

EXPLORING THE UNTAPPED POTENTIAL: A COMPREHENSIVE STUDY ON THE PROPERTIES OF JACKFRUIT LEAVES TEA POWDER

Submitted in partial fulfilment of the requirements for the award of Bachelor of
Science degree in Clinical Nutrition & Dietetics

by

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SCHOOL OF ALLIED HEALTH SCIENCES**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade A++ by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of GAYATHIRI S (41736003) and PAVITHRA K (41736011) who carried out the project entitled "EXPLORING THE UNTAPPED POTENTIAL: A COMPREHENSIVE STUDY ON THE PROPERTIES OF JACKFRUIT LEAVES TEA POWDER" under my supervision from JUNE 2023 to APRIL 2024.

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We Gayathiri S and Pavithra k hereby declare that the project entitled "Exploring The Untapped Potential: A Comprehensive Study On the Properties Of Jackfruit Leaves Tea Powder" done by me under the guidance of Mrs. Kanya S is submitted in partial fulfilment of the requirements for the award of Bachelor of Science degree in Clinical Nutrition & Dietetics.

DATE: 27.04.2024

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SIGNATURE OF THE CANDIDATES

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ABSTRACT

Artocarpus heterophyllus, commonly known as jackfruit, is a tropical tree with leaves that have been historically utilized in traditional medicine and culinary practices. This study aimed to explore the phytochemical composition, nutritional content, antibiotic sensitivity, and sensory attributes of *A. heterophyllus* leaves. Phytochemical screening was conducted to identify various secondary metabolites present in the leaves using standard qualitative methods. Nutritive analysis involved determining the proximate composition, mineral content, and vitamin levels of the leaves. Antibiotic sensitivity testing was performed using well-established methods to evaluate the susceptibility of potential microbial contaminants to commonly used antibiotics. Additionally, sensory evaluation was carried out to assess the organoleptic properties, including taste, aroma, texture, and overall acceptability of *A. heterophyllus* leaf preparations. This involved a panel of trained assessors using standardized sensory evaluation techniques. The results revealed the presence of diverse phytochemicals such as alkaloids, flavonoids, phenols, tannins, and terpenoids in the leaves. Nutritive analysis indicated that the leaves are rich in essential nutrients, including proteins, carbohydrates, vitamins, and minerals, making them a potential source of dietary supplements. Antibiotic sensitivity testing demonstrated varying degrees of susceptibility among microbial strains tested, suggesting potential antimicrobial properties of *A. heterophyllus* leaves. Furthermore, sensory evaluation highlighted the palatability and culinary versatility of *A. heterophyllus* leaves, with positive responses regarding taste, aroma, and overall sensory appeal. In conclusion, this comprehensive study provides valuable insights into the phytochemical composition, nutritional quality, antibiotic sensitivity, and sensory characteristics of *A. heterophyllus* leaves, emphasizing their potential as functional foods, dietary supplements, and sources of natural antimicrobial agents. Further research is warranted to explore their therapeutic and culinary applications in greater depth.

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LIST OF ABBREVIATIONS

AI	:	Adequate Intake
DRI	:	Dietary Reference Intake
TDEE	:	Total Daily Energy Expenditure
DHA	:	Docosahexaenoic Acid
EPA	:	Eicosapentaenoic Acid
HDL	:	High-Density Lipoprotein
LDL	:	Low-Density Lipoprotein
TG	:	Triglycerides
BG	:	Blood Glucose
HbA1c	:	Hemoglobin A1c
GI	:	Glycemic Index
GERD	:	Gastroesophageal Reflux Disease
PERT	:	Pancreatic Enzyme Replacement Therapy
FODMAPs	:	Fermentable Oligosaccharides, Disaccharides, Monosaccharides, and Polyols
FOD	:	Frequency of Distribution
PRAL	:	Potential Renal Acid Load
DGA	:	Dietary Guidelines for Americans
ADA	:	American Diabetes Association

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1. INTRODUCTION

The *artocarpus heterophyllus* is a species of tree which belongs to mulberry, fig and breadfruit family (Moraceae) is known by other names jackfruit (Eng), Kathal, Panas (Hindi), Kanthal (Beng), Palua (Tamil), Pharmas (Guj & Mar) & Chakka (Malayalam). *Artocarpus heterophyllus*, commonly called as jackfruit. It is a tropical tree species belonging to the Moraceae family((Om Prakash, 2010).



FIG 1.1 : JACKFRUIT TREE WAS FOUND IN ALATHUR, KERALA

Jackfruit is originated in areas such as India, Indonesia, Central Africa, Florida, Brazil, Australia, and the Pacific Islands, jackfruit is a plant with several therapeutic uses for its roots, stems, leaves, and fruit. Notably, β -sitosterol, tannin, cycloartenone, cycloartenol, and sapogenins are abundant in jackfruit leaves. (A Utari, 2020) Furthermore, because jackfruit contains a high concentration of phenolic compounds, particularly flavonoids, which are very poisonous, it shows promise as a cytotoxic agent((L Warly, 2020). Many agricultural wastes are currently being investigated as possible feed ingredients, and their effectiveness is being assessed. In tropical regions, feed availability varies greatly with the seasons, frequently leading to poor quality and irregular supplies. Feed shortages

occur frequently during the dry season; on the other hand, during the rainy season, feed becomes plentiful. Using substitute feed ingredients, such as those made from forages like jackfruit, is one way to address this problem((Rajesh Kumar, 2010). Members of this family usually have small, petalless male or female blooms paired with alternating or opposite leaves and a milky latex. This family has many species that fuse the fruits of different flowers to form numerous fruits. This family of flowering plants has more than 1180 species and about 38 genera. (Vijaya poojitha, April 2017)Southeast Asia's jackfruit has been cultivated for a long time—between 3000 and 6000 years, according to archeological finds in India. This large evergreen tree can grow to a height of 10 to 15 meters. It is indigenous to evergreen woods that are found between 450 and 1,200 meters above sea level. Widely grown in India's warmer regions, it requires soil that is both moist and well-drained, with a pH range of 4.3 to 8.0 and moderate fertility. (Devarakonda Ramadevi, April 2017). These plant-based compounds have been used for many years to treat a wide range of illnesses and infections, such as cancer, toxicity from paracetamol, stroke, diabetes, and many more. (A. A. Uwakwe, June 2018). Humans consume minerals as vital nutrients, which are naturally occurring chemical components found in soil and plants. They are an essential part of diet and are required for animals' bodies to function properly. Iron promotes blood flow, calcium keeps teeth and bones strong, while potassium helps muscles and skeleton contract. (F. C. Anacletus, June 2018). It is commonly known that the use of herbal treatments is becoming more and more popular. (L F Mustanti, 2020).The leaf of *A. heterophyllus*, commonly known as jackfruit, is used for treating a variety of conditions, such as asthma, wound healing, ringworm infestation, gallstones, abscesses, antisyphilitic properties, anthelmintic effects, lactagogue properties, relief from earaches, antiulcer properties, dental cavity prevention, toxin absorption, anemia, dermatitis, cough, diarrhea, fever, sedation, and promoting healthy digestion. (Periyanayagam K, May 2013).

1.1 DESCRIPTION OF ARTOCARPUS HETEROPHYLLUS LEAVES

The leaves of *Artocarpus Heterophyllus*, more commonly recognized as jackfruit, stand out not only for their visual appeal but also for their considerable importance across different spheres of human existence. (Jonathan Smith, 2024)

heterophyllus tree are also very important, even if the fruit of the jackfruit tree is well-known for its distinct flavor and adaptability in cooking. (Benjamin Nguyen, 2024). The qualities, therapeutic possibilities, and culinary significance of Artocarpus Heterophyllus leaves will all be thoroughly examined in this essay. By examining the size, shape, color, traditional medicinal uses, and culinary versatility of these leaves, a more comprehensive understanding of their complex nature can be gained. (Sarah Johnson, 2024).



FIG 1.2 PHYSICAL CHARACTERISTICS ARTOCARPUS HETEROPHYLLUS

Artocarpus Heterophyllus leaves are distinguished in part by their unusual physical characteristics, which include their huge size, oblong form, and vivid green color. With up to 9 inches of length, these leaves rank among the largest in the plant kingdom. Their smooth surfaces with pronounced veins add visual appeal, and their robust but flexible nature allows for a variety of uses, both in the culinary and medical arts. Because of these qualities, Artocarpus Heterophyllus leaves are quite versatile and easy to identify in a variety of settings. (Olivia Garcia, 2024).

TAB 1 : PHYSICAL CHARACTERISTICS OF THE LEAVES

SIZE	The leaves are typically large and can reach up to 9 inches in length and 4 inches in width.
SHAPE	They are generally elliptical or ovate in shape with pointed tip.
TEXTURE	The leaves have a smooth texture on the upper surface and a slightly hairy texture on the underside.
COLOR	The color of the leaves can vary from bright green to dark green , and they often have a glossy appearance.
VEINS	The leaves have prominent veins running through them, which contribute to their overall appearance.
DISTINCTIVE FEATURES	Prominent veining , with deeply impressed veins on the upper surface and raised veins on the lower surface. The leaves are arranged alternately on the stems.

