

Full Length Research Paper

Ethnopharmacology, toxicology and phytochemical composition of *Mondia whitei* (Hook.f.) skeels (Apocynaceae)

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Received 1 April, 2025; Accepted 18 August, 2025.

***Mondia whitei* (Hook.f.) skeels (Apocynaceae) is endemic to Africa, except for its northern part, and demonstrates a wide array of therapeutic properties. This work provides an overview of published findings related to the ethnopharmacological phytochemical properties and toxicological aspects of *M. whitei*. The information was retrieved from databases, including PubMed, PubMed Central, ScienceDirect, and Google Scholar, using search terms related to *M. whitei*'s ethnopharmacology, toxicology, and chemical composition, along with specific plant part designations. *M. whitei* roots, the most used part, have demonstrated androgenic, reversible antispermatogenic, and sperm motility-enhancing effects: antioxidant, antimicrobial, antifungal properties, effects on female reproductive organs, and duration-dependent neurotoxicity. The leaves exhibit antioxidant and antiepileptic activities. The fruit shows protective effects against cadmium-induced hepatic damage, central nervous system depressant effects, and anti-hyperglycemic and antioxidant properties. Seeds have been utilized by some communities. *M. whitei* enjoys widespread application across diverse communities, with the roots being the most employed part. The leaves and fruits are also used, while the seeds are scarcely used.**

Key words: *Mondia whitei*, ethnopharmacology, toxicology, phytochemical composition, plant parts.

INTRODUCTION

Mondia whitei (Hook.f.) skeels is currently categorized under the Apocynaceae family, specifically the Periplocoideae subfamily. It was initially classified as *Chlorocodon*, but this was revised to *Mondia* to resolve a homonym issue with an unrelated plant genus. *Mondia* skeels genus comprises two species, namely *M. whitei* and *Mondia ecorruta* (Ross, 1978; Venter et al., 2009). Despite their comparable external appearance, the two *Mondia* species, *M. whitei* and *M. ecorruta*, are

differentiated by variations in the morphology and count of their corona lobes (Venter et al., 2009). The generic name *Mondia* originates from the Zulu word umondi/mundi, while the specific epithet 'whitei' honors Mr. A. S. White, the collector from Fundisweni, Natal, who sent the plant to the Royal Botanical Gardens, Kew, for scientific classification. *M. whitei* is also commonly referred to as White's ginger or tonic root (Ross, 1978).

M. whitei is identified as a climbing, woody perennial

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that can grow to a height of 3 to 6 m, characterized by its twining stems that release white latex when damaged. It possesses large, heart-shaped leaves arranged in opposite pairs, with a surface covered in soft hairs and distinctive star-shaped stipules (Ross, 1978). *M. whitei* produces visually appealing reddish-purple flowers that grow in branched inflorescences. These flowers are most likely pollinated by insects, especially flies, and have a short lifespan of 3–4 days. The flowering period varies depending on the hemisphere, occurring from October to March (peaking November to January) in the southern hemisphere and from May to August (peaking June to July) in the northern hemisphere (Venter et al., 2009).

The root system of *M. whitei* expands horizontally in the shallow subsurface, allowing for efficient collection due to its wide distribution. The ovoid fruit, a follicle, dehisces to distribute roughly 180 to 320 seeds, each fitted with comae for wind-aided dissemination (Ross, 1978). Excluding northern Africa, *M. whitei* is indigenous to most of the continent. It thrives in humid environments, particularly in various forest and grassland types, from sea level up to 1800 m in altitude (Venter et al., 2009). *M. whitei* has various local names: Angola: “mundondo” or “mudondo”; in the Central African Republic: Cissongo—“mundondo,” “bondo” or “molo busio”; in the Democratic Republic of the Congo: Ngwaka—“nlondo,” “kimbiolongwa” or “kumba,” Lugware—“ubasangbwandiya” or “gatimba,” Tshiluba—“mujimbaye”; Guinea Bissau: Fula—“lacadje”; Malawi: “citumbulo”; South Africa: Zulu—“umondi,” “mundi” or “mind”; Uganda: “sedando omutona”; Zimbabwe: “tonic root” (Venter et al., 2009). *M. whitei* is prevalent in West African nations such as Guinea, Ghana, and Nigeria, while in Central Africa, it is found in Cameroon. In East Africa, its presence is noted in Kenya, Tanzania, and Uganda (McGeoch et al., 2008; Venter et al., 2009). Records indicate that *M. whitei* is found in the Southern African nations of South Africa, Malawi, Angola, Mozambique, and Zimbabwe (Venter et al., 2009).

