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Efficacy of jackfruit components in prevention and control of human disease: A scoping review

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Abstract:

The jackfruit (*Artocarpus heterophyllus*) is one of the natural remedies significantly used in folk medicine. The ethnopharmacological applications of jackfruit are mainly concerned with the management of inflammation, diarrhea, and diabetes mellitus. Flavonoids, stilbenoids, aryl benzofurans, and lectin jacalin are abundant in jackfruit species. Jacalin is a good indicator for evaluating the immunological state of HIV-1 patients. The extracts and metabolites of jackfruit, particularly those from the leaves, bark, stem, and fruit, contain several beneficial bioactive mixtures. New studies are focused on exploring these bioactive compounds used in various biological activities such as antiviral, antiplatelet, anticancer, antiatherosclerotic, immunomodulatory effects, inhibitors of 5-alpha reductase activity, and the formulation of fast-dissolving tablets (orodispersible, rapid melts porous). Multidisciplinary programs that integrate traditional and modern technology play a crucial role in the lies ahead expansion of jackfruit as the prospective inception of therapeutic compounds. This review aims to highlight significant results on the identification, production, and bioactivity of metabolites found in jackfruit, with current developments in jackfruit research in the control and prevention of human diseases.

Keywords:

Anticancer effect, anti-inflammatory effect, jackfruit, medicinal properties, phytochemistry properties

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Introduction

The jackfruit, or *Artocarpus heterophyllus*, is an Indian native and a member of the Moraceae family [Table 1].^[1-5] It is frequently found in India's Western Ghats, a region known for its biodiversity. Jackfruit is frequently produced inside backyard conservatories in equatorial and subequatorial nations, including Burma, Bangladesh, Sri Lanka, Philippines, Thailand, Indonesia, Brazil, and Malaysia and also in.^[2,6-11] Uttar Pradesh, West Bengal, Assam, Kerala, Tamil Nadu, and Karnataka are some of the states in India where it is commonly available and is regarded as "poor man's food."^[1,4,5] Jackfruit has a standard-sized woody perennial plant

with an easily accessible fruit that normally grows to a height of 28 to 80 feet. Fruits typically weigh between 3.5 and 10 kg; however, they occasionally can weigh as much as 25 kg.

The fully developed plant has 54% rind, 29% mush, and 12% seeds.^[11] The components of jackfruit are listed in Figure 1. Each jackfruit fruit has 100–500 seeds, which are 2–3 cm lengthy and 1–2 cm wide-ranging. There are several purported medical benefits of jackfruit. According to the reports, the phenolic chemicals extracted from jackfruit have anti-inflammatory properties.^[4] Phenyl flavonoids, which are found in jackfruit, have demonstrated potent antioxidant effects and are anticipated to protect biological membranes from lipid

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peroxidation.^[12] Ayurvedic therapy for diabetes and hyperglycemia uses hot water extract from mature leaves.^[4] The extract's non-toxic hypoglycemic activity has been linked to flavonoids, which are contained in the extract.^[13] Broad-spectrum antibacterial activity has been detected in root bark and stem extracts.^[14]

A phytochemical found in jackfruit is called resveratrol (trans-3,5,4-trihydroxystilbene),^[15,16] which is well-identified for its anti-inflammatory and cardioprotective properties.^[16] Significant promise exists for the treatment of cancer in substances that can prevent angiogenesis.^[17] Jackfruit seeds contain flavonoid-class metabolites with anticancer properties.^[18] For the creation of quickly dissolving tablets, jackfruit seed starch works well as a super disintegrant.^[19] By reducing the formation of nitric oxide (NO), extracts of jackfruit pulp display significant anti-inflammatory action. Extracts of the fruit's leaves also exhibit attenuation of hyperglycemia and hyperlipidemia that gives rise to outstanding antioxidant activity.^[20-22] Fresh jackfruit tree roots, bark, leaves, and fruits have been shown to contain a variety of chemicals, including sterols, phenolic acids, carotenoids, stilbenes, phenolic acids, and flavonoids, particularly prenylflavonoids.^[2,23,24] The processed dried pulp of jackfruit may be used to make products such as jackfruit chips and leather.^[25] This woody plant perennial has many components and is utilized for many medical procedures. This woody is a crucial resource for the lumber industry.^[26]

Nowadays, it is generally acknowledged that fruits and vegetables have positive health impacts on disease

prevention by the action of the bioactive substances they contain.^[27] Consumers, experts, and the food industry have shown an increased interest in recent years in how natural food items might assist to preserve health. It has also been widely recognized that nutrition plays a significant role in the prevention and control of many ailments. This study provides general information on plant biodiversity as well as information on the functions, benefits, nutritional value, and health benefits of many components of jackfruit to prevent and control human diseases.

