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Review Article

Diverse application of *Phoenix sylvestris*: A potential herb

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ABSTRACT

Phoenix sylvestris is commonly known as Indian date and is native to India and southern portions of Pakistan. It is traditionally important and known for its nutritional values throughout the world. It is a rich source of carbohydrate, phenols, amino acids, flavonoids, tannins, alkaloids, terpenoids, dietary fibers, essential vitamins and minerals. Different parts of the plant exhibit diverse medicinal properties such as being antipyretic, cardiotonic, laxative, diuretic and antioxidant. In the present review, an attempt has been made to compile most of the information available regarding the distribution, cultivation, phytochemical characteristics, Ayurvedic properties, ethno-pharmacological, medicinal and non-medicinal uses of *P. sylvestris* in the last four decades.

Introduction

Since the inception of mankind, human beings have been using traditional plants for the management of various ailments. One traditional plant, *Phoenix sylvestris*, is widely known as Wild date palm (Fig. 1). The synonyms of *P. sylvestris* are Date-sugar palm, Indian wild date, Indian wine palm, Silver date palm, Sugar date palm, and Sugar palm. The word Phoenix means purple, while 'sylvestris' means wild. This palm produces edible fruits but it is generally called Wild date palm to distinguish it from the closely related *Phoenix dactylifera*, which is known as Date palm and is cultivated agriculturally as the commercial source of edible dates. The taxonomic position of *P. sylvestris* is presented in Table 1 (Natural resources conservation service).

The plant is also known as Sugar date palm or Toddy palm or Silver date palm due to its abundant sugar content. The Silver date palm is very popular among landscapers because of its low maintenance and beautiful appearance. *P. sylvestris* has been considered as a traditional medicine to cure various ailments like abdominal complaints, fevers, loss of consciousness, constipation and in heart complaints. The sap of the plant is a laxative and is nutritious and cooling whereas the central tender part of the plant is used in the treatment of gonorrhea. The root of the plant is useful to treat toothache, nervous debility and helminthiasis.

Distribution

P. sylvestris Roxb., together with 13 other species, forms the genus *Phoenix*. All these species share similar morphological, anatomical and genetic characteristic with Date palm (*P. dactylifera* L.). *P. sylvestris* grows naturally and is cultivated around homesteads, farmland periphery and in marginal lands along the roadside and canals, even on fallow land. It can survive in disturbed areas, such as wastelands or seasonally inundated areas. *P. sylvestris* is widely distributed in India, Pakistan, Myanmar, Nepal, Bhutan, Bangladesh, Mauritius, China and Sri Lanka. In India, it is most commonly found in Rajasthan, Gujarat, Himachal Pradesh and Haryana states (Newton et al., 2013).

Cultivation

P. sylvestrisis is mainly found in drier-to-moist tropical and subtropical climatic zones. This tree occurs at an altitude of 1500 m. It cultivates better in the temperature range 20–40 °C. It requires a mean annual rainfall in the range 40–70 cm for growth, but it can survive with a minimal rainfall. *P. sylvestris* grows in a wide range of soil types, preferably sandy, well drained and moist. It can grow in a pH range of 5.5–7.5, and it can tolerate pH from 5 to 8. Fully matured *P. sylvestris* are known as a drought adaptor (Barrow, 1998).

Botanical description

P. sylvestris shares several characteristics with *P. dactylifera* (Date palm). It is a medium height tree of 9–50 m. It has a solitary, robust

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Fig. 1. *Phoenix sylvestris*.

trunk. Leaves are 3–4.5 m in length, greenish brown in color with thorns on the base, slightly curved, with 100–120 sharply pointed at the end leaflets. Leaflets usually of 30–45 cm long by 2.5–5 cm wide and arranged in groups of 2 or 3, often criss-crossed. The leaf sheath is a reddish-brown, fibrous, pseudo petiole 40–50 cm long and 3–5 cm wide at the base. Acanthophylls are yellow-green, very sharp, conduplicate and arranged in several planes on each side of the rachis. Staminate flowers are white-yellow, musty-scented, wherein the calyx is a deep cupule with three poorly defined lobes 2–2.5 mm long. Usually the three or rarely four petals include obtuse apices, slightly hooded. Anthers are 3–4 mm long; pistillate inflorescences are erect and changed arch-shaped on fruit maturation. The peduncle is green, upright and becoming golden-orange with arching on fruit maturation. Fruits are obovoid in shape 15–25 mm long and 12 mm broad and change color from green to orange-yellow on ripening. Fruits contain a moderately fleshy and astringent mesocarp. Seed are 15–20 mm long and 7–10 mm wide with obovoid and rounded apices (Barrow, 1998; Robert and Paul, 2003).

