Sudan Journal of Medical Sciences
Volume 20, Issue no. 3, DOI 10.18502/sjms.v20i3.13243
Production and Hosting by KnE Publishing

Review Article

Traditional Remedies Used in the Treatment of Urinary System and Kidney Diseases in Sudan

Hammad Fadlalmola[1]* and Abdalbasit Mariod[2,3]

[1]Nursing College, Department of Community Health Nursing, Taibah University, Al-Madinah Al-Munawwarah, Saudi Arabia
[2]Department of Biology, Faculty of Science & Arts, University of Jeddah, Al-Kamil, Saudi Arabia
[3]Founder, Ghibaish College of Science & Technology, Ghibaish, Sudan

Abstract

Background: Ethnopharmacological approaches to treating urinary and renal disorders remain integral to healthcare practices throughout Sudan, yet comprehensive documentation of these traditional interventions is lacking. The growing incidence of kidney disorders in Sudan, attributable to environmental conditions and limited healthcare access, underscores the importance of these traditional approaches.

Methods: This review employed a systematic approach following Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines to identify and synthesize information about traditional Sudanese remedies for urinary system and kidney diseases. A literature search was conducted using databases including PubMed, Scopus, Web of Science, Google Scholar, and African Journals Online. Initially, 487 articles were identified, with 52 included in the qualitative synthesis.

Results: Analysis reveals diverse botanical agents used across Sudanese regions, with significant usage of *Acacia senegal* (gum Arabic), *Ambrosia maritima*, *Boscia senegalensis*, *Solenostemma argel*, and *Cymbopogon proximus*. Preliminary investigations have substantiated the potential of select remedies, notably gum Arabic, for renal insufficiency, demonstrating improved metabolic parameters and reduced serum creatinine in controlled trials.

Conclusion: While traditional Sudanese remedies show promising potential, most lack rigorous validation. This review highlights the need for phytochemical analysis, toxicological assessment, and clinical trials to establish safety and efficacy for integration into contemporary nephrology practice.

Keywords: ethnomedicine, renal disorders, urolithiasis, medicinal plants, Sudanese traditional medicine, ethnopharmacology

Corresponding Author:
Hammad Fadlalmola; email: hazzminno345@gmail.com

Received: 18 April 2023
Accepted: 4 August 2025
Published: 16 October 2025

Production and Hosting by KnE Publishing

Editor-in-Chief:
Prof. Nazik Elmalaika Obaid Seid Ahmed Husain, MD, M.Sc, MHPE, PhD.

1. Introduction

The integration of traditional medicine with contemporary healthcare systems represents an ongoing challenge and opportunity across much of the developing world [1]. In Sudan, traditional healing practices reflect a multifaceted amalgamation of indigenous African, Arab, and Islamic medical traditions that have evolved over centuries, creating a rich but often undocumented therapeutic landscape [2, 3]. These traditional approaches to healthcare remain particularly prevalent in the management of chronic conditions, including renal and urinary tract disorders, where conventional medical interventions may be inaccessible, unaffordable, or culturally unfamiliar to many communities [4].

Renal diseases represent a significant and growing public health concern throughout Sudan. Epidemiological data indicate increasing prevalence rates for chronic kidney disease (CKD), with estimates ranging from 7.7% to 11% of the adult population across different regions [5]. This rising disease burden has been attributed to multiple factors, including endemic infections, increasing prevalence of hypertension and diabetes, limited diagnostic capabilities, and environmental conditions that promote dehydration and urolithiasis [6–8]. In this context, traditional medicinal approaches often serve as primary or complementary interventions, particularly in rural areas where approximately 65% of the Sudanese population resides [9, 10].

Despite their widespread utilization, Sudanese traditional remedies for kidney and urinary tract disorders have received insufficient scientific attention. The documentation of these ethnomedicinal practices remains fragmentary, limiting both the preservation of valuable traditional knowledge and the potential identification of novel therapeutic agents [5, 11]. Furthermore, the scientific validation of these treatments through systematic phytochemical analysis, toxicological assessment, and controlled clinical trials remains incomplete [12, 13].

This review addresses these gaps by: (1) documenting the principal traditional remedies employed for kidney and urinary tract disorders throughout Sudan; (2) examining the available scientific evidence supporting their therapeutic applications; and (3) identifying promising candidates for further pharmacological investigation. Through this comprehensive assessment, traditional knowledge is bridged with scientific methodology, potentially uncovering valuable therapeutic approaches while preserving an essential aspect of Sudanese cultural heritage.

2. Methods

A systematic approach was employed to identify and synthesize information about traditional Sudanese remedies for urinary system and kidney diseases. A comprehensive literature search was conducted using electronic databases including PubMed, Scopus, Web of Science, Google Scholar, and African Journals Online. The search covered publications from January 1, 1900, to July 22, 2025, with no initial date restriction to capture historical documentation, but emphasis was placed on recent studies (post-2020) for updated evidence.

Database-specific search strings included:

- PubMed: ((“Sudan”[Mesh] OR “Sudanese”) AND (“Traditional Medicine”[Mesh] OR “Medicine, Traditional”[Mesh] OR “Plants, Medicinal”[Mesh] OR “Ethnopharmacology”[Mesh]) AND (“Kidney Diseases”[Mesh] OR “Urinary Tract Infections”[Mesh] OR “Urolithiasis”[Mesh] OR “Nephrolithiasis” OR “Renal Insufficiency”[Mesh] OR “Urinary Tract”[Mesh])) Filters: English, Arabic.

