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Caryota Urens- Underutilized Multipurpose Medicinal Plant

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ABSTRACT

Caryota urens (Shivjata) is one of the most important underutilized medicinal plants. It is distributed widely in Asia. Each part of the plant has some important medicinal value. It is now considered as an important source of several novel products for medicine against various diseases. The present review is to focus on the beneficial phytochemicals and pharmacological activity of plant *C. urens*. Various parts of the plant like seeds, leaves, flowers, phloem sap, and fruits have been investigated for their significant pharmacological activity. Phytochemicals like flavanoid, glycoside, alkaloid, essential oils, tannin, saponins, oxalic acid, terpenoid have been reported for significant hair tonic, antioxidant, antifungal, antibacterial, anti-inflammatory, antidiabetic and remediating activities of *C. urens* and emphasize the need for further exploring available information.

KEYWORDS: *Caryota urens*, Anti-inflammatory, Anti-bacterial, Antifungal, Antioxidant, Antidiabetic activity

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INTRODUCTION

Plants are an important source of drug from ancient times. The most of world population use plant-based medicine due to their easy availability, safer use, and affordability. Medicinal plants, the world's oldest drugs are useful in traditional medicine. These plants are not only used for primary health care, but also as pharmaceuticals. Knowledge regarding traditional medicine is very significant and forms the basis for the development of plant-based drugs. Instead of the modern medicine, traditional medicine are used in a large portion of the population, mostly in the rural areas.[1]

Palms are the most beneficial plants in the tropical region. *Caryota urens* L (family: Arecaceae) is underutilized multipurpose palm species which is native to a low land forest of tropical Asia including, India, Malaysia, Indonesia, Burma, Philippine, and Srilanka.[2] They are commonly known as fishtail palm, toddy palm, wine palm, jaggery palm, elephant's palm and Indian sago palm. *Caryota urens* is a handsome palm growing up to a height of 20m and a width of 0.3m with a smooth, cylindrical annulated trunk. The leaves are triangular in shape looking like a fish tail and the plant bears clusters of white, unisexual flower at maturity. The fruit matures to become round, 1cm (0.39) drupe and is red in colour.[3] The epithet urens is Latin for "stinging" alluding to the chemicals in the fruit. Due to the presence of calcium oxalate in *C. urens* fruit, causes skin and membrane irritation. It contains analgesic, anti-inflammatory, antidiabetic, antirheumatic, antimalarial, antioxidant, antimicrobial and larvicidal activity. Leaf is useful for curing hemicranias.[4] Root of the plant is reported for treatment of abortion, dysentery and tooth ailments.[5] Root bark and terminal bud are used for treating rheumatic swelling and snake bite. Tender Flowers are used for the improvement of hair growth and porridge prepared from flowers used for the treatment of gastric ulcer, migraine headache, snake bite poisoning as well as rheumatic swelling. In Ayurveda, this plant recommended for seminal weakness and urinary disorders. Palm heart used as flour but also used for diabetes control.[6] The bark and seeds of the plant are used for treating boils. [7-12] Traditionally, *C. urens* palm is used for its sweet phloem sap which is obtained from young inflorescence to produce treacle and jaggery and fermented beverages like toddy. [13] Starch obtained from stem which is used for making sago. Some sugar substitute obtained from juice of inflorescence called kithul honey or jaggery. Toddy is useful in controlling body pain when utilize in small quantity.

Plant description

C. urens is hermaphroditic, which is producing flower and leaf throughout the year. This palm prefers a rich, moist, cool but well-drained soil. It occurs from moist grassland at sea level, to

mountainous rain forests up to 1000 feet in an apex. *C. urens* is a slow-growing, shadow-tolerant or shadow-demanding species.

Geographical distribution

It is indigenous to a low land forest of tropical Asia.

