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CHEMICAL CONSTITUENTS, PHYTONUTRIENTS, PHARMACOLOGICAL ACTIVITIES AND HEALTH BENEFIT OF JACK FRUIT: A REVIEW

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ABSTRACT

Jackfruit (*Artocarpus heterophyllus*) belongs to the Moraceae family, native to India and seen abundant in Western Ghats, a biodiversity spot of India. Jackfruit grow as an evergreen tree that has a relatively short trunk with a dense treetop. It easily reaches heights of 10 to 20m (33 to 66 feet) and trunk diameters of 30 to 80cm (12 to 31 inches). There are two varieties of jackfruit in India: one is small, fibrous, soft and mushy, with sweet carpels and a texture like that of raw oysters and is called Barka, and the other variety is crisp and crunchy, but not very sweet and is called Kapa. Jackfruit is a monecious plant, depending on the soil and climate, pollinated blossoms can take several months to mature into ripe fruit. The jackfruit seed starch as super disintegrant is suitable for the preparation of fast-dissolving tablets. Jackfruit contain high amount of vitamins and minerals**.** The fruit is rich in carotene and carbohydrates and moderately rich in ascorbic acid. Jackfruit also contains minerals like calcium and potassium and Vitamin B complex group like thiamin, riboflavin and Niacin and Jackfruit is a tropical tree, which has numerous health benefits of jackfruit including anti-carcinogenic, anti-microbial, anti-fungal, anti-inflammatory, healing.

KEYWORDS

Jackfruit, Taxonomy, Morphology, Phytonutrients and Pharmacological activity.

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INTRODUCTION

Jackfruit (*Artocarpus heterophyllus*) belongs to the Moraceae family, native to India and seen abundant in Western Ghats, a biodiversity spot of India[1-5]. Besides India, jackfruit is commonly grown in home gardens of tropical and subtropical countries especially in Sri Lanka, Bangladesh, Burma, Philippines, Indonesia, Thailand, Malaysia and Brazil[6-10]. In India, it is widely distributed in the states of Assam, West Bengal, Uttar Pradesh,

Maharashtra, Kerala, Tamil Nadu, and Karna taka[11] and considered to be the "poor man's food"[12]. It is a medium-size tree typically reaching 28-80ft. in height that is easily accessible for its fruit. The fruit is borne on side branches and main branches of the tree. The average weight of a fruit is 3.5-10kg and sometimes a fruit may reach up to 25kg. The ripe jackfruits consisted 29% pulp, 12% seeds, and 54% rind. Figure No.1 shows the various parts of a jackfruit. The jackfruit seed is 2-3cm long and 1-2cm in diameter and each fruit contains 100-500 seeds.

There are two varieties of jackfruit in India: one is small, fibrous, soft and mushy, with sweet carpels and a texture like that of raw oysters, and is called Barka, and the other variety is crisp and crunchy, but not very sweet, and is called Kapa[13]. In Bangladesh, Khaja, Gala and Durasha are the main varieties. Khaja is characterized by its hard and crispy bulb; Gala is soft and juicy and mostly melting bulb. On the other hand, Durasha is an intermediate between Khaja and Gala[14]. Jackfruit is reported to possess many medicinal properties. The phenolic com pounds isolated from jackfruit are reported to exhibit anti-inflammatory effect. The prenylflavonoids present in jackfruit had shown strong antioxidant properties[15] and is expected to act against lipid peroxidation of biological membranes[16]. The hot water extract of mature leaves are utilized in Ayurvedic treatment for hyperglycemia and diabetes. The flavonoids present in the extract have been identified to be responsible for the nontoxic hypoglycemic action[17]. Lectins present in the seeds have shown antifungal properties, while the crude methanolic extracts from root bark and stems have shown broad-spectrum antibacterial activity[18].

