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# **Review Article**

# Pharmacological and nutritional uses of *Phoenix reclinata* JACQ (Wild date palm)

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# Abstract

Phoenix reclinata Jacq, commonly known as Senegal date palm or African wild date palm, is a tree belonging to the Arecaceae family. Its fruits, pulp and cores are a rich source of dietary fiber, carbohydrates, and various essential vitamins and minerals. A comprehensive search was conducted to identify the pharmacological and nutritional value of Phoenix reclinata. Databases such as PubMed, Google Scholar, Scopus, and Science Direct were searched using terms like "Phoenix reclinata," "phytochemicals," "Pharmacological activity," "Ethno-pharmacology," and "Anti-inflammatory." Phoenix reclinata has medicinal uses and is employed to treat various ailments, including malaria. Phytochemical investigations of the methanol extract of the leaves revealed the presence of alkaloids, glycosides, saponins, flavonoids, tannins, terpenoids, sterols, and phenolic compounds. The studies showed that the leaves exhibit antioxidant, anti-inflammatory, nephroprotective, antipyretic, and antiplasmodial properties. This review provides a comprehensive analysis of the pharmacological and nutritional benefits of Phoenix reclinata.

Keywords: Phoenix reclinata, Phytochemicals, Nutrition, Pharmacological activity, Ethno-pharmacology

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# INTRODUCTION

Phoenix reclinata Jacq, commonly known as Senegal date palm or African wild date palm, is a tree that belongs to the family Arecaceae. The generic name 'Phoenix' is a Greek word for date palm. It is an ancient name used by Theophrastus, probably to indicate its first introduction to the Greeks by the Phoenicians. The word 'reclinata' is a derivative from a Latin word which means bent backwards, and refers to the leaves of more mature trees of the species, where these often bend onto the slender but tough trunk [1]. It is a clumping palm that produces multiple stems up to 10 m tall, often forming dense thickets [2]. The unbranched and slender stems reach up to 25 cm in diameter (excluding leaf sheaths) and are frequently bent over [3]. The natural habitat of *Phoenix reclinata* extends from Senegal across West Africa to Ethiopia, and includes all of central and eastern Africa, reaching down to Botswana and South Africa. Accordingly, *Phoenix reclinata* is native to Zambia, Benin, Botswana, Burkina Faso, Togo, Central African Republic, Chad, Egypt, Eritrea,

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Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Democratic Republic of Congo, Liberia, Mali, Mauritania, Cote d'Ivoire, Mozambique, Namibia, Niger, Cameroon, Nigeria, Senegal, Sierra Leone, Tanzania, Uganda, Zimbabwe, South Africa, and other continents and island nations of Africa [1]. *Phoenix reclinata* is a widespread palm with an extensive geographic distribution. Although it faces local habitat loss, the overall extent of occurrence is considerable, and the species distribution encompasses 86 protected areas.

According to the International Union for Conservation of Nature's (IUCN) Red List of 2016, the plant is not currently considered threatened [4]. *Phoenix reclinata* has traditionally been used to treat various ailments such as malaria in the Sasiga district of western Ethiopia [2,15]. Information on the use of herbal medicines dates back to historical experiences and observations recorded since the dawn of humanity [5]. To develop alternative therapies to synthetic drugs, it is essential to scientifically validate plants with proven ethnomedicinal properties [6].



Figure 1: Tree of *Phoenix reclinata* [7]



Figure 2: Fruit of *Phoenix reclinata* [8]

