IJP (2016), Vol. 3, Issue 9 **(Research Article)**

Received on 08 August 2016; received in revised form, 06 September 2016; accepted, 26 September 2016; published 30 September 2016

PHARMACOGNOSTICAL STUDIES ON MEDICINAL AND NUTRITIONAL SEEDS OF JACK FRUIT: *ARTOCARPUS HETEROPHYLLUS* LAM.

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Keywords:

Seeds, Pharmacognosy, Chemical analysis, *Artocarpus Heterophyllus*, Jack fruit

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ABSTRACT: In the present day world the consumption of fruits, vegetables and natural diet for the prevention of certain diseases, in addition to their nutritional benefits is increased. Jack fruit is well known for its nutritional and therapeutic qualities for many years. The present communication deals on the macroscopical, microscopical, powder microscopical studies along with the preliminary phytochemical studies on the seeds of *Artocarpus heterophyllus* Lam. belonging to the family Moraceae. The study revealed the presence of abundant simple to compound starch grains and oil globules in the cotyledon region; powder study revealed the presence of abundant starch grains, spiral to helical xylem vessels, stone cells with broad lumen with the highly lignified wall, orange colored cork cells in surface view. Phytochemical studies revealed the presence of carbohydrates, proteins, starch, flavonoids, saponins, phenols and alkaloids. Seeds are rich in protein, highly nutritious and have numerous culinary uses; starchy flour is also made out of seeds.

INTRODUCTION: *Artocarpus heterophyllus* Lam., commonly known as 'Jack fruit' which is a large monoecious evergreen tree, native to Western Ghats of India and rainforests of Malaysia. Typically it attains a height of 18-25 m, and stem diameter of 30-80 cm. Bark mottled with green, rough with warty excrescences, heartwood bright yellow, sapwood pale, leaves simple, alternate, coriaceous, entire, dark shiny, green above penninerved, lateral nerves 7-8 pairs, stipules sheathing, leaving a scar on falling.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.IJP.3(9).384-91

Article can be accessed online on: www.ijpjournal.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.3(9).384-91

Male flowers crowned on cylindrical receptacles, female flowers crowded on globose receptacles, both cauliflorous, fruits multiple, large, fleshy globose or oblong covered with tubercles. The fruit has a compound or multiple fruits with a green to the yellow-brown exterior rind. Fruits are oblong-cylindric in shape. Seeds oval with a membranous testa, cotyledons unequal [1, 2]. Seeds are sweet, diuretic, aphrodisiac and constipating [3].

The seeds are often included in curried dishes and must be cooked by boiling or roasting before eating, boiled and preserved in syrup like chestnuts, canned in brine and tomato sauce. Because of boiling/cooking of seeds for about 60 minutes, the anti-nutritional factors present in seeds such as tannins, trypsin inhibitor contents are reduced along with crude protein and phytin, oxalates and saponins.

Roasted, dried seeds are ground to make flour (starchy flour) which blended with wheat flour is used for baking. The jackfruit seeds are a good source of starch (22%) and dietary fibre [1, 2, 4]. The purified protein Lectin (Jacalin) extracted from seeds is useful for growth inhibition of Human Breast Cancer (MCF7) and Non-small Lung Carcinoma (H1299) cancer cell lines, which is accompanied by significant apotopic death [5]. Seed lectin, N-acetyl-D-galactosamine specific non-glycosylated protein, is useful as a histochemical marker for ethmoid carcinoma in bovines [6]. A dipeptide, aurantiamide acetate [7], monosaccharide, α-D-galactose [8], Lectins like jacalin and artocarpin [9], were isolated from the seeds.

