicity activities

The cytotoxicity activities of the aqueous, dichloromethane, water, petroleum ether, methanol, dichloromethane:methanol (1:1) extracts of *T. brownii* wood, stem bark and roots using the brine shrimp lethality assay with cyclophosphamide as a positive control. The extracts demonstrated activities exhibiting median lethal concentration (LC_{50}) values ranging from 2.6 µg/mL to 88.1 µg/mL (58). The cytotoxicity activities of acetone extract of *T. brownii* leaves 3-(4,5-dimethylthiazole-2-yl)-2,5-diphynyltetra-zolium bromide MTT assay on the African green monkey kidney (Vero) cell line with berberine chloride as a positive control. The extract demonstrated activities exhibiting LC50 value of 23.8 µg/mL (108). The anticancer activities of 80 % methanol extract of *T. brownii* leaves against HepG2 human hepatoma cancer cells using MTT assay in a colorimetric assay. The extract demonstrated activities by exhibiting median cytotoxic concentration (CTC_{50}) value of 0.4 mg/mL (112). The cytotoxicity activities of aqueous, n-hexane, ethyl acetate and chloroform extracts of *T. brownii* leaves against human breast cancer cells (MCF-7), human colon cancer cells (HCT 116) and human liver cancer cells (HEPG-2) using the *in vitro* SRB protein stain assay. The extracts exhibited activities against all three types of cancer cell lines at 100.0 µg concentration (96). The cytotoxicity activities of the ethanol extract of *T. brownii* leaves against the human diploid embryonic lung cell line (MRC-5) using the MTT assay with taxotere as a positive control. The extract demonstrated activities exhibiting IC_{50} value of 83.1 µg/mL (74).

Conclusion

The current review provides a summary of the medicinal uses, phytochemical and pharmacological properties of *T. brownii.* The ethnopharmacological interest in the species is reflected in the large numbers of recent publications focusing on its ethnomedicinal applications, phytochemical and pharmacological properties. The ethnomedicinal applications of the species are quite broad, ranging from cultural to usage against microbial infections such as sexually transmitted infections, wounds, respiratory infections and gastro-intestinal problems and other ailments such as diabetes, malaria, epilepsy, jaundice, liver problems, rheumatism, yellow fever, menstrual problems, skin diseases, fever and typhoid. *T.brownii* has become an important medicinal plant species in tropical Africa and the full potential of the species as a medicinal plant is yet to be explored. This wide application of *T. brownii* crude extracts requires detailed pharmacological validation such as assessment of toxicity and safety, mechanisms of action *in vivo* and clinical research of the species aimed at corroborating the ethnomedicinal applications of the species. Future ethnopharmacological studies should also examine the combinational effects of *T. brownii* extracts with other plant species such as *A. indica, B. abyssinica, C. barbatus, C. macrostachyus, C. spinarum, F. thonningii, J. fluminense, L. calostachys, M. decumbens, N. tabacum, O. europaea, O. europaea* subsp. *africana, R. tridentata, R. usambarensis, V. nobilis, V. xanthophloea, W. ugandensis* and *Z. asiaticum*.

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Compliance with ethical standards

