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JACKFRUIT: A HEALTH BOON

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ABSTRACT

Jackfruit, botanically known as *Artocarpus heterophyllus*, grows in tropical and subtropical regions throughout the world. The Jackfruit can be used raw as vegetable and ripe as fruit. The Jackfruit is an extremely versatile and sweet tasting fruit that possesses high nutritional value. From the time immemorial, the whole jackfruit tree is used as a traditional medicine. *Artocarpus heterophyllus* has multifaceted medicinal properties. The medicinal properties of Jackfruit include anti-asthmatic, antioxidant, antibacterial, antifungal, anticancer, hypoglycemic, antimalarial, anti-diarrhoeal, anti-arthritic, anti-helminthic, anti-inflammatory, ant carcinogenic, anti platelet, antiviral, anti tubercular, anti atherosclerotic activities. It has also shown wound healing effect and causes decrease in the sexual arousal, libido, performance and vigor in men. The present paper reviews the Introduction, Geographical distribution, history, cultivation, uses, strange facts, side effects, synonyms, varieties, nutritional value, botanical description, taxonomical classification, phytochemical constituents, and pharmacological activities along with the current trends in research on jackfruit.

Keywords: *Artocarpus heterophyllus*, antibacterial, antioxidant, anti-inflammatory, cytotoxicity.

INTRODUCTION

A 'Moraceae family' member- *Artocarpus heterophyllus* Lam, well known as Jackfruit, is an age old plant. Jackfruit is the largest tree-borne fruit in the world which can weigh from a mere 3 kilograms to 36 Kilograms. A full mature jackfruit can have a length of 36 inches and width that extends to 20 inches. Major two types of varieties soft flesh and firm flesh are found. Some jackfruit varieties can reach up to 100 feet in height and there are some dwarf varieties like black gold that restrict up to only 10- 20 feet height. Jackfruits have a distinctive, sweet and fruity aroma.

The word "jackfruit" comes from Portuguese jaca, which is derived from the Malayalam language term, Chakka. Traditional medicines are plant derived medicines. According to WHO, more than 80% of developing country's population depends on plant based medicines for their health care needs. From the time immemorial, the whole jackfruit tree is used as a traditional medicine. *Artocarpus* is used in medicine and also as source of food, influencing agriculture industry. It contains secondary metabolites, which have biological activity, kindling scientific interest. In addition, the wood of Jackfruit is used in making musical instruments, furniture and even in house construction¹.

Geographical Distribution

It is widely cultivated in tropical, subtropical and temperate regions of the world.

World scenario: It is cultivated in Bangladesh, Malaysia, Burma, Srilanka, Indonesia, in parts of USA (Florida and California), Brazil, Pacific islands, Palau, Yap, and Samoa.

Indian scenario: It is widely cultivated in southwestern parts of India such as Goa, Kerala, Tamil Nadu, Karnataka, and Maharashtra^{1,2}.

History

It is believed that jackfruit has originated in the rain forests of the Western Ghats of India. Garcia de Orta- a physician & naturalist, in his book '*Coloquios dos simples e drogasda India*' written in 1563 gives reference of 'Jack Fruit'. Laterbotanist Ralph Randles Stewart suggested that it was named after a Scottish Botanist who worked for East India Company in Bengal, Sumatra & Malaysia. In 1782, few plants from one of the French ship were taken to Jamaica. In the1800 century it was a common fruit in Florida. It was introduced into northern Brazil in the mid of 19th century and became very popular there. Today, the trees are widely growing in Bangladesh, Malaysia, Burma, Indonesia, in the Caribbean islands, in the evergreen forest zone of West Africa, in northern Australia, in parts of USA, Brazil, Puerto Rico, Pacific islands, Yap, Samoa, and other islands³.

Cultivation^{1,4,5}

Climate: Jackfruit grows in a wide range of tropical to subtropical environments. Hot and humid regions of Asia are suitable for the growth of Jackfruit tree. Although jackfruit is essentially a tree of the tropical lowlands, it is adapted to a wider range of conditions. It cannot tolerate higher altitudes and cold. Jackfruit tree does not tolerate frost and drought.