Occurrence and distribution

Jackfruit is said to have first appeared in the Western Ghats of India among rainy forests. Ralph Randles Stewart, a botanist, proposed to be named in honor of a Scottish botanist who served for the East India Company in Malaysia, Sumatra, and Bengal. Jackfruit plants were sent to Jamaica in 1782 through French cargo. It was a widespread fruit in Florida throughout the 1800s. The middle of the 19th century saw its introduction in northern Brazil, where it quickly gained enormous popularity. The trees are now found in abundance growing in countries of the Caribbean, Indonesia, Malaysia, Bangladesh, Burma, northern Australia, the United States, Brazil, Puerto Rico, the Pacific Islands, Yap, Samoa, and West Africa's evergreen forest zone.^[28,29]

Various parts of the jackfruit

The fruiting axis, perianth, and bulbs are the three primary components of jackfruit [Table 1].^[28] The core, latex, and arils may be found in the axis [Figure 1]. Latex, a sap with a sticky consistency, is produced by lactiferous cells in jackfruit.^[30] An edible section and seeds are in the bulbs, whereas the rind and rags are in the perianth. Prickly rind, inedible perianth, and the center core of jackfruit are among its inedible components.^[31] This whole inedible jackfruit is a possible source of raw resources for the manufacture of biochar and bioenergy.

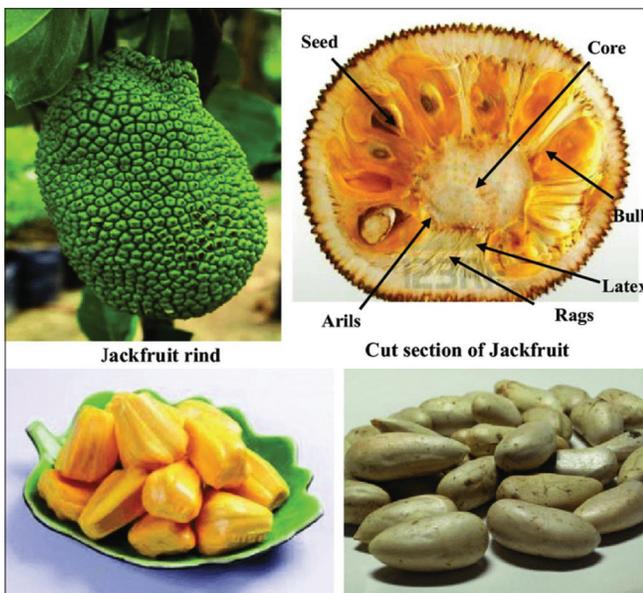


Figure 1: Parts of jackfruit [Swami, S. B., and Kalse, S. B [2018]. Jackfruit (*Artocarpus heterophyllus*): biodiversity, nutritional contents, and health. <https://doi.org/10.1007/978-3-319-54528-8>]

Table 1: Classification of jackfruit green^[28]

Popular Name (s)	→	Jackfruit
Kingdom	→	Plantae
Division	→	Magnoliophyta
Class	→	Magnoliopsida
Order	→	Rosales
Family	→	Moraceae
Subfamily	→	Asteroideae
Tribe	→	Artocarpeae
Genus	→	Artocarpus
Species	→	Artocarpus heterophyllus
Parts used	→	Seeds
Habitat	→	Rainforest

Botanic description and heterogenicity

Jackfruit is a monoecious plant, depending on the soil and climate, pollinated blossoms can take several months to mature into ripe fruit.^[2,32] The bottom soft edible section of the jackfruit is called the bulb, followed by the middle-fused area, known as the syncarp, and the outer as the spiny region (spike).^[4] When mature, the fruit's flesh becomes soft and golden and the outside spines spread.^[33] The axis and prickly outer bark, however, are not edible.^[34] The phenotypical and organoleptic features, which include variations in bulb color, size, shape, odor, flake size, flake color, and time of maturation, were used to categorize the jackfruits [Table 2].^[1,4,35] The majority of jackfruit, which may be found in a variety of habitats and niches, is breadfruit.^[5,36] There are two recognized ecotypes with differing flake features, one with hard carpels and the other with soft, spongy carpels.^[32,37-41]