Resveratrol (trans-3, 5, 4-trihydroxystilbene, RES) is one of the polyphenols naturally present in jackfruit[19] and is well-known for its health-promoting activities of antioxidant, cardio protect, and anti-inflammatory[20]. Compounds that can inhibit angiogenesis have great potential for cancer treatment[21]. Jackfruit seeds contain secondary metabolites that display anticancer effects, especially anti-angiogenesis and belong to the flavonoid group[22]. The jackfruit seed starch as super disintegrant is suitable for the preparation of fast-dissolving tablets[23]. Extracts of jackfruit pulp show considerable anti-inflammatory activity by suppressing the production of nitric oxide (NO) and prostaglandin E2 (PGE2)[24], its leaf extracts also give remarkable antioxidant activity and exhibit attenuation on hyperglycemia and hyperlipidemia[25]. Its wood was reported to be used as antioxidant, antiaging, anti-inflammatory and skin care agents[26]. The leaf, root, bark and fresh fruit of this plant have been certified to contain various compounds like flavonoids, phenolic acids, organic acids, carotenoids, stilbenes, triterpenes, and sterols, especially prenylflavonoids[27,28]. Jackfruit is also used for further processing. For instance, jackfruit leather and jackfruit chips can be made from dried jackfruit pulp[29]. Pureed jackfruit is also manufactured into baby food, juice, jam, jelly, and base for cordials[30]. Jackfruits are made into candies, fruit-rolls, marmalades, and ice cream[31]. Other than canning, advances in processing technologies too have pushed toward more new products[32]. Freeze-dried, vacuum-fried and cryogenic processing are new preservation methods for modern jackfruit-based products. Various parts of the jackfruit tree have been used in medicine and its wood is an important source in timber industries[33]. Nowadays, it is widely accepted that the beneficial health effects of fruits and vegetables in the prevention of disease are due to the bioactive compounds they contain. In recent years, there has seen increased interest on the part of consumers, researchers, and the food industries into how food products can help maintain health and the role that diet plays in the prevention and treatment of many illnesses has become widely accepted. This chapter describes an overview of the biodiversity of the tree and functional, medicinal, nutritional and health aspects of jackfruit and its various parts.

Botanical Description and Heterogenicity

Jackfruit is a monecious plant, depending on the soil and climate, pollinated blossoms can take several months to mature into ripe fruit[34,35]. The

bottom soft edible section of the jackfruit is called the bulb, followed by the middle-fused area, known as the syncarp and the outer as the spiny region (spike)[4]. When mature, the fruit's flesh becomes soft and golden and the outside spines spread[36]. The axis and prickly outer bark, however, are not edible[37]. The phonotypical and organoleptic features, which include variations in bulb color, size, shape, odor, flake size, flake color and time of maturation, were used to categorize the jackfruits[38,39]. The majority of jackfruit, which may be found in a variety of habitats and niches, is breadfruit[40,41]. There are two recognized ecotypes with differing flake features, one with hard carpels and the other with soft, spongy carpels[42-46].

Synonyms

Artocarpus brasiliensis Gomez., Artocarpus heterophylla Lam., Artocarpus maxima Blanco, Artocarpus philippinensis Lam., Polyphema jaca Lour., Soccus arboreus major Rumph., Artocarpus integra (Thunb.), Artocarpus integrifolia L.f., Artocarpus integrifolius auct., Artocarpus integer auct[48].

Morphology of Jackfruit

Size and Shape

Jackfruit grow as an evergreen tree that has a relatively short trunk with a dense treetop. It easily reaches heights of 10 to 20m (33 to 66 feet) and trunk diameters of 30 to 80cm (12 to 31 inches). The canopy shape is usually conical or pyramidal in young trees and becomes spreading and domed in older trees. It sometimes forms buttress roots. The bark of the jackfruit tree is reddish brown and smooth. In the event of injury to the bark, a milky juice is released. In young trees, the leaf edges are irregularly lobed or split. The tree casts a very dense shade. Heavy side branching usually begins near the ground. All parts of the tree exude sticky white latex when injured.

