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Jackfruit (*Artocarpus heterophyllus* Lam.): A systematic review of its potential for diabetes management and cancer prevention

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Abstract

Jackfruit (*Artocarpus heterophyllus* Lam.), the world's largest fruit-bearing tree, is an underutilised tropical crop with remarkable nutritional and therapeutic potential. Jackfruit is traditionally eaten as both a fruit and a vegetable. It is rich in dietary fibre, resistant starch, essential amino acids, vitamins, minerals and a variety of bioactive compounds like flavonoids, phenolics, carotenoids, lectins and saponins. There is a growing interest in plant-based functional food products that provide safe, economical and long-lasting health advantages due to the growth in lifestyle-related illnesses, especially diabetes mellitus and cancer. This review article critically analyses the antidiabetic and anticancer effects of jackfruit and compiles the most recent scientific data on its biochemical makeup. Its low-to-moderate glycaemic index (GI), high fibre and resistant starch content, enzyme-inhibitory activity against α-amylase and α-glucosidase and improved insulin sensitivity caused by the flavonoids and antioxidants in jackfruit are all together thought to contribute to its antidiabetic potential. Through mechanisms like antioxidant action, inhibition of cell proliferation, activation of apoptosis, suppression of tumour growth and interference with metastatic processes, jackfruit leaves, seeds, peel and pulp demonstrate significant anticancer potential. Overall, the present study highlights jackfruit as a functional food and nutraceutical option that can help in the prevention of cancer and diabetes, two significant global health issues.

Keywords: anti-cancer; bioactive substance; diabetes; glycaemic index; jackfruit

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Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.) is one of the most important tropical fruit tree species belonging to the family Moraceae. It is the largest fruit in the world and is rich in fibre, flavonoids, lignans, isoflavones, saponins, vitamins and potassium, which may help obese individuals (1). It originated in India and Malaysia and is widely grown worldwide; it is also grown in Southeast Asia and other tropical areas including Thailand, India, Bangladesh, Australia, USA (Florida), Latin America and the Caribbean (2). It is a large, evergreen fruit tree, with 10–15 m in height and is indigenous to the evergreen forests at altitudes of 450–1200 m. The softness or firmness of the fruitlets' flesh at the ripening stage can be used to distinguish between two main varieties of jackfruit (3). It exudes milky latex and has a straight, rough stem with green or black bark that is about 1.25 cm thick (4). The dark green, broad, elliptic leaves are arranged alternately. Female heads are oblong ovoid receptacles, whereas male heads are typically sessile, present on short peduncles, or occasionally borne on the terminal twig (5). The fruits are borne on the main and side branches of the tree. They are oblong, cylindrical, dicotyledonous compound fruits (6). Jackfruit has a green to yellowish brown exterior rind that is composed of hexagonal, bluntly conical carpel apices that cover a thick, rubbery and whitish to yellowish wall (5). It is a fruit with multiple aggregates formed when several flowers combine to form an inflorescence (6). There are three primary sections to the fruit. They are the true fruit, the fruit axis and the persistent perianth. The axis and core of the fruit are inedible because they contain laticiferous cells that produce latex, which keeps the fruits together. The perianth is made up of three regions:

- the bulb (the bottom fleshy edible part);
- the middle-fused section that produces the rind of the syncarp; and
- the horny nonedible region generally known as the spikes (5, 7).

As the fruit ripens, pigments called carotenoids, anthocyanins and chlorophylls shift from yellowish green to yellow (8). The fleshy white cotyledon is covered by a thin brown spermoderm, which is encircled by the flesh. Jackfruit has been reported to be high in protein and carbohydrates (6, 9). Jackfruit is considered a nutrient-rich starchy staple, a tasty fruit and a healthy vegetable in tropical and subtropical regions, making it one of the world's most important crops for food security (3). The aril or flesh of the fruitlet in mature syncarps is the main edible part of jackfruit; immature syncarps are also prepared as a nutrient-rich vegetable. All parts of the jackfruit tree have a variety of therapeutic qualities and are frequently utilised in traditional medicine. Due to sedentary lifestyles and poor eating habits brought on by industrialisation and urbanisation, diabetes and cancer have reached pandemic proportions in many economically developing nations, impacting the younger population. Since ancient times, Indian Ayurveda has used jackfruit to treat a variety of illnesses, including diabetes, cancer and inflammatory diseases. Although numerous studies have investigated the nutritional and phytochemical properties of jackfruit, an integrated review of its biochemical composition and therapeutic potential remains limited.

Methodology

This systematic review adopted a systematic methodology aligned with the PRISMA 2020 guidelines to ensure transparent and reproducible evidence synthesis while systematically addressing the lack of a unified evidence base on jackfruit for diabetes management and cancer prevention. The methodology adopted for this systematic review is outlined below.