Habitat

Jackfruit has been domesticated since prehistoric times.^[42] The kinds vary from one another in terms of the shape, size bearing, latex, size, color, and duration of maturity as well as the density and form of the spikes on the rind. The jackfruit-growing regions exhibit a wide range of bulb sweetness, acidity, flavor, and taste. There is a lot of room for this crop to be improved through selection because of the large variety of jackfruit kinds found in the Western Ghats.^[43,44] There is a prevailing misconception that eating too many jackfruit bulbs causes various stomach problems.^[43] The species exhibits a significant degree of variety as a result of cross-pollination and the preponderance of seed propagation over a long period of phase. It was discovered that genetic drift and natural selection under various environmental conditions could produce more diversity than geographic distance. Total soluble solids (TSS) (34.33 B), carotenoids (0.857 mg/100 g), total sugar (31.33%), and reducing sugars (13.37%) were the greatest in cluster "B," whereas the TSS/acid ratio was the highest in cluster "D." (123.29). In cluster "A," which had the most choices, the single-bulb mass

was the greatest (26.42 g); yet, the edible part was the highest (37.81%) in cluster "C," which had the lone bulb. Cluster "C" displayed the greatest value in terms of fruit mass (14.86 kg) and flake mass (5.62 kg); however, cluster "E" had the highest titratable acidity (0.768%). They concluded that because jackfruit is native to India and is a crop that is heavily cross-pollinated, it exhibits a great deal of variation.^[35]

Hereditary diversity

Jackfruit has a somatic chromosomal number of (4n) 56, making it a tetraploid. The fundamental chromosomal number is thus 14.^[45] Utilizing amplified fragment length polymorphism (AFLP) markers, Schnell *et al.* conducted the first study to date that depicted the genetic diversity and genetic relatedness of 26 accessions from around the globe.^[46] Only two accessions from India were included in this analysis. The current study focused on Bangladeshi jackfruit isozyme variation.^[47] The practical use of isozyme markers is constrained because it is known that both the environment and post-translational modification can alter them.^[48] Additionally, there are variations in the fruit's sensory quality, varieties of flesh, sweetness, flavor, and taste, as well as the density, size, and shape of the spines on the rind.^[49]

Compounds Rich in Jack Fruit Parts and Their Medicinal Properties

For centuries, *Artocarpus* species compounds have been used for their traditional herbal medicinal effects, such as antibacterial, anti-diabetic, antioxidant, anti-inflammatory, and anti-helminthic agents.^[50] A variety of minerals, such as N, P, K, Ca, Mg, S, Zn, Cu, and others are abundant in jackfruit and are given below in Table 3.^[51] Despite having significant nutritious fruit weight, jackfruit seeds are underused and less appreciated by the public, thereby making its use for about 10% to 15% of the total.^[52]

The seeds are said to contain lectins such as jacalin and artocarpin, according to Mukprasirt and Sajjaanantakul. It has been demonstrated that jacalin is helpful for assessing patients with human immunodeficiency virus infection immunological state [Figure 2].^[53] It was discovered that seed nanoparticles were efficient against the microorganisms such as *Bacillus megaterium* and *Escherichia coli*. It has antioxidant properties, fights inflammation, malarial fever, and skin conditions, and has also demonstrated antibacterial and anthelmintic properties. The leaves of the tree are frequently used to treat ulcers. Due to the presence of chemicals that are hypoglycemic and hypolipidemic, its leaves have the ability to heal diabetes mellitus.^[2] When vinegar and latex generate aldosterone when combined, glandular swelling and snake bites are helped to recover. According

Table 2: Botanical description of jackfruit tree^[41]