Flowers

This species is monoecious, having male and female inflorescences (or "spikes") on the same tree. The flowers are small, sitting on a fleshy rachis. Male and female spikes are borne separately on short, stout stems that sprout from older branches and the trunk. The male flowers are greenish, some flowers are sterile (Figure No.1). Male spikes are found on younger branches above female spikes. Male spikes are dense, fleshy, cylindrical to club shaped and up to 10cm (4 in) in length. Flowers are tiny, pale green when young, turning darker with age. The male flowers are less and small hairy and the perianth ends with two 1 to 1.5mm (3⁄64 to 1⁄16 in) membrane. After the pollen distribution, the stamens become ash-gray and fall off after a few days. Female flowers are larger, elliptic or rounded, tubular calyx, with hairy and tubular perianth, have a fleshy flower-like base. The female flowers contain an ovary with a broad, capitate or rarely bilobed scar. The flowers are reportedly pollinated by insects and wind, with a high percentage of crosspollination. The blooming time ranges from December until February or March[49].

Fruit

The inflorescences are formed on the trunk, branches or twigs (cauliflory). Jackfruit trees are monoecious, having both female and male flowers on a tree. Fruit of jackfruit has a compound or multiple fruit with a green to yellow brown exterior rind that is composed of hexagonal, bluntly conical carpel apices that cover a thick, rubbery, whitish to yellowish wall (Figure No.1). The ellipsoidal to roundish fruit is a multiple fruit formed from the fusion of the ovaries of multiple flowers. The fruits grow on a long and thick stem on the trunk. The heavy fruit is held together by a central fibrous core. They vary in size and ripen from an initially yellowish-green to yellow, and then at maturity to yellowish-brown. They possess a hard, gummy shell with small pimples surrounded with hard, hexagonal tubercles. The large and variously shaped fruit have a length of 30 to 100cm (10 to 40 inches) and a diameter of 15 to 50cm (6 to 20 inches) and can weigh 10-25kg (22-55 pounds) or more[50].

Leaves

Leaves are dark green, alternate, entire, simple, glossy, leathery, stiff, large (up to 16cm [6 in] in length), and elliptic to oval in form. The leaves are alternate and spirally arranged (Figure No.3). They are gummy and thick and are divided into a petiole

and a leaf blade. On older trees, the leaves are rounded and dark green, with a smooth leaf margin. The petiole is 2.5 to 7.5cm (1 to 3 inches) long. The leathery leaf blade is 20 to 40cm (7 to 15 inches) long and 7.5 to 18cm (3 to 7 inches) wide and is oblong to ovate in shape. Leaves are often deeply lobed when juvenile and on young shoots.

Seeds

Seeds are light brown, rounded, 2-3cm (0.8-1.2 in) in length by 1-1.5cm (0.4-0.6 in) in diameter, and enclosed in a thin, whitish membrane. There may be about 100-500 seeds per fruit (Figure No.4). Seeds are recalcitrant and can be stored up to a month in cool and humid conditions. The seed coat consists of a thin, waxy, parchment-like and easily removable testa (husk) and a brownish, membranous tegmen. The cotyledons are usually unequal in size, and the endosperm is minimally present. An average fruit consists of 27% edible seed coat, 15% edible seeds, 20% white pulp (undeveloped perianth, rags), bark and 10% core.

History and Distribution

Historical reports suggest that jackfruit tree is supposed to have originated in the rain forests of the Western Ghats in the Southwestern part of India. However, with time, the trees have been introduced to other parts of India and tropical regions of the world. Today, the trees are found widely growing in Bangladesh, Malaysia, Burma, Sri Lanka, Indonesia, Philippines, in the Caribbean islands, in the evergreen forest zone of West Africa, in northern Australia, in parts of USA (Florida and California), Brazil, Puerto Rico, Pacific Islands Palau, Yap, Pohnpei, Nauru, Tabiteuea in Kiribati, Samoa, and other islands[51].

