Exploring the phytochemical composition of Jackfruit (*Artocarpus heterophyllus*) for anticancer applications

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Abstract. Plants are dependent on phytochemicals for defense and other interactions with their surroundings. These phytochemicals with biological activity are the new class of pharmaceutical compounds which has a novel chemical structures and modes of action in various diseases including cancers. The qualitative and quantitative analysis of the extremely important biologically active phytochemicals in medicinal plants. Plants have therapeutic value against cancer because they contain certain bioactive components. To identify the phytoconstituents in the extracts of Jackfruit, scientifically named as *Artocarpus heterophyllus* was carried out in this study.The few studies were reported that the *Artocarpus heterophyllus* extracts possess several antioxidants, antidiabetic, antibacterial and anti-inflammatory properties. The methanol extract of Jackfruit Kernel, Rind and Seed samples were collected using the Soxhlet equipment, by using the previous reported phytochemical analysis techniques for alkaloids, steroids, flavonoids, saponins, tannins, and terpenoids were qualitatively estimated. Alkaloids, Steroids,Tannin and Saponin were present in all parts of *Artocarpus heterophyllus*. These functional components are finding provided scientific evidence for the use of these traditionally used medicinal plants against diseases.

Keywords: Phytochemical analyses, *Artocarpus heterophyllus*, methanol, Jackfruit Kernel, Rind, Seed.

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1. Introduction

Jackfruit, scientifically named as *Artocarpus heterophyllus* possess several antioxidant, antidiabetic, antibacterial and anti-inflammatory properties. They are native to India and are found in other tropical areas throughout the world with variation in their species type. In India Jackfruits are abundantly found in Western ghat region especially in Kerala. Jackfruit can be considered as both medical plant and also as food [1]. They are also known as poor man's food due to their availability in abundance during their seasonal availability [2]. Jackfruit comes from Class Magnoliopsida, subclass Hemamelidae and Family Moraceae.

Artocarpus heterophyllus is tropical fruit which is a family of Moraceae. Jack fruit contains high concentration of phytochemical that have antioxidant properties [3]. Various amino acids like cystine, histidine, leucine, lysine, methionine, threonine, and tryptophan is present in this fruit. They contain 1.9 g proteins per 100g. They are rich source of both vitamin C and vitamin B6 (pyridoxine). Previous studies shown that this provitamin A have a beneficial effect on several acute and chronic degenerative diseases, including cancer, inflammatory conditions, heart disease, eye infections and macular degeneration [4-6]

Arotenoids are present in the different parts of jackfruit, which are all-trans-lutein, all-trans-β-carotene, all-trans-neoxanthin, 9-cis-neoxanthin, and 9-cis-violaxanthin. This fruit contains various components, which have different beneficial activities. The studies shown which are antimicrobial, anti-inflammatory, antioxidant and biological activities. Also, this plant have lignans, isoflavones, and saponins, which are the major phytonutrients showed therapeutic activity against anticancer and antihypertensive properties. These phytocomponents generally, prevent the formation of cancer cells in the body [7].

Phytochemical screening is a process that identifies, characterized and quality assurance of bioactive compounds (phytochemicals) in plant extracts, such as alkaloids, flavonoids, tannins, terpenoids, and saponins. This are responsible for medicinal properties, supporting traditional uses and for drug development via simple chemical tests which changes in solution. Phytochemical screening forms the foundation of drug discovery from herbs and its standardization [8].

Phytochemical perspective, jackfruit possesses a valuable profile of bioactive compounds including polyphenols (flavonoids, tannins, phenolic acids), volatile acids, amino. Sterols, triterpenes, stilbenes, and prenyl flavonoids are all known to be produced by the plant. A few of these substances have shown intriguing biological properties, such as cytotoxicity, antioxidant activity, anti-inflammatory activity and anti-malarial activity, inhibition of enzyme tyrosinase and melanin biosynthesis and inhibition of 5α-reductase acids, carotenoids, and minerals. Those compounds contribute to its pharmaceutical properties [9].

2. Materials and Methods

2.1 Collection of Plant Material

Whole jackfruit was collected from Aroorkutty, Alapuzha district, Kerala, India (9.8479656, 76.3283371) and was chopped into smaller pieces and kernel, seed and rind was then separately collected. These samples were then cut into smaller pieces and was then partially sun dried separately until all the moistures were removed from the sample. The dried samples were taken and ground into powder form using mixer grinder and was stored in separate containers. The dried form of powdered samples was carefully placed in -20°C freezer for longer storage and for further study.

