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Palmyra Palm (Borassus Flabellifer Linn) - A Celestial Tree

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ABSTRACT:

Palmyra palm (*Borassus flabellifer Linn*.), commonly known as "Palm tree", belongs to the family Arecaceae. The life span of the tree is more than 120 years and the tree is considered as the nature's perennial gift due to its immense use to mankind. The Tamil literature describes palm tree as a "celestial tree" with more than 800 uses. Each part of the tree possesses a unique use. It is one of the trees which are used completely for various needs such as housing, medicine, shade and food. A thorough literature survey for more than 75 years necessitate the need to prepare this review on *Palmyra palm* tree to provide information on the historical, religious, pharmacological and beneficial role of each part of the tree with substantial literature evidence.

Historical Importance

Palmyra palm is commonly named as sugar palm, or toddy palm or fan palm [1]. The tree name was originally derived from the Latin word for "Palm" the resemblance of the leaf to the palm of a hand. The scientific name of *Palmyra palm* is *Borassus flabellifer* Linn. Which derive from the Greek words '*Borassus*' and '*flabellifer'* referring to the leathery covering fruits and fan bearer respectively. The tree belongs to the family "*Arecaceae"* which is a very old group of perennial species, and distinguished by having strong woody stems. [2-4]. The other common names for palm tree include, Sugar palm, Asian Palmyra palm, Toddy palm, Fan palm, Cambodian palm, Kerigi, Mak tan kok, Borassus palm, Taan, African fan palm, Doub palm, Ron palm, Wine palm, Pannai maram, Great fan palm, Than, Lontar palm, Tala palm etc [5-7]. Mahatma Gandhi, the father of our Indian nation termed the *Palmyra palm* as "antidode to poverty" [8].

Palmyra tree is equated to the "Karpaka Vrisha "(a wish-fulfilling divine tree) of the mythology [9, 10]. The tree enjoys a special status by honored as the "official tree" and it is being depicted in the state Government logo of Tamil Nadu, a south Indian state since 1978, owing to its widest distribution across the state of Tamil Nadu and its undeniable contribution in rural and cottage industries and the impact on rural livelihood [11-15]. In Tamil culture, it is considered as celestial or heavenly tree and is highly respected by all the people irrespective of religion and caste [16]. *Palmyra palm* is considered as the nature's perennial gift that has the ability to withstand adverse climatic conditions [15]. *Palmyra palm* is a versatile tree of immense use to mankind of which no part is wasted. Tamil literature describes Palmyra as a "celestial tree with more than established 800 uses". All the parts of the tree possess a unique use [17, 18].

Morphology and Distribution

Several places in the state of Tamil Nadu were named as Panaiyur, Panagudi, Panaimarathupatty, Thirupanangadu, Panaikulum, Panaimadal, Kavarpanai, Mudivaithaanendal, Sernthamarm, Panavadalichatram, Panaimangalam, Panaiyur, Panangkadu etc. due the existence of palm trees in abundance. The presence of single or twins or group of palm trees is often referred by the village people to identify their fields by terming as ottrai panai (single tree), eratai panai (twin trees) or kuuttu panai (bunch of trees), Kattai Panai (Short tree), Natai Panai (tall tree) etc [12].The young palm trees before the development of sex differentiation is often termed as "Vadali panai" which means before the attainment of puberty.

Palm trees are declared as "Thalavirusham" in several Hindu temples. Cheras, one among the three prominent crowned dynasties namely Cheras, Cholas and Pandias who ruled the Tamil Country during the Sangam Age, adopted the flowers of the palm tree in their garland as a unique identity. Palmyra has nuptial significance in Indian weddings. It has general religious status as well, one can see bunches of Palmyra fruits among the plant

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decorations of Hindu temples. Indian Baya weaver (*Ploceus philippinus)* birds often build their nests at the tip of the palm leaves owing to the limberness and one can witness at least 30 to 50 nests in a single palm tree. Gauli, a unique type of lizard species known for its special sound (Nemithum) creation, plays an important role in lizard mythology commonly known as "Gauli shastra" for thousands of years inhabits in Palm trees.

