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Elephant apple fruit and its potential health benefits: A review

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Abstract

Elephant apple fruit is reported to have medicinal properties; similarly leaves and bark are also known for various health beneficial compounds. The fruit rich in fibre and due to presence of adhesive substances, extraction of juice becomes tough. The elephant apple fruit is found to have numerous health benefits viz. Antimicrobial, inhibitor, Analgesic, anti-inflammatory drug, dysentery, medicinal drug etc. Fruit and juice of the plant traditionally used for the treatment of varied diseases including diabetes. Additionally elephant apple is used for making curries and other recipes. In this review we intend to give some emphasis on the food and clinical use of flowering tree *Dillenia indica* (elephant apple) as medicinal herb.

Keywords: Elephant apple, nutrition, analysis, health, medicine

Introduction

Elephant apple (*Dillenia indica*) is a huge, knobby fruit with an acidic flavor that belongs to the Dilleniaceae family. The fruit is rounded with a few strange lumps, resembling an elephant's toe, and served as the principal food source for wild elephants. As a result, it is commonly referred to as the elephant apple. This plant is widely utilised as a herb by numerous tribes in the North East, including Assam (Sandipan *et al.*, 2009) [6]. The fruits are greenish yellow in colour and have a tough, leathery husk. When the fruits are fully mature, they emit a sour odour. The fruits are eaten fresh, and the unripe fruits are frequently used to make pickles. The bitter- sour fruit pulp is employed in Indian cuisine, such as curries, jams, and jellies. Chutneys are made by combining it with coconut and spices. *Dillenia indica* and *Dilleniapentagyna* fruits were also consumed raw, but they were not widely known (Dubey *et al.*, 2009; Pradhan and Badola, 2008; Sharma and Pegu, 2011) [29, 36, 11]. *Dillenia indica* and *Dilleniapentagyna* are known by several other names (Nadkarni and Nadkarni, 1954; Shah, 1978; Khanum *et al.*, 2007; Khare 2007; Rastogi *et al.*, 2001) [17, 23, 13]. Elephant apple (*Dillenia indica*) is an underutilized horticulture crop that is mostly grown in India's northeast. It can be eaten raw or cooked in a variety of ways. The fruit has been used to make jams, jellies, pickles, chutneys, and juices, among other things. It's an Ayurvedic herb that's traditionally used to cure uneasiness, indigestion, and weariness (Janick & Paul, 2008). Furthermore, literature research revealed that this fruit has medical properties such as antibacterial (Nazma, Mohammad, Mohammad, & Mohammad, 2009) [20], antioxidant (Deepa & Jena, 2011) [8], analgesic, anti-inflammatory, and anti-diabetic (Kumar, Kumar, & Prakash, 2011) [31]. Vitamin C, tannins, malic acid, arabino galactan, betulin, betulinic acid, and flavonoids are abundant in the fruit's fleshy sepals (Talukdar, Talukdar, Deka, & Sahariah, 2012) [38]. The fruits' utility is limited by their high moisture content and seasonal availability. As a result, appropriate preservation strategies (sun drying, solar drying, hot air drying, and so on) should be developed to retain higher amounts of bioactive components in the final products while increasing the shelf life of fresh elephant apples. It can be eaten raw or cooked in a variety of ways. The fruit has been used to make jams, jellies, pickles, chutneys, and juices, among other things. It's an Ayurvedic herb that's traditionally used to cure uneasiness, indigestion, and weariness (Janick & Paul, 2008) [15]. Furthermore, literature research revealed that this fruit has medical properties such as antibacterial (Nazma, Mohammad, Mohammad, & Mohammad, 2009) [20], antioxidant (Deepa & Jena, 2011) [8], analgesic, anti-inflammatory, and anti-diabetic (Kumar, Kumar, & Prakash, 2011) [31]. Vitamin C, tannins, malic acid, arabino galactan, betulin, betulinic acid, and flavonoids are abundant in the fruit's fleshy sepals (Talukdar, Talukdar, Deka, & Sahariah, 2012) [38].

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The fruits' utility is limited by their high moisture content and seasonal availability. As a result, appropriate preservation strategies (sun drying, solar drying, hot air drying, and so on) should be developed to retain higher amounts of bioactive components in the final products while increasing the shelf life of fresh elephant apples. Drying is a frequently used process for increasing the shelf life of perishable foods. It reduces water activity by removing moisture, resulting in increased physicochemical and microbiological stability (Moreira, Chenlo, Chaguri, & Fernandes, 2008; Nayak, Mohan, & Radha Krishnan, 2018) [21, 29]. Thus this review is focused on the phytochemicals present, health benefits, food and medicinal uses of elephant apple (*Dillenia indica*).