The jackfruit has innumerable types in the Western Ghats with varying fruit characteristics. The types differ among themselves in the shape and density of spikes on the rind, bearing, size, shape, latex, flake size, flake color, quality, and period of maturity. Innumerable variations in bulb sweetness, acidity, flavor and taste are observed in jackfruit growing areas. Such a wide diversity among jackfruit types in Western Ghats offers tremendous scope for improvement of this crop by selection[52,53]. Due to crosspollination and predominance of seed propagation over a long period of time, there is high degree of variability within the species.

Cultivation and Collection

Jack tree is a medium-sized ever green tree, and typically reaches 8-25m in height[4]. The tree grows rapidly in early years, up to 1.5m/year (5 ft/year) in height, slowing to about 0.5m/year (20 in/year) as the tree reaches maturity[54]. It has a straight rough stem and a green or black bark which has a thickness of around 1.25cm, exuding milky latex[55]. The leaves are broad, elliptic, dark green in colour and alternate. They are often deeply lobed when juvenile on young shoots. Male heads are usually sessile or on short peduncles receptacles and sometimes born on the ultimate twing, while female heads are oblong ovoid receptacle[56]. Jackfruit has a relatively high productivity, about 25.71 t/ha[57]. The fruits are borne in the main and side branches of the tree[58]. A mature jack tree can yield from ten to two hundred fruits[59-62]. They are dicotyledonous compound fruits[52], which are oblong cylindrical in shape and the length of the fruit's ranges from 22 to 90 centimeters with the diameter 13-50 centimeters. The weight of individual fruits may vary between 2 and 20 kilo grams and larger fruits of about 50 kilograms have been recorded[63,64]. Jackfruit has a green to yellow brown exterior rind that is composed of hexagonal, bluntly conical carpel apices that cover a thick, rubbery and whitish to yellowish wall. It is a multiple aggregate fruit which is formed by the fusion of multiple flowers in an inflorescence. About 30% of the fruit weight is occupied by the flesh[65,66]. There are large number of bulbs inside the fruit, which have high nutritional value.

Chemical constituents

Jackfruit contain high amount of vitamins and minerals**.** The fruit is rich in carotene and carbohydrates and moderately rich in ascorbic acid[67]. Jackfruit also contains minerals like calcium and potassium and Vitamin B complex group like thiamin, riboflavin and Niacin and. The seeds of jackfruit are reported to be more nutritious than its bulb. Seeds are rich in protein, carbohydrate fat,

potassium and with fair amount of phosphorus and calcium[68]. Jackfruits are a good source of vitamin C. According to United State of Agriculture Department report (2016) Jackfruit has the unique nutritional values (Table No.2).

Phytonutrients and Their Health Benefit

The phytonutrients can prevent the formation of cancer cells in the body, can lower blood pressure, can fight against stomach ulcers and can slow down the degeneration of cells that make the skin look young and vital[69]. The phytonutrients present in jackfruit are presented in (Table No.3).

Pharmacological Activities

Jackfruit is a tropical tree, which has numerous health benefits of jackfruit including anti-carcinogenic, anti-microbial, anti-fungal, anti-inflammatory, healing[70].

Anticancer

The recent studies show all phytonutrients in jackfruit bulb shave anticancer benefits. The main role of these nutrients is to help prevent the harmful free radicals that have been known to develop cancer and many other chronic diseases. The phytonutrients prevent the very initial stage of cancer cell formation. Saponins are also strong anticancer agents. According to a study, saponins show colon cancer preventative properties. These phytonutrients have been found to induce mitotic arrest in the case of leukemia cells. The study also found that it helped in some cases to cause remission. Saponins were found to react to the outer layers of cancer cells. They bound the cells and prevented their further growth[71].