Medicinal uses

In Indonesia and India, sugars derived from *P. sylvestris* (Murphy and Briscoe, 1999) are considered more nutritious than cane sugar (Rangaswami, 1977; Morton, 1988). Fresh sap of *P. sylvestris* is highly rich in vitamin C (Barh et al., 2005). *P. dactylifera* fruits are useful in the treatment of sore throats, fever, colds, intestinal troubles, bronchial catarrh, gonorrhea, edema, cystisis and liver and abdominal issues (Morton, 1987). The sap is used as micronutrients and acts as a source of iron and vitamins that improve the vitamin B12 level in anemic patients (Barh and Mazumdar, 2008).

Table 1
Taxonomic position of *P. sylvestris*.

Rank	Classification
Kingdom	Plantae
Sub kingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Liliopsida
Subclass	Arecidae
Order	Arecales
Family	Arecaceae
Genus	*Phoenix* L.
Species	*Phoenix sylvestris* (L.) Roxb

Table 2
Ayurvedic properties of *P. sylvestris*.

Properties	Action
Guna (Qualities)	Heavy (Guru), Shiny (Snigdha)
Rasa (Taste)	Sweet (Madhura)
Virya (Potency)	Cold (Sheeta)
Vipaka	Madhura (Undergoes sweet taste after digestion)
Karma (Action)	Vatapitta shamaka (Reduces vitiated vata and pitta dosha) Balya (Provide strength)

The fruit serves as a tonic and restorative, and is also used as an analgesic to mitigate pain from backache and in the buttocks. In addition, it is widely used as an aphrodisiac, sweetener and diuretic and in the treatment of vomiting, vertigo and unconsciousness. Dates contain a good amount of dietary fiber and facilitate evacuation of the bowels. Dried dates improve cardiovascular health by soaking out all the cholesterol from the arteries. They have high calcium content and improve bone health. Generally the juice of *P. sylvestris* is consumed as a cooling beverage (Sravani et al., 2010). The leaf is useful in eye inflammation (Kamble et al., 2011) and the central tender part of the plant cures gonorrhoea and gleet. Roots of *P. sylvestris* are useful in toothache and are recommended for nervous debility. The gum of the plant is also found to be beneficial in genital-urinary disorders and diarrhea.

Ayurvedic properties of *P. sylvestris*

According to Ayurveda, there are two varieties of kharjur—kharjur and Pind kharjur. Fruits and juices of *P. sylvestris* are advocated in the treatment of various diseases. Several health benefits of kharjur and their Ayurvedic properties and their actions are described in Tables 2 and 3 (Anonymous, 2004; Sharma et al., 2001).

Ethnopharmacological uses

The plethora of literature reviews describe the use of different plant parts such as roots, leaves, fruits, juices and saps utilized by different tribal communities and local peoples of different regions of India, Pakistan and Bangladesh for the treatment of various ailments. Ethnopharmacological uses of *P. sylvestris* plant parts are described in Table 4.

Herbal formulation

P. sylvestris along with many herbs is used for the preparation of different herbal formulations for curing various diseases in different regions. Different authors have reviewed various herbal formulations that have been used by different tribes and in different regions of the world. They focused on various herbal

Table 3
Reported actions of *P. sylvestris* in Ayurveda.

Action	Use
Trishanahara	Relieves thirst
Swasahara	Relieves asthma
Hridya	Good for the heart
Kshayahara	Relieves emaciation
Atisarahara	Relieves diarrhea
Chardhinigrahana	Relieves vomiting
Raktapittaghna	Pacifies rakta & pitta
Ruchikara	Increases taste
Shukrala	Increases shukra
Tarpana	Nourishing
Jwaraghna	Anti-pyretic

Table 4
Uses of *P. sylvestris* in different regions of world.

