

Phytochemical, Nutritional, Laxative and Hypoglycemic Activity Evaluation of Seeds of Jackfruit (*Artocarpus heterophyllus* Lam)

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ABSTRACT

In the present work, we have investigated nutritional, phytochemical content, laxative and hypoglycemic activity of seeds of Jackfruit (*Artocarpus heterophyllus* Lam), one of the most ancient fruit in South East Asia, especially Vietnam. The spasmolytic, anti-cholinergic and laxative properties were evaluated using Phytochemical analysis. Secondary metabolites including alkaloids, saponins, flavonoids and phenolics content were determined in the Jackfruit seeds. Nutritional properties including moisture, fat, carbohydrate, protein, ash content and metal content in the seeds were estimated. Jackfruit seed produced hypoglycemic effects similar as taking Metformin (Glucophage), or Pioglitazone (Actose). Results indicated jackfruit seeds to be a good source of nutritional, laxative, and hypoglycemic activity and evaluate the potential of nutritional and therapeutic development.

INTRODUCTION

Plant products are considered to be the most important components of diet for good health. Fruits and vegetables have been shown to have nutritional and therapeutic effect. Phytochemical have been found to be responsible for such effects includes alkaloids, vitamins, mineral, and therapeutic effect. Phenolic compounds such as flavonoids and phenolic acids, especially saponins exhibit spasmolytic, anticholinergic, laxative effect. It also has nutritional content as well as hypoglycemic effect. Not even the fruit but the seeds also are considered to be containing large number of bioactive components which can have nutritional and therapeutic effect ^[1].

Jackfruit (*Artocarpus heterophyllus* Lam) belonging to family Moraceae is popular fruit crop that is widely grown in Vietnam and other tropical areas. Jackfruit appears in Vietnam in spring and is available till summer. The ripe fruit contains well flavored yellow sweet bulbs and seeds (embedded in the bulb). Seeds make up around 10% to 15% of total fruit weight. Seeds are normally discarded or steamed and eaten as a snack or used in some local dishes. Jackfruit seeds are less popular as vegetable and are eaten when boiled or roasted. The composition of jackfruit seeds has been reported and found to contain similar compositions as that of grains. The seeds are also rich sources of nutritional supplement such as protein, and good sources of fiber and vitamins.

This work investigated some physicochemical properties of jackfruit seed from a local jackfruit variety. This variety is of local origin rural area of Ho Chi Minh City, Vietnam and at Irvine, Orange County, California. In Orange, California we have evaluated the fiber, laxative properties of jackfruit seeds and found to show more than 87% contribution to spasmolytic, laxative, and fiber activity. In Vietnam, we have evaluated the hypoglycemic properties, similar effect of two anti-diabetic drug, Metformin (Glucophage) and Pioglitazone (Actose). Jackfruit seeds have been given to all diabetic patients at Nguyen Tri Phuong Hospital, HCM, Vietnam, both sample material/extraction, and compare the result with Metformin, Pioglitazone medication. These researches have been taken places in HCM, Vietnam and Orange, California, USA from December 2015 to August 2016 ^[2].

MATERIAL AND METHODS

Collection of Sample Material and Extraction

The raw jackfruit was collected from local market both in Ho Chi Minh City, Vietnam and also in orange county, California

were used for this study. The seeds (10 kgs) were cleaned and were peeled off. Seeds were then divided into 3 parts: one part for nutritional analysis, one part for laxative activity and last part for hypoglycemic activity. Crushed jackfruit seed were extracted into solvent systems: dichloromethane: methanol (1:1) and acetone. Solvent were evaporated under vacuum and resulting extracts were stored at 4 °C [3] (Figure 1).



Figure 1. Jack fruit.

Determination of Nutritional Attributes

Proximal analysis

Jackfruit seeds were dried in an oven at 105 °C overnight for 18 hours to obtain moisture content by weighing the samples before and after drying, the ash content was also analyzed. The macro Kjeldhal method was used for estimation of total nitrogen and crude protein content. The fat content of the seeds was determined by Soxhlet extraction, using petroleum ether as a solvent. Total carbohydrate was estimated using the formula: Total carbohydrates (%fresh weight) =100-moisture %- protein content (% fresh weight)-crude fat (%fresh weight)-ash (%fresh weight) (Table 1).

Table 1. Proximate composition of Jackfruit seeds.