2.2 Materials and methods

2.2.1 Materials

All laboratory glass wares and consumables including, water bath, oven, aluminum foil paper, mortar and pestle, analytical weighing balance, glass funnels, glass stirrers, spatulas, measuring cylinders of various sizes, beakers, conical flasks, glass cylinders, and test tubes.

2.2.2 Chemicals and Reagents

As analytical grade and laboratory grade chemicals such as methanol, distilled water, ferric chloride, sodium hydroxide, glacial acetic acid, hydrochloric acid, chloroform, and sulfuric acid were used for all experiments.

2.3 Extraction and Fractionation

The crushed and air-dried plant materials were extracted three times for twenty-four hours each using methanol 1:1 (v/v). Crude extracts were obtained by concentrating the extracts at 40°C using a rotary evaporator. A concentrator was then used to concentrate each fraction of the plant extracts [10-14].

2.4 Phytochemical Components Screening

In accordance with conventional procedures, the primary classes of chemicals such as tannins, saponins, flavonoids, alkaloids, phenols, glycosides, steroids, and terpenoids presence in the plant extracts were identified using confirmatory qualitative phytochemical screening based on the previous reports [11-13]

2.4.1. Analysis for Tannins

1 ml of the plant extract and 1 ml of distilled water were brought to a boil, and then 0.1% ferric chloride solution was added. The presence of Tannins are then confirmed to be present in the sample was analyzed, when a blue, black, or green color forms [10-14].

2.4.2. Analysis for Saponins

The presence of saponins were analyzed by taking about 0.5 mL of the extract and 5 mL of distilled water were combined and agitated in a vortex. Then, the solution turns into a foam formation, which indicated the presence of saponins [8, 10].

2.4.3. Analysis for Glycosides

About 0.5 mL of the plant extracts and 1mL of NaOH were added with distilled water. Then, the formation of yellowish-brown indicating the presence of Glycosides [8, 11-14].

2.4.4. Analysis for Cardiac Glycosides

The analysis of cardiac glycosides were identified by adding about 1 ml of the plant extract in 4ml of glacial acetic acid and followed by adding 3 drops of ferric chloride. Appearance of violet colour ring confims the presence of Cardiac Glycosides [9].

2.4.5. Analysis for Volatile Oils

The analysis of volatile oils confirmed by 5 drops of dil and 3 drops of 0.1% NaOH were mixed with around 1 ml of the plant extract. HCL. After giving it a good shake, the presence of volatile oils was detected by looking for white precipitation [9, 14].

2.4.6. Analysis for Terpenoids

The presence of terpenoids was determined by the production of colour formation in reddish-brown in the test which indicated the presence of terpenoids. This was identified by mixing of 0.5 mL of crude extract with 2 mL of chloroform and 3 mL of sulfuric acid solution [9].

2.4.7. Analysis for Steroids

1mL of crude plant extracts were added with 5mL of chloroform and 5mL of conc. Sulfuric Acid, which was allowed for incubation. The formation of red top layer and greenish bottom layer of the bilayer confirms the presence of steroids [9].

2.5. *Statistical Analysis*

All results were presented as means ± standard error mean (SEM) from triplicate experiments performed in a parallel manner. This study employed statistical analysis with unpaired testing for intergroup comparisons.

3. Result

Methanol extract of Jackfruit Kernel, Rind and Seed presented notable positive results for the phytochemical assays conducted (Table 1), showing remarkable colour changes. Tannins, Glycosides and Terpenoids were found in large quantity in the extract. Terpenoids were the highly exhibited class of compound in all the three extracts which was significant with the colouration released during the assay. Glycosides were the second most commonly found class in all three extract in which Seed extract showed the highest quantity followed my Rind and seed extracts, Seed extract showed higher content of tannins compared to rind extract and was absent in kernel extract.

