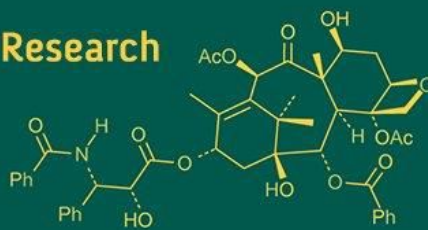


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Divya C
Ph.D. Scholar, Department of
Food Science and Nutrition,
University of Agricultural
Sciences, Bangalore,
Karnataka, India

Kalpna B
Professor and Scheme Head,
Women in Agriculture,
University of Agricultural
Sciences, Bangalore,
Karnataka, India

Geetha M Yankanchi
Scientist, Women in
Agriculture, University of
Agricultural Sciences,
Bangalore, Karnataka, India

Jamuna KV
Rtd Professor, Department of
Food Science and Nutrition,
University of Agricultural
Sciences, Bangalore,
Karnataka, India

Vasanth Kumari R
Professor and Head,
Department of Horticulture,
University of Agricultural
Sciences, Bangalore,
Karnataka, India

Revanna ML
Professor, Department of Food
Science and Nutrition,
University of Agricultural
Sciences, Bangalore,
Karnataka, India

Corresponding Author:
Divya C
Ph.D. Scholar, Department of
Food Science and Nutrition,
University of Agricultural
Sciences, Bangalore,
Karnataka, India

Phytochemical profiling and *in-vitro* antidiabetic evaluation of tender jackfruit flour (*Artocarpus heterophyllus* L.)

Divya C, Kalpna B, Geetha M Yankanchi, Jamuna KV, Vasanth Kumari R and Revanna ML

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Abstract

Diabetes, a widespread metabolic disorder, is a major cause of illness and death worldwide. The International Diabetes Federation reports that one in every three households has a diabetic patient. Jackfruit, a tropical fruit commonly grown in South India, especially in its tender (6-9 weeks old) form, contains a variety of compounds that may help manage diabetes. In view of this the study aimed to process tender jackfruit flour and assess its potential anti-diabetic effects. Two varieties of tender jackfruit, HV2 and TCV, were selected and subjected to pre-treatments, followed by drying at 60 °C. The tender jackfruit flour was analyzed for phytochemicals constituents and anti-diabetic properties. The HV2 variety, in particular, had higher levels of polyphenols (67.93 mg GAE/100 g), flavonoids (53.54 mg QE/100 g), and antioxidants (301.4 mg TE/g). Both varieties were rich in dietary fiber (HV2: 36.71 g/100 g; TCV: 34.75 g/100 g). The extracts from both varieties showed inhibitory effects on alpha-amylase and alpha-glucosidase enzymes, which are involved in carbohydrate digestion. Thus tender jackfruit flour, with its high fiber, antioxidant content, and ability to inhibit carbohydrate-digesting enzymes, shows promise as a functional food ingredient for managing blood glucose levels in individuals with diabetes.

Keywords: Tender jackfruit, phytochemicals, *In-vitro* anti-diabetic and blood glucose

Introduction

Diabetes is a widespread metabolic disorder that has become a major global health issue, contributing to high mortality rates and increasing healthcare costs. In 2021, diabetes was responsible for over 6.7 million deaths worldwide. In India, which has the second-largest diabetic population globally, 74.9 million people aged 20-79 had diabetes in 2021, with the number expected to rise to 124.9 million by 2045. As a result, there is a growing interest in herbal medicines for managing diabetes, as they are often considered safer with fewer side effects compared to synthetic drugs. India grows many fruits with untapped potential, and jackfruit (*Artocarpus heterophyllus* L.) is one of the most valuable yet underused. Native to India, Bangladesh, and Southeast Asia, jackfruit is rich in carbohydrates, vitamins, minerals, and dietary fiber (Baliga *et al.*, 2011) [7]. It is also known for its antioxidant properties and contains B-complex vitamins like vitamin B-6, niacin, riboflavin, and folic acid. Many parts of the plant, including the fruit, bark, and leaves, have medicinal properties. Furthermore, jackfruit is packed with phytochemicals such as phenolics, flavonoids, and sterols that may help prevent noncommunicable diseases (NCDs) (Baliga *et al.*, 2011) [7]. However, jackfruit remains underutilized commercially due to challenges like its large inedible portion, difficulty in peeling, and lack of proper post-harvest handling and processing facilities. As a result, a significant portion of the fruit up to 70% is wasted. Tender jackfruit, in particular, is valued for its nutritional and medicinal benefits. It is a good source of potassium, magnesium, and vitamin C, which supports immune health. Its low sugar content, including natural sugars like fructose and sucrose, helps regulate blood sugar levels without causing spikes. However, there is limited research on the effects of jackfruit flour on blood glucose control, making it an area for further study. This research aims to conduct a phytochemical analysis and *In-vitro* evaluation of the antidiabetic potential of tender jackfruit flour (*Artocarpus heterophyllus* L.).

