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Review

Exploring the Therapeutic Potential: A Thorough Survey on the Phytochemistry and Pharmacology of Borassus flabellifer leaf

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	Abstract
Published on: 27 Apr 2024	<p>Palmae is the family that includes the tall palm tree <i>Borassus flabellifer</i> Linn. It inhabits the tropical regions of Africa. All of its parts, including the roots, leaves, inflorescence, flowers, fruits, and seeds, are potentially medicinally valuable, making it a most precious gift to humanity. Updating <i>Borassus flabellifer</i> Linn's compressive potential overview was the primary objective of the current investigation. The medicinal qualities of the different plant sections are also emphasized in the review paper. It possesses antibacterial and anti-diabetic properties in its roots, according to the review. Plant leaves have antibacterial, antifungal, antioxidant, anti-inflammatory, and anticancer effects, among other pharmacological characteristics. The male inflorescence of the plant exhibits potent anti-inflammatory, antioxidant, antidiabetic, analgesic, and antipyretic characteristics. The pharmacological effects of plant fruits are diverse and include immunomodulatory, wound healing, antioxidant, anthelmintic, diuretic, and antimicrobial and antibacterial, antiarthritic activity, hypertensivity. Antimicrobial, antibacterial, and antioxidant properties are displayed by the seed coat. The phytochemical, pharmacological screening, and use are included in this study.</p>
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	<p>Keywords: pharmacological investigations, traditional usage, phytochemistry, <i>Borassus flabellifer</i> Linn.</p>

INTRODUCTION

All human illnesses have an endless supply of natural remedies. The use of herbal medicine dates back thousands of years to human civilization^[1]. Many medicinal plants have different pharmacological effects due to the presence of phytoconstituents in them. *Borassus flabellifer* Linn. is one of them and it has several therapeutic uses.



Fig 1: Borassus flabellifer Linn Tree

Classification

Kingdom: Plantae
Super division: Spermatophyta
Class: Liliopsida
Order: Arecales
Family: Arecaceae
Genus: Borassus L.
Species: *Borassus flabellifer* L.

Different species

Borassus aethiopicum - African palm
Borassus akeassii – Ake Assi’s palm
Borassusflabellifer – Asian palm.
Borassusmadagascariensis – Madagascar palm.
Borassus sanbiranensis–Sambirano palm

Vernacular Names

The plant names in different languages as follows

Sanskrit : Tal
English : Palmyra palm
Hindi : Tal, Tar
Kannada : Tale mara
Marathi : Tad
Malayalam : Pana
Tamil : Panai
Telugu : Tadichettu

Parts used

Roots, buds, toddy(i.e.-juice from buds), spadices, flowering stalk, fruits, leaves and bark, Seed, whole plant etc.

Depiction

The tall palm tree *Borassus flabellifer* Linn. grows 20-30 meters tall with a straight trunk in sandy soil^[8]. There are more restricted cross over branches and a shaggy root. Wood and bark are dim. The stem is dark in variety and is essentially comprised areas of strength for of strands in its hard external segment. The substance is delicate and bland and is situated in the middle. Petioles with terminal leaves that are palmately parted, fan-molded, and 0.6-1.2 meters long with spinulose edges. Yellow blossoms are created in spadices, and the female spadix has not many branches and a couple of solitary, scattered sprouts. Male blossoms are little, secund in two series inside a little spikelet, and blended with layered bracts. The globose of female blossoms is bigger. Large and sinewy, organic products generally incorporate three segments that look like nuts and every one contains a seed. Plant produces products of the soil from December to August^[2].