Anti-Diabetics

Diabetes mellitus is a metabolic disorder characterized by hyperglycemia resulting from defects in insulin action, insulin secretion, or both. The most common type of diabetes mellitus is type 2 diabetes mellitus, which accounts for 85-95% of all cases and constitutes a major public health problem[72]. Hot water extract of mature jack leaves is recommended by Ayurvedic and traditional medical practitioners as a treatment for diabetes mellitus (Fernando *et al*, 1991[73]. It is already indicated that an extract of jackfruit improves the glucose tolerance in normal human subjects and diabetic patients[74]. The leaves and stem show the presence of sapogenins, cycloartenone, ß-sitosterol and tannins[75]. Jackfruit contains vitamin A, vitamin C, thiamin, riboflavin, niacin, calcium, potassium, iron, manganese and magnesium among many other nutrients. It is good for diabetes as they improve insulin resistance.

Anti-Atherosclerosis Activity

High blood total cholesterol and LDL-C levels have been linked to an increased risk of cardiovascular disease and have been linked to atherosclerosis, according to epidemiological research. A number of inflammatory and oxidative changes inside the artery wall contribute to atherosclerosis, a serious degenerative disease of the arteries[76]. Nitric oxide levels drop as a result of oxidative excess in the vasculature, which also damages tissue and DNA and causes protein oxidation, while also triggering pro-inflammatory reactions[77]. Jackfruit (Parkinson) Fosberg extracts in various solvents were tested for their cytoprotective properties. Using the 4-[3-[4-iodophenyl]-2-[4-nitrophenyl]-2H-5-tetrazolio]-1, 3-benzene Di sulfonate [WST-1] test, the cytoprotective effects were assessed in human U937 cells exposed to oxoxidized DL (OxLDL). The outcomes indicated the cytoprotective properties of the ethyl acetate extract. The cytoprotective action provides promising opportunities for the therapeutic uses of *Artocarpus altilis*[78].

Antiviral Activity

The heartwood of the jackfruit, which has a high concentration of oxyresveratrol, could serve as a source of raw materials for the creation of a novel natural product with anti-HSV and anti-HIV properties[79]. When used at a concentration of 10g/mL, the methanolic extract of *Artocarpus gomezianus* heartwood inhibited HSV-1 and HSV-2 by 90% and 80%, respectively. Along with the known substances cycloartocarpin, isocyclomorusin, artocarpin, norcycloartocarpin, norartocarpetin and oxyresveratrol, a novel chemical called artogomezianone was also recovered during the separation process. The inactivation technique was used to assess these

isolates for inhibitory activities against herpes simplex virus (HSV) types 1 and 2. In the same test, acyclovir (ACV) served as the positive control. The compounds cycloartocarpin, isocyclomorusin, norartocarpetin and oxyresveratrol showed modest activity against both types of HSV[80].

Antiplatelet Activity

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

Antidiarrheal Activity

In vitro studies of certain medicinal plants, including jackfruit, used to treat diarrhea in Brazil were conducted by Goncalves *et al*, in 2005[81]. Both viruses were susceptible to the antiviral effects of jackfruit bark extracts [480g/mL]. For human rotavirus and simian rotavirus, respectively, they demonstrated 99.2% and 96.4% inhibition. As a result, if rotavirus is the cause of diarrhea in humans, *Artocarpus integrifolia* extracts may be effective in treating the condition.

Dental Problems

Both the tree's trunk and its fruit, the jackfruit, are coated with latex or resin. White, sticky latex generated by unique secretory cells known as laticifers is present in all regions of the jackfruit tree. An aqueous emulsion known as latex contains a variety of substances, including lipids, proteins, carbohydrates, rubbers, resins and proteolytic enzymes[82]. The emulsion uproots of this woody plant have antibacterial and antifungal properties due to consist a high amount of flavonoids and alkaloids[83] and they found that they performed rather well and much better than typical antibacterial and antifungal medications. In terms of cost-effectiveness, they concluded that the information provided regarding the many significant applications of this woody plant emulsion can be used in dental problems such as preparing affusion solution and another type of upcoming dental impletion substance.