World scenario

C. urens is cultivated in India, Malaysia, Indonesia, Burma, Philippine, and Srilanka.

Table No.1:"Taxonomical classification of *C. urens*"

Domain	**Eukaryota**
Kingdom	Plantae
Phylum	Spermatophyta
Subphylum	Angiospermae
Class	Monocotyledonae
Order	Arecales
Family	Arecaceae
Genus	Caryota
Species	*Caryota urens* L

Table No.2:"Indian synonyms of *C. urens*"

Tamil	kondapanei
Malayalam	Chuntappana
Sanskrit	Moha-karin
Hindi	Mari
Gujarati	Shivjata
English	Fishtail palm
Telugu	Jeelugu
Portuguese	palmeirajaggeri
Marathi	Bherlimaad
Kannada	Bagani
French	Palmier celery
Finnish	Malesianeväpalmu
Dutch	Jagerieboom
Burmese	Kimbo
Botanical name	*Caryota urens*

Characteristic features of Caryota urens

C. urens is an evergreen tall handsome plant growing up to 12-20m height and 30cm width. It is solitary trunk palm which is covered with leaf scar rings. Leaves are bipinate, triangular in shape and bright to deep green in color held on long petioles. Flower emerges at each leaf node from top to bottom and white in color. Fruits are round, yellow in color and become red when mature.[3]

Leaves: Leaves are large, compound, bipinnate, bright to deep green in color, 24-28 cm ×6-8 cm, and held 60cm long petioles. Leaflet triangular, irregularly cut, wedge- shaped, obliquely truncate, apex praemorse, the margin prolonged into a tail like a process which resembles with the lower fin of fish so-called fishtail palm. Leaf sheath smooth and fibrous netted. [14]

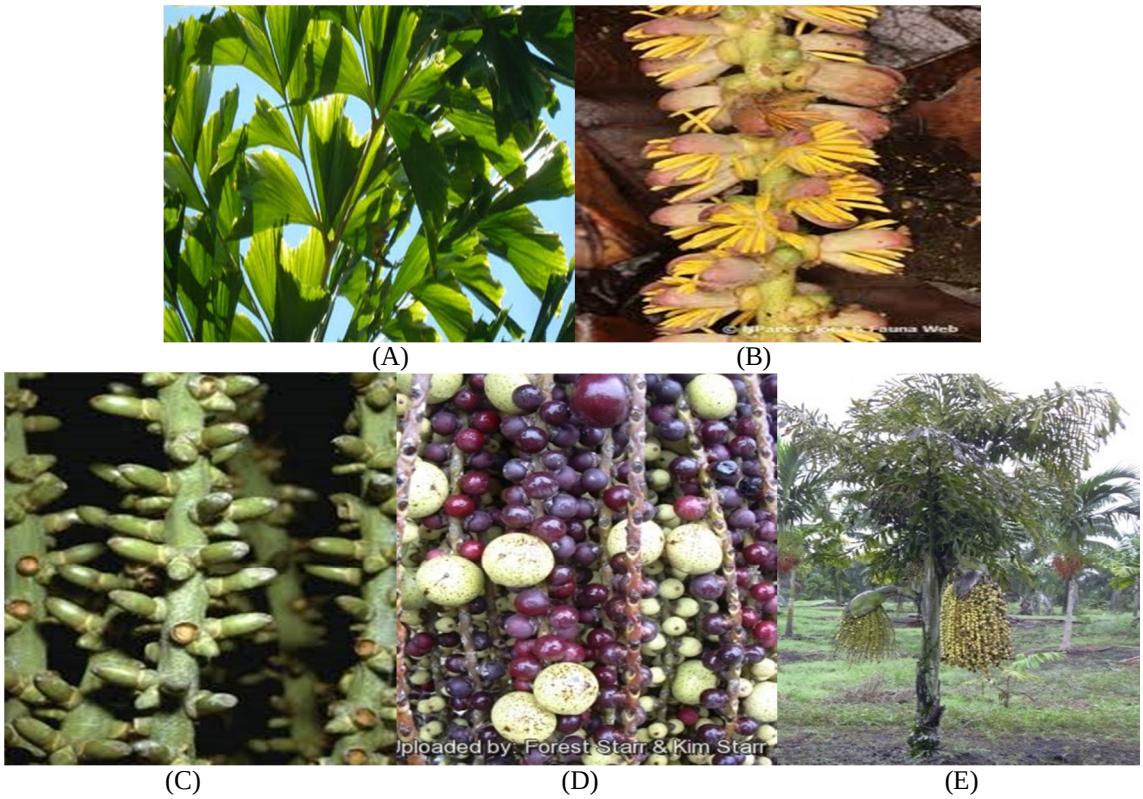
In Sri Lanka, *C. urens* leaves are used as a 'delicacy fodder' for domesticated elephants. The leaves contain 2% crude protein and 9.3% crude fiber for that purpose used as fodder. A very strong, fine, soft and durable fiber is obtained from the leaf bases. It is essential to make different products, but mostly brooms, brushes, ropes, baskets etc. It is also used for stuffing cushions.