S. No.	Tribe/area	Region	Plant part	Uses	References
1	Bhil, Bhilala, Barela, Patelia	Dhar, India	Heart wood	Increasing lactation	Alawa and Ray, 2012
2	Orchha wildlife sanctuary	Tikamgarh, India	Fruits	Toothache, Gonorrhea	Jitin et al., 2013
3	Taindol village	Jhansi, India	Fruits	Asthma, Cough dehydration, Diarrhea, Fever, Heart-related problems, Pains, Toothache, Tuberculosis	Jitin, 2013
4	Kalrayan hills	Eastern Ghats, India	Roots	Toothache	Manikandan and Lakshmanan, 2014
5	Local Nattu Vaidiya	Tamil Nadu, India	Roots	Toothache	Gunasekaran and Balasubramanian, 2012
	Garo ethnic community	Madhupur, Tangail, India	Sap Seed (decoction)	Diarrhea Stomach ache Dysentery	Anisuzzaman et al., 2007
	Paliyar tribals	Dindigul, India	Fruits	Laxative, Strengthen body	Mayilsamy and Rajendran, 2013
	Angul forest division	Mandaragiri, India	Fruits	Cardio tonic Aphrodisiac seminal weakness, General debility	Pradhan et al., 2014
	Shivalik Hills	NW Himalaya, India	Fruit juice	Constipation, General weakness	Devi et al., 2014
	Local peoples	Islamic University, Bangladesh	Fruit juice	Gonorrhea, Cough, Fever	Masum et al., 2013
	Tribals of Chora village	Bhadrawati, Chandrapur, India.	Fruits	Headache, Piles, Fever Arthritis, Tonic Cold flu	Harney, 2013
	Yanadi tribal populations	Chittoor, India	Roots	Dysentery	Sudha and Reddy, 2014
	Peoples	Kathua, India	Roots Fruit	Tooth ache Good source of vitamins B and C	Kumar and Bhagat, 2012
	West Bank (bordering Israel and Jordan)	Palestine	Fruits Fruit juice Gum	Diuretic, Diabetes, Demulcent Cooling agent, Laxative Diarrhea, Genitourinary	Jaradat et al., 2016
	Locals of Noshpho salt mine	Karak, Pakistan	Crude drug	Eaten raw, Tonics, Fodder	Khan et al., 2011
	Ethnomedicinal Flora	Mandi Bahaudin, Pakistan	Fruits	General body weakness	Nisar et al., 2011
	Bantar of Bhaudaha,	Morang, Nepal	Sap	Diarrhea, Stomach ache	Acharya and Pokhrel, 2006
	Local peoples, Mithakhel	Karak, Pakistan	Fruit, Root, juice	Tonic, Laxative, Toothache	Daud, 2014
	Local peoples	Mianwali, Pakistan	Fruit, Root, Juice	Toothache, Tonic, Cooling, Laxative	Ghani et al., 2006
	Subarnachar upazilla	Noakhali, Bangladesh	Juice of root seedling	Fever	Uddin et al., 2011
	Kani tribals	Tirunelveli hills, Western Ghats, India	Fruit	Male fertility, Body strength	Ayyanar and Ignacimuthu, 2011

formulations that with their plant parts, mode of preparation and applications with dose and duration are presented in Table 5.

Non medicinal uses

The different plant parts of *P. sylvestris* are utilized by local habitants for their routine life requirements. The trunk is used as a supporting beam of the roof in the construction of houses and also used for changing the path of water into the turbines of water-mills (Punjani, 2002). In Bangladesh and India, about 70% of the population resides in villages and their earning sources mainly rely on tree-based products, agriculture and landholdings (Uddin et al., 2011). The leaves are frequently used for preparing floor mats, brooms and hand fans among other things. (Kumar and Bhagat, 2012; Reddy et al., 2008; Rekha and Kumar, 2014), while long spines and plant spines are used for preparing a toothbrush and traditional needles, respectively. The plant juice (Neera) is collected by the peoples for preparing jaggery and toddy and thus the cultivation of the date palm has now been considered as a reliable source of household income (Dinesh et al., 2013). Worldwide, wild date palm flowers are extensively used in the preparation of sugar and alcohol. The sweet fruits of this plant are consumed as picked as well as in the form of a jelly. Regular consumption of date palm improves the fat content of milk in farm animals (Patil et al., 2014).

The stem and leaf of *P. sylvestris* and other varieties of palms are extensively utilized as construction materials of hutments by forest dwellers. The central soft part of the stem of *P. sylvestris* and other varieties of this plant are considered a rich source of starch. Tribals of the Khasia hills cultivate *P. acaulis* and P. *humilis* for bread preparation using the palm powder (Kulkarni and Mulani, 2004). The sap from *P. sylvestris* is extensively used for preparing sugar and traditional sweet Bengali cuisine (Ahmed, 2007). In southeastern Bangladesh, rural farmers depend upon date palm cultivation for their seasonal livelihood.

Phytochemical studies

The chemical composition of palmyra (*Borassus flabellifer*), sago (*Caryota urens*) and neera (*Phoenix sylvestris* sweet juice) was reviewed by Rao et al. (1970). They revealed that neera contains thiamine, vitamin B12, ascorbic acid, nicotinic acid, minerals, non-reducing sugars and reducing and amino acids. They advocated that neera possesses good nutritive value due to its abundance of vitamins and minerals.