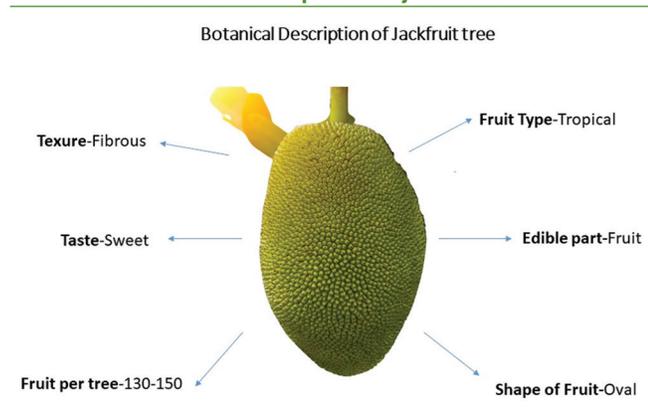


Table 3: Chemical composition of jackfruit [Modified after; Jagtap and Bapat, 2010]^[36]

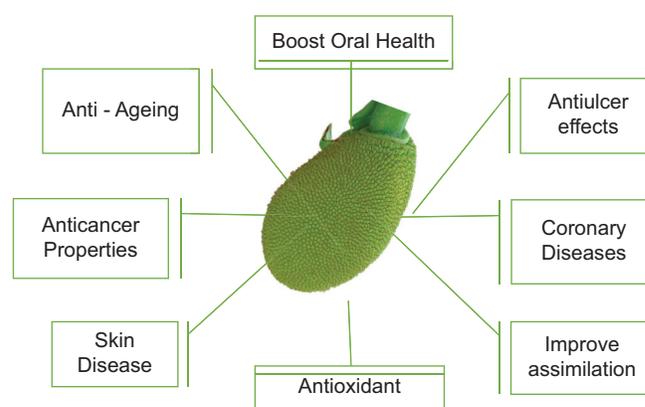
Constitution	Sprouting fruit	Ripened fruit	Ovule
Moisten (g)	76.2–85.2	72.0–94.0	51.0–64.5
Amino acids (g)	2.0–2.6	2.0–2.6	6.6–7.04
Fat (g)	0.1–0.6	01–04	0.40–0.43
Starch (g)	9.4–11.5	16.0–25.4	25.8–38.4
Fiber (g)	2.6–3.6	1.0–1.5	1.0–1.5
Total glucose (g)	-	20.6	-
Total minerals (g)	0.9	0.87–0.9	0.9–1.2
Calx (Ca) ion (mg)	30.0–73.2	20.0–37.0	50
Magnesium (Mg) ion (mg)	-	27	54
Phosphorous (P) (mg)	20.0–57.2	38.0–41.0	38.0–97.0
Saltwater (K) (mg)	287–323	191–407	246
Sodium (Na) (mg)	3.0–35.0	2.0–41.0	63.2
Iron (Fe) (mg)	0.4–1.9	0.5–1.1	1.5
Vitamin A (IU)	30	175–540	10–17
Thiamine (mg)	0.05–0.15	0.03–0.09	0.25
Riboflavin (mg)	0.05–0.2	0.05–0.4	0.11–0.3
Vitamin C (mg)	12.0–14.0	7.0–10.0	11
Intensity or energy (Kj)	50–210	88–41	133–139

to Sidhu AS *et al.*, root extract has been positively used in the treatment of asthma and skin conditions [Table 2].^[41] Wood is thought to have sedative properties and has the ability to treat fever and diarrhea, and even promote abortion.^[54] Eighteen carotenoids were effectively isolated, recognized, and measured from the fruit.

According to DeFaria *et al.*,^[24] the stem and leaves exhibit estrogenic actions because these contain components such as non-saccharide sapogenins, cycloartenol, sitosterol, and tannins.^[55] The crude fiber (2.36%) found in jackfruit seeds is a thin, dark spermoderm; however, the type of seeds used to make flour will determine how the flour is made. Magnesium, which is abundant in the seeds, is important for bone health as it helps the body absorb calcium; it is also important for reducing blood pressure and preserving bone health.^[28] Additionally, the seeds' high protein content makes them effective in treating and preventing anxiety and stress-related illnesses. Due to their poor capacity to absorb water and fat, the seeds aid in the reduction of obesity.^[56]