Origin and Distribution of elephant apple

Dillenia indica is native to southeastern Asia, including India, Sri Lanka, and eastern China (Yunnan) and Vietnam, as well as Thailand, Malaysia, and Indonesia (Lim, 2012). *Dillenia indica* and *Dillenia pentagyna* are found in a wide range of Asian countries. Bhutan, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Bangladesh, Philippines, Sri Lanka, Thailand, and Vietnam have *Dillenia indica* in their valleys and streamside areas. It is found in the Sub-Himalayan region of India, as well as Assam, North Bengal, Bihar, Orissa, Madhya Pradesh, and Gujarat. In Bhutan, India, Indonesia, Malaysia, Myanmar, Nepal, Thailand, and Vietnam, *Dillenia pentagyna* is found in tropical rainforest, thickets, and hills below 400 meters. It is found in Himalayan terrain in India, as well as in South India, the Andaman Islands, Gujarat, Mizoram, and West Bengal (Khanum and Khan, 2007; Khare, 2007) [17].



Fig 1: Elephant apple plant and its fruit

Elephant apple and its nutritional value

Elephant apple (*Dillenia indica*) is a huge evergreen shrub or a small to medium-sized semi-deciduous, branches-spreading tree that can reach a height of 15 m. fasciculate leaves are oblong-lanceolate, acuminate, 20-30 cm long, and strongly serrate. Flowers are white and huge, up to 15 cm in diameter,

and solitary, appearing at the end of each branch let. The fruit is huge, having a diameter of 7.5-10 cm. The purpose of this review was to concentrate on *D. Indica*'s anti-diabetic properties. In the long run, allopathic drugs used to treat diabetes have negative effects. As a result, it is preferable to treat diabetes using indigenous traditional knowledge systems.

Nutritive value

Nutritional value per 100 g of edible elephant apple flesh is listed in Table 1. Gopalan *et al.*, 1993) [18] reported that elephant apple fruits contain 82.3% moisture, 0.8% protein, 0.2% fat, 0.8% minerals, 2.5 % fibre, 13.4% carbohydrate, 0.016% calcium and 0.026% phosphorus.

Calories	59 kcal
Protein	8%
Fat	2-2.5%
Fiber	2.1-2.5%
Ash	3.54%
Calcium	16mg
Phosphorus	26mg
Ascorbic acid	4mg

Source: www.naturestudysociety.org/Chalta– Elephant apple

Elephant apple as source of Phytochemicals

Fresh elephant apple fruit has three volatile taste components: methyl hexanoate, ethyl-3-hydroxyhexanoate, and butanoic acid (Qureshi *et al.*, 2010; Patel, 2013) [33, 27]. Diarrhea, dysentery, tumours, asthma, wounds, heart debility, and hepatitis are all treated with the fruit. Flavonoids, saponins, tannins, and glycosides are all found in the fruit. The fruits were used to isolate coumarins and tyramine derivatives. Hepatoprotective substances such as psoralene, xanthotoxin, 2,6-dimethoxybenzoquinone, and osthenol are found in the leaves, and antifungal compounds such as psoralene, xanthotoxin, 2,6-dimethoxybenzoquinone, and osthenol are found in the fruit shells (Pradhan *et al.*, 2012) [30]. The fruit pulp accounts for 36% of the total weight of the fruit. The pectin level of the pulp ranges from 3% to 5%. A bland, non-bitter oil rich in unsaturated fatty acids is found in the seeds (Morton, 1987).

Phytochemical Constituent

The phytochemical constituent of elephant apple of crude extract includes Glycoside, Steroids, Flavonoids, Saponines and reducing sugar. The investigation of the phytochemical constituent indicates that the leaves are provided a rich source of triterpenoids and flavonoids Rahaman *et al.*, (2010). It also reported to contain various chemical constituents like 3, 5, 7-trihydroxy-3', 4'-dimethoxy flavones (dillenetin), betulinic acid, β -sitosterol and stigma sterol Bala and Rahaman *et al* 2010).

Antidiabetic activity

Kumar *et al.*, (2011) carried out an investigation to know the antidiabetic activity of bioactive fraction of *D. indica* methanolic extract in experimental diabetic Wistar rats. They induced type-I diabetes in Wistar rats by single intraperitoneal injection of Streptozocin (60 mg/kg body weight) and type-II diabetes was induced by single intraperitoneal injection of Streptozocin (60 mg/kg body weight) followed by intraperitoneal injection of Nicotinamide (120 mg/kg body weight) after 15 minutes. The rats were treated by administering graded oral doses of isolated ethyl acetate

fraction of methanolic extract of *D. indica* for 21 days. They found a significant reduction in blood glucose level for both the experimental rats. The possible mode of action of the plant extract might be by potentiation of the insulin effect by increasing the pancreatic secretion of insulin from cell of islet of Langerhans or its release from the bound form or regeneration of the cells.