Rangaswami (1977) and Dalibard (1999) reported that the fruits of *P. sylvestris* contain tannins, sugars, mucilage, vitamins A, B and D, ascorbic acid, and free amino acids—mainly alanine, with carbohydrate (33.8%), minerals (1.7%), protein (1.2%), enzymes (3.7%), phosphorus (0.38%), calcium (0.002%) and fatty acid (0.4%).

Parmar and Kaushal (1982) reported the fruit pulp of *P. sylvestris* contained: protein (3.261%), total soluble solids (18.42%), sugars (18.42%, mostly reducing); vitamin C (9.42 mg/100 g), pectin

Table 5
Herbal formulation of *P. sylvestris* used in different regions of world.

S. No.	Tribe/area	Region	Formulation	Uses	Reference
1	Local population resides in forests and villages	Chhattisgarh, India	Janamaghutti prepared from powder of Harra (*Terminalia chebula* L.), Jaiphal (*Myristica fragrans*), Haldi (*Curcuma longa*), Chhuhara (*P. sylvestris* Roxb.), Badam (*Prunus amygdalus* Batsch) rubbing with mother's milk and given to children up to 8 mth old	Develop resistance against diseases	Dewangan et al., 2011
2	Local peoples	Nizamabad, India	20–40 mL of leaf extract of *Coccinia grandis* (L.) with one teaspoon of seeds of *Cuminum cyminum*, sugar and volume is made up with a toddy of *P. sylvestris* up to 200 mL and given orally once a day for 5 d	Dissolve kidney stone	Dinesh et al., 2013
3	Mancherial and Jannaram reserve forest division	Adilabad, India	A cup of *P. sylvestris* toddy is mixed with a half teaspoon of tender tips paste of *Soymida febrifuga* administered twice daily for a week	Body pains	Krishna et al., 2014
4	Tribal communities	Chhattisgarh, India	Beverage (*chind*)	Alcoholic	Ekka, 2012
5	Different tribes —Gonda, Munda, Kondhs Kharias, Bhumiji	Deogarh, India	200 mL *P. sylvestris* toddy (sap) taken and mixed with fresh leaf juice of *Woodfordia fruticosa* (10 mL) taken on an empty stomach early morning and at noon for 2–3 d	Irregular menstrual	Sahu et al., 2010
6	Localized people	Vizianagaram, India.	Leaf and tuber are ground together and the paste massaged under the foot	Burnings sensation	Padal et al., 2013
7	Rural and tribal people	Bangladesh	A paste prepared from aerial roots and leaves of *Vanda tessellata* and grounded with tender buds of *P. loureirii*	Plastering bone fractures	Hossain, 2009
8	Localized people	West Bengal, India	The root of *Achyranthes aspera* L. and the seeds of *P. sylvestris* are ground up and chewed with betel leaves (*Areca catechu*)	Ague	Barrow, 1998
9	Pathardi areas	Ahmednagar, India	Tooth powder prepared from the dried root powder of *P. sylvestris* mixed with one teaspoon of sunth (*Zingiber officinale*) rhizome powder and used once a day early morning	Dental caries and toothache	Punjaji, 2012
10	Folk Medicinal Practitioners	Narail, Jessore, Bangladesh	Macerated swollen base juice of *P. sylvestris* mixed with lime water	Helminthiasis	Biswas et al., 2011
11	Ethnic people	Medak, India	Paste prepared from stem bark of *Soymida febrifuga* and mixed with a *Phoenix sylvestris* toddy is administered daily once for 3 d	Gynecological disorders	Reddy et al., 2010

(0.51%), ash (0.549%), phosphorus (1.12%), moisture (66.7%), calcium (0.139%), magnesium (0.042%), potassium (0.006%) and iron (0.007%).

The fresh juice from the tree contains nicotinamide, thiamine, aspartic acid, nicotinic acid and reducing sugars and the seed contain fatty acid—principally palmitic, oleic and linoleic acid (Ghani, 2003).

Hemoglobin deficiency in male anaemic individuals can be well treated by the administration of Wild date (*P. sylvestris* Roxb.), Palmyra (*Borassus flabellifer* L.), and Coconut (*Cocos nucifera* L.) sap as described by Barh and Mazumdar (2008). Their analysis showed that the palm saps from all three species contain high nourishing value. Fresh date palm contained the highest amount of total sugars, Zn, P, Ca, Fe, Cu and niacin followed by male Palmyra which was richest in vitamin A; Coconut had high amounts of Na and K. In addition, the thiamin; riboflavin and niacin level were dramatically increased in fermented date and male Palmyra sap.