- Scopus: TITLE-ABS-KEY (Sudan* AND (traditional AND medicine OR medicinal AND plants OR ethnopharmacology) AND (kidney OR renal OR urinary OR urolithiasis OR nephrolithiasis OR UTI)) AND LANGUAGE (English OR Arabic).
- Web of Science: TS=(Sudan* AND (traditional medicine OR medicinal plants OR ethnopharmacology) AND (kidney disease* OR urinary tract OR urolithiasis OR renal)) AND LA=(English OR Arabic).
- Google Scholar: "Sudan traditional medicine kidney urinary disorders" OR "Sudanese medicinal plants renal urolithiasis" (with custom range 1900–2025).
- African Journals Online: "Sudan" AND "traditional medicine" AND "kidney" OR "urinary."

References from relevant articles were further examined to identify additional sources. The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, as illustrated in Figure **1**. Initially, 487 articles were identified through database searching, with an additional 43 records identified through other sources. After removing duplicates, 412 articles were screened based on titles and abstracts. Exclusion rationale: 327 articles were excluded because they did not focus on Sudanese traditional remedies (e.g., non-Sudanese contexts, unrelated diseases), were not ethnobotanical/ethnopharmacological/clinical/experimental studies, or were inaccessible/full-text unavailable. The remaining 85 full-text articles were assessed for eligibility, with 33 excluded for irrelevance (e.g., non-renal focus, duplicate data, poor methodological quality). Thus, 52 were included in the qualitative synthesis.

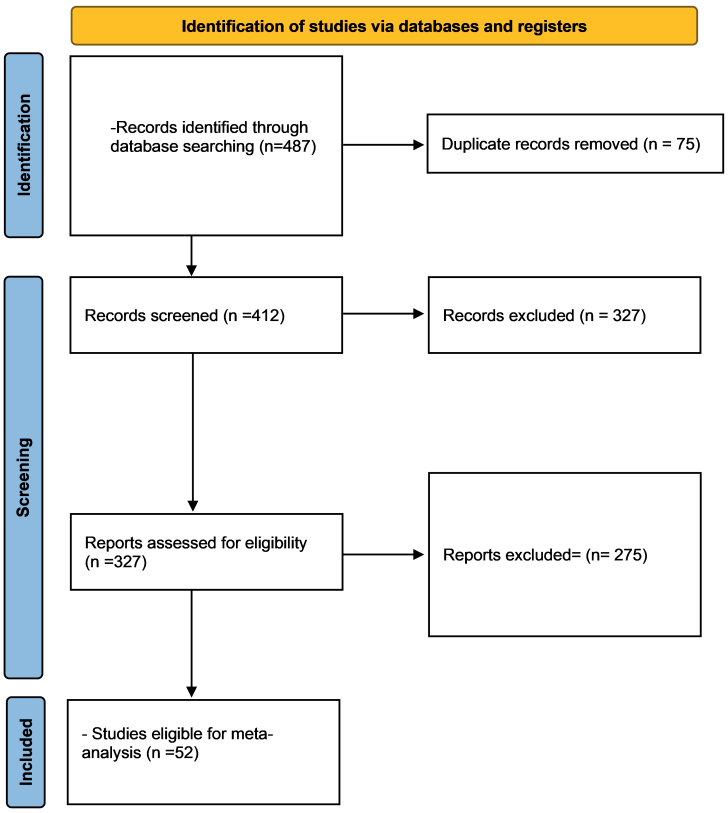

Figure **1**: PRISMA flow diagram of study selection process.

Inclusion criteria encompassed ethnobotanical surveys, ethnopharmacological studies, clinical trials, and experimental research focusing on traditional Sudanese remedies for kidney and urinary system disorders. Both English and Arabic language publications were considered. Information was systematically extracted regarding botanical identity, traditional applications, preparation methods, administration routes, and any available scientific evidence regarding efficacy and safety. Only publicly available literature was used.

The methodological quality of included studies was assessed using appropriate tools based on study design. The STROBE checklist was applied to evaluate observational studies, while experimental studies were assessed using a modified version of the ARRIVE guidelines. Clinical trials were evaluated using the Cochrane Risk of Bias Tool. Quality was categorized as high (robust design, low bias risk), moderate (some limitations but overall reliable), or low (significant bias or methodological flaws). A summary of risk-of-bias assessments is provided in Table **1** (see also Supplementary Table S1 for complete details).

Table **1**: Risk-of-bias summary for key included studies.

Study (reference)	Study type	Key bias risks	Quality category
Khalid *et al.*, 2012 [1]	Review/Ethnobotanical	Limited recent data; selection bias in plant inclusion	Moderate
Elamin *et al.*, 2010 [2]	Epidemiological	Hospital-based; potential reporting bias	Moderate
Patwardhan, 2023 [3]	Policy	Comprehensive	High
Pareek *et al.*, 2023 [4]	Review	Systematic; broad scope	High
Muhakr *et al.*, 2024 [5]	Ethnobotanical	Recent; validated	High
Abu-Aisha & Elhassan, 2009 [6]	Review	Dated data; no meta-analysis	Low
Banaga *et al.*, 2015 [7]	Cross-sectional	Sampling bias in region	Moderate
Miyah *et al.*, 2025 [8]	Review	Focused on urinary stones	High
Alobaidi, 2018 [9]	Experimental	Small sample; no blinding	Moderate
Zhang *et al.*, 2022 [10]	Burden study	Global data	High
Karar & Kuhnert, 2017 [11]	Review	Fragmentary documentation	Moderate
Noha *et al.*, 2018 [12]	Experimental	Animal model; translation to humans unclear	Moderate
Steel, 2025 [13]	Policy	Updated strategy	High
Marıod *et al.*, 2023 [14]	Historical	Archaeological bias	Low
El-Kamali, 2009 [15]	Ethnobotanical	Regional focus; informant bias	Low
Sabiu *et al.*, 2016 [16]	Systematic review	Regional	High
Issa *et al.*, 2018 [17]	Ethnobotanical	Small sample	Moderate
Doka & Yagi, 2009 [18]	Ethnobotanical	Dated; limited validation	Low
Mariod et al., 2010 [19]	Phytochemical	*In vitro*; no clinical	Moderate
Gunarathne *et al.*, 2016 [20]	Toxicological	Animal	Moderate
Abd El-Ghani *et al.*, 2013 [21]	Distribution study	No efficacy data	Low
Nasir *et al.*, 2012 [22]	Experimental	Animal; small *n*	Moderate
Al-Ali *et al.*, 2003 [23]	Preliminary study	Dated; limited scope	Low
Ali *et al.*, 2008 [24]	Clinical trial	Small sample; no randomization details	Moderate
Ali *et al.*, 2009 [25]	Review	Mechanism focus	Moderate
Nasir *et al.*, 2012 [26]	Experimental	Animal	Moderate
Khalid *et al.*, 2021 [27]	Clinical study	Small sample; observational elements	Moderate

