

Anti-Microbial and Anti-Diabetic Properties of *Dillenia Indica* Linn (Elephant Apple): A Short Review

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ABSTRACT:

Dillenia indica Linn. is classified under (Dilleniaceae) family, generally known as elephant apple with many other names like bhavya, chalta, karambel, ramphal. This evergreen deciduous tree mainly found in Asian countries and in India, mainly found in Assam, Bihar, Bengal. There are many *Dillenia* species however only some are established scientifically. Historically the unripe end result are used to make curries due to its sour taste and ripe end result are making pickles. The end result are commonly high in fibre and due to presence of gummy substances, extraction of juice turns into tough. Not only the culmination have medicinal values but the leaves and the bark also showed numerous pharmacological interest. *Dillenia indica* is a well-known medicinal plant of this genus for their therapeutic capability in pre-clinical research. Various parts of this plant shows beneficial properties against various diseases like antidiabetic, antimicrobial, antiprotozoal, antioxidant, anticancer activities. Fruit of *Dillenia indica* can be consumed as dried powder or in juice form with various health benefits. It is an important medicinal plant and has been prevalently utilized in Indian conventional and ayurvedic medicinal drug for curing plethora of ailments along with digestive, respiration and crucial nervous system problems. Plant extracts have been reported that it contains many phytochemicals as well as their active constituents i.e flavonoids, triterpenoids, phytosteroids, phenolics. These active constituents shows wide range of pharmacological activities like antimalarial, anticancer, anti inflammatory. The slime, extracts and crude sample having medicinal uses like treatment of various skin problems like eczema, skin itching, treatment of dandruff and hair related issues. Consumption of leaves directly help to neutralize food poisoning also.

KEYWORDS: *Dillenia indica*, anti-microbial, anti-diabetic, elephant apple, phytochemicals.

INTRODUCTION:

There are variety of herbs with medicinal properties, Elephant apple is one of them. (*Dillenia indica*) a member of Dilleniaceae family, is a huge fruit, lumps on their surface and generally sour in taste. Fruit is circular with uneven shape, somehow looks like an elephant's foot.[1] The fruits are green when unripe, outer covering is thick, hard and fruit are mainly used for making pickles, jams, chutneys.[2]

The *Dillenia* genus have 60 more species, i.e *Dillenia indica*, *pentagyna*, *suffruticosa*, *excelsa*, *serrata*, *ovata* etc all are the species of *Dillenia* with good medicinal properties, only two species are mainly found in India i.e *Dillenia indica* Linn. And *Dillenia pentagyna*. All parts of the plant including

fruit, leaf, bark used in medicines because of their effective therapeutic usefulness.[3]

Elephant apple (*Dillenia indica*), tropical tree with medium in size, height upto 15.2m according to the origin. Elephant apple mainly found in Assam, Bihar, Bengal, Himalayan tracts and river banks of South - East Asia. The ripened fruit is sour in taste and at commercial level, fruits are processed to prepare ready-to-consume beverages and squash. The fruit are also beneficial for improving abdominal pain and increases bowel movement.[4]

The *Dillenia indica* plant's fruit and leaf extracts shows antimicrobial, antidiabetic, antioxidant, anti-inflammatory properties and fruit slime can be used in the process of formation of drugs. The dried fruit powder also shows antidiabetic properties. This species of *Dillenia* is mainly used for the treatment of high fever, diabetes, cough, cancers, rheumatism, skin diseases.[4]

The plant extract of *Dillenia indica* contains wide range of phytochemicals like flavonoids, phytosteroids, phenolics, alcohol and ketones. Various phytochemical studies revealed that there are various active constituents of phytochemicals including β -sitosterol, betulinic acid, betulin, myricetin, rhamnetin. The main two active constituents i.e betulin and betulinic acid shows high therapeutic value.[5]

CLASSIFICATION OF *Dillenia indica* :

Dillenia indica Linn. is globally reported in North and South - East Asia. In India, its mainly found in Assam, Bihar, Bengal, the Himalayan tracts. [4]

Table 1: Classification of *Dillenia indica* Linn.[3]

KINGDOM	Plantae
DIVISION	Phanerogarnae
SUB-DIVISION	Angiospernae
CLASS	Dicotyledonae
SUB-CLASS	Polypetalae
ORDER	Dilleniales
FAMILY	Dilleniaceae
GENUS	Dillenia
SPECIES	<i>Indica</i> Linnaeus