A thorough review of *M. whitei* is essential because there is a significant disconnect between its extensive traditional use in African communities and the current scattered scientific data. While some studies have explored its specific aspects, such as its purported aphrodisiac properties, a comprehensive picture integrating its ethnopharmacological use, toxicological evaluation, and phytochemical composition across different parts and regions, as well as the full range of these aspects in the various plant parts, is still lacking. This review aims to bridge that gap by synthesizing existing information about the ethnopharmacological, toxicological, and phytochemical composition of the various plant parts of *M. whitei*. A comprehensive synthesis of this information could lead to the development of standardized, evidence-based plant-derived medicines and address unmet medical needs. Ultimately, this work will help integrate *Mondia whitei*

responsibly into modern healthcare.

MATERIALS AND METHODS

This review of *M. whitei* followed a systematic methodology, involving comprehensive searches in major scientific databases, including PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar, as well as specialized sources like African Journals Online (AJOL). The search spanned six months, from September 2024 to February 2025, using search terms that combined “*M. whitei*” with the names of its frequently utilized parts (roots, leaves, fruits, and seeds).

Original research, whether *in vitro* or animal studies, as well as other relevant articles like reviews and ethnobotanical reports that directly addressed *M. whitei*’s phytochemical characteristics, traditional applications, or toxicological status, were included. Studies that were not primary research on *M. whitei* and those without accessible full text were excluded. Conservation and harvesting of *M. whitei* were outside the scope of this review, and articles that solely focused on these topics were also excluded.

This rigorous selection process yielded a total of 34 articles for detailed analysis. Key information, including specific plant parts studied, identified chemical compounds, observed biological effects, documented traditional uses, and reported safety data, was extracted and summarized from the selected papers, providing a holistic overview of *M. whitei*.

Limitations of this process include the exclusion of non-English articles and the lack of quality assessment of the included studies.

RESULTS AND DISCUSSION

The pharmacological activities of *M. whitei* extracts are evident, highlighting its therapeutic potential in a dosage and duration manner. In male reproductive health studies showed the biphasic or dose-dependent effect of *M. whitei* (Watcho et al., 2001, 2004). This suggests a narrow therapeutic window for its application in male fertility, emphasizing the critical need for precise dosage and duration in any future clinical translation. The *in vitro* human sperm studies further corroborate its direct positive influence on sperm function (Lampiao et al., 2008; Tendwa et al., 2024), which could underpin some of the observed *in vivo* pro-fertility effects. The consistent demonstration of antimicrobial activity against various bacterial and fungal pathogens, both *in vitro* (e.g., against *Escherichia coli*, *Staphylococcus aureus*, *Candida albicans*, *Salmonella* Typhi, *Klebsiella pneumoniae*, *Aspergillus niger*, *Aspergillus flavus*, and *Penicillium* species) (Gbadamosi and Aboaba, 2016; Shehu et al., 2022; Woguem et al., 2023; Youassi et al., 2019) and *in vivo* (insecticidal activity against *Acanthoscelides obtectus*) (Woguem et al., 2023), points to its potential as a natural source for combating infections and pests. Furthermore, the antimalarial efficacy was observed in infected mice (Olanlokun et al., 2021), and the estrogenic activity in female rats (Mensah et al., 2015), broaden its pharmacological profile, indicating systemic effects that warrant further investigation. The effect on fictive ejaculation in male rats also adds to its complex