The chemical composition analysis of *P. sylvestris* sap was carried out by Salvi and Katewa (2012) who found that it contained high amounts of carbohydrate (85.83%), appreciable amounts of reducing sugar (3.95%), crude protein (1.08%), crude lipid (1.15%), crude fiber (0.18%) and ash (0.46%). Mineral composition analysis identified potassium (80 mg/100 g) followed by calcium (4.76 mg/100 g) sodium (18.23 mg/100 g) and magnesium (2.23 mg/100 g) along with vitamin B3 (12.3 mg/100 g) and vitamin C (12.75 mg/100 g). They reported that the palm heart of *P. sylvestris* is rich in carbohydrate and protein and has low amounts of minerals compared with the palm heart of *Euterpe* spp. In addition, they advocated that palm heart of *P. sylvestris* as a good nutritive supplement and can be used as a good alternative to cabbage or vegetables to alleviate hunger and malnutrition.

Girhepuje et al. (2015) observed an alteration in the physiochemical properties in Wild date palm (*P. sylvestris*) sap during its

peak production period (December to February, 2012–13, 2013-14). The results indicated that the specific gravity of the sap changed little from 1.041 to 1.052 during December to February while the total soluble solids (TSS) were at a maximum during February (14.33%). In addition, chemical composition analysis revealed that the sap had the highest pH (6.75), lowest acidity (0.04%) and the sugar/acid ratio decreased from 325.47 to 42.93, with the ascorbic acid content being 14.58–13.75 mg/100 mL and the total sugar content being 11.72–12.50% during January to February. The sap also contained ample amounts of phenol ranging from 67.90 mg/100 mL to 81.47 mg/100 mL. The overall study showed that the Wild date palm sap is a good nutrient supplement with ample amounts of carbohydrates and vitamin C.

Phytochemical evaluation of the leaves of Date palm was carried out by Nadia et al. (2013). The results showed the presence of many secondary metabolites such as tannins, alkaloids, terpenoids, carbohydrate, phenols, amino acids and flavonoids.

Cholesterol, β-amyrin, β-sitosterol and quercetin were isolated from the butanol and chloroform extracts of male flower inflorescence of *P. sylvestris* Roxb. In addition Lupeol, epilupeol and β-sitosterol were isolated from the carbon tetrachloride and n-hexane soluble fraction of a methanol extract of the leaves of *P. paludosa* Roxb. by Hasan et al. (2010) and Alam et al. (2009), respectively.

Ogungbenle (2011) determined the proximate, sugar, minerals and fatty acids compositions of fruits of Date palm revealing that the ether extract value, moisture content, crude fiber content, carbohydrate content and crude protein content were 1.54 ± 0.01%, 5.24 ± 0.05%, 4.34 ± 0.03%, 80.87 ± 0.05% and 4.94 ± 0.04%, respectively. The fractions of sugar contained fructose (22.8 mg), glucose (22.3 mg) and maltose (33.7 mg). The most abundant mineral in the sample was potassium (710.0 mg). The most concentrated fatty acids available in Date palm were oleic acid (44.51 g/100 g), palmitic acid (23.05 g/100 g) and linoleic acid (11.66 g/100 g).

Phytochemical screening of crude hexane, dichloromethane and methanol leaf extracts of *P. sylvestris* was performed by Sharma et al. (2016). The crude extracts showed the presence of alkaloids, flavonoids and phenols. Methanol extract was further fractionated by column chromatography and GC-MS analysis. These studies showed the presence of various biologically active compounds such as aldehydes, alcohols, flavonoids, phenolics, aromatic compounds, terpenoids and fatty acid methyl esters.

The physico-chemical characteristics and antimicrobial activity of Oil palm syrup, Raffia palm syrup and honey were analyzed by Oboh et al. (2016). All three samples contained mainly carbohydrates (64.76–68.79%) and water (28.05–31.50%). They exhibited similar densities (1.23–1.26 g cm^{-3}) and pH (3.51–4.18), and had low contents of ash (0.30–0.50%), lipid (2.20–3.62%) and protein (0.24–1.04%). They had modest contents of Fe (2.35–3.30 mg/100 g), Ca (37.06–79.05 mg/100 g) and phenolic compounds (4.19–6.27 mg gallic acid equivalent- (GAE)/100 g), and were rich in potassium (325.12–628.56 mg/100 g) along with non-enzymatic browning products.