Fruit

The palm starts to bear fruit when it is between 16 and 20 years old. A tree can produce 60–200 fruits in 7–14 bunches annually. The delicate fruits are available from May to August, while the ripe fruits are available from July to October, depending on the locale. The seeds have a soft, tasty endosperm that resembles jelly and contains sap. After forming a fibrous shell, the fluid pulp eventually hardens into a bony kernel. The mature fruit's color varies from light gold to nearly black at the tip, where it connects to the spadix.^[3]

Chemical constituents

Chemical constituents include fatty acids, sterol, and amino acids. Aspartate, glutamate, phenylalanine, and lysine are the predominant free amino acids found in it. Flabelliferins, steroidal saponins, are also present. Sucrose, glucose, and fructose are the three basic simple sugars that are easily digested. Carotenoids:- β -carotene, a combination of the four primary carotenoids α -carotene, β -zeacarotene, lycopene, and zeta-carotene. Small constituents:- The vitamin B complex and vitamin C also present.^[4]

Traditional uses^[5]

Root

The root has anthelmintic, diuretic, stimulant, antiphlogistic, restorative, and cooling properties. beneficial for burning feeling, inflammation, stress, and hyperdipsia. Hiccups and stomach catarrh can be relieved by the juice of leaf stalks and young root. It is utilized as a treatment for gonorrhoea. As a bestant acid, inflorescence is antiperiodic and useful in hyperacidity, also demonstrates use in splenomegaly, hepatomegaly, heartburn, bilious fever, and skin conditions. Root decoction helps clear respiratory conditions, encourages urine flow, and eliminates worms in the body.

Fruit

These are antihelmintic, laxative, sedative, aphrodisiac, depurative, styptic, stomachic, pleasant, and cooling. Fruits are used to treat intestinal worms, dyspepsia, constipation, colic, gas, general debility, and pitta and vata^[4]. Stonic is used as a stimulant, anti-aprotic, diuretic, antiphlogistic, and for individuals with asthma who have gastric problems.

Flower

Diabetes is treated using the juice from the flowering stalks. The dried flowers talk shootis work on enlarged liver and bilious affections. Sweet-tasting juice from flowers is stimulating and cooling, and it functions as a relaxant when used frequently.

Leaves

An extract from green leaves is helpful for secondary syphilis patients. Gastritis is relieved and hiccups are regulated by leaf juice. A excellent antidote for poisoning is palm sugar made from toddy. It given to liver and gastrointestinal problems.

Other uses

It has been found that young palm branches are neurotoxic to rats but not hepatotoxic; they contain a toxic component that is heat stable and insoluble in chemical solvents. It is said that the extract prepared by boiling the central axis of the male inflorescence with mustard oil is useful to treat joint discomfort and swelling brought on by rheumatic condition.

Origin and distribution

The distribution of *Borassus flabellifer* Linn is found in New Guinea, Cambodia, Burma (Myanmar), and South-East Asia. It grows throughout India on sand- or dry-filled areas beside riverbanks. It can be acquired from West Bengal, A. P., Bihar, Karnataka, Tamil Nadu, Odessa, and Maharashtra.

Cultivation

The palm grows naturally, thus no extra cultivation is required. Manuring or artificial irrigation are not necessary. The technique used for propagation is direct seeding. During the early stages of germination, only the underground stem component thickens; after 15 to 20 years, the airy section of the trunk elongates and becomes its characteristic black, cylindrical stem. Usually, fifteen years after aerial development starts, the palmyra starts to blossom. It blossoms from March to May in some areas, and the fruit ripens from August to September.

By product

There are such countless items are shaped by the different pieces of plant Like Drink, jaggery, sugar, Oil,

candy, spread, toffee, Toddy palm wine, burfi, Pickle, Canned Palm, Chilling, Cola, Honeyetc. Not many of them are used from many years prior.

Toddy

It is framed by aging of sweet sap. Aging is finished by regular yeast and microbes. It content roughly 4-8% liquor. Drink is a conventional beverage with invigorating quality. It is gathered after aging becomes sharp, in morning or in night. It is one of the crude cocktails.

Jaggery

Because of its dietary and restorative properties its cost is high. It gives earthy, intense taste like chocolate. It is called as palmgur.

Sugar: It is ready from organic products.

Oil: It is acquired from natural product through wet handling.

Candy: Candy is planning by warmed the Neera for 2 hours to obtain the thick consistency.