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

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References

1. Jordaan M, Van Wyk AE, Maurin O. A conspectus of *Combretum* (Combretaceae) in southern Africa, with taxonomic and nomenclatural notes on species and sections. Bothalia. 2011;41 (1):135–60. https://doi.org/10.4102/abc.v41i1.36.
2. Christenhusz MJM, Byng JW. The number of known plant species in the world and its annual increase. Phytotaxa. 2016;261(3):201–17. https://doi.org/10.11646/phytotaxa.261.3.1.
3. Raj SP, Solomon PR, Thangaraj B. Combretaceae. In: Raj SP, Solomon PR, Thangaraj B, editors. Biodiesel from flowering plants. Singapore: Springer; 2022. p. 159–64. https://doi.org/10.1007/978-981-16-4775-8_12.
4. Dharani N. Field guide to common trees and shrubs of East Africa. Cape Town (South Africa): Struik Nature; 2019.
5. Gebremedhin AT, Gedo AH, Edo GY, Haile ST. Evaluation of multi-functional fodder tree and shrub species in mid-altitudes of South Omo Zone, southern Ethiopia. J Hort For. 2020;12(1):27–34. https://doi.org/10.5897/JHF2019.0617.
6. Kamau CN, Luvanda AM, Uchi SM. Determinants of distribution and utilization of *Terminalia brownii* (Fresen) in Eastern Kenya. J Dryland Agr. 2021;7(3):42–51. https://doi.org/10.5897/JODA2021.0065
7. Medley KE, Kalibo HW. Ethnobotanical survey of 'wild' woody plant resources at Mount Kasigau, Kenya. J East Afr Nat Hist. 2009;96(2):149–86. https://doi.org/10.2982/0012-8317(2007)96[149:ESOWWP]2.0.CO;2
8. Mosango DM. *Terminalia brownii* Fresen. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 245–8.
9. Maundu P, Tengnäs B. Useful trees and shrubs for Kenya. Nairobi (Kenya): World Agroforestry Centre; 2005.
10. Quattrocchi U. CRC world dictionary of medicinal and poisonous plants: Common names, scientific names, eponyms, synonyms and etymology. Boca Raton (USA): CRC Press; 2012.
11. Handiso MA, Lemma B, Asfaw Z, Bromm T, Mellisse BT, Glaser B. Farmers' perceptions of *Terminalia brownii* management in agroforestry parklands and its impact on soil physicochemical properties in the South Ari District, southern Ethiopia. Agroforest Syst. 2025;99:35. https://doi.org/10.1007/s10457-025-01138-3.
12. Alemu M, Asfaw Z, Lulekal E, Warkineh B, Debella A, Sisay B, et al. Ethnobotanical study of traditional medicinal plants used by the local people in Habru District, North Wollo Zone, Ethiopia. J Ethnobiol Ethnomed. 2024;20:4. https://doi.org/10.1186/s13002-023-00644-x.
13. Burkill HRM. The useful plants of West tropical Africa. Richmond (UK): Royal Botanic Gardens, Kew; 1994.
14. Tafokou RBJ. *Terminalia avicennioides* Guill. & Perr. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 238–40.
15. Matu EN, Lemmens RHMJ. *Terminalia bellirica* (Gaertn.) Roxb. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 240–3.
16. Neuwinger HD. African traditional medicine. Stuttgart (Germany): MedPharm Scientific Publishers; 2000.
17. Matu EN, Lemmens RHMJ. *Terminalia bentzoë* (L.) L.f. In: Schmelzer

GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 243–4.

18. Gelfand M, Drummond RB, Mavi S, Ndemera B. The traditional medical practitioner in Zimbabwe. Gweru (Zimbabwe): Mambo Press; 1985.

19. Matu EN, Lemmens RHMJ. *Terminalia brachystemma* Welw. ex Hiern. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 244–5.

20. Zhang X-R, Kaunda JS, Zhu H-T, Wang D, Yang C-R, Zhang Y-J. The genus *Terminalia* (Combretaceae): An ethnopharmacological, phytochemical and pharmacological review. Nat Prod Bioprospect. 2019;9:357–92. https://doi.org/10.1007/s13659-019-00222-3.

21. Sanogo R. *Pteleopsis suberosa* Engl. & Diels. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 208–10.

22. Kokwaro JO. Medicinal plants of East Africa. Nairobi (Kenya): University of Nairobi Press; 2009.

23. Mutie FM, Mbuni YM, Rono PC, Mkala EM, Nzei JM, Phumthum M, et al. Important medicinal and food taxa (orders and families) in Kenya, based on three quantitative approaches. Plants. 2023;12:1145. https://doi.org/10.3390/plants12051145.

24. Foyet HS, Nana P. *Terminalia laxiflora* Engl. & Diels. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 248–9.

25. Sanogo R. *Terminalia macroptera* Guill. & Perr. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 249–51.

26. Matu EN. *Pteleopsis myrtifolia* (M.A.Lawson) Engl. & Diels. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 207–8.

27. Delbanco AS, Burgess ND, Cuni-Sanchez A. Medicinal plant trade in Northern Kenya: Economic importance, uses and origin. Econ Bot. 2017;71:13–31. https://doi.org/10.1007/s12231-017-9368-0.

28. Irvine FR. Woody plants of Ghana: With special reference to their uses. Oxford (UK): Oxford University Press; 1961.

29. Lemmens RHMJ. *Terminalia schimperiana* Hochst. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers; 2013. p. 251–4.