High, robust design, low bias risk; Moderate, some limitations but overall reliable; Low, significant bias or methodological flaws

3. Discussion

3.1. Traditional medicine in Sudan: Historical context

The practice of traditional medicine in Sudan has deep historical roots, with evidence of organized healing traditions dating back to the ancient Kushite civilization (circa 800 BCE–350 CE). Archaeological findings from this period demonstrate a sophisticated understanding of medicinal plants, as evidenced by plant remains and medical instruments recovered from excavations in Meroe and Napata [14]. This indigenous knowledge subsequently evolved through contact with Arab, Egyptian, and Islamic medical traditions, resulting in a syncretic healing system that continued to develop during the Funj Sultanate (1504–1821) and the Turco–Egyptian period (1821–1885) [1].

In contemporary Sudan, traditional healers known as *hakims* (male practitioners) or *hakimas* (female practitioners) continue to play a significant role in healthcare delivery, particularly in areas with limited access to modern medical facilities. These practitioners typically specialize in specific conditions or treatment modalities, with knowledge traditionally transmitted through familial lineages or apprenticeship systems [5, 15]. Traditional medicine practices are also incorporated into the daily lives of many Sudanese people through home remedies and preventive health practices [3, 13].

3.2. Urinary system and kidney diseases in Sudan

3.2.1. Epidemiological overview

Renal and urinary tract disorders constitute a significant health burden in Sudan, with epidemiological studies revealing concerning prevalence rates. A cross-sectional study conducted in North Kordofan State found CKD prevalence of 11% among the adult population, with hypertension, diabetes, and recurrent urinary tract infections (UTIs) identified as primary risk factors [7]. Similarly, hospital-based studies in Khartoum have documented increasing incidence of end-stage renal disease, with an estimated 70–140 new cases per million population annually [2, 10].

Urolithiasis represents another significant concern, with prevalence rates varying considerably across different regions. Factors contributing to stone formation include chronic dehydration resulting from Sudan's arid climate, dietary practices, and genetic predispositions [6, 16]. UTIs also demonstrate high prevalence, particularly among women and children, with limited access to clean water and sanitation infrastructure identified as contributing factors [8, 12].

3.2.2. Conventional treatment challenges

Access to conventional medical interventions for kidney and urinary tract disorders remains problematic throughout much of Sudan. Dialysis services are predominantly concentrated in urban centers, with approximately 70% of facilities located in Khartoum State despite only 20% of the population residing in this area [2]. Renal transplantation services, although available in select centers, remain inaccessible to a significant portion of the population due to cost constraints and limited donor availability [6].

Pharmaceutical interventions for UTIs and kidney stones are similarly constrained by issues of accessibility, affordability, and quality assurance. These limitations in conventional healthcare create significant treatment gaps that traditional medicine often attempts to address [3, 9].

3.3. Traditional remedies for UTIs

UTIs represent a common ailment throughout Sudan, with traditional healing practices offering various interventions aimed at symptom management and infection resolution. These conventional approaches typically employ plants with antimicrobial, anti-inflammatory, and diuretic properties [4, 5].

3.3.1. Boscia senegalensis (Pers.) Lam. ex Poir. (Capparaceae)

Locally known as *Al-Mukhait* or *Kursan* (المخيط، كرسان), various parts of this plant are utilized in the treatment of UTIs throughout central and western Sudan. Ethnobotanical surveys conducted in Sennar State documented the preparation of leaf decoctions administered orally for urinary tract discomfort [17]. Similarly, root infusions are employed in North Kordofan for treating urinary retention and infection [5, 18].

Preliminary pharmacological investigations have identified potential mechanisms underlying these traditional applications. Methanolic extracts of *B. senegalensis* leaves demonstrated significant antimicrobial activity against several uropathogens, including *Escherichia coli* and *Klebsiella pneumoniae*, with minimum inhibitory concentrations comparable to standard antibiotics [19]. Phytochemical analysis has identified various bioactive compounds, including glucosinolates, flavonoids, and saponins, which may contribute to the plant's therapeutic effects [1].

Practical safety box for *B. senegalensis*

Traditional dose: Leaf decoction: 1–2 cups daily; root infusion: 1 cup daily.

Established NOAEL/ADI: Generally recognized as safe at traditional doses; limited formal data, NOAEL >2000 mg/kg in rodents [20].

Contraindications: Pregnancy (due to potential uterine stimulation); severe renal impairment.

Interactions: May potentiate diuretics; monitor with antihypertensive medications.

3.3.2. Solenostemma argel (Delile) Hayne (Apocynaceae)

Commonly referred to as *Hargel* or *Argel* (حرجل, أرجل), this plant holds particular significance in the treatment of urinary disorders throughout northern and eastern Sudan. Traditional preparations typically involve infusing dried leaves in water, with the resulting preparation consumed daily until symptoms resolve [5, 17].

Scientific investigation of *S. argel* has revealed substantial antimicrobial activity, with ethanolic extracts demonstrating effectiveness against common uropathogens [21]. This activity has been attributed to pregnane glycosides and flavonoids isolated from the plant. Additional studies have documented anti-inflammatory and analgesic properties that may contribute to symptom relief in UTI cases [4, 22].