Table 2: Different names of *Dillenia indica* Linn.[3]

LANGUAGES	<i>Dillenia indica</i> Linn.
English	Elephant apple
Sanskrit	Bhavya, Ruvya
Hindi	Chalta, Girnar
Gujarati	Karmbel, Mota karmal
Bengali	Chalta, Hargesha
Malyalam	Punna, Valapunna, Syalitha
Nepali	Ramphal, Panchpal
Telugu	Peddakalinga
Tamil	Akku, Uvav, Uvatteku
Kannada	Kondukanagala

MORPHOLOGY OF *Dillenia indica* Linn. :

Dillenia indica Linn. is an evergreen large deciduous shrub with spreading branches grows approx. 15m tall. Leaves are greenish, blunt at the end, parallel lines all over the leaf . Leaves examine microscopically shows the irregular-celled stomata, transport tissue i.e xylem fibers, calcium oxalate crystals etc.[7]

From seeds, the developing period is 8 to 10 years. In India, flowers blossom in mid of the year specially in the month of July and flowering period continues for about 15-20 days. Anther starts releasing pollen grains after 56 hours of flower blossom.[8] The flowers are milky whitish colour and large upto 15cm according to the diameter.[6] The fruit is round to oval in shape with hard outer covering, about 2 to 5 inch wide. The fruit pulp is light brownish in colour, acidic smell, sticky like slime. The fruit taste is sour with many small seeds present inside it.[9]