Literature search

A systematic literature search was conducted to identify relevant studies on the application of jackfruit for diabetes management and cancer prevention. The search was conducted across several reputable databases, including Scopus, ScienceDirect, PubMed, MDPI and Google Scholar, to ensure comprehensive coverage of the available literature. The literature search was conducted between January 2026 and February 2026 using primary search terms, including “jackfruit for diabetes”, “glycaemic index”, “anticancer properties of jackfruit” and “bioactive components in jackfruit”. Boolean operators were used to refine the search strategy. The operator AND was employed to combine major concepts, while OR was employed to include synonymous terms. Duplicate records were removed; titles and abstracts were screened according to the eligibility criteria using the AND NOT operator where applicable. The review included peer-reviewed original research articles and short communications published in the English language. Studies published between 2000 and 2025 were included to capture recent advances.

Selection of suitable records

A total of 1450 articles were identified from the initial search and duplicates were removed, resulting in 928 articles remaining to be screened. After screening the titles and analysing the abstracts of the studies, 70 articles were chosen for further analysis according to the exclusion and inclusion criteria.

Finally, 45 studies were selected for inclusion in the review after all the full-text articles were evaluated and examined. The article selection process is outlined in the PRISMA diagram. Common reasons for articles to be excluded included studies in which the articles did not evaluate the therapeutic effects of *A. heterophyllus* on cancer cell development and studies in which different species of jackfruit (not *A. heterophyllus*) were used. Each record was appropriately tagged against its respective database of origin to facilitate tracking and management (Fig. 1).

Results and Discussion

The systematic literature search identified 1450 records from electronic databases, namely Scopus, ScienceDirect, Web of Science, PubMed, the Multidisciplinary Digital Publishing Institute (MDPI) and Google Scholar, ensuring comprehensive coverage of the available literature on jackfruit for anti-diabetes and anti-cancer activities. After removing duplicates, 928 unique records were screened based on their titles and abstracts. Following the eligibility assessment, 45 studies met all the inclusion criteria and were retained for qualitative synthesis. The removal of approximately 36 % of the initially identified records as duplicates highlights the importance of multi-database searching. Each database indexes partially overlapping but distinct journal portfolios and a single-database approach would have risked omitting relevant studies, a concern frequently noted in methodological guidance on comprehensive literature searching. The subsequent reduction from 70–45 included studies reflects the stringent application of predefined eligibility criteria. A large proportion of the excluded articles did not evaluate the therapeutic effects of *A. heterophyllus* on cancer cell development or focused on different species of jackfruit rather than *A. heterophyllus*.

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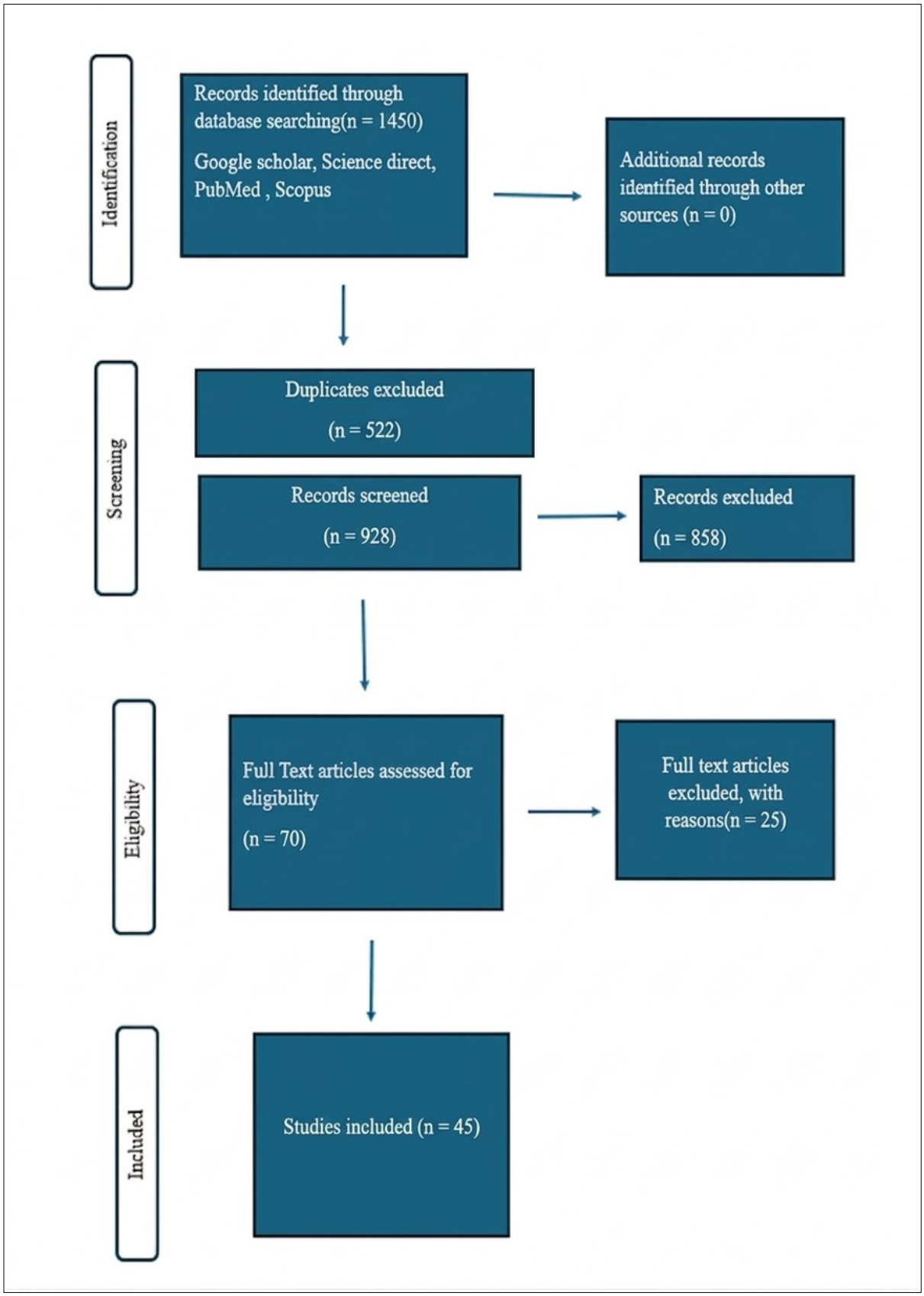