Flowers: Inflorescence is spadix, 3m long and freely hanging around the palm and flower remains open on each inflorescence for six weeks. It produces a cluster of the white and unisexual flower. Unisexual flowers resulting in about 35000 to 40000 seeds per inflorescence.[15]

Kithul honey or jaggery made from juice of inflorescence of *C. urens* in a rural area. When extracted pure sap boiled and concentrated in large vessel to prepare dark brown and viscous golden syrup with a delicious flavor. Alternatively, the sap is further concentrated to give kithul jaggery. Inflorescence of *C. urens* phloem Sap is fermented with mixed inoculums of yeast to obtained toddy. The alcoholic beverage prepared from *C. urens* can be distilled, to prepare a more concentrated spirit. [16-17]

Fruits: Fruits are round and yellow in color but it matures to become red drupe about 1 cm wide and has a single seed. Seeds are spread by fruit bats and palm civets. [18]

Trunk and bark: Trunk is smooth and contains annular leaf scar. The mature wood is strong, heavy and sustainable. The stem gives timber used for construction purposes, especially in traditional buildings and also for rafting, roofing, partitioning, fencing, planking, and flooring. It is also useful as a food source.



(A) (B)

(C) (D) (E)

Fig.1 (A) Leaves (B) Flowers (C) Immature seed (D) Unripened and ripened fruit (F) Whole plant

Table No.3:"Common and medicinal uses of *Caryota urens*"

Plant parts	Common uses	Medicinal uses
Root		Tooth ailments
Stem	Planking, flooring, rafting, roofing, partitioning and fencing	
Bark		Boil
Flower	Sugar, toddy, alcoholic beverages	Hair growth, gastric ulcer, migraine headaches, snakebite poisoning and also rheumatic swellings, seminal weakness and urinary disorders.
Leaf base	Brooms, brushes, ropes, baskets, stuffing cushions, caulking boats, thatching.	
Seed		Boil, gastric ulcers, migraine headaches, snake-bite poisoning and rheumatic swellings.

Phytochemical analysis of Caryota urens

The leaves of *Caryota urens* contains different alkaloid, flavanoid, glycoside, steroid, terpenoid etc.[19]

Different primary and secondary metabolites reported in flowers of *C. urens*. Flower extracts of *C. urens* contains secondary metabolites like alkaloids, steroids, flavonoids, phenolics, glycosides, essential oils, tannins, saponins etc. and some primary metabolites are iron, magnesium, calcium, potassium, zinc, copper, nitrogen, phosphorous, sodium, sulfur, zinc, Boron, molybdenum and ash. [20]

Fruit extracts of *C. urens* contains alkaloid, flavonoid, carbohydrate, organic and inorganic compounds. *C. urens* fruit contains oxalic acid, crystal compound which causes skin irritation and not edible. Protein and amino acid are absent. [21]

Table No.4:"Phytochemical analysis of different parts of *C. urens*"