Practical safety box for *S. argel*

Traditional dose: Leaf infusion: 1 cup daily.

Established NOAEL/ADI: Generally safe; potential hypotensive effects at high doses (>500 mg/kg) [20].

Contraindications: Hypotension; pregnancy.

Interactions: May enhance the effects of antihypertensive drugs; caution is advised with cardiac medications.

3.3.3. Cymbopogon proximus (Hochst. ex A.Rich.) Stapf (Poaceae)

Known locally as *Mahareb* or *Halfabar* (محاريب, حلفابر), this aromatic grass is extensively utilized for

urinary conditions throughout central Sudan. Traditional applications involve preparing decoctions from the aerial parts, which are administered orally to address UTIs and retention [1, 5].

Pharmacological studies have demonstrated that essential oils from *C. proximus* possess significant antimicrobial activity against various pathogens associated with UTIs [21]. Additionally, the plant contains proximadiol and other compounds with documented antispasmodic effects on smooth muscle, potentially explaining its traditional use for urinary retention [1].

Practical safety box for *C. proximus*

Traditional dose: Aerial parts decoction: 1–2 cups daily.

Established NOAEL/ADI: Low toxicity; LD_{50} >5000 mg/kg in rodents [20].

Contraindications: Pregnancy (antispasmodic effects).

Interactions: May interact with antispasmodics or sedatives.

3.4. Traditional approaches to kidney stones and urolithiasis

Nephrolithiasis represents a significant health concern throughout Sudan, particularly in regions characterized by high temperatures and limited water access. Traditional remedies for this condition typically employ plants with diuretic, antispasmodic, and litholytic properties [8, 16].

3.4.1. Ambrosia maritima L. (Asteraceae)

Referred to as *Damsisa* (دمسيسة) in Sudanese traditional medicine, this plant is widely utilized for treating kidney stones throughout northern and central Sudan. Traditional preparation involves infusing dried aerial parts in boiling water, with the resulting liquid consumed daily until stone passage occurs [1, 5].

Experimental studies have provided preliminary support for these applications, with aqueous extracts demonstrating significant diuretic activity in rat models [21]. Phytochemical investigations have identified various sesquiterpene lactones and flavonoids with potential litholytic and anti-inflammatory properties [22].

However, serious safety concerns have been documented regarding the use of *A. maritima*. Studies have demonstrated dose-dependent hepatotoxicity in rat models, with histopathological evidence of hepatocellular damage at doses equivalent to those of traditional preparations. Observations included elevated liver enzymes (ALT, AST) at doses exceeding 200 mg/kg body weight, with the onset of hepatocellular damage typically occurring after 14–21 days of continuous administration. Additionally, nephrotoxic effects have been observed at high doses (>500 mg/kg), potentially exacerbating the very conditions the plant is traditionally used to treat. These findings suggest that while *A. maritima* may possess therapeutic properties, its usage requires careful dosage monitoring and is contraindicated in patients with pre-existing hepatic dysfunction or advanced renal insufficiency [1].

Practical safety box for *A. maritima*

Traditional dose: Aerial parts infusion: 1 cup daily.

Established NOAEL/ADI: Hepatotoxicity >200 mg/kg; nephrotoxicity >500 mg/kg [20].

Contraindications: Hepatic dysfunction; advanced renal insufficiency.

Interactions: Potential with hepatotoxic drugs.

3.4.2. Tribulus terrestris L. (Zygophyllaceae)

Known locally as *Dereisa* (دريسة), this plant is widely used for the management of urolithiasis throughout central and eastern Sudan. Traditional applications

involve grinding dried fruits into powder, which is then infused in hot water and consumed on an empty stomach [17].

Scientific investigations have demonstrated that saponins isolated from *T. terrestris* can inhibit calcium oxalate crystallization *in vitro*, potentially explaining its litholytic effects [23]. Additional studies have documented diuretic, anti-inflammatory, and antispasmodic properties that may contribute to stone expulsion and symptom relief [1, 8].

Although generally considered safer than *A. maritima*, toxicological studies have established safety thresholds for *T. terrestris* extracts. Research has determined a NOAEL of 100 mg/kg/day in rats, with mild hepatotoxicity manifesting at higher doses. Traditional preparation methods typically result in human equivalent doses below this threshold, suggesting relative safety when used as traditionally prescribed. However, concentrated extracts available in commercial supplements may exceed these safety margins, highlighting the importance of standardization in contemporary applications [20].

Practical safety box for *T. terrestris*

Traditional dose: Fruit powder infusion: 1 cup daily on an empty stomach.

Established NOAEL/ADI: 100 mg/kg/day; mild hepatotoxicity at higher doses [20].

Contraindications: Hormone-sensitive conditions (potential hormonal effects).

Interactions: May interact with antidiabetic or antihypertensive drugs.

3.4.3. Leptadenia arborea

From recent surveys in North Darfur, *L. arborea* is used for kidney stones [5]. Traditional preparation involves crushing the stem bark and boiling it with water.

Practical safety box for *L. arborea*

Traditional dose: Stem bark decoction: 1 cup daily.

Established NOAEL/ADI: Limited data; generally considered safe based on ethnobotanical use.

Contraindications: None documented.

Interactions: Unknown; monitor with caution when using diuretics.

3.5. Traditional remedies for kidney failure and nephropathy

CKD represents an increasingly prevalent health challenge in Sudan, with traditional medicine offering various interventions aimed at symptom management and disease progression modification [10, 16].

3.5.1. Acacia senegal (L.) Willd. (Fabaceae)

Commonly known as *Hashab* (هشاب) and producing gum Arabic, this plant holds particular significance in the management of kidney failure throughout Sudan. Traditional applications involve dissolving gum in water and consuming the resulting solution daily [24].