1.2 LEAF ARRANGEMENT

The leaves of the *Artocarpus heterophyllus* (jackfruit tree) are alternately and spirally arranged on the branches. The petiole is 1 to 3 cm long, and the leaf blade is elliptic to obovate, measuring 7 to 15 cm in length and 3 to 7 cm in width. On young trees, the leaves are lobed, while on mature trees, the leaves are entire with a leathery texture. The leaves have a pale green underside with scattered resin cells and a dark green, shiny, and glabrous upper surface. The base of the leaf is cuneate, the margin of mature leaves is entire, and the apex is blunt to acuminate. The midvein is prominently visible on the underside, and there are 6 to 8 secondary veins on each side of the midvein.

Phyllotaxis: The leaves are arranged alternately and spirally on the branches of the tree. This means that the leaves emerge from the stem in a helical pattern, with each leaf positioned at an angle to the previous one.

Petiole: The leaves are attached to the stem via petioles, which are generally 1 to 3 cm long. The petioles serve to support the leaf and position it for maximum exposure to sunlight.

Leaf Blade: The leaf blade is elliptic to obovate in shape, measuring approximately 7 to 15 cm in length and 3 to 7 cm in width. These dimensions can vary slightly depending on the age of the tree and the specific growing conditions.

Leaf Texture: On young trees, the leaves may be lobed, while on mature trees, the leaves are entire, meaning they are undivided and have a smooth, leathery texture.

Leaf Color and Surface: The underside of the leaves is pale green and contains scattered resin cells. In contrast, the upper surface of the leaves is dark green, shiny, and smooth (glabrous).

Leaf Base, Margin, and Apex: The base of the leaf is cuneate (wedge-shaped), while the margin of mature leaves is entire, meaning it is smooth and unbroken. The apex of the leaves can range from blunt to acuminate, depending on the specific leaf.

Veins: The midvein of the leaf is prominently visible on the underside, and there are typically 6 to 8 secondary veins on each side of the midvein.

The jackfruit tree efficiently captures sunlight for photosynthesis and contributes to its overall growth and development.

1.3 LEAF BASE:

- The leaf base refers to the lower part of the leaf where it is attached to the stem or petiole.
- In the case of *Artocarpus heterophyllus* leaves, the leaf base is cuneate, meaning it is wedge-shaped, tapering to a narrow point at the attachment to the petiole or stem.

- The base of the leaf provides structural support and serves as the point of attachment for the leaf, allowing it to remain connected to the rest of the plant and facilitating the transport of water, nutrients, and sugars. (Smith,J.A, 2019)

1.4 LEAF APEX:

- The leaf apex, or tip, is the uppermost part of the leaf.
- In the context of *Artocarpus heterophyllus* leaves, the apex can vary from blunt to acuminate, with some leaves having a more rounded or blunt tip, while others have a sharper, pointed tip.
- The apex of the leaf is involved in regulating transpiration and gas exchange. It also plays a role in protecting the leaf meristem, the growing tip of the leaf, and may aid in deterring herbivores. (Garcia, 2020)

1.5 UNIQUE FEATURES OF THE LEAVES:

Glossy Texture: One of the most notable features of the leaf surface is its glossy texture. The upper surface of the leaves has a smooth and shiny appearance, which gives them a distinct visual appeal. This feature sets them apart from many other types of leaves and adds to their aesthetic value. (Patel, 2017)

Waxy Coating: The leaf surface may possess a natural waxy coating, which contributes to the glossy appearance and helps reduce water loss through transpiration. This waxy layer also serves as a protective barrier against pests and pathogens, enhancing the leaf's resilience. (Wang, 2018)

Microscopic Structures: Under a microscope, the leaf surface reveals intricate microscopic structures, such as stomata and trichomes. Stomata are small pores that facilitate gas exchange, while trichomes are hair-like outgrowths that can have various functions, including deterring herbivores and reducing water loss. (y, 2015)

Distinct Vein Patterns: The leaf surface showcases distinct vein patterns that contribute to its overall appearance. The network of veins, including the midrib

and secondary veins, creates a visually appealing and intricate design on the leaf surface. (H, 2017)

1.6 MEDICINAL AND TRADITIONAL USE OF LEAVES

Apart from their aesthetic value, *Artocarpus Heterophyllus* leaves have gained recognition for their wide range of medicinal and therapeutic properties, which have been valued for ages by a variety of cultures. These leaves have been used historically to treat a wide range of ailments, including fever, diarrhea, and skin infections. They are highly valued for their medicinal properties. Their abundance of vitamins, minerals, and antioxidants is what makes them so effective. For those who wish to enhance their health and well-being with natural therapies, *Artocarpus Heterophyllus* leaves can be added to teas or applied topically. These leaves have long been used in traditional medicine, which emphasizes their value and efficacy in complementary therapies. (Lily Chen, 2024)

In addition to their therapeutic uses, *Artocarpus Heterophyllus* leaves are important in culinary and cultural traditions, especially in Asian nations where they are frequently used in traditional dishes. When used in several cooking techniques, like steaming, frying, or as organic wrappers, these leaves provide food a mildly flavorful but unique taste that improves the overall flavor profile. Especially, they give savory foods a hint of sweetness, which enhances their distinct flavor profile. In addition, *Artocarpus Heterophyllus* leaves are a great complement to a balanced diet because they are a great source of fiber, antioxidants, and vitamins A and C. These leaves have a crucial function in fostering holistic nutrition and enhancing culinary traditions due to their culinary variety and cultural significance. (David Kim, 2024)the leaves of *Artocarpus Heterophyllus* are distinguished by their wide variety of health advantages in addition to their striking appearance. With their eye-catching look, culinary applications, and therapeutic qualities, these leaves present a plethora of opportunities to improve human well-being. We can continue to appreciate the diverse nature of *Artocarpus Heterophyllus* leaves and gain a deeper grasp of their value by exploring their exquisite intricacies in a variety of contexts. (Maria Rodriguez, 2024)

CHAPTER – 2

AIM AND OBJECTIVES

Nutritional Analysis: The nutritional composition of *Artocarpus heterophyllus* to determine health benefits and culinary applications.

Phytochemical Analysis: Analyzing the phytochemical compounds present in *Artocarpus heterophyllus* to explore its potential medicinal properties.

Value-Added Products: Exploring innovative ways to utilize *Artocarpus heterophyllus* in human diet, by developing value-added products such as tea powder, soup mix and chappathi flour.

- The main aim is to evaluate the phytochemical components, antimicrobial reaction and antioxidant activity present in *Artocarpus hirsutus*.
- It serves multiple purposes which include culinary and medicinal properties with potential health benefits.
- It is also used as a biodegradable plate.

CHAPTER 3

REVIEW OF LITERATURE

The *Artocarpus heterophyllus* is native to Western Ghats of India, Malaysia and also found in central and eastern Africa, south-eastern Asia, the Caribbean, Florida, Brazil, Australia, Puerto Rico and many Pacific Islands. It is a large, evergreen tree, 10-15m in height, indigenous to the evergreen forests at altitude of 450-1,200m and cultivated throughout the hotter parts of India. Stem of this plant is straight rough whereas bark is green or black, 1.25cm thick, exuding milky latex, leaves broad obovate, elliptic, decurrent, glabrous, entire inflorescence solitary axillaries, cauliflorous and ramiflours on short leafy shoots. Male head is sessile or on short peduncles receptacles, sometimes born on the ultimate twing, Female head are oblong ovoid receptacle, syncarpus, cylindrics. Seeds are separated horny endocarpus enclosed by sub-gelatinous exocarpus (1mm thick) oblong ellipsoid in nature. The sweet yellow sheaths around the seeds are about 3–5 mm thick and have a taste similar to that of pineapple, but milder and less juicy Jackfruit (*Artocarpus heterophyllus* Lam) produces heavier yield than any other tree species, and bear the largest known edible fruit (up to 35 kg). The jackfruit tree has several uses. Flakes of ripe fruits are high in nutritive value; every 100 g of ripe flakes contains 287-323 mg potassium, 30.0-73.2 mg calcium and 11-19 g carbohydrates. In Bangladesh, it is commonly referred to as “poor man’s food” as it is cheap and plentiful during the season. The nutritious seeds are boiled or roasted and eaten like chestnuts, added to flour for baking, or cooked in dishes. The tree is also known for its durable timber, which ages to an orange or reddish brown color, with anti-termite properties. The leaves and fruit waste provide valuable fodder for cattle, pigs and goats. Jackfruit wood chips yield a dye, which is used to give the famous orange-red color to the robes of Buddhist priests. In addition, many parts of the plant, including the bark, roots, leaves and fruits have medicinal properties. Leaves are dark green, alternate, entire, simple, glossy, eathery, stiff, large (up to 16 cm [6 in] in length), and elliptic to oval in form. Leaves are often deeply lobed when juvenile and on young shoots. The leaves are useful in fever, boils, wounds and skin diseases. The ripe fruits are sweet, cooling, laxative, aphrodisiac and also used as a brain tonic. The seeds are, diuretic, and

constipating. The wood is nervine, antidiabetic, sedative and is useful in convulsions. The latex is useful in dysopia, ophthalmic disorders and pharyngitis and also used as antibacterial agent .