Materials and Methods

Selection and Collection of Raw Materials

Two varieties of tender jackfruit (6-8 weeks old) were selected for the study: Horticulture Vegetable-2 (HV2) and Tissue Culture Variety (TCV). These were collected from trees near the Department of Horticulture, College of Agriculture, GKVK, Bangalore. The fruitlets were tagged, and horticulturists were consulted to determine the right maturity stage for harvest. Additional ingredients, food-grade preservatives, were sourced from local supermarkets in Bengaluru.

Statistical Analysis: All analyses were conducted in triplicate, and the data were processed using MS Excel and OPSTAT software. To assess the differences between varieties, a Student's independent t-test was applied.

Processing of the tender jackfruit flour

Tender jackfruit, with uniform size and free from spoilage, were sorted and washed under running tap water to remove

any dirt or soil. The cleaned jackfruits were then manually sliced into uniform pieces (1.5-2 cm thickness) for further processing. The sliced jackfruit were subjected to pre-treatment (Blanching at 80 °C with 0.5% per cent potassium meta bisulphate for 3 minute) and then tray-dried at 60 °C for 6.5 hours.

Estimation of phyto chemicals

The non- nutrient such as polyphenols, antioxidants, tannins and flavonoids, carotenoids, anthocyanidin were estimated in tender jackfruit flour. The methods followed for phyto-chemical analysis are as follows

Estimation of total polyphenol (Sadasivam and Manickam, 1991)

Phenols react with Folin-Ciocalteu Reagents (FCR) and form a blue coloured complex which can be measured at 700 nm. Total polyphenol was calculated as follows.

$$\text{Total polyphenol content (mg GAE/100g)} = \frac{\text{Absorbance of sample} \times \text{standard value} \times \text{total vol. extracted} \times 100}{\text{Assay volume} \times \text{Weight of the sample(g)} \times 1000}$$

Total Antioxidant activity (Miliauskas *et al.*, 2004) [16]

Antioxidant capacity of sample was estimated by DPPH (2,2-diphenyl-1- picrylhydrazyl) radical scavenging activity method. Standard curve was prepared using ascorbic acid

standard and absorbance was measured at 517 nm. Results were expressed as antioxidant activity/ ascorbic acid equivalents.

$$\text{Antioxidant capacity (mg ascorbic acid equivalents/100g)} = \frac{(a-b) \times \text{Total volume} \times 100}{\text{Assay volume} \times \text{Weight of the sample(g)} \times 1000}$$

Where, a=Absorbance of standard DPPH, b=Absorbance of sample with DPPH activity

Estimation of Flavonoids

Powdered samples were defatted before the analysis and were dried in a hot air oven at 60 °C. Flavonoids estimation was carried out with the Quercetin reagent. Flavonoids react with aluminum chloride and sodium acetate in Quercetin reagent and produce light yellow colour.

Proanthocyanidin content (Lakshmi *et al.*, 2021) [17]

0.5 to 1.0 g of sample is extracted with 50mL of acidified methanol (4%), agitated for 3 hours at room temperature and centrifuged at 5000 rpm at 4 °C. The supernatant obtained is used for further analysis. The vanillin-HCl reagent (2%) is prepared using 4% acidified methanol. 5mL of vanillin-HCl reagent is added to the 1mL of sample extract, the mixture is incubated for 20min and the absorbance is read at 500nm. Catechin hydrate is used as standard and the results are expressed as mg/100g of catechin equivalents.

Total carotenoids (Rodriguez Amaya and Kimura 2004)

Carotenoids were analyzed according to the method reported by Rodriguez-Amaya and Kimura, 2004. The sample extraction was carried out under dark condition. In brief, sample (3.0 g) was extracted using 10 ml of 12% methanolic KOH, vortex (2 min) and incubated at room temperature for 30 min. Petroleum ether was added to the solution each time until it will become colorless, vortex and

pool the upper layer into round bottom flask. The sample solution was concentrated under vacuum using rotary evaporator, the residues obtained was reconstituted with chloroform (3 mL) and the absorbance of the solution was recorded at 450 nm using UV-Vis spectrophotometer. Total carotenoid content was calculated using the equation mentioned below,

$$\text{Total carotenoid content} = \frac{A \times \text{volume} \times 10^4}{AE \times \text{sample weight}} \times 100$$

Where, A = absorbance of sample, volume = total volume of extract, AE = absorption co-efficient of β-carotene.

Estimation of tannins (Ranganna, 2005) [18]

Tannin was estimated calorimetrically based on the measurement of blue colour formed by the reduction of phosphotungstomolybdate acid in alkaline solution

Estimation of insoluble dietary fiber, soluble dietary fiber and total dietary fiber (AOAC, 1995) [11]

Defatted foods are gelatinized and proteins and starch are removed by enzymatic digestion. The residue is quantitated gravimetrically. Insoluble, soluble and total dietary fiber content of tender jackfruit powder and its residue was analysed, in order to check dietary fiber.