Altitude: Jackfruit tree grows well in low land forests up to the height 250 m (820 feet) but decreases in abundance at height of about 1000 m above sea level. It thrives best in moist tropical environments below 1000 m (3300 feet).

Soil: The jackfruit can be grown on a variety of soils as long as they are well-drained, but does best in deep alluvial soils of open texture. The tree can grow in light and medium textured soils (sands, sandy loams, loams, and sandy clay loams). The tree tolerates moderately acid to neutral soils (pH 5.0–7.5).

Propagation

Seeding: The most common method of propagation of jackfruit is by sowing seeds, which is easy and cost effective and suitable method for cultivation. The seeds may be selected from a well ripened, well grown jackfruit. Soaking of seed in water for 24 hours improves germination. 100% results after soaking in 10% solution of gibberellic acid. Generally, 4-5 seeds are planted in situ so that the tap root can grow undisturbed. Seeds are sown 2-3 cm deep in pits filled with cow dung. Germination starts within 10 days and 100% seeds germinate within 35-40 days. The seedlings can also be raised in pots or poly bags. After one or two years, the seedlings are planted in the field.

Grafting: It is a most reliable method of propagation. Jackfruit seedling may serve as rootstocks. It takes 6-12 months to get the root stock ready for grafting. Grafted trees will bear fruits in 2-3 years after planting. Jackfruit grafting is now becoming a viable method of propagation. Today, grafted cultivators are common in India, Indonesia, Malaysia and Thailand and increasingly in South Florida. The grafting method is suggested as a traditional method for propagating the jackfruit as it maintains good characters. It is easy and cheap, produces disease free plants, trees start fruiting quickly. It needs less plant materials and treatments than the other methods.

Rainfall: Mean annual rainfall of about 1000–2400 mm (40–94 in) is ideal for the growth of Jackfruit tree.

Irrigation: The effective method for irrigation of jackfruit plants is drip irrigation.

Harvesting: Fruits mature 3 to 8 months from flowering. If the fruit is within the reach, it can be cut with a sickle or twisted. In tall trees, a sack is placed on the fruit with a rope tied on the peduncle. After cutting, the fruit is gradually lowered to the ground. It is laid on its peduncle against railing for some time to allow the latex to flow and coagulate.

Storage: The jackfruit should be stored at 85-90% relative humidity and at 11-13°C. At this temperature, jackfruit can stay fresh for the longest duration. A ripe jackfruit can stay fresh for 3 to 10 days. It is best to store jackfruit at the temp of 8 - 12°C.

Uses^{1,2,3}

General Health Benefits

- The bulbs of jackfruit contain simple sugars (Fructose and sucrose) in quantity of 19.8g per 100g of edible jackfruit bulbs and provide 95 calories. Thus when eaten, it replenishes energy and revitalizes the body instantly.
- Jackfruit is rich in dietary fiber, which makes it good bulk laxative.
- Jackfruit contains Vitamin A which is useful for maintaining integrity of mucosa and skin.
- Jackfruit helps to fight wrinkles. Its consumption helps in getting a glowing complexion and flawless skin.
- Jackfruit seeds are very beneficial in hair growth.
- Jackfruit seeds promote healthy blood circulation, and provide healthy digestion.
- 100 g of jackfruit contains 0.60mg of iron, thus it prevents and cures anemia.

Medicinal Uses

Traditionally jackfruit is used in treatment of ulcers, prevention of night blindness and bone loss. It possesses antibacterial, anti-inflammatory, antidiabetic, antioxidant, antipyretic property. It is immunity booster and acts as a remedy for snake bites. Seeds have diuretic and laxative effects.

Pharmacological activities of *Artocarpus heterophyllus* are summarized in Table 8.

Culinary Uses

Jackfruit is commonly used as a cuisine all over the world.

In **Bangladesh**, unripe fruit is used in curry. The seed is often dried and preserved to be later used in curry.

In **Thailand** and **Vietnam**, jackfruit is used as canned sugary syrup.