Fig. 1. PRISMA 2020 flowchart diagram.

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Biochemical composition of jackfruit

Jackfruit is a highly nutritious fruit. It contains potassium (287–323 mg/100 g), carbohydrate (11–19 g/100 g), calcium (30.0–73.0 mg/100 g) (5) and studies have shown that these elements are absorbed more efficiently by the human body. Jackfruit seeds contain 12 non-essential amino acids (aspartate, glutamic acid, asparagine, glutamine, serine, glycine, alanine, proline, arginine, cysteine and ornithine) and 8 essential amino acids (threonine, valine, isoleucine, leucine, tryptophan, phenylalanine, lysine and histidine). In general, the jackfruit flower had a phenolic content of 883.20 g gallic acid equivalent (GAE)/g (10). In jackfruit seeds, the proportion of essential amino acids to total amino acids is 45.6 %, whereas the ratio of essential amino acids to non-essential amino acids is 83.8 %. These values satisfy the Food and Agriculture Organization/World Health Organization (FAO/WHO) requirements for high-quality protein (11). The phytochemicals like alkaloid, tannin and flavonoids are higher in jackfruit leaves. (12). Anti-inflammatory activity of phenolic compounds like artocarpesin, norartocarpetine and oxyresveratrol are isolated from jackfruit (13). The phytonutrients like saponins, isoflavones and antioxidants present in jackfruit have anticancer properties (14). Minerals and bioactive substances such as Jacalin-derived lectin and starch polysaccharides are abundant in jackfruit seeds and have the ability to inhibit DNA viruses like varicella-zoster (15). The properties of *A. heterophyllus* are illustrated in Fig. 2.

Resveratrol (trans-3,5,4-trihydroxystilbene), a phytochemical present in jackfruit, is well known for its anti-inflammatory and cardioprotective qualities (16). Significant levels of fatty acids are found in jackfruit, with unsaturated fatty acids making up 63.56 %. The main components of these fatty acids are linoleic acid (55.20 %), stearic acid (1.81 %), docosanoic acid (1.79 %), palmitic acid (30.50 %) and linolenic acid (5.96 %). The most common fatty acid in jackfruit is linoleic acid (17). The total phenolic content in jackfruit was reported to be 0.36 mg GAE/g dry weight (DW) (18). The jackfruit kernel is reported to contain β-carotene, α-carotene, β-zeacarotene, α-zeacarotene and β-carotene-5,6α-epoxide, a dicarboxylic carotenoid and crocetin (19). The key carotenoids present in jackfruit are all-trans-lutein, all-trans-β-carotene, all-trans-neoxanthin, 9-cis-neoxanthin and 9-cis-violaxanthin (20) and the perianth and seeds of jackfruit contain significant amounts of starch (21).

Jackfruit in diabetes management

Nutritional significance

Jackfruit is a nutrient-rich tropical fruit that is relatively low in calories and fat while providing fibre, vitamins and minerals. It contains naturally occurring sugars that do not cause blood sugar levels to surge, indicating that it may be an effective way to control diabetes, since it has a good quantity of fibre and protein, which the body absorbs and digests gradually (22). The nutritional significance of jackfruit is summarised in Table 1.

Changes due to effect of jackfruit on diabetes

Reduced glucose absorption and lower glycaemic response

Jackfruit plays an important role in glycaemic regulation mainly by limiting intestinal glucose absorption and reducing the overall glycaemic load of the diet. Jackfruit exhibits a moderate glycaemic index (GI; approximately 50–60), which helps to prevent sharp post-prandial increases in blood glucose levels. This favourable glycaemic response is largely attributed to its high dietary fibre content, which slows gastric emptying and delays the enzymatic breakdown and intestinal absorption of carbohydrates (23). The α-glucosidase inhibitory activity of methanolic extracts at concentrations of 0–20 mg/mL from the peel, seed, pulp and flake of jackfruit was evaluated. The peel extract demonstrated the highest inhibitory effect (IC_{50}: 0.05 ± 0.00 mg dry matter (DM)/mL), followed by the seed (IC_{50}: 1.79 ± 0.15 mg DM/mL), pulp (IC_{50}: 6.81 ± 0.52 mg DM/mL) and flake extract (IC_{50}: mg 10.52 ± 0.73 DM/mL), while the peel extract also showed the highest total phenolic content, at 48.04 ± 4.57 mg GAE/mL. This implies that the overall phenolic content of the extracts and their α-glucosidase inhibitory action are related (23).