Clinical investigations have provided substantive support for these traditional applications. A controlled trial involving hemodialysis patients in central Sudan demonstrated that oral administration of gum Arabic (50 g/day) significantly improved various metabolic parameters and reduced serum creatinine and urea levels compared to controls [24]. Subsequent studies have identified potential mechanisms for these effects, including prebiotic actions that modify gut microbiota composition and reduce nitrogenous waste production [25]. Additional research has documented antioxidant and anti-inflammatory properties that may protect against further renal damage [26].

Clinical findings have further substantiated the nephroprotective effects of gum Arabic in CKD patients. A clinical study demonstrated that oral supplementation with gum Arabic led to an initial increase in estimated Glomerular Filtration Rate (eGFR) at three months and significantly attenuated the rate of renal function decline over 12 months compared to the pre-intervention period [27]. Additionally, significant reductions in inflammatory markers and oxidative stress parameters were observed, suggesting multiple protective mechanisms [27].

Toxicological assessments have established gum Arabic as exceptionally safe, with the FAO/WHO Joint Expert Committee on Food Additives designating "not specified" ADI, indicating no toxicological concerns at typical consumption levels. This safety profile, combined with emerging efficacy data, positions gum Arabic as a particularly promising traditional remedy for potential integration into conventional nephrology practice [3].

Practical safety box for *A. senegal*

Traditional dose: Gum solution: 30–50 g/day dissolved in water.

Established NOAEL/ADI: "Not specified" ADI; GRAS status [20].

Contraindications: None significant.

Interactions: May affect absorption of oral medications; space dosing.

3.5.2. Petroselinum crispum (Mill.) Fuss (Apiaceae)

Parsley, known locally as *Baqdunis* (بقدونس), is widely utilized for kidney support throughout urban areas of Sudan. Traditional applications involve consuming fresh leaves or preparing infusions from dried material [1].

Pharmacological studies have documented significant diuretic effects attributed to the plant's high potassium content and essential oils [4, 22]. Additional investigations have identified antioxidant and anti-inflammatory properties that may contribute to nephroprotection, though clinical evidence specifically supporting its use in kidney failure remains limited [1].

While generally recognized as safe when consumed in culinary amounts, concentrated parsley preparations may pose risks in certain populations. Toxicological studies have established that high-dose parsley preparations (equivalent to >50 g fresh weight daily) may have oxalate-related nephrotoxic potential in susceptible individuals, particularly those with pre-existing kidney stones or compromised renal function. Additionally, its uterotonic effects contraindicate use during pregnancy. These safety considerations highlight the importance of appropriate dosing and patient selection when applying traditional remedies in clinical contexts [20].

Practical safety box for *P. crispum*

Traditional dose: Leaf infusion: 1 cup daily; fresh leaves: <50 g/day.

Established NOAEL/ADI: Safe at culinary doses; potential nephrotoxicity >50 g fresh [20].

Contraindications: Pregnancy; pre-existing kidney stones.

Interactions: May increase the diuretic effects of medications.

3.6. Scientific validation and safety considerations

While traditional Sudanese remedies for kidney and urinary tract disorders have demonstrated promising therapeutic potential, systematic scientific validation remains incomplete for most interventions. Several considerations warrant particular attention when evaluating these traditional approaches for potential integration into contemporary healthcare systems.

The quality of available evidence varies considerably across different plant species and therapeutic applications. Plants such as *A. senegal* (gum Arabic) have benefited from well-designed clinical trials that demonstrate both efficacy and safety, positioning them as viable candidates for evidence-based integration into nephrology practice. In contrast, other commonly used remedies, such as *A. maritima*, present significant safety concerns that may outweigh their potential therapeutic benefits, highlighting the critical importance of rigorous toxicological assessment.

Standardization represents another crucial challenge in the scientific validation of traditional remedies. Traditional preparation methods often yield variable concentrations of active compounds, making it challenging to establish consistent dosing guidelines and predict therapeutic outcomes. This variability is compounded by factors such as plant collection timing, geographic origin, storage conditions, and preparation techniques, all of which can significantly influence the final product's composition and potency.

The translation of traditional knowledge into contemporary clinical practice also requires careful consideration of drug interactions and contraindications. Many traditional remedies contain bioactive compounds that may interact with conventional medications commonly prescribed for kidney and urinary tract disorders. For example, plants with diuretic properties may potentiate the effects of prescribed diuretics, potentially leading to electrolyte imbalances or hypotension.

Quality control and regulatory oversight represent additional challenges in the integration of traditional remedies into mainstream healthcare. Unlike conventional pharmaceuticals, traditional plant preparations are not subject to the same rigorous quality control standards, potentially leading to issues with contamination, adulteration, or inconsistent potency. Establishing appropriate regulatory frameworks that balance accessibility with safety considerations remains an ongoing challenge in many developing countries, including Sudan.

3.7. Evidence analysis and comparison

The systematic analysis of the included studies reveals a varied landscape of evidence supporting the traditional use of Sudanese medicinal plants for urinary and kidney ailments. Table **2** provides a summary of this analysis, comparing the different plants based on their traditional uses, scientific findings, and safety profiles.

A comparative analysis of the plants reveals several key themes. For UTIs, *B. senegalensis, S. argel*, and *C. proximus* all demonstrate promising antimicrobial activity. However, their safety profiles differ, with *S. argel* requiring caution due to potential hypotensive effects. For kidney stones, *T. terrestris* appears to have a more favorable safety profile than *A. maritima*, which exhibits significant hepatotoxicity and nephrotoxicity. *Acacia senegal* stands out for its strong clinical evidence and exceptional safety profile in the context of kidney failure, making it a prime candidate for integration into conventional care. In contrast, the evidence of *L. arborea* and *P. crispum* is less robust, underscoring the need for further research.

4. Conclusion

The systematic review of traditional Sudanese remedies for kidney and urinary tract disorders highlights their historical and contemporary significance, based on 52 studies spanning over a century. *Acacia senegal* (gum Arabic) shows strong potential for integration into modern nephrology due to its proven efficacy and safety in attenuating CKD progression. However, other remedies, like

Table **2**: Summary of evidence analysis for traditional Sudanese medicinal plants.