Insoluble dietary fiber= IDF residue– (protein+ash)

$$\text{IDF}\% = \frac{\text{Wt of the IDF residue(g)} - \{\text{Protein} + \text{Ash(g) in IDF residue}\}}{\text{Weight of the sample (g)}} \times 100$$

Estimation of soluble dietary fiber

The soluble fiber is estimated in the filtrate obtained after enzymatic digestion of protein and carbohydrates of defatted sample. The soluble fiber is precipitated and estimated gravimetrically

Soluble dietary fiber= Weight of SDF residue- (protein + ash)

$$\text{SDF}\% = \frac{\text{Wt of the SDF residue (g)} - \{\text{Protein (g) in SDF residue} + \text{Ash (g) in SDF residue}\}}{\text{Weight of the sample (g)}} \times 100$$

Estimation of total dietary fiber

The total dietary fiber is the sum of the insoluble and soluble dietary fiber, estimated as follows;

Total Dietary Fiber = IDF+SDF

In-vitro anti-diabetic Assay

The capability of tender jackfruit flour to inhibit α -amylase (Extracted from porcine pancreas – 10 to 25 units/ mg) and α -glucosidase (Extracted from yeast – 100 units/ mg) was studied. The results were correlated to the inhibitory activity by Acarbose, a standard drug used to inhibit α -amylase and α -glucosidase enzymes.

α -Amylase inhibition activity (Budnimath *et al.*, 2023) [8]

The α -amylase inhibition was carried out using the previously reported method by Budnimath *et al.*, 2023 [8]. In brief, different concentrations of phenolic extracts of samples was reacted with phosphate buffer (20 μ L) and pre-incubated α -amylase at 37 °C (10 min). 20 mM phosphate buffer (pH 6.9) with 6.7 mM NaCl and 100 μ L of soluble starch (1%) was added and incubated for 30 min. The reaction was terminated by addition of 96 mM 3,5-dinitrosalicylic acid reagent (250 μ L) and further incubated for 5 min in boiling water bath. The reactant solution was cooled to room temperature, then the volume was made up to 10 mL with ultrapure water and the absorbance of the solution was recorded at 540 nm. Acarbose was used as a positive control and the α -amylase inhibitory activity of sample extracts was calculated using the equation.

$$\% \text{ Inhibition} = \frac{A(\text{control}) - A(\text{sample})}{A(\text{control})} \times 100$$

Where, A control is the absorbance of blank solution, A sample is the absorbance of the sample.

α -Glucosidase inhibition activity (Budnimath *et al.*, 2023) [8]

The α -glucosidase enzyme inhibition activity of the samples was analyzed using the spectrophotometric method. The reagent solutions of 5 mM p-nitrophenyl- α -D-glucopyranoside (PNPG) and α -glucosidase (3.92 U/mL) were prepared using phosphate buffer (100 mM, pH 6.9).

Phenolic extracts of sample (100 μ L) were reacted with 0.5 μ L α -glucosidase (10 mg/mL) and incubated at 37 °C for 10 min. 200 μ L of PNPG solution is added to the sample extracts, incubated for 30 min and the reaction was terminated by addition of 0.5 mL of Na₂CO₃. The volume was made up to 5 mL with ultrapure grade water and the absorbance of the solution was read at 410 nm. Acarbose was used as positive control and the α -glucosidase inhibition activity was calculated using the equation.

$$\% \text{ Inhibition} = \frac{A(\text{control}) - A(\text{sample})}{A(\text{control})} \times 100$$

where, A control is the absorbance of the control, A sample is the absorbance of the sample.

GC profile of compounds (Bail *et al.*, 2008) [6]

Extraction

The sample (1 g) was extracted in the automated Soxhlet extraction system (Pelican Equipments, Chennai) using the petroleum ether for 2 hours at 80 °C. The temperature of the distillation process was increased to 120 °C after one hour. The extracted solvent after the extraction was evaporated in rotary evaporator and the residue obtained was dissolved in n-hexane (5 mL). The sample extracts were used for further analysis after filtration through 0.20 μ M PVDF membrane.

Gas chromatographic (GC) analysis

GC-FID analyses were carried out for the sample extracts. The GC system was attached with GC column of fused silica (30 m x 0.25 mm, 0.5 μ , J & W Scientific Corp., USA). The carrier gas used for analysis was hydrogen, the injector temperature was 250 °C and the detector temperature was maintained at 320 °C. The injector was split/splitless of 1:100. The temperature programme was 40 °C to 280 °C with the heating rate of 6 °C per min.

Statistical Analysis

All analyses were conducted in triplicate, and the data were processed using MS Excel and OPSTAT software. To assess the differences between varieties, a Student's independent t-test was applied.