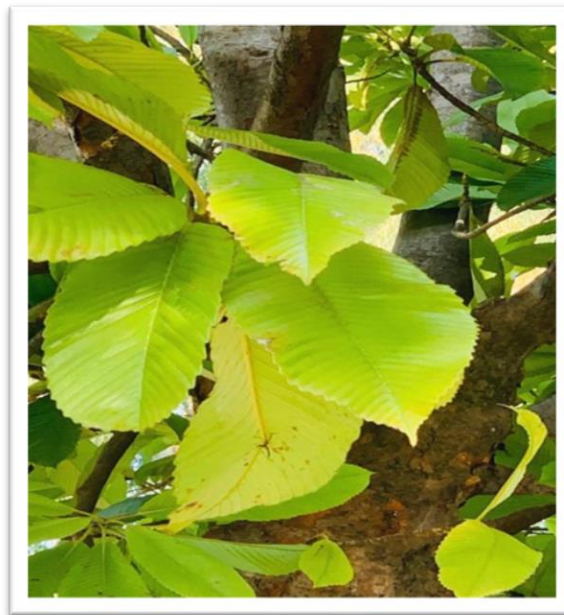


Fig 2. *Dillenia indica* Linn leaves

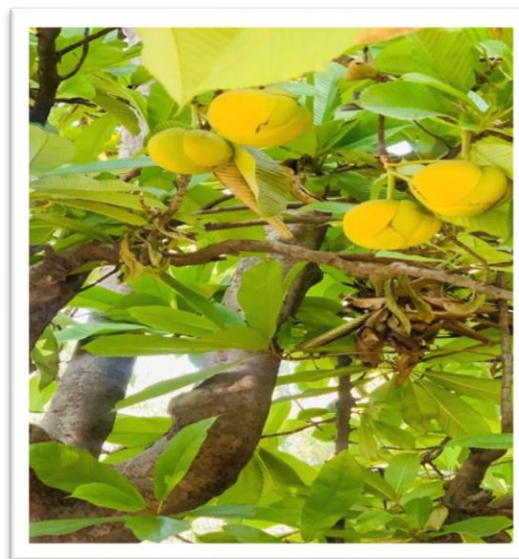


Fig 3. *Dillenia indica* Linn. tree with fruits

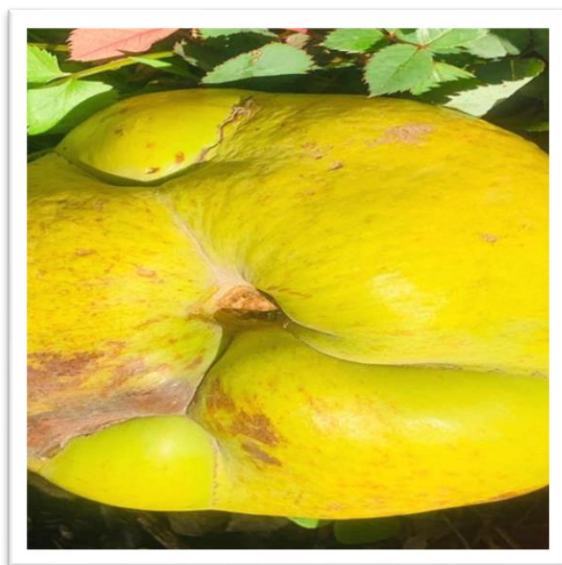
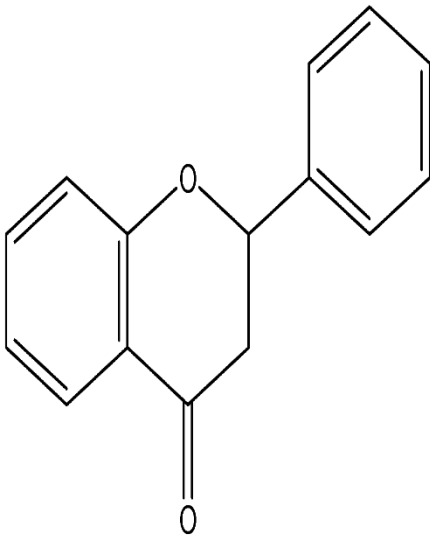
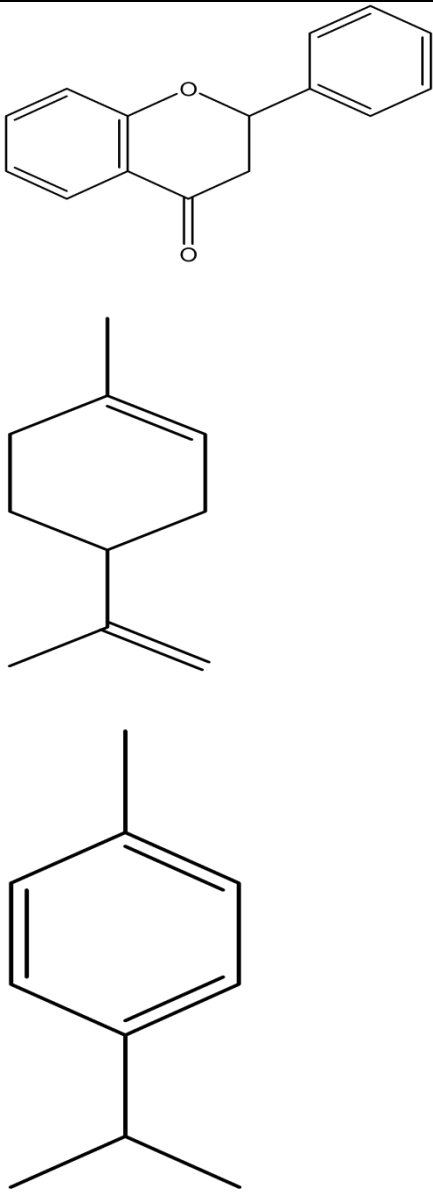
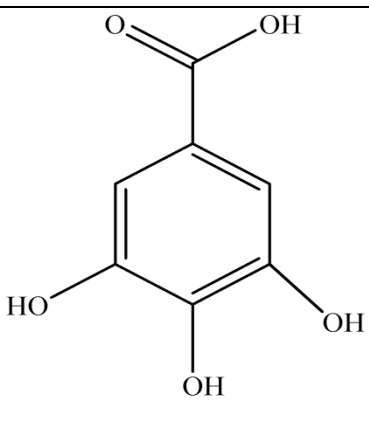


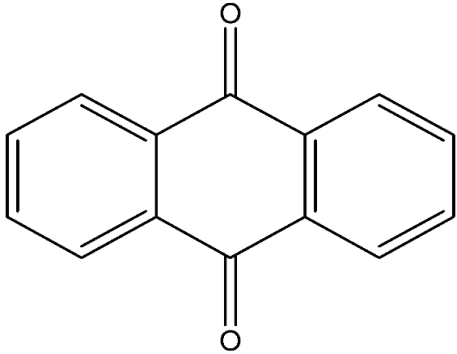
Fig 4. *Dillenia indica* Linn. fruit

PHYTOCHEMICALS PRESENT IN *Dillenia indica* Linn.