The ash of Jackfruit leaves is used in case of ulcers. The dried latex yields artostenone, convertible to artosterone, and a compound with marked androgenic action. Mixed with vinegar, the latex promotes healing of abscesses, snakebite and glandular swellings . The root is a remedy for skin diseases and asthma. An extract of the root is taken in cases of fever and diarrhoea. The bark is made into poultices. Heated leaves are placed on wounds. The wood has a sedative property and its pith is said to be abortifacient. Latex is used as an anti-inflammatory agent (Om prakash., 2010).

Jackfruits comprises a wide range of nutrients, including minerals, carbohydrates, volatile compounds, proteins, and vitamins. The fruit, bark, leaves, and roots are endowed with therapeutic attributes and are utilized in the many traditional medicinal systems for the management of various ailments. Fruit and seeds are commonly used to prepare various food items, including sauce, ice creams, jams, jellies, and marmalades. Due to unique texture, jackfruit is becoming a popular meat substitute. Based on preclinical studies, jackfruit exhibits antimicrobial, antioxidant, anti-melanin, antidiabetic, anti-inflammatory, immunomodulatory, antiviral, anthelmintic, wound-healing, and antineoplastic activities. Clinical studies reveal that the leaves possess antidiabetic action in healthy and insulin-independent diabetic individuals. (Rajiv Gupta et., 2022)

The maceration process is carried out, the Jackfruit leaves to be used are cleaned first and then dried at room temperature without sunlight . This is because exposure to direct sunlight at high temperatures can damage and cause degradation of the compounds contained in the sample. After drying, the jackfruit leaves and then mashed using a blender. Phytochemical Screening After obtaining the thick extract, the extract was then tested for the chemical compounds contained in it using a phytochemical screening test .At this stage, five types of examinations are carried out, namely the examination of alkaloids, flavonoids, tannins, saponins, steroids and triterpenoids.

The phytochemical screening test result was done for presence in jackfruit leaves alkaloid, Flavonoid, Fenolic/tannin. Steroid and Triterpenoid and absent for jackfruit leaves in saponin. This is supported by the color change that occurs due to the supply reagent for extracting jackfruit leaf . (Mishra, 20210) .Phytochemical test results show that jackfruit leaves contain various types of secondary metabolites .

The taller plants have good flavonoids in the vegetative section, especially in the flower. Flavonoids as flower pigments play an important role. Other functions of flavonoids are able to absorb ultraviolet light to direct insects, regulate plants, regulate photosynthesis, work in anti-microbial and anti-virus work on insects. The effects of flavonoids on many organisms are numerous. flavonoids are widely used in traditional medicine. In addition content of flavonoids work as a strong respiratory inhibitor, inhibiting enzyme and non-enzyme oxidation reactions The highest chemical extracts of jackfruit leaves are obtained from tritertenoid and steroid substances .flavonoids are found in low content. (warly, 2021)

The Preliminary phytochemical screening of EAAH leaves .The presence of flavonoids, sterols, carbohydrates, proteins, tannins, phenolic compounds and absence of alkaloids, volatile and fixed oils, glycosides anthroquinone, cardiac, cyanogenetic and isothiocyanate. (PERIYANAYAGAM, 2013) The total phenolic content of EAAH was found to be 376.5mg/g.The trace element content of XRF analysis showed the presence of Calcium (39.4%), Potassium (29.6%), Magnesium (2.06%), Iron (0.99%), Sulphur (1.83%), Zinc (0.083%), Strontium (0.23%), Manganese (0.13%) and Aluminium (0.005%). The HPTLC analysis of EAAH contain 134mg/g of ursolic acid . (V, 2013)

The ethanolic leaf extract Showed in the phytochemical screening in flavanoids, phenols, terpenoids, saponins, steroids,and aqueous extracts showed the presence of flavonoids , phenols, saponins,and steroids .The analgesic activity is presented in hot plate method , writhing method and Tail flick method . The antioxidant activity is presented in nitric oxide radical scavenging property of aqueous extarct and ethanolic extract with ascorbic acid , DPPH free radical scavenging property of aqueous extarct and ethanolic extract with ascorbic acid . (widyawati, 2020)

The preliminary phytochemical test for methanolic extract in leaves alkaloids, amino acid, carbohydrate, phenols, tannin, terpenoids, saponins, flavonoids, protein, steroids, fixed oil and fat. The ash content is (27.50%), water soluble content is (24.92%), Acid soluble content is (14.06%), Alcohol soluble content is (13.05%). Methanolic extract of *Artocarpus heterophyllus* was found to exhibit maximum antimicrobial activity against *E. coli*. With respect to the zone of inhibition. Zone of inhibition was exhibited by leaf extract with the high concentration. The Gram-positive bacterial strains were found to be more susceptible to the extracts of various plant parts tested as compared to Gram-negative bacteria (POOJITHA, 2017)

The phytochemical screening revealed the presence of alkaloids, flavonoids, carbohydrate, tannins, steroid, terpenoids, cardiac glycoside, saponins, carboxylic acid, all phytochemical screening content is Positive in *Artocarpus heterophyllus* leaves. The macro and micro mineral content in jack fruit leaves (7.150)Mg, (34.945)K, (85.108) Ca, (47.05) Na, (5.410) P. The mineral content is (8.579) Zn, (0.640) Cu, (1.296)Mn, (3.949) Cr, (40.740) Fe. (Onuah, 2018)

Aqueous methanol exhibited highest yield percentage in 10.98% . Methanol solvent least percentage in 0.22% . Ethyl acetate solvent yield 4.68% . Methanol extract presence in coumarin , steroids . Ethyl acetate presence in coumarin , terpenoid. Aqueous methanol presence in coumarin, tannin, saponin. Coumarin was present in all three extract blood thinning , antifungicidal, and antitumor activity . Terpenoid presence in aromatic properties and antibacterial , anti cancer properties (Uwakwe, 2018).

This plant reduce of cholesterol problem presence of steroid . Saponin present in aqueous methanol extract lowering of blood cholesterol and inhibition of cancer cell growth . Saponin used are traditional medicines, especially asia and intensively used in food, veterinary and medicinal industries. Tannin present in aqueous methanol extract naturally occurring polyphenols binding and precipitating proteins (Anacleto, 2018).

Phytochemical screening from the presence of phytosterols, anthraquinone, terpenoids, phenols, glycosides, flavonoids, and diterpenes . The antioxidant activity of tannin result from their free radical and reactive oxygen species- scavenging

properties, as well the chelation of transition metal ions that modify the oxidation process. Among three solvents used for the methanol extract the best antioxidant activity. So, the leaf extract of the plant has some anti-cancer activity (Nita thapa ET AL., 2016).

The proximate composition of jack fruit leaves. The moisture content range from (85.33%). The crude fiber content range from (4.91%). Ash content range (2.53%). Protein content range (1.19%). Fat content range (0.73%). Carbohydrate content range (5.33%). Minerals and vitamin content for jack fruit leaves. Calcium content range (0.52g/100g) Potassium content range (0.21g/100g) Manganese content range (12.75g/100g) Iron content range (59.50g/100g) Zinc content range (5.73g/100g) Vitamin c content range (0.99g/100g) Phytochemical composition of jack fruit leaves. Phytic acid content range (7.5 /mg/100g) Oxalate content range (0.42 /mg/100g) Alkaloid content range (12.43/mg/100g) Tannin content range (0.07/mg/100g) Flavonoid content range (3.91/mg/100g) (bhandari, 2016).

The calcium content for jackfruit leaves is high. Ash content is higher in jackfruit leaves. Potassium consumption improves blood pressure. The iron content is highest in jack fruit leaves. Vitamin c content is very low for jack fruit leaves. Phytic acid content is low. The tannin content is very low compared to oxalate and alkaloids. The presence of flavonoids indicates medicinal benefits. Antioxidant properties and increased activity of enzymes detoxify carcinogens (Amadi, 2018).

CHAPTER 4

MATERIALS AND METHODS

4.1 COLLECTION OF LEAVES

Fresh leaves of jackfruit were collected in November 2023 from a village in Alathur of Kerala. They were identified by Assistant professor S. Kanya Department of clinical nutrition and dietetics, Sathyabama institute of science and technology, Chennai. The leaves were washed slightly in distilled water, dried in sunlight for 1-2 weeks and used immediately.



FIG 4.1 DRIED JACK FRUIT LEAVES

4.2 EXTRACTION OF LEAVES MATERIAL

The extraction methods described by Professor James Department of Medical Laboratory Technology were adopted. Leaves were grinded into fine powder. 2gm of leaf powder is mixed with 50ml of ethanol and kept in a beaker. Water bath of leaf extract using ethanol at 40°C for a day. Leaf extract using ethanol was continued by the process of filtration using filter paper. Filtration has been done twice and preserved in deep freezer. The extract was again kept in water bath. 50% of ethanol extract has been reduced to 25% after 3 hours of water bath.