[Indian Baya weaver nests built in the leaves of palm tree]

Palms are characteristic of tropical and sub - tropical regions across the planet. They are among the oldest monocotyledonous flowering plants and have an upscale fossil record. Palmyra is allotetraploid X= 8 or 9, n= 18 dioecious with a sex ratio of 1:1 [19, 20]. The life span of palm tree is up to 120 years [11, 21]. They grow in a slow rate of about 30cm per year and needs 15 to 20 years for sex differentiation. However, the growth rate decreases in regions of higher altitude [22]. In 9-12 months, the tip of 1-2 sword-shaped first seedling leaves with a blade (eophylls) emerge above the ground, after which true leaves follow. After a rosette-stage of 4-6 years, trunk formation starts. The trunk of the *Palmyra palm* tree is grey, robust; base of the trunk is conical up to about 4 m high and may have a circumference of 1.7m, thereafter cylindrical and occasionally branched. The trunk of *Borassus flabellifer* is straight, black and may grow to a height of 30-35 m with a stem diameter of as much as 1.5 to 3.0m at its base, the trunk is fringed with a black dense mass of long adventitious roots.

[*Palmyra Palm* tree]

The trunk of a young tree is black and covered with dry leaves or clasping leaf bases. The older trees are smooth and have narrow petiole scars. The trunk of the Palmyra is substituted for wooden poles in the construction of sheds and fencing purposes. The trunk is also used to

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make the drums and takudis that are so common in Indian music. The wood of older trees resembles that of the coconut palm, but is much darker in color and bear crown of leaves at the top; leaves would be around 2-3 m in diameter. Normally, the crown possesses up to 60 palmate leaves. One leaf per month is produced [11, 4]. However, the number of leaves per year is believed to be depends on the number of full moons appear per year. Roughly once in every two and a half years a 13th full moon is seen. This additional full moon does not fit with the normal naming scheme and so is instead referred to as a "Blue moon". Accordingly the 13th leaf may appear during the blue moon year. The leaves are leathery, gray green, fan shaped, folded along the midrib; and are divided to the center into 70-80 linear segments, which measure about 3 cm broad at the base; these provide an excellent raw material for a wide range of products. The petiole of a matured leaf is 1-1.5 m long, strong and having black serrated hard margins [23]. The old leaves remain attached to the trunk for several years before falling clearly. The unfurled leaves longevity was estimated was about 5 years. Palm trees exhibit a dioecious nature, with an equal sex ratio of male to female individuals at 1:1 [20].

Origin

Archaeological and historical data evidenced the presence Palm species in South East Asia from time immemorial. Palm trees are believed to have originated in Africa, made its way to South Asia, and finally migrated into Southeast Asia through the development of cultures and trade networks during prehistoric time [6, 24, 15]. The worldwide distribution of natural and cultivated populations of the Palmyra shows that it occupies a band on either side of the equator and extends laterally over a considerable girth. The immigrants collected the fertile seeds and planted them near their living place. As a result, the trees can be seen near the living vicinity and this may be the reason for the nonexistence of the palm trees in the wild. *Palmyra palm* exhibit adaptability to a wide range of soil types, including arid and wastelands. They thrive particularly well in sandy soil, red soil, black soil, and river alluvium. These palms are also suited for semi-arid regions with an annual rainfall of less than 750 mm. They can grow at altitudes from sea level up to 800 meters, with a cultivation period typically coinciding with the northeast monsoon from October to November [4, 20]. It is easily grown without much care and can be spotted growing in agricultural fields and sporadically even on wastelands as stray plantation. The Palmyra follows self sufficient lifestyle and eco-friendly that leads to sustainable progressive development in an area; on the other hand, it can be referred to as "Palmyra culture" [25].

The most economically prominent species of *Borassus flabellifer L.* are found in tropical regions of Asia and Africa. These regions include countries such as India, Nepal, Bangladesh, Myanmar, Sri Lanka, Indonesia, and Thailand. It is also grown in Laos, Vietnam, Malaysia, Indonesia, Burma, and Cambodia [26-28, 12]. *Palmyra palm* is widely grown throughout India in different soil types and climate zones, including the coastal strip, agricultural margins, and wastelands of Karnataka, Kerala, Maharashtra, Madhya Pradesh, Andhra Pradesh, Chhattisgarh, West Bengal, Bihar, and Odisha. India has nearly 102 million palms [29, 30, 12,4] and more than 60 % of them are in Thoothukudi, Tirunelveli, Viruthunagar and Ramanathapuram districts in Tamil Nadu [31]. Thoothukudi district alone has a major share of more than 10 million palms (AICRP Palms, 2015). The state of Bihar has a rich diversity of Palmyra next to Tamil Nadu.