In **Indonesia**, The ripe fruit is usually sold separately and consumed on its own or sliced and mixed with shaved ice as a sweet dessert.

In **Philippines**, the unripe fruit is usually cooked in coconut milk and is eaten as a viand together with rice. The ripe fruit is used as an ingredient in local desserts.

In **Vietnam**, jackfruit is used to make a sweet dessert soup called as jackfruit chè.

In **Nepal**, The unripe fruit is used to prepare savory curry.

In **Srilanka**, Jackfruit is used to make wine and Pickles.

In **Africa**, Seeds of jackfruit are grounded into a flour type meal and used mainly for bread and other baking purposes.

In **Australia**, Jackfruit is used to make patties, casserole and salad.

In **Malaysia**, Jackfruit is often added to rice dishes and salads, mixed with shrimp, or used in drinks like lassi.

In **Florida**, Jackfruit is used in ice creams, Jams, Jelly, and to make sweet curry and fruit salad.

In India

In **West Bengal**, The fruits are either eaten alone or as a side to rice, roti, chira, or muri. Sometimes, the juice is extracted and either drunk straight or as a side with muri. The extract is sometimes condensed and eaten as candies. Seeds are used to make spicy side-dishes with rice or roti.

In **Kerala**, a sweet preparation called chakkavarattiyathu (jackfruit jam) is made by pieces of jackfruit. Jackfruit is deep fried to make chips.

In **Karnataka**, The pulp of the jackfruit is ground and made into a paste, then spread over a mat and allowed to dry in the sun to create a natural chewy candy. Jackfruit is also used to make jackfruit burfi.

In **Maharashtra**, Jackfruit seeds are used to make Daleecha Sambaaraa and raw jackfruit is used in phanasaachi bhaji and the fruits are either eaten alone or used to prepare phanaspoli.

In **Goa**, Jackfruit is used to make curry and the ripe jackfruit is widely used in cake (Phansache dhonas).

In **Tamil Nadu**, raw jackfruit is used to make CHAKKAKKARI-Brahmin special; Seeds are used to make seed pakoda.

In **North India**, jackfruit is used as a vegetable to make stir-fries and curries.

Miscellaneous Uses

- Jackfruit trees are used in landscaping of gardens.
- The leaves are excellent adsorbents and are reported to remove dye from the aqueous solutions.
- The leaves as well as non-pulp parts of the jackfruit are of use as feed for livestock.
- Chips of heartwood are used as a dying agent.
- Wood is used to make furniture, brush backs and musical instruments like veena, mridangam, thimila, and kanjira.
- The wood of jackfruit with good grains is a useful and a durable timbre.
- The heated latex is employed as household cement for mending chinaware and earthenware, and to caulk boats and holes in buckets.

- The latex can also be mixed with vinegar to heal abscesses, snakebites and glandular swellings.
- The leaf decoction and latex are effective in the treatment of asthma.
- The bark, due to its fibrous nature, is occasionally used in cordage or cloth.

Strange Facts

- The jackfruit is the largest of all tree-borne fruits.
- Jackfruit is also known to grow from the underground roots in some rare cases. In such situations, the fruit cracks the ground over it and emerges outside.
- In a single year, the jackfruit tree can produce as many as two hundred fifty fruits.
- In South India, the jackfruit is a popular food ranking after mango and banana.
- Jackfruit is a national fruit of Bangladesh¹.

Side effects, contraindications and precautions

- It causes some allergic reactions to the people suffering from birch pollen allergies.
- Jackfruit may alter the tolerance levels of glucose in diabetes patients.

- The men trying to have a baby should avoid jackfruit as it may inhibit sexual arousal, libido, performance, and vigor in men.
- People undergoing therapy for immuno-suppression should avoid eating the seeds of this fruit because these seeds are immuno-stimulant.
- Over consumption of jackfruit can upset the stomach, due to its high fiber content⁶.