Ash	Moisture	Crude fat	Total protein	Total carbohydrate
0.15 ± 0.01	61.8 ± 0.09	1 ± 0.006	11.85 ± 0.45	26.20 ± 0.56

Data are mean ± SD values of triplicate determinations. Concentrations are measured on dry weight basis (g/100 g)

Determination of Laxative Properties

Mineral analysis

The mineral components of the jackfruit seeds were analyzed by inductively coupled plasma optical emission spectrometry (ICP-OES). 1 gram of crushed jackfruit seeds were digested by 5 ml of concentrated nitric acidic microwave. After digestion, the sample was cooled and volume made up to 25 ml with double distilled water. Set plasma conditions for analysis were: Argon on 160/min, auxiliary 0.22/min, nebulizer flow at 0.9/min, RF power on 1300 W and chiller at 15 °C. Setoff the standards were run and then samples were analyzed against the standard. ICP-OES studies demonstrated jackfruit seeds to be highly rich in K (potassium), followed by Mg (Magnesium), calcium and sodium (Table 2). K and Mg are the main elements make fiber so rich hence enrich the property of laxative [4-6].

Table 2. Mineral related to laxative/fiber activity of Jackfruit seeds.

Analyze	Concentration
K	790 ± 1.4
Mg	709 ± 0.55
Calcium	29.5 ± 0.32
Na	27.43 ± 0.23
Ba	0.282 ± 0.34
Zn	2.273 ± 0.45
Cr	0.023 ± 0.03

Data are mean ± SD values of triplicate determinations. Concentrations are measured on dry weigh basis (ppm).

Phytochemical analysis

The phytochemical content of jackfruit seeds was analyzed and high quantity of saponins (6.40 ± 0.098 gram/100 gram) was found. Saponins have been known for their medicinal uses, including antispasmodic activity. Some alkaloids function as spasmolytic, anticholinergic. The alkaloid content in jackfruit seeds was found to be 1.18 ± 0.09 gram/100 gram. Also, some flavonoids prevent platelet stickiness and hence platelet aggregation. Colorimetric study of two extract of jackfruit seeds showed that dichloromethane: methanol (1:1) solvent system was able to extract more phytochemical in comparison to acetone (Table 3).

Table 3. Total phenolic (saponins) and total flavonoid content of extracts of jackfruit seeds

Jackfruit seed extracts	Total phenolic content (mcg GAE/mg extract)	Total flavonoid content (mcg RE/mg extract)
Acetone	1.18 ± 0.09	291.7 ± 2.414
Dichloromethane: Methanol (1:1)	2.14 ± 0.009	460.2 ± 5.97

Data are mean ± values of triplicate determinations. GAE, Gallic acid equivalent, RE, Rutin equivalent. Mean values within each column followed by different letters are significantly different at p value <0.05.

Cross sectional study

All jackfruit seeds have been given to 527 patients with constipation, spasmodic, abdominal pain patients in Orange County, California. All seeds have been boiled and left on refrigerator with appropriate degree storage as guide. 5 boiled Jackfruit seeds were given to all GI patients who had chronic constipation history, spasmodic experience, or abdominal pain. All 5 boiled jackfruit seeds were given to patients before the appointment date, and all 5 boiled jackfruit seeds were taken 1 hour before appointment time. Signs of symptoms after taking of jackfruit seeds have been written as the mandatory survey sheet with all the check lists included: wanted to go to restroom, bloating, flatulence, feeling relieve after taking the jackfruit seeds. Data have been collected and analyzed as percentage (Table 4) [7,8].

Table 4. Signs and symptoms of ingestion Jackfruit Seed for laxative.

Bloating (80%)	Gas (98%)	Contraction of intestinal Muscle (95%)	Increased Thirsty (75%)	Wanting go to restroom (89%)	Nausea (2%)
Vomiting (0.02%)	Diarrhea (76%)	Constipation (1%)	Blood diarrhea (0.03%)	Headache (0.01%)	Dizziness (0.001%)

Determination of Hypoglycemic Properties

Cross sectional study

All Jackfruit seeds have been given to 1027 patients with DM type2 patient age ranges from 19 to 82 years, male and female ratio mixed, education randomly from high school graduate to college professional level in Ho Chi Minh University of Medicine/ Pharmacy at Endocrine Department, Nguyen Tri Phuong Hospital, HCM, Vietnam and at local medical office of Dr. Chi-Thanh Le Nguyen. 10 boiled jackfruit seeds were given to all DM type 2 patients, signs, and symptoms of hypoglycemic have been recorded after 1 hour, 1.5 hour ingested of jackfruit seeds. All DM type 2 patients' age range from 19 to 82 years old, both male and female mixed with education randomly from high school graduated to college professional level. Signs of symptoms after Jackfruit seeds have been written as the mandatory survey sheet with the all the check list based on designated organs: Whole body: excess sweating, excessive hunger, fainting, fatigue, lightheadedness, or shakiness. Gastrointestinal: nausea or vomiting, Cognitive: mental confusion or unresponsiveness Mouth: dryness or tingling lips. Also, common: anxiety, blurred vision, headache, irritability, pallor, sensation of an abnormal heartbeat, sensation of pins and needles, sleepiness, slurred speech, tremor, or unsteadiness. After that we compare signs and symptoms after ingestion of Jackfruit seeds with taking Motorman (Glucophage) and Pioglitazone (Actose) (Table 5) [9].