While most of the palm plants have a fibrous root system, Palmyra has a tap root system that shoots straight downward vertically. It could store a massive volume of water in their tubular roots and increases the water table level of the locality. Thus it has a greater capacity to turn arid land into highly fertile land with rich groundwater resource. This could be a major reason for our ancestors planting palm trees around the water resources like rivers, tanks and wells [31]. This plant is too sturdy that could withstand natural calamities like a magical wall.

Cultivation

Palmyra is mainly propagated through seeds and there is no vegetative method available for its propagation [32]. The process of cultivating Palmyra trees begins with the collection of healthy ripened fruits from elite trees. These fruits are carefully gathered and stored in shade for about eight weeks and the individual seeds are planted typically spaced at 3 meters by 3 meters, resulting in a population density of around 1000 plants per hectare. For the actual planting process, pits measuring 30 cm x 30 cm x 60 cm are prepared. These pits are initially filled halfway with a mixture of 10 kg of farmyard manure and topsoil. The seed nut is then carefully positioned in the pit; with its germ pore (narrow conical end) facing

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downward or sidewise at a depth of around 20 cm. planting coincides with the monsoon season. Watering is done once a week during non-rainy periods for the first year. The Palmyra seed takes about two months to initiate germination and the eophyll (first leaf) emerge out after a period of about three months from sowing [33, 34].

Palm Heart

The tender growing point of the *Palmyra Palm* tree is edible and commonly referred to as Palm heart or Palm cabbage or Panankguruthu; this green vegetable is extracted from many species of palms. Although this food item is generally known about in Tamil Nadu, it is rarely sold in markets. Since the palm must be destroyed to remove the heart, it is only available when a tree is felled for some other reason, such as when land is cleared for annual crops. The inner portion is crisp and sweet. Reports of unpalatability seem to be attributable to eating the outer portion, which has a slightly bitter taste No data are available on the composition of *Palmyra palm* hearts, but it appears unlikely that they are particularly nutritious, for chemical analyses have shown no important nutritional value for palm hearts [35].

Sex Differentiation

The first flowering takes place when the palm is 15-20 yr of age, only then is the sex of each tree revealed. Male spadixes are about 2 m long, stout, branched, and covered by many imbricate spathes. Primary branches are flat, ending in two, three, or rarely four cylindrical, fleshy, flower-bearing spikes. The small, sessile male flowers are arranged in compact spikelets covered by bracts.

[Male inflorescences]

The male spadix has 5 to 10 branches and each branch is ensheathed by a spathe. Each branch has 2 to 3 branchlets or spikes. Each spike is stout, cylindrical, 30-40 cm long and 2 to 4.0 cm wide. The width of the spike decreases gradually from base to apex. The spikes are imbricated by numerous bracts. The bracts are wedge shaped, cuneate, retuse and adhere by their lateral margins to the keel or back next one above to form a cavity enclosing small scorpoid spikelets. The number of spikelets in each spike range from 800-1000 and each spikelet has 15-20 sessile, little florets. In total, a single spadix may contain 2, 00,000 to 2, 50,000 florets [4]. Flowers are sessile with three sepals imbricate, cuneate with truncate tips. Petals are three, short, ovate and imbricate. The stamens are six numbers, filaments connate into a stalk with corolla. Another is large, sessile, oblong, bilocular and split longitudinally [12].

Female inflorescences are also branched, giving rise to 10-15 flower-bearing spikes [36]. The female spadix has only 2 to 4 branches or spikes, sheathed by spathes. The upper half of the spike is imbricate by bracts while the lower end is a smooth peduncle. A barren bract ensheathes the spike, from where the flowers rise and the

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terminal of the spike extending to 5 to 8 cm beyond the flowers is also ensheathed by barren bracts. The number of female flowers in a spadix range from 30 to 75. The female flowers are large, globose. The perianth is six lobed, fleshy, imbricate, reniform and accrescent. Staminodes 6, overy globose, 3 to 4 celled, pistils 3 to 4, syncarpous, stigma 3, sessile and recurved [12]. Though flowers bloom throughout the day, most of them open between 8 and 11 am. Pollination is through insects (bees, wasps, beetles) and wind. It takes around 4-5 months for the fertilized female flowers to mature into ripe fruits. The fruit is a fleshy drupe and weighs 1-3 kg. All inflorescences may be tapped to obtain a sweet sap. In Tamil Nadu, the palm flowers from February to July.

