Eurasian Journal of Analytical Chemistry
ISSN: 1306-3057 OPEN ACCESS 2024 19 (1): 542-548

Exploring The Unique Benefits Of *Artocarpus heterophyllus* and *Linum usitatissimum*: A Review

Haresh Mehta Chaudhary[1*], Foram[2], Dr. Pragnesh Patani[3]

[1]Student, Khyati College Of Pharmacy, Palodia, Ahmedabad
[2]Asistant Professor, Khyati College Of Pharmacy, Palodia, Ahmedabad
[3]Principal, Khyati College of Pharmacy, Palodia, Ahmedabad.

[*]**Corresponding Author:** Haresh Bhagaji Chaudhary
*Student, Khyati College of Pharmacy, Palodia, Ahmedabad, Email: hareshpatel9863@gmail.com

ABSTRACT:
Bio-waste from the processing of jackfruit (Artocarpus heterophyllus Lam) is produced in significant quantities. Since this garbage has the potential to pollute the air and water, its accumulation is seen as a health issue. recycling the leftover fruit components, so lessening the amount and effect of the bio-waste discharged into the surroundings. This study aimed to ascertain the phytochemical profile, antibacterial and antioxidant properties of three fruit component extracts(1) The biggest fruited evergreen tree, the jackfruit (Artocarpus heterophyllus Lam), may be native to the Western Ghats rain forests in southwest India. Known by many as kanthal, kathal, or kathar, it is a traditional meal in India. It first occurs in market from spring through summer. A significant yet underappreciated fruit, jackfruit is frequently referred to as the poor man's fruit, was a popular meal in ancient India that was eaten by the fruits' added value Jackfruit has higher levels of iron, calcium, protein, vitamins, and various vital elements in contrast to the typical fruits Another application for jackfruit is as a conventional medication for the management of dermatitis, cough, ulcers, wound healing, and asthma constipation, anxiety, and hypertension. In the many investigations on anti-inflammatory, qualities that are both antibacterial and anti-diabetic(2) According to clinical research, the leaves have anti-diabetic properties in both insulin-dependent and healthy diabetic patients. Unfortunately, jackfruit has not been successfully used on a commercial basis in the regions where it is cultivated, despite its many health advantages. In order to fully explore the potential of jackfruit in health and illness, this review provides an up-to-date, thorough, and critical examination of the nutritional value, phytochemical profile, pharmacological qualities, and underlying mechanisms of action(3). Standard techniques were used to analyze the preliminary phytochemical contents of Artocarpus heterophyllus leaves; atomic absorption spectrophotometry (AAS) was used to analyze the leaves' mineral content; and GC-MS was used to analyze the components of the essential oils. The presence of alkaloids, flavonoids, carbohydrates, terpenoids, tannins, cardiac glycoside, steroids, saponin, and carboxylic acid was shown by qualitative phytochemical screening of the leaves.(4) Scavenging hydroxyl radicals has the strongest antioxidant activity; it is followed by scavenging hydrogen peroxide and chelating ferrous iron. The outcome findings of this study indicate that the potential of jackfruit extract as an agent for diabetes(5)

Keywords: Artocarpus, heterophyllus, Jackfruit ,Phytochemistry, Pharmacology, Antioxidant Anti-inflammatory, Antibacterial, Anticariogenic, Antifungal, Antineoplastic, Hypoglycemic, Nutritional composition

1. Jackfruit:

Introduction:

Jackfruit is one of the commonly consumed foods in Sri Lanka from the ancient time. It is a nonseasonal fruit and had a major contribution to the food supply of the people and their livestock when there were short supplies of staple food grains(5) Artocarpus heterophyllus Lam, (Fig. 1) belonging to the family *Moraceae* (mulberry family) and popularly known as jackfruit or Ceylon Jack tree, is one of the important and commonly found trees in the home gardens of India and Bangladesh(7) Phytonutrients contain in jackfruit such as lignans, flavones, and saponins exhibit anti-cancer, anti-ulcer, anti-hypertensive, and anti-aging activities(8) It is now widely accepted that the beneficial effects of fruits and vegetables for the prevention of certain diseases are due to the bioactive compounds they contain(9) In India, the jack fruit (Artocarpus heterophyllus) is a popular fruit. The jackfruit tree is thought to have evolved in the Western Ghats rain forests in India's southwest Thiamine and riboflavin are two B vitamins found in abundance in these seeds. Both aids in the production of energy and perform other vital activities in the body. Additionally, jackfruit seeds include fibre and resistant starch, which pass through the body undigested and provide nourishment for our healthy gut bacteria(10) Jackfruit (Artocarpus heterophyllus Lam) is popular fruit crop that is widely grown in Thailand and other tropical areas. The ripe fruit contains well flavored yellow sweet bulbs and seeds (embedded in the bulb). The edible bulbs of ripe jackfruit are consumed fresh or processed into canned products. Seeds make-up around 10 to 15% of the total fruit weight and have high carbohydrate and protein contents (11) The seeds are also rich source of carbohydrates and proteins and good source of fibre and vitamins. A major protein, Jacalin has been isolated from jackfruit seeds and possessed immunological properties(12) It is a leading source of bioactive compounds like vitamin C and beta-carotene that act as antioxidants to protect the body against free radicals and strengthens the immune system. It is also rich in various phytonutrients such as lignans, isoflavones, and saponins(13) Starch has found immense industrial use in the manufacture of products such as food, textile, paper, adhesives, and pharmaceuticals. Starch can also serve as a thickening, gelling, and film-forming properties(14) Jackfruit is a dicotyledonous compound fruit and consists primarily of three regions, which are the fruit axis, the persistent perianth and the true fruit. The fruit axis (core of the fruit) is inedible and has numerous laticiferous cells with milky latex. The perianth is the most important part and forms the bulk of the fruit(15)

Scientific classification:

Kingdom: *Plants* Order: *Rosales*
Family: *Moraceae* Species: *A. heterophyllus*
Genus: *Artocarpus* Botanical name: *Artocarpus heterophyllus*

Materials and Methods:

Biological material:

Four genotypes—known locally as "Agüitada," "Rumina," "Licenciada," and "Virtud"—were utilized in this study. They were harvested in February 2022 at Estacion Nanchi, which is located at 32 meters above sea level in the municipality of Santiago Ixcuintla, Nayarit, Mexico, at physiological maturity. For the morphological, physiological, and physicochemical investigations, fifty leaves and forty-five fruits—that is, fifteen of each genotype of jackfruit (Artocarpus heterophyllus Lam.)—were utilized. The fruits were then taken to the Tecnologico Nacional de Mexico-Tepic's Laboratorio Integral de Investigacion en Alimentos, where they were immersed for three minutes in thiabendazole at a concentration of 800 parts per million as an antifungal treatment. Following that, the fruits were allowed to air dry at room temperature. The peduncle was then sealed using copper oxychloride to stop the(16)

Physiological Analysis:

With minor adjustments, the Tovar et al. [19] method was used to assess the jackfruit's respiration rate (RR) and ethylene production (EP). 20 L containers were filled with whole fruits (genotypes "Agüitada," "Licenciada," and "Virtud"). The genotype "Rumina" was housed in a 40 L container because of its larger size; physiological analyses were carried out every 24 hours, and the containers containing the fruits were hermetically sealed for 30 minutes before 0.5 mL was extracted from the headspace on each occasion for RR and EP analysis. A gas chromatograph (GC6890; Hewlett-Packard, Palo Alto, CA, USA) fitted with an HP-PlotQ column (15 m × 0.53 mm and 40 µm film thickness) was used to examine the samples. A thermal conductivity detector was used to identify(17)

Chemical composition:

The jackfruit that was utilized to extract starch came from the Campina Grande, Paraiba, Brazil, local market. Analytical grade chemical reagents were used in all cases. Neon provided the tribasic sodium citrate dihydrate ($Na_3C_6H_5O_7 \cdot 2H_2O$, purity 99.0%), hydrogen peroxide (H_2O_2, 35%), and silver nitrate ($AgNO_3$, purity 99.0%). Sigma-Aldrich provided the glycerol ($C_3H_8O_3$, purity ≥99%) and sodium borohydride ($NaBH_4$, purity ≥96%). Using ultrapure water (18.2 mΩ·cm) from a GEHAKA Master System MS2000 System, the aqueous solutions were made. The Rio de Janeiro Cell Bank in Brazil provided the ATCC NCTC clone 929, which is the L929 Mouse Fibroblast Cell Line(18). Using the AOAC (2005) standard procedures, triple chemical analyses of the RJSM and