FIG 4.2 : WATERBATH LEAVES



FIG 4.3 : FILTRATION PROCESS

ETHANOL EXTRACT

4.3 PHYTOCHEMICAL SCREENING

The method of jackfruit leaves ethanol extract were used to identify the following phytochemicals in the extract :

Flavonoids, tannins, alkaloids, steroids, phenols, amino acid, carbohydrate, anthraquinone, terpenoids.

DETECTION OF FLAVONIODS:

Two to three drops of sodium hydroxide were added to 2ml of extract. Initially, a deep yellow colour appeared but it gradually became colourless by adding few drops of dilute HCL, indicating that flavonoids were present.

DETECTION OF TANNINS:

About 2.5mg of each plant extract was boiled in 5ml of water in a test tube and then filtered through WHATMAN'S no. 1 filter paper. Two to three drops of 0.1% ferric chloride added and read for brownish green or a blue –black precipitate indicating a positive result.

DETECTION OF ALKALOIDS:

By adding 1ml of Dragendorff's reagent to 2ml of extract, an orange red precipitate was formed, indicating the presence of alkaloids.

DETECTION OF STEROIDS:

Leaf extract was mixed with 2ml of chloroform and concentrated H₂SO₄ was added sidewise. A red colour produced in the lower chloroform layer indicated the presence of steroids. Another test was performed by mixing leaf extract with 2ml of chloroform. Then 2ml of each of concentrated H₂SO₄ and acetic acid were poured into the mixture. The development of a greenish coloration indicated the presence of steroids.

DETECTION OF PHENOLS :

Appearance of red color indicates the presence of phenols. Lead acetate test. Three drops of Pb(OAc)₂ was added to 5ml of extract and mixed well. Formation of yellow precipitate indicates the presence of phenols.

DETECTION OF AMINO ACID :

Take 2ml of given sample compound in a test tube. A few drops of concentrated sulphuric acid and heat. If there is formation of yellow precipitate then the presence of amino acid .

DETECTION OF CARBOHYDRATE:

One ml of the analyte sample must be mixed with 2ml of Benedict's reagent and heated in a bath of boiling water for 3 to 5 minutes. The development of a brick red coloured precipitate of cuprous oxide confirms the presence of reducing sugars in the analyte. The test for carbohydrate is negative.

DETECTION OF ANTHRAQUINONE:

To 2ml of extract 1ml of concentrated H₂SO₄ and 0.5ml diluted ammonia was added. Appearance of rose pink colour indicates the presence of anthraquinone. The test for anthraquinone is negative.

DETECTION OF TERPENOID:

Salkowski test was used to detect terpenoids . Extract (5ml) was mixed with chloroform(2ml), and concentrated sulphuric acid (3ml) was carefully added to

form a layer. A reddish brown coloration of the interface was formed to show positive results for the presence of terpenoids. The test for terpenoids is positive.

TAB 2 : PHYTOCHEMICAL SCREENING

PHYTOCHEMICALS	NEGATIVE	POSITIVE
FLAVANOIDS		+
TANNIS		+
ALKALOIDS		+
STEROIDS		+
PHENOLS		+
AMINO ACIDS		+
CARBOHYDRATE	-	
ANTHRAQUINONE	-	
TERPENOIDS		+

4.4 NUTRITIVE ANALYSIS

CARBOHYDRATE

Procedure:

Total carbohydrates are calculated as follows after determining the percentage of moisture, total protein, fat and total ash

$$\text{Total Carbohydrate} = 100 - (A + B + C + D)$$

ENERGY

Procedure:

Food energy values in both kilocalories (kcal) and kilojoules use the same factors.

$$\text{Energy (kcal/100g)} = (\text{Carbohydrate} \times 4) + (\text{Protein} \times 4) + (\text{Fat} \times 9)$$

A = P by mass of moisture

B = Percent by mass of total ash,

C = Percent by mass of fat

D = Percent by mass

FAT

AOAC Official Method 954.02, 20th editions, 2016

Principle: Not applicable

Apparatus:

- Hot air oven.
- Aluminum dish.
- Desiccators
- Soxhlet apparatus
- Thimble

Chemicals and Reagent :

- Hexane - Food grade
- Ethanol
- Petroleum ether
- Diethyl ether
- Hydrochloric acid

Procedure:**For more than 10% of fat contained samples:**

Weigh accurately about 2 g of sample in a pre-weighed aluminum dish with a cover.

Shake the dish until the contents are evenly distributed. With cover removed place the dish and cover in hot air oven maintained at 100°C and dry for at least 2 hours. Place cover on dish, cool in a desiccators and weigh. Weigh accurately about 2.5 g of moisture free sample in thimble. Extract with Hexane in a Soxhlet apparatus for 4 hours. Dry the extract on a hot air oven for overnight, cool in desiccators and weigh.

For Less than 10% of fat contained samples:

Applicable to fruit juices, cereal based products also.

Weigh accurately about 2 g of sample in a fat extraction tube; add 2.0 ml of alcohol to prevent lumping on addition of acid, and shake to moisten all particles. Add 10 ml HCL (25+11), mix well and set tube 30 to 40 mins in water bath at 70°C to 80°C, shaking frequently. Cool to room temperature and add alcohol. Add 25 ml diethyl ether to flask and shake 1.0 mins. Then add 25 ml petroleum ether to flask and shake 1 mins. Decant ether layer in to pre weighed dry flask through anhydrous sodium sulphate. Then Decant ether layer in to pre weighed dry flask through anhydrous sodium sulphate. Then add 25 ml of 1:1 diethyl ether, petroleum ether to flask and shake 1.0 min. Ether layer can be evaporated under water bath. Keep the flask in to oven for further evaporation of ether residue.

Remove flask from oven and place in desiccators to cool to room temperature. Record the weight of flask plus fat.

Calculation:

$$\% \text{ of Fat} = \frac{(\text{Weight of flask +fat}) - \text{Empty weight of the flask} \times 100}{\text{Sample Weight}}$$

PROTEIN

Procedure:

Weigh 0.7 to 2.2 g sample into digestion flask. Add 10g of potassium sulphate or anhydrous sodium sulphate, about 0.4 g CuSO₄ and 25 mL. or more, if necessary of Con H₂SO₄ to the flask. Heat the flask for 90 min for complete digestion. Cool, cautiously add 250 ml. H₂O, and cool to room temperature. Add 100 ml of 4% boric acid to the beaker, that condenser tip will be sufficiently immersed. Add 3-4 drops of mixed indicator. Connect flask to distillation apparatus, add sufficient 45% NaOH solution, mix completely, such that mixture will be strongly alkaline and distil until 150 mL. distillate is collected in titration beaker. Titrate against 0.1N HCl solution. Correct for blank determination on reagents.

Calculation:

$$\% \text{ N (w/w)} = (\text{TV}_s - \text{TV}_b) \times \text{Normality of standard Hcl} \times 1.4007 \text{ Sample Weight}$$

Where

TV_B Titer value of Blank.

TV_s Titer value of sample

Calculate Crude protein from Nitrogen

TAB 3 : NUTRITIVE ANAIYSIS

Animal feed (General factor)	NX 6.25
Milk and Dairy products	NX 6.38
Wheat flour	NX 5.7
Gelatine	NX 5.55
Egg	NX 6.68
Soya flour	NX 5.70
Ground Nuts	NX 5.46
Rice	NX5.95
Rye/Barley/Oats	NX 5.83
Wheat meal	NX 5.83

SODIUM

This standard operating procedure describes a method for the determination of sodium and potassium all type of ready to eat food products.

REFERENCE

AOAC20th edition 2016

PRINCIPLE

Flame emission is directly proportional to the concentration of the solution.

APPARATUS

Silica crucible

Muffle furance

Standard measuring flasks-100ml

Flame photometer

CHEMICALS AND REAGENTS

Conc. Nitric acid

Sodium chloride High purity

Potassium chloride High purity

Sodium standard solution

Stock solution - 1mg na/ml. Dry reagent grade Nacl 2 h at 110o c ; cool in deciccators. Weight 2.5421gram in to 1L Volumetric flask and dilute to volume with H2O.

Working standard solution

5,10,25,50, 100mg 1 prepare from 1000 ppm of stock solution .

Potassium standard solution

1,9068 g into 1L volumetric flask and dilute to volume with H2O (or) Use potassium 1000 mg/1 if available.

Working standard solution

5,10,25,50, 100mg/l prepare from 1000 ppm of stock solution.

Procedure :

Dry ash method:

Weigh 4 g test sample into crucible, and char on electric hot plate or over low flame. Place in cold furnace and bring to 525°C. Ash 2 h to white ash. Cool, and weigh if total ash is desired. Add 15 ml dilute HNO₃ (1+4) to crucible, breaking up ash with stirring rod if necessary. Filter through acid-washed quantitative paper into 100 mL. volumetric flask. Wash residue and paper 3 times with H₂O. Dilute to volume and read directly. Prepare blank solution by diluting 2 mL HNO₃ to 100 ml with H₂O. If sample goes to out of calibration make suitable dilution and read once again.