[Immature *Palmyra palm* fruits]

Palm fruits

The female tree produces edible products viz, the endosperm, pulp and tuber. Palmyra fruit is roughly hemi-spherical, large and fibrous containing 2-8 nut-like seeds. Inner to outer covering is the fruit pulp, which is embedded in fibres. Average weight of a fruit is about 800g [22]. Palmyra fruits are coconut like structure, oval in shape and capped at the base with overlapping sepals [2].

[Endosperms-Nungu]

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[Palm fruit with multiple numbers of endosperms]

The palm fruits have been used in both forms i.e. tender and matured. At an early stage the tender endosperm part is edible, while after ripening, the yellow coloured fibrous mesocarp squeezed to collect the pulp. The ripe fruit pulp contains beta-carotene and possesses significant anti-inflammatory effects [37]. The natural

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food colouring substances can be extracted from matured ripe husk or mesocarp of Palmyra [38]. The male inflorescence is used for the production of chemicals such as pectin, cellulose, hemicelluloses, pentosan-polysulfates, polyphenols and lignins [39, 1]. The juicy fruit opens from the top by cutting, where it usually contains 3 sockets inside, kernel as the soft jelly, translucent like ice, filled with watery sweet liquid commonly named as ice apple since it resembles to ice [40]. It acts as coolant for the parching throat in summers and relished during months of summers. The material, "nunggu," is then sucked out or removed with a spoon. Immature endosperm deteriorates rapidly after harvest of the fruit. The whole fruit or Nunggu is sold by the number of "eyes," as each seed is called [11]. In recent years jars of preserved nunggu have been produced by the Tamil Nadu Palmgur Federation in Madras (TNPF) and reportedly in other Palmyra areas of India.

The immature endosperm is made up of about 93% water; glucose is the predominant solid material [41]. Harvesting of Palmyra fruits for the immature endosperm appears wasteful in that it reduces the chance of getting the more useful, ripened fruits. The palm produces fruits when 15-20 years old, giving an annual crop of 50-200 fruits in 6-12 bunches per tree [22]. The tender fruits appear from April to August, whereas the ripe ones are available from October to December and duration varies from locality to locality. The seeds contain a soft, sweet, jelly-like endosperm with sap. The gelatinous pulp gradually hardens into a bony kernel and develops a fibrous coat. The ripened fruit varies in color from a light gold to brow attached to spadix and nearly black at end. It mainly contains gums, albuminoids, fats, steroidal glycosides, and carbohydrates as sucrose. It contains spirostane type steroids like borassosides and diosin [42, 43]. The coat of seed extracted from Palmyra tree possesses antimicrobial activity whereas the male inflorescence shows an anti - inflammatory activity [44].

It is popularly believed, but scientifically unsubstantiated, that two seeded fruits will grow into female palms while the three-seeded and one-seeded fruits will grow into males. Upon germination, the Palmyra seedling becomes tuberous because its underground first juvenile leaf (cotyledonary sheath), about 15 cm long, stores nutrients rich in edible starch. This stored food is rapidly consumed by the plant as subsequent above ground leaves are produced [11]. It can be eaten fresh, but is more commonly boiled, sundried, or baked before being consumed, generally after being mixed with sugar. A paste may also be made from the pulp and added to other dishes [45].

[Matured *Palmyra palm* fruits]

Palmyra fruit is seasonal and has an orange or yellow mesocarp with a sweet, dense, and juicy pulp. It is a healthy fruit with vitamin A and C, tannins, sugars, and saponins [46], as well as iron, calcium, potassium, and zinc [47]. This is also used to make soft drinks, toffee, jams, and sweet treats [46]. According to [48], Palmyra fruit has a great popularity worldwide due to its nutritive and medicinal value. Sri Lanka annually collects around 1500 tons of fruit during season when inflorescence of the female palm become mature, and starts to give fruits. One palm tree gives around 200 - 300 fruits in one season. September and October are the seasons in which fruiting happens. In the month of August Palmyra fruits become mature and ripened fruit starts falling from the month of September and October. To reduce the wastage of Palmyra fruits, a far better preservation technique is required. Palmyra fruit is seasonal and has an orange or yellow mesocarp with a sweet, dense, and juicy pulp. It is a healthy fruit with vitamin A and C, tannins, sugars, and saponins, as well as iron, calcium, potassium, and zinc. Mature ripe fruit is rich source of carbohydrates. The fibrius outer layer of ripen fruits can be eaten raw or boiled [15]. This is also used to make soft drinks, toffee, jams, and sweet treats [46]. Palmyra fruit pulp is available in abundance to an