Shakya and Singh (2014) isolated and evaluated polysaccharide from *P. sylvestris* as a carrier for trans-soft palatal delivery of Pioglitazone hydrochloride. The results of study revealed that biomaterial derived from the fruits of *P. sylvestris* can serve as a promising mucoadhesent for formulating the mucoadhesive disks of Pioglitazone hydrochloride improving its residence time in the body.

Pharmacological studies

Selvi and Rajkumar (2012) determined the acute and chronic toxicity of ethanolic extract of roots of *P. sylvestris* Roxb. (EPS) in rats. General behavioral adverse effects and mortality were recorded for 14 d. In the chronic toxicity study, the EPS was administered in rats orally at doses of 100, 200 and 400 mg/kg once in a week for 6 wk and biochemical and hematological parameters were determined. The acute toxicity study revealed that the EPS values were nontoxic and safe up to a dose of 2000 mg/kg body weight. In the chronic toxicity study, EPS did not cause any biochemical behavioral changes in rats and was found to be safe. Similar results were also obtained by Gandhimathi and Sreedevi (2012).

The anthelmintic activity of the ethanolic root extract of *P. sylvestris* Roxb. examined by Islam et al. (2014) reported that the ethanolic extract significantly decreased paralytic duration and death mortality time of the nematode *Haemonchus contortus* and showed dose dependent activity.

The lethal dose 50% (LD_{50}) values of methanol, chloroform and butanol extracts of the male flower inflorescence of *P. sylvestris* in brine medium were determined by Mohtasheem et al. (2001). The results showed that the methanolic and butanolic extracts were significantly toxic to the shrimps, while the chloroform extract was found to be non-toxic. Similarly Islam et al. (2014) investigated the cytotoxic properties of ethanolic root extract of *P. sylvestris* Roxb. against brine shrimp nauplii. The extract exhibited low toxicity inhibitory concentration 50% (IC_{50} 58.745 μg/mL) against brine shrimp nauplii compared to standard vincristine sulphate (IC_{50} 0.6449 μg/mL).

The antimicrobial screening and brine shrimp lethality bioassay of n-hexane and the carbon tetrachloride soluble fraction of a methanol extract of the leaves of *P. paludosa* Roxb. were performed by Alam et al. (2009). Their findings showed that fractions were completely insensitive to microbial growth, while the *n*-hexane, chloroform and methanol soluble fractions showed significant cytotoxicity having lethal concentration 50% (LC_{50}) values of 2.17 μg/mL, 2.77 μg/mL and 2.46 μg/mL, respectively. Similarly, Lima et al. (2010) prepared ethanolic extracts from leaves of *P. paludosa* and examined the cytotoxic activity using brine shrimp lethality bioassay. The results suggested that the ethanolic extract was moderately cytotoxic with LC_{50} and LC_{90} values of 6.67 μg/mL and 34.81 μg/mL, respectively.

The *in vitro* antibacterial activity of different extracts of seeds of *P. sylvestris* Roxb. and *Tricosanthes dioica* L. against Gram-negative and Gram-positive bacteria was investigated by Kothari, (2011), using disc diffusion and broth dilution methods. The outcomes of their study demonstrated that the ethanol extract of *P. sylvestris* was most active (bacteriostatically) against both Gram-positive and Gram-negative organism strains with minimum inhibitory concentration values of 410 μg/mL and 481 μg/mL against *Staphylococcus epidermidis* and *Salmonella paratyphi A*, respectively. Phytochemical screening revealed the presence of phenols, alkaloids, and flavones in the extracts.

Sharma et al. (2016) isolated methanol purified fractions from methanolic leaf extracts of *P. sylvestris* that exhibited better antioxidant activity, antibacterial activity and cytotoxicity against J774 and THP1 cell lines with significant reactive oxygen species (ROS) generation compared to crude extract.

Ramanuj et al. (2012) determined the minimum inhibitory concentration of seed extracts along with four different plants including *P. sylvestris* using broth dilution assay. *P. sylvestris* showed significant inhibitory activity against various pathogenic microbes such as three yeasts (*Malassezia furfur, Candida albicans, Saccharomyces cerevisae*), one mold (*Aspergillus flavus*) and one anaerobic bacterium (*Propionibacterium acnes*).

Similarly, the antimicrobial activity of *Emblica officinalis, Tamarindus indica, Manilkara zapota, P. sylvestris* and *Syzygium cumini* seed extract was screened against pathogenic microbes and multidrug resistant *Streptococcus mutans* (a major pathogen associated

with human dental caries) in its planktonic as well as biofilm form by Patel et al. (2013). The authors evaluated the ability of these extracts to eradicate *S. mutans* biofilm. All the extracts showed significant activity against all strains. Interestingly, *P. sylvestris* was found ineffective against *S. pyogenes*.

