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Importance of jackfruit (*Artocarpus heterophyllus* L.) and its medicinal values: A review

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Abstract

Jackfruit (*Artocarpus heterophyllus* L.) is regarded as "poor man's meal." It is mostly enjoyed by rural people and is Bangladesh's national fruit. The primary goal of this study is to record the therapeutic value of jackfruit (*Artocarpus heterophyllus* L.). All components of the fruit and plant are utilised as human food, animal feed, and furniture wood. Despite the fact that the jack fruit is the tree's major fruit, it is utilised as furniture due to its lovely texture and colour. Antibacterial, anti-diabetic, anti-oxidant, anti-inflammatory, and anti-helminthic characteristics are all found in jackfruit. Carbohydrates, minerals, carboxylic acids, dietary fibre, vitamins, and minerals abound in this fruit. The seed is high in manganese, magnesium, potassium, calcium, iron, and lectins, hence it satisfies human nutritional needs. The purpose of this study was to examine the therapeutic value and health-promoting benefits of jackfruit and seeds, with a focus on their use in food.

Keywords: Jack fruit, antioxidants, health benefits, nutrients

Introduction

The Moraceae family's jackfruit (*Artocarpus heterophyllus* Lam.) thrives in tropical and subtropical regions with warm and humid temperatures (Zhang *et al.*, 2021) [57]. Recently, it was estimated that the world's jackfruit plantation acres and output exceeded 300,000 hectares and 3.6 million tonnes of edible bulbs (Wu *et al.*, 2013) [54]. Due to the flexibility of crop planting and harvesting, jackfruit trees may be grown on poor soils and marginal lands, and they are available all year. Jackfruit has become the fastest growing and most popular fruit tree in tropical and subtropical countries due to its minimal environmental needs and labour expenses (Swami, *et al.*, 2012) [46]. Commercially farmed in Malaysia, Thailand, India, Bangladesh, Indonesia, China, Australia, the Philippines, Florida (USA), Latin America, and the Caribbean, jackfruit is one of the most important evergreen trees (Zhang *et al.*, 2021) [57]. It is a huge, evergreen tree that grows to be 10-15 metres tall and is native to evergreen woods at altitudes of 450-1,200 metres. It is farmed across India's hotter regions. The stem of this plant is straight and rough, with green or black bark that is 1.25cm thick and exudes milky latex. The leaves are wide, obovate, elliptic, decurrent, glabrous, and the whole inflorescence is solitary axillaries, cauliflorous, and ramflours on short leafy branches. Female heads are oblong oval receptacles, syncarpous, and cylindrical, while male heads are sessile or on short peduncles receptacles, occasionally born on the final twing (P. Rowe-Dutton *et al.* 1985) [33]. In nature, the seeds are separated by a horny endocarpus encircled by a sub-gelatinous exocarpus (1mm thick) that is oblong ellipsoid. The 3–5 mm thick sweet yellow sheaths that surround the seeds have a taste similar to pineapple, but gentler and less juicy (The Wealth of India *et al.* 1985) [49]. The jackfruit tree (*Artocarpus heterophyllus* Lam) yields more than any other tree species and has the biggest edible fruit known (up to 35 kg). The jackfruit tree is useful in a variety of ways. Ripe fruit flakes have a significant nutritional value, with 287-323 mg potassium, 30.0-73.2 mg calcium, and 11-19 g carbs per 100 g. (C. E. Elevitch *et al.* 2006) [11]. Because it is inexpensive and plentiful throughout the season, it is popularly referred to as "poor man's meal" in Bangladesh. The nutritious seeds can be boiled or roasted and eaten like chestnuts, or they can be ground into flour and baked into meals. The tree is also recognised for its strong, anti-termite timber, which matures to an orange or reddish brown hue (E. T. Arung *et al.* 2006) [17]. Cattle, pigs, and goats all benefit from the leaves and fruit waste. The dye produced from jackfruit wood chips is used to give Buddhist monks' robes their renowned orange-red hue. In addition, the bark, roots, leaves, and fruits of the plant all have therapeutic benefits (S. Shyamamma *et al.*, 2008) [43]. It need a well-drained but wet soil with a pH of 4.3 to 8.0 and modest soil fertility.