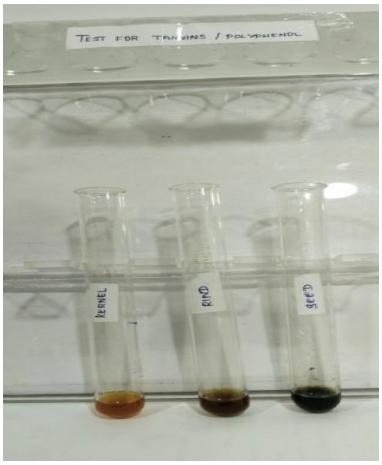

Fig.1. Analysis for Tannins on Methanol extract of Jackfruit Kernel, Rind and Seed samples

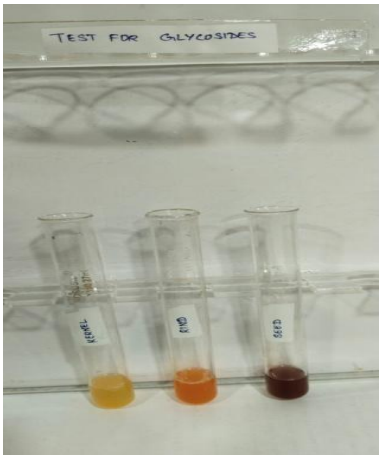

Fig.2. Test for Glycosides on Methanol Extract of Jackfruit Kernel, Rind and Seed samples

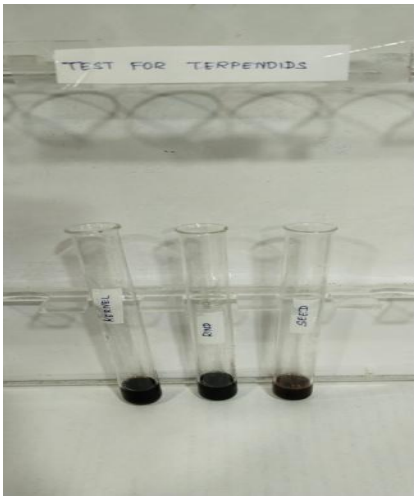

Fig.3. Analysis for Terpenoids on Methanol Extract of Jackfruit Kernel, Rind and Seed samples

Table 1: Phytochemical assay results for crude extract of Jackfruit Kernel, Rind and Seed sample

S. No.	Phytochemical assay	Plant extract		
		Kernel	Rind	Seed
1	Tannins	-	++	+++
2	Saponins	-	-	-
3	Glycosides	+	++	+++
4	Cardiac Glycosides	-	-	-
5	Volatile oil	-	-	-
6	Terpenoids	+++	+++	+++
7	Steroids	-	-	-

Note: (-) negative, (+) mildly positive, (++) moderately positive, (+++) highly positive are indicated with significant colour

4. Discussion

The current study investigated the qualitative phytochemical composition of extracts prepared in methanal of jackfruit kernel, rind, and seed. The obtained results clearly indicates that all three parts of the jackfruit possess distinct phytochemical profiles, with variations in intensity of the compounds. These differences in intensity is due to variation in tissue type. Terpenoids were found in larger quantities in almost all the Jackfruit extract. This suggest that jackfruit has high biological activities and through various reports these terpenoids exhibits antioxidant, anti-inflammatory, anticancer and antimicrobial properties.

Glycosides were the second highest biological compounds to be detected in all three extracts, in which highest contents were found in seed followed by rind and kernel extracts. The presence of glycosides are indicates for their diverse pharmacological activities, including cardioprotective, antimicrobial, and antioxidant effects. Tannins were present in moderate to high levels in the rind and seed extracts but were absent in the kernel extract. Tannins are polyphenolic compounds reported that known for their biological properties including antioxidant, anti-inflammatory and antimicrobial properties.

Saponins, cardiac glycosides, volatile oils, and steroids were not effectively detected in any of the methanolic extracts of jackfruit kernel, rind and seed samples in this study. Similar variations in phytochemical profiles depending on extraction methods and plant parts have been shown in earlier studies on *Artocarpus heterophyllus*. Overall, the qualitative phytochemical screening confirms that jackfruit rind and seed, often considered agro-waste, are rich sources of biologically active compounds, particularly terpenoids, glycosides, and tannins.

5. Conclusion

The current study shows that methanolic extracts of *Artocarpus heterophyllus* kernel, rind, and seed contain different phytochemical constituents, were terpenoids being present prominently in all the samples. Glycosides and tannins were mainly observed in the rind and seed extracts, indicating a higher concentration of bioactive compounds in these parts. Further studies are recommended to quantify these compounds and evaluate their biological activities. This results which can be used as a preliminary step for the further study of this extracts on different types of cancer cells to evaluate its anticancer properties which can be further developed to perform *in- vivo* study in the future research.

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