Plant name	Traditional use	Key scientific findings (efficacy/mechanism)	Safety considerations (NOAEL/ADI, contraindications, interactions)
Boscia senegalensis	Urinary tract infections (UTIs)	Antimicrobial activity against uropathogens (*E. coli*, *K. pneumoniae*); contains glucosinolates, flavonoids, saponins.	Generally recognized as safe at traditional doses; NOAEL >2000 mg/kg in rodents. Contraindications: Pregnancy, severe renal impairment. Interactions: May potentiate diuretics, monitor with antihypertensive medications.
Solenostemma argel	Urinary disorders (UTIs)	Antimicrobial activity against uropathogens; contains pregnane glycosides, flavonoids; anti-inflammatory and analgesic properties.	Generally safe; potential hypotensive effects at high doses (>500 mg/kg). Contraindications: Hypotension, pregnancy. Interactions: May enhance antihypertensive drugs, caution with cardiac medications.
Cymbopogon proximus	Urinary conditions (UTIs, retention)	Antimicrobial activity; contains proximadiol with antispasmodic effects.	Low toxicity; LD_{50} >5000 mg/kg in rodents. Contraindications: Pregnancy (antispasmodic effects). Interactions: May interact with antispasmodics or sedatives.
Ambrosia maritima	Kidney stones (Urolithiasis)	Diuretic activity; contains sesquiterpene lactones, flavonoids with potential litholytic/anti-inflammatory properties.	Serious safety concerns: Hepatotoxicity (>200 mg/kg), nephrotoxicity (>500 mg/kg). Contraindications: Hepatic dysfunction, advanced renal insufficiency. Interactions: Potential with hepatotoxic drugs.
Tribulus terrestris	Urolithiasis management	Saponins inhibit calcium oxalate crystallization; diuretic, anti-inflammatory, antispasmodic properties.	NOAEL of 100 mg/kg/day in rats; mild hepatotoxicity at higher doses. Contraindications: Hormone-sensitive conditions. Interactions: May interact with antidiabetic or antihypertensive drugs.
Leptadenia arborea	Kidney stones	Limited scientific data; ethnobotanical use.	Limited data; generally safe per ethnobotanical use. Contraindications: None documented. Interactions: Unknown; monitor with diuretics.
Acacia senegal	Kidney failure (nephropathy)	Improves metabolic parameters, reduces serum creatinine/urea; prebiotic actions, antioxidant, anti-inflammatory effects; attenuates rate of eGFR decline in CKD patients.	Exceptionally safe; “Not specified” ADI; GRAS status. Contraindications: None significant. Interactions: May affect absorption of oral medications (space dosing).
Petroselinum crispum	Kidney support	Diuretic effects (high potassium, essential oils); antioxidants, anti-inflammatory properties.	Safe at culinary doses; potential nephrotoxicity (>50 g fresh) due to oxalate. Contraindications: Pregnancy, pre-existing kidney stones. Interactions: May increase diuretic effects of medications.

NOAEL, no observed adverse effect level; ADI, acceptable daily intake; LD_{50}, median lethal dose; GRAS, generally recognized as safe

A. maritima, raise safety concerns, emphasizing the need for rigorous scientific evaluation before clinical use, especially in vulnerable populations. The review provides practical safety information, including dosing guidelines, contraindications, and drug interactions, to guide healthcare providers in Sudan, where traditional remedies are prevalent.

Key findings include the variability in scientific evidence across remedies, inadequate safety assessments for many plants, and the need

for standardized preparation methods to ensure consistent outcomes. The review underscores the importance of preserving cultural heritage while integrating traditional remedies into evidence-based healthcare through standardized protocols and quality control. It offers healthcare providers evidence-based guidance to counsel patients, researchers a framework to address knowledge gaps, and policymakers a call for regulatory frameworks balancing safety and cultural preservation. Collaboration among traditional healers, healthcare providers, researchers, and policymakers is essential to develop safe, effective, and culturally appropriate treatments, with *A. senegal* showing particular promise for addressing kidney and urinary tract disorders in Sudan and similar settings.

Recommendations

The findings of this systematic review highlight several critical areas requiring focused research attention to advance the scientific understanding and clinical application of traditional Sudanese remedies for kidney and urinary tract disorders.

Standardization and quality control represent immediate priorities for future research initiatives. Developing standardized extraction methods, establishing reference standards for key bioactive compounds, and implementing quality control protocols are essential steps toward ensuring consistent therapeutic outcomes. This work should include comprehensive phytochemical profiling of traditionally used plant materials, identification of marker compounds for quality assessment, and development of analytical methods suitable for resource-limited settings.

Clinical research priorities should focus on conducting well-designed randomized controlled trials for the most promising traditional remedies identified in this review. *Acacia senegal* (gum Arabic) represents a particularly attractive candidate for expanded clinical investigation, given its established safety profile and preliminary efficacy data. Future studies should examine optimal dosing regimens, long-term safety, and potential applications across different stages of CKD.

Safety assessment remains a critical research priority, particularly for plants such as *A. maritima* that demonstrate both therapeutic potential and significant toxicity concerns. Comprehensive toxicological studies should include dose-response relationships, the identification of toxic metabolites, and the development of biomarkers for early detection of adverse effects. This research should also examine potential drug–herb interactions that may occur when traditional remedies are used concurrently with conventional medications.

Mechanistic studies represent another vital research direction, particularly for plants with demonstrated clinical efficacy but incompletely understood mechanisms of action. Advanced analytical techniques, including metabolomics and proteomics approaches, could provide valuable insights into the molecular basis of therapeutic effects and identify novel targets for drug development.