Unripe or raw jackfruit appears to be particularly advantageous for glycaemic control, as it contains comparatively lower levels of sugars (around 20 %) and higher amounts of fibre and protein than the ripe fruit. In addition, the fibre-rich matrix of jackfruit flour enhances satiety, helps to regulate appetite and reduces mid-meal snacking, thereby indirectly improving glycaemic control (22).

Increased resistant starch and dietary fibre

When compared to refined cereal flours, unripe jackfruit flour has far higher quantities of resistant starch and dietary fibre. These elements lessen post-prandial blood glucose increases by slowing intestinal glucose absorption and delaying gastric emptying. When green jackfruit flour is used as a staple meal substitute, its high fibre profile helps to improve glycaemic management (24).

Enzyme inhibition activity

The ethanolic extract of *A. heterophyllus* stem bark, which contains polyphenolic compounds, was found to exhibit concentration-dependent inhibition of α-amylase and α-glucosidase activity *in vitro* (IC_{50} = 4.18 ± 0.01 and 3.53 ± 0.03 mg/mL respectively) (25). This implies that the extract may control the metabolism of carbohydrates by blocking the enzymes that convert complex carbohydrates into simpler sugars.

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Table 1. Nutrient significant of jackfruit

Sl. No.	Nutrient	Amount per 1 cup of raw jackfruit
1	Energy	143 kcal
2	Water	111 g
3	Carbohydrates	35.0 g
4	Protein	2.6 g
5	Fat	0.966 g
6	Dietary fibre	2.26 g
7	Sodium	3.02 mg
8	Magnesium	43.8 mg
9	Phosphorous	31.7 mg
10	Vitamin B6	0.497 mg
11	Vitamin C	20.7 mg

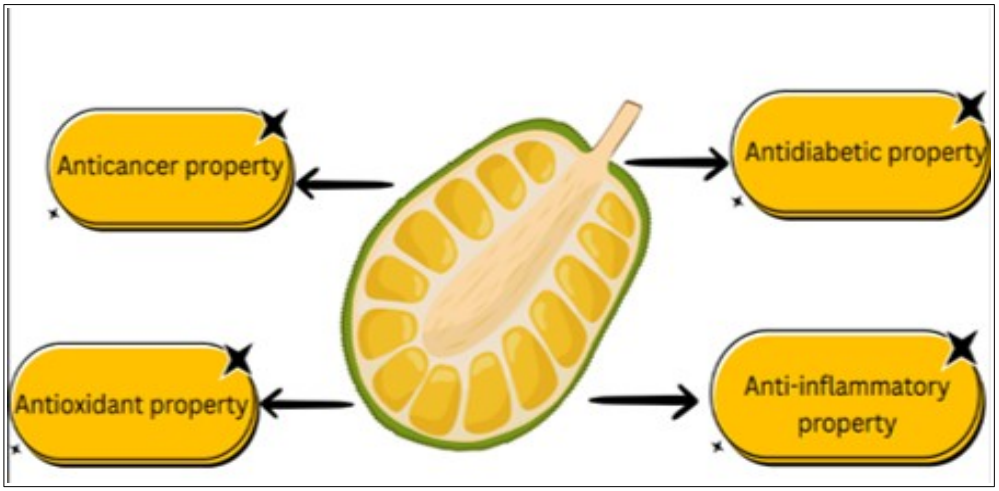


Fig. 2. Integrated illustration of properties of *Artocarpus heterophyllus*.

The extracts from jackfruit pulp, peel and seeds also exhibit α-amylase and α-glucosidase inhibitory activities, which is essential for treating diabetes. Jackfruit may reduce the conversion of starch into glucose by blocking carbohydrate-digesting enzymes, hence reducing blood glucose increases following meals (26).

The multifaceted role of jackfruit in glycaemic regulation and diabetes management is illustrated in Fig. 3.

Mechanisms of improved insulin sensitivity

Evidence suggests that jackfruit may improve glucose homeostasis through multiple mechanisms.

Flavonoid-mediated insulin signalling

In both normal and maturity-onset diabetes, hot water extracts from mature leaves of jackfruit contain flavonoids that enhance glucose tolerance and promote insulin receptor sensitisation without causing any harmful effects. Daily consumption of 100 g of jackfruit for four months has been reported to reduce fasting blood glucose (FBG), post-prandial blood glucose (PBG) and glycated haemoglobin (HbA1c) through enhanced insulin production or release from bound forms (24).