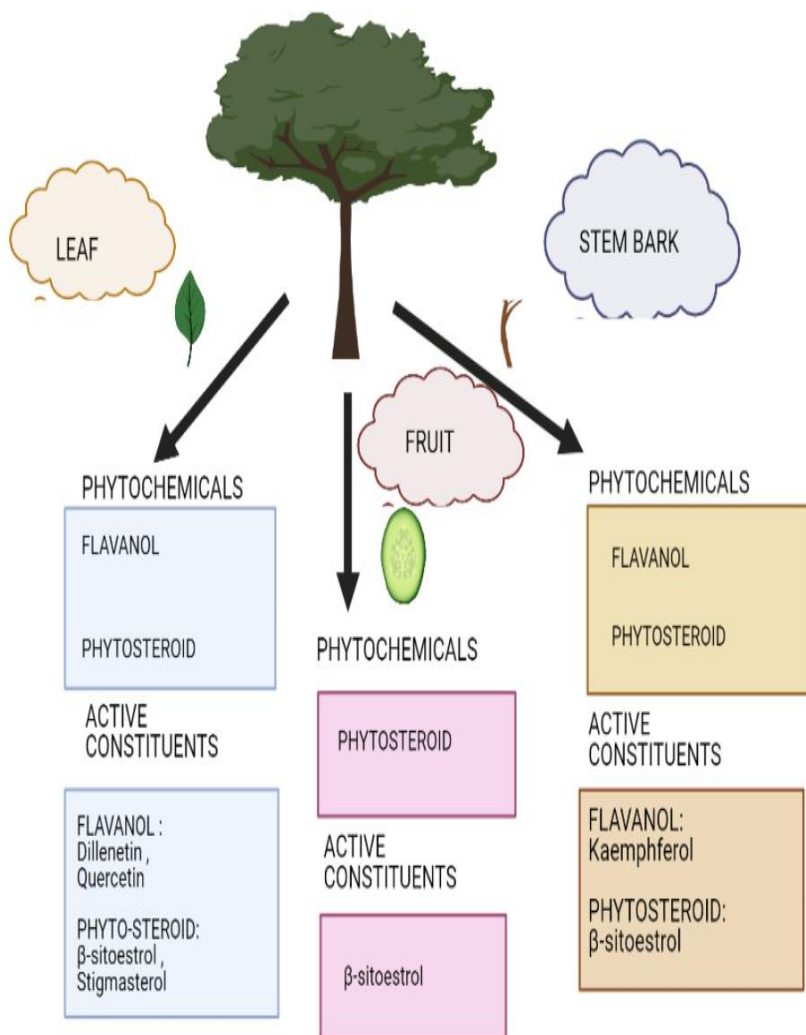
Table 3 : Structures and Phytochemicals extracted from various parts of *Dillenia indica* Linn. (Elephant apple)

S.NO	PARTS OF PLANT	PHYTOCHEMICALS	STRUCTURE
1.	Stem bark, Leaf	Flavanol	

<p>2.</p>	<p>Fruit</p>	<p>Flavanoid , Tannin, Terpenes</p>	
<p>3.</p>	<p>Dried fruit powder</p>	<p>Tannins & Reducing sugars</p>	

4.	Stem bark	Anthraquinone (Aromatic compound)	
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PHYTOCHEMICALS AND THEIR ACTIVE CONSTITUENTS:

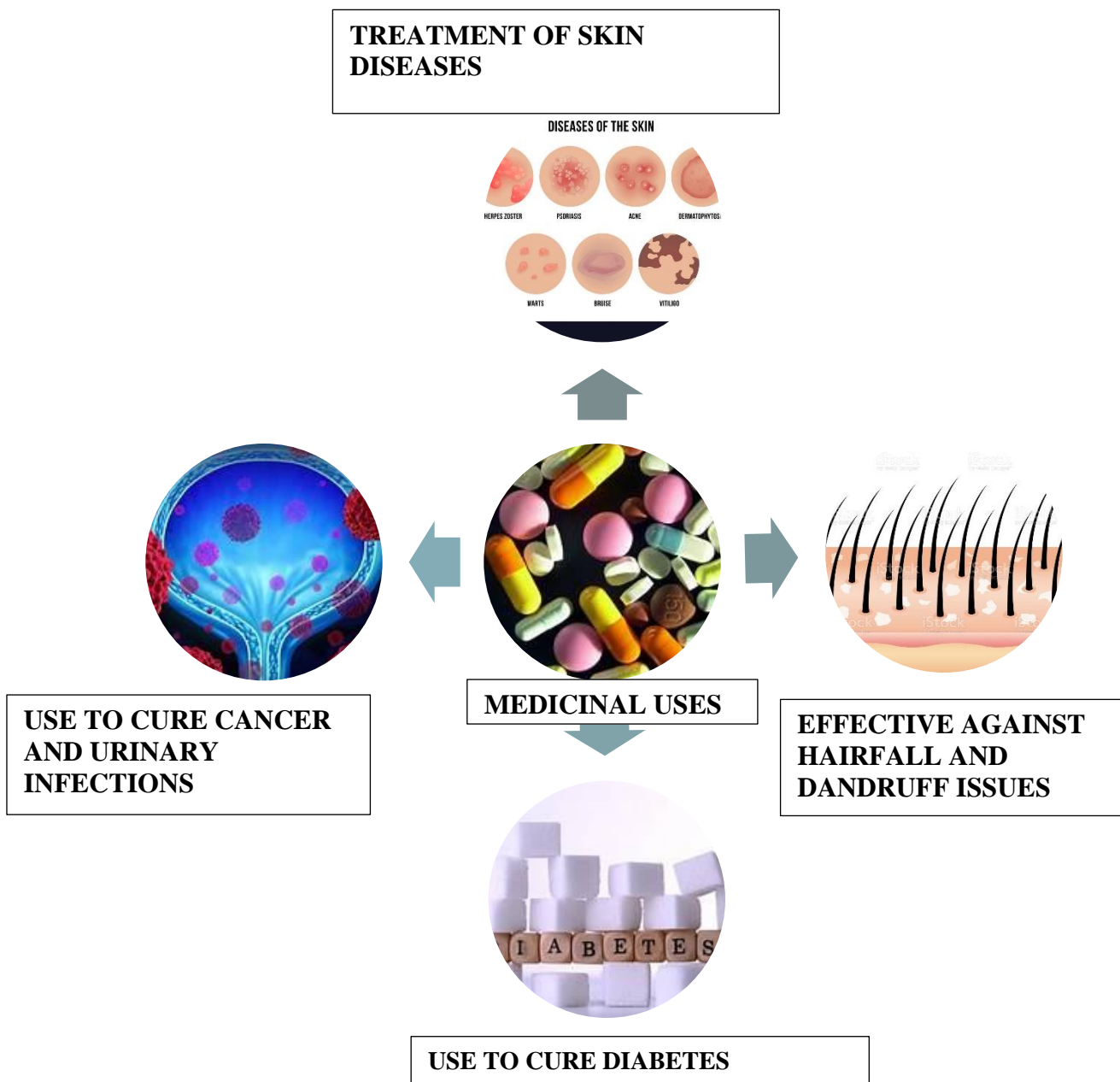


MEDICINAL USES :

Generally all the parts of *Dillenia indica* Linn. are anciently used for therapeutic purposes.

- Fruit , leaf, stem bark of *Dillenia indica* used to cure a variety of skin diseases like eczema, skin itching / rashes, leukoderma.[10][11]
- 2.The slime present in the fruit of *Dillenia indica* is used against dandruff and hairfall.[12][13]

- Mucilage is applied over the wounds which is due to burns.[14]
- The fresh or dried leaves, fruit powder, stem are processed and further use to cure diabetes, cancers, diaherria, wound, fever, cough, urinary infections, skin diseases, hair related issues.[10][11]
- 5.Oil from seeds of *Dillenia indica* shows antimicrobial, antifungal and antibacterial properties.[14][17]
- 6. Stem bark and fruit juice of *Dillenia indica* expressed benefits against cancer, mainly its effective against few types of cancers i.e breast and gastric cancer and helpful against fever and cough.[15][16][10]
- 7.The roots and stem bark of the plant has been used for a very longer period of time as a food poisoning neutralizer. The lemon-scented fruit of this plant may be eaten up directly or in the form of juice as a healthy drink.[20][21]



BIOLOGICAL PROPERTIES :