Plant parts	Phytoconstitutes	References
Flower	Alkaloids, glycosides, carbohydrate, flavonoids, saponin, phenolics, lignin, serpentine, tannin, triterpenoid, phytosterol, fixed oil and fats, gums/mucilage	(Charles *et al*.,2011)
	Ash, organic carbon, nitrogen, potassium, phosphorus, calcium, magnesium, sulfur, zink, copper, iron, manganese, boron, cobalt, molybdenum, sodium	
Fruits	Flavanoid, phenolic compound, carbohydrate, alkaloid, oxalic acid, malic acid and inorganic compounds	(Vaishnavi*et al*.,2013)
Leaves	Alkaloid, terpenoid, saponin, steroid, triterpenoid, glycosides, cardiac glycoside, gums and mucilage, phenol, tannin, flavonoid, oxalic acid, phytosterol, resin	(Kavitha*et al*.,2017)

Chemical constituents of Caryota urens

C. urens leaf, immature fruit and fruit skin studied for determination of chemical compound by methanolic extraction and GC-MS method. Methanolic extract of *C. urens* leaf contains 23

compounds, immature fruit contains 18 compounds and fruit skin extract has 25 compounds. Out of 66 compounds, the most frequently occurring compounds were stearic acid (28.51%), 10-undecenoic acid (12.86%), hendecynoic acid (18.09%) and caffeine (22.12%). [22]

The leaf base of *C. urens* was extracted with petroleum ether and benzene and then with methanol. From leaf base some other compounds identified which are Triacontane, Lupeol, Tetracosonid, Ursolic acid, Myricadiol, β-sitosterol. [23]

Table No.5:"Chemical constitutes of *C. urens*"

Plant parts	Chemical constituents
Leaves	Benzoic acid, Hexanoic acid, Nitrous acid, Dodecanoic acid, Linolenic acid,
	Lignoceric acid, Pyroglutamic acid, Pentadecanoic acid, 8-nonynoic acid,
	10-undecenoic acid, Oleic acid, Stearic acid, Aziridine, Cyclohexylester,
	2-oxabicyclo octane 3- one, 3,4-hexanediol, 1,3-Cyclohexane-1,3-D2-diamine,
	Palmitaldehyde, 9,12-Octadecadienoic acid, 11-Octadecenoic acid,
	Butyl propyl ester, N-ethyl acrilamide, 4-Hexen-2-one, 3-Methyl-
Immature fruit	Cyclopentanone, Stearic acid, Oleic acid, Palmitic acid, Hendecynoic acid,
	3-butenoic acid, Pthelic acid, Cyclopentaneundecanoic acid, 1,5-Heptadiene,
	(2E,6E)-Farnesol, Pyroglutamic acid, Decylenic alcohol, 11-Octadecenoic acid,
	Pyrogallol 1,3-dimethyl ether, 2-Methoxy-4-vinylphenol,
	Phenol, Acidecarbolique, 1,8-Nonadien-4-Ol
Fruit skin	4-flurobenzoyl, Cyclobutane, Nitrous acid, 1-propanol, Oxalic acid,
	Hexanoic acid, Isobutene, Oxetane, 1-butanol, Aziridine, Borezine,
	1-propanyl aziridine, Nonadecanoic acid, 2,2-Bis(trimethylsilyl)styrene oxide,
	Amylnitrite, Levoglutamide, 8-nonynoic acid, Bis(trimethylsilyl) ester,
	Isonitropropane, Dodecanoic acid, propanedioic acid, Isoxazolidine, Caffeine,
	Cyclopentaneundecanoic acid, 10-Undecynoic acid
Base leaves	Triacontane, Lupeol, Tetracosonid, Ursolic acid, Myricadiol, β-sitosterol

Antioxidant activity of Caryota urens

The ethanolic extract of flower reported for its antioxidant activity which was determined by the following methods like DPPH, Hydrogen peroxide, and reducing power scavenging activity which showed the inhibition percentage is 17.30%, 53.0%, and 44% respectively. The ethanolic extracts observed higher potential in Hydrogen peroxide assay. [24]