Jackfruit Edible Portion or Bulbs and Their Carotenoid Composition

Jackfruit is large and heavy, and about 20 to 25% of its edible component, or bulbs, has a high nutritional value, with 84 calories and 18.9 g of carbohydrates, 1.9 g of protein, 0.1 g of fat, 77% moisture, 1.1 g of fiber, 0.8 g of total minerals, 20 mg of calcium, 30 mg of phosphorus, 500 mg of iron, 540 international unit of vitamin A, and 30 mg of thiamine in every 100 g of ripe fruit pulp.^[43] In all, there are 1,07,98 carotenoids in the jackfruit bulb.^[24] All the trans-carotene in jackfruit is crucial for human health as an antioxidant.^[34] Carotenoids found in

**Figure 2: Medicinal benefits of jackfruits**

jackfruit have a key role in the prevention of a number of chronic degenerative illnesses, including cataracts and age-related macular degeneration as well as cancer, inflammation, cardiovascular disease, and cancer.^[57,58] All-trans-lutein, all-trans-carotene, all-trans-neoxanthin, 9-cis-neoxanthin, and 9-cis-violaxanthin are the major carotenoids in jackfruit (24–44%, 24–30%, 4–19%, 4–9%, and 4–10%, respectively). The provitamin A carotenoids in jackfruit are good, but not as good as those in papaya.^[13]

Jackfruit Ovule

The seeds of the jackfruit, which make up around 10% to 15% of the entire fruit weight, are rich in proteins and carbohydrates.^[59] Both carbohydrates (22%) and dietary fiber (3.19%) are abundant in jackfruit seeds. Phytonutrients present in jackfruit seeds, such as lignans, isoflavones, and saponins, have a variety of health advantages, including the ability to fight cancer and hypertension as well as to prevent aging and diseases. Jacalin and artocarpin are two of the lectins found in seeds. The efficacy of jacalin in assessing individuals with HIV-1 infection's immunological state has been demonstrated.^[34] There is 32% amylose in the starch of jackfruit seed.^[60] The proteolytic activities of several animal pancreatic preparations are successfully inhibited by jackfruit seed extract, according to research.^[61]

Biophysical properties of jackfruit ovule

The high amylose concentration of jackfruit seed starch results in less edema-inducing effects. According to Mukprasirt and Sajjaanantakul,^[62] jackfruit seed starch has a lower breakdown viscosity than commercial starch. Given that fats enhance food flavor and mouth feel, fat absorption is a crucial ingredient in food composition.^[63] In the food sector, jackfruit seed flour has a lot of promise, particularly for use as a thickening and binding agent in food systems. According to research by Kumar *et al.*,^[64] there are significant biochemical differences between the two types of jackfruit seeds when it comes to their proximate components.

Essential metabolites in jackfruit ovule

Acetic-alkali equilibrium is regulated by organic acids, and it has an influence on human health and all bodily processes. Table 4 displays the different organic acid contents found in jackfruit seeds. The body becomes more alkaline as a result of organic acids' impact on the acetic-alkali equilibrium. As a consequence, organic acids play a role in eupepsia.

According to studies, the average concentration of anhydrous oxalic acid in 100 mL of blood is 288 µg. The immune system needs access to oxalic acid to combat disorders including cancer and viral, bacterial, and vascular diseases.

Jackfruit seeds contain a considerable amount of tryptophan, an amino acid that is used to form the mood-regulating hormone melatonin, serotonin, which is also present in jackfruit seeds. The amount of essential and non-essential amino acids varies based on the protein type of the food.^[65] Organic and amino acids are more prevalent in the jackfruit seed covering material, where the concentration of primary metabolites is higher. Sapogenins, cycloartenol, cycloartenol, beta-sitosterol, and tannins found in jackfruit leaves and stems have estrogenic action. Betulinic acid, cycloartenol, and ursolic acid are present in the roots.^[66]

Phytonutrients of Jackfruit

Flavonoids, stilbenoids, and aryl benzofurans are only a few of the phenolic chemicals abundant in jackfruit. Upon investigation, the heartwood produced moisture of 6.7%, glucosides of 38.0%, lipids of 0.7%, albumin of 1.7%, and cellulose of 59.0%.^[67] Jackfruit also has a number of amino acids, fatty acids, and other compounds already mentioned.