Table 5. Signs and symptoms of hypoglycemic after ingestion of Jackfruit seed.

Excess sweating (90%)	Excess hunger (72%)	Light-headacheness (0.01%)	Nausea and Vomiting (0.03%)	Mouth dryness (56%)	Sensation of tingling (65%)
Sleepiness (80%)	Slurred speech (5%)	Tremor (85%)	Fatigue (3%)	Irritability (2.5%)	Anxiety (0.05%)

RESULTS AND DISCUSSION

Determination of Nutritional Attributes

Nutritional studies have demonstrated potential benefits of Jackfruit seeds. Moisture content and dry matter analysis during nutrition reporting is very important because it directly affects its nutritional content, its stability and storage. Proximal values were calculated and depicted in the Table 1. Jackfruit seeds were found to be rich in proteins and carbohydrates, crude fat and ash content were found to be very low (Table 1). Total N values number of patients=1027 [10].

Determination of Laxative Properties

ICP-OES studies demonstrated jackfruit seeds to be highly rich in K, and Magnesium are the main elements make fiber so rich hence enrich the property of laxatives (Table 2). Total N number of patients=527.

Phytochemical Analysis with high quantity of saponins (90% of total phenolic content) has been known to have medicinal uses, including antispasmodic activity, anticholinergic. Also, jackfruit seeds also contain flavonoid, which prevent platelet stickiness and hence platelet aggregation. Colorimetric study of the two extracts of jackfruit seeds showed that Dichloromethane: Methanol (1:1) solvent system was able to extract more phytochemical in comparison in comparison to acetone (**Table 3**). Total N values number of patients=527.

Cross sectional study for signs and symptoms of relieving for constipation have been documented for all patients taking 5 boiled jackfruit seeds in Orange County, California by percentage (**Table 4**). Total N values number of patients=527^[11].

Determination of Hypoglycemic Properties

Cross sectional study for signs and symptoms of hypoglycemic after taking 10 boiled jackfruit seeds in Ho Chi Minh City Vietnam have been documented by percentage (**Table 5**). Total N values number of patients=1027.

Also, see how low of blood sugar compare b/w taking jackfruit seeds and Metformin (Glucophage), and Pioglitazone (Actose) after 1 and 1.5 hour ingested of jackfruit seeds (**Figure 2**).

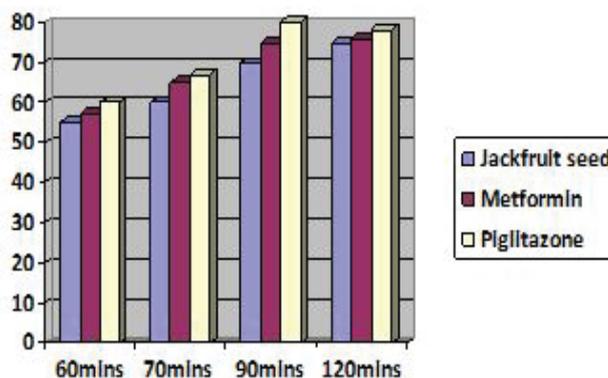


Figure 2. Level of blood sugar while ingested jackfruit seed vs Metformin (Glucophage)/Pioglitazone (Actose).

CONCLUSION

Jackfruit seeds were found to be rich in proteins, carbohydrates and mineral with moderate amount of phytochemicals and strong laxative, hypoglycemic properties. The results of different *in vivo* laxative and hypoglycemic activity indicate its need for therapeutic advantage.

Thus, jackfruit seeds could be used in balanced diets and functional foods which can be consumed safely without any concern of health risk. This study helps in promoting increased consumption of jackfruit seeds by general public and offer opportunity to develop the valued added for nutritional, laxative, and anti-diabetic effects from them.

Physicians were in Nguyen Tri Phuong Hospital, and University of California at Irvine both agreed that research was backed up with blood glucose values.

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