BJSM were conducted; the moisture (934.01), ash (942.05), Crude fiber (978.10), fat (948.22), protein (960.52), and The amount of carbohydrates was determined via the variations in relation to the other's levels elements.(19) Using recognized methods, approximate assessments of total carbohydrates, reducing sugars, proteins, lipids, ash, and moisture were carried out(20)

Antimicrobial activity:

Examined the antibacterial properties of five fruit peel wastes (pineapple, custard apple, jackfruit, pomegranate, and papaya) extracted in four different solvents (benzene, acetone, petroleum ether, and chloroform) against pathogenic bacteria isolates that were clinically isolated and gram positive. Fruit peels were gathered.based on the large quantity of peel waste (unused portion thrown of). The substances in charge of the GC-MS analysis was used to find antibacterial activity. In order to evaluate the antibacterial potential, measurements the minimal inhibitory concentration (MIC), minimum growth inhibition zone diameter, and minimum values for the bactericidal concentration (MBC). Acetone extract demonstrated the best performance among the solvents examined.antimicrobial efficacy. In the order of pomegranate peels >, the acetone extracts exhibited the highest level of activity.Custard apple peels are inferior than jackfruit peels. Acetone extract GC-MS analysis revealed(21)

Medicinal Significance Of Jackfruit:

Phytonutrients have the ability to decrease blood pressure, prevent the body from forming cancer cells, and prevent stomach ulcers. and may inhibit the cellular deterioration process.that give the skin a fresh, vibrant appearance 2015; Sajesh et al. The available phytonutrients Jackfruits are displayed in(22) Traditional medicine has made use of the Artocarpus species. The plants' antimicrobial, anti-diabetic, antioxidant, anti-inflammatory, and antihelminthic properties have all been employed. It provides a significant source of vitamins, minerals, and carbs . According to Hasan et al. the average yearly net returns discovered were higher than the agricultural system. Alves and colleagues noted that The fruit has flavones, saponins, and lignins. which has anti-cancer and anti-ulcer characteristics anti-aging and anti-hypertensive. It includes tremendous therapeutic benefits and regarded as a abundant supply of minerals, carbs, and carboxylic vitamins like ascorbic acid dietary fibre, and acids thiamine and acid(23) Here, the fruit is rich in vitamin C as well as other nutrients and antioxidants that may improve the condition of the skin.

This shields the skin from oxidative damage brought on by aging naturally and prolonged exposure to sunlight. Vitamin C makes skin smoother and stronger and is necessary for the synthesis of collagen.(24) The fruit helps with smooth bowel movement, reduces constipation, and has a high dietary fibre content. It shields the mucous membrane from the big intestine's carcinogens. Due to its antiulcer qualities, it aids in the treatment of ulcers and digestive issues. The dietary lipids in jackfruit aid in the removal of toxins from the colon, lessen their effects, and offer protection against colon cancer. Jack fruit may also provide you with vitamin A, which keeps the skin and eyes healthy and aids in the treatment of muscle degeneration and night blindness(25)

Flaxseed:

Cardiovascular disease (CVD) is the leading cause of death, accounting for 35.2% of all deaths in 2005.1 Coronary artery disease (CAD) caused 20% of all deaths.1 Atherosclerosis and its complications such as CAD and CVD remain major causes of mortality and morbidity in the Western world. Major risk factors of atherosclerosis include