Seeds contain proteins, magnesium, manganese, sodium, potassium, phosphorus, copper, sulphur, chlorine, oxalic acid, Iron, phytin, chlorine, and thiamine. The essential amino acids cysteine, leucine, isoleucine, lysine, phenylalanine, methionine, threonine, tryptophan and valine are present in the seeds. Seed kernels contain 29.5% starch on dry bais after purification [10, 11]. Some of the mineral components present in seeds like phosphorus, iron, copper, manganese, zinc, calcium, potassium and sodium were significantly increased when the seeds were cooked/boiled for 60 min [4].

Literature review revealed that, though many researchers worked on other parts of the plant, and no Pharmacognostical work has been carried out on the seeds of *A. heterophyllus*, hence the present studies have been taken up to highlight the macro, microscopical, powder microscopical characteristics, physicochemical and preliminary phytochemical analysis of the seeds, which will serve as diagnostic tool for identification both in fresh and powder form.

MATERIALS AND METHODS: Seeds of *Artocarpus heterophyllus* were collected locally Bangalore city, India, and identified through local floras. Seeds were shade dried, powdered and used for carrying out microscopical studies, powder characteristics, physic-chemical, preliminary phytochemical and fluorescence studies. Dried seeds were soaked in 70 % alcohol for 24 h, and were used to take freehand sections, cleared with chloral hydrate solution and water, stained with safranin according to the standard prescribed methods [12, 13]. Photomicrographs were captured with Nikon Digital camera. Physicochemical standards such as total ash, acid-insoluble ash, pH (5% aqueous solution), water and alcohol soluble extractives were determined according to the standard procedures. Preliminary phytochemical screening of the seeds for different phyto-constituents was carried out according to the standard methods [13, 14].

RESULTS:

Macroscopical Studies: Seed pendulous, covered with thin papery white husk, oval with a membranous testa, cotyledons unequal, external surface dark brown in color, surface wrinkled, dried seeds are hard, measures 2.0 to 4.0 cm in length, 1.5 to 2.5 cm by width. Cotyledon light creme in color, embryo straight or incurved, cotyledons fleshy, equal or unequal radicle short, superior. Seeds separated by horny endocarps enclosed by subgelatinous exocarps 1mm thick, oblong, ellipsoid 30 × 15-20 mm.

Microscopical Studies: T.S. of the seed shows outer single layer of epidermis, which is reddish-brown to orange in colour, followed by epidermis few layers of cells which are thin-walled, brown coloured and followed by this is single layered epidermis covered with thin cuticle, and many-layered thin-walled parenchymatous cells, where cells show abundant simple to compound starch grains and few oil globules embedded in cotyledon portion. The upper portion of the cotyledon region shows abundant vascular strands with helical to spiral vessels. Thin papery Covering of the seed (Husk) shows abundant stone cells which are small and in groups with the small lumen, which are irregular in shape and highly lignified.

Powder Microscopy: Powder light pink in color with an agreeable sweet smell and with a sweet taste, when it is treated with chloral hydrate, and water, observed under the microscope following fragments of tissues were observed.

- Presence of abundant simple to compound starch grains in cotyledon region.
- Presence of polygonal reddish colored thin walled epidermal cells in surface view.

- Presence of thin-walled parenchymatous cells.
- Presence of helical to spiral xylem vessels.
- Presence of polygonal stone cells with the narrow lumen walls highly lignified.

Physico-chemical Analysis: Various physico-chemical parameters like total ash, acid-insoluble ash, pH (5% aqueous solution) were determined.

Extractive values with water, alcohol, methanol, chloroform, ethyl acetate and petroleum ether (40-60 °C) soluble extractive values were carried out at room temperature by keeping in constant rotation for 8 h with rotary shaker, and the results given in **Table 1**.

Phytochemical Studies: Preliminary phyto-chemical studies were carried out by treating the different extracts of seeds powder with different reagents to identify the presence of different phytoconstituents; results showed the high percentage of carbohydrates, proteins, and starch and good amounts of phenols and small amounts of alkaloids, saponins, steroids, tannins and absence of flavonoids. The results were given in **Table 2**.