Jackfruit seeds contain the main protein called jacalin. Jacalin is useful for researching different O-linked glycoproteins, including human IgA1.^[68,69]

Table 4: Organic tart component in ovule kernel and ovule coating membrane of jackfruit tree^[65]

Organic c [mg/kg]	Ovule kernel	Ovule-coating membrane
Oxalic acid	649.45±26.38	122.38±12.36
Aconitic acid	650.51±6.93	96.52±6.53
Citric acid	8086.95±807.60	1745.72±120.31
Pyruvic acid	–	59.32±6.25
Malic acid	3539.64±335.53	877.97±137.97
Quinic acid	460.84±10.50	230.38±44.69
Shikimic acid	–	12.95±0.30
Acetic acid	–	84.28±5.82
Fumaricaicd	535.88±1.37	26.33±1.47
Total	13923.26±1188.30	3255.85±335.70

Artocarpesin ([5,7,2',4'-tetrahydroxy-6-[3-methylbut-3-enyl]) flavone norartocarpetin (5,7,2',4'-tetrahydroxyflavone), and oxyresveratrol (trans-2,4,3',5'-tetrahydroxystilbene) were identified as three phenolic complexes by spectroscopic techniques and compared with data from the literature.^[70]

Phytonutrient Assay

When Gupta *et al.* examined the jackfruit seeds' phytochemical composition, they discovered a significant amount of saponins. In addition to their antispasmodic and cancer cell-toxic properties, saponins have long been used medicinally.^[71] Some alkaloids have anticholinergic, spasmolytic, and cosmetic effects. Jackfruit seeds had 1160.09 g of alkaloid per 100 g, according to research. Numerous methods, such as radical scavenging by H-donation, chain initiation prevention by donating electrons, or binding of transition metal ion catalysts, are known to be employed by polyphenolics to exert their antioxidant effects. Platelet aggregation is prevented by flavonoids by preventing platelet stickiness.

Therapeutic Potential of Medicinal Food Jackfruit on Various Diseases

Though many pharmacological studies have been conducted based on the components found in jackfruit, there are still many more that might be investigated and used therapeutically. Below is an overview of the conclusions from a few of these investigations.

Therapeutic role of jackfruit on type 2 diabetes mellitus

A metabolic condition known as diabetes mellitus is characterized by hyperglycemia brought on by deficiencies in insulin activity, secretion, or both. Ayurvedic and conventional medical professionals advise using a hot water extract of developed jack leaves to treat diabetes mellitus [Fernando *et al.* 1991].^[72]

According to research by Kumar *et al.*, eating 100 g feast of this jackfruit plant in a day for 4 months causes quantifiable decreases in hemoglobin (HbA1c), postprandial blood glucose (PBG), and fasting blood glucose (FBG) compared to the baseline.^[73]

A jackfruit meal's nutritional value was examined by Hettiaratchi *et al.*^[74] A serving of jackfruit provides 1370 kJ of total energy. An individual who is moderately active needs 20% of their daily energy from a jackfruit meal. Resistant starch (RS) was abundant in the seeds of jackfruit (undigestible starch).

"International Tables of Glycaemic Indices and Glycaemic Load Values"^[75] was the first publication of jackfruit meal GI data. Both the nutritional and GI

characteristics of jackfruit are favorable fibers, glucose that is released slowly, and carbohydrate crumbs present in the ovule.

Therapeutic role of jackfruit on anti-atherosclerosis activity

High blood total cholesterol and LDL-C levels have been linked to an increased risk of cardiovascular disease and have been linked to atherosclerosis, according to epidemiological research. A number of inflammatory and oxidative changes inside the artery wall contribute to atherosclerosis, a serious degenerative disease of the arteries.^[76] Nitric oxide levels drop as a result of oxidative excess in the vasculature, which also damages tissue and DNA and causes protein oxidation, while also triggering pro-inflammatory reactions.^[77]

Jackfruit (Parkinson) Fosberg extracts in various solvents were tested for their cytoprotective properties. Using the 4-[3-[4-iodophenyl]-2-[4-nitrophenyl]-2H-5-tetrazolio]-1,3-benzene Di sulfonate [WST-1] test, the cytoprotective effects were assessed in human U937 cells exposed to oxidized DL (OxLDL). The outcomes indicated the cytoprotective properties of the ethyl acetate extract. The cytoprotective action provides promising opportunities for the therapeutic uses of *Artocarpus altilis* [Wang *et al.*, 2006].^[78]