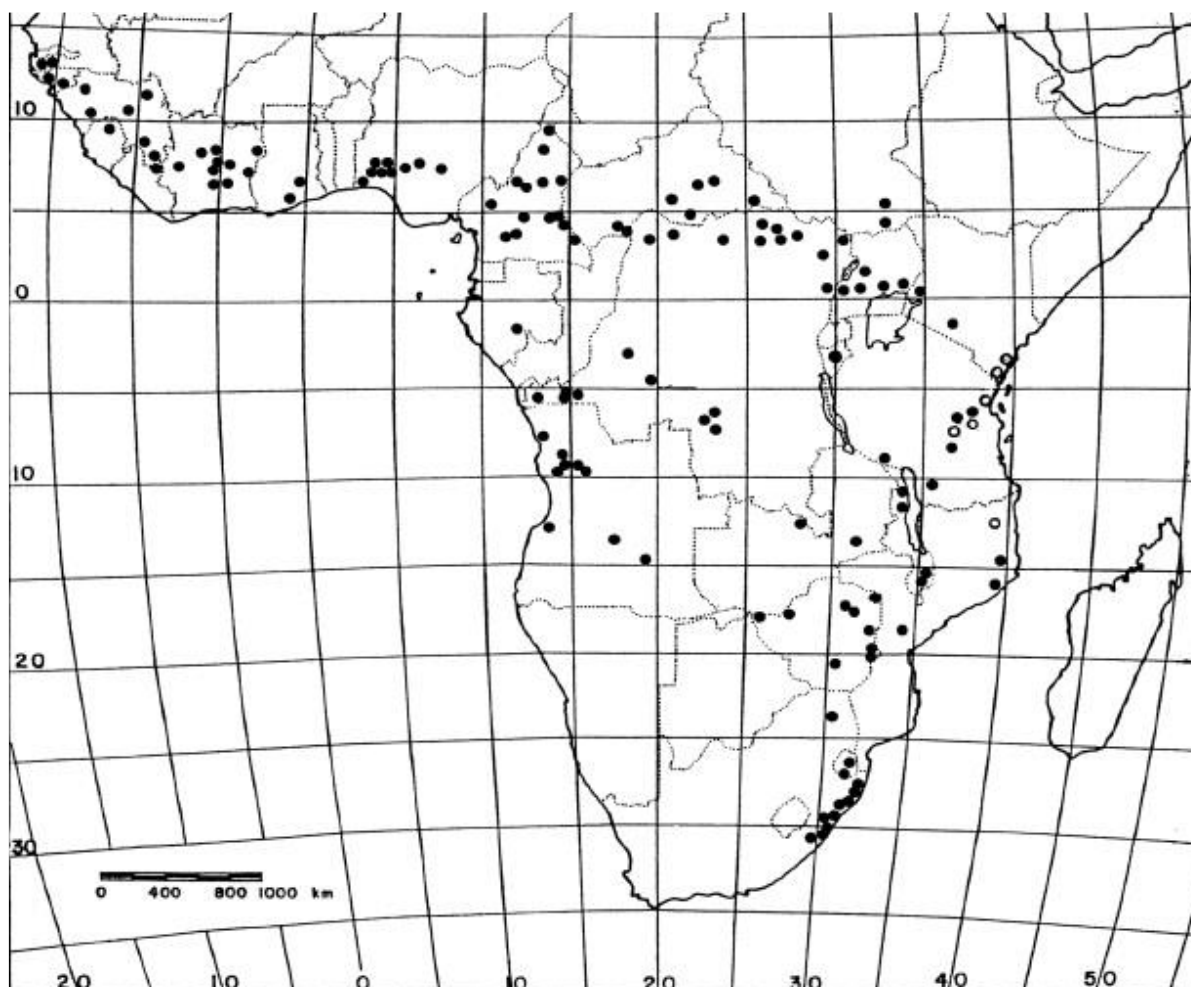


Figure 1. Known distribution of *Mondia ecornuta* and *M. whitei*.
Source: Venter et al. (2009).

effects on the reproductive system (Watcho et al., 2013). The observed changes in organ weights (e.g., seminal vesicle, prostate) (Watcho et al., 2005) and lipid profiles (Mensah et al., 2015) suggest complex physiological interactions that are not yet fully elucidated.

A map of Africa illustrating the known distribution of *Mondia ecornuta* and *M. whitei* was published by Venter et al. (2009) (Figure 1).

M. whitei leaf extracts reveal distinct pharmacological profiles, primarily highlighting their antioxidant and antiepileptic properties (Ahmed et al., 2023; Fred-Jaiyesimi and Ogunjobi, 2013). This finding suggests the potential of *M. whitei* leaves as a natural source of antioxidants, which could have implications for mitigating oxidative stress-related conditions.

M. whitei fruit extracts reveal a distinct set of bioactivities, particularly in neuropharmacology and protective effects against toxicity and oxidative stress (Adewale, 2024; Anadozie et al., 2022; Taiwo et al., 2017). These findings collectively suggest *M. whitei* fruit

as a source of compounds with neuro-sedative, hepatoprotective, and antioxidant properties, warranting further research into the specific active constituents and their mechanisms of action.