TABLE 1: PHYSICOCHEMICAL PARAMETERS OF DRIED SEEDS POWDER

S. no.	Name of the parameter	Values (%) w/w
1	Description	Whitish cream
2	Foreign matter	Below 0.5%
3	pH (5% w/v aq. solution)	6.10
4	Loss on drying at 105 °C	12.70
5	Total ash	2.92
6	Acid-insoluble ash	0.17
7	Water-soluble extractive	23.1
8	Alcohol-soluble extractive	10.40
9	Methanol -soluble extractive	18.35
10	Chloroform -soluble extractive	1.13
11	Ethyl acetate -soluble extractive	1.18
12	Petroleum ether -soluble extractive	0.80

TABLE 2: PRELIMINARY PHYTOCHEMICAL TESTS FOR DIFFERENT SEED EXTRACTS

S. no.	Natural product group	Test for natural products	Presence (+)/ Absence (-)
1	Alkaloids	Dragendorff's test	+
		Hager's test	+
		Mayers's test	+
		Wagner's test	+
2	Carbohydrates	Anthrone test	+++
		Benedict's test	+++
		Fehling's test	+++
		Molisch's test	+++
3	Flavonoids		-
4	Phenols	Ferric chloride test	++
		Lead acetate test	++
5	Proteins	Biuret's test	+++
		Millon's test	+++
6	Saponins		+
7	Starch		+++
8	Steroids	Salkowski reaction	+
		Libermann-Burchard's test	+
9	Tannins	Ferric chloride test	+
		Lead acetate test	+

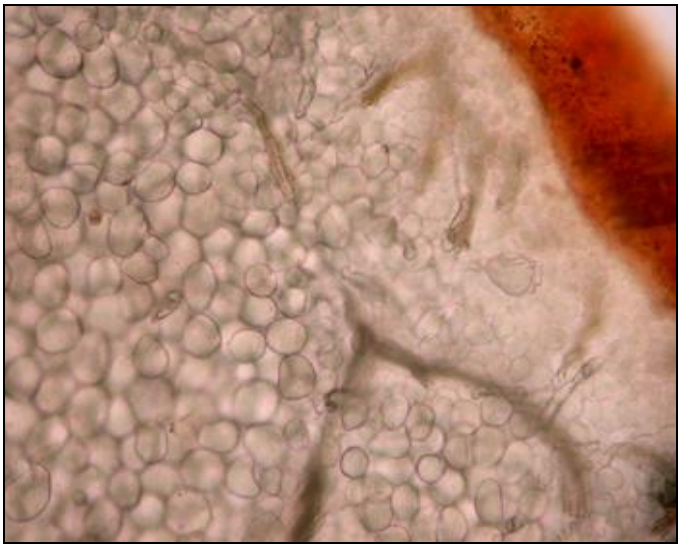
+++ = High percentage, ++ = moderately present, + = small amounts present.

SUMMARY: Pharmacognostical studies on the seeds of *Artocarpus heterophyllus* Lam. revealed that seeds are highly nutritious, fruit is earned the well-deserved name "Poor mans food'', easily available, used in many culinary uses. Seeds are sweet, diuretic, aphrodisiac, rich in starch and constipating. Microscopical studies showed that seeds show abundant simple and compound starch grains in the cotyledon region with a spiral to helical xylem thickenings, well-developed epidermis with brown to orange color, abundant small stone cells with the highly thickened cell wall. Phytochemical studies revealed the presence of high amounts of proteins, carbohydrates, starch, and minimum amounts of flavonoids, saponins, alkaloids, phenols, *etc.* As there is scarce information about chemical constituents of seeds, further investigation on the seed chemical constituents may help researchers, general public and students of Ayurveda for revalidation of the seed drug as the therapeutic and nutritional agent. This study will help as a diagnostic tool for identifying the seeds in powder form in order to check its adulteration with other flours.