Future prospects of jackfruit

Jackfruit is grown mainly on homestead farms and produces multiple products for food, feed, and industry as well as contributing towards soil management for sustainable environments. In recent decades, a number of scientific and economic interests have emerged to promote and commercialize jackfruit products. The primary reason for this is that the crop is already well-suited to the household and farming systems of small farmers vulnerable to food shortages and nutritional deficiencies. Nowadays jackfruit is widely used in medicine. There is a need to develop strategic plans based on the results of research and cooperation between neighboring countries or regions, for genetic conservation of the jackfruit gene pool. Further research in exploring the medicinal properties is essential to promote its use to alleviate the ailment.

Table 1: International synonyms of *Artocarpus heterophyllus*⁸

S/No	Name	Language	Country/Region
1	Fakihat Al Jaka	Arabic	Middle East, North Africa
2	Bōluómi	Chinese	China
3	Jackfruit, Nangka	Dutch	Netherlands, south Africa
4	Jackfruit	English	England, USA, New Zealand
5	Jacquier, Jaquier	French	France
6	Jackbaumfrucht, Jackfrucht	German	Germany
7	καρποί [karpoi]	Greek	Greece, Cyprus
8	katahal	Hindi	India
9	Catala	Italian	Italy
10	Paramitsu	Japanese	Japan
11	Baramil	Korean	Korea
12	Jaca	Portuguese	Portugal
13	Árbol de jack, Panapén, Yaca	Spanish	Spain

Table 2: Indian synonyms of *Artocarpus heterophyllus*²

S/No	Name	Language	State/Region
1	Halasinahannu	Kannada	Karnataka
2	Kathal, Panas	Hindi	North India
3	Panasa	Telgu	Andhra Pradesh
4	Theibong	Manipuri	Manipur
5	Pala pazham	Tamil	Tamil Nadu
6	Phanas	Marathi	Maharashtra

Table 3: Availability of *Artocarpus heterophyllus* fruits in different countries²

Country	Month of the year	Major Varieties found
Australia	June-April	Black gold, Golden nugget, cheena, cochin, kappa, nahen, Mutton
Bangladesh	June-August	Topa, Hazari, Chala, Goal, Khaja
Brazil	January-March, August-October	Jaca-dura, Jaca-Mole
India	April-July	Khujja, ghila, hazari, gulabi, varika, champa, handia, Safeda
Indonesia	August-January	Nagakasalak, Tabouey, Kandel
Malaysia	April-August, September-December	J-31, J30, Nagakabilulang, Na29, Na31
Philippines	March-August	J-01, J-02, TVC, Torres
Sri Lanka	February-November	Vela, varaka, peniwaraka, kuruwaraka
Thailand	January-May, October-December	Dang Rashmi, Golden pillow
USA (Florida)	May-August, September-October	Fair childfirst, Sweet Fairchild, Black gold, Golden nugget, Dang Rashmi, J-31, J-30, Tabouey

Table 4: Nutritional value of *Artocarpus heterophyllus*¹

Nutrients	Units	Value per 100 grams
Water	G	76.2-85.2
Energy	Cal.	95
Carbohydrate	G	23.5
Dietary Fiber	G	1.5
Fat	G	0.64
Protein	G	1.72
Sugar	G	19.08
Minerals		
Calcium	Mg	34
Iron	Mg	0.60
Magnesium	Mg	37
Manganese	Mg	0.197
Phosphorus	Mg	36
Potassium	Mg	303
Sodium	Mg	3.3
Zinc	Mg	0.42
Vitamins		
Folates	µg	24
Niacin	Mg	0.920
Pyridoxine	Mg	0.329
Riboflavin	Mg	0.055
Thiamin	Mg	0.105
Vitamin A	IU	110
Vitamin C	Mg	13.7
Vitamin E	Mg	0.34
Phyto-Nutrients		
Carotene-β	µg	61
Crypto-xanthin-β	µg	5
Lutein-zeaxanthin	µg	157

Table 5: Botanical Description of *Artocarpus heterophyllus*¹

Fruit type	Tropical
Edible part	Fruit
Shape of fruit	Oval
Fruits per tree	130-150
Texture	Fibrous
Taste	Sweet