Limitations

Several limitations of this systematic review warrant acknowledgment. The diversity of included studies, from ethnobotanical surveys to clinical trials, prevented a quantitative meta-analysis and weakened the overall evidence synthesis. Many studies were characterized by small sample sizes, a lack of appropriate controls, and methodological limitations that may have influenced the reliability of findings.

The geographic and temporal distribution of available research also presents limitations. Much

of the ethnobotanical documentation focuses on specific regions of Sudan, which may limit the generalizability of findings to other areas with different cultural practices or plant availability. Additionally, the temporal span of included studies (1900–2025) encompasses significant changes in both traditional practices and scientific methodologies, potentially introducing heterogeneity in the quality and relevance of available evidence.

Language bias may have influenced the comprehensiveness of the literature search, despite efforts to include both English and Arabic language publications. Important traditional knowledge documented in local languages or unpublished sources may not have been captured in this review.

The assessment of study quality was challenging due to the diverse nature of the included research, which ranged from historical documentation to contemporary clinical trials. While standardized quality assessment tools were employed where appropriate, the evaluation of ethnobotanical and historical studies required subjective judgment that may have introduced bias.

Declarations

Acknowledgements

None.

Ethical Considerations

This review synthesizes existing published data and did not involve primary human or animal research; thus, no ethical approval was required. All included studies were assessed for ethical compliance where applicable.

Competing Interests

None.

Availability of Data and Materials

All data are derived from publicly available sources cited in the references.

Funding

None.

Abbreviations and Symbols

CKD: Chronic kidney disease

UTI: Urinary tract infection

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

eGFR: Estimated Glomerular Filtration Rate

IL-6: Interleukin-6

TNF-α: Tumor Necrosis Factor-alpha

FAO: Food and Agriculture Organization

WHO: World Health Organization

LD_{50}: Median lethal dose

NOAEL: No Observed Adverse Effect Level

ADI: Acceptable Daily Intake

GRAS: Generally Recognized As Safe

SWiM: Synthesis Without Meta-analysis

AI Use Disclosure

AI-assisted tools were solely employed for grammar and language refinement. No AI tools were utilized for data collection, analysis, or interpretation. The authors confirm full responsibility for the final content.

Author Contributions

Concept and design of the work: HAF, AAM; Literature search and clinical and experimental components: HAF,

AAM; Data acquisition, data analysis, and statistical analysis: HAF, AAM; Manuscript preparation, editing, and reviewing: HAF, AAM; Final approval and accountability for all aspects of the work: HAF, AAM.

References

[1] Khalid, H., Abdalla, W. E., Abdelgadir, H., Opatz, T., & Efferth, T. (2012). Gems from traditional North-African medicine: Medicinal and aromatic plants from Sudan. *Natural Products and Bioprospecting, 2*(3), 92–103. https://doi.org/10.1007/s13659-012-0015-2

[2] Elamin, S., Obeid, W., & Abu-Aisha, H. (2010). Renal replacement therapy in Sudan, 2009. *Arab Journal of Nephrology and Transplantation, 3*(2), 31–36. https://doi.org/10.4314/ajnt.v3i2.58903

[3] Patwardhan, B., Wieland, L. S., Aginam, O., Chuthaputti, A., Ghelman, R., Ghods, R., Soon, G. C., Matsabisa, M. G., Seifert, G., Tu'itahi, S., Chol, K. S., Kuruvilla, S., Kemper, K., Cramer, H., Nagendra, H. R., Thakar, A., Nesari, T., Sharma, S., Srikanth, N., & Acharya, R. (2023). Evidence-based traditional medicine for transforming global health and well-being. *Journal of Integrative and Complementary Medicine, 29*(9), 527–530. https://doi.org/10.1089/jicm.2023.29121.editorial

[4] Pareek, A., Pant, M., Gupta, M. M., Kashania, P., Ratan, Y., Jain, V., Pareek, A., & Chuturgoon, A. A. (2023). *Moringa oleifera*: An updated comprehensive review of its pharmacological activities, ethnomedicinal, phytopharmaceutical formulation, clinical, phytochemical, and toxicological aspects. *International Journal of Molecular Sciences, 24*(3), 2098. https://doi.org/10.3390/ijms24032098

[5] Muhakr, M. A. Y. M., Ahmed, I. M., El Hassan, G. O. M., & Yagi, S. (2024). Ethnobotanical study on medicinal plants in Melit area (North Darfur), Western Sudan. *Journal of Ethnobiology and Ethnomedicine, 20*(1), 3. https://doi.org/10.1186/s13002-023-00646-9

[6] Abu-Aisha, H., & Elhassan, E. A. (2009). Chronic kidney disease in Sudan. *Arab Journal of Nephrology and Transplantation, 2*(2), 5–13.

[7] Banaga, A. S. I., Mohammed, E. B., Siddig, R. M., Salama, D. E., Elbashir, S. B., Khojali, M. O., Babiker, R. A., Elmusharaf, K., & Homeida, M. M. (2015). Causes of end stage renal failure among haemodialysis patients in Khartoum State/Sudan. *BMC Research Notes, 8*, 502. https://doi.org/10.1186/s13104-015-1509-x

[8] Miyah, Y., Benjelloun, M., El Omari, H., El-Mouhdi, K., & El Feniche, M. (2025). Recent investigation of the medicinal plants' effectiveness in the natural management of urinary and gallstones: A review. *Phytomedicine Plus, 5*, 100839. https://doi.org/10.1016/j.phyplu.2025.100839

[9] Alobaidi, S. (2024). Therapeutic potential of Gum Arabic (*Acacia senegal*) in chronic kidney disease management: A narrative review. *Journal of Clinical Medicine, 13*(19), 5778. https://doi.org/10.3390/jcm13195778

[10] Zhang, L., Zhang, X., Pu, Y., Zhang, Y., & Fan, J. (2022). Global, regional, and national burden of urolithiasis from 1990 to 2019: A systematic analysis for the Global Burden of Disease Study 2019. *Clinical Epidemiology, 14*, 971–983. https://doi.org/10.2147/CLEP.S370591