Mechanisms for glycaemic control and HbA1c reduction

The glycaemic benefits associated with jackfruit consumption appear to arise from multiple complementary mechanisms. One of the important pathways involves the inhibition of haemoglobin glycation (HbA1c), which has been linked to the antioxidant constituents of jackfruit flesh, including ascorbic acid, β-carotene and lycopene. These phytochemicals help to mitigate oxidative stress and suppress non-enzymatic protein glycation, processes that are central to the development of diabetic complications (27).

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Fig. 3. Multifaceted role of jackfruit in glycaemic regulation and diabetes management.

Furthermore, jackfruit seeds contain lectins capable of binding mono- and oligosaccharides, which may slow carbohydrate digestion or reduce intestinal glucose absorption. When jackfruit is consumed as part of a mixed meal, it provides carbohydrates from both the vegetable flesh and seeds, creating a complex carbohydrate matrix that modulates insulin secretion and glycaemic response more effectively than refined carbohydrate sources.

Antidiabetic potential of jackfruit: *in vitro* studies

In vitro studies consistently demonstrate that extracts and isolated polyphenols from *A. heterophyllus* inhibit carbohydrate-digesting enzymes, suppress protein glycation and modulate insulin secretion, supporting the antidiabetic potential of the plant. Multiple plant parts, including unripe whole fruit flour, leaves and stem bark, show bioactivity against distinct diabetes-relevant targets. Whole unripe jackfruit flour methanol extract and its isolated polyphenols, including caffeic acid, syringic acid and rutin, competitively inhibit α-glucosidase and α-amylase at low IC_{50} values (7.5–8.0 µg/mL for α-glucosidase; 22–26.9 µg/mL for α-amylase) (28).

The hot water extract of jackfruit leaves considerably improved glucose tolerance in normal individuals and diabetic patients when studied at oral doses comparable to 20 g/kg (29).

Consuming roughly 30 g of raw or green jackfruit powder on a regular basis lowers HbA1c levels, as well as fasting and post-prandial blood glucose levels. In a double-blind trial, one group of diabetic patients was given 30 g of green jackfruit powder for 3 months, whereas the other group received regular meals without jackfruit powder (30). Unexpectedly, the group that consumed jackfruit powder showed improvements in blood glucose levels.

The daily consumption of 100 g of a raw jackfruit-based preparation (“Chakka Aviyal”) over a 4-month period among people with type 2 diabetes mellitus (T2DM) resulted in significant improvements in glycaemic parameters (27). Specifically, fasting blood glucose, post-prandial glucose and HbA1c levels were reduced by 22.68 %, 25.69 % and 13.59 % respectively compared with the control group, with strong statistical significance ($p < 0.001$). The reduction in blood glucose was observed only in the experimental group of patients with diabetes mellitus, while the control group showed a significant increase in blood glucose levels. *Artocarpus heterophyllus* fruit preparation has sufficient quantities of energy, carbohydrates, fat and protein. The dietary fibre content of jackfruit is an important factor in controlling blood glucose levels and it also contains 11 types of essential vitamins (27).

Jackfruit flakes have a low GI, providing 1370 kJ of energy per serving and meeting 20 % of daily requirements with resistant starch, fibre and slow-release glucose that reduce the need for insulin (31).

Evidence from animal studies

The antidiabetic properties of jackfruit stem bark ethanolic extract were investigated in rats with diabetes induced by alloxan. Ethanol extract at doses of 50, 100 and 150 mg/kg body weight was administered to the diabetic rats (32). Treatment significantly improved insulin secretion, β-cell function and insulin resistance

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compared with untreated diabetic controls. After 3 weeks of treatment, the blood sugar levels were much lower than those of the diabetic rats (308.12 ± 1.10 mg/dl) and diabetic rats had higher homeostatic model assessment of insulin resistance (HOMA-IR) levels (5.36 ± 0.03) than normal rats (4.16 ± 0.01). Insulin and HOMA-β levels increased in all treatment groups, whereas HOMA-IR levels decreased (32).

The effects of jackfruit leaf ethyl acetate (EA) fraction on glycaemic responses were evaluated in both normoglycemic and streptozotocin (STZ)-induced diabetic rats. Rats receiving 10 mg/kg, 20 mg/kg and 0.6 mg/kg glibenclamide showed reductions in blood glucose of 18.9 %, 26.4 % and 35.9 % respectively in normoglycemic rats. After receiving jackfruit leaf extracts (20 mg/kg) for 5 weeks, diabetic rats showed an 11 % increase in body weight, 39 % lower serum glucose, 23 % lower serum total cholesterol and 40 % lower serum triglyceride (TG) levels. This demonstrated that jackfruit's EA fraction may be used to treat diabetes in the future (33).