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extent of 10-15×106 kg per annum [49]. It has many potential uses, such as jams, cordials, a source of pro-vitamin A, pectin and alcohol but it is largely underutilized due to the presence of bitterness. There is a family of such steroidal glycosides for which the term *flabelliferin* was coined from the specific (species) name flabellifer [50].

Palm sap (Pathaneer or Toddy)

Palm sap commonly known as "Pathaneer" can be obtained by tapping the developing inflorescence, a practice having minimal adverse effects on the tree. In order to tap Palmyra inflorescences and derive maximum sap production, [51, 52] the tapper must possess a high degree of technical skill for the delicate operation involved, as well as have the physical strength and agility to climb tall Palm trees. The tapping process involves the bruising of the interior of the developing inflorescence by means of a wooden mallet or tong, thereby stimulating sap flow. The end of the individual inflorescence is sliced off with a knife and a receptacle placed over it to catch the dripping sap, which is collected morning and evening. At the morning collection, the tapper freshen the cut and may further bruise the inflorescence to maintain maximum sap flow [53]. Both male and female Palmyra's are tapped in Tamil Nadu, although there is an overwhelming preference for female trees, which yield a larger quantity of sap [54]. An individual inflorescence will continue to yield sap for 3-5 months. One Palmyra tapper can care for 20-40 trees [55- 57].

Fresh palm juice is white, very sweet, and not fermented. Sucrose is the main component of fresh toddy juice and accounts for about 12-15% of its weight [58, 59]. Fresh juice is rich in iron, calcium, phosphorus and vitamins such as carotenoid, vitamin B complex like thiamin, riboflavin and niacin [60-62, 1]. It contains a small quantity of reducing sugars. There is enormous variability in daily per-tree and tree-to-tree sap production, depending on the tree, from one to seven inflorescences may be tapped at a time. Sap flow diminishes as the process continues and it is linked to wind flow. The skill of the tapper significantly influences production levels. It is estimated that a *Palmyra palm* will yield 150 litre of neera annually [63]. In its natural fresh state, the sweet and pleasant tasting sap can be drunk immediately. It is a refreshing juice perfect for the summertime. Fermentation of the sugars through the action of yeast, however, takes place rapidly and within hours the sap becomes a mild palm wine with an alcohol content of 5-6%. It then is referred to as palm toddy. To prevent fermentation, a dab of slaked lime (calcium hydroxide) is commonly added to the collection receptacle. This practice has both practical and social significance. Neera that contains lime remains drinkable for a longer period of time than unadulterated sap.

Toddy is produced by various bacteria and fungi during the fermentation of Palmyra sap. Toddy is an uncontrolled natural fermentation by several different strains of yeast and bacteria. The alcohol content in fully fermented toddy is 6- 8%. But fermentation of Palmyra sap using pure yeast cultures gives about 8- 10% [64, 65]. Palm toddy is a traditional drink and has a refreshing quality. The juice collected in the evening or after fermentation becomes sour and is consumed by coastal villagers as a raw alcoholic beverage. Sugar, primarily fructose, sucrose, and glucose, are the main components of fermented toddy. During the fermentation process, it is converted to ethyl alcohol [61]. Toddy is a probiotic drink with many nutraceutical benefits. It also contains 26 different primary amino acids [66] and is high in niacin, riboflavin, and thiamin. It also demonstrated remarkable antibacterial activity against microbes such as *Escherichia coli, Klebsiella pnemoniae, and Staphylococcus aureus* [67, 68].