Results and Discussion

Phytochemical constituents of Tender Jackfruit flour

Phytochemicals, are bioactive compounds found in fruits, play a crucial role in promoting health and preventing disease. They exhibit strong antioxidant properties, with flavonoids and carotenoids effectively neutralizing free radicals and lowering the risk of chronic diseases like cancer and heart disease. Many phytochemicals also have anti-inflammatory effects that can help manage conditions such as arthritis. Additionally, polyphenols are known to boost immune function and support cardiovascular health by reducing blood pressure and LDL cholesterol levels. They also aid in metabolism and promote feelings of fullness, which can be beneficial for weight management. Some studies have even shown that phytochemicals can inhibit tumor growth, contributing to cancer prevention. These compounds can affect nutrient availability and influence the

etiology, progression, and treatment of diseases by modifying risk factors. The mechanisms by which phytonutrients reduce disease risk are complex and not fully understood; some may work directly by scavenging free radicals, while others may engage in cell signaling pathways that are sensitive to redox balance (Dias, 2012) [15]. Numerous studies highlight the significance of polyphenols,

anthocyanins, carotenoids, and flavonoids in fruits, vegetables, and spices as natural antioxidants that help combat cellular damage by scavenging free radicals. Furthermore, phenolic compounds are essential plant constituents, as their hydroxyl groups enhance their scavenging abilities and contribute to notable *In-vitro* antioxidant and antidiabetic effects.

Table 1: Phytochemical composition of tender jackfruit flour

Parameters	HV2	TCV	t- test
Total polyphenol (GAE/100g)	67.93±2.85	55.75±3.34	4.79*
Antioxidant activity (AAE /100g)	301.4±15.58	182.45±13.37	7.13*
Total flavonoids (QE /100g)	53.54±0.07	48.16±0.08	3.99*
Total tannins (mg TAE/100g)	89.40±0.2	79.93±2.57	2.99*
Total Carotenoids (µg/100g)	608.07±0.17	550.95±0.26	5.16*
Proanthocyanidin content (µg/100g)	870.63±0.48	813.68±0.82	3.04*
Dietary fibre (%)			
Total dietary fibre	36.71±1.43	34.75±1.07	1.53 ^{NS}
Insoluble	33.08±1.11	31.33±0.16	2.19 ^{NS}
Soluble	4.33±0.36	3.94±0.11	1.43 ^{NS}

AAE- Ascorbic acid equivalent, TAE- Tannic acid equivalent

The phytochemical composition of tender jackfruit flour depicted in table 1 shows significant differences between HV2 and TCV in several parameters. HV2 contains higher levels of total polyphenols (67.93 GAE/100 g) compared to TCV (55.75 GAE/100 g), indicating a statistically significant difference ($t = 4.79^*$). The results for the total phenols in the present study were slightly higher than those reported by Tamanna *et al.*, (2023) [19], who found the total phenolic content (TPC) of freeze-dried (FD) jackfruit bulbs was 4.13 ± 0.25 mg GAE/g. reported that the total phenolic content of jackfruit juice varied widely, ranging from 144 to 10,086 mg GAE/L. This range contrasts with the findings of the present study. The discrepancy may arise from variations in factors such as the specific jackfruit variety used, the ripeness of the fruit, or differences in extraction and measurement methods.

In the study Chamara *et al.*, (2018) [9], the highest total phenolic content was found in the mature stage crude extract, measuring 434.04 ± 7.38 mg GAE/g. In contrast, the lowest value was reported for the ripe stage crude extract, at 52.08 ± 7.03 mg GAE/g. This indicates a decline in total phenolic content as jackfruit progresses through maturity and ripening.

Antioxidant activity is markedly high in HV2 (301.4 AAE) than in TCV (182.45 AAE), similarly Total flavonoid content was also higher in HV2 (53.54 QE) compared to TCV (48.16 QE). The higher levels of total polyphenols and antioxidant activity in HV2 indicate a greater potential for health benefits, particularly in combating oxidative stress and related diseases. Polyphenols and flavonoids are known for their antioxidant properties, which can help reduce the risk of chronic diseases. Tamanna *et al.*, (2023) [19] reported that the total flavonoid content (TFC) of jackfruit bulbs ranged from 23.52 ± 0.92 mg QE/100 g to 20.30 ± 0.62 mg QE/100 g. Additionally, they found that the total carotenoid ranged from 5.60 ± 0.35 mg β -carotene/100 g, to 3.61 ± 0.16 mg β -carotene/100 g. These values were lower than those observed in the present study, suggesting that present findings may indicate a greater capacity for antioxidant retention under the drying methods utilized. Almeida *et al.*, (2011) [4] assessed the antioxidant activity of jackfruit through ABTS and DPPH assays, reported 0.63 ± 0.01 TEAC (μ M/g) and 0.16 ± 0.03 TEAC (μ M/g) when measured

against Trolox equivalents, respectively. Reported that in breadfruit (*Artocarpus altilis* and hybrids), the total carotenoid content ranged from 0 to 6549 mg per 100 g. Suggested that heat energy can break down cellular components, leading to a greater release of polyphenols from the matrices. This may explain the relatively higher total phenolic content (TPC) and total flavonoid content (TFC) observed at 60 °C in the current study. Similarly, Cherrat *et al.*, (2019) [10] found that elevated drying temperatures can result in the destruction of cellular structures, which facilitates the release of flavonoids during extraction. Conversely, Azam and Pandey (2021) [5] noted that as drying temperature increases, drying time decreases, allowing for shorter exposure periods that help preserve polyphenols and flavonoids.