Diabetes: Interpretation

Current evidence suggests that *A. heterophyllus* possesses significant antidiabetic potential through multiple complementary mechanisms, including inhibition of carbohydrate-digesting enzymes, delayed glucose absorption, improved insulin sensitivity and antioxidant activity. However, the strength of the evidence differs across *in vitro* and animal studies. While experimental studies provide strong mechanistic support, clinical evidence remains relatively limited and requires further validation through large-scale randomised controlled trials. The flavonoid-rich leaf extracts improved glucose tolerance and enhanced insulin activity, whereas antioxidant constituents such as vitamin C, β-carotene and lycopene may reduce oxidative stress and inhibit protein glycation, thereby lowering HbA1c levels (24, 29). These complementary mechanisms suggest that jackfruit not only reduces glucose absorption but also improves overall glucose homeostasis.

Similarly, animal studies demonstrated significant reductions in blood glucose, improved insulin secretion, enhanced β-cell function and favourable effects on lipid metabolism (32, 33).

Jackfruit in cancer management

Anticancer potential of jackfruit

One of the biggest global health issues is cancer and the emergence of drug resistance, high treatment costs and unfavourable side effects frequently restrict the efficacy of conventional chemotherapy. These restrictions have increased interest plant-derived bioactive molecules as less expensive potential sources of therapeutics. The leaves, seeds, bark and wood of the jackfruit tree are rich sources of phytochemicals with significant anticancer potential. Phytonutrients such as lignans, isoflavones and saponins present in jackfruit are responsible for its anticancer, antihypertensive, antiulcer and antiaging properties. They combat stomach ulcers and may inhibit cancer cell proliferation (20). The flesh of jackfruit contains compounds that may be helpful in the prevention or treatment of lymphoma and the fruit itself contains compounds with chemoprotective properties that may reduce the mutagenicity of aflatoxin B1 (AFB1) and the growth of cancer cells (34). Jackfruit works well as a bulk laxative since it contains dietary fibre. This shortens the duration of exposure to carcinogenic substances and binds to substances that cause cancer, thereby protecting the colon's mucous membrane by binding to minerals and vitamins (35).

Flavonoids, prenylated flavones, phenolic acids, tannins, alkaloids, coumarins, steroids, lectins and chromones have all been found in *A. heterophyllus* by phytochemical investigations. There is a considerable correlation between the biological activity of jackfruit leaves and their significant total phenolic and flavonoid contents in ethanolic extracts. Additionally, saponins have strong anticancer properties. It was discovered that saponins interact with the outer coverings of cancer cells. Saponins interact with cancer cell membranes and may induce apoptosis and inhibit proliferation (36).

Effect of jackfruit against cancer

Artocarpus heterophyllus leaf ethanolic extracts have shown specific cytotoxic effects against the triple-negative breast cancer (TNBC) cell line MDA MB-231. Anchorage-independent growth was significantly inhibited, cell survival and clonogenic capability were significantly reduced after treatment with these extracts, especially in three-dimensional (3D) culture methods that more closely mimic tumour behaviour *in vivo*. On the other hand, the cell's capacity to migrate was less impacted, indicating some cell-type selectivity in the anticancer response (37).

Three solvents (acetone, methanol and hexane) were utilised for the extraction and partitioning of two jackfruit development stages. Commercial jackfruit extract in methanol–hexane exhibits strong antimutagenicity properties that show dose dependence with a concentration of 500 ng AFB1, which was selected for further fractionation by high-performance liquid chromatography (HPLC). F1, F2, F3 and F4 are the four fractions that were collected. In the cell line M12, subfraction F1 (IC_{50} = 49.2 µg/mL) exhibited the strongest antiproliferative activity. Bioactive compounds discovered in *A. heterophyllus* leaves, such as artocarmitin B, artocarpin and cudraflavone C, suppressed the growth of cancer cell lines PC-3, NCI-H460 and/or A549 (34).

Additionally, jackfruit leaf extracts have demonstrated strong anticancer efficacy against TC-1 cells associated with HPV-16-positive cervical carcinoma. TC-1 cells were more sensitive to the extracts than breast cancer cells. In both two-dimensional (2D) and three-dimensional (3D) culture models, the treatment dramatically reduced cell viability, inhibited colony formation and lowered migratory capacity (37).

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Mechanism of anticancer action

Artocarpus heterophyllus's anticancer potential is mediated by a number of interrelated molecular pathways. These include a decrease in tumour growth and multiplicity, partially through cytochrome P450 enzyme regulation, interference with the cell cycle to prevent the growth of cancer cells and induction of apoptosis via both intrinsic and extrinsic cascade-dependent pathways. Additionally, it has been demonstrated that jackfruit extracts prevent anchorage-independent growth and cancer cell migration, two crucial steps in metastasis. Additionally, synergistic interactions with common chemotherapeutic medications, such as cisplatin and doxorubicin, enable efficient tumour suppression at lower drug dosages (36).