#### **Botanical description**

Phoenix reclinata grows to a height of 10 to 12 m, with a stem that measures about 25 cm in diameter. The stem may be straight or curved and is sometimes swollen at the base. It typically features a dense mass of pencil-thick roots emerging from the lower part. This tree grows as a stemless suckering bush or develops short multiple stems. The bark is smooth and black. displaying slight markings from concentric rings of leaf scars. The crown consists of 15 to 30 live leaves, along with 10 to 20 dead and dving ones. The live leaves are erect, while the dead ones hang downward. These evergreens have pinnate, feather-shaped leaves that are 3 to 4 m long, comprising 100 to 200 leaflets arranged in two ranks. The leaflets are sessile (without stalks), folded, up to 30 cm long, glossy, dark green, long, and narrow, ending in sharp points. The lower 30 to 50 leaflets are particularly pointed and spiny, arranged in pairs, with the lowest leaflets measuring about 3 cm long. The flowers are small, cream-colored, and stalkless, borne in 20 cm wavy spikes, surrounded by a bright yellow casing that opens to allow the flowers to drop out. These flowers are found in the axils of young leaves. Male flowers feature a cup-shaped calyx with three petals and six stamens that are fused at the base. They have a vestigial ovary and produce large, showy sprays that release clouds of dust-like pollen. In contrast, the female flowers are globose and less conspicuous, sharing a similar calvx structure with three petals but possessing a rounded ovary with three free carpels and six vestigial stamens. The fruits grow in large, drooping bunches. Each fruit is oval-shaped and ranges in color from orange to reddish or yellow-brown, measuring up to 2.5 cm long. The flesh is fleshy and date-like, though somewhat insipid, yet it is edible. Phoenix reclinata is closely related to the true date palm, Phoenix dactylifera [9]. Trees of Phoenix reclinata vary in morphology, size and wood characteristics. These traits often depend on the location and environmental conditions of the area where the trees have been growing [1].

#### **Common and local names**

Common names of *Phoenix reclinata* include Senegal date palm or African wild date palm [1], Senegal palm, feather palm, wild date palm, coffee palm, false date palm, mukindu palm [9]. It is also called elekikobi in Yoruba (Nigeria), Ngala in Igbo (Nigeria), Afutu, Kabba or Kilijjiri in Hausa (Nigeria), Ukukon in Edo (Nigeria), Wure in Tiv (Nigeria), Nkeresia in Twi (Ghana) Chob, Sorsor, Siba or Koroso in Wolof (Gambia) [12], Mubu, Mupudu, Muqwana in Tswana (Southern africa)

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[11], Isundu in Zulu (Southern Africa) [12], Isundu in Xhosa (Southern africa) [12], Dadelpalm in Afrikaans (Namibia) [13] or Wilde Dadelpalm in Afrikaans (Namibia) [13,14] Mkindu in Swahili (Kenya) [15].

Table 1: Taxonomy profile

141 1	
Kingdom:	Plantae – Plants
Sub Kingdom:	Tracheobionta - Vascular plants
Super division:	Spermatophyta - Seed plant
Division:	Magnoliophyta - Flowering plants
Class:	Liliopsida - Monocotyledons
Subclass:	Arecidae
Order:	Arecales
Family:	Arecaceae Bercht. & J. Presl -
	Palm family
Genus:	Phoenix L date palm
Species:	Phoenix reclinata Jacq Senegal
	date palm

#### Local uses

Young, unexpanded leaves are often employed in crafting a wide range of items, including mats, bags, baskets, hats, sieves, ropes, strings, fishing nets, traps, parasols, and decorative ornaments. Strips derived from mature leaves are fashioned into hats, while the split petiole and rachis are used for coarse weaving projects like baskets, mats, fish traps, and binding. The entire rachis is also suitable for building huts and fish kraals. Furthermore, the Maasai people utilize the rachis for cleaning gourds, and leaves are used for thatching and as fans [16,17]. Hand brooms are crafted by pounding the stem's end until the fibers separate. Additionally, dried flower clusters are utilized to make brooms. Despite the trunk often being bent, it is frequently used in building huts, houses, fences, bridges, landing stages, traps, and hives.