Calculation:

$$\text{Sodium or potassium (mg/kg)} = \frac{\text{Concentration} \times \text{Made up volume} \times \text{Dilution}}{\text{Weight of the sample}}$$

$$\text{Sodium or Potassium (mg/100g)} = \frac{\text{Sodium or Potassium (mg/kg)}}{10}$$

CALCIUM**Reference:**

IS : 5949:1990 RA 2020 volumetric determination of calcium and magnesium using EDTA.

Principle: Not applicable.

Apparatus:

- Silica crucible
- Muffle furnace
- volumetric flasks
- Gooch filter
- Pipettes
- What man filter paper No.40

Chemicals and Reagents:

- P & R indicator
- EBT indicator
- Sodium hydroxide diluted -20%
- Standard EDTA Solution - 0.01M
- Triethanolamine solution
- Buffer solution
- Hydroxylamine Hydrochloride

Procedure:

Weigh 5 g of sample in Silica crucible and ignite at 550 deg * C plus/minus 25 deg * C in furnace to C- free ash. Boil residue with 40 mL dil HCl and few drops concentrated HNO_3 and Cool Transfer to 250 mL volumetric flask, dilute to volume, and mix thoroughly.

For Calcium:

Take a suitable aliquot of the sample solution, 10 ml of hydroxylamine hydrochloride solution and 2 ml of potassium cyanide solution. Dilute to about 150 to 200 ml with water and adjust pH to 12.5 to 13.0 with 20% sodium hydroxide solution using a pH meter. Add P & R indicator. Titrate with 0.01 M EDTA solution from a burette, till the colour changes from red to pure blue free from any violet tinge. The end point the colour turns a violet which on further drop wise addition gives the pure blue end point. Where a slight excess of EDTA has been added. Note the volume as V1.

For Magnesium:

Take a same as above aliquot of the solution. Expected to contain approximately 10 to 30 mg of calcium and magnesium combined oxides in a 500 ml conical flask. Add 10 ml of hydroxylamine hydrochloride solution, 2 ml of potassium cyanide solution and 25 ml of triethanolamine solution. Dilute to 150 to 200 ml and add sufficient quantity of buffer solution to bring the pH to 9.5 to 10. Add 3 to 4 drops of EBT indicator solution and titrate with 0.01 M EDTA solution till the red colour changes to pure blue end point free from violet tinge. It is easier to note the end point by comparing the colour with that of previously titrated solution having a pure blue end point, where a slight excess of EDTA Solution has been added. Note the volume as V2.

Note: Make necessary dilution and take necessary aliquots according to the Calcium and magnesium concentration.

Calculation:

$$\% \text{ of calcium (mg/100g)} = \frac{V1 \times 40.08 \times \text{Molarity} \times \text{Dilution} \times 100}{\text{Weight of the sample}}$$

4.5 ANTIBIOTICS SENSITIVITY TEST

The same procedure is followed as we have done for Phytochemical testing. The broth has been inserted in the test tube and it has been closed tightly using cotton.

The extract has been kept in autoclave for 45minutes. There 8 different bacteria inserted Into the test tube. The test tube is kept in incubator for incubator to view the bacterial growth.



FIG 4.4 : BROTH WAS COLLECTED



FIG 4.5: MATERIALS USED



FIG 4.6 : 8 SPECIFIC BACTERIA

4.6 DATA ANALYSIS AND INTERPRETATION

GENDER :

TAB 4 : NUTRITIVE ANAIYSIS GENDER

Male	13
Female	37

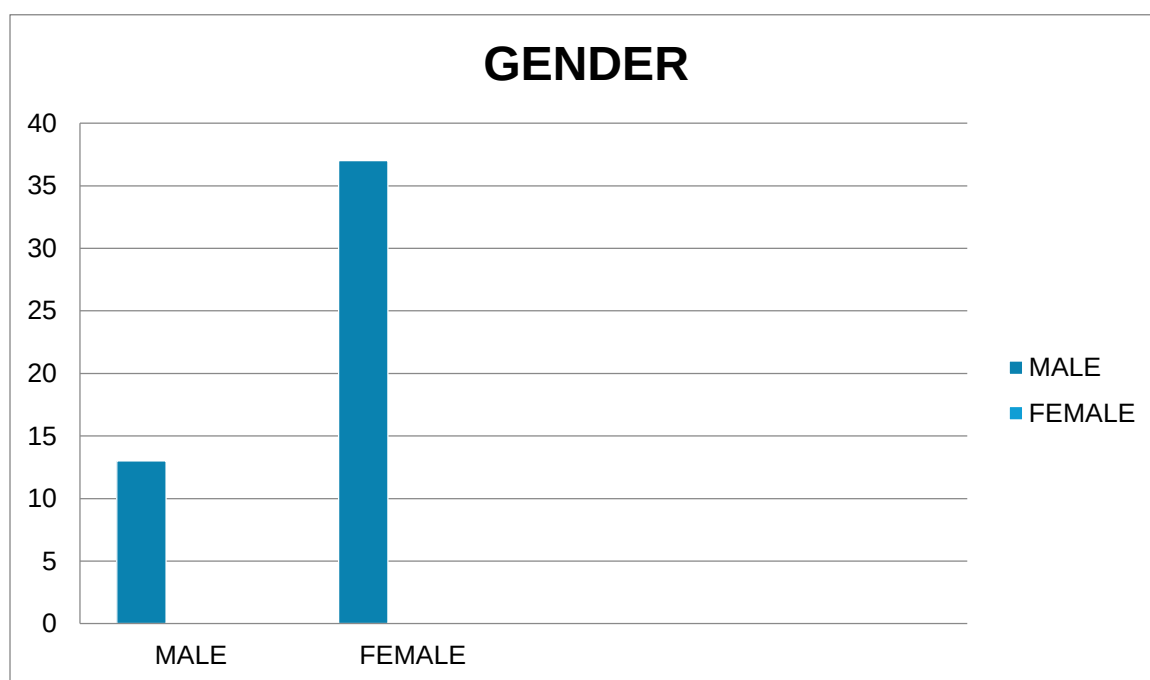


FIG 4.7 : SENSORY ANALYSIS BASED ON GRAPH

Calculation :

$$\text{Male} = 13 \times 50 \div 100 = 6.5$$

$$\text{Female} = 37 \times 50 \div 100 = 18.5$$

INTERPRETATION :

In this data was collected in both male and female people. 13 male people and 37 female people were collected.

OCCUPATION :

TAB 5 : NUTRITIVE ANALYSIS OCCUPATION

RANGE OF OCCUPATION	NO.OF RESPONSE
Bio chemistry	35
Bio technology	10
B.com	5

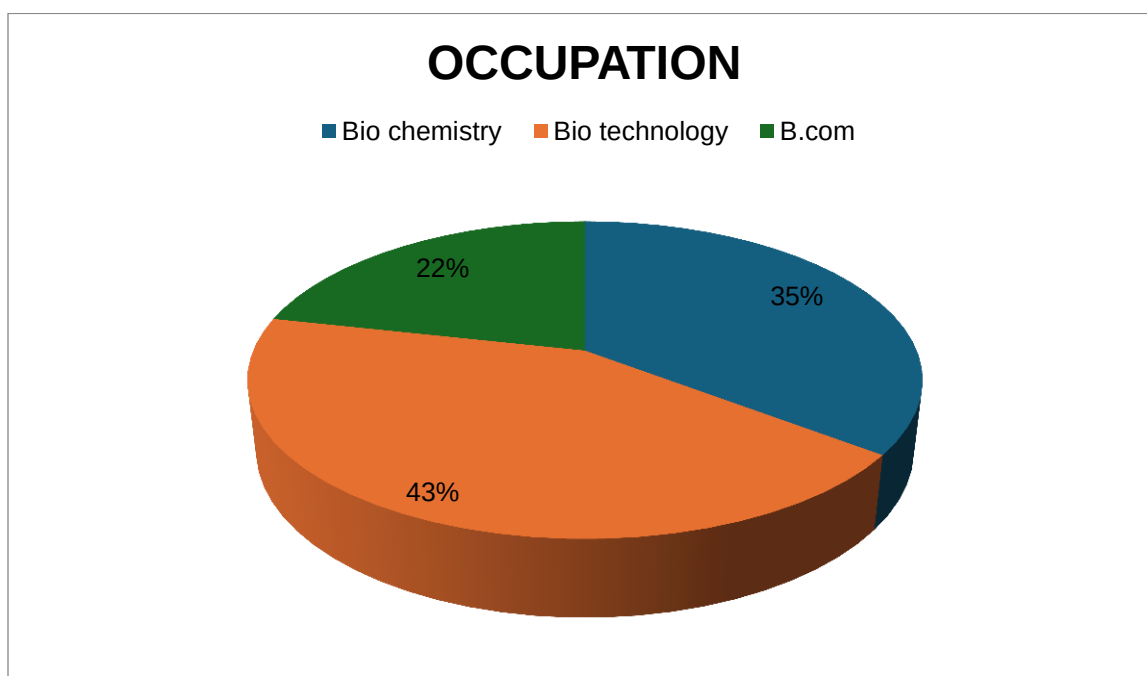


FIG 4.8 : SENSORY ANALYSIS BASED ON PIECHART

Calculation :

$$\text{Biochemistry} = 35 \times 50 \div 100 = 17.5$$

$$\text{Biotechnology} = 10 \times 50 \div 100 = 5$$

$$\text{B.com} = 5 \times 50 \div 100 = 2.5$$

INTERPRETATION :

It was found that people lifestyle. bio chemistry student is 35. Biotechnology student is 10 people. B.com student is 5 people.

