Borassus Flabellifer Fruit Versatile Pharmaceutical Application:An Overview

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ABSTRACT: ***Plant and their products have always been a source of various drugs as wellas excipients used in pharmaceutical industry.At present scenario natural origin excipients have gained importance over synthetic excipients because they are non toxic,less expensive,freely available.New excipients continue to be developed to meet the needs of the conventional and novel drug delivery systems. The medicinal plants have very important role in the health of human beings as well as animals. India is the largest producer of medicinal plants. One such plant, Borassus flabellifer L, belongs to family Arecaceae, commonly known as Palmyra palm is a native of tropical Africa but cultivated throughout India. Traditionally the different parts of the plant such as root, leaves, fruit, and seeds are used for various human disorders. Leaves are used for thatching, mats, baskets, fans. Flowers of B. flabellifer were investigated for analgesic and antipyretic effects, anti-inflammatory activity, haematological, biochemical parameters, and immunosuppressant property. The different parts of the plant are being used for medicinal properties like antihelminthic and diuretic. The fruit pulp of B. flabellifer has been used in traditional dishes and the sap, has been used as a sweetener for diabetic patients. Phytochemical studies of the plant revealed the presence of spirostane-type steroid saponins; steroidal glycoside also contains a bitter compound called flabelliferrins. Although investigations have been carried out a lot more can still be explored, exploited and utilized. The present review highlights the phytochemical and excipient studies including folklore medicinal uses of this plant.***
Key words:Borassus flabellifer,Excipients,Natural,Phytochemical.

I.INTRODUCTION

Excipients are also called additives,these are used in pharmaceutical formulations to convert drug in to dosage form.In recent years plant derived additives have evoked tremendous interest due to their diverse pharmaceutical applications.plant derived additives are bio compatible ,cheap,easily available,low toxicity,non irritant[1.] Present day consumers look for natural substances in medicines,cosmetics as well as food that they believe natural products will be more safe and devoid of side effects.Majority of investigations on natural additives in dosage forms are centered on polysaccharides and proteins due to their ability to produce a wide range of materials and properties based on their molecular structures[2.] Herbal medicines have become more sensitive to unwanted effects over synthetic medicines which led to the increasing demand for herbal resources and awareness for maintaining quality and purity of raw materials [3]. Herbal medicines are popular remedies for diseases used by a vast majority of the world‘s population . The healing properties of many herbal medicines have been recognized in many ancient cultures [4]. In this scenario, detailed review of this plant Borassus flabellifer has been discussed.

CLASSIFICATION

Kingdom: Plantae
Sub-Kingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Liliopsida
Subclass: Arecidae
Order: Arecales
Family: Arecaceae
Genus: *Borassus* L.
Species: *Borassus flabellifer* L.

SYNONYMS

Wine Palm, longer palm, lontar, palmyra, toddy palm.

VERNACULAR NAMES

English: Toddy palm, Palmyra palm
Tamil: Talam
Telugu: Tatichettu
Malayalam: Karimpana
Bengali: Taala
Kannada: Olegari
Sanskrit: Taalah

DESCRIPTION: Borassus flabellifer is a robust tree and can reach a height of 30 metres (98 ft). The trunk is grey, robust and ringed with leaf scars; old leaves remain attached to the trunk for several years before falling cleanly. The leaves are fan-shaped and 3 m (9.8 ft) long, with robust teeth on the petiole margins. Likeall *Borassus*species, *B. flabellifer* is dioecious with male and female flowers on separate plants. The male flowers are less than 1 cm long and form semi-circular clusters, which are hidden beneath scale-like bracts within the catkin-like inflorescences. In contrast, the female flowers are golfball-sized and solitary, sitting upon the surface of the inflorescence axis[5]. After pollination, these blooms develop into fleshy fruits 15–25 cm wide, each containing 1-3 seeds. The fruits are black to brown with sweet, fibrous pulp and each seed is enclosed within a woody endocarp. Young palmyra seedlings grow slowly, producing only a few leaves each year (establishment phase), but at an as yet undetermined time, they grow rapidly, producing a substantial stem[6]. The fruit measures 10 cm (3.9 in) to 18 cm (7.1 in) in diameter, has a black husk, and is borne in clusters. The top portion of the fruit must be cut off to reveal the sweet jelly seed sockets, translucent pale-white, similar to that of the lychee but with a milder flavor and no pit. The sweet jelly seed sockets occur in combinations of two, three or four seeds inside the fruit. The jelly part of the fruit is covered with a thin, yellowish-brown skin. These are known to contain watery fluid inside the fleshy white body. These seed sockets have been the inspiration behind certainSandeshes called *Jalbhora* found in Bengal.