The Methanolic extract of leaves was investigated for its antioxidant activity at different concentration using hydrogen peroxide, reducing power and DPPH methods. *C. urens* leaves possess great antioxidant activity. [19]

C. urens leaves extract prepared in different solvents like crude ethanol, chloroform, ethyl acetate, and methanol. Antioxidant activity of all extracts was determined by total antioxidant activity, DPPH radical scavenging assay, and hydroxyl radical scavenging assay. The antioxidant activity of crude ethanol extract (CEE), chloroform fraction (CLF), ethyl acetate fraction (EAF) and methanol fraction (MNF) of *C. urens* leaves reported. The CEE of the *C. urens* leaves showed the highest total antioxidant activity compared to CLF, EAF, and MNF. The highest scavenging activity

of CEE observed in DPPH scavenging assay and the hydroxyl radical scavenging assay which is 42.36% and 53.36% with an IC50 value of 472.14 and 374.81 µg/mL respectively. [25]

C. urens sap also reported for its antioxidant activity. These are important and different actions of dietary antioxidants which help to control cellular damages that occur under oxidative stress conditions. [26]*C. urens* sap showed marked free radical scavenging activity, measured using DPPH (0.8±0.29 mmol TE/100 g) and ABTS+ (1.4±0.21 mmol TE/100 g) radicals. Free radical scavenging activity of *C. urens* sap that was estimated using DPPH radicals showed lower activity compared to the activity estimated using ABTS+ radicals. [27]

Antimicrobial activity of Caryota urens

Ethanol extract of flower possess antibacterial activity against *Clostridium septicum, Proteus mirabilis* and *Proteus vulgaris* and antifungal activity against Mucor at a concentration of 25µg/25µl.[24]

Methanol extract of fruit skin and immature fruit possess antibacterial activity against *E. coli* and *V. cholerae*. [22]

Methanol extract of leaf possess good antibacterial activity against *S. aureus* at 100 µg/ml concentration and antifungal activity against *Fusarium sp*.[19]

Carbon tetrachloride, chloroform extract of leaves active against *B. megaterium* and *S. lutea* respectively. N-hexane extract of leaves possess antibacterial activity against gram-positive bacteria *B. subtilis* and *B. cereus* but Chloroform extract possess good activity against gram-negative bacteria. [28-30]

Recent studies on the antimicrobial effect of *C. urens* had shown that the methanol extract of the leaves is also effective against some other bacteria such as *S. aureus, V. cholera, S. typhi* and *S. flexneri.*[31]

Larvicidal activity of Caryota urens

Larvicidal activity reported against dengue vector *Aedes aegypti*. The insecticidal activity of *Aedes aegypti* mosquito was determined by direct contact application.

Methanol extract of *C. urens* leaf possess larvicidal activity at various concentrations (100-400 µg/ml). The LC50 values of the leaf extracts were found to be 230 µg/ml. High larvicidal activities of methanol leaf extracts of *C. urens* is supported by the presence of phytochemicals such as steroids, saponins, and triterpenoids which possessed good insecticidal and pesticidal activity. [19]

Anti-inflammatory activity of Caryota urens

Anti-inflammatory activity of the *C. urens* leaf extract was studied by protein denaturation

method against egg albumin. Diclofenac sodium, a powerful non-steroidal anti-inflammatory drug was used as a standard. The standard anti-inflammatory drug diclofenac sodium showed maximum inhibition of 82.78% at the concentration of 400µg/ml. The maximum percentage of inhibition observed was 62.6% at 400µg/ml. It has been reported that the presence of phenols, terpenoids, and saponins in plants are related to the anti-inflammatory activity. [19]

Antidiabetic activity of Caryota urens

Anti-diabetic activity of *C. urens* flour was studied by α- amylase, and α- glycosidase enzyme inhibition assays. α- amylase enzyme having percentage inhibition were 8.42 ± 0.97 % and 10.77 ± 2.64 % for 5 mg/mL concentrated raw *C. urens* flour and boiled flour respectively. Both raw and boiled *C. urens* flour possesses very low α- glycosidase enzyme inhibition activity up to 5 mg/mL concentrated *C. Urens* flour.