30. Lemmens RHMJ. *Terminalia sericea* Burch. ex DC. In: Lemmens RHMJ, Louppe D, Oteng-Amoako AA, editors. Plant resources of tropical Africa 7: Timbers 2. Leiden (Netherlands): Backhuys Publishers; 2012. p. 628–30.

31. Foyet HS, Nana P. *Terminalia spinosa* Engl. In: Schmelzer GH, Gurib-Fakim A, editors. Plant resources of tropical Africa 11: Medicinal plants 2. Leiden (Netherlands): Backhuys Publishers. 2013:254–5.

32. Kimpouni V. *Terminalia superba* Engl. & Diels. In: Lemmens RHMJ, Louppe D, Oteng-Amoako AA, editors. Plant resources of tropical Africa 7: Timbers 2. Leiden (Netherlands): Backhuys Publishers. 2012:630–35.

33. Stace CA. Combretaceae. In: Kubitzki K, editor. The families and genera of vascular plants, volume 9. Berlin (Germany): Springer. 2007:67–82. https://doi.org/10.1007/978-3-540-32219-1_11.

34. Maurin O, Chase MW, Jordaan M, Van Der Bank M. Phylogenetic relationships of Combretaceae inferred from nuclear and plastid DNA sequence data: Implications for generic classification. Bot J Linn Soc. 2010;162:453–76. https://doi.org/10.1111/j.1095-8339.2010.01027.x

35. Maurin O, Gere J, Van Der Bank M, Boatwright JS. The inclusion of *Anogeissus*, *Buchenavia* and *Pteleopsis* in *Terminalia* (Combretaceae: Terminaliinae). Bot J Linn Soc. 2017;184:312–25. https://doi.org/10.1093/botlinnean/box029.

36. Taia WK, Hamdy RS, El-Maged AMA. Morpho-palynological assessment of the genus *Terminalia* L. (Combretaceae) in Egypt. Acta Bot Croat. 2024;83(2):107–14. https://doi.org/10.37427/botcro-2024-016.

37. Palmer E, Pitman P. Trees for southern Africa covering all known indigenous species in Republic of South Africa, South West Africa, Botswana, Lesotho and Swaziland. Cape Town (South Africa): AA Balkema. 1972.

38. Chakrabarty T, Krishna G, Rasingam L. Taxonomic notes on Indian *Terminalia* (Combretaceae). Pl Sci Tod. 2019;6(3):281–6. https://doi.org/10.14719/pst.2019.6.3.539.

39. Rayane T, Ribeiro M, Maria I, Loiola B, Margareth FDES. Look at the trees: Synopsis of *Terminalia* ss in the Brazilian Amazon with conservation and distribution implications. Anais Acad Brasil Ciências. 2022;94(4):1–19. https://doi.org/10.1590/0001-3765202220210265

40. Glen H. Sappi: What's in a name? The meanings of the botanical names of trees. Johannesburg (South Africa): Jacana Media (Pvt) Ltd. 2004.

41. Wickens GE. Combretaceae. In: Polhill RM, editor. Flora of tropical East Africa. London (UK): Crown Agents for Oversea Governments and Administrations. 1973:1–99.

42. Thulin M. Flora of Somalia Volume 1. Richmond (UK): Royal Botanic Gardens, Kew. 1993.

43. Edwards S, Tadesse M, Hedberg I. Flora of Ethiopia and Eritrea Volume 2 Part 2. Addis Ababa (Ethiopia): National Herbarium, Addis Ababa University. 1995.

44. Darbyshire I, Kordofani M, Farag I, Candiga R, Pickering H. The plants of Sudan and South Sudan. Richmond (UK): Kew Publishing, Royal Botanic Gardens, Kew. 2015.

45. Govaerts R, Lughadha NE, Black N, Turner R, Paton A. The world checklist of vascular plants, a continuously updated resource for exploring global plant diversity. Sci Data. 2021;8:215. https://doi.org/10.1038/s41597-021-00997-6.

46. Kareru PG, Kenji GM, Gachanja AN, Keriko JM, Mungai G. Traditional medicines among the Embu and Mbeere peoples of Kenya. Afr J Trad Compl Alt Med. 2007;4(1):75–86.