hypercholesterolemia, hypertension, diabetes, smoking, obesity and inflammation(26) Flaxseed is the seed from the flax plant, an annual herb, which is a member of the Linaceae family. It thrives in deep moist soils rich in sand, silt, and clay. The specie is native to the region extending from the eastern Mediterranean, through Western Asia and the Middle East, to India(27) Flax is rich in fat, protein and dietary fibre. An analysis of brown Canadian flax averaged 41% fat, 20% protein, 28% total dietary fibre, 7.7% moisture and 3.4% ash, which is the mineral-rich residue left after samples are burned(28) The nutritional components of flaxseed are oil, protein, lignans, soluble fiber, minerals and vitamin, etc. Flaxseed is known as the richest source of the n-3 fatty acid, alpha linolenic acid(29) potential health benefits associated with consumption of flaxseed and flaxseed meal have become more prominent. These potential health benefits include anticancer effects, antiviral and bactericidal activity, anti-inflammatory effect, ion reduction, laxative uses, and reduction of atherogenic risks (30) Flaxseed is rich in fat, protein and dietary fibre. Chemical analysis of flaxseed averaged 30 to 40% oil, 20 to 25% protein, 20 to 28% total dietary fibre, 4 to 8% moisture and 3 to 4% ash and the oil contains vitamins A, B, D and E, minerals and amino acids. By virtue of the presence of physiologically active food components that may provide health benefits beyond basic nutrition(31) The composition of flaxseed can vary with genetics, growing environment, seed processing and method of analysis13. Flaxseed has been the focus of growing interest for the nutritionists and medical researchers due to its potential health benefits associated with its biologically active components(32) Based on archeological evidence, it was proposed that flax was used first for fibre. However, a more recent comparative study of genetic diversity of the stearoyl-ACP desaturase II (sad2) locus from flax and pale flax (L. angustifolium) showed reduced diversity in the cultivated species. This suggests that flax may have been initially selected as an oilseed crop(33) . It has been established that the highest concentration of this phytohormone is possessed by some plant seeds, from which vegetable oils are subsequently obtained The efficacy of flaxseed oil and melatonin can be enhanced and side effects mitigated when they are combined wisely. Moreover, the nature and direction of their joint action may differ significantly from the impact of individual components(34) Flaxseed has many medicinal proprieties such as antioxidant, antiviral, antibacterial, antifungal, anti inflammatory, antiatherosclerosis, anticarcinogenic and chemo-preventive properties in animals and humans It prevents diabetic complications, has cardio-protective effects in rats decreases menopausal symptoms and osteoporosis in women and many others (35)

Morphology:

Scientific classification:

Kingdom: *Plante* Species*: L.Usitatissimu*
Family: *Linaceae* Botanical name: *Linum usitatissimum*
Genus: *Linum* Order : *Malpighiales*
Order: *Malpighiales*

MATERIALS AND METHOD:

In Florianópolis, SC, Brazil, a local vendor provided a 500 g bulk sample of golden flaxseed (27°35′49′′ S 48°32′56′′ W). Up until the time of analysis, the sample was stored at room temperature in its original packing. The ITS1 region was sequenced with great performance to identify the fungi. A proprietary approach was used in the development of the library (Neoprospecta Microbiome Technologies, Brazil). Primers for the ITS1 region (GAACCWGCGGARGGATCA) were used for amplification(36) AGRITEC Research, Breeding, Services Ltd., Sumperk, Czech Republic, and SEMPRA Breeding Station Ltd., Slapy u Tabora, Czech Republic, provided the 53 flax cultivars Linum usitatissimum L. seeds. The list of flax cultivars examined in this research may be found in (37) We bought sun-dried flaxseeds from a commercial supplier. All extraneous objects and damaged seeds were physically removed from the seeds.(38)

Chemical Composition:

About 40% of the seed's content is made up of fats, 30% is dietary fibre, and 20% is protein. The chemical makeup of a plant varies greatly between kinds and is also influenced by the growing environment.75 percent of lipids and 76 percent of protein are found in cotyledons. discovered in the seed. The endosperm only has 23 percent of the16% of protein and fats(39) Sprouts of flaxseed are edible and have a little peppery taste. Though there is evidence to the contrary, powdered flaxseed can grow rancid at room temperature in as little as one week. Whole flaxseeds are chemically stable. By refrigerating and keeping in sealed containers, ground flax will not grow rancid for an extended period of time. Milled flax can withstand oxidation for nine months at room temperature and twenty months at ambient temperatures in a warehouse when it is packed tightly and kept out of the light and air.(40)

Antimicrobial activity:

To determine the antibacterial efficacy of flaxseed ethanol and chloroform extracts against five microorganisms—Salmonella typhini, Enterococcus, Escherichia coli, Bacillus subtilis, and Staphylococcus aureus—a trial research was conducted.The outcome shows that ethanol extract is less effective than chloroform extract at bacteria. Extracts from chloroform shown antibacterial efficacy against each of the five bacteria. Although there was no antibacterial action demonstrated by ethanol extract against Esherichiacoli(41)

Antioxidant activity:
Flaxseed's antioxidant activity has been demonstrated to lower platelet aggregation and total cholesterol. Lower levels of lipid peroxidation (TBARS) and the prediction enzyme γ-glutamyl transpeptidase proile in flaxseed chutney demonstrated its antioxidant properties. Rats given azoxymethane(42).