In Ghana, the wood is fashioned into drums and also serves as firewood, making it ideal for charcoal production. The base of the stem is edible, and the palm is tapped for sap, which is fermented into palm wine. The apical bud, known as palm cabbage, is eaten as a vegetable and has a slightly bitter flavor. The ripe fruits are consumed, typically after a brief dip in boiling water. In Sierra Leone, the kernels are roasted and ground into flour for eating, while roasted seeds are used as a coffee alternative. The roots yield an edible gum and contain tannins. In Kenya and Tanzania, a brown dye is derived from the roots. This species is extensively planted for ornamental purposes and locally for shade and amenities. The leaves and petioles are employed for dune stabilization, and in various countries, the leaves have ceremonial

applications. For instance, in Senegal, they are fashioned into loincloths worn durina circumcision ceremonies. In Ethiopia, the leaves are used on Palm Sunday in the Orthodox Church and for wedding decorations. Between Palm Sunday and Easter, children craft finger rings from young soft leaflets, and the leaves are woven into floor mats and baskets, especially for weddings and to store milk and butter [18,19]. Palm wine is produced from the sap of Phoenix reclinata tree. It plays a significant role in the culture and traditional beliefs of the Zitundo people in Mozambique. beina used in ceremonies and forming part of local folklore [20]. Kinnaird [21] reported the human use of Phoenix reclinata and grouped it into 6 broad categories (Table 1).

#### Ethnomedicinal uses

Phoenix reclinata is used to prevent and treat malaria in the Sasiga district of Western Ethiopia [22]. In Senegal, traditional medicine considers root macerations to be astringent, using them to alleviate stomach pain and diarrhea. A decoction made from the apical bud is employed in baths and beverages to treat fatigue, while leaf preparations are applied externally for eye ailments. In Côte d'Ivoire, the fruit is used to address female infertility. In Uganda, roots are pounded and mixed with banana juice or beer to treat gonorrhea and impotence, and fresh leaves are chewed and swallowed to relieve abdominal discomfort. In Tanzania, the root decoction is used to treat epilepsy. Also, the leaves may be roasted, crushed, and combined with water to alleviate stomach pain and flu symptoms [23,24].

#### Ethnopharmacological properties

#### **Phytochemicals**

Roots of *Phoenix reclinata* yield an edible gum and contain tannins [18,19] Phytochemical screening of the methanol leaf extract revealed presence of flavonoids, phenolic compounds, tannins, saponins, terpenoids, glycosides, sterols, alkaloids, and terpenes [25].

#### Acute toxicity profile

A study evaluated acute toxicity of the crude methanol leaf extract of *Phoenix reclinata* in mice [25]. A total of 12 mice was employed for the procedure, and consisted of two phases. In phase one, nine mice were randomized into three groups (n = 3) receiving 10, 100, and 1000 mg/kg body weight of extract orally.

Category	Plant part/specific use	Harvesting method
Food and beverage	<ul> <li>a) Palm heart- an infrequently used vegetable source</li> <li>b) Fruits- infrequently used diet item</li> </ul>	The heart of the palm is extracted and can be consumed either raw or cooked. The rachillae of immature fruit are severed, submerged in water, and suspended until the fruits mature. They can be consumed fresh, or the fruits are pressed in a cloth to extract the sweet mesocarp, which is then utilized in baking.
	c)Vascular bundles- alcoholic beverages	To collect the oozing exudates, place a cover on top of the palm and hang the gourd to one side. After filling the gourd, pour out the fermented liquid and slice a thin section from the top of the trunk. Put the cover and gourd back in place, and continue this routine each day until the exudates cease to flow.
Construction	a) Trunk poles for building construction	Traditionally, a tall trunk is cut at its base to be used in the construction of community or political buildings.
	<ul> <li>b) Leaf rachis - wattle for constructing mud houses</li> </ul>	Cut the frond at its base, detach the leaflets, and position it horizontally between a building and poles before applying mud.
	c) Leaflet- building ties	Remove leaflets from a newly cut leaf and use them to secure poles, attach thatching to the roof, and so on.
	d) Leaf- door entrance and covers	Trim many lengthy fronds at their base, allow them to dry in the sun, tie them into bundles, and position them over entrances.
Technology	a) Leaf rachis-fish trap	Remove the leaflets from a newly cut leaf, and use the fresh rachis and leaflets to create oblong funnel traps.
	<ul> <li>b) Leaf- fans for stoking fires and fanning insects</li> </ul>	Trim the unexpanded "sword leaf" into broad, flat squares, using the rachis as a handle.
	c) Leaflets– strapping for hanging food and items that attract animals	Harvest unexpanded "sword leaf," dry it in the sun, then split and weave it into broad, flat straps. Use these straps to tie around banana rings and hang them from the ceiling.
	d) Leaf- rachis hand brooms	Divide the rachis into several strands, gather them together, fold them in the middle, and secure them beneath the fold using leaflets
Remedy	a) Leaflets- protecting healthy or curing diseased mango trees	Cut a leaflet and fasten it in a circle around the lower part of the mango tree trunk, keeping it there throughout the flowering and fruiting periods
Commerce	a) Leaf- sleeping and prayer mats, baskets	Harvest unexpanded "sword leaf," dry it in the sun, then split and braid the strips to make mats or weave them into baskets
	b) Rachis- floor mats	Trim the leaves, detach the leaflets, and divide the rachis into narrow strips. Gather these strips loosely to form large mats
Other	a) Leaf- ornamentation	Cut leaf at base, fold, bind, or weave as desired
	b) Roots- insect larvae for fishing	Excavate the soil and remove leaf debris at the base of the roots to uncover large wood grubs
	Leaf dolls	Fold in different ways to create human figures.