47. Ofukwu R, Ayoola A, Akwuobu C. Medicinal plants used in the management of tuberculosis in humans and animals by Idoma Tribe of north central Nigeria. Nig Vet J. 2008;29(2):25–30. https://doi.org/10.4314/nvj.v29i2.3588.

48. Gakuya DW, Itonga SM, Mbaria JM, Muthee JK, Musau JK. Ethnobotanical survey of biopesticides and other medicinal plants traditionally used in Meru Central District of Kenya. J Ethnopharmacol. 2013;145:547–53.

49. Kioko J, Baker J, Shannon A, Kiffner C. Ethnoecological knowledge of ticks and treatment of tick-borne diseases among Maasai people in Northern Tanzania. Vet World. 2015;8(6):755–62. https://doi.org/10.14202/vetworld.2015.755-762.

50. Kigen G, Some F, Kibosia J, Rono H, Kiprop E, Wanjohi B, et al. Ethnomedicinal plants traditionally used by the Keiyo community in Elgeyo Marakwet County, Kenya. J Biodivers Biopros Dev. 2014;1:132. https://doi.org/10.4172/2376-0214.1000132.

51. Maroyi A. *Vachellia xanthophloea* (Benth.) P.J.H.Hurter (fever tree): Traditional and present uses and future potential. Ethnobot Res Appl. 2024;29:54.

52. Ngari FW, Wanjau RN, Njagi EN, Gikonyo NK. Herbal materials used in management of oral conditions in Nairobi, Kenya. J Oral Health Comm Dent. 2014;8(1):36–42.

53. Mesfin F, Seta T, Assefa A. An ethnobotanical study of medicinal plants in Amaro Woreda, Ethiopia. Ethnobot Res Appl. 2014;12:341–54.

54. Belayneh A, Bussa NF. Ethnomedicinal plants used to treat human ailments in the prehistoric place of Harla and Dengego valleys, eastern Ethiopia. J Ethnobiol Ethnomed. 2014;10:18.

55. Wondimu T, Asfaw Z, Kelbessa E. Ethnobotanical study of medicinal plants around 'Dheeraa' town, Arsi Zone, Ethiopia. J Ethnopharmacol. 2007;112:152–61.

56. Wanjohi BK, Sudoi V, Njenga EW, Kipkore WK. An ethnobotanical study of traditional knowledge and uses of medicinal wild plants among the Marakwet community in Kenya. Evidence-Based Compl Alt Med. 2020;2020:3208634. https://doi.org/10.1155/2020/3208634.

57. Sultan S, Telila H, Kumsa L. Ethnobotany of traditional cosmetics among the Oromo women in Madda Walabu district, Bale Zone, southeastern Ethiopia. J Ethnobiol Ethnomed. 2024;20:39. https://doi.org/10.1186/s13002-024-00673-0.

58. Mbwambo ZH, Moshi MJ, Masimba PJ, Kapingu MC, Nondo RS. Antimicrobial activity and brine shrimp toxicity of extracts of *T. brownii* roots and stem. BMC Compl Alt Med. 2007;7(1):9. https://doi.org/10.1186/1472-6882-7-9.

59. Kipkore W, Wanjohi B, Rono H, Kigen G. A study of the medicinal plants used by the Marakwet community in Kenya. J Ethnobiol Ethnomed. 2014;10:24. https://doi.org/10.1186/1746-4269-10-24.

60. Keter LK, Mutiso PC. Ethnobotanical studies of medicinal plants used by traditional health practitioners in the management of diabetes in lower Eastern Province, Kenya. J Ethnopharmacol. 2012;139:74–80. https://doi.org/10.1016/j.jep.2011.10.014

61. Demoz MS, Gachoki KP, Mungai KJ, Negusse BG. Ethnobotanical survey and preliminary phytochemical studies of plants traditionally used for diabetes in Eritrea. Eur J Med Plants. 2015;9 (2):1–11. https://doi.org/10.9734/EJMP/2015/18777

62. Issa TO, Mohamed YS, Yagi S, Ahmed RH, Najeeb TM, Makhawi AM, et al. Ethnobotanical investigation on medicinal plants in Algoz area (South Kordofan), Sudan. J Ethnobiol Ethnomed. 2018;14:31. https://doi.org/10.1186/s13002-018-0230-y

63. Kisangau D, Kauti M, Mwobobia R, Kanui T, Musimba N. Traditional knowledge on use of medicinal plants in Kitui County, Kenya. Int J Ethnobiol Ethnomed. 2017;4(1):1–10.