APPEARANCE :

TAB 6 : NUTRITIVE ANALYSIS APPEARANCE

Range of Appearance	No. of Response
Like	28
Like extremely	10
Like very much	12

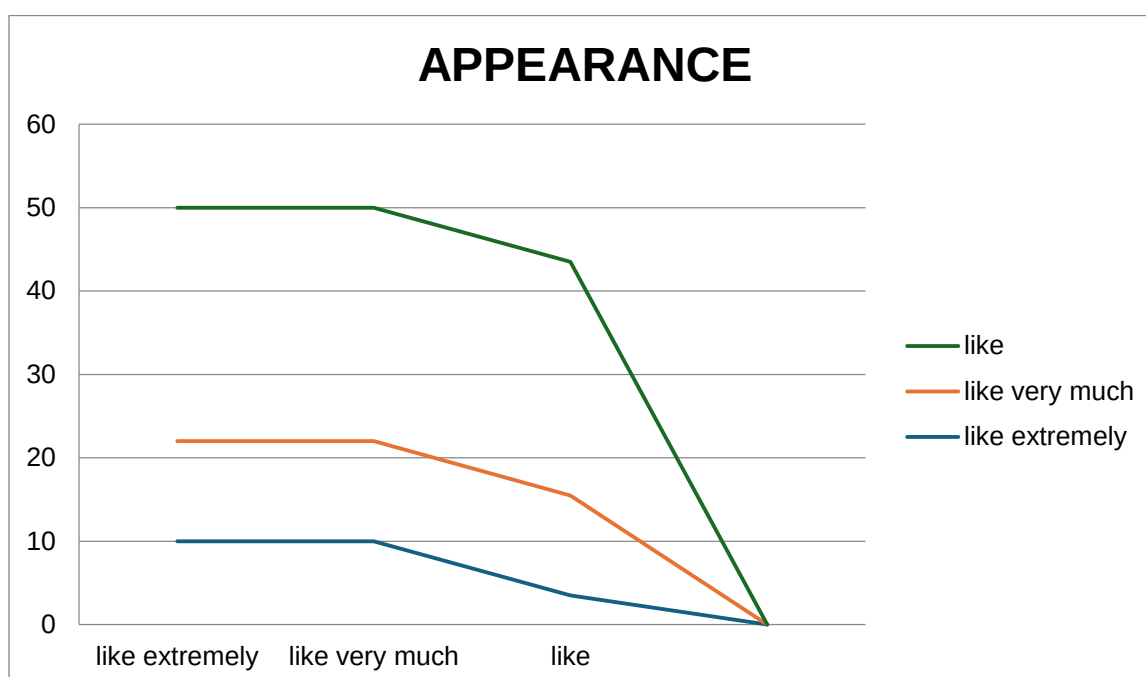


FIG 4.9 : SENSORY ANALYSIS BASED ON LINECHART

Calculation :

$$\text{Like} = 28 \times 50 \div 100 = 14$$

$$\text{Like extremely} = 10 \times 50 \div 100 = 5$$

$$\text{Like very much} = 12 \times 50 \div 100 = 6$$

INTERPRETATION :

The data was collected in appearance in tea powder for people. Like extremely for 27, like very much for 8, like 15 people.

TEXTURE :

TAB 7 : NUTRITIVE ANAIYSIS TEXTURE

Range of texture	No. of Response
Like extremely	20
Like slightly	17
Neither like or dislike	8
Like	5

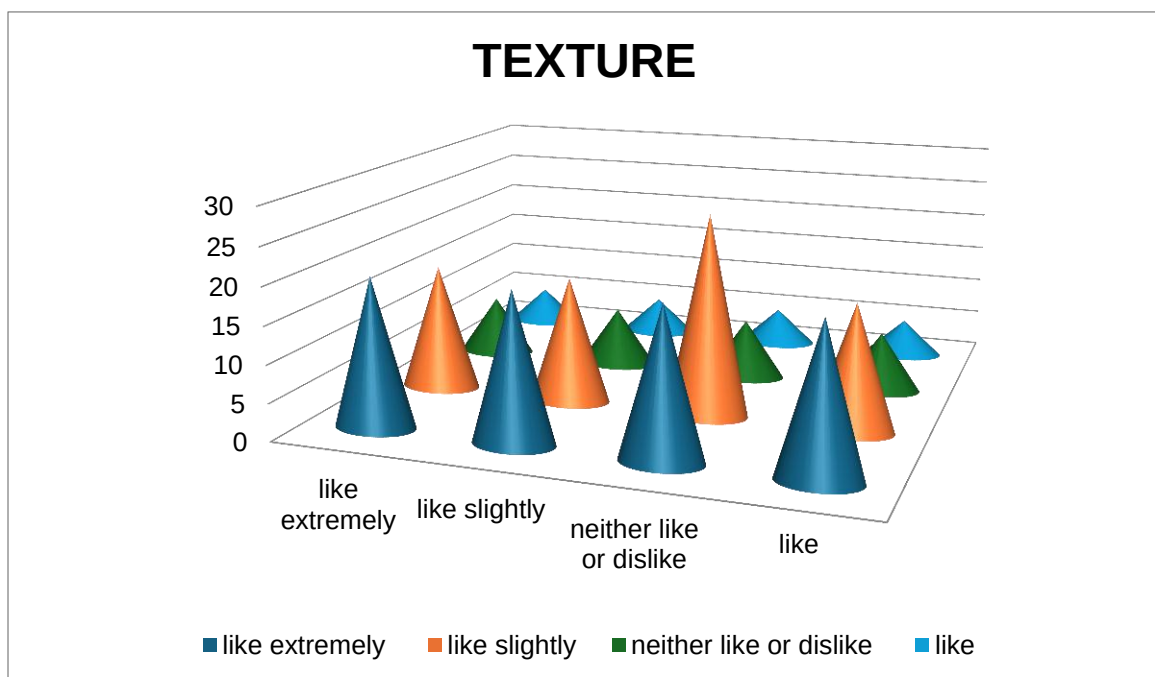


FIG 4.10 : SENSORY ANALYSIS BASED ON BARCHART.

Calculation :

Like	=	$5 \times 50 \div 100 = 2.5$
Like extremely	=	$20 \times 50 \div 100 = 10$
Like slightly	=	$17 \times 50 \div 100 = 8.5$
Neither like or dislike	=	$8 \times 50 \div 100 = 4$

INTERPRETATION :

The data was collected in appearance in tea powder for people. Like extremely for 27, like very much for 8, like 15 people.

FLAVOUR / TASTE :

TAB 8 : NUTRITIVE ANAIYSIS FLAVOUR/TASTE

Range of flavor/ taste	No. of Response
Like extremely	18
Like very much	10
Neither like or dislike	7
Like	15

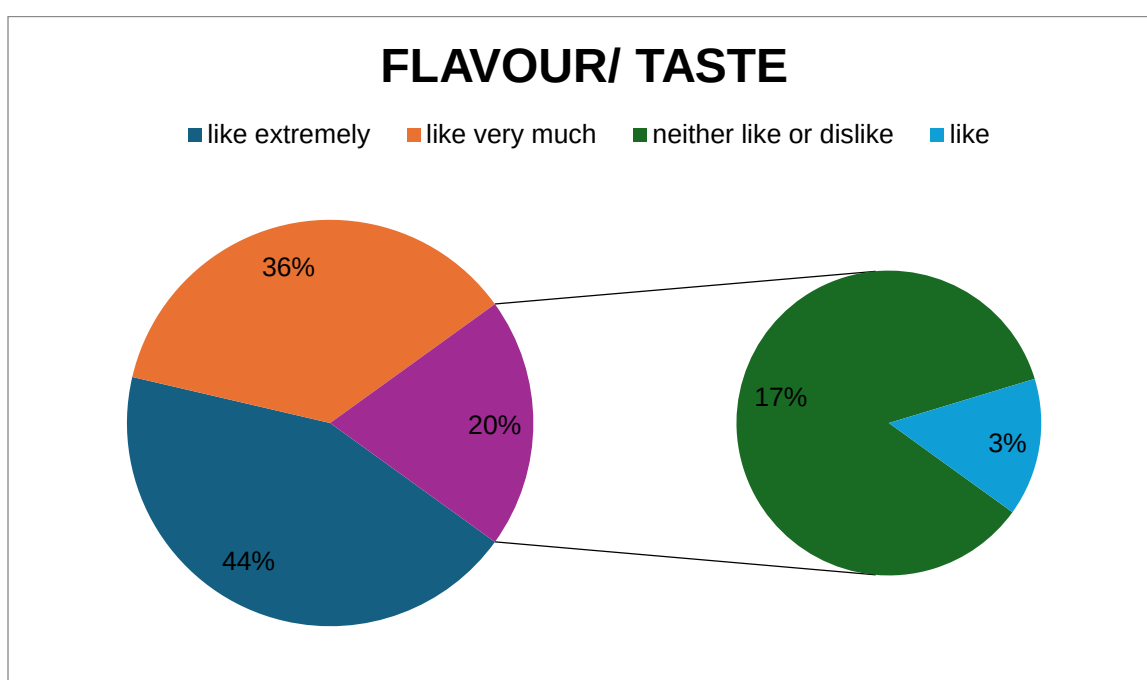


FIG 4.11 : SENSORY ANALYSIS BASED ON PIECHART.