Spread:

Fruit mash is removed by utilizing water and heat (70°C for 10 min). The removed mash is blended in with other and warmed on a most minimal fire with ceaseless mixing. Cooked material on cooling filled into broadmouth bottles, covered, named and put away.

Toffee

Palm toffee is ready by blending organic product mash with sugar, skim milk powder, glucose, refined flour and starch. The blend is cooked for 40 minutes with steady mixing. Blend is stretch on spread aluminum tray and left it short-term.

Wine

Wine is made by utilizing the matured blossom sap. It is white, drunkard, sweet having solid smell with gentle taste. The sap of blossom goes through aging on account of regular yeast.

Burfi

It is plan with khoa, spread and lime water. Organic product mash and sugar is additionally utilized for planning of Burfi.

Pickle

It is made with little natural products which are salted in vinegar.

Borassus flabellifer Linn has a great deal of nutritive and nutraceutical values which are very much examined and revealed by numerous scientists as like medication. *Borassus flabellifer* Linn. is a generous wellspring of biopharmaceutical, it displays numerous organic properties and used as a solution for some sicknesses.^[5]

Microscopical studies

Cross over part of leaf (The Ayurvedic Pharmacopeia of India, 2004; Khandelwal, 2002) Microtome segment was finished for new leaf to get a dainty area. The part was stained with toluidine blue, safranin, phloroglucinol-hydrochloric corrosive (1:1) and iodine. Photomicrographs were taken at various amplifications and examined. Powder microscopy (The Ayurvedic Pharmacopeia of India, 2004; Khandelwal, 2002) Shade dried leaves were powdered with the assistance of an electric processor till a fine powder was gotten. This fine powder was exposed to powder microscopy, according to standard systems referenced. Estimation of cell construction and content (Khandelwal, 2002; Ansari, 2010) the length and width of phloem filaments and distance across of the starch grains were estimated involving stage micrometer and the eyepiece micrometer according to standard references. Assurance of physico synthetic boundaries (The Ayurvedic Pharmacopeia of India, 2004; Ansari, 2010) Absolute debris, corrosive insoluble debris, water dissolvable debris, unrefined fiber content, dampness content, liquor solvent extractive worth, water dissolvable extractive worth, chloroform dissolvable extractive worth and oil ether solvent extractive upsides of leaves of *Borassus* still up in the air according to standard systems. Leaf constants (Khandelwal, 2002) The stomatal number, stomatal record, vein islet number and vein end not entirely settled according to standard references. Assurance of Fluorescence examination (Madhavan, Hema Basnett, 2009; Madhavan, Pravinkumar, 2009; Ansari, 2010) Powdered leaf was exposed to investigation under bright light after treatment with different reagents like Extraction The gathered leaves were washed and dried under the shade. It was coarsely powdered utilizing an electric processor. Around 50 g of the coarsely powdered leaf was pressed in a Soxhlet device and removed with ethanol in the wake of defatting with petrol ether. The concentrate got was concentrated under vacuum utilizing rotational vacuum evaporator.

Starter compound screening (The Ayurvedic Pharmacopeia of India, 2004; Kokate, 2008; Kokate, 2006). The concentrate got was exposed to different substance tests according to the technique referenced in the standard reference books. Result and conversation.

Microscopical studies: transverse section of leaf [fig 2,3]