Health benefits of Elephant Apple

Elephant apples area unit loaded with a spread of health-giving nutrients Regardless if you eat them within the sort of jam or as a part of a dish, you may definitely get a tremendous variety of perks. Here are units few of these bonuses that elephant apples area unit better-known to offer:

Lower Blood Pressure

In case when we feel bored with feeding bananas simply to stay your vital sign in traditional vary because of its metallic element content, Elephant apple is one amongst the most effective alternatives. With these exotic treats, it will be easier to stay high vital sign unfree (Rai *et al.*, 2020) Good for Eye Health Elephant apples are good sources of vitamin A, nutrient known to keep the eyes healthy. Eye experts say that there are a number of eye issues that can actually lead to vision loss, and, most of them can be cured by outstanding to diet that's rich in vitamin A. Regular of used of Elephant apple is considered quite beneficial for taking good care of your eyes.(Das *et al.*,2009)

Fights Infections Elephant apples consist of good amount of vitamin C. We all know that vitamin C is very important for maintaining a strong immune system. If you are susceptible to have flu, cold or any other type of infection, then frequent use of vitamin C-rich fruits like elephant apples can work to your utmost advantage. Use it frequently. (Chadha *et al.*, 2008)

Delayed Aging Vitamin C is also extremely beneficial for people who want to look young. It is the fact that Vitamin C is essential for the synthesis of collagen, which is a type of protein that helps to make skin firm so that it can become less vulnerable to wrinkling. Furthermore, vitamin C is an antioxidant that fights off free radicals that quicken skin aging (Hoque *et al.*, 2014)

Cure stomach related problems

As we have a tendency to all grasp that tannin-containing substances area unit quite helpful for endless loose bowels and abdomen torment. Elephant Apple blends the bark of the tree beside nectar and plays a crucial role for such abdomen problems. This natural product extracts fills in as a preventive prescription for infectious disease and plenty of additional. (Prakash *et al.*, 2009)^[31]

Increase energy level

Elephant apples have a lot of B vitamins in them. If you tend to get tired easily, eating these fruits can help you feel more energized. B vitamins, likewise, aren't just energy producers. They're also important for maintaining the health of your brain and nerve cells. Nayak *et al.* (2020).

Protect kidney against infection

Elephant Apple is remarkably unique in terms of stimulant and safety. This natural supplement aids in the reliable protection of the kidneys. Elephant apple was once thought to be the best traditional medication for treating kidney problems by ancient Indian researchers. It is also beneficial to the liver

and heart Katus *et al.* (2012)

Anti-diabetic activity

In experimental diabetic Wister rats, (Sunil Kumar *et al.*, 2011)^[42] investigated the anti-diabetic effect of the bioactive component of *Dillenia indica* methanolic extract. They used an intra - peritoneal iv drip of Streptozocin (60 mg/kg body weight) to induce type I diabetes in Wister rats, and an intra - peritoneal injectors of Applied to prevent (60 mg/kg body mass) followed by intraperitoneal injection of Nicotinic acid (120 mg/kg body weight) after 15 minutes to induce type II diabetes in Wister rats. The rats were given graded oral dosages of the isolated ethanol extract of *Dillenia indica* methanolic extract for 21 days. Both experimental rats showed a considerable drop in blood glucose levels. The plant extract's mechanism of action could be potentiating of the insulin effect by raising pancreatic secretion of insulin from Langerhans cells, or its release from the bound state, or cell regeneration.

Therapeutic Potential of *Dillenia indica* in Diabetes: Human Study

Das and Sarma conducted a human study with *Dillenia indica* at the Government Medical College and Hospital in Assam, India. *Dillenia indica* fruit powder has been demonstrated to have significant hypoglycemic effects in type 2 diabetes patients. In this study, 40 patients with type 2 diabetes (nineteen men and twenty-one women) were chosen at random but *met all* of the inclusion criteria. They were given *Dillenia indica* fruit powder at a dose of 30g/day (split into two doses) half an hour before lunch and supper with warm water for 24 weeks, as well as diet and lifestyle changes. They are checked again at the eighth, sixteenth, and twenty-fourth weeks. Diabetic patients' fasting and postprandial blood glucose levels were significantly reduced without any negative consequences. The fruit was found to have potential therapeutic usefulness in the treatment of hyperglycemia in humans in this investigation Sarma *et al* (2013).