Similarly, total tannins are higher in HV2 (89.40 TAE) versus TCV (79.93 TAE), which is statically significant ($t = 2.99^*$, $p < 0.05$). The total carotenoid content in HV2 (608.07 ± 0.17 μ g/100 g) is significantly greater than that in TCV (550.95 ± 0.26 μ g/100 g). Proanthocyanidin content is also elevated in HV2 (870.63 μ g) compared to TCV (813.68 μ g).

Dietary fiber (DF) includes a diverse array of non-digestible food components, such as non-starch polysaccharides, oligosaccharides, lignin, and similar polysaccharides that provide health benefits. DF is generally classified based on its solubility in water, fermentation by gut microbes, and viscosity. Soluble fibers include pectin, gums, and certain polysaccharides, while insoluble fibers encompass cellulose, hemicellulose, and lignin. Dietary fiber is vital for promoting health and preventing disease, particularly concerning digestive health, energy balance, cancer, heart disease, and diabetes. The protective effects of dietary fiber against obesity and type 2 diabetes (T2D) have often been attributed to increased satiety from enhanced chewing, calorie displacement, and decreased macronutrient absorption. This is believed to result from the ability of soluble fibers to form viscous solutions that slow gastric emptying, which in turn inhibits the absorption of glucose, triglycerides, and cholesterol in the intestine. Soluble fiber, in particular, can help slow the absorption of sugar, leading to better blood sugar control. A diet high in insoluble fiber may also reduce the risk of developing type 2 diabetes.

Furthermore, dietary fiber is essential for lowering the risk of cancer and atherosclerosis, as it helps regulate the gradual release of glucose, thereby assisting in the management of diabetes mellitus and obesity. Increasing dietary fiber intake is therefore crucial for maintaining overall health and preventing a variety of diseases.

The total dietary fiber content of HV2 was 36.71 ± 1.43 , while TCV had 34.75 ± 1.07 . HV2 recorded slightly higher insoluble fiber i.e., 33.08 ± 1.11 compared to 31.33 ± 0.16 for TCV. In terms of soluble fiber, HV2 had 4.33 ± 0.36 , whereas TCV had 3.94 ± 0.11 . Overall, there were no significant differences in the dietary fiber components between the two varieties. Reported that in breadfruit flour (*Artocarpus altilis* and hybrids), the insoluble fiber content ranged from 7.5 g to 62.3 g per 100 g, while the soluble fiber content ranged from 0.2 g to 11.5 g per 100 g. The significant difference in total tannins and carotenoids also suggests that HV2 may offer enhanced protective effects, as these compounds are associated with various health benefits, including anti-inflammatory properties and potential roles in preventing certain cancers. The elevated proanthocyanidin content in HV2 further emphasizes its nutritional value, as proanthocyanidins have been linked to cardiovascular health and improved circulation. HV2 outperforms TCV in phytochemical content supported by presence of vitamin-c as obtained in present study (table 12), the total dietary fiber levels do not show significant differences between the two

samples. This finding suggests that both HV2 and TCV could be equally beneficial in providing dietary fiber, an essential component for digestive health.

***In-vitro* antidiabetic activity of tender jackfruit flour**

Diabetes mellitus affects around 450 million people globally, with projections indicating a two- to three-fold increase by 2045, making it a major cause of death and disability (Cho *et al.*, 2018) ^[11]. To manage postprandial hyperglycemia, one effective strategy involves inhibiting starch-digesting enzymes, specifically α -amylase and α -glucosidase, which reduces glucose absorption in the gastrointestinal tract. Common antidiabetic medications like acarbose and miglitol serve this purpose but can lead to side effects such as diarrhea, abdominal pain, and hypoglycemia. Consequently, there is increasing interest in herbal treatments, which are supported by the World Health Organization for their therapeutic properties in diabetes management (Choudhury *et al.*, 2018) ^[12]. Controlling postprandial blood glucose spikes is vital for preventing chronic complications, and α -amylase inhibitors may help delay glucose absorption by partially obstructing the enzymatic breakdown of complex carbohydrates. In this context the antidiabetic potential of tender jackfruit flour and its ability to inhibit α -amylase and α -glucosidase activities was investigated.