The erythropioetic activities of some medicinal plants such as *Boerhavia diffusa, Aegel marmelos, Eugenia jambolana, Asparagus recemosus, Spinaca oleracean, Carissa congesta, Ficus carica, Phyllanthus emblica, Vitis vinifera* and *P. sylvestris* were determined using Wistar albino rats. Different extracts of these plant parts (fruit, leaf and root) were fed to experimental rats for seven consecutive days to evaluate their effects on hematological parameters such as red blood cells count and haemoglobin. The results revealed that *P. sylvestris, Phyllanthus emblica,* and *Vitis vinifera* caused significant improvement in their haematological parameters (Lohar et al., 2009).

Similarly, Barh and Mazumdar (2008) found *P. sylvestris* sap had high nutritive value in terms of micronutrients and vitamins. Fresh and fermented Date sap was especially rich in iron and vitamin-B complex, respectively. The researchers suggested the balanced administration of fresh and fermented Date sap alone could be used for the treatment of hemoglobin deficiency in anemic patients and to improve the vitamin B12 level in the body. A sap mixture containing vitamin B complex with an iron tonic could provide more beneficial effects to the patients than either the sap or vitamin B complex or iron tonic alone.

Lima et al. (2010) evaluated the antidiarrheal activity of the crude ethanolic extract of the leaves of *P. paludosa* using castor oil-induced diarrhea in mice. The extract showed dose dependant activity and reduce the frequency of liquid stools in rats.

The analgesic and diuretic activities of the methanol extract of roots of *P. sylvestris* on Swiss albino mice were examined by Howlader et al. (2006). The extract significantly ($p < 0.001$) reduced the percentage inhibition of writhing induced by acetic acid (0.5% v/v) at a dose level of 150 mg/kg and 300 mg/kg body weight, respectively. The extract also had a diuretic effect at the 1st, 2nd and 4th hours at both 150 mg/kg and 300 mg/kg body weight in rats. The onset of the diuretic effect was faster at a dose of 300 mg/kg body weight than at 150 mg/kg body weight. In the same way, the analgesic activities of the ethanolic extract of leaves of *P. padulsa* were studied in acetic acid-induced writhing in mice by Lima et al. (2010). The authors found that leaves of *P. padulsa* had a significant ($p = 0.009$) analgesic effect. Kumar et al. (2010) also reviewed the analgesic activity of the methanol extract of roots of *P. sylvestris* on Swiss albino mice.

The anti-ulcer activity of the ethanol extract of root of *P. sylvestris* Roxb. (EPS) was evaluated in ethanol, indomethacin, pyloric ligation and cold-restraint, stress-induced gastric ulcer models in albino rats by Gandhimathi and Sreedevi (2012). The ethanol extract of the root of *P. sylvestris* Roxb. exhibited anti-ulcer properties via cytoprotective mechanism. EPS at doses 200 mg/kg and 400 mg/kg showed marked reduction in the ulcer severity in all four models.

Mukherjee et al. (2014) and Das et al. (2015) determined the anti oxidant activity of methanolic, acidic ethanolic and basic ethanolic extracts of the fruit of *P. sylvestris* L. in different *in vitro* assays, namely hydroxyl radicals, the DPPH radical, superoxide radicals, nitric oxide and lipid peroxidation (LPO) The results of the study revealed that the Date palm extracts significantly reduced the oxidative stress at the *in vivo* and *in vitro* level. Similarly, Prakash et al. (2013) evaluated total phenolic contents (TPC), antioxidants (AOA) and free radical scavenging activities (FRSA) of some fruits and their underutilized parts of *P. sylvestris, S. cumini, Ziziphus jujuba, and Zanthoxyllum acanthopodium* and *Protium serratum*. The leaves of *P. sylvestris* contained TPC (73.8 mg/g) and the fruits of *P. sylvestris* exhibited high amounts of TPC (69.4–128.6 mg/g GAE). The inflorescence and leaves of *P. sylvestris*, fruits of *P. serratum, S. cumini* and *Psidium guajava* had reasonably good AOA (60.7–84.9%). In addition, the authors performed DNA nicking assay on fruit extracts of *P. sylvestris, P. serratum* and leaves of *Z. acanthopodium* using supercoiled pBR322 plasmid. All the plants effectively prevented pBR322 DNA nicking.