C. urens flour contains very low anti-diabetic properties. [32]

Remediation activity of Caryota urens

C. urens seeds (CUS), a novel bio-absorbantreported to possess remediation activity for hexavalent chromium Cr (VI) from aqueous solution. [33]

C. urens inflorescence waste biomass (CUIWB), a novel biosorbantusedfor the removal of Cr(VI) from aqueous solutions. The equilibrium bioabsorption phenomena were described by both Langmuir and Redlich–Peterson isotherm models. The bioabsorption capacity obtained using Langmuir isotherms for hexavalent chromium bioabsorption was 100 mg/g. [34]

Table No.6:"Remediation property of *C. urens*"

Biosorbant	Biosorption capacity (mg/g)	Heavy metals	References
C. urens inflorescence	100	Cr(VI)	S. Rangabhashiyam*et al.*, 2015
C. urens seed	52.63	Cr(VI)	Suganya*et al*.,2016
ACSCU	89%	Pb (II)	Ravulapalli *et al*., 2018
CABCU	96%	Pb (II)	Ravulapalli *et al*., 2018

Activated carbon from the seeds of *C. urens* plant (ACSCU) and the active carbon in the calcium alginate beads (CABCU) both asdorbants investigated for their sorption nature towards Pb (II) from water. The adsorption capacities for ACSCU and CABCU are found to be 42.9 mg/g and 86.9 mg/g respectively. It is interesting to note that when active carbon is embedded in Ca-alginate beads, the adsorption capacity is almost doubled. [35]

Biodiesel production

The bio-oil was extracted from the non-edible seed *Caryota urens* by soxhlet extraction using hexane as an organic solvent and then further, the oil was analyzed for moisture content, pH, specific

gravity, density, viscosity, saponification value, refractive index, peroxide value, acid number, free fatty acid, and iodine value. *Caryota urens* seed oil has dominating fatty acids, which easily gets converted into their respective methyl esters during trans-esterification. It was found that Palmiticacid and oleic acid concentration were high of about 41.24% and 28.48% respectively. It was clear that most of the fatty acids present were saturated fatty acids which can be converted into good biodiesel. This bio-oil was then subjected for trans esterification reaction for converting it into biodiesel. The results showed that the bio-oil content was 21.57% and characterized by GC-MS which showed Palmitic acid and oleic acid as dominant fatty acids. The bio-oil extracted from the plant seeds was converted into biodiesel using KOH catalyst and the biodiesel yield was calculated as 82%. [36]

CONCLUSION

From the present review concluded that *Caryota urens* is a valuable medicinal plant. It has various primary and secondary metabolites in different parts of plants, which incorporated with different antioxidant, antimicrobial property and medicinal property. It possesses antioxidant, antimicrobial, antidiabetic, larvicidal, anti-inflammatory, remediation activity due to metabolites. It is a unique source of alkaloid, flavanoid, glycoside, saponin, phenolicsandterpenoid. *C. urens* seed oil has property to produce biodiesel.

FUTURE PROSPECT

C. urens is an evergreen underutilized medicinal plant. It contains antioxidant, antimicrobial, antidiabetic, anti-inflammatory, larvicidal, and remediation activity. Until now only invitro study carried out for pharmacological activity. So, it is required to explore work in vivo.It also required finding out new compound having potent medicinal property. It is necessary to do work on anticancer potential of this plant. An Underutilized plant has to explore in such a way that it becomes useful to people for a medicinal purpose. There is no work carried out on microbial study of plant. That is also necessary to isolate novel endophyte from plant source and evaluate their pharmaceutical property.

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