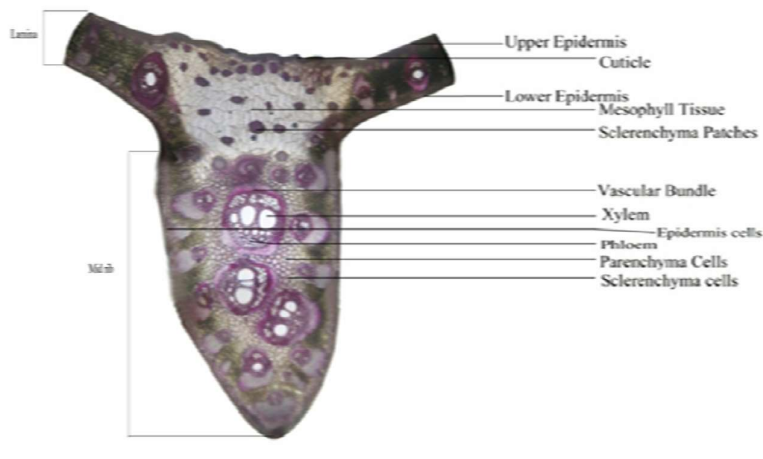


Fig 2: Transverse Section Of Borassus Leaf , T.S Stained With Phloroglucinol Hydrochloric Acid

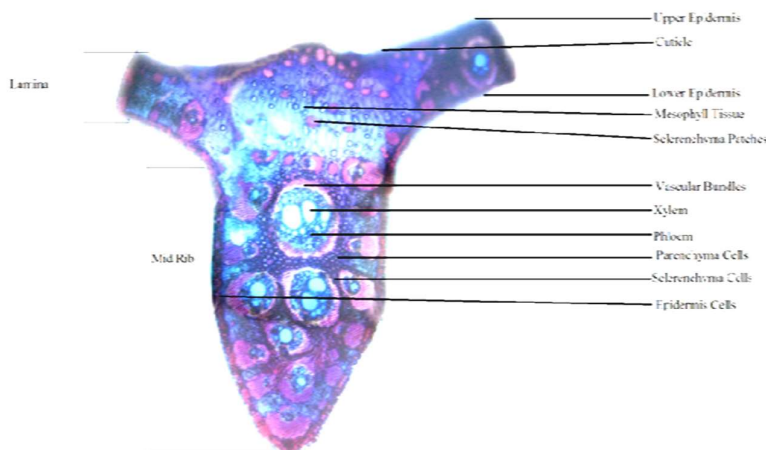


Fig 3: Transverse Section Of Borassus Flabellifer Leaf, T.S Stained With Toluidine Blue And Safranin

The Transverse section segment of *Borassus flabellifer* leaf showed dorsiventral nature .transverse section segment showed a particular lamina and midrib locale. The lamina district showed the presence of epidermis which was viewed as on both upper and lower side of leaf .The epidermal cells were barrel formed and were organized intently with practically no intercellular spaces. Epidermis was remotely covered by a waxy layer of fingernail skin. Parasitic sort of stomata was seen in epidermal layer. The following layer found was the ground tissue comprising of the mesophyll cells lying between the upper and lower epidermal layers. It was comprised of columnar cells. Patches of sclerenchyma and vascular groups were found dissipated all around the mesophyll area and the lamina locale (Fig 2). An exceptionally particular and huge midrib locale which showed the presence of 15-20 vascular packs was noticed. The vascular packs were shut sort. Xylem was available towards the upper side and phloem towards the lower side. The vascular packs were covered by a layer of sheath cells (Fig 3.). Towards the outside of the vascular packs a few layers of sclerenchymatic filaments were noticed. Paracytic sorts of stomata were seen.^[6]

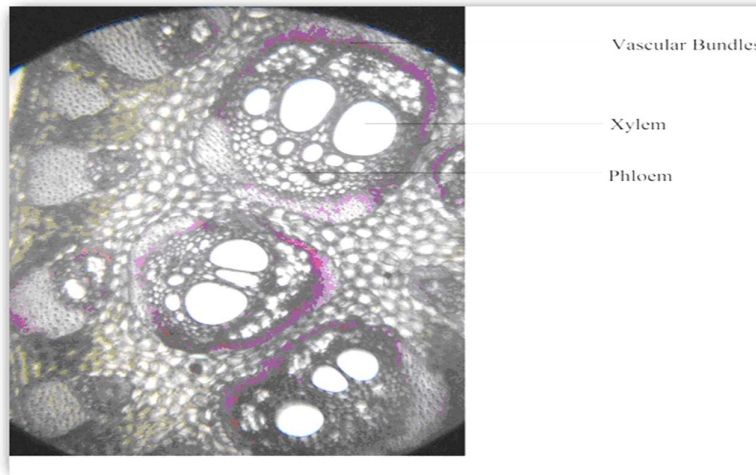


Fig 4: Portion showing the vascular bundles , xylem and phloem.