The toxicological profile of *M. whitei* presents a complex picture, indicating both potential safety at certain dosages and specific concerns, particularly with prolonged exposure to certain plant parts (Aremu et al., 2011; Dikibo et al., 2012; Mibo'o et al., 2016; Oketch-Rabah, 2012). These contrasting findings emphasize the importance of part-specific and duration-dependent toxicity assessments. While some preparations may exhibit a wide safety margin, a thorough investigation into the specific compounds responsible for these effects and comprehensive safety profiling across all plant parts and extraction methods before any therapeutic applications should be considered.

A table outlining the ethnomedicinal profile of *Mondia whitei* roots, including their effects on testosterone, fertility, sperm function, male reproductive

organs, and their antioxidant, antimicrobial, antimalarial, insecticidal, and antifungal activities, as well as their effects on body and organ weights, was compiled by various researchers (Watcho et al., 2001, 2004, 2005, 2013; Gbadamosi and Erinoso, 2015; Gbadamosi and Aboaba, 2016; Lampiao et al., 2008; Shehu et al., 2022; Tendwa et al., 2024; Olanlokun et al., 2021; Woguem et al., 2023; Mensah et al., 2015; Mabonga et al., 2020; Youassi et al., 2019; Hongbe et al., 2012) (Table 1).

The diverse pharmacological activities attributed to *M. whitei* are underpinned by its rich and varied phytochemical profile, with distinct distributions observed across different plant parts (Gbadamosi and Aboaba, 2016; Gbadamosi and Erinoso, 2015; Koorbanally et al., 2000; Shehu et al., 2022). Specifically, phenolic compounds, flavonoids, and proanthocyanidins are found in significant quantities, particularly in aqueous and ethanolic fractions (Onohuean et al., 2022). A table summarizing the ethnopharmacological profile of *Mondia whitei* leaves, specifically detailing their antioxidant and antiepileptic activities, was compiled by Ahmed et al. (2023) and Fred-Jaiyesimi and Ogunjobi (2013) (Table 2).

While alkaloids are detected in chloroform fractions, steroids and anthraquinones appear to be absent from the leaf extracts examined (Onohuean et al., 2022). Beyond organic compounds, the leaves also contain essential micro- and macronutrients, with their distribution influenced by the extraction solvent. The relatively low moisture content of the plant roots (10.5 g/100 g) (Bouba et al., 2012) also suggests inherent stability, which is beneficial for storage and potential commercial applications. The varying concentrations of phytochemicals and minerals across different fractions underscore the importance of extraction methodology in determining the final chemical profile and, consequently, the biological activity of *M. whitei* extracts.

A table detailing the ethnopharmacological profile of *Mondia whitei* fruit, including its neuropharmacological effects, and its protective effects against cadmium-induced hepatotoxicity and high-sucrose-induced oxidative stress was compiled by Adewale (2024), Anadozie et al. (2022), and Taiwo et al. (2017) (Table 3).

Despite these promising findings, several aspects require deeper exploration. Future research should focus on isolating and characterizing the specific bioactive compounds responsible for each observed effect, conducting rigorous toxicological assessments, and establishing optimal therapeutic doses, with various extraction methods. Also, more information is needed on the seeds' ethnopharmacological properties, toxicological properties, and phytochemical constituents. Moreover, the transition from *in vitro* and animal models to human clinical trials is crucial to validate efficacy, confirm safety, and understand the full therapeutic implications of *M. whitei*. A table outlining the toxicological profile of *Mondia whitei* roots and seeds, including adverse effects on brain tissue and acute and sub-acute toxicity tests, was

compiled by Dikibo et al. (2012), Mibo'o et al. (2016), Aremu et al. (2011), and Oketch-Rabah (2012). (Table 4). A table detailing the phytochemicals of *Mondia whitei* roots was compiled by Abdou Bouba et al. (2012), Gbadamosi & Aboaba (2016), Gbadamosi & Erinoso (2015), Koorbanally et al. (2000), and Shehu et al. (2022). The table identifies the presence of various compounds, including saponins, tannins, flavonoids, alkaloids, and terpenes, and reports specific compounds identified through GC-MS analysis, such as (E)-2-hexen-1-ol, heptacosane, n-hexadecanoic acid, and isovanillin (Table 5).

A table detailing the phytochemicals of *Mondia whitei* leaves, including the presence of tannins, saponins, flavonoids, and resins, as well as various macro- and micronutrients, was compiled by Fred-Jaiyesimi & Ogunjobi (2013) and Onohuean et al. (2022). The table also outlines the quantitative analysis of these compounds across different extraction fractions (Table 6).