FRUITS: The conventional way this fruit is eaten is when the outer casing is still unripe while the seeds are eaten as the fruit. But if the entire fruit is left to ripen, the fibrous outer layer of the palm fruits can also be eaten raw, boiled, or roasted. When this happens, the fruit takes a purple-blackish hue and tastes similar to coconut flesh. The skin is also eaten as part of the fruit similar to how mango skins are often consumed along with the fruit. Bengali Peoplehave perfected the art of making various sweet dishes with the yellowish viscous fluid substance obtained from a ripe palm fruit[7] .These include mustard oil-fried (alternatelysunflower oil-fried) *Taal-er bora* "palmyra vadas" or mixed with thickened milk to prepare *Taal-kheer* .

SAP: Obtaining the sap traditionally involves tapping the top shoots and collecting the dripping juice in hanging earthen pots [8]. The juice so collected before morning is refreshing and light drink called Thaati Kallu in Telugu, Neera in Marathi and "Pathaneer"in Tamil is extremely cool in sensation, and has a sugary sweet taste. The juice collected in evening or after fermentation becomes sour, and is calledTadi in Marathi. Tadi is consumed mostly by coastal villagers Maharashtra as a raw alcoholic beverage. A sugary sap called toddy, can be obtained from the young inflorescence, either male or female. Toddy is fermented to make a beverage called arrack, or it is concentrated to a crude sugar called jaggery or Taal Patali in Bengaliand Pana Vellam or Karuppukatti in Tamil. It is called*Gula Jawa* (Javanese sugar) in Indonesia, and is widely used in Javanese cuisine. In addition, the tree sap is taken as a laxative, and is believed to possess medicinal virtues have also been ascribed to other parts of the plant.

SPROUTS: In the Indian states of Tamil Nadu, Andhra Pradesh, Telangana and Bihar, and in Jaffna, Sri Lanka, the seeds are planted and made to germinate and the fleshy stems (below the surface) are boiled or roasted and eaten. It is very fibrous and nutritious[9]. It is known as Thegalu or Gaygulu in Telugu, asPanai Kizhangu or Panangkizhangu in Tamil.The germinated seed's hard shell is also cut open to take out the crunchy kernel, which tastes like a sweeter water chestnut. It is called Buragunju in Telugu and "thavanai" in Tamil.The white kernel of the ripe palm fruit after being left for a few months is used as an offering in Lakshmi Puja in various parts of Bengal and is also eaten raw.

II.PHYTO CHEMISTRY

Borassus contains albuminoids, fats and the fresh pulp is reportedly rich in vitamins A and C .The fresh sap is reportedly a good source of vitamin B-complex. It also contains 20 known steroidal glycosides and carbohydrates like sucrose. It also contains a bitter compound called flabelliferrins; these are steroidal saponins.28 chemical constituents are present they are 2-Furanmethanol, Propane, 1-(1-methylethoxy), 2-Cyclopenten-1-one, 2-hydroxy-, 2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one, Glycerin, 1,3-Propanediamine, 1,2-Propanediol 2-acetate, Butane, 1-(ethenyloxy)-3-methyl-, Propane, 1,1-diethoxy-,1H-Imidazole-4-carboxamide, 5-amino-, 4H-

Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-, Resorcinol, Phenol, 2,6-dimethoxy-,6H-Purin-6-one, 2-amino-1,7-dihydro-,6H-Purin-6-one, 2-amino-1,7-dihydro-, 1,4-Benzenediol, 2-methoxy-, Phenol, 3,4-dimethoxy-, Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-, Phenol, 4-[2-(dimethylamino)ethyl]-, 1-Butanol, 2-amino-, 3-Hydroxy-4-methoxybenzoic acid, Phenol, 3,4,5-trimethoxy-, Phenol, 5-(1,5-dimethyl-4-hexenyl)-2-methyl-, (R)-, 7H-Furo[3,2-g] benzopyran-7-one, n-Hexadecanoic acid, Pentanoic acid, 10-undecenyl ester, Octadecanoic acid .