Therapeutic role of jackfruit as anticancer substance

Recent research has demonstrated the anticancer properties of phytonutrients found in jackfruit bulbs. The primary function of these nutrients is to aid in the prevention of dangerous free radicals, which have been linked to the development of many chronic illnesses, including cancer. Saponins are potent anticancer substances as well. It was discovered that saponins interacted with cancer cells' outer coats. They gripped the cells and stopped them from proliferating.^[79]

A dosage of 35.00 mg/mL of jackfruit seed metabolic extract was shown to be efficient by Swastika *et al.*^[18] in inhibiting angiogenesis. Isoflavones and lignans are found in the jackfruit fleshy part.^[80] Fiber is plentiful in jackfruit. Additionally, it has a distinct sticky shape. A powerful colon cleanser can be created by combining these two qualities. Artocarpesin, norartocarpetin (5,7,2',4'-tetrahydroxyflavone), and oxyresveratrol (trans-2,4,3',5'-tetrahydroxystilbene) were identified as three phenolic anticancer components of jackfruit. Reactive oxygen species (ROS) generation was noted by Gowri *et al.*, as another characteristic of tumor promotion.^[81]

Jackfruit effect on antiviral activity

The heartwood of the jackfruit, which has a high

concentration of oxyresveratrol, could serve as a source of raw materials for the creation of a novel natural product with anti-HSV and anti-HIV properties [Likhitwitayawuid *et al.*, 2005].^[82] When used at a concentration of 10 g/mL, the methanolic extract of *Artocarpus gomezianus* heartwood inhibited HSV-1 and HSV-2 by 90% and 80%, respectively. Along with the known substances cycloartocarpin, isocyclomorusin, artocarpin, norcycloartocarpin, norartocarpetin, and oxyresveratrol, a novel chemical called artogomezianone was also recovered during the separation process. The inactivation technique was used to assess these isolates for inhibitory activities against herpes simplex virus (HSV) types 1 and 2. In the same test, acyclovir (ACV) served as the positive control. The compounds cycloartocarpin, isocyclomorusin, norartocarpetin, and oxyresveratrol showed modest activity against both types of HSV [Likhitwitayawuid *et al.*, 2006].^[83]

Jackfruit effect on antiplatelet activity

The substances examined in human platelet-rich plasma PRP, dihydromunoxanthone, Vitamin B, and artocommunol CC significantly reduced the secondary aggregation brought on by adrenaline. The antiplatelet effects of these substances were mostly brought on by a reduction in thromboxane production. A significant pathogenic component in the formation of atherosclerosis and related thrombosis in humans was platelet aggregation. Thus, according to Wang *et al.*, [2006]^[78] substances such as dihydroartomunoxanthone, artochamins B, and artocommunol CC are promising antithrombotic agents.

Jackfruit works as inhibitor of 5-alpha reductase activity

A naturally occurring substance called jackfruit was discovered in a jackfruit heartwood diethyl ether extract. According to Shimizu *et al.*, [2000]^[84] jackfruit has a strong 5-reductase inhibitory action that prevents testosterone from being converted to 5-dihydrotestosterone. Both preputial skin and non-geminal skin include androgen receptors, which are influenced by 5-reductase inhibitors. As a result, jackfruit may help in the targeted treatment of androgen-dependent diseases including male pattern baldness and acne. Because skin serves as a physical barrier, the penetration of jackfruit into the deeper layers of the skin where androgen receptors are located is constrained. The substance has to be used topically to treat these conditions.

Immunomodulatory effect of jackfruit green

A tetrameric two-chain lectin with a molecular mass of 65 kDa, jacalin is the main protein found in the seeds of the jackfruit (*A. heterophyllus*). Also, jackfruit consists of one heavy chain with 133 amino tart groups and one light chain with 20–21 amino tart group.

Jacalin is a special substance that is significantly mitogenic for human CD4 + T cells, making it a valuable tool for assessing the immunological state of people who have HIV-1 infection.