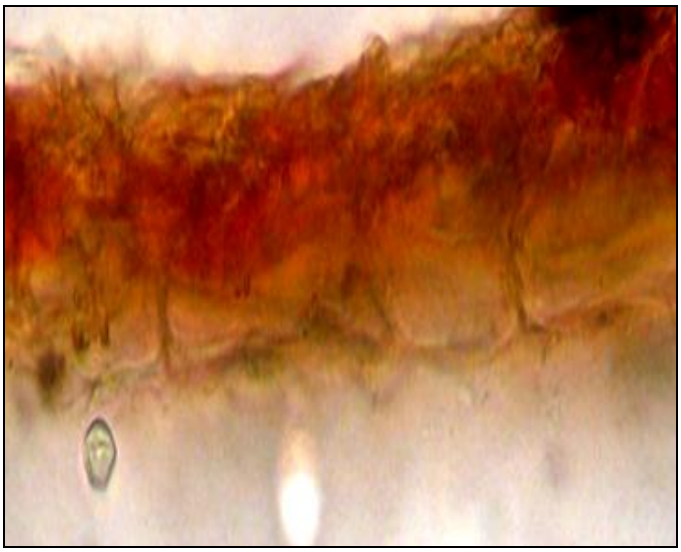
FIG. 1: *ARTOCARPUS HETEROPHYLLUS* – FRESH FRUITS

FIG. 2: *ARTOCARPUS HETEROPHYLLUS* – DRIED SEEDS

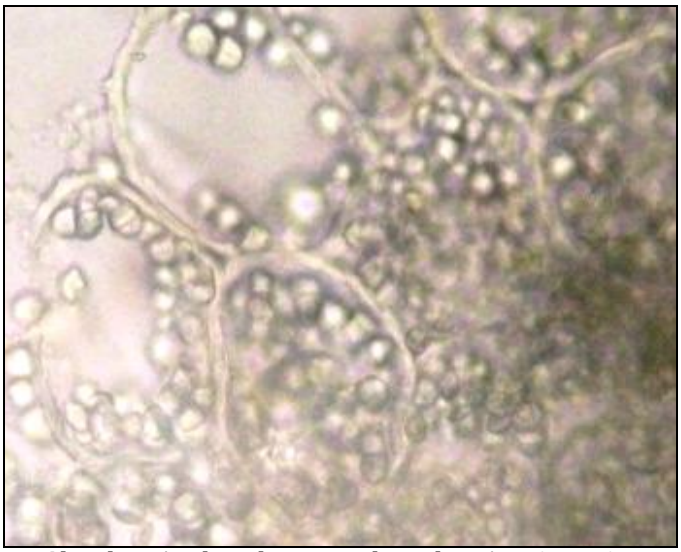
Seeds covered with husk, without husk, seeds with unequal testa and separated white thin husk



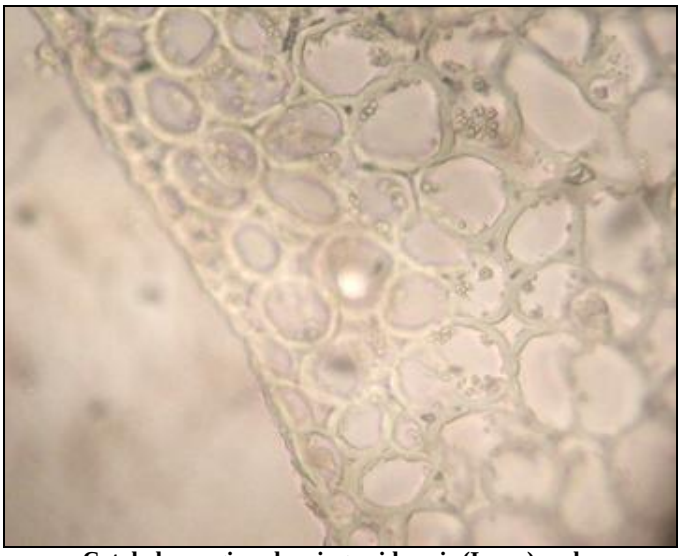
T.S. of the seed showing epidermis, cotyledon region, vascular strands with helical xylem vessels and abundant starch grains