64. Kidane B, Van Andel T, Van der Maesen LJG, Asfaw Z. Use and management of traditional medicinal plants by Maale and Ari ethnic communities in southern Ethiopia. J Ethnobiol Ethnomed. 2014;10:46. https://doi.org/10.1186/1746-4269-10-46

65. Mutwiwa C, Rotich B, Kauti M, Rithaa J. Ethnobotanical survey of medicinal plants in Mwala Sub-County, Machakos County, Kenya. J Dis Med Plants. 2018;4(4):110–19. https://doi.org/10.11648/j.jdmp.20180404.12

66. Zenebe G, Zerihun M, Solomon Z. An ethnobotanical study of medicinal plants in Asgede Tsimbila district, northwestern Tigray, northern Ethiopia. Ethnobot Res Appl. 2012;10:305–20. https://doi.org/10.17348/era.10.0.305-320

67. Kewessa G, Abebe T, Demessie A. Indigenous knowledge on the use and management of medicinal trees and shrubs in Dale district, Sidama zone, southern Ethiopia. Ethnobot Res Appl. 2015;14:171–82. http://dx.doi.org/10.17348/era.14.0.171-182

68. Mutie FM, Gao L-L, Kathambi V, Rono PC, Musili PM, Ngugi G, et al. An ethnobotanical survey of a dryland botanical garden and its environs in Kenya: The Mutomo Hill plant sanctuary. Evid Based Compl Alt Med. 2020;2020:1543831. https://doi.org/10.1155/2020/1543831

69. Hankiso M, Asfaw Z, Warkineh B, Abebe A, Sisay B, Debella A. Ethnoveterinary medicinal plants and their utilization by the people of Soro District, Hadiya Zone, southern Ethiopia. J Ethnobiol Ethnomed. 2024;20:21. https://doi.org/10.1186/s13002-024-00651-6

70. Bekele M, Woldeyes F, Lulekal E, Bekele T, Demissew S. Ethnobotanical investigation of medicinal plants in Buska Mountain range, Hamar district, Southwestern Ethiopia. J Ethnobiol Ethnomed. 2022;18:60. https://doi.org/10.1186/s13002-022-00558-0

71. Wilson RT, Woldo Gebre M. Medicine and magic in Central Tigre: A contribution to the ethnobotany of the Ethiopian plateau. Econ Bot. 1979;33(1):29–34. https://doi.org/10.1007/BF02858209

72. Hassan-Abdallah A, Merito A, Hassan S, Aboubaker D, Djama M, Asfaw Z, et al. Medicinal plants and their uses by the people in the Region of Randa, Djibouti. J Ethnopharmacol. 2013;148:701–13. http://dx.doi.org/10.1016/j.jep.2013.05.033

73. Omara T. Antimalarial plants used across Kenyan communities. Evid Based Compl Alt Med. 2020;2020:4538602. https://doi.org/10.1155/2020/4538602

74. Elmi A, Mohamed AS, Mérito A, Charneau S, Amina M, Grellier P, et al. The ethnopharmacological study of plant drugs used traditionally in Djibouti for malaria treatment. J Ethnopharmacol. 2024;325:117839. https://doi.org/10.1016/j.jep.2024.117839

75. Shibeshi A, Sebsibe A, Teka A, Aklilu E. Ethnobotanical study of mosquito repellent plants used in Seweyna District, Bale Zone, Southeast Ethiopia. Evid Based Compl Alt Med. 2024;2024:6610579. https://doi.org/10.1155/2024/6610579

76. Mailu JK, Nguta JM, Mbaria JM, Okumu MO. Medicinal plants used in managing diseases of the respiratory system among the Luo community: An appraisal of Kisumu East Sub-County, Kenya. Chin Med. 2020;15:95. https://doi.org/10.1186/s13020-020-00374-2

77. Marealle AI, Moshi M, Innocent E, Qwarse M, Andrae-Marobela K. Ethnomedical survey of plants used for the management of HIV and AIDS-related conditions in Mbulu District, Tanzania. J Med Plants Res. 2021;15(1):1–21. https://doi.org/10.5897/JMPR2020.7036

78. Wambugu SN, Mathiu PM, Gakuya DW, Kanui TI, Kabasa JD, Kiama SG. Medicinal plants used in the management of chronic joint pains in Machakos and Makueni counties, Kenya. J Ethnopharmacol. 2011;137:945–55. https://doi.org/10.1016/j.jep.2011.06.038

79. Watt JM, Breyer-Brandwijk MG. The medicinal and poisonous plants of southern and eastern Africa: Being an account of their medicinal and other uses, chemical composition, pharmacological effects and toxicology in man and animal. London: E & S Livingstone Ltd; 1962.