Economical Value

The palms provide opportunity for increasing the employment and also provide a source of income to the poor in the rural areas. Palmyra warriors are those who climb Palmyra trees and extract Palmyra milk (Toddy/ Sap) from them. The most notable literary reference to the Palmyra is the Tala Vilasam, by Arunachalam of Kumbakonam, a long and famous Tamil poem that lauds it as a "tree of life" and catalogues 801 uses Food, beverage, and medicinal uses account for the greatest number of attributes of the Palmyra, but also detailed are the uses of the leaves, trunk, and other parts [69, 70]. Several South Indian rulers wore garlands of Palmyra flowers. The trunk of Palmyra trees of widely used as pillars and roof supporters due to their non-corrosive nature and durability.

Leaves of *Borassus flabellifer L*. have long been used for the preparation of writing materials in India and other neighboring countries. They are still in use in many parts of Kerala [71]. They are resistant to the attack of insects

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and are impervious to water, but the mode of preparation differs according to the species. In India the young leaves of Borassus were much used for writing [72]. Van Rheede, in his Hortus Malabaricus (1678–1693) [73], mentioned that the Palmyra leaves were used in Kerala as parchment paper and that the leaves of this palm were quite durable. Marshal [74], in his account of the coconut tree, wrote, "The leaflets are sometimes used to write upon, and the instrument employed to make the impression is an iron stylus. The leaves of the *Palmyra palm* are however much more frequently employed for this purpose." In India the history of writing on palm leaves dates from the famous Sanskrit scholar Paniny-rishee, who lived in the year 790 of 'kaliyuga,' i.e., approximately 4161 years ago, on the banks of the river Ganga at Haridwarum [75]. In Sri Lanka, talipot palm leaves were adopted for writing before 900 BC [76]. Ferguson (1888) reported the existence of 400–500 year old Palmyra leaf manuscripts in Sri Lanka. The English term leaf and folio with reference to the printed word appear to be derived from palm leaf writing [11].

Matured Palm leaves can be woven into mats, knitted into baskets used to make hand fans, hats, umbrellas, buckets, sandals and more importantly to thatch roofs. Additionally, the leaves can be making use of a rich source of fuel while cooking. Due to the strength, durability and length of the petiole fibre is recurrently used in the production of rope. The fibre extracted from the petiole and leave's blades are often used to create several useful products like brushes, brooms etc [15]. The natural fibre that is taken from the *Palmyra palm* is used for the construction of thatched homes and fences [1]. Palm leaves have been used extensively for writing horoscopes, religious and Ayurvedic documents. In India, the processed single rectangular palm leaflet is known as taliola. A manuscript contains a number of rectangular pages, or taliolas, threaded at each end on a string. A palm leaf book is held together with a pin through one end so that the leaves can be fanned for reading. Sometimes holes are bored through each end, and the strings are passed through them so that the leaflets can be turned over and read in sequence.

The Manuscripts Library and The University of Kerala Oriental Research Institute, have a collection of more than 70,000 palm leaf manuscripts, some as old as 500 years. The palm leaf documents for the purpose of executing promising notes, land registration and ayurvedic practice are still seen in the royal houses, and they have been used for more than 600 years. Mature leaflets are dried in partial shade, cut into standard sizes and submerged in either mud or lime for three days and then dried in partial sunlight until the color changes to brown. The leaflets obtained by this technique are resistant to termites and fungi. Writing on palm leaflets requires much practice. Those persons experienced in the art of writing are known as Ezhuthu Assans (Ezuthu = writing, Assans = experienced person) in the Malayalam language. The stylus used for writing on leaves is known as Narayam. The stylus is made of iron, silver or brass. It is about 25–30 cm in length, having a bulbous middle portion for resting against the hand and tapered, and pointed ends [71].

Periodic cleaning of the leaves with turmeric powder and drying in the sun also increase the durability of palm leaves. The ways by which knowledge is stored and disseminated have changed dramatically over the years, and the art of writing on palm leaves has almost disappeared. However, in many places in Kerala, Hindu children are still required to write their first alphabet on palm leaves and astrologers are the main users of palm leaves for writing horoscopes.

Pharmaceutical and Beneficial Properties of *Borassus flabellifer*

The golden words of the elders who have lived and gone are fulfilled with current science in several means especially with regard to the medicinal properties of many trees on the earth. Plants and trees have been used partly and as whole plant or trees for many medicinal purposes Palmyra tree is one such type of the tree highly foreseen by the people. There were times people considered Palm tree as "God" because of its benefits. It is one of the trees which used completely for various needs such as housing, medicine, shade and food. All parts of the tree possess antimicrobial activity ,anti-inflammatory, anti-arthritic, anti-oxidant and analgesic activity, wound healing, immunomodulatory, malaria, syphilis, antiperiodic, heart burns, liver and spleen enlargement and antidiabetic activity [77-84, 91-95], Palm trees are rich source of ecologically derived secondary metabolites such as alkaloids, flavonoids, glycosides, saponins, phenolic compounds, tannins, steroids and sterols. Flavonoids and tannins are phenolic compounds which act as primary antioxidants. The astringent flavor palm fruits are rich in tannins.