Enhancement of chemotherapeutic sensitivity (adjuvant mechanism)

The synergistic interaction between jackfruit leaf extract and traditional chemotherapy medications is another significant mechanism. The ethanolic extract of *A. heterophyllus* leaves (AHEE), which is rich in flavonoids, phenolics, tannins, coumarins and alkaloids, has moderate intrinsic anticancer activity. The extract produced effects equivalent to the whole IC_{50} dose of doxorubicin or cisplatin when coupled with modest doses (one-fifth of the IC_{50}). This suggests that the extract from *A. heterophyllus* improves drug sensitivity and could aid in lowering the dosage of chemotherapy and its related adverse effects. Modification of cellular pathways implicated in drug resistance and survival signalling is suggested by this adjuvant mechanism. The observed enhancement of chemosensitivity suggests possible modulation of cellular pathways involved in drug resistance and survival signalling, including phosphoinositide 3-kinase/protein kinase B (P13K/Akt), nuclear factor kappa B (NF-kB), mitogen-activated protein kinase/extracellular signal-regulated kinase (MAPK/ERK) and mechanistic target of rapamycin (mTOR) pathways. Suppression of these pathways could impair DNA repair mechanisms, reduce adaptive stress responses and facilitate apoptosis following chemotherapeutic treatment. However, these mechanisms remain hypothetical because apoptosis-related proteins, multidrug resistance transporters and intracellular signalling molecules were not experimentally evaluated (37).

Suppression of inflammatory pathways linked to carcinogenesis

Phytochemicals like phenols and flavones found in jackfruit decrease the pro-tumorigenic inflammatory microenvironment by blocking relevant pathways. Tumour development is significantly influenced by chronic inflammation. Phenolic components of jackfruit, such as artocarpesin, norartocarpetin and oxyresveratrol, have been shown to decrease the formation of prostaglandin E_2 (PGE_2) and nitric oxide (NO) in activated macrophage cells. Artocarpesin, which is extracted from the fruits of *A. heterophyllus*, can prevent RAW 264.7 cells from producing NO, PGE_2 and reactive oxygen species (ROS) when exposed to lipopolysaccharide (LPS). The suppression of NO generation in LPS-stimulated RAW 264.7 cells may be caused by the downregulation of COX-2 and iNOS proteins. *Artocarpus heterophyllus* fruits may have a positive impact on illnesses caused by inflammation (38).

Modulation of cancer-related cellular responses

The HT29 and SW620 colon cancer cell lines were used to test the water-soluble polysaccharides that were isolated from jackfruit. Despite the lack of significant morphological changes, antioxidant assays [2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP)] verified biological activity that might help to modify the oxidative balance of cancer cells. This implies an indirect chemopreventive action through antioxidant pathways (39).

Evidence from animal studies

The artocarpin found in jackfruit demonstrated strong cytotoxicity against human colon cancer cells in a dose-dependent manner. At IC_{50} values of approximately 15 µmol/L, artocarpin induced autophagy and apoptosis, which was corroborated by poly (ADP-ribose) polymerase (PARP) cleavage and the up-regulation of LC3B expression. Artocarpin also caused cell cycle arrest in the G1 phase. Oral artocarpin treatment for 16 weeks dramatically raised the survival rate and decreased the number of colonic neoplasms by 56 % in the mouse model (40).

The treatment of ArtinM at a dose of 50 µg/kg resulted in a reduction in the number of preneoplastic lesions and a decrease in the number of proliferating cell nuclear antigen (PCNA) positive cells in diethyl-nitrosamine (DEN)-induced Wistar rats. In addition, these rats showed decreased expression of proliferating cell nuclear antigen (PCNA), increased nuclear p21 and p27 staining, heightened expressions of p53 and p21 and upregulated the p42/44 MAPK pathway, which are involved in apoptosis and stress response. An inflammatory response is also indicated by elevated expressions of the TNFα and IFNγ genes (41).

The compilation of evidence on the bioactive constituents and health-promoting roles of different parts of *A. heterophyllus* is summarised in Table 2.

Future perspectives

The previous studies provided evidence using the human myelocytic leukaemia cell lines U937, K562 and NB4. NB4 showed the highest intensity of ArtinM binding, which may be the result of higher levels of N-acetylglucosaminyltransferase V transcripts. The IC_{50} values for NB4, K562 and U937 cells were 10 (±1), 14 (±1) and 84 (±1.5) µg/mL. Because ArtinM recognises the trimannosyl core of N-glycans with a β1,6-GlcNAc branch attached to α1,6-mannose, ArtinM treatment causes ROS production and autophagy. These results imply that components of jackfruit have a range of anticancer qualities and could be useful in the development of new cancer treatments (42).

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Cancer: Discussion

Further mechanistic research suggests that jackfruit's anticancer properties include cell-cycle arrest, apoptosis induction, reduction of inflammatory mediators, antioxidant modulation and increased chemotherapeutic sensitivity. However, the strength of the evidence varies considerably across experimental models and most published studies are based on *in vitro* investigations. Ethanolic leaf extracts also enhanced the cytotoxic effects of doxorubicin and cisplatin, suggesting potential use as adjuvant agents to improve chemotherapeutic efficacy (36). Although these findings provide valuable mechanistic insights, the concentrations used in cell culture experiments may not be achievable under physiological conditions, limiting their direct clinical relevance.