It has uses in a variety of fields, including the separation of human plasma glycoproteins (IgA1, C1-inhibitor, hemopexin, and 2-HSG), research on IgA nephropathy, examination of O-linked glycoproteins, and detection of tumors.^[85]

Therapeutic role of jackfruit on diarrhea or antidiarrheal activity

In vitro studies of certain medicinal plants, including jackfruit, used to treat diarrhea in Brazil were conducted by Goncalves *et al.* in 2005.^[86] Both viruses were susceptible to the antiviral effects of jackfruit bark extracts [480 g/mL]. For human rotavirus and simian rotavirus, respectively, they demonstrated 99.2% and 96.4% inhibition. As a result, if rotavirus is the cause of diarrhea in humans, *Artocarpus integrifolia* extracts may be effective in treating the condition.

Therapeutic role of jackfruit on dental problems

Both the tree's trunk and its fruit, the jackfruit, are coated with latex or resin. White, sticky latex generated by unique secretory cells known as laticifers is present in all regions of the jackfruit tree. An aqueous emulsion known as latex contains a variety of substances, including lipids, proteins, carbohydrates, rubbers, resins, and proteolytic enzymes.^[87]

The emulsion uproots of this woody plant have antibacterial and antifungal properties due to consist a high amount of flavonoids and alkaloids was examined by Rao *et al.*,^[88] and they found that they performed rather well and much better than typical antibacterial and antifungal medications. In terms of cost-effectiveness, they concluded that the information provided regarding the many significant applications of this woody plant emulsion can be used in dental problems such as preparing affusion solution and another type of upcoming dental impletion substance.

Jackfruit seeds play a role in the formulation of fast-dissolving tablets (FDT)

It has been shown that amino acids and carbohydrates are found in the jackfruit plant. The results of a recent study indicate that jackfruit seed starch has been used in the pharmaceutical sector. For the creation of fast-dissolving tablets (FDT), starches derived from jackfruit seeds are employed as super disintegrants. Fast-dissolving pills are sometimes referred to as mouth-dissolving pills, melt-in-your-mouth pills, orodispersible pills, rapid melts, porous pills, and

quick-dissolving pills.^[89] The angiotensin II type receptor antagonist irbesartan (IRB).

According to Vidyadhara *et al.*,^[19] has been chosen as a model medication. Moist granulating technology was used to create IRB and FDT formulations that comprised jackfruit starch extracts in varying quantities and croscarmellose sodium (CCS). It was shown that dissolving characteristics of different formulations were significantly impacted by the kind of starch used as a super disintegrant and the amount of super disintegrant used.

It was discovered that the jackfruit seed starch-based tablets used as a super disintegrant were ideal for making tablets that dissolve quickly. The ability of jackfruit to inhibit 24 different bacterial species is widely recognized.^[90] Different types of diseases related to DNA viruses including the herpes simplex virus type-2, varicella-zoster virus, and cytomegalovirus are inhibited by a lectin found in jackfruits called jacalin.^[91]

Conclusion

The aim of this review is an effort to compile all crucial information on jackfruit phytonutrients and pharmacological actions published to date. Jackfruit, an edible fruit, is a storehouse of minerals, vitamins, antioxidants, and other nutrients. The present study examined the relevance of jackfruit as a great source of medicinally significant chemicals. A variety of human illnesses are caused by reactive oxygen species and free radicals, which are scavenged by the antioxidant components found in fruits.

The present study has accurately observed and characterized the pharmacological actions. According to the study discussed here, jackfruit's crude extracts and phytochemicals have been proven to have antibacterial and anti-diabetic properties. In comparison to single compounds, the effects of phytomedicines are more noticeable because they are complex combinations of components. *Artocarpus* species may be used to create novel chemotherapeutic drugs that could slow or stop the growth of tumors and malignancies. These cytotoxic substances, along with numerous flavonoids and other phenolic compounds, showed antioxidant, anti-inflammatory, anti-atherosclerosis, and antiviral actions.

Lectins, which are glycoproteins, occur in high concentrations in jackfruit seeds that engage with CD4, a high-affinity HIV receptor. Lectins prevent HIV-1 infection of lymphoid cells *in vitro*. As a result, it should be investigated if jacalin may be utilized as a therapeutic agent for a variety of illnesses, including HIV, as well as to modify the immune response to infections. There is

much scope to conduct scientific studies to understand the medicinal properties to support the traditional claims as well as, research some new and promising “conduct,” to highlight significant results on identification, production, and bioactivity of metabolites found in jackfruit, in control and prevention of human diseases.

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Conflicts of interest

All authors declared no conflicts of interest.

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