Antibacterial activity:
An agar-well diffusion technique was used to measure the antibacterial activity in accordance with. Bacterial strains were cultured for 24 hours in petri plates with 20 milliters of Nutrient agar medium. 50 µl of the plant extracts were evaluated at concentrations of (50, 75, 100) mg/ml after wells with a diameter of 6 mm were cut into the ager. The final inoculum was produced with the inoculum size modified to deliver around 10^8 colony-forming units (CFU)/ml. The incubation process lasted 24 hours at 37 0C. Based on a measurement of the diameter of the inhibitory zone that developed around the well, the antibacterial activity was calculated. Using highly diluted (2-fold) plant extracts, the micro-dilution technique was used to assess the minimum inhibitory concentration (MIC).(43)

Therapeutic Uses:
a. Flaxseeds are a fantastic source of fibre and have several anti-cancer properties. They also function as a lubricant and reduce the risk of constipation. It also lowers blood sugar levels, which helps to alleviate the symptoms of diabetes.
b. According to one study, schoolchildren who took no more than one teaspoon of flax oil daily experienced fewer and milder respiratory tract diseases than their non-flax oil-taking peers. As a result, it also promotes improved immunity.
c. Your heart and circulatory system will benefit from flax. Ultra-high doses of omega-3 fatty acids lower LDL (bad) cholesterol levels. Fish oils and algae are other sources of essential fatty acids
d. Flax is good for your skin. Flax oil has been utilized as a dietary supplement in my patients with dry skin, skin that is particularly sun-sensitive or eczema
e. Lipids found in flax are precursors to the formation of the mind. This is especially important during certain life periods, such as pregnancy and the early years of childhood, when an infant's brain grows at its highest rate. A prudent mother might think about include a teaspoon of flax oil in her normal diet when she is pregnant or nursing.(44)

Health skin and hair
As a medicinal substance, flaxseed oil reduces inflammatory reactions of the skin, including swelling, eczema, and itching (Neukam et al. Citation2011). Preparations made from flaxseed gum and oil have also been shown to reduce hair loss. Specifically, the abundance of B-vitamins and omega-3 fatty acids (ALA) in flaxseed helps lessen dryness and flakiness in the skin. Because flaxseed oil reduces inflammation, it can assist with a number of dry skin issues, including psoriasis, acne, and atopic dermatitis. Both oil and roasted whole flaxseed reduce inflammation; however, flaxseed oil is said to work better on dry skin. There have been suggestions that flaxseed oil's high ALA percentage helps keep skin from drying out. It has been recommended to take 10 mL of flaxseed oil every day or to use a lotion that combines flaxseed oil and essential oil (Hubbard Citation 2021). One of the main components of scalp treatments that slow down hair loss is flaxseed mucilage. This component is made up of two substances that resemble mucin and pectin. Because mucin's sticky component and flaxseed pectin are comparable, a combination is created that sticks to the scalp and removes dead skin cells without causing discomfort. Mucin has the dual effect of keeping the hair cuticle from breaking and decomposing by inhibiting the breakdown of proteins. Similar to mucin, flaxseed gum can also contain(45)

CONCLUSION:

Nutritiously dense and adaptable, jackfruit seeds have a good effect on food product development and health. They are an excellent complement to a balanced diet because of their high protein and fibre content as well as vital vitamins and minerals(46) Research has indicated a noteworthy augmentation in the nutritional value of goods supplemented with jackfruit concerning ash, protein, dietary fibre, and phytochemical contents. The appropriate concentration of jackfruit seed flour added to various goods helped to improve their physicochemical, textural, colour, and sensory qualities. The review also investigated the impact of jackfruit seed flour addition on other typical product qualities. To create cost-effective and efficient methods for producing value-added goods with jackfruit seed flour, more research is needed(47) Based on the results of this experiment, chocolate cake may effectively contain 10% jackfruit seed flour. It has been noted that there was a notable impact of chocolate made by substituting jackfruit seed flour for wheat flour cake, there was a decrease in fat and a rise in protein(48). The purpose of the study was to examine the functional and chemical characteristics of powdered jackfruit seed. To make composite flour biscuits, various levels of jackfruit seed powder were included(49) It is an organic source of sugars, mostly fructose and sucrose, with a sweet taste profile suitable for a range of culinary uses. Additionally,

jackfruit has a significant quantity of nutritional fibre. supporting good digestion and helping to keep cholesterol levels within normal ranges(50)