Table 1: Human uses of Phoenix reclinata grouped into 6 broad categories

The animals were monitored for changes in physical appearance, gross behavioral changes, and death within the first 4 h and subsequently for 24 h. After analyzing results from Phase 1 treatment, Phase 2 treatment was conducted using 3 new mice that each received 2000, 3500, and 5000 mg/kg body weight of extract orally. In the acute toxicity test, there was no lethality or signs of acute intoxication after a 24 h observation period, even at 5000 mg/kg [25].

#### Anti-inflammatory activity

#### Acute anti-inflammatory activity

Treatment with crude methanol extract (ME) of *Phoenix reclinata* leaf (ME; 100, 200, and 400 mg/kg) significantly reduced paw oedema induced by egg albumin. In the negative control group, egg albumin caused local paw oedema, reaching its maximum at 5 h. Administration of crude ME (400 mg/kg) produced the highest inhibition (52 %) at 5 h (p < 0.05) compared to

negative control. Positive control group (Ibuprofen 400 mg/kg) also produced significant reduction in paw oedema (55 %) at 5 h compared to control (p < 0.05) [25].

#### Chronic anti-inflammatory activity

In the chronic model, groups receiving ME (100, 200, and 400 mg/kg), and ibuprofen (400 mg/kg) demonstrated significant reduction in formaldehyde-induced paw edema over time (p < 0.05). The methanol leaf extract of *Phoenix reclinata* (400 mg/kg) produced the highest inhibition (46 %) on the 10th day (p < 0.05) [25].

#### Antipyretic activity

The antipyretic effect of ME was investigated using Brewer's assay method, subcutaneous administration of Brewer's yeast increased rectal temperature of the animals above baseline after 18 h. The methanol extract (ME) significantly (p <0.05) decreased rectal temperature at 200 and 400 mg/kg [25]. Solvent fractions of ME (Ethylacetate fraction, N-hexane fraction, and Butanol fraction) significantly (p < 0.05) decreased rectal temperature at 400 mg/kg. The Ethylacetate fraction (400 mg/kg) exhibited significant decrease in rectal temperature [26].