III.EXCIPIENT PROPERTIES

The extracted mucilage from Borassus flabellifer endosperm is non toxic and edible. Ravikumar etal was carried out to check the suspending property of Borassus flabellifer mucilage. paracetamol was selected as model drug and BFM was used as suspending agent in different concentration of 1%, 1.5%, 2.0 and 2.5% w/v[10.]The study indicates that Borassus flabellifer mucilage appeared to exhibit the best suspendability for paracetamol suspensions, compared with gum tragacanth. The results showed that sedimentation volume, viscosity and particle size were directly proportional to the concentration of the suspending agents [11.]The study reveals that BFM at 2.5%w/v concentration has excellent suspending properties in paracetamol suspension formulations.Additionally used gum tragacanth produced a stable, redispersible, flocculated suspension with all the features of an ideal suspension. Hence by considering, all above evaluation parameters it can be concluded that BFM used in the concentration of 2.5% w/v was proving as good suspending agent. [12] Due its high viscosity it could be employed as stabilizer and thickener of choice in pharmaceutical suspension preparation and also in cosmetic, pharmaceutical industries. BFM may provide a suitable alternative to gum tragacanth as suspending agent in pharmaceutical oral suspensions, providing a more readily available and affordable option in the countries where it is found growing abundantly, wild or cultivated. Thus, it can be concluded that the extracted mucilage from Borassus flabellifer endosperm has the potential of a suspending agent and it can be used as a pharmaceutical adjuvants.[13]The endosperm of Borassus flabellifer is having a potential gelling property and it can be used for the development of gel formulations, because of its good release profile, water-soluble nature, physical stability and good spreadability.[14] It is effective in a very low concentration as compared to that of the standard gelling agent (tragacanth) used. The 4% w/w BFM was found to be suitable for topical application based upon its physicochemical properties.[15] While comparing the gelling characteristics of gels prepared by BFM and that of tragacanth it was found that the gel prepared with 4%w/w of BFM is more effective in comparison to that of the gel prepared by using 6%w/v of gel using tragacanth. The anti-inflammatory activity of this gel formulation in rat hind paw edema model reveals that diclofenac was delivered to the inflammation site at a controlled level over a period of 4 h[16]. Moreover as this plant is widely distributed in nature, Borassus flabellifer endosperm are eaten by the local tribes and used as food supplement, available chiefly in India and many other countries and easily available option without destroying the natural sources as compared to that of the other available natural option will be one of the suitable options to utilize as pharmaceutical excipient.[17] Since the primary ingredients are in expensive, devoid of toxicity, biocompatible, biodegradable and easy to manufacture, and they can also be modified to have tailor-made products for drug delivery systems and thus can compete with the synthetic pharmaceutical excipients available in the market. They can be used as gelling agents in place of currently marketed synthetic gelling agents. The disintegrating properties of the Borassus flabellifer mucilage has been studied in comparison with croscarmellose sodium. The isolated natural disintegrant exhibits faster drug dissolution in comparison to the super disintegrant. [18]Isolated mucilage exhibited potentially as a rapidly disintegrating agent for faster drug dissolution and improved bioavailability, thereby helping in effective therapy and improving patient compliance. It may be exploited as a gelling agent. It may well be used as a binder due to its sticky nature when hydrolyzed with water. Therefore, in the years to come, there will be continued interest in natural mucilages and their modifications aimed at the development of better materials for drug delivery systems. Borassus flabellifer fruit endosperm was having mucoadhesive character and if any modifications are done in chemical structure then it may possess an enhanced adhesiveness, which may replaces the synthetic non-ideal mucoadhesive polymer.[19]Study reveals that natural BFM can be used as mucoadhesive agent for its pharmaceutical application.During the last decade there has been interest in developing sitespecific formulations for targeting drug to the colon. The colon has gained attention on the delivery of drugs not only for the treatment of local diseases associated with the colon but also for its potential for the delivery of proteins and therapeutic peptides sensitive to the enzymes in both the stomach and small intestine[20]. Among the different approaches to achieve colon specific drug delivery, the use of polymers, specifically biodegraded by colonic bacterial enzymes holds promise[21.]The in vitro and in vivo study indicated that containing 25%w/w of BFM was limited the drug release in stomach and small intestinal environment and released maximum amount of drug in the colonic environment [22]. In-vitro biodegradability studies suggested that BFM is degraded in the presence of rat caecal