80. Tali MBT, Kamdema BP, Tchouankeu JC, Boyom FF. Current developments on the antimalarial, antileishmanial and antitrypanosomal potential and mechanisms of action of *Terminalia* spp. S Afr J Bot. 2023;156:309–33. https://doi.org/10.1016/j.sajb.2023.03.028

81. Dzoyem JP, Kuete V. Review of the antifungal potential of African medicinal plants. In: Razzaghi-Abyaneh M, Rai M, editors. Antifungal metabolites from plants. New York: Elsevier; 2013. p. 79–153. https://doi.org/10.1007/978-3-642-38076-1_4

82. Gebre T, Chinthapalli BR, Chitra DSV. Ethnobotanical study of the traditional use and maintenance of medicinal plant species and indigenous knowledge by the Konso people, southern Ethiopia. Pharmacogn J. 2023;15(5):719–31. https://doi.org/10.5530/pj.2023.15.143

83. Iwu MM. Handbook of African medicinal plants. London: CRC Press; 2014.

84. Negishi H, Maoka T, Njelekela M, Yasui N, Juman S, Mtabaji J, et al. New chromone derivative terminalianone from African plant *Terminalia brownii* Fresen (Combretaceae) in Tanzania. J Asian Nat Prod Res. 2011;13(3):281–3. https://doi.org/10.1080/10286020.2011.552431

85. Opiyo SA, Manguro LOA, Owuor PO, Ochieng CO, Ateka EM, Lemmen P. Antimicrobial compounds from *Terminalia brownii* against sweet potato pathogens. Nat Prod J. 2011;1:116–20. https://doi.org/10.2174/2210315511101020116

86. Machumi F, Midiwo OJ, Jacob MR, Khan IS, Tekwani LB, Walker LA, et al. Phytochemical, antiparasitic and antimicrobial investigations of *Terminalia brownii*. Pl Med. 2013;79:87. https://doi.org/10.1055/s-0033-1336529

87. Machumi F, Midiwo JO, Jacob MR, Khan SI, Tekwani BL, Zhang J, et

al. Phytochemical, antimicrobial and antiplasmodial investigations of *Terminalia brownii*. Nat Prod Comm. 2013;8:761–4. https://doi.org/10.1177/1934578X1300800619

88. Salih E, Abdelrahman H, Ahmed AM, Fyhrquist P. Flavonoids, stilbens and pentacyclic triterpenoids in antifungal bark and wood extracts of *Terminalia brownii*. Pl Med. 2014;80:36. https://doi.org/10.1055/s-0034-1394693

89. Salih EYA, Kanninen M, Sipi M, Luukkanen O, Hiltunen R, Vuorela H, et al. Tannins, flavonoids and stilbenes in extracts of African savanna woodland trees *Terminalia brownii*, *Terminalia laxiflora* and *Anogeissus leiocarpus* showing promising antibacterial potential. S Afr J Bot. 2017;108:370–6. https://doi.org/10.1016/j.sajb.2016.08.020

90. Salih EYA, Fyhrquist P, Abdalla AMA, Abdelgadir AY, Kanninen M, Sipi M, et al. LC-MS/MS tandem mass spectrometry for analysis of phenolic compounds and pentacyclic triterpenes in antifungal extracts of *Terminalia brownii* (Fresen). Antibiotics. 2017;6:37. https://doi.org/10.3390/antibiotics6040037

91. Salih EYA, Julkunen-Tiitto R, Lampi AM, Kanninen M, Luukkanen O, Sipi M, et al. *Terminalia laxiflora* and *Terminalia brownii* contain a broad spectrum of antimycobacterial compounds including ellagitannins, ellagic acid derivatives, triterpenes, fatty acids and fatty alcohols. J Ethnopharmacol. 2018;227:82–96. https://doi.org/10.1016/j.jep.2018.04.030