A table outlining the phytochemicals of *Mondia whitei* fruit, including proximate composition, vitamin and mineral content, and the presence of various bioactive compounds such as flavonoids, tannins, and saponins, was compiled by Amaechi and Egesi (2018), Egesi (2018), and Chinonyerem & Maryjane (2017). The table also identifies specific compounds, like glyceryl monoleate (GMO), glycerol monostearate (GMS), and oleoyl chloride, as determined by GC-MS analysis (Table 7).

Conclusion

Secondary metabolites with pharmaceutical significance are abundant in medicinal plant species. In addition to being affordable and efficient, their safety is a benefit of their therapeutic applications in a variety of illnesses, as well as their accessibility. This concise review aimed to summarize and showcase recent scientific and medical findings regarding the diverse employment of *M. whitei* in traditional therapies. Concerning this plant's chemical make-up, it includes a variety of secondary metabolites and minerals that may contribute to the various documented medicinal effects. *M. whitei* may, therefore, be considered for the creation of novel plant-derived aphrodisiac medications for human health and wellness, as well as wound-healing medications. The roots of *M. whitei* are chewed or decanted with water and have been used extensively among various communities for various purposes, the main being used as an aphrodisiac. Many studies on the roots proved their purpose, and other studies evaluated their safety and their effects on organ weights and the female reproductive system. The leaves are mainly used in some communities as spices to add flavor to food. As indicated in this review, it has been shown to have some bioactive compounds, which may be responsible for antioxidant activity and antiepileptic

Table 1. Ethnopharmacological profile of *M. whitei* roots.

Pharmacological activity/observed biological effect	Study design	Reference
Effects on testosterone production and fertility	<i>In vivo</i> , an animal study with male adult Wistar rats. The treated group received a single dose of 400 mg/kg of <i>M. whitei</i> root extract (Acute treatment). Chronic study treated groups received 400 mg/kg on days 1, 2, 4, and 8.	Watcho et al. (2004)
Reversible antispermatogenic and antifertility activity	<i>In vivo</i> animal study with long-term administration of <i>M. whitei</i> root bark extract of 400 mg/kg/day for 55 days.	Watcho et al. (2001)
Effects on human sperm function	<i>In vitro</i> study with human sperm samples from both healthy (30) and infertile (30) donors. Samples were prepared with human tubular fluid medium with increasing concentrations of 0.0185, 0.185, 1.85, 18.5, and 185 µg/ml of aqueous rhizome extract and then incubated for 1 h at 37° Celsius.	Tendwa et al. (2024)
Effect on male reproductive organs	<i>In vivo</i> animal study on adult male Wistar rats. Chronic administration of 500 and 1000 mg/kg b.w. of hexane extracts of dried roots for 30 days.	Watcho et al. (2005)
Antioxidant activity	<i>In vitro</i> study, antioxidant activity was determined by the 2, 2-diphenyl-1-picryl hydrazyl (DPPH) assay. 0.2 mL of the methanolic extract of the leaves and roots was used.	Gbadamosi and Erinoso (2015)
Antimicrobial activity	<i>In vitro</i> study using oil extracted from <i>M. whitei</i> roots tested for its antimicrobial activity against nine clinical pathogens, including <i>Bacillus cereus</i> , <i>E. coli</i> , <i>C. albicans</i> , <i>K. pneumoniae</i> , <i>P. aeruginosa</i> , <i>Proteus mirabilis</i> , <i>Salmonella typhi</i> , <i>S. aureus</i> , and <i>Streptococcus pyogenes</i> . Agar well diffusion method was used, with 50 µL of the oil.	Gbadamosi and Aboaba (2016)
Antimicrobial activity	<i>In vitro</i> study of the antimicrobial activity of the chloroform extracts of <i>M. whitei</i> roots, using the paper disc diffusion method. Five bacterial strains were used: <i>E. coli</i> , <i>K. pneumoniae</i> , <i>Salmonella typhi</i> , <i>P. aeruginosa</i> , and <i>S. aureus</i> . Concentrations of 50, 100, 200, and 400 mg/ml of the extract were used. These were compared with the antimicrobial activity of the standard drug, ciprofloxacin (5 µg/ mL).	Shehu et al. (2022)
Effects on human sperm motility	<i>In vitro</i> study using human sperm samples, using aqueous extracts of <i>Mondia whitei</i> roots.	Lampiao et al. (2008)
Effects on fictive ejaculation in male rats	<i>In vivo</i> study using spinal rats. The aqueous and hexane extracts of <i>M. whitei</i> 20mg/kg were injected together with saline (0.1 ml/100g) and dopamine (0.1µM/kg).	Watcho et al. (2013)
Antimalarial activity	<i>In vitro</i> study using <i>M. whitei</i> root extracts obtained through methanol extraction and subsequent fractionation. Male Swiss mice infected with <i>Plasmodium berghei</i> were used. A dose of 400 mg/kg of <i>M. whitei</i> root extract was used.	Olanlokun et al. (2021)
Insecticidal activity against <i>Acanthoscelides obtectus</i>	<i>In vivo</i> study against <i>Acanthoscelides obtectus</i> . The oil was extracted from the roots by hydro-distillation with a yield of 1.5%.	Woguem et al. (2023)
Antifungal activity	<i>In vitro</i> study using oil extracted from the roots by hydro-distillation with a yield of 1.5%.	Woguem et al. (2023)
Estrogenic activity and anti-hyperglycemic activity	<i>In vitro</i> study using Chick oviduct Uterotrophic assay and estrous cyclicity assay. An ethanolic extract of the dried roots of <i>Mondia whitei</i> was used. A dose of (30-300) mg/kg of the extract was used. Female adult Sprague-Dawley rats were used.	Mensah et al. (2015)