REFERENCE:

1. Adan AA, Ojwang RA, Muge EK, Mwanza BK, Nyaboga EN. "Phytochemical composition and essential mineral profile" *antioxidant and antimicrobial potential of unutilized parts of jackfruit. Food Res.* **2020 Aug**;4(4):1125-34.
2. Srivastava R, Singh A. "Jackfruit (Artocarpus heterophyllus Lam) biggest fruit with high nutritional and pharmacological values:" *A review. International Journal of Current Microbiology and Applied Sciences*. **2020**;9(8):764-74.
3. Gupta A, Marquess AR, Pandey AK, Bishayee A. "Jackfruit (Artocarpus heterophyllus Lam.) in health and disease: a critical review". *Critical Reviews in Food Science and Nutrition*. **2023 Sep** 10;63(23):6344-78.
4. Onuah CL, Uwakwe AA, Anacletus FC. "Mineral and essential oil composition of jackfruit (Artocarpus heterophyllus) leaves". *Scientia Africana*. **2018**;17(1).
5. Biworo A, Tanjung E, Iskandar K, Suhartono E. "Antidiabetic and antioxidant activity of jackfruit (Artocarpus heterophyllus) extract". *Journal of Medical and Bioengineering*. **2015 Aug**;4(4).
6. Ranasinghe RA, Maduwanthi SD, Marapana RA. 'Nutritional and health benefits of jackfruit (Artocarpus heterophyllus Lam.): a review". *International journal of food science.* **2019;2019**(1):4327183.
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 Aug** 1;44(7):1800-11.
8. Khan AU, Ema IJ, Faruk MR, Tarapder SA, Khan AU, Noreen S, Adnan M. "A review on importance of Artocarpus heterophyllus L.(Jackfruit)". *Journal of Multidisciplinary Applied Natural Science*. **2021**.
9. Swami SB, Thakor NJ, Haldankar PM, Kalse SB. "Jackfruit and its many functional components as related to human health: a review". *Comprehensive Reviews in Food Science and Food Safety.* **2012 Nov**;11(6):565-76.
10. Aswin GA, Bhasin A, Mazumdar A. Utilization of jackfruit by-products and application in food industry. *Pharma Innov. J*. **2022**;11:2293-9.
11. Tulyathan V, Tananuwong K, Songjinda P, Jaiboon N. "Some physicochemical properties of jackfruit (Artocarpus heterophyllus Lam) seed flour and starch'. *Science Asia.* **2002**;28(1):37-41.
12. Gupta D, Mann S, Sood A, Gupta RK. "Phytochemical, nutritional and antioxidant activity evaluation of seeds of jackfruit (Artocarpous heterolphyllus Lam.)". *International Journal of Pharma and Bio Sciences.* **2011**;2(4):336-45.
13. Akter F, Haque MA. "Jackfruit waste: a promising source of food and feed". *Annals of Bangladesh Agriculture.* **2019**;23(1):91-102.
14. Noor F, Rahman MJ, Mahomud MS, Akter MS, Talukder MA, Ahmed M. "Physicochemical properties of flour and extraction of starch from jackfruit seed". *International Journal of Nutrition and Food Sciences*. **2014**;3(4):347-54.
15. Ong BT, Nazimah SA, Osman A, Quek SY, Voon YY, Hashim DM, Chew PM, Kong YW. "Chemical and flavour changes in jackfruit (Artocarpus heterophyllus Lam.) cultivar J3 during ripening". *Postharvest Biology and Technology.* **2006 Jun** 1;40(3):279-86.
16. Morelos-Flores DA, Montalvo-González E, Chacón-López MA, Santacruz-Varela A, Zamora-Gasga VM, Torres-García G, de Lourdes García-Magaña M. "Comparative study of four Jackfruit genotypes": *Morphology, physiology and physicochemical characterization. Horticulturae.* **2022 Oct 31**;8(11):1010.
17. Tovar, B.; García, H.S.; Mata, M." Physiology of pre-cut mango. I. ACC and ACC oxidase activity of slices subjected to osmotic dehydration". *Food Res. Int.* **2000**, *34*, 207–215.
18. Rodrigues JF, Azevedo VS, Medeiros RP, Barreto GB, Pinto MR, Fook MV, Montazerian M. "Physicochemical, morphological, and cytotoxic properties of Brazilian jackfruit (Artocarpus heterophyllus) starch Scaffold loaded with silver nanoparticles". *Journal of Functional Biomaterials*. **2023 Mar 3**;14(3):143.
19. Juárez-Barrientos JM, Hernández-Santos B, Herman-Lara E, Martínez-Sánchez CE, Torruco-Uco JG, Ramírez-Rivera EJ, Pineda-Pineda JM, Rodríguez-Miranda J. "Effects of boiling on the functional, thermal and compositional properties of the Mexican jackfruit (Artocarpus heterophyllus) seed jackfruit seed meal properties". *Emirates Journal of Food and Agriculture*. **2017**;29(1):
20. Trejo Rodriguez IS, Alcantara Quintana LE, Algara Suarez P, Ruiz Cabrera MA, Grajales Lagunes A. "Physicochemical properties, antioxidant capacity, prebiotic activity and anticancer potential in human cells of jackfruit (Artocarpus heterophyllus) seed flour". *Molecules*. **2021 Aug 11**;26(16):4854
21. Pragalyaashree MM, Monikca A, Blessie F, Deivanayagame T. "Jackfruit processing and utilization of its waste: A review*". Asia-Pacific Journal of Science and Technology*. **2023**;28(04)..
22. Srivastava R, Singh A. "Jackfruit (Artocarpus heterophyllus Lam) biggest fruit with high nutritional and pharmacological values: A review*". International Journal of Current Microbiology and Applied Sciences.* **2020**;9(8):764-74.