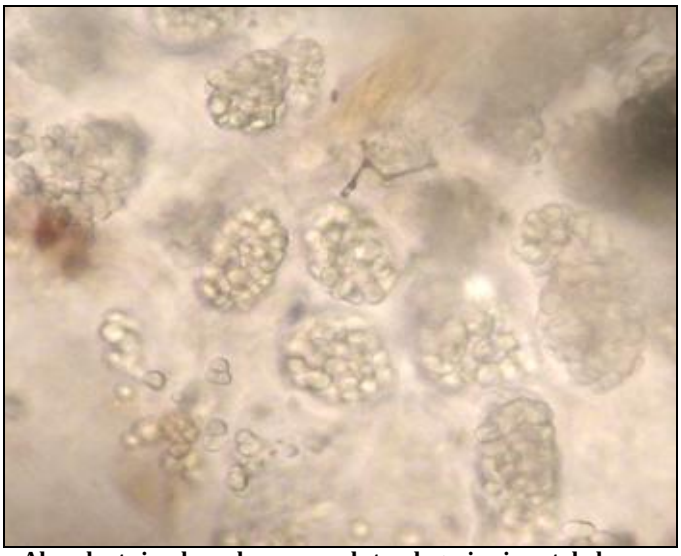
Outer epidermis enlarged 10X × 40X



Abundant simple and compound starch grains 10X × 40X



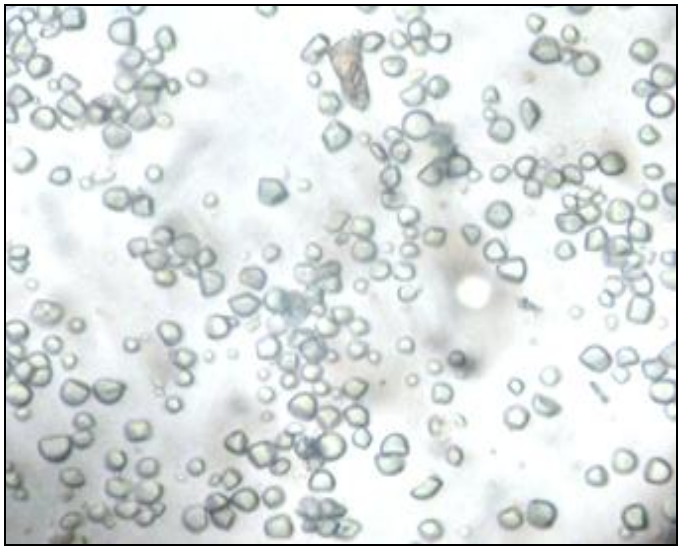
Cotyledon region showing epidermis (Inner) and parenchymatous cells 10X × 40 X



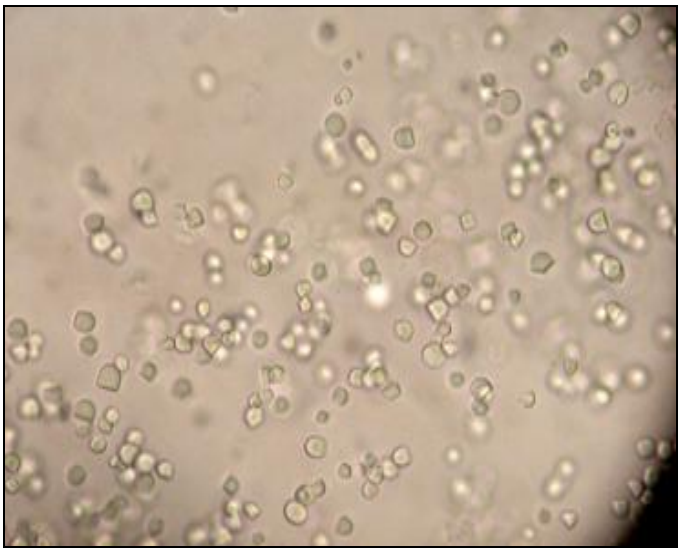
Abundant simple and compound starch grains in cotyledon region 10X × 40X