Evidence from animal studies further supports these observations by demonstrating reduced tumour burden, induction of apoptosis and autophagy, G1-phase cell-cycle arrest and activation of tumour suppressor proteins such as p53, p21 and p27. The flavonoid artocarpin exhibits anticancer and antioxidant activities, while the lectin ArtinM has immunomodulatory and antimicrobial effects (41). These studies provide stronger biological evidence than cell-based assays because they account for complex physiological interactions. Nevertheless, differences in animal species, tumour models, extract preparation, dosage and treatment duration make comparisons across studies difficult and limit extrapolation to humans.

In contrast, clinical evidence in humans remains extremely limited, creating a significant gap between experimental findings and clinical application. While jackfruit has shown beneficial effects on glycaemic control in clinical studies related to diabetes, comparable well-designed clinical trials evaluating its anticancer efficacy are lacking. Consequently, the anticancer potential of jackfruit cannot yet be confirmed in human populations despite encouraging preclinical findings.

Several molecular mechanisms have been proposed to explain the observed anticancer effects. Phenolic compounds such as artocarpesin, norartocarpetin and oxyresveratrol suppress inflammatory mediators by downregulating COX-2 and iNOS, thereby reducing the production of nitric oxide, prostaglandin E_2 and ROS, which contribute to tumour progression (38). In addition, modulation of signalling pathways including PI3K/Akt, NF-κB, MAPK/ERK and mTOR has been suggested in previous reports. However, these pathways have not been consistently validated through direct mechanistic studies and therefore their involvement should be interpreted cautiously rather than considered established.

Overall, the available evidence demonstrates a consistent trend of anticancer activity across *in vitro* and animal studies, supporting the biological plausibility of jackfruit-derived phytochemicals as potential anticancer agents. However, the current evidence base is weakened by methodological heterogeneity, lack of standardised extracts, limited pharmacokinetic and toxicity data and the absence of randomised controlled clinical trials. Future research should prioritise standardised phytochemical characterisation, molecular target validation, bioavailability studies, long-term safety assessment and adequately powered human clinical trials to establish the therapeutic potential of jackfruit-derived compounds in cancer prevention and treatment.

Conclusion

Jackfruit is gaining prominence in functional food studies owing to its potency in regulating blood sugar as well as its properties against certain cancers. Alongside its strong immunomodulatory property, jackfruit polysaccharides also possess numerous health benefits, which include antioxidants, antibacterial and anti-cancer properties in nature. In addition, phenolics components and flavonoids, including bioactive components like artocarpin, have shown cytotoxic and antioxidant actions against a variety of cancer cell lines (20). These results should not be regarded as proven therapeutic effects in humans, though, as they are primarily based on *in vitro* and animal research.

Table 2. Compilation of evidence on the bioactive constituents and health-promoting roles of different parts of *Artocarpus heterophyllus*, categorised by disease/condition

Condition	Part used	Action	Bioactive component	References
Colorectal cancer (HCT-15)	Seeds	Jacalin-containing nanoparticle formulation promoted cancer-cell cytotoxicity and apoptosis, accompanied by increased reactive oxygen species (ROS)	Jacalin (plant lectin), in an IP6–jacalin–pectin–gold nanoparticle formulation (IJP-GNP)	(43)
Prostate cancer (PC-3) and lung cancer (NCI-H460 and A549)	Leaves	Several isolated compounds showed moderate to weak cytotoxic or inhibitory activity against cancer cells	Artocarstilbene B, benzaldehyde, artocarmitin B, artocarpin, cudraflavone C, albanin A, cudraflavone, brosimone I, norartocarpanone, euchrenone A7, moracin M, moracin C, albafuran B, artoindonesianin B-1, demethylmoracin I, moracin D, artocarbene and griffithine	(44)
Breast cancer (T47D)	Wood	Reduced cancer-cell viability in a concentration-dependent manner and increased caspase expression	Artocarpin (prenylated flavonoid)	(45)

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Due to their dietary fibre and phytochemical content, the consumption of unripe jackfruit, jackfruit flour, jackfruit seeds and jackfruit leaves has been found to improve glycaemic parameters, including fasting blood glucose (FBG), post-prandial blood glucose (PBG) and glycated haemoglobin (HbA1c), primarily due to its dietary fibre and plant-based phytochemicals present in it (22, 24). This article emphasises the benefits of consuming jackfruit in various forms and its extracts for decreasing blood glucose levels and assisting in managing the glycaemic index (GI), as well as its potential to prevent cancer. Despite these positive outcomes, strong clinical evidence is still lacking. More extensive randomised clinical trials are required to confirm the efficacy, optimal dosage and long-term safety of jackfruit and its bioactive compounds for glycaemic control and cancer prevention.

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Authors' contributions

SSL contributed to the collection of articles and prepared the initial draft of the manuscript; VSKS formulated the concept and edited the manuscript; AJ, MBN and BA revised and edited the final manuscript. All authors have read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest

Authors do not have any conflict of interests to declare.

Ethical issues

None

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Grammarly tool for language refinement, grammar correction and improving the clarity of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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