23. Parihar PS, Brahma S, Shirole A. "Benefits of jackfruit and its natural properties to treat diabetes or colon cancer and weight loss related issues. Benefits". **2021 Mar**;8(03).
24. Pragalyaashree MM, Monikca A, Blessie F, Deivanayagame T. "Jackfruit processing and utilization of its waste: A review*". Asia-Pacific Journal of Science and Technology.* **2023**;28(04).
25. U. B. Jagtap, S. N. Panaskar, and V. A. Bapat. **(2010**). "Evaluation of antioxidant capacity and phenol content in jackfruit (Artocarpus heterophyllus Lam.) fruit pulp". *Plant Foods for Human Nutrition*. 65 (2): 99 –104. 10.1007/s11130-010-0155-7.
26. Prasad K."Flaxseed and cardiovascular health". Journal of cardiovascular pharmacology. **2009 Nov 1**;54(5):369-77.
27. Bernacchia R, Preti R, Vinci G. "Chemical composition and health benefits of flaxseed". *Austin J Nutri Food Sci*. **2014 Oct**;2(8):1045.
28. Ganorkar PM, Jain RK "Flaxseed--a nutritional punch". *International Food Research Journal.* **2013 Apr 1**;20(2).
29. Zhang ZS, Wang LJ, Li D, Jiao SS, Chen XD, Mao ZH. "Ultrasound-assisted extraction of oil from flaxseed". *Separation and Purification Technology.* **2008 Aug 1**;62(1):192-8.
30. Collins TF, Sprando RL, Black TN, Olejnik N, Wiesenfeld PW, Babu US, Bryant M, Flynn TJ, Ruggles DI. "Effects of flaxseed and defatted flaxseed meal on reproduction and development in rats*". Food and chemical toxicology.* **2003 Jun 1**;41(6):819-34.
31. Herchi W, Arráez-Román D, Boukhchina S, Kallel H, Segura-Carretero A, Fernández-Gutierrez A. "A review of the methods used in the determination of flaxseed components". *African Journal of Biotechnology***. 2012**;11(4):724-31.
32. Nowak W, Jeziorek M. "The role of flaxseed in improving human health". In Healthcare **2023 Jan 30** (Vol. 11, No. 3, p. 395). MDPI.
33. Jhala AJ, Hall LM. "Flax (Linum usitatissimum L.): current uses and future applications". *Aust. J. Basic Appl. Sci*. **2010 Dec 8**;4(9):4304-12.
34. Sobolevskaya IS, Krasnobaeva MI, Myadelets OD. "Effect of exogenous melatonin and flaxseed oil on the expression state of MT1 receptors in rat skin under light deprivation". *Reports of morphology.* **2021 Jun 25**;27(2):30-8.
35. Shaban SN, Mokhtar KI, Ichwan SJ, Ashour AE, Alahmad BE. "Flaxseed (Linum usitatissimum) Extract Activity on Human Oral Fibroblasts (HOrF) Cell Line". *Annals of Dentistry University of Malaya.* **2020 Nov 23**;27:50-4.