Table 2: Antidiabetic potential of extracts tender jackfruit flour extracts

α -Amylase inhibition activity					
Parameters	HV2		Control	TCV	
	OD (540nm)	% inhibition		OD (540nm)	% inhibition
Control	1.028	0		1.028	0
Tender Jackfruit flour	0.645	37.25	Tender Jackfruit flour	0.840	18.28
	0.501	51.36		0.512	50.19
	0.067	93.48		0.103	89.98
α -Glucosidase inhibition activity					
Control	HV2		Control	TCV	
	OD (410nm)	% inhibition		OD (410nm)	% inhibition
	0.988	0		0.988	0
Tender Jackfruit flour	0.763	22.77	Tender Jackfruit flour	0.698	29.00
	0.586	40.68		0.579	41.39
	0.243	76.62		0.299	70.95

The antidiabetic properties of tender jackfruit, particularly its ability to inhibit α -amylase and α -glucosidase, were systematically examined in this study. The α -amylase inhibition assay aimed to validate the hypoglycemic effects of tender jackfruit flour, as inhibiting α -amylase effectively reduces postprandial hyperglycemia by controlling starch breakdown. Results, summarized in Table 2, indicated that higher concentrations of tender jackfruit flour extract led to a significant decrease in α -amylase activity, with inhibition rates of 37.25% (0.5 ml), 51.36% (1 ml), and 93.48% (1.5 ml) in HV2 variety. The corresponding α -amylase activity ranged from 18.28 (0.5 ml) to 89.98 (1.5 ml), in TCV variety demonstrating a clear dose-dependent relationship. The highest recorded inhibition was 93.48% in 1.5 ml of the HV2 variety extract, compared to 89.98% with 1.5 ml of the TCV variety extract suggesting that HV2 may be more effective at slowing starch digestion and reducing postprandial blood glucose spikes. These findings demonstrate a significant reduction in α -amylase activity, supporting the hypoglycemic potential of both varieties under the assay conditions.

Alpha-glucosidase is an essential enzyme in carbohydrate metabolism, primarily responsible for breaking down complex carbohydrates into simple sugars, such as glucose, in the small intestine. By catalyzing the hydrolysis of oligosaccharides and disaccharides, alpha-glucosidase plays a critical role in regulating postprandial blood glucose levels. In terms of α -glucosidase inhibition, HV2 achieved 76.62% inhibition at the highest concentration, slightly surpassing TCV's 70.95%. However, TCV displayed stronger inhibition at lower concentrations, indicating potential differences in their enzyme-inhibitory profiles. The differences in enzyme inhibition between HV2 and TCV could be attributed to variations in starch composition, antioxidant potential, and the presence of bioactive or polyphenolic compounds, as detailed in the table(1). These findings suggest that tender jackfruit flour could help regulate blood glucose levels by modulating starch digestion and glucose absorption, making it a promising option for diabetes management. The presence of good amounts of antioxidant components has translated into higher

antidiabetic property in terms of inhibition of alpha glucosidase and alpha amylase as depicted in table(1) The findings from Nair *et al.*, (2013) ^[20] study align with existing findings. The results demonstrated that *A. altilis* required a concentration of 118.88 µg/mL to achieve 50% inhibition of alpha-amylase activity, while *A. heterophyllus* was more effective, showing 50% inhibition at a lower concentration of 70.58 µg/mL. Additionally, the IC50 values for alpha-glucosidase inhibition were 129.85±10.29 µg/mL for *A. altilis* and 76.90±9.55 µg/mL for *A. heterophyllus*. Maradesha *et al.*, (2022) ^[21] found that polyphenols from jackfruit, specifically caffeic acid (CA) and syringic acid (SA), help lower blood sugar by inhibiting key enzymes. Their results support the current study, showing that jackfruit's compounds are important for controlling blood sugar levels.

Similarly, Devarasu *et al.*, (2024) ^[14] reported that ethanolic extracts of *Artocarpus heterophyllus* (ETAH) demonstrated notable inhibitory effects against aldose reductase, α-amylase, and α-glucosidase, outperforming the standard drug acarbose. Ajiboye (2016) ^[3] reported that the extracts showed strong inhibitory activity against α-amylase and α-glucosidase enzymes, with IC50 values of 4.18±0.01 mg/mL for α-amylase and 3.53±0.03 mg/mL for α-glucosidase. These values highlight the extract's effectiveness in regulating carbohydrate metabolism. Overall, these results not only reinforce the potential of these extracts as effective natural inhibitors but also contribute to the growing body of evidence advocating for the incorporation of plant-based solutions in diabetes management strategies.