Calculation :

Like	=	$15 \times 50 \div 100 = 7.5$
Like extremely	=	$18 \times 50 \div 100 = 9$
Like very much	=	$10 \times 50 \div 100 = 5$
Neither like or dislike	=	$7 \times 50 \div 100 = 3.5$

INTERPRETATION :

The data was collected in flavor/ taste tea powder for people. Like extremely for 18, like very much for 10, like 15, neither like or dislike 7 people.

AROMA :

TAB 9 : NUTRITIVE ANAIYSIS AROMA

Range of aroma	No. of Response
Like extremely	28
Like	12
Neither like or dislike	4
Like very much	6

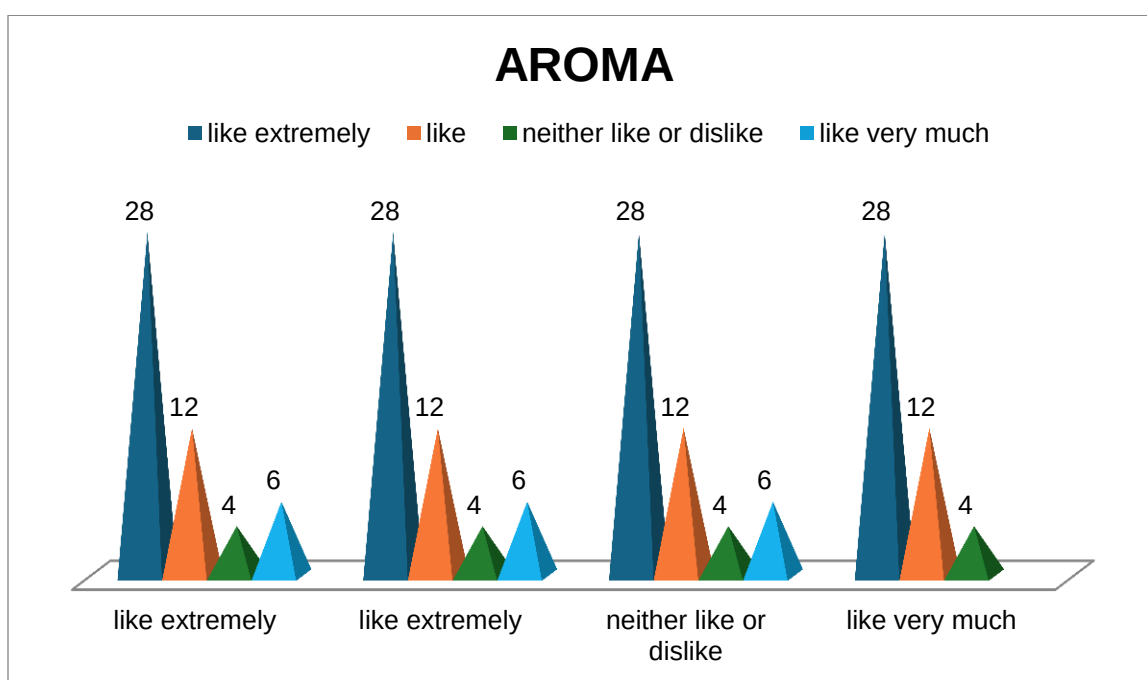


FIG 4.12 : SENSORY ANALYSIS BASED ON BARCHART

Calculation :

$$\begin{aligned}\text{Like} &= 12 \times 50 \div 100 = 6 \\ \text{Like extremely} &= 28 \times 50 \div 100 = 14 \\ \text{Like very much} &= 6 \times 50 \div 100 = 3 \\ \text{Neither like or dislike} &= 4 \times 50 \div 100 = 2\end{aligned}$$

INTERPRETATION :

The data was collected in aroma for tea powder for people. Like extremely for 28, like very much for 6, like 12, neither like or dislike 4 people.

OVER ALL ACCEPTABILITY

TAB 10: NUTRITIVE ANALYSIS OVER ALL ACCEPTABILITY

Range of over all acceptability	No. of Response
Like extremely	27
Like	13
Neither like or dislike	3
Like very much	7

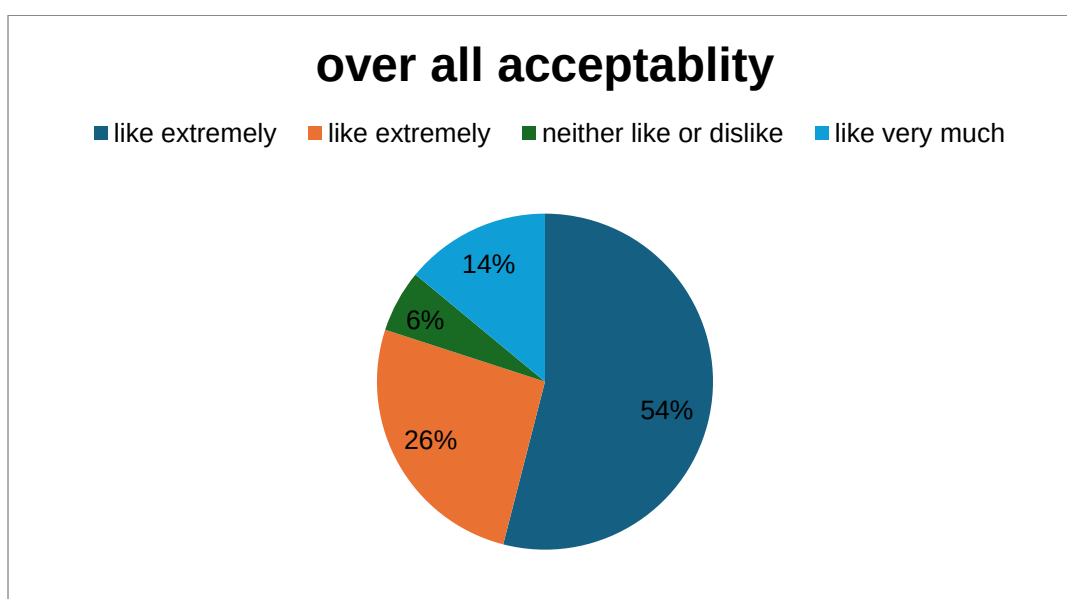


FIG 4.13 : SENSORY ANALYSIS BASED ON PIECHART.

Calculation :

Like	=	$13 \times 50 \div 100 = 6.5$
Like extremely	=	$27 \times 50 \div 100 = 13.5$
Like very much	=	$7 \times 50 \div 100 = 3.5$
Neither like or dislike	=	$3 \times 50 \div 100 = 1.5$

INTERPRETATION :

The data was collected in over all acceptability tea powder for people. Like extremely for 27, like very much for 7, like 13, neither like or dislike 3 people.

CHAPTER – 5

RESULTS AND DISCUSSION

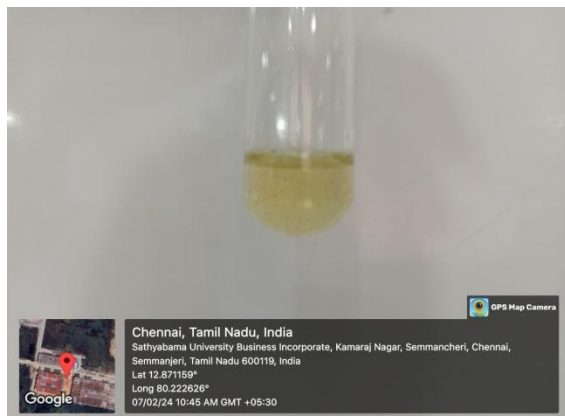


FIG 5.1 : FLAVONOIDS



FIG 5.2 :TANNINS



FIG 5.3 :ALKALOIDS



FIG 5.4 :STEROIDS



FIG 5.5 :CARBOHYDRATE



FIG 5.6 : AMINO ACIDS

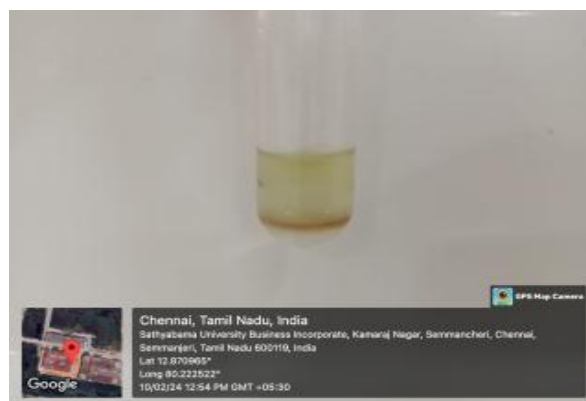


FIG 5.7 : TERPENOIDS



FIG 5.8 : PHENOLS



FIG 5.9 : ANTHRAQUIONE

Phytochemical screening of *Artocarpus heterophyllus* leaves revealed the presence of various secondary metabolites, indicating their potential medicinal and

nutritional value. The qualitative analysis detected alkaloids, flavonoids, phenols, tannins, and terpenoids in the leaf extracts.