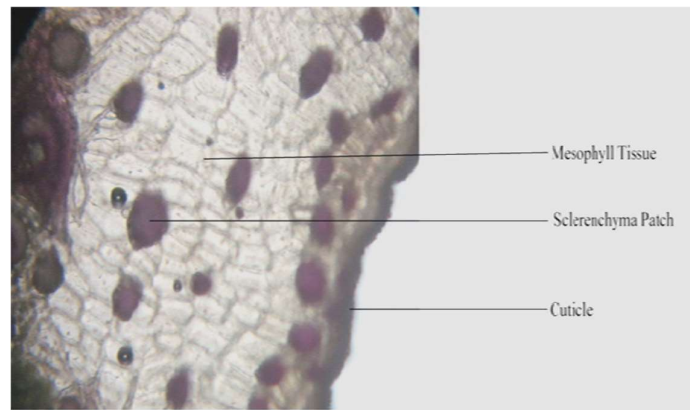


Fig 5: Portion showing the mesophyll, sclerenchyma patches and cuticle



Fig 6: Reticulate Xylem vessel

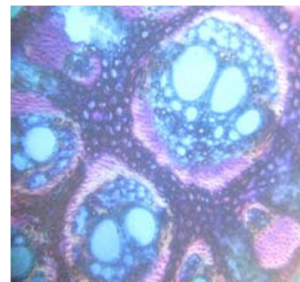


Fig 7: Laminar with vascular bundles

Powder microscopy

Fibres: Long and lignified phloem fibres were found which mostly occurred in groups.

Xylem vessels: Spirally arranged lignified xylem vessels with annular rings were found though out slide.

Stomata: Parasitic type of stomata was observed.

Starch grains: Mostly circular to oval shaped starch grains were seen.

Calcium oxalates: These were present as tetragonal prisms

Measurement of cell structure and content

This helps in identification of adulteration. The results obtained are tabulated in Table-1.

Table 1: Measurement of cell structure and content

Parameters	Result
Width Of Fibre	12.04 μm – 27.34 μm – 62.2 μm
Length Of Fibre	202.64 μm – 750.0 μm – 1170.6 μm
Diameter Of Starch	12.04 μm – 19.864 μm – 37.12 μm

Determination of physiochemical properties

The physicochemical properties help to gauge how much pollutants like soil and molecule present in the medication. It additionally assists with evaluating the calculi salts present in the medication test. The outcomes acquired for the general examination are organized in Table-2.

Table 2: Physio Chemical Properties

Parameter	Value
Total Ash	9.2
Acid Insoluble Ash	3
Water Soluble Ash	2
Moisture Content	6.9
Crude Fiber Content	38
Alcohol Soluble Extract	10.4
Water Soluble Extract	4.8
Petroleum Extract	3.2
Chloroform Extract	2.4

Preliminary chemical screening

The chemical test are used to confirm the what type of chemical constituents present in the plant extract. The result of preliminary chemical test are organized in table 3.

The qualitative preliminary phytochemical studies of leaf of borassus flabellifer linn tree