92. Salih EYA, Julkunen-Tiitto R, Luukkanen O, Fyhrqvist P. Anti-Candida activity of extracts containing ellagitannins, triterpenes and flavonoids of *Terminalia brownii*, a medicinal plant growing in semi-arid and savannah woodland in Sudan. Pharmaceutics. 2022;14:2469. https://doi.org/10.3390/pharmaceutics14112469

93. Schrader KK, Cantrell CL, Midiwo JO, Muhammad I. Compounds from *Terminalia brownii* extracts with toxicity against the fish pathogenic bacterium *Flavobacterium columnare*. Nat Prod Comm. 2016;11(11):1679–82. https://doi.org/10.1177/1934578X1601101114

94. Yamauchi K, Mitsunaga T, Muddathir AM. Screening for melanogenesis-controlled agents using Sudanese medicinal plants and identification of active compounds in the methanol extract of *Terminalia brownii* bark. J Wood Sci. 2016;62:285–93. https://doi.org/10.1007/s10086-016-1546-7

95. Tali MBT, Dize D, Wouamba SCN, Fokou PVT, Keumoe R, Ngansop CN, et al. *In vitro* antiplasmodial activity-directed investigation and UPLC–MS fingerprint of promising extracts and fractions from *Terminalia ivorensis* A.Chev. and *Terminalia brownii* Fresen. J Ethnopharmacol. 2022;296:115512. https://doi.org/10.1016/j.jep.2022.115512

96. Alfaifi MY, Alqasem ZA. The apoptotic potential activity of *Terminalia brownii* extracts against various cancer cell lines. Asian Pac J Cancer Prev. 2023;24(8):2629–39. https://doi.org/10.31557/APJCP.2023.24.8.2629

97. Mbiri JW, Ogila K, Kisangau P, Gicheru M. *Terminalia brownii* Fresen: Stem bark dichloromethane extract alleviates pyrogallol-induced suppression of innate immune responses in Swiss albino mice. Evidence-Based Compl Alt Med. 2023;2023:9293335. https://doi.org/10.1155/2023/9293335

98. Ikikii S, Odalo J, Ogweno A, Heydenreich M. Bioactive polyphenolic and terpenoid compounds from stem bark and flowers of *Terminalia brownii*. Open Med Chem J. 2025;19:e18741045361160. http://doi.org/10.2174/0118741045361160241218112748

99. Omolara TT, Amatulhafeez A, Ayodele OA, Garba D, Ibrahim A, Sule MI. Isolation and characterization of geranylated chalcone from ethyl acetate fraction of *Terminalia brownii* Fresen (Combretaceae). J Drug Design Med Chem. 2025;11(1):8–12. https://doi.org/10.11648/j.jddmc.20251101.12

100. Idries AH, Naser EH, Dafalla MB, Elmubarak SAA, Abdelrahim YE, Abdalrhman EA, et al. Biological activity and characterization of leaf and seed lectins from *Terminalia brownii*: Insights into their analgesic and antiulcer properties. Heliyon. 2024;10:e39351. https://doi.org/10.1016/j.heliyon.2024.e39351

101. Kareru PG, Gachanja AN, Keriko JM, Kenji GM. Antimicrobial activity of some medicinal plants used by herbalists. Afr J Trad Compl Alt Med. 2008;5:51–5. https://doi.org/10.4314/ajtcam.v5i1.31256

102. Muddathir AM, Mitsunaga T. Evaluation of anti-acne activity of selected Sudanese medicinal plants. J Wood Sci. 2013;59:73–9. https://doi.org/10.1007/s10086-012-1303-5

103. Mechesso AF, Asrade B, Hailu H, Toma A. *In vitro* antimicrobial activity of three medicinal plants of Ethiopia against some selected bacterial isolates. Afr J Microbiol Res. 2016;10(42):1779–83. https://doi.org/10.5897/AJMR2015.7772

104. Mohieldin EAM, Muddathir AM, Mitsunaga T. Inhibitory activities of selected Sudanese medicinal plants on *Porphyromonas gingivalis* and matrix metalloproteinase-9 and isolation of bioactive compounds from *Combretum hartmannianum* (Schweinf) bark. BMC Compl Alt Med. 2017;17:224. https://doi.org/10.1186/s12906-017-1735-y