FIG. 3: MACROSCOPY AND MICROSCOPY OF SEEDS

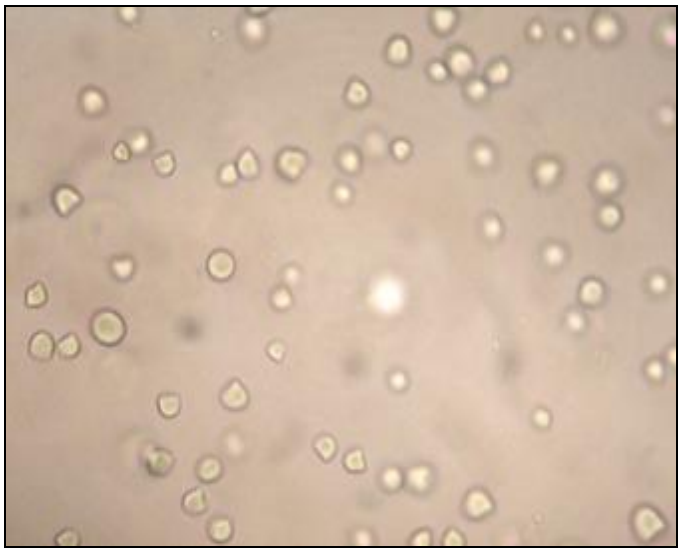
Seed Powder



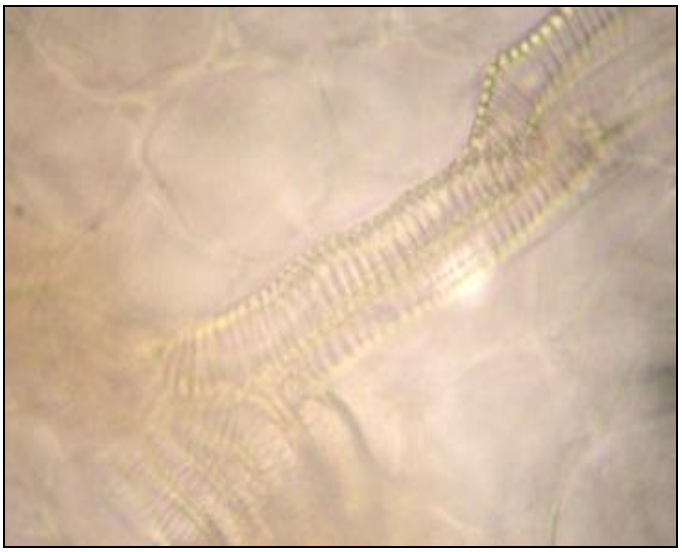
Abundant starch grains



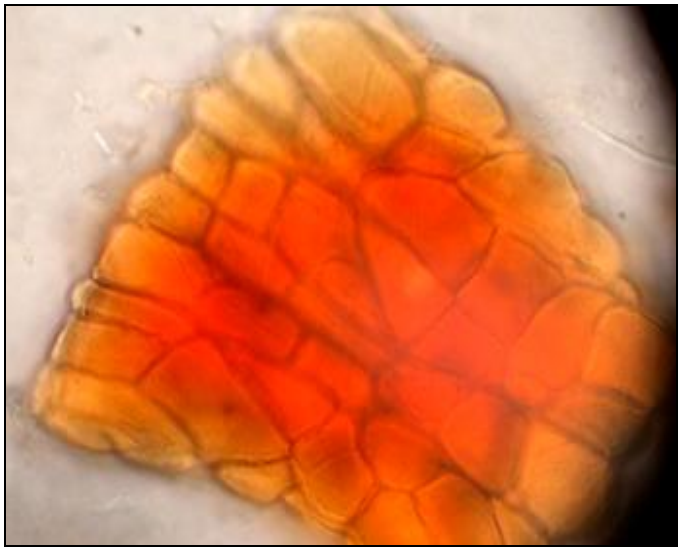
Abundant simple and compound starch grains 10X × 40X