Table 1. Cont'd

Testicular tissue changes in male rats	<i>In vivo</i> study using male albino rats (n=30). Chronic administration of the aqueous root extracts of <i>Mondia whitei</i> for 30 days. The concentrations used were 100, 200, and 400 mg/kg b.w.	Mabonga et al. (2020)
Antifungal activity	Essential oil of the roots of <i>M. whitei</i> was extracted by hydro-distillation and was tested against <i>Aspergillus flavus</i> and <i>Penicillium</i> species. The antifungal activity on mycelia growth was done using the agar incorporation method. Varying concentrations of the extract of 100 to 600 µl/l were used.	Youassi et al. (2019)
Effect on body and organ weights	<i>In vivo</i> study, <i>M. whitei</i> was administered at graded levels (4.5, 9.0, and 13.5g) in feed rations for 3 weeks. Male adult Wistar rats were used (n=16).	(Hongbe et al. (2012)

Table 2. Ethnopharmacological profile of *M. whitei* leaves.

Pharmacological activity/ Observed biological effect	Study design	Reference
Antioxidant activity	Different extracts were prepared from <i>M. whitei</i> leaves for analysis. These included a methanol extract, a combination of water and methanol, an ethyl acetate extract, and a water extract. The antioxidant capabilities of all the extracts were determined using several standard laboratory tests. These <i>in vitro</i> assays included methods such as FRAP (Ferric reducing antioxidant power), DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS [2,2'-Azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid)], CUPRAC (cupric reducing antioxidant capacity), PBD (phosphomolybdenum), and MCA (metal chelating ability).	(Ahmed et al., 2023; Fred-Jaiyesimi and Ogunjobi, 2013)
Antiepileptic activity	<i>In vivo</i> study, methanol extract, ethyl acetate, and hexane fractions of <i>Mondia whitei</i> dried leaves were used in the Pilocarpine-induced seizure model. Wistar albino rats (200-220g) were used. The rats in the study (with 5 animals per group) first received either the experimental treatment or a standard reference drug. Then, thirty minutes later, each rat was given a 400 mg/kg dose of pilocarpine via intraperitoneal injection.	Fred-Jaiyesimi and Ogunjobi (2013)

Table 3. Ethnopharmacological profile of *M. whitei* fruit.

Pharmacological activity/ Observed biological effect	Study design	Reference
Neuropharmacological effect	<i>In vivo</i> study using fresh fruit ethanol extracts of <i>M. whitei</i> . The extract was subjected to sedative and anxiolytic assays. Swiss albino mice (18 to 25 g) were used. Graded doses of 100, 200 and 300 mg/kg i.p. were used.	Taiwo et al. (2017)
Protective effect against cadmium-induced hepatotoxicity	In this study, 25 Wistar rats were divided into five groups to investigate the protective effects of silymarin and <i>M. whitei</i> fruit extract against cadmium toxicity. One group served as a control. The remaining four groups were exposed to cadmium chloride for five days. Among these, one group received only cadmium, while the others were concurrently treated for seven days with either silymarin or different doses (250 or 500 mg/kg) of the <i>M. whitei</i> aqueous dried fruit extract.	Anadozie et al. (2022)

Table 3. Cont'd

Effects on high-sucrose induced oxidative stress	<i>M. whitei</i> aqueous fruit extract (AEMW), administered at 0.25 and 0.5 mg/g diet for seven days in <i>Drosophila melanogaster</i> .	Adewale (2024)
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Table 4. Toxicological profile of *Mondia whitei* roots and seeds.