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The ideal temperature is from 19 to 29 degrees Celsius, with a height of around 1600 metres above sea level and an annual rainfall of between 1000 and 2400 millimetres (Roy *et al.*, 1996) [37]. Furthermore, its output grows at a 15% annual pace (Zhang *et al.*, 2018) [26]. The economic value of jackfruit has gradually risen as more areas have been planted. In particular, it should be noted that jackfruit production in Mexico has expanded by twofold in the last ten years, with an output value of USD 3.7 million (SIAP, 2015). The studies of jackfruit that are possibly beneficial are considerably less well recognised and neglected as a crop. The fruit, tree, and branches of the jackfruit provide several advantages. The fruit is nutrient-dense and edible, with the ripe section of the fruit being consumed and the green part being used as a vegetable. The edible bulbs of mature jackfruit are normally consumed fresh or processed into canned items; the seed weight accounts for 10-15% of the overall fruit weight. People in Asia utilise the plants for medicinal purposes, and they have antibacterial, anti-diabetic, anti-oxidant, anti-inflammatory, and anti-helminthic effects (A. U. Khan *et al.* 2021) [25]. 2 Megajoule energy per kg/wet weight of ripe perianth (about). Furthermore, the fruit might provide at (S. B. Swami *et al.* 2018) [38]. Lignans, flavones, and saponins, which are found in jackfruit, have anticancer, antiulcer, antihypertensive, and antiaging activities (S. Palamthodi *et al.* 2021) [41]. Carbohydrates, minerals, carboxylic acids, dietary fibre, vitamins, and minerals abound in this fruit. Manganese, magnesium, potassium, calcium, iron, and lectins are abundant in the seed, which provides the nutritional needs of rural people. The jackfruit seed flour is not only a good amount of protein, carbohydrates, and dietary fibres, but it's also a good supply of nutrients for a low price. Antibacterial, antifungal, and anticarcinogenic activities have been discovered for lectin, a kind of glycoprotein present in jackfruit seeds (A. N. M. Ramli *et al.* 2021) [6]. Juice, biscuits, chutney, jam, jelly, toffee, paste, leather, bar, nectar, squash, and pickle are all made using ripe jackfruit pulp, which is processed, dried, and marketed as a dry powder (Y. Li *et al.* 2017) [55]. It's also available in syrup, either plain or mixed with dried bulbs, chutney, preserves, candies, concentrates, and powder. Consumer tastes have shifted to diets that contain more natural antioxidants, dietary fibre, natural colourants, minerals, vitamins, decreased calories, low cholesterol and sugar, and are chemical-free, among other things. The potential for using jackfruit waste, as well as by-products of leaves and wood, to make biogas, briquettes, and biochar (D. Nsubuga *et al.* 2020) [14].

The supply of nutrients has a direct impact on jackfruit growth and development, and those nutrients increase the nutritional quality of jackfruit (M. D. Toor 2021) [27]. The high-quality jackfruit and some seeds are exported to the United Kingdom (Al Riyadh *et al.* 2020) [56]. The jackfruit tree is a cross-pollinated fruit tree that is mostly propagated by seeds (C. Witherup *et al.* 2019) [13]. The tree can also be used for a variety of other environmental purposes. The leaves of the jackfruit tree are fed to cattle as a source of nutrition. Vitamins and minerals are abundant in the leaves, which are beneficial to the animal. The stalks that remain are utilised to make wood. The main stem, on the other hand, adds to the house's elegance by serving as furnishings. It is conceivable to profit from selling wood as wood, just as it is possible to profit from selling well-shaped wood. However, selling regular jackfruit fruits might bring in a lot of cash. However,

the jackfruit trees that are grown around the village house are neglected, and no fertiliser is provided. The purpose of this study was to gather information regarding the nutritional and therapeutic value of jackfruit in Bangladesh, taking into account the aspects mentioned above.

Morphological characters of jackfruit tree

Jackfruit is an evergreen tree with a thick treetop and a relatively short trunk. It grows to heights of 10 to 20 metres (33 to 66 feet) with trunk diameters of 30 to 80 centimetres (12 to 31 inches). In young trees, the canopy is normally conical or pyramidal, but as the tree becomes older, the canopy becomes more spread out and domed. It can generate buttress roots on occasion. The jackfruit tree's bark is smooth and reddish-brown. In the case that the bark is damaged, a milky fluid is emitted. The leaf margins of immature trees are irregularly lobed or divided. The tree provides a deep canopy of shade. The beginning of heavy side branching is generally near the ground. The tree's whole surface is coated in a sticky white substance.

Flowers

Male and female inflorescences (or "spikes") grow on the same tree in this monoecious plant. The blooms are tiny and sit atop a rachis of flesh. Short, strong stems sprouting from older branches and the trunk bear male and female spikes individually. Male blooms are greenish in colour, and some are infertile. Male spikes are positioned above female spikes on younger stems. Male spikes are thick, fleshy, cylindrical to club-shaped, and can reach a length of up to 10 cm (4 in). Flowers are little and light green when young, darkening with age. Male flowers are smaller and less hairy, with two 1 to 1.5 mm (3/64 to 1/16 in) membranes at the end of the perianth. The stamens turn ash-gray when pollen is distributed. Female flowers are bigger, elliptic or rounded, with a fleshy flower-like base and a tubular calyx with hairy and tubular perianth. An ovary with a large, capitate, or occasionally bilobed scar can be found in female flowers. Insects and wind are said to pollinate the blooms, with a high rate of crosspollination. The flowering season lasts from December through February or March (E. M. Gardner *et al.* 2018) [16].