contents under conditions mimicking colon[23.] In-vitro drug release studies under conditions mimicking mouth to colon transit, demonstrated the ability of BFM to release the drug in pH 6.88 Sorenson's phosphate buffer with RCC. Thus on the basis of the above mentioned findings it could be concluded that BFM could be successfully used in colon specific delivery systems[24.]

IV.PHARMACOLOGICAL PROPERTY

Anti-inflammatory activity : Anti-inflammatory activity was evaluated using acute and chronic models like; carrageenan-induced paw oedema like cotton pellet induced granuloma and carrageenan-induced air-pouch model in rats for the ethanol extract of male flowers. The animals were divided into four groups (n = 6). Group I served as Control received the vehicle only (1% Carboxymethylcellulose, CMC, 10 ml/kg p. o.). Group II served as Standard, received Diclofenac Sodium at a dose of 100 mg/kg b.w. Group III and IV served as a test, received ethanolic extract at doses of 150 and 300 mg/kg b.w. p. o. respectively [25]. Nystatin-induced rat paw edema model was employed to investigate the anti-inflammatory activity of ethanolic extract of male flowers (inflorescences) of *Borassus flabellifer* L (Arecaceae). The extract at doses 200 mg/kg b.w. and 400 mg/kg b.w. and diclofenac sodium (standard) at 100 mg/kg b.w. showed significant anti-inflammatory when compared to control ($p<0.0001$) .

Antibacterial activity: The antibacterial activity of methanol extract of Borassus flabellifer L. (Arecaceae) seed coat (soft outer shell) was studied by agar well diffusion method *in vitro*. The antibacterial potential was examined against Gram-positive bacteria, i.e., Staphylococcus aureus, *Bacillus subtilis and G*ram-negative bacteria, i.e., Klebsiella pneumonia and Serratia marcescens . The methanol extract of the seed coat has showed consistently significant inhibitory activity on different bacterial species tested. Furthermore, the minimum inhibitory concentration studies carried out by broth dilution assay and found the MIC ranged between 100 µg to 1 mg/ml implying the significance of antibacterial activity of Borassus flabellifer.[26]

Analgesic activity: The ethanolic extract of male flowers (inflorescences) of Borassus flabellifer L.(Arecaceae) were investigated at doses 150 mg/kg b.w. and 300 mg/kg b.w. using acetic acid induced writhing ,hotplate , tail-clip , method. Oral administration of Borassus flabellifer ethanolic extract (BFEE) produced significant ($P<0.0001$) reduction in no. of writhes induced by acetic acid. Moreover, in the hot-plate test, (BFEE) significantly ($P<0.0001$) raised the pain threshold at the different time of observation (0-60 min) in comparison with control. In tail-clip test also, the extract caused a significant ($P<0.0001$) inhibition of pain at both the doses used. There was a significant dose-dependent inhibition of both phases of the formalin-induced pain response in mice.[27]

Cytotoxic activity : The seed coat of Borassus flabellifer extracts was tested for inhibitory effect on HeLa Cell Line. The cytotoxicity of Borassus flabellifer on HeLa cell was evaluated by the MTT assay. In concentration range between 32 µg/ml to 750 µg/ml. Borassus flabellifer were administered at different concentrations viz., 32, 64, 128, 256, 500 and 750 µg/ml and found that the growth of the HeLa cells was significantly inhibited [28].

CONCLUSION

Borassus flabellifer is a plant with good qualities for all parts used since ancient times. Besides the plant having traditional uses it is also used for people who make their living from this tree using its wood, fruits, sap, stems, petioles and leaves to process a variety of food products, beverages, furniture, building materials, and handicrafts. In this review, an attempt was made to provide excipient uses of Borassus flabellifer. Furthermore, a detailed and systematic approach can be done in exploiting and identifying the phytopharmacology to explore in knowing the maximum potentiality of the plantwhich will be useful.

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