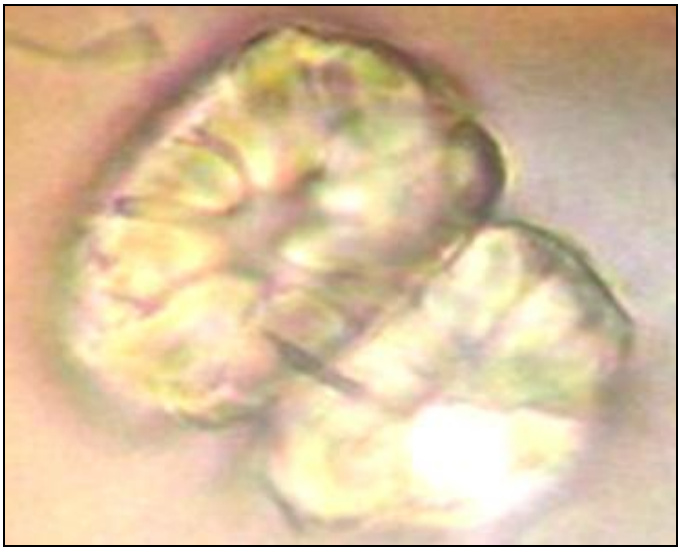
Starch grains 10X × 40X



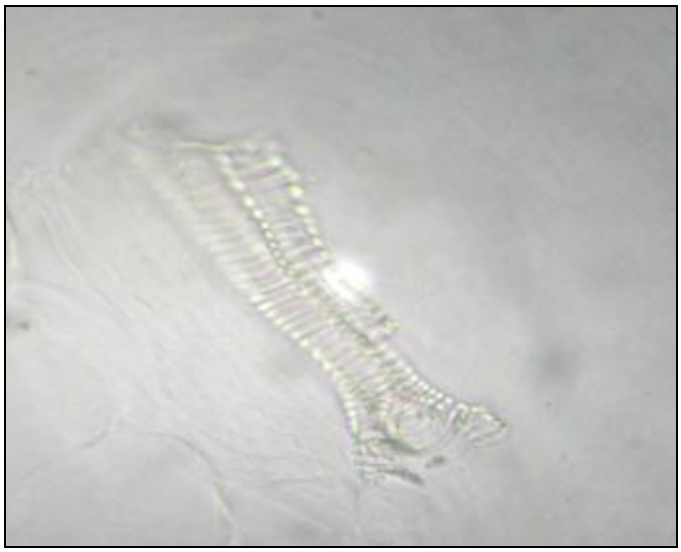
Helical to annular xylem vessel 10X × 40X



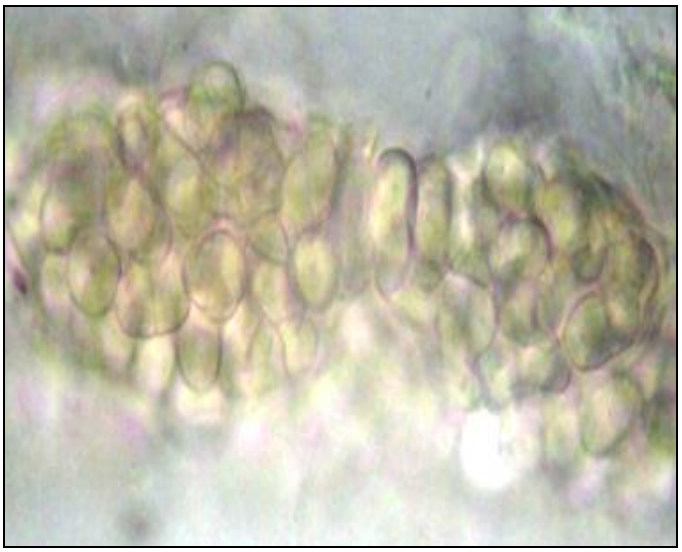
Epidermal cells in surface view 10X × 40X