Toxicological profile	Study design	Reference
Adverse effect on brain tissue.	The roots of <i>M. whitei</i> were blended into fine powder and administered together with feed to male adult Wistar rats for 3 weeks.	Dikibo et al. (2012)
Acute and sub-acute toxicity tests.	Dried roots of <i>M. whitei</i> were ground into fine powder, and then macerated in deionised water to make a soft drink. Acute and sub-acute testing was evaluated in rats according to OECD guidelines 423 and 407 techniques.	Mibo'o et al. (2016)
Toxicological reports of <i>M. whitei</i> seeds.	Review articles.	Aremu et al. (2011) and Oketch-Rabah (2012)

Table 5. Phytochemicals of *M. whitei* roots.

Phytochemicals/ Bioactive compounds	Tests applied	Reference
Chemical analysis revealed that <i>M. whitei</i> roots had a higher concentration of saponins and tannins compared to the leaves, which were richer in flavonoids.	The powdered forms of the leaf and root were analyzed to identify the presence of specific compounds, including alkaloids, flavonoids, polyphenols, saponins, and tannins, using established laboratory procedures.	Gbadamosi and Erinoso (2015)
The presence of twenty-eight distinct compounds in the <i>M. whitei</i> root essential oil, comprising 99.92% of the oil's composition. The main compounds detected were (E)-2-hexen-1-ol (25.96%), heptacosane (20.94%), phytol (15.60%), 1-hexanol (8.94%), (E)-2-hexenal (4.29%), and 2-hydroxy-p-anisaldehyde (4.21%).	The make-up of the essential oils was identified using gas chromatography-mass spectrometry (GC/MS). This analysis was performed with an Agilent 7890N GC system connected to an Agilent mass detector, Triple Quad 7000A. The detector operated in EI mode at 70 eV, scanning a mass-to-charge ratio range of 40 to 600 atomic mass units (amu), and the data was managed by an Agilent Chem Station data system.	Gbadamosi and Aboaba (2016)
Analysis of the extract was found to contain various phytochemicals, including compounds such as steroids, phlobatannins, flavonoids, terpenoids, cardiac glycosides, and phytosterols. Gas chromatography-mass spectrometry (GC-MS) analysis identified seventeen compounds, with n-hexadecanoic acid being the most abundant (23.80%).	The preliminary phytochemical analysis of the chloroform fraction was conducted using the methodology detailed by Jones and Kinghorn in 2006. The chloroform extract derived from <i>M. whitei</i> root underwent analysis using a GC-MS-QP2010 Plus Shimadzu, Japan system to determine its composition via gas chromatography-mass spectrometry.	Shehu et al. (2022)

Table 5. Cont'd

Extraction of <i>M. whitei</i> (Hook.f.) Skeels with methylene chloride resulted in the isolation of 2-hydroxy-4-methoxybenzaldehyde and 3-hydroxy-4-methoxybenzaldehyde (isovanillin). The chemical structures were confirmed through ¹ H NMR spectral comparison. While 2-hydroxy-4-methoxybenzaldehyde was previously known in <i>M. whitei</i> , isovanillin was identified as previously unreported in this plant species.	Extraction of <i>M. whitei</i> roots was done with 1 L of methylene chloride. The crude extract was chromatographed using column chromatography with silica gel (Merck 1.9385) as the stationary phase and a hexane: ethyl acetate step gradient (9:1, 8:2, 7:3, 6:4) as the mobile phase.	Koorbanally et al. (2000)
Moisture levels of 10.5 g/100 g in <i>M. whitei</i> .	The plant was analyzed for its crude protein, non-protein nitrogen, ash, and moisture content. These measurements were performed following the established procedures outlined in the AOAC (Association of Official Analytical Chemists) methods.	Abdou Bouba et al. (2012)

Table 6. Phytochemicals of *M. whitei* leaves.