#### Nephroprotective activity

The nephroprotective effect of combined ether and methanol root extract of Phoenix reclinata on kidney damage induced by Tenofovir (TDF) was investigated using Wistar albino rats [27]. A total of 6 groups of Wistar albino rats (n = 8) were utilized to assess the nephroprotective activity of the crude root extract of Phoenix reclinata. A total of 3 groups received 600 mg/kg tenofovir in addition to varying doses of plant extract (200, 400, and 800 mg/kg), administered via gavage. The negative control group received only Tenofovir, positive control group received both Tenofovir and Calcitriol, and normal control group was given only distilled water. After 21 days, blood samples were collected through cardiac puncture for analysis of serum urea, creatinine, sodium, potassium, and chloride levels. Additionally, kidney tissue sections were taken for histopathological examination. Results indicated that oral administration of TDF significantly increased serum levels of creatinine (57.33 ± 6.61 µmol/L), urea (7.33 ± 0.82 mmol/L), sodium (157.2 ± 5.07 mmol/L), potassium (14.29 ± 2.96 mmol/L), and chloride mmol/L; (107.9 ± 6.16 р 0.05). < Histopathological findings revealed severe proximal tubular necrosis, glomerular degeneration, renal tubular degeneration with a tendency toward necrosis, lymphocyte infiltration, and intertubular hemorrhages. However, these negative effects were significantly reversed following administration of the extract in a dosedependent manner. Notably, the effects observed at 800 mg/kg dose of the extract were comparable to those of calcitriol group. This study demonstrated for the first time the protective effect of *Phoenix reclinata* against TDF-induced nephrotoxicity [27].

#### Antiplasmodial activity

Ethno-botanical survey conducted in Karsa Mojo, a village in the Sasiga District of Western Ethiopia, found Phoenix reclinata as one of the most frequently utilized anti-malarial traditional medicinal plants [22]. The methanol extract (ME) at 100, 200, and 400 mg/kg, along with its solvent fractions of ethyl acetate (EF), N-hexane (HF), and butanol (BF) at 200 and 400 mg/kg, were evaluated for parasitaemia levels using curative, suppressive, and prophylactic antiplasmodial models. In the curative model, ME demonstrated dose-dependent chemosuppression of 18.4, 46.4, and 79.6 % at 100, 200, and 400 mg/kg, respectively. The HF showed chemo-suppression of 24.5 and 28.9 % at 200 and 400 mg/kg, EF achieved 56.8 and 85.3 %, and BF resulted in 48 and 56.8 % at the same doses. In the suppressive model, ME showed dose-dependent chemo-suppression of 19.08, 45.23, and 80 % at 100, 200, and 400 mg/kg, while HF exhibited 15.55 and 28.89 %, EF achieved 61.32 and 81.94 %, and BF showed 34.06 and 43.08 % at 200 and 400 mg/kg. In the prophylactic model, ME demonstrated dosedependent chemo-suppression of 8.71, 15.59 and 17.48 % at 100, 200, and 400 mg/kg. Also, HF showed 2.66 and 8.6 % suppression at 200 and 400 mg/kg, respectively. The BF exhibited anti-plasmodial suppression of 15.73 and 21.68 % at 200 and 400 mg/kg, respectively. Therefore, EF consistently showed the highest chemosuppression among the solvent fractions across all models [26].

# **Nutritional profile**

Another study investigated the nutritional content of seeds of *Phoenix reclinata* using standard analytical procedures [28]. Results obtained showed crude protein, carbohydrate, ash content, moisture content, crude fat and fiber in seeds of *Phoenix reclinata* (Table 2). Elemental analysis revealed the presence of Sodium (Na), Potassium (K), Iron (Fe), Zinc (Zn), Calcium (Ca), and Magnesium (Mg; Table 3). Chinwuba et al



**Figure 3:** Transverse section of the kidney displaying histopathological changes [27]. Plate 1 (normal control group) showed a normal kidney structure (the renal corpuscle (Rn) located deep in the cortex, proximal convoluted tubules (T) clearly visible). Plates 2 (TDF group), plate 3 (TDF + 200 mg/kg) and plate 4 (TDF + 400 mg/kg), showed varying levels of nephrotoxicity, including noticeable tissue hemorrhage (arrow heads), lymphocyte infiltration (double arrowheads), atrophy of renal corpuscles, and disintegration of renal tubules. Plate 5 (TDF + 800 mg/kg) and plate 6 (Calcitrol group) showed kidney architecture comparable to that of control group (Plate 1). Scale bar was 25  $\mu$ m