Others Activity

All the parts of the jackfruit tree are used as a traditional medicine to treat malarial fever, kidney stones, infected wounds, diarrhea, asthma, dermatitis and its seeds are used to heal sexual disorders due to its aphrodisiac properties[84-87]. Because of hypoglycemic and hypolipidemic chemicals in jackfruit leaves, they can help people with diabetes[88]. Artosterone from latex combined with vinegar promotes glandular swelling and snake bite recovery[89]. Root extract is a therapy for asthma and skin disorders and root extract has soothing properties that may promote abortion cure, diarrhea and fever. Seeds contain lectin (Jaclin), which assesses an HIV positive person's immune system[90]. In Sri Lanka, the formulation of sausages together with jackfruit and different spices maintain the powerful immune boosting ability[91]. However, traditionally jackfruit plants are used to treat various diseases (inflammation, malarial fever, diarrhea, diabetes and tapeworm infection) as they contain various constituents such as protein, jacalin, flavonoids, stilbenoids, coloring matters, morin, dihydromorin, cynomacurin, artocarpin, isoartocarpin, carotene, essential amino acids. Artocarpus (from leaves, bark, stem) and several bioactive compounds (from fruit) are used in various biological activities, including anti-bacterial, anti-tubercular, anti-viral, anti-fungal, anti-platelet, anti-arthritic, tyrosinase inhibitory and cytotoxicity[92].

Taxonomical Classification[47]

Table No.1: Taxonomical Classification of Jackfruit

Kingdom	Plantae-- planta, plantes, plants, vegetal
Subkingdom	Tracheobionta -- vascular plants
Division	Magnoliophyta -- angiosperms, flowering plants, phanérogames
Class	Magnoliopsida -- dicots, dicotylédones, dicotyledons
Subclass	Hamamelidae
Order	Urticales
Family	Moraceae-mulberries
Genus	Artocarpus-bread fruit
Species	*Artocarpus heterophyllus Lam.*

Table No.2: Nutritional Profile of Jackfruit (100gm Edible Portion)

S.No	Composition	Young Fruit	Ripe Fruit	Seed
Proximate Analysis				
1	Water (g)	76.2-85.2	72.0-94.0	51.0-64.5
2	Protein (g)	2.0-2.6	1.2-1.9	6.6-7.04
3	Fat (g)	0.1-0.6	0.1-0.4	0.40-0.43
4	Carbohydrate (g)	9.4-11.5	16.0-25.4	25.8-38.4
5	Fibre (g)	2.6-3.6	1.0-1.5	1.0-1.5
6	Total Sugar (g)	20.6		
Minerals				
7	Total Minerals (mg)	0.9	0.87-0.9	0.9-1.2
8	Calcium (mg)	30.0-73.2	20.0-37.0	50.0
9	Magnessium (mg)		27.0	54.0
10	Phosphorus (mg)	20.0-57.2	38.0-41.0	38.0-97.0
11	Potassium (mg)	287-323	191-407	246
12	Sodium (mg)	3.0-35.0	2.0-41.0	63.2
13	Iron (mg)	0.4-1.9	0.5-1.1	1.5
Vitamins				
14	Vitamin A (IU)	30	175-540	10-17
15	Thiamine (mg)	0.05-0.15	0.03-0.09	0.25
16	Riboflavin (mg)	0.05-0.2	0.05-0.4	0.11-0.3
17	Vitamin C (mg)	12-14	7.0-10.0	11.0