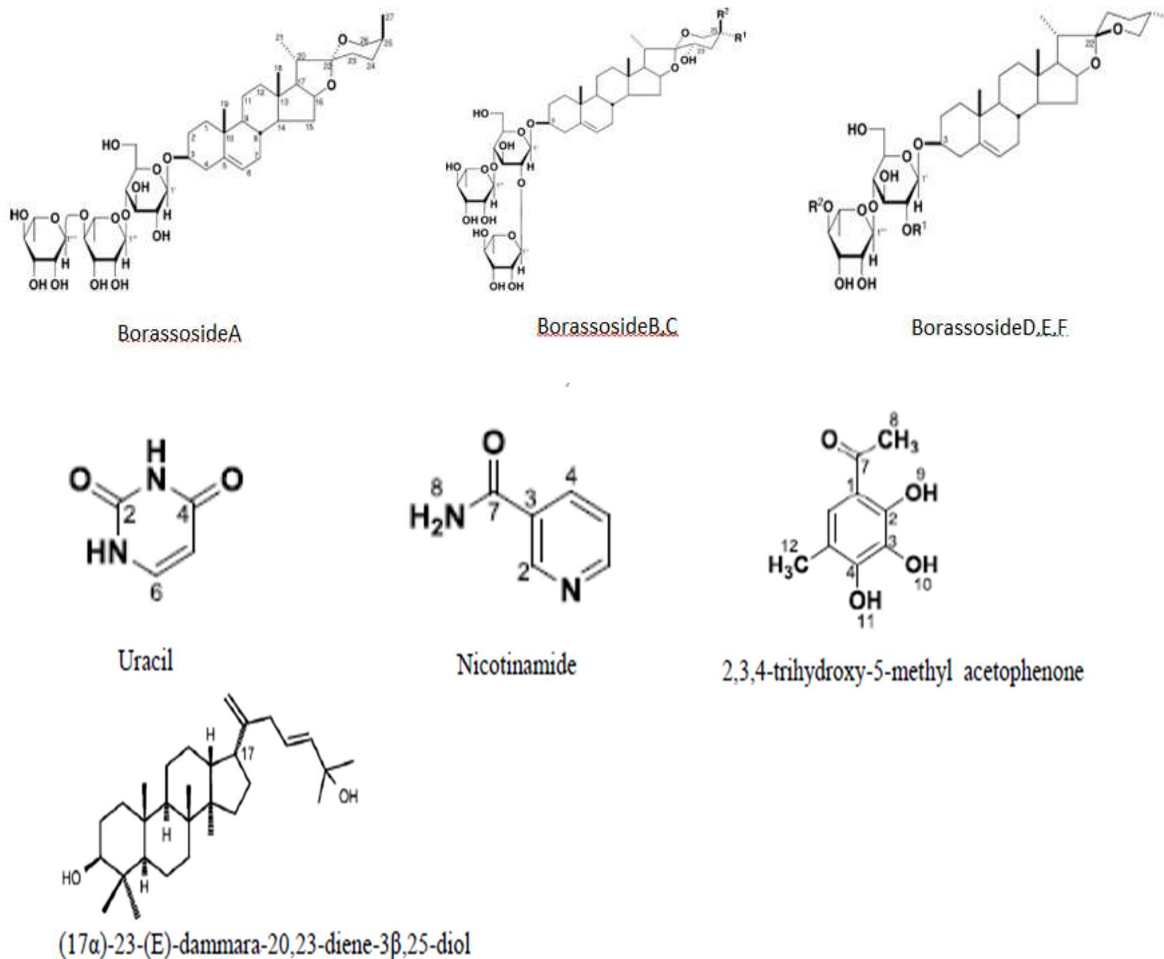
Phyto Constituents	Pet. Ether Extract	Benzene Extract	N- Butanol Extract	Ethanollic Extract
Alkaloids	Absent	Absent	Absent	Absent
Glycosides	Absent	Absent	Absent	Absent
Carbohydrates	Present	Present	Present	Absent
Tanins& Phenolic Compunds	Absent	Absent	Absent	Present
Amino Acids	Absent	Absent	Absent	Absent
Proteins	Absent	Absent	Absent	Absent
Steroids	Present	Present	Absent	Present
Flavonoids	Absent	Absent	Absent	Present
Saponins	Absent	Absent	Present	Present