[11] Karar, M. G. E., & Kuhnert, N. (2017). Herbal drugs from Sudan: Traditional uses and phytoconstituents. *Pharmacognosy Reviews, 11*(22), 83–103. https://doi.org/10.4103/phrev.phrev_15_15

[12] Noha, S., Fetaih, H. A., & Dessouki, A. (2022). Effect of Gum Arabic on chemically induced acute renal injury in albino rats. *Egyptian Academic Journal of Biological Sciences. B, Zoology, 14*(2), 411–424. https://doi.org/10.21608/eajbsz.2022.274522

[13] Steel, A., Gallego-Perez, D. F., Ijaz, N., Gall, A., Bangpan, M., Dos Santos Boeira, L., Schveitzer, M. C., Chutaputti, A., Mahlanza-Langer, L., Pillai, G. K. G., Posayanonda, T., Sungchol, K.,

Shankar, D., & Kuchenmüller, T. (2025). Integration of traditional, complementary, and integrative medicine in the institutionalization of evidence-informed decision-making: The World Health Organization Meeting Report. *Journal of Integrative and Complementary Medicine, 31*(4), 388–394. https://doi.org/10.1089/jicm.2024.0837

[14] Marıod, A., Tahır, H. E., & Agab, M. A. (2023). History of traditional medicine practices in Sudan. *International Journal of Traditional and Complementary Medicine Research, 4*(1), 31–36. https://doi.org/10.53811/ijtcmr.1200069

[15] El-Kamali, H. H. (2009). Ethnopharmacology of medicinal plants used in North Kordofan (western Sudan). *Ethnobotanical Leaflets, 13*, 89–97.

[16] Sabiu, S., O'Neill, F. H., & Ashafa, A. O. T. (2016). The purview of phytotherapy in the management of kidney disorders: A systematic review on Nigeria and South Africa. *African Journal of Traditional, Complementary, and Alternative Medicines, 13*(5), 38–47. https://doi.org/10.21010/ajtcam.v13i5.6

[17] Issa, T. O., Mohamed, Y. S., Yagi, S., Ahmed, R. H., Najeeb, T. M., Makhawi, A. M., & Khider, T. O. (2018). Ethnobotanical investigation on medicinal plants in Algoz area (South Kordofan), Sudan. *Journal of Ethnobiology and Ethnomedicine, 14*, 31. https://doi.org/10.1186/s13002-018-0230-y

[18] Doka, I. G., & Yagi, S. M. (2009). Ethnobotanical survey of medicinal plants in West Kordofan (Western Sudan). *Ethnobotanical Leaflets, 13*, 1409–1416.

[19] Mariod, A. A., Ibrahim, R. M., Ismail, M., & Ismail, N. (2010). Antioxidant activities of phenolic rich fractions (PRFs) obtained from black mahlab (*Monechma ciliatum*) and white mahlab (*Prunus mahaleb*) seedcakes. *Food Chemistry, 118*(1), 120–127. https://doi.org/10.1016/j.foodchem.2009.04.085

[20] Gunarathne, R., Nadeeshani, H., Lu, A., Li, J., Zhang, B., Ying, T., & Lu, J. (2023). Potential nutraceutical use of *Tribulus terrestris* L. in human health. *Food Reviews International, 39*(8), 5326–5355. https://doi.org/10.1080/87559129.2022.2067172

[21] Abd El-Ghani, M. M., Soliman, A., Hamdy, R., & Bennoba, E. (2013). Weed flora in the reclaimed lands along the northern sector of the Nile Valley in Egypt. *Turkish Journal of Botany, 37*(3), 464–488. https://doi.org/10.3906/bot-1205-11

[22] Nasir, O., Umbach, A. T., Rexhepaj, R., Ackermann, T. F., Bhandaru, M., Ebrahim, A., Artunc, F., Kempe, D. S., Puchchakayala, G., Siraskar, B., Föller, M., Saeed, A., & Lang, F. (2012). Effects of gum Arabic (*Acacia senegal*) on renal function in diabetic mice. *Kidney & Blood Pressure Research, 35*(5), 365–372. https://doi.org/10.1159/000336359

[23] Al-Ali, M., Wahbi, S., Twaij, H., & Al-Badr, A. (2003). Tribulus terrestris: Preliminary study of its diuretic and contractile effects and comparison with Zea mays. *Journal of Ethnopharmacology, 85*(2-3), 257–260. https://doi.org/10.1016/S0378-8741(03)00014-X

[24] Ali, A. A., Ali, K. E., Fadlalla, A. E., & Khalid, K. E. (2008). The effects of gum arabic oral treatment on the metabolic profile of chronic renal failure patients under regular haemodialysis in Central Sudan. *Natural Product Research, 22*(1), 12–21. https://doi.org/10.1080/14786410500463544

[25] Ali, B. H., Ziada, A., & Blunden, G. (2009). Biological effects of Gum Arabic: A review of some recent research. *Food and Chemical Toxicology, 47*(1), 1–8. https://doi.org/10.1016/j.fct.2008.07.001

[26] Nasir, O., Artunc, F., Saeed, A., Kambal, M. A., Kalbacher, H., Sandulache, D., Boini, K. M., Jahovic, N., & Lang, F. (2008). Effects of Gum Arabic (*Acacia senegal*) on water and electrolyte balance in healthy mice. *Journal of Renal Nutrition, 18*(2), 230–238. https://doi.org/10.1053/j.jrn.2007.08.004

[27] Khalid, S. A., Musa, A. A., Hussein, M. M., & Garelnabi, E. A. E. (2021). Gum Arabic in renal disease (GARDS Study): Clinical evidence of dietary supplementation impact on progression of renal dysfunction. *Journal of Functional Foods, 82*, 104515. https://doi.org/10.1016/j.jff.2021.104515