Fruits

On the trunk, branches, and twigs, inflorescences develop (cauliflory). Jackfruit trees are monoecious, meaning they produce both female and male flowers. The external skin of the jackfruit fruit is comprised of hexagonal, bluntly conical carpel apices that cover a thick, rubbery, white to yellowish wall. The ellipsoidal to roundish fruit is a multiple fruit made up of the ovaries of many flowers fused together. On the trunk, the fruits grow on a long and robust stem. A central fibrous core holds the hefty fruit together. They come in a variety of sizes and ripen from yellowish-greenish to yellow, then yellowish-brown at maturity. They have a sticky, rigid shell. The huge, irregularly shaped fruit measures 30 to 100 cm (10 to 40 inches) in length and 15 to 50 cm (6 to 20 inches) in diameter, and can weigh up to 10 kg (22–55 pounds) (S. S. Rana *et al.* 2018) [42].

Leaves

Dark green, entire, simple, glossy, leathery, stiff, huge (up to 16 cm [6 in] in length), and elliptic to oval in shape, the leaves are alternate, entire, simple, glossy, leathery, stiff, and

elliptic to oval in shape. The leaves are arranged in a spiral and alternate between each other. They are separated into a petiole and a leaf blade, and are sticky and thick. The leaves of elder trees have a smooth leaf edge and are rounded and dark green. Petioles range in length from 2.5 to 7.5 cm (1 to 3 inches). The oblong to ovate-shaped leathery leaf blade is 20–40 cm (7–15 inches) long and 7.5–18 cm (3–7 inches) broad. When young and on young stems, leaves are generally strongly lobed.

Seeds

Seeds are light brown, spherical, and 2–3 cm (0.8–1.2 in) long by 1–1.5 cm (0.4–0.6 in) wide, with a thin, white membrane around them. Each fruit may contain 100–500 seeds. Seeds are tough and may be kept in cold, humid settings for up to a month (E. M. Gardner *et al.* 2018) [16]. A thin, waxy, parchment-like, readily detachable testa (husk) and a brownish, membrane tegmen make up the seed coat. In most cases, the cotyledons are uneven in size, and the endosperm is absent. A typical fruit has 27% edible seed coat, 15% edible seeds, 20% white pulp (undeveloped perianth, rags) and bark, and 10% core (A. U. Khan. 2020).

Table 1: Nutrition composition of jackfruit (100g edible portion)

Nutrients	Jackfruit
Water(g)	72.0-94.0
Protein (g)	1.20-1.90
Fat (g)	0.10-0.40
Carbohydrates (g)	16.0-25.40
Fiber (g)	1.0-1.50
Sugar (g)	20.60
Minerals (g)	0.87-0.90
Calcium (mg)	20.0-37.0
Magnesium (mg)	27.0
Phosphorous (mg)	38.0-41.0
Potassium (mg)	191-407
Sodium (mg)	2.0-41.0
Iron (mg)	0.50-1.10
Vitamin A (IU)	175-540
Thiamine (mg)	0.03-0.09
Riboflavin (mg)	0.05-0.40
Vitamin c (mg)	7.0-10.0

Source: Khan *et al.* 2021 [8]

Health benefits of jackfruit

Traditional remedies have been made from *Artocarpus* species. Antibacterial, anti-diabetic, antioxidant, anti-inflammatory, and anti-helminthic properties have been found in the plants (U. B. Jagtap, *et al.* 2010) [51]. Many minerals, including N, P, K, Ca, Mg, S, Zn, Cu, and others, are abundant in jackfruit (A. Gohain Barua *et al.* 2004) [2]. The nutritional value of the meat, seeds, and meal of jackfruit. The water content of the young, mature fruit and seeds, respectively, was (51.0-94.4) g. The quantities of accessible digestible carbohydrate in the young, ripe fruit and seeds were (16.0-38.40) g and (16.0-38.40) g, respectively. Although jackfruit seeds are underused and underappreciated, they provide significant nutritional advantages and account for 10% to 15% of the fruit's weight (M. T. Hossain 2014) [32]. The meal's protein content was (0.40- 2.60) g in the young, ripe fruit, and seeds of jackfruit, with the young fruit contributing the most, while the fat content was (0.10-0.60) g in the young, ripe fruit, and seeds, respectively. The fibre content of the meal was (1.0- 2.60) g in the young, ripe fruit,

and seeds of jackfruit, with the young fruit contributing more fibre, and the mineral content was (0.87-0.90) g in the young, ripe fruit, and seeds, respectively. The meal contains 20.60 g sugar from ripe fruit. Calcium, magnesium, phosphorus, potassium, salt, iron, vitamin A, thiamine, riboflavin, and vitamin C are all found in jackfruit. When compared to meat, jack seeds had a high total dietary fibre (TDF) content (11.1%). (2.6%). The seeds of the jackfruit also contained 8% resistant starch (undigestible starch).