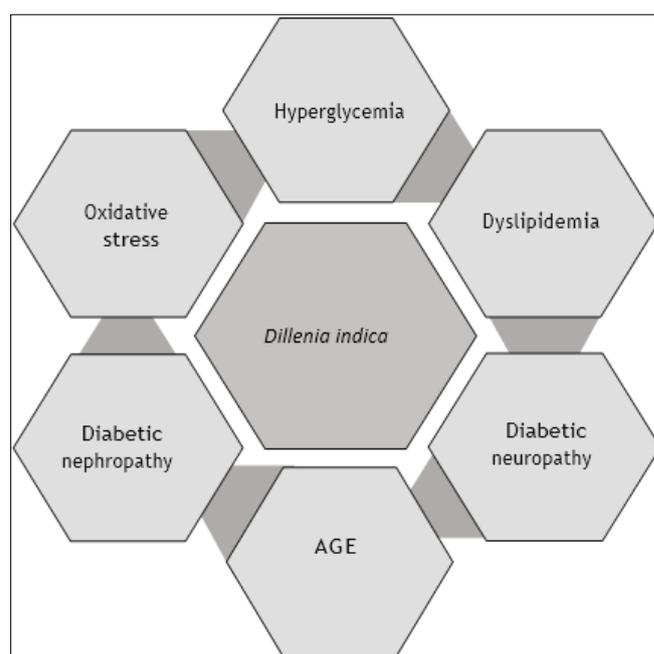


Fig 2: Therapeutic effects of *Dillenia indica* in diabetes and its associated complications.

Food Uses

Elephant apple fruit can be consumed raw, blended into drinks and sweets, or preserved as jam (Vidhya and Narain, 2011). The pulp can be eaten raw with or without sugar, or it can be combined with coconut milk and palm sugar syrup and frozen as ice cream. Wood apple is combined with honey and eaten for breakfast in Indonesia (Morton, 1987). The leaves are used in salads in Thailand, while the pulp is used in savory chutneys in India. Fruit pulp is used to make jam, jelly, chutney, fruit bars, and ready-to-drink beverages (Vidhya and Narain, 2011). (Lande *et al.*, 2010). Wood apple is a seasonal and underappreciated fruit. In the last few decades, the demand for wood apple fruit has skyrocketed. The fruit shell is frequently cracked open with a hammer, and the sticky pulp is physically scraped out with a stainless steel spoon. (Patel *et al.*, 2013) [27]. Diluting the pulp with water, putting it through a pulper to remove seeds and fibre, and then diluting, filtering, and pasteurizing it results in bottle nectar (Patel, 2013) [27]. The nectar is clarified with pectinases to provide a clear liquid for mixing with other fruit juices. Pulp that has been sweetened with cane or palm sugar syrup has been bottled and sterilized. The pulp can be freeze-dried for later use, but other methods haven't worked successfully (Morton, 1987) [22]. To extract juice, machines such as presses, decanters, centrifuges, and pulpers/finishers can be employed. Traditional rack and cloth presses, hydraulic presses, screw presses, horizontal presses, and belt presses are all available. The type of the material to be processed must be considered while choosing a juice extraction equipment (Patel, 2013) [27]. Patel (2013) [27] investigated the processing of wood apple juice in terms of pulp extraction, juice formulation, and pasteurisation. The wood apple juice obtained via standardised juice extraction had a Brix of 5.6 \pm 0.21, a titratable acidity of 0.71 \pm 0.16, and an ascorbic acid concentration of 4.73 \pm 0.115 mg/100 g. Total sugar was 1.53 g/100 g, while reducing sugar was 1.14 g/100 g. The pH of the juice was 3.71 \pm 0.02 and the pectin content was 0.51 \pm 0.05 percent, with a clarity of 35.13 \pm 0.26 percent T at 590 nm. The standardized wood apple juice was used for the sensory evaluation. Overall acceptability was given a score of 7.45 out of ten. All of the aspects that were examined (color and appearance, flavor, taste, and overall acceptability) had mean ratings greater than 7.0 and within the acceptable range.

Conclusion

Indigenously elephant apple is being employed in numerous food products as sole or tributary ingredient, however there's lack of revealed works in terms of depth scientific investigations concerning the fruit. Elephant apple act as a good anti-diabetic foodstuff and its healthful properties with negligible facet effects helps in preventing numerous health diseases together with providing bound nutritionary health edges. Elephant apple has promising effects in treating foremost aspects of polygenic disease together with hyperglycemia and lipoidaemia. Thus making different food recipes and food products would help to get add on benefits of elephant apple, medicinal herb.

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