Figure 4: Parasitized and normal red blood cells

Therefore, the seeds of *Phoenix reclinata* demonstrated great nutritional potential for

humans [28]. Table 4 showed pH of the pulp and cores (6.37  $\pm$  0.13 and 5.74  $\pm$  0.06), dry matter content (90.39  $\pm$  0.14 and 92.12  $\pm$  0.02 %), lipid content (1.69  $\pm$  0.01 and 3.32  $\pm$  0.17 %), fiber levels (10.4  $\pm$  0.17 and 88.7  $\pm$  0.48 %), protein content (11.1  $\pm$  0.05 and 5.62  $\pm$  0.32 %), energy values (335.2  $\pm$  0.44 and 378.7  $\pm$  1.07 kcal), and ash content (8.12  $\pm$  0.04 and 1.57  $\pm$  0.09 %), respectively. Total phenolic content of pulps and cores of *Phoenix reclinata* was 2.63  $\pm$  0.19 mg GAE/ 100 g DM and 3.69  $\pm$  0.18 mg GAE/100 g DM; vitamin C was 3.22  $\pm$  0.12 mg vs 3.69  $\pm$  0.18 mg, respectively [29].

 Table 2: Nutritional composition of Phoenix reclinata seeds

Parameters (%)	Phoenix reclinata	
Moisture content	12.50±0.41	
Ash	1.17±0.24	
Crude fat	15.50±1.47	
Crude fiber	16.52±1.46	
Crude protein	10.39±0.45	
Carbohydrate	60.44±1.65	

Values were expressed in means ± standard deviations (SD) of triplicate determinations

 Table 3: Mineral Composition (mg/kg) of Phoenix reclinate

Mineral element (mg/kg)	Phoenix reclinata		
Calcium (Ca)	1547.38±0.64		
Sodium (Na)	1847.49±0.23		
Potassium (K)	1847.49±0.23		
Magnesium (Mg)	3538.66±0.55		
Iron (Fe)	1119.98±0.42		
Zinc (Zn)	491.28±0.28		
Copper (Cu)	123.45±0.31		
Values were expressed	in means + standard		

deviations (SD) of triplicate determinations

**Table 4:** Physicochemical properties of pulp and cores of *Phoenix reclinate*

Physicochemical	Con	tent
properties	Pulp	Cores
рН	6.37±0.13	5.74±0.06
Dry matter	90.40±0.14	92.10±0.02
Lipid	1.69±0.01	3.32±0.17
Fiber	10.40±0.17	88.70±0.48
Protein	11.10±0.05	5.62±0.32
Total glucid	68.80±0.12	81.61±0.48
VE (kcal)	335.20±0.44	378.70±1.07
Ash	8.120±0.44	1.57±0.09
Total sugars	64.10±0.02	4.47±0.11
Crude cellulose	6.43±0.08	16.90±0.50
Starch	4.73±0.16	69.40±0.53
SR	51.40±0.03	3.42±0.08

Table 5: Antioxidant nutrient levels in pulp and cores

Antioxidant nutrients	Content	
	Pulp	Cores
Vitamin C (mg/100 g DM)	0.03±0.00	0.04±0.00
Total phenolic (mg GAE/100 g DM)	2.63±0.19	3.69±0.18

Values were expressed in means ± standard deviations (SD) of triplicate determinations

# CONCLUSION

This review has highlighted the traditional uses, nutritional profile, and pharmacological potential of *Phoenix reclinata*. Further studies are recommended to investigate the ethnomedicinal claims associated with *Phoenix reclinata*, such as antimicrobial and gastroprotective effects, applications for infertility, fatigue, diarrhea and aphrodisiac properties, which are linked to the presence of saponins, and wound healing.

# DECLARATIONS

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None.

#### **Ethical approval**

None provided.

# Use of Artificial intelligence/Large language models

We also declare that we did not use generative artificial intelligence (AI) and AI-assisted technologies in writing the manuscript.

#### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

#### **Conflict of interest**

No conflict of interest is associated with this work.

#### **Contribution of authors**

We declare that this work was done by the author(s) named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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