Table 3: Phytochemical components identification by GC-MS

Sl. No	GC profile of compounds (mg/100g)	HV2
1	17-Octadecynoic acid	0.22
2	Hydroquinone	0.26
3	β-L-Arabinopyranoside	0.28
4	Stigmasterol	0.58
5	8,11,14-Eicosatrienoic acid	1.87
6	Lanosterol	0.48
7	Palmitoleic acid	1.48
8	n-Hexadecanoic acid	0.31
9	Campesterol	0.39
10	γ-Sitosterol	1.05
11	5-Hydroxymethyl furfural	0.51
12	9,12-Octadecadienoic acid	3.58

The gas chromatography (GC) profile of compounds in HV2 were presented in table 3 and fig 1, it reveals a diverse array of bioactive components, quantified in mg/100g. Notably, 9,12-octadecadienoic acid is present at 3.58 mg/100 g, recognized for its potential anti-inflammatory properties and cardiovascular support. Additionally, 8,11,14-eicosatrienoic acid, found at 1.87 mg/100 g, may aid in reducing cholesterol levels and improving lipid profiles, further highlighting HV2's role in promoting heart health. Palmitoleic acid, at 1.48 mg/100 g, is associated with improved insulin sensitivity, which is particularly beneficial

for diabetic individuals. The profile also includes γ-sitosterol (1.05 mg/100 g) and stigmasterol (0.58 mg/100 g), both phytosterols known to lower cholesterol and enhance cardiovascular health. Furthermore, 5-hydroxymethyl furfural, present at 0.51 mg/100 g, offers potential antioxidant benefits. Additional compounds such as lanosterol, campesterol, and various fatty acids (Including 17-octadecynoic acid, n-hexadecanoic acid, and β-L-arabinopyranoside) enrich the nutritional profile of HV2, suggesting benefits related to cholesterol management, inflammation reduction, and antioxidant activity.

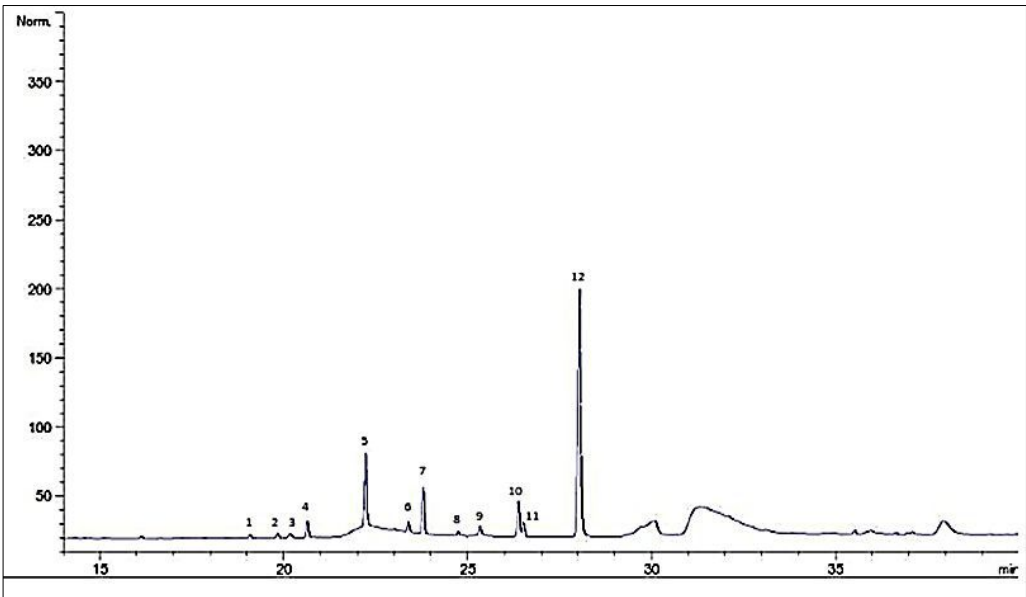


Fig 1: Phytochemical components identification by GC-MS

Overall, the GC profile indicates that HV2 is rich in bioactive compounds that may positively impact health, particularly in managing cardiovascular and metabolic conditions. Incorporating HV2 into the diet could support overall health and assist in managing issues such as diabetes and hyperlipidemia. Further research is warranted to explore the specific health effects and bioavailability of these compounds to fully understand their potential benefits.

Neha and Abdussalam identified five major compounds in ether extracts from fresh fruit pulp of *Artocarpus hirsutus* through GC-MS analysis, with squalene (62.36%), medowlactone (3.64%) and dodecanal (2.95%) being the most prominent.

Conclusion

The tender jackfruit flour, with its high fiber, antioxidant content, and ability to inhibit carbohydrate-digesting enzymes, shows promise as a functional food ingredient for managing blood glucose levels in individuals with diabetes.

