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Medicinal and therapeutic properties of pecan (*Carya illinoensis*)

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Abstract
Carya illinoensis is a widespread species, belonging to the Juglandaceae family, commonly known as Pecan. It is one of the most economically important members of the genus *Carya.* Nutritional value of pecan is very high. Popularly, the leaves have been used as a hypoglycemic, cleansing, astringent, keratolytic, antioxidant, and antimicrobial agent. The detailed pharmacological investigations are required for this plant so that the medicinal activities of this plant could further be exploited.

Keywords: *Carya illinoensis*, antioxidant, hypoglycemic, astringent, antimicrobial

1. Introduction
Carya illinoensis (Wang) K. Kocbelongs to the family Juglandaceae, is an important edible nut crop and one of the most economically important member of the genus *Carya*. Pecan is native to North America. The natural range extends from north – central USA to northern Mexico. It is also produced at commercial level in Australia, Brazil, Canada, Israel, Mexico and South Africa, though USA is the leading producer. In USA, it is considered 'Queen of Nuts' because of its value both as wild and as cultivated nut [1-3].
Pecan can be grown successfully in areas having an elevations of about 914-1829 m above mean sea level [4]. Areas free from severe spring frost and excessive heat in summer, which characterize a mild temperate climate, are well suited for its successful cultivation. Pecan nut is the one of the most important temperate nuts grown in India. In India, it is mainly grown in Jammu and Kashmir, and Himachal Pradesh. Nutritional value of the nut is very high. It is a rich source of fat (71.43%) and protein (12.05%). The pecan nuts are commonly used to add aroma, flavour, crisp ness, rich colour and to garnish a large number of dishes. However, most commonly, it is used in baking of dishes and in ice creams. Pecan shell, a by- product is also used to manufacture tannin, charcoal and abrasives in preparation of hand soap. The pecan tree is valuable as timber too, due to its strength and hardiness. There is a great demand for its veneer and lumber in decorative paneling, fine furniture, and flooring and in pallet manufacturing [5].

2. Plant Characteristics [6].

Duration	:	Perennial
Habit	:	Tree
Leaf type	:	deciduous
Leaf arrangement	:	Alternate
Leaf shape	:	Lanceolate
Leaf venation	:	pinnate
Fruit type	:	Nut
Leaf	:	yellow green
Size class	:	70- 100ft.

Fig: *Carya illinoinensis*

3. Phytochemistry

The moisture, protein, lipid, total soluble sugars and ash contents in pecan range from 2.1% to 6.4%, 6% to 11.3%, 65.9% to 78%, 3.3 to 5.3% and 1.2% to 1.8% respectively. Unsaturated fatty acids oleic (52.52-74.09% and linoleic (17.69-37.52%) are the predominant unsaturated fatty acids [7]. The plants are reported to be rich in phenolics notably, flavonoid glycosides and aglycones, galloylated glycosides and condensed tannins building units [8-10].

4 Pharmacological activities

4.1 Antioxidant activity

Common foods and vegetables were screened across the US and pecan kernels were reported to have the highest antioxidant capacity (AC) and total extractable phenolic content (TP) within the nut group. Pecans were ranked among the foods with highest phenolic content. [11]. Six pecan cultivars were analyzed for their antioxidant capacity (AC), total phenolics (TP), condensed tannin (CT), HPLC phenolic profile, tocopherol and fatty acid composition and it was found that phenolic compounds with high antioxidant capacity is in kernels and shells [12].

4.2 Anti-mycobacterial activity

Medicinal plants traditionally used to treat respiratory diseases are a potential source of compounds to treat tuberculosis. The Bark and leaf crude extracts of *Carya illinoensis* (Wangenh) K. Koch showed *in vitro* anti-Mycobacterium tuberculosis activity. Hexane bark extracts from C. illinoensis were the most active with a minimal inhibitory concentration (MIC) of 31µg/mL. Ethanol bark extracts from *C. illinoensis* showed activity at 100 µg/mL [13].

4.3 Anti-diabetic activity

Compounds from the *n*-butanol fraction (BF) of bark of Pecan tree, *Carya illinoinensis* (Wangenh) K. Koch (Juglandaceae) were investigated for their hypoglycaemic, antioxidant as well as the aldose reductase (AR) inhibitory effect in streptozotocin diabetic rats. Many of the isolated compounds showed significant hypoglycaemic and antioxidant activities and a marked AR-inhibitory effect was also identified for some of the compounds [14]. Pecan shell aqueous extract (PSAE) were evaluated in diabetic and hypercholesterolemic Wistar rats. Animals were orally administered PSAE (100 mg/kg body weight, b.w.) for 28 days. PSAE treatment decreased the blood glucose level and stabilized clinical signs of diabetes in streptozotocin induced diabetic rats [15].

4.4 Antimicrobial activity

Antimicrobial activity of *Carya illinoinensis* was tested against 20 microorganisms by determining the minimum inhibitory concentration (MIC). Phenolic acids (gallic acid and ellagic acid), flavonoids (rutin), and tannins (catechins and epicatechins) were identified by HPLC-DAD and may be partially responsible for the antimicrobial activity against Gram-positive, Gram-negative, and yeast. The results showed MIC values between 25 mg/mL and 0.78 mg/mL. The extracts were also able to inhibit the production of germ tubes by *Candida albicans* [16].

4.5 Anticancer activity

Effect of *Carya illinoinensis* shell aqueous extract (AE) on toxicity induced by cyclophosphamide (CP) in the heart, kidney, liver, bladder, plasma and erythrocytes of rats was studied. Rats treated with cyclophosphamide (CP) showed an increase in lipid peroxidation (LP) and decrease in reduced glutathione (GSH) levels in all structures. Catalase (CAT) activity was increased in the heart and decreased in liver and kidney. Besides, CP treatment decreased plasmatic vitamin C (VIT C) levels and induced bladder macroscopical and microscopical damages. In contrast, co-treatment with pecan shell AE prevented the LP development and the GSH depletion in all structures, except in the heart and plasma, respectively. CAT activity in the heart and liver as well as the plasmatic VIT C levels remained unchanged. Finally, AE prevented CP-induced bladder injury. The findings revealed the protective role of pecan shell AE in CP-induced multiple organ toxicity [17].

4.6Effect on lipid profile: Pecan kernels may improve human serum lipid profile and lower low density lipoprotein levels, due to their high monounsaturated fatty acid content [18]. Pecan shell aqueous extract (PSAE) diminished the increase in total cholesterol and triglyceride levels in hypercholesterolemic rats [19].

5. Conclusion

Pecans considered as 'Queen of Nuts' because of its value both as wild and as cultivated nut. It has a good nutritional value as well as antioxidant, antidabetic, antimicrobial, anticancer properties. It is also effective against high cholesterol levels and against tuberculosis. We do not found any literature regarding anthelmentic, antiviral, hepatoprotective properties of this plant. So pharmacological investigations regarding various activities of this plant can be done so that the medicinal activities of this plant could be exploited.

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