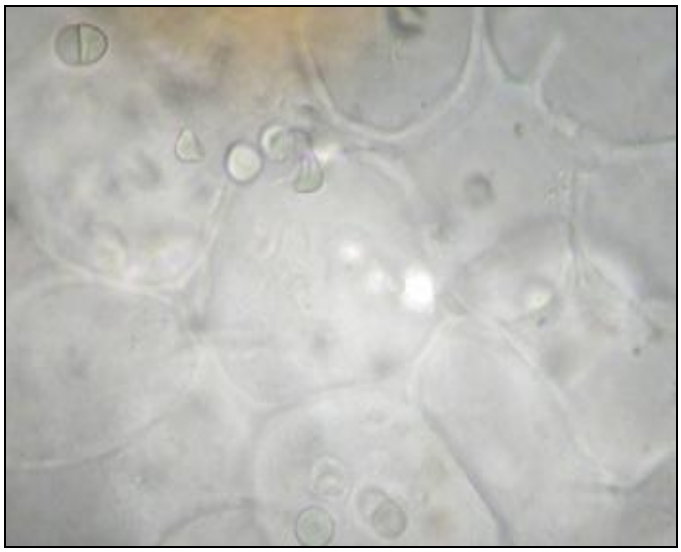
Stone cells 10X × 40X



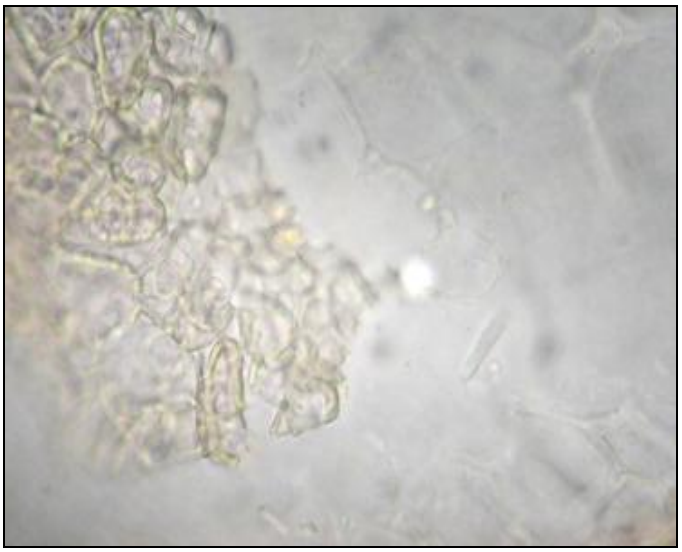
Helical to xylem vessels 10X × 40X



Simple and compound starch grains in groups 10X × 40X



Cotyledon cells with starch grains 10X × 40X



Groups of stone cells 10X × 40 X

FIG. 4: POWDER STUDY

ACKNOWLEDGEMENT: Authors are thankful to the Director General, CCRAS, New Delhi, for encouraging to carry out the work for carrying out the studies successfully.

CONFLICT OF INTEREST: Nil

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How to cite this article:
Reddy MP, Shantha TR and Bhat S: Pharmacognostical studies on medicinal and nutritional seeds of jack fruit: *Artocarpus heterophyllus* Lam. Int J Pharmacognosy 2016; 3(9): 384-91. doi link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.3(9).384-91.