36. Rollemberg ND, Hassemer GD, Pierezan MD, Maran BM, Dalla Nora FM, Verruck S. "Identification of fungi in flaxseed (L. usitatissimum L.) using the ITS1 and ITS2 intergenic regions". Microbiology Research. **2022 Jun 1**;13(2):315-22**.**
37. Dana W, Ivo W. "Computer image analysis of seed shape and seed colour for flax cultivar description". *Computers and electronics in agriculture.* **2008 May 1**;61(2):126-35
38. Coşkuner Y, Karababa E. "Some physical properties of flaxseed (Linum usitatissimum L.)". *Journal of food Engineering.* **2007 Feb 1**;78(3):1067-73..
39. Tulsi P, Darshan M. "Flaxseed: A nutritional smash for superior health". *International Journal of Scientific and Technical Advancements.* **2016**;2(2):113-6.
40. Rahimlou M, Hejazi J. Perspective Chapter: "Flaxseed (Linumusitatissimum L)–Chemical Structure and Health-Related Functions". *In Lignin-Chemistry, Structure, and Application* **2022 Oct 28**. *IntechOpen*.
41. Katare C, Saxena S, Agrawal S, Prasad GB, Bisen PS. "Flax seed: a potential medicinal food". *J Nutr Food Sci.* **2012**;2(1):120-7.
42. Hussien ZG, Aziz RA. "Chemical composition and antibacterial activity of Linum usitatissimum L.(Flaxseed)". Systematic Reviews in Pharmacy. 2201;12(2):145-7.
43. Pansare TA, Panchaware P, Makadi A, Jankar S, Verma D. "AYARVEDIC NUTRITIONAL, PHYTOCHEMICAL, THERAPEUTIC AND PHARMACOLOGICAL OVERVIEW ON ATASI (LINUM USITATISSIMUM LINN.)".
44. Hussain MS, Kaur G, Mohapatra C. "Nutritional composition and functions of flaxseed (Linum usitatissimum linn.)". *Food Ther Health Care*. **2021**;3(4):88-91
45. Shim YY, Kim JH, Cho JY, Reaney MJ. "Health benefits of flaxseed and its peptides (linusorbs)". *Critical Reviews in Food Science and Nutrition.* **2024 Mar 10**;64(7):1845-64..
46. Shajahan MS, Das S, Sharma A, Wani AW, Rawat N, Kumar S, Ahmad M. "JACKFRUIT SEED: A FUNCTIONAL FOOD COMPANION".
47. Waghmare R, Memon N, Gat Y, Gandhi S, Kumar V, Panghal A."Jackfruit seed: an accompaniment to functional foods". *Brazilian Journal of Food Technology*. **2019 Jun 13**;22:e2018207.
48. Arpit S, John D. "Effects of different levels of jackfruit seed flour on the quality characteristics of chocolate cake". *Res. J. Agric. For. Sci*.. **2015**;2320:6063
49. Islam MS, Begum R, Khatun M, Dey KC. "A study on nutritional and functional properties analysis of jackfruit seed flour and value addition to biscuits*". Int J Eng Res Technol.* **2015**;4(12):139-47..
50. Anaghasree MS, Dubey PK, Kumar S. "Utilization of Jackfruit: Nutritional Composition and its Application in a Food Model System".