105. Karim MA, Ibrahim M, Mohamed S, Ayda Y. Isolation and partial characterization of a flavone from Sudanese *Terminalia brownii* (Combretaceae) root and biological activity of ethanol extract. IJRDO J Biol Sci. 2019;5(8):1–8. https://doi.org/10.53555/bs.v5i8.3179

106. Ikikii SM, Odalo JO, Omondi AO, Kahindo JM. Phytochemical screening and antimicrobial activity of flowers of *Terminalia brownii*. J Pharmacogn Phytochem. 2022;11(5):24–7. https://doi.org/10.22271/phyto.2022.v11.i5a.14499

107. Salih E, Fyhrquist P, Hiltunen R, Vuorela H. Antimycobacterial effects of African medicinal plants *Terminalia brownii* and *Terminalia laxiflora*. Pl Med. 2014;80:122. https://doi.org/10.1055/s-0034-1394779

108. Muraina IA, Adaudi OA, Mamman M, Kazeem HM, Picard J, McGaw LJ, et al. Antimycoplasmal activity of some plant species from northern Nigeria compared to the currently used therapeutic agent. Pharmaceut Biol. 2010;48(10):1103–7. https://doi.org/10.3109/13880200903505633

109. Alema NM, Periasamy G, Sibhat GG, Tekulu GH, Hiben MG. Antidiabetic activity of extracts of *Terminalia brownii* Fresen stem bark in mice. J Experiment Pharmacol. 2020;12:61–71. https://doi.org/10.2147/JEP.S240266

110. Kassaw KI, Wondafrash DZ, Yesuf JS, Mengistie MG. Evaluation of the antidiarrheal activity of the 80% hydromethanolic crude extract and solvent fractions of *Terminalia brownii* Fresen (Combretaceae) leaves in Swiss albino mice. Front Pharmacol. 2025;15:1510171. https://doi.org/10.3389/fphar.2024.1510171

111. Mbiri JW, Kasili S, Patrick K, Mbinda W, Piero NM. Anti-inflammatory properties of methanolic bark extracts of *Terminalia brownii* in Wistar albino rats. Int J Current Pharmaceut Res. 2016;8(3):100–4.

112. Sintayehu B, Kakoti BB, Kataki MS, Gebrelibanos M, Periyasamy G, Aynalem A, et al. Hepatoprotective, antioxidant and anticancer activities of *Terminalia brownii* Fresen leaf extract. Ethiop Pharm J. 2017;33:29–38. https://doi.org/10.4314/epj.v33i1.3

113. Abd-Elfattah M, Maina N, Kareru PG, El-Shemy HA. Antioxidant potential of eight selected Kenyan medicinal plants. Egypt J Chem. 2023;66(1):545–53. https://doi.org/10.21608/EJCHEM.2022.127658.5666

114. Waiganjo B, Moriasi G, Onyancha J, Elias N, Muregi F. Antiplasmodial and cytotoxic activities of extracts of selected medicinal plants used to treat malaria in Embu County, Kenya. J Parasitol Res. 2020;2020:8871375. https://doi.org/10.1155/2020/8871375

115. Biruk H, Sentayehu B, Alebachew Y, Tamiru W, Ejigu A, Assefa S. In vivo antimalarial activity of 80% methanol and aqueous bark extracts of *Terminalia brownii* Fresen (Combretaceae) against *Plasmodium berghei* in mice. Biochem Res Int. 2020;2020:9749410. https://doi.org/10.1155/2020/9749410

116. Mbiri WJ, Kasili S, Kisangau DP, Musila NM, Piero NM, Mbinda WM. Antinociceptive properties of methanolic bark extracts of *Terminalia brownii* in Wistar rats. J Pain Relief. 2016;5(5):261. https://doi.org/10.4172/2167-0846.1000261

117. Mbiri JW, Kasili S, Mbinda W, Kisangau PD, Piero NM. Antipyretic properties of methanolic bark extracts of *Terminalia brownii* in Wistar rats (*Rattus novegicus*). J Pharmacogn Nat Prod. 2016;2 (3):121. https://doi.org/10.4172/2472-0992.1000121

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