The allergenic potential was also evaluated for the pollen of *P. sylvestris* Roxb. in the air of Greater Calcutta by Chakraborty et al. (1999). Pollen extract of *P. sylvestris* was fractionated using $(NH_4)_2SO_4$ and a Sephacryl S-200 column. The allergenicity of each fraction was checked using a skin test and immunoglobulin E, enzyme-linked immune sorbent assay (ELISA) inhibition. *P. sylvestris* pollen grains were found to be prevalent in the air of the suburban zone of Calcutta from January to March with a peak in February. The pollen extract showed a high (44.07%) positive skin reaction on 540 respiratory allergic patients.

The anti-nociceptive and neuro pharmacological activities of methanol extract of *P. sylvestris* fruit pulp (MEPS) were determined in heat-induced (tail immersion test, hot plate) and chemical-induced pain models (glutamate-induced nociception, acetic acid-induced writhing, paw edema test and formalin-induced nociception). The effect of MEPS on the central nervous system was studied using the sodium thiopental-induced sleeping time, hole cross test, elevated plus maze test and open field test. MEPS exhibited strong, significant and dose-dependent anti nociceptive activity in the chemical-induced and heat-induced pain models at all experimental doses. In addition, MEPS displayed good locomotor activity and anxiolytic activity in the elevated plus maze test (Shajib et al., 2015)

Rathod et al. (2014) reported on the antilithiasis activity of roots of *P. sylvestris* and suggested the use of *P. sylvestris* in the treatment of urinary disorders and polyurea. Das et al. (2012) determined the α-glucosidase and α-amylase inhibitory properties of extracts of 16 edible indigenous fruits of West Bengal, India. The outcome of the study demonstrated that among the 16 fruit extracts, the aqueous extracts of *P. sylvestris* exhibited very potent α-amylase and α-glucosidase inhibitory properties with IC50 values of 5.0 μg/mL and 9.0 μg/mL, respectively.

Powdered seeds (pits) of *P. sylvestris* can be used to prepare economic adsorbent for the management of various poisoning events including paracetamol as reported by Khan et al. (2012).

In addition to their good mineral and phytochemical contents, the palm syrups could be useful (like honey) as an antimicrobial substance that can be used as a food preservative and medicinal agent. Oboh et al. (2016) examined the antimicrobial activities of honey solutions (0.1 mL, 0.5% aqueous solutions) of honey (containing 360 μg dry matter) and syrups (raffia, 360 μg and oil palm, 340 μg dry matter) and compared them with streptomycin. Both preparations exhibited antimicrobial activity against most pathogenic strains of *P. aeruginosa*, *B. cereus, E. coli* and *S. aureus*.

Nyman et al. (1998) reported that tannin containing extracts of *P. roebelinii*, showed significant inhibition of angiotensin converting enzyme ACE (79.7 ± 7.5%). After the removal of tannins, a marked reduction in ACE inhibition (8%) was observed. The authors suggested that the presence of tannins was responsible for the biological activity. Similarly, Braga et al. (2007) reported that *P. roebelinii* caused significant ACE inhibition (48%) at a concentration 0.33 mg/mL. Along the same line, Das and De (2013) evaluated the ACE inhibitory properties of a few underutilized minor fruits of West Bengal using ACE isolated from rabbit lung. The outcome of study showed that fruits of *P. sylvestris* have impressive anti ACE property (90.68 ± 9% inhibition) compared to the standard (99.29 ± 1.11%).

In conclusion, *P. sylvestris* has been considered as having medicinal properties and has been used in the treatment of abdominal complaints, fevers, loss of consciousness, constipation, heart complaints, toothache, nervous debility and helminthiasis. This review focused on the phytochemical and pharmacological and traditional uses of Wild date palm (*Phoenix sylvestris* Roxb.). The plant contains vitamins, minerals, enzymes, amino acids, minerals, reducing and non-reducing sugars, amino acids, tannins, proteins, steroids and flavonoids. It is a good source of natural antioxidants, nutritional supplements and its plant parts are widely used as functional foods in the food industry. The plant exhibits many pharmacological activities having anti oxidant, anthelmintic, antimicrobial, cytotoxic, erythropioetic, antidiarrhoeal, analgesic, diuretic, anti-ulcer, antihypertensive and antidiabetic properties. Toxicity studies on *P. sylvestris* concluded that the extracts were quite safe and had no toxic effects at preclinical levels. These reviews strengthen the traditional claim of *P. sylvestris* as reported in the literature of Ayurveda.

Conflict of interest

The author declares no conflict of interest.

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