Phytochemicals/ Bioactive compounds	Tests applied	Reference
Analysis of <i>M. whitei</i> leaves revealed the existence of tannins, saponins, flavonoids, and resins.	Standardized methods were employed for both the phytochemical analysis and fluorescence screening.	Fred-Jaiyesimi and Ogunjobi (2013)
The occurrence of micro and macronutrients in <i>M. whitei</i> leaves varied depending on the extraction method. Copper, sodium, potassium, iron, and nickel were most abundant in the ethanolic fraction, whereas magnesium, zinc, and manganese were highest in the aqueous fraction.	The aqueous, ethanol, and chloroform fractions of <i>M. whitei</i> leaf extract for important macro and micronutrients. An atomic absorption spectrophotometer was used for general elemental detection following AOAC 2000 protocols, while a flame photometer specifically measured sodium and potassium levels.	Onohuean et al. (2022)
<i>M. whitei</i> leaf (MWL) extracts, including aqueous, ethanolic, and chloroform fractions, contained phenolic compounds, flavonoids, tannins, triterpenoids, reducing sugars, and cardiac glycosides. Saponins and terpenoids were found in aqueous and ethanolic fractions, and alkaloids were present within chloroform-separated components. No steroids or anthraquinones were found in any of the fractions. Quantitatively, the aqueous fraction had the highest phenol content, while the ethanolic fraction had the highest proanthocyanidin, flavonoid, and flavanol content.	The levels of various phytochemicals, including phenolic compounds, flavonoids, saponins, tannins, steroids, alkaloids, anthraquinones, terpenoids, triterpenoids, reducing sugars, and cardiac glycosides, were determined using established analytical methods from literature, specifically those described by Sofowora, Trease and Evans, and Harborne.	Onohuean et al. (2022)

consumed in some communities in West Africa. Studies have shown that it has both nutritional

value and bioactive molecules responsible for depression of the central nervous system and

antihyperglycemic properties. There is a significant scarcity of published data on the pharmacological,

Table 7. Phytochemicals of *M. whitei* fruit.

Phytochemicals/Bioactive compounds	Tests applied	Reference
Analysis using the fresh weight of the <i>M. whitei</i> fruit as a basis showed a high-water content of 88.20%. The fruit's ash content was low; it contains little fat and contributes some fiber. The fruit's carbohydrate content is also low.	The proximate composition of <i>M. whitei</i> fruit pulp using established analytical methods. Crude protein was measured via the micro-Kjeldahl method. Ash content was analyzed using a muffle furnace at 550°C through gravimetric incineration, while fat was determined by gravimetric solvent extraction. The Weende method was employed for crude fiber analysis and moisture content was found by drying the pulverized pulp in an oven at 65°C until a constant weight was achieved. Finally, total sugar in the fruit pulp was quantified colorimetrically using the anthrone method.	Chinonyerem and Maryjane (2017)
<i>M. whitei</i> fruit, on a fresh weight basis, was found to contain vitamin C, thiamine, riboflavin, niacin, vitamin A, and vitamin E.	Vitamins A, C, E, B1, B2, and niacin were determined by established methods. All vitamins, except Vitamin C, were quantified using a UV-spectrophotometer.	Chinonyerem and Maryjane (2017)
<i>M. whitei</i> fruit was found to contain the minerals magnesium, potassium, sodium, phosphorus, zinc, and iron. Phytochemical analysis of <i>M. whitei</i> fruit revealed the presence of flavonoids, tannins, phenols, phytates, carotenoids, oxalates, saponins, hydrogen cyanide, and alkaloids.	The minerals were analyzed and quantified using a dry ash extraction method. Phytochemicals were determined using established methods.	Chinonyerem and Maryjane (2017)
Analysis of <i>M. whitei</i> fruit pulp showed a total of 21 compounds were found in the dichloromethane/methanol extract, and 28 were found in the methanol extract. The dichloromethane/methanol extract was characterized by high levels of glyceryl monoleate (GMO) and glycerol monostearate (GMS), whereas the methanol extract contained 3-O-methyl-D-glucose (26.10%), α1, β2, α3, β5-cyclohexenetetrol (10.70%), and oleoyl chloride (29.62%) as the major compounds	Two distinct extracts were prepared from the <i>M. whitei</i> fruit pulp: a methanol extract and a dichloromethane/methanol extract. Gas Chromatography-Mass Spectrometry (GC-MS) system (Shimadzu, Japan, Model QP 2010 series). This system featured an Optima 5 ms fused capillary column measuring 30 mm in length, 0.25 mm in diameter, with a 0.25 μm film thickness. Helium (99.99%) served as the carrier gas for the analysis.	Amaechi and Egesi (2018); Egesi, 2018; Chinonyerem & Maryjane, 2017)

toxicological, and phytochemical profiles of *M. whitei* seeds.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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