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References

1. AOAC. Official Methods of Analysis. Association of Official Agricultural Chemists. 13th edition. Washington, D.C, USA; c1995.
2. AOAC. Official Methods of Analysis. Association of Official Analytical Chemists. 18th edition. Washington, D.C, USA; c2005.
3. Ajiboye BO, Ojo OA, Oyinloye BE, Okesola MA, Oluwatosin A, Boligon AA, *et al.* Investigation of the *in vitro* antioxidant potential of polyphenolic-rich extract of *Artocarpus heterophyllus* Lam stem bark and its antidiabetic activity in streptozotocin-induced diabetic rats. *Journal of Evidence-Based Integrative Medicine*. 2020;25:2515690X20916123.
4. Almeida MMB, de Sousa PHM, Arriaga ÂMC, do Prado GM, de Carvalho Magalhães CE, Maia GA, *et al.* Bioactive compounds and antioxidant activity of fresh exotic fruits from northeastern Brazil. *Food Research International*. 2011;44(7):2155-2159.
5. Azam M, Pandey S. Studies on drying characteristics of guava (*Psidium guajava*) under different drying methods. *Mysore Journal of Agricultural Sciences*. 2021;55(1):46-51.
6. Bail S, Buchbauer G, Schmidt E, Wanner J, Slavchev A, Stoyanova A, *et al.* GC-MS analysis, antimicrobial activities and olfactory evaluation of essential davana (*Artemisia pallens* Wall. ex DC) oil from India. *Natural Product Communications*. 2008;3(7):1934578X0800300705.
7. Baliga MS, Shivashankara AR, Haniadka R, Dsouza J, Bhat HP. Phytochemistry, nutritional and pharmacological properties of *Artocarpus heterophyllus* Lam (Jackfruit): A review. *Food Research International*. 2011;44(7):1800-1811.
8. Budnimath SH, Bhuvaneshwari G, Ganiger VM, Jagadeesh SL, Goudar G, Patil SN, *et al.* Physical, reconstitution and phenolic properties of instant drink mix prepared with *Moringa oleifera* leaf, raw banana, and whey protein concentrate. *Measurement: Food*. 2023;11:100108.
9. Chamara AMR, Peramunugama D, Thiripuranathar G. Comparative study in antioxidant activities of the different ripeness stages of *Artocarpus heterophyllus* Lam fruit. *International Journal of Ayurveda and Pharma Research*. 2018;6(3):2322-0902.
10. Cherrat S, Boulkebach-Makhlouf L, Iqbal J, Zeghichi S, Sait S, Walker G. Effect of different drying temperatures on the composition and antioxidant activity of ginger powder. *Annals of the University Dunarea de Jos – Food Technology*. 2019;43(2):125-142.
11. Cho NH, Shaw JE, Karuranga S, Huang Y, Fernandes JDR, Ohlrogge AW, *et al.* IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Research and Clinical Practice*. 2018;138:271-281.
12. Choudhury H, Pandey M, Hua CK, Mun CS, Jing JK, Kong L, *et al.* An update on natural compounds in the remedy of diabetes mellitus: A systematic review. *Journal of Traditional and Complementary Medicine*. 2018;8(3):361-376.
13. Datusalia K, Dora CP, Sharma S. Acute and chronic hypoglycemic activity of *Sida tiagii* fruits in N5-streptozotocin diabetic rats. *Acta Poloniae Pharmaceutica Drug Research*. 2012;69(4):699-706.
14. Devarasu P, Natarajan V, Sendhamaraikannan T, Velmurugan A, Yokesh A, Nivedha B, *et al.* GC-MS analysis and *in-vitro* anti-diabetic activity of ethanolic extract of *Artocarpus heterophyllus* (Unripe Jack Fruit). *Journal of Advanced Zoology*. 2024;45(1).
15. Dias SJ. Nutritional quality and health benefits of vegetables: A review. *Food and Nutrition Sciences*. 2012;3:1354-1374.
16. Miliauskas G, Venskutonis PR, Van Beek TA. Screening of radical scavenging activity of some medicinal and aromatic plant extracts. *Food chemistry*. 2004 Apr 1;85(2):231-7.
17. Lakshmi S, Hughes TA, Priya S. Exosomes and exosomal RNAs in breast cancer: A status update. *European Journal of Cancer*. 2021 Feb 1;144:252-68.
18. Verma A, Ranganna KM, Reddy RS, Verma M, Gordon NF. Effect of rosuvastatin on C-reactive protein and renal function in patients with chronic kidney disease. *The American journal of cardiology*. 2005 Nov 1;96(9):1290-2.
19. Tamanna T, Islam MM, Chaity AR, Shams SN, Rasel MA, Haque MM, *et al.* Water relation, gas exchange characteristics and yield performance of selected mungbean genotypes under low soil moisture condition. *Agronomy*. 2023 Apr 6;13(4):1068.
20. Nair H, Simões EA, Rudan I, Gessner BD, Azziz-Baumgartner E, Zhang JS, *et al.* Global and regional burden of hospital admissions for severe acute lower respiratory infections in young children in 2010: a systematic analysis. *The Lancet*. 2013 Apr 20;381(9875):1380-90.
21. Maradesha T, Patil SM, Al-Mutairi KA, Ramu R, Madhunapantula SV, *et al.* Inhibitory effect of polyphenols from the whole green jackfruit flour against α -glucosidase, α -amylase, aldose reductase and glycation at multiple stages and their interaction: Inhibition kinetics and molecular simulations. *Molecules*. 2022 Mar 14;27(6):1888.