Table No.3: Phytonutrients in Different Parts of Jackfruit

S.No	Phytonutrients	Phytochemicals	Plant Part
1	Carbohydrate	Starch, Sugar, Dietary Fiber	Fruit, Seed
2	Protein	Arginine, Cystine, Histidine, Leucine, Lysine, Methionine, Tryptophan	Fruit, Seed
3	Mineral	Calcium, Magnessium, Potassium, Sodium, Iron, Phosphorus	Fruit, Seed
4	Vitamins	Vitamin A, Vitamin C, Vitamin E, Thiamine, Ribofalvin	Fruit
	Fatty Acids	Capric, Myristic, Lauric, Palmitic, Oleic, Stearic	Fruit
6	Organic Acid	Acid-Malic Acid, Citric Acid	Fruit
7	Carotenoids	2-Carotene, 1-Carotene, 1-Zeacarotene, Dicarboxilic Carotenoid	Fruit
8	Flavonoids	Artocarpetin, Artonins A, Morin, Artocarpanone, Artocarpesin	Fruit
9	Lectin	Jacalin	Seed
10	Volatiles	Isopentylisovalereate, Butylisovalearte, Butylacatate	Fruit, Seed
11	Tannins	-	Stem, Leaf

Figure No.1: Jackfruit Tree

Figure No.2: Jackfruit

Figure No.3: Leaves of Jackfruit

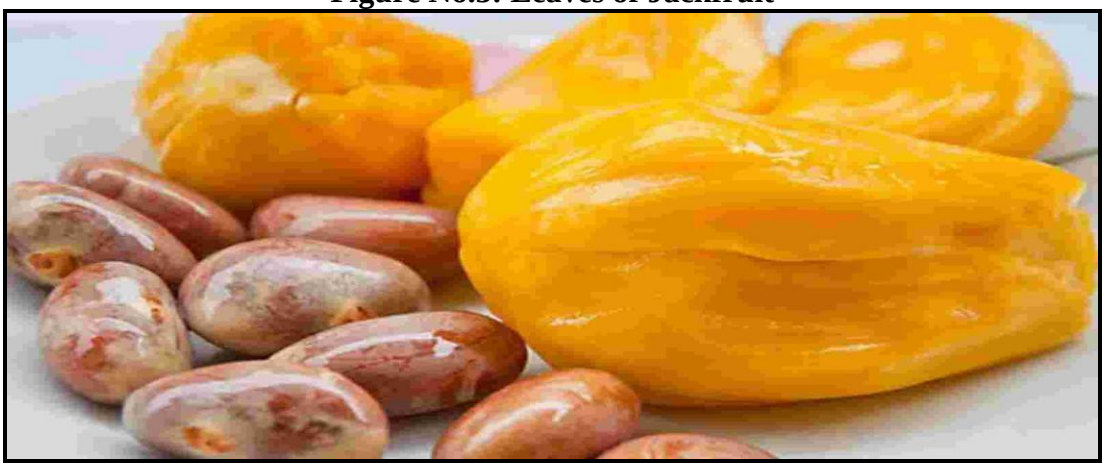

Figure No.4: Seeds of Jackfruit

CONCLUSION

Jackfruit is reported to possess many medicinal properties. The phenolic com pounds isolated from jackfruit are reported to exhibit anti-inflammatory effect. The prenylflavonoids present in jackfruit had shown strong antioxidant properties and is expected to act against lipid peroxidation of biological membranes. The hot water extract of mature leaves are utilized in Ayurvedic treatment for hyperglycemia and diabetes. The flavonoids present in the extract have been identified to be responsible for the nontoxic hypoglycemic action. Lectins present in the seeds have shown antifungal properties, while the crude methanolic extracts from root bark and stems have shown broad-spectrum antibacterial activity. Jackfruit contain high amount of vitamins and minerals. The fruit is rich in carotene and carbohydrates and moderately rich in ascorbic acid. Jackfruit also contains minerals like calcium and potassium and Vitamin B complex group like thiamin, riboflavin and Niacin and. The seeds of jackfruit are reported to be more nutritious than its bulb.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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