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The flabelliferins are steroidal saponins chiefly present in Palmyra and are of importance and have a significant role in food and medicine because of their bioactivity [85]. It has reported that the bitterness in Palm fruit pulp is caused by the presence of flabelliferins [50]. The fruit pulp is extensively used in the traditional medicine for the treatment of gynecological disorders especially for urinary tract infections [86, 87]. The identification of flabelliferins is considered as a milestone of Palmyra research. The members of this group are di, tri and tetra glycosides and they were named "flabelliferins" coined from the specific name of Palmyra, viz., flabellifer. Flabelliferins consist of a steroidal part and sugar moiety attached to the 3-β OH position of the steroid [88]. According to Ariyasena (2002) more than 14 different flabelliferins have been identified from different morphological types and their structural elucidation has been successfully performed.

All different parts of *Borassus flabellifer Linn.* Comprise of biological and pharmacological functions like anthelmintic, diuretic, antioxidant, wound healing etc [44]. Green leaves extract is beneficial in secondary syphilis. The leaf juice checks hiccup and relieves gastric catarrh. The extract of young leaves has proven to be a highly effective medicine against a variety of infections caused by pathogenic micro organisms [89]. Crushed the Palmyra leaves heals both excision and incision wounds in a few days. The leaves are used for thatching roofs, screening as a fence, as mats, baskets, fans, hats, umbrellas, buckets, sandals etc. Senesced leaves are utilized as fuel for cooking. The leaves after using for thatching and fencing when replaced are used by the farmers as organic fertilizer. Tough and long fibre extracted from petiole is used for making of ropes used in the building of houses and boats. The fibre extracted from leaf blades is hard, stiff and very resistant. The petiole fibre and leaf blade are used to make products such as brushes and handicrafts artefacts etc (PDB souvenir., 1998). There was no scientific evidence for it at the time, but after numerous studies on its phytochemical and pharmacological activity [90].

In view of the above credentials bestowed with the *Palmyra Palm* and its various parts, we have systematically studied the antidiabetic, antilipidemic, antioxidant and antimicrobial properties of immature *Palmyra palm* fruits. The phytochemical screening evidenced the presence of pharmacologically active ingredients such as flavonoids, alkaloids,glycosides, saponins, tannins, phytosterols and phenols in the immature fruits. The in vitro assays revealed the significant antioxidant properties of the immature fruits extract [91]. The immature fruits extract exhibit significant anti-bacterial and anti-fungal activities which were evidenced from the data obtained through Minimum bactericidal concentration and Minimum fungicidal concentration assays [92]. Biochemical evaluation of antidiabetic properties of the immature fruits extract in High fat diet fed- low dose streptozotocin induced experimental type 2 diabetes in rats revealed the regulatory role fruit extract in the maintenance of normo-glycemia by regulating the activity vital enzymes of carbohydrate and glycogen metabolism. [93].

Evaluation of antioxidant properties of immature *Palmyra Palm* fruits extract in high fat diet- fed- low dose streptozotocin induced experimental type 2 diabetes in rats [94]. Likewise, the immature fruit extract treatment significantly improves the altered levels of lipid profile markers to near physiological range [95]. The results obtained through the above studies provide evidence for the use of immature palm fruits extract in the treatment of diabetes and its secondary complications. Further studies are in progress in identifying the phytochemical present in the immature fruits responsible for the established beneficial and pharmacological activities.

Conclusion

The review describes the origin, distribution, sex differential, economical, social, pharmaceutical and beneficial properties of each part of the palm tree with up to date literature survey to provoke interest on the biological scientists to elucidate the presence of biologically and pharmacologically important active secondary metabolites from various part of the palm tree. This review also provides substantial scientific evidence for the use of various part of the tree in the traditional medicine system.

Conflict Of Interest

The authors declare no conflict of interest.

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