Phyto chemical Potential of Palmyra Palm

The phytochemicals like alkaloids, flavonoids, terpenes, glycosides, saponins, phenolic, tannin, steroids, and sterols are found in palmyra organic product. These mixtures are notable for their cardio-tonic properties, antimicrobial properties, and use in natural drugs and beauty care products. Flavonoids and tannin are phenolic intensifies that go about as essential cell reinforcements and have antimicrobial, mitigating, hostile to hypersensitive, anticancer, against neoplastic, and against neoplastic movement, as well as the capacity to treat digestive problems. Saponins are additionally restoratively significant due to their hypolipidemic and anticancer action. Saponins are additionally expected for heart yield action. The astringent flavor natural products are wealthy in tannin. Sahni *et al.*, 2014 announced gastrointestinal issues like loose bowels and diarrhea can be dealt with utilizing palm organic product. It contains 1.61g/100gm alkaloids, 0.63g/100g saponin, 36.3-99.34 μg /100mg of absolute phenolic content, 98.48-222 μg /100mg of complete flavonoid content. The presence of Dimethyl Sulfoxide, Dimethyl sulfone, 5-methyl-2-Furancarboxaldehyde, 1,3,5-Benzenetriol, 2-Furancarboxaldehyde, 9-Octadecene, 1-Tridecene, 9-Eicosene, 4-Pyridinecarboxamide, D-Allose, Altrosan, Hydroxy-4-methoxybenzoic corrosive, Cyclododecane, Methyl alpha- d-Ribopyranoside, ethyl octadecyl ester Phthalic corrosive, Campesterol, Stigmasterol, betaSitosterol, gamma.- Sitosterol, alpha.- Amyrin, beta.- Amyrin compounds were affirmed in dry underlying foundations of palmyra palm. The presence of these phenolics, alkaloids and

phytosterol compounds were utilized in ayurved as they have calming, antiarthritic, cytotoxic, antibacterial, pain relieving, antipyretic, hypoglycemic and cell reinforcement action. Again a few creators revealed the presence of 2-Furanmethanol, Propane, 1-(1-methylethoxy)2-Cyclopenten-1-one, 2,4-Dihydroxy-2,5-dimethyl-3(2H)- furan-3-one, Glycerin, 1HImidazole-4-carboxamide and Butane in ethanolic concentrate of palmyra palm root (Salvemini *et al.*, 1996 ; Turner *et al.*, 1971). While the presence of nutrients An and C, Flabelliferrins (steroidal saponins), vitamin B-complex were found in new mash of palmyra palm (Nadkarni, 2002). The plant has a few restorative purposes, including anthelmintic and diuretic, in different locales. Customary recipes frequently incorporate organic product mash, and the sap has been utilized as a sugar for diabetic individuals (Selvakumar and Thanapaul, 2020).^[7]

Chemical structure of isolated phytochemicals from various part of *b.flabellifer*



Pharmacological activities

Cytotoxic activity

The MTT experiment indicated that the seed coat's cytotoxic effects on HeLa cells had ended. There was a notable growth inhibition of the HeLa cells. ^[8]

Antimicrobial activity

Five bacterial strains were detected in the methanolic seed coat extract screening. Disc diffusion and agar well diffusion methods were used to screen the antimicrobial activity for Staphylococcus aureus, Escherichia coli, Bacillus subtilis, Klebsiella sp., and pseudomonas aeruginosa. ^[9]

Anthelmintic activity

The best anthelmintic action is shown by toddler palm sap. In this experiment, three groups of earthworms were divided and exposed to varying quantities of extract. Albendazole was the standard of reference. Normal saline is administered to the control group.^[10]

Antifungal activity

Candida albicans and *Aspergillus niger* were subjected to the antifungal activity test using nutrient agar medium and the cupplate method.

Antioxidant activity

Various fruit extracts, including petroleum ether, chloroform, methanol, and chloroform-water, were assessed for antioxidant properties.

Anti-arthritis activity

In order to screen for antiarthritic potential, an ethanolic extract from the flower at a concentration of 200 mg/kg was used for 21 days in a polyarthritis model caused by Freund's Complete Adjuvant (FCA). Findings indicated a strong anti-arthritis effect when measured at 100 mg/kg against the control, diclofenac sodium.