It is high in carbs, minerals, and vitamin C. (Goswami *et al.* 2016) [12]. The average yearly net returns found larger than the agriculture system, according to (Hasan *et al.* 2008) [29]. Alves *et al.* (Alves *et al.* 2020) [22]. The fruit includes lignins, flavones, and saponins, which have anti-cancer, anti-ulcer, anti-hypertensive, and anti-aging qualities. It is high in carbs, minerals, carboxylic acids, dietary fibre, and vitamins including ascorbic acid and thiamine (S. B. Swami 2018) [38]. Potassium, calcium, and iron (A. Gohain Barua 2004) [2], manganese and magnesium (A. Gohain Barua 2004) [2], and manganese and magnesium (A. Gohain Baru *et al.* 2014). Seeds include a variety of components. The seeds include lectins such as jacalin and artocarpin, according to (A. Mukprasirt 2004) [5]. Jacalin has been demonstrated to be helpful in determining the immunological state of patients who have been infected with the human immunodeficiency virus (I. A. Ajayi, 2011) [21]. The microorganisms *Escherichia coli* and *Bacillus megaterium* were discovered to be resistant to seed nanoparticles (T. Theivasanthi, *et al.* 2011) [48]. It contains anti-oxidant properties (A. K. Gupta *et al.* 2020) [3] and serves as an anti-inflammatory, anti-malarial, and anti-helminthic agent (K. Soumya *et al.* 2015) [24]. (A. Soeksmanto *et al.* 2007) [7]. The leaves of the tree are widely used to treat ulcers. Because of the presence of hypoglycemic and hypolipidemic chemicals in its leaves, it has the ability to cure diabetics (M. S. Baliga *et al.* 2011) [31]. Saponins, cyclooctenone, cycloartenol, -sitosterol, and tannins are found in the leaves and stems. When latex yield artosteron is combined with vinegar, glandular swelling and snake bites heal faster (A. Mandhare *et al.* 2020) [4]. (H.B. Long and colleagues, 2015) [20]. The root extract has been described as a treatment for asthma and skin disorders. The wood has sedative properties, and it's said to help with abortion, diarrhoea, and fever (A. W. Septama 2017) [9]. Tapeworm infestation is treated using the fruits and roots (T. M. Nguyen *et al.* 2005) [47]. Carbohydrates, complex B vitamins, and minerals abound in this fruit (S. L. Jagadeesh *et al.* 2007) [40]. The freshly picked fruit is eaten. In immature fruit, it can be processed into candies, sweets, frozen pulps, juices, and vegetables. Its seed may be cooked or utilised in cooking to create a variety of dishes. There are now research examining the use of seed meal as an alternate carbohydrate source in cookies, sweets, and bread. Moisture (6.7%), glucosides (38.0%), lipids (0.7%), protein (1.7%), and cellulose (59.0%) are all variable elements in jackfruit (S. L. Jagadeesh *et al.* 2007) [40]. (Bapat and Jagtap 2010) [50]. Ripe fruits are high in nutritional content, with each 100 g containing 287-323 mg potassium, 30.0-73.2 mg calcium, and 11-19 g carbs. According to (Chowdhury *et al.* 1997) [18], the bark contains betullic acid and cycloheterophyllin, a flavone colour (C30H30O7). Lycopene is also found in the fruit pulp (B. Setiawan *et al.* 2001) [10]. According to (De-Faria *et al.* 2009) [1], the fruit contains 18 carotenoids, 14 of which were effectively isolated, identified,

and measured. Saponin, cycloartenone, cycloartenol, -sitosterol, and tannins with estrogenic action are found in the leaves and stem. -sitosterol, ursolic acid, betulinic acid, and cycloartenone are all found in the root (R. Uddin *et al.* 2021) [35]. The crude fibre (2.36%) in jackfruit seeds is a thin brown spermoderm, however the flour's composition varies depending on the seed's nature (F. Noor. 2014) [19].

Conclusion

The jackfruit is a fruit that may be used in a variety of ways. It's delicious in a range of sweet and savoury meals, whether fresh, cooked, ripe, or unripe. Due to its purported health advantages, jackfruit consumption has increased in recent years. The pulp and seeds of the jackfruit are high in various high-value chemicals that may have health advantages. Jackfruit is a very nutritious and appealing fruit crop due to its diverse bioactive profile. According to the findings, all nutrients, such as vitamins and minerals, contribute to malnutrition in Bangladesh's rural areas.

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