Table 6: Taxonomical classification of *Artocarpus heterophyllus*¹

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Embryophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Alismidae
Order	Rosales
Family	Moraceae
Genus	Artocarpus
Species	A. heterophyllus

Table 7: Phytoconstituents of *Artocarpus heterophyllus*⁸

Sr.	Phytoconstituents	Plant Part
1	Carbohydrates - Starch, sugar, Dietary fiber	Fruit, Seed
2	Minerals - Calcium, Magnesium, Phosphorus, Potassium, Sodium, Iron	Seed, Fruit
3	Fatty Acids - Capric, Myristic, Lauric, Palmitic, Oleic, Stearic	Fruit
4	Organic Acids - Malic acid, Citric acid	Fruit
5	Carotenoids - 2-carotene, 1-carotene, 1-zeacarotene, 2-zeacarotene, Dicarboxylic Carotenoids	Seed, Fruit
6	Flavonoids - Artocarpine, Artocarpetin, Artonins A, Morin, Dihydromorin, Artocarpanone, Artocarpesin	Fruit
7	Lectin - Jacalin	Seed
8	Volatiles - Isopentylisovalerate, Butyl isovalerate, Butyl Acetate	Seed, Fruit
9	Tannins	Stem, Leaf
10	Vitamins - Vitamin A, Thiamine, Riboflavin, Vitamin E	Fruit

Table 8: Pharmacological Activities of *Artocarpus heterophyllus*

Pharmacological Activities	Plant Parts	Extracts	Phytoconstituent	References
1 Anti-infective				
Anti-Fungal	Leaf, Seed	Alcoholic extract	Chalcone	8, 9, 10
Anti-viral	Seed	Alcoholic extract	Oxyresveratrol	11, 12, 13
Anti-bacterial	Bark of stem and root, leaves, fruit	Alcoholic extract	Isoprenyl Flavones	9, 14, 15
2 Anti-cancer	Wood	Alcoholic extract	Isoprenoid Flavonoids	16, 17, 18, 19
3 Inflammatory diseases				
Anti-inflammatory	Fruit	Ethyl acetate extract	Flavonoids	18, 20, 21, 22
Wound Healing	Leaf	Alcoholic extract	Lectin	23, 24, 39
4 Anti-Diabetic	Leaf	Aqueous extract	Prenyl Flavonoids	26, 25, 27
5 Miscellaneous				
Anti-oxidant	Fruit, Seed	Alcoholic and aqueous extract	Prenyl Flavonoids	28, 29, 30, 31
Anti-malarial	Bark of Root and stem	Aerial part extract	Prenylated Flavones	32, 33
Anti-diarrhoeal	Bark of Root and stem	Artocarpusintegrifolia extract	Prenylated Flavones	34, 35
Anti-carcinogenic	Leaf	Alcoholic extract	Flavonoids	14
Anti-platelets	Root, Seed	Alcoholic extract	Flavonoids	28
Anti-tubercular	Root, Stem	Dichloromethane extract	Prenylated Flavones	36, 37
Anti-atherosclerosis	Fruit, Root	Ethyl acetate extract	Flavonoids	28
Anti-arthritis	Leaf, Fruit	Ethyl acetate extract	Flavonoids	22, 38

Table 9: Top five producers of Jackfruit³

Rank	Country	Production 1000 (tonnes)
1	India	1436
2	Bangladesh	926
3	Thailand	392
4	Indonesia	340
5	Nepal	18.97

CONCLUSION

Artocarpus heterophyllus is an excellent plant due to its multifaceted medicinal properties like antiasthmatic activity, antioxidant, antibacterial, antifungal, anticancer, hypoglycemic, antimalarial, antidiarrhoeal, antiarthritic, antihelminthic, anti-inflammatory, anticarcinogenic, antiplatelets, antiviral, antitubercular, antiatherosclerosis and show wound healing effect and decrease in the sexual activity. In addition *Artocarpus heterophyllus* also has food value with numerous culinary uses. The wood of the tree is also used for making musical instruments and furniture. So we can conclude that jackfruit is a health boon to the mankind.

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