Diuretic activity

The aqueous and alcoholic extracts of *Borassus flabellifer* seedlings were tested on albino rat, where furosemide is used as a standard medication. The results showed that the extracts increased urine output and levels of Na⁺, K⁺, and Cl⁻. *Borassus flabellifer* has diuretic activity.

Immunomodulatory activity

colleagues examined the immunomodulatory impact of a 300µg/ml floral ethanol extract on mice during a 26-day period. The outcomes demonstrated the immunomodulatory potential of the exopolysaccharides produced by two strains of *Leuconostoc mesenteroides*. At the same concentration, Dextran was used as a comparison.

Hypersensitivity

The powerful immune suppressive efficacy of an ethyl acetate tuber extract was studied in mice at a dosage of 0.4 mg/kg (effective dose) (ED50) for five hours, and this was compared with cyclosporin A.

α-glucosidase inhibitory activity

Sukanya and associates carry it out. The outcomes showed that α-glucosidase was inhibited by ethyl acetate extract.

Haemolytic activity

Palmyra flour was tried for haemolysis. It is evaluate don human RBC.

In-vitro anticancer activity using SRB assay

Dr. Ashok was done anticancer action of methanolic leaves separate which was screened on Human colon malignant growth cell line, Human hepatoma cell line and Human lung cancer cell line by SRB measure.

Anti-inflammatory activity

Root extricate (ethanolic) was assessed for calming movement by utilizing intense and persistent models like; carrageenan-instigated rodent paw oedema and carrageenan-actuated air-pocket model.

Analgesic activity

Acidic corrosive instigated squirming, hotplate, tail-cut technique were utilized for examination of pain relieving movement. An ethanolic separate at a portion of 150 mg/kg from the flower was tried on yeast-prompted pyrexia in mice and rodents and results showed that the concentrate fundamentally switched hyperthermia and this was contrasted and ibuprofen at 200mg/kg focus.

Antipyretic activity

The antipyretic properties of the ethanolic extract of male flowers, or inflorescences, were studied. Significant action is shown at both doses.

Hypoglycemic activity

An ethanolic extract of dried inflorescence was found to significantly lower blood glucose levels. [33]

Anticonvulsant activity

Using the maximal electro shock seizure test and the pentylenetetrazole seizure test, the anticonvulsant activity of an alcoholic leaf extract was assessed.

Antifungal, antibacterial, and antioxidant evaluation

The agar well diffusion method was used to examine the antibacterial properties of eight pathogenic strains of bacteria and fungus.

Antimicrobial activity of Immature palmyra palm

Five bacterial strains were detected in the methanolic extract from the seed coat of palmyra palms. Disc diffusion and agar well diffusion methods were used to screen the antimicrobial activity for *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Klebsiella sp.*, and *Pseudomonas aeruginosa*.

Wound healing activity

Another preliminary human trial was conducted to assess the effectiveness of applying Flabelliferin b. (FB) locally to seven volunteers who were chosen to demonstrate the fruit extract's ability to heal wounds at a concentration of 4 mg/ml for a week. The created FB ointment caused no side effects during the healing of wounds, and the positive control in this trial was metronidazole.

Anti-diabetic activity

Flowers' ethanolic extract was tested against Alloxan-induced diabetic rats to determine whether it has any anti-diabetic properties.

Anticancer activity of leaf

The anti-cancer properties of ethanol leaf extract were assessed. The plant showed good cytotoxic effect

CONCLUSION

The different parts of *Borassus flabellifer Linn.* have different types of pharmacological activities, such as anti-inflammation, analgesic, anticancer, cytotoxicity, anti-hyperglycemic, antioxidant, antibacterial, antifungal, anthelmintic activity, and hemolytic activity, according to our updated comprehensive potential review. Researches on pharmacology that examine the plant's potential that could benefit society and researchers in general.

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