• ANTIMICROBIAL ACTIVITY

Dillenia indica was reported as antimicrobial, antifungal, antiviral activity. The various extracts were documented to suppress the growth of gram-positive bacteria and gram-negative bacteria. In comparison with the bacteria, it highly weakens the different fungal species which includes *Aspergillus niger*, *Aspergillus fumigatus*, *Saccharomyces cerevisiae*, *Candida albicans*, *Rhizopus oryzae*, *Candida krusei*, *Trichoderma viride*. [22][23][24][25]. Triterpenoid especially isolated from *Dillenia indica* has proven to show antimicrobial activity.[22][23] Some non polar fractions such as chloroform, hexane, carbon tetrachloride; methanolic extract of the leaves slows down or hinders the growth of *Bacillus subtilis*, *Escherichia coli*, *Staphylococcus aureus*, *Vibrio mimicus*, *Vibrio parahemolyticus*, *Salmonella typhi*, *Shigella boydii* and inhibit the growth of fungi i.e *Aspergillus niger*, *Sacharomyces cerevisiae* with zones of inhibition.[26] In other experiment, hexane (a well known constituent of gasoline), dichloromethane (an organochloride compound), ethyl acetate fractions of stem bark methanolic extract hinders the growth of *Escherichia coli*, *Bacillus subtilis* with MIC (Minimum inhibitory concentration) range between 0.31 to 20.00mg/mL in comparison with kanamycin and amoxicillin. The fruit and stem bark's aqueous extract hinders the growth of food-borne microorganisms with MIC ranges between 1.25 to 10.00 mg/mL. These reporting provides the information that *Dillenia indica* shows high antimicrobial properties, that further shows some therapeutic effect against various diseases caused by microorganisms.[27][28]

• ANTI-DIABETIC ACTIVITY :

Diabetes mellitus is a chronic disease, which is linked with high glucose level in blood. Hyperglycemia result in the secretion of low insulin and further this will affect various tissues, organs like kidneys, eyes, heart.[18] Insulin is secreted by pancreas, it may affect when pancreas secretes insufficient amount of insulin, then it leads to (type 1 diabetes) or when pancreas properly secretes insulin but body does not utilize that insulin, it leads to (type 2 diabetes).[19] Diabetes associated with the other major health issues like cardiovascular diseases, vision loss, kidney failure etc.[30]

A study conducted by Das and Sarma at the Govt. Medical College and Hospital in Assam. This was particularly based on human study with *Dillenia indica*, the fruit has a very high therapeutic significance to treat diabetes (high blood sugar level) in humans. The powder of that fruit shows antidiabetic response against type 2 diabetes. In this study, total 40 patients were selected randomly, all the patients were suffering from type 2 diabetes in that (19 males and 21 females). They got powder of that fruit and dividing them into two doses, total 30g per day, given that dose prior to half an hour before the lunch and dinner with lukewarm water for 24 weeks. They continue the same process till 24 weeks and the blood glucose level decreases without any side effects. This study concluded that fruit of *Dillenia indica* has a high medicinal value to treat diabetes in humans.[29]

• ANTIPROTOZOAL ACTIVITY :

Dillenia indica show antiprotozoal activity against leishmaniasis and malaria have been tested. Leaves ethanolic extract of the plant *Dillenia indica* was reported to hinders the growth of parasite *Plasmodium falciparum*. In that experiment, cyclohexane fraction of ethanol extract of the leaves show 53% inhibition against *Plasmodium falciparum* as compared to the chloroquine.[31]

CONCLUSION:

Herbal medicines are widely used nowadays. The literature survey and reports revealed that *Dillenia indica* has good potential in herbal medicines. The two main active constituents i.e Betulin and Betulinic acid are present in generally all parts of the plant which can cure many diseases. *Dillenia indica* fruit juice may be taken as energy drink because of their good nutritional value. *Dillenia indica* also have some other beneficial properties to cure diabetes, skin diseases, wound healing, dandruff and hairfall related concerns. Various pharmacological studies investigate that different parts of the plant such as leaves which have anti-oxidant, anti-microbial, anti-protozoal, anti-diarrheal properties, seeds have hepatoprotective and antimicrobial property and fruit of *Dillenia indica* have anti-leukemic property.

The main aspect of this article is to target on the medicinal uses of *Dillenia indica* Linn. Different plant extracts contain active constituents like flavonoids, phytosteroids, saponins, phenolics. Additionally, employed new techniques to extract the essential oils and phytochemicals from the plant extracts found to have more therapeutic values for further evaluation need to be checked to explore the pharmacological activity which can be useful for the society.

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CONFLICT OF INTEREST : No conflict of interest.

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