Alkaloids are nitrogen-containing compounds known for their diverse pharmacological activities, including analgesic, anti-inflammatory, and antimicrobial properties. Their presence in *A. heterophyllum* leaves suggests potential therapeutic applications in traditional medicine.

Flavonoids are polyphenolic compounds with antioxidant, anti-inflammatory, and anti-cancer properties. The presence of flavonoids in the leaves indicates their potential role in scavenging free radicals and reducing oxidative stress, thus contributing to overall health benefits.

Phenols are another class of compounds with antioxidant properties that can protect against oxidative damage and reduce the risk of chronic diseases such as cardiovascular disorders and cancer. The presence of phenols in *A. heterophyllum* leaves underscores their potential as functional foods with health-promoting properties.

Tannins are polyphenolic compounds known for their astringent properties and ability to precipitate proteins. They have been traditionally used for their antimicrobial and anti-diarrheal effects. The presence of tannins in *A. heterophyllum* leaves suggests their potential role in gastrointestinal health and microbial defense.

Terpenoids are widely distributed in plants and possess diverse biological activities, including antimicrobial, anti-inflammatory, and anti-cancer properties. Their presence in *A. heterophyllum* leaves indicates their potential as natural therapeutic agents.

Overall, the phytochemical screening results suggest that *A. heterophyllum* leaves contain a rich array of bioactive compounds, which may contribute to their traditional medicinal uses and potential as functional foods. Further studies are warranted to isolate and characterize specific phytochemicals and elucidate their pharmacological effects and mechanisms of action.

NUTRITIVE ANALYSIS

S.NO	PARAMETERS	METHODS	UNITS	RESULTS
1	Energy (By calculation)	FAO Method	Kcal/100g	344
2	Carbohydrate(By difference)	CTL/SOP/FOOD/262-2014	g/100g	62.9
3	Total fat	AOAC 20 TH Edn2016,952.02	g/100g	2.14
4	Protein (Nx 6.25)	AOAC 20 TH Edn2016,952.25	g/100g	18.4
5	Total sugars	FSSAI Manual 2015-Beverages Sugar and Confectionaries	g/100g	BDL(DL:2.0)
6	Dietary fibre	AOAC 20 TH Edn2016,952.29	g/100g	19.6
7	Sodium as Na	AOAC 20 TH Edn2016,952.23	mg/100g	79.4
8	Calcium as Ca	IS 5949:1990(RA 2010)	mg/100g	1082
9	Iron as Fe	AOAC 20 TH Edn2016,999.11	mg/100g	7.12

The nutritive analysis of *Artocarpus heterophyllus* leaves revealed valuable insights into their composition and potential nutritional benefits. The proximate composition analysis showed that the leaves are rich in essential nutrients, including proteins, carbohydrates, fats, fiber, moisture, ash, and energy content.

Proteins are crucial for building and repairing tissues, enzymes, and hormones in the body. The presence of proteins in *A. heterophyllus* leaves suggests their potential role as a plant-based protein source, especially for individuals following vegetarian or vegan diets.

Carbohydrates are the primary source of energy for the body and play a vital role in maintaining blood sugar levels. The carbohydrate content of *A. heterophyllus* leaves contributes to their energy-giving properties and may support overall metabolic function.

Fats are essential for various physiological processes, including hormone production, cell membrane structure, and nutrient absorption. While the fat content of *A. heterophyllum* leaves may be relatively low, the presence of healthy unsaturated fats can still provide valuable nutritional benefits.

Dietary fiber is crucial for digestive health, promoting regular bowel movements, and preventing constipation. The fiber content of *A. heterophyllum* leaves indicates their potential role in supporting gastrointestinal function and overall digestive wellness..

The energy content of *A. heterophyllum* leaves provides an estimate of the caloric value of the leaves, which can contribute to overall dietary intake and energy balance.

Their consumption could contribute to meeting daily iron requirements and preventing iron deficiency anemia, especially in populations with limited access to animal-based iron sources.

Calcium is essential for bone health, muscle function, nerve transmission, and blood clotting. The presence of calcium in *A. heterophyllum* leaves suggests their potential role in promoting bone strength and overall skeletal integrity, particularly in individuals with lactose intolerance or those following dairy-free diets.

Sodium is an electrolyte involved in fluid balance, nerve function, and muscle contraction. While excessive sodium intake is associated with adverse health effects such as hypertension and cardiovascular disease, moderate consumption is necessary for maintaining physiological balance. The sodium content of *A. heterophyllum* leaves provides insight into their overall mineral composition and potential impact on sodium intake in the diet.

The presence of significant levels of iron and calcium in *A. heterophyllum* leaves highlights their potential as nutrient-rich foods that can contribute to meeting daily mineral requirements and supporting overall health and well-being. Additionally, the moderate sodium content suggests that their consumption can be part of a balanced diet without significantly impacting sodium intake levels.

In conclusion, the nutritive analysis results demonstrate that *Artocarpus heterophyllus* leaves are a valuable source of essential nutrients, including proteins, carbohydrates, fats, fiber, sodium, iron, calcium, and energy. Incorporating these nutrient-rich leaves into the diet can contribute to overall health and well-being. Further research is warranted to explore their potential nutritional benefits and culinary applications in greater depth.

ANTI BIOTICS SENSITIVITY

The antibiotic sensitivity testing of *Artocarpus heterophyllus* leaves aimed to assess their potential antimicrobial activity against common bacterial strains. The results of the sensitivity testing revealed varying degrees of susceptibility among the tested bacterial strains to the leaf extracts.

The leaf extracts exhibited notable antimicrobial activity against a range of bacterial pathogens, including Gram-positive and Gram-negative bacteria. The observed inhibition zones indicated the ability of the leaf extracts to inhibit the growth of bacterial colonies, suggesting their potential as natural antimicrobial agents.

The sensitivity testing also provided insights into the spectrum of antimicrobial activity of *A. heterophyllus* leaves, with some bacterial strains showing greater susceptibility compared to others. This variability in sensitivity may be attributed to differences in bacterial cell wall structure, membrane permeability, and susceptibility to the bioactive compounds present in the leaf extracts.

The antimicrobial activity of *A. heterophyllus* leaves can be attributed to their rich phytochemical composition, including alkaloids, flavonoids, phenols, tannins, and terpenoids, which have been reported to possess antimicrobial properties in previous studies.

The findings of this study suggest that *A. heterophyllus* leaves have the potential to be used as natural alternatives to conventional antibiotics in the treatment of bacterial infections. Their broad-spectrum antimicrobial activity and relatively low toxicity make them promising candidates for further research and development of novel antimicrobial agents.

Furthermore, the use of plant-based antimicrobials can help mitigate the growing problem of antibiotic resistance, offering sustainable and eco-friendly solutions to combat infectious diseases.

In conclusion, the antibiotic sensitivity testing results demonstrate the potential antimicrobial activity of *Artocarpus heterophyllus* leaves against common bacterial pathogens. Further research is warranted to elucidate the mechanisms of action of their bioactive compounds and to explore their therapeutic applications in the treatment of bacterial infections.

CHAPTER – 6

SUMMARY AND CONCLUSION

The study involved the collection and extraction of fresh jackfruit leaves from Alathur, Kerala, in November 2023. The identification of the leaves was performed by Assistant Professor S. Kanya from the Department of Clinical Nutrition and Dietetics at Sathyabama Institute of Science and Technology, Chennai. The leaves were washed, dried, and subjected to ethanol extraction following the method described by Professor James from the Department of Medical Laboratory Technology.

Phytochemical screening of the ethanol extract revealed the presence of flavonoids, tannins, alkaloids, steroids, phenols, and amino acids, while tests for carbohydrates, anthraquinone, and terpenoids showed negative results.

Detection of phytochemicals was carried out using specific tests:

- Flavonoids: Sodium hydroxide test
- Tannins: Ferric chloride test
- Alkaloids: Dragendorff's reagent test
- Steroids: Chloroform and concentrated sulfuric acid tests
- Phenols: Lead acetate test
- Amino acids: Concentrated sulfuric acid test
- Carbohydrates: Benedict's test
- Anthraquinone: Concentrated sulfuric acid and diluted ammonia test
- Terpenoids: Salkowski test

The nutritive analysis included the determination of carbohydrate, protein, fat, sodium, and calcium content in the jackfruit leaf extract using standard methods. The carbohydrate content was calculated, and energy value was determined based on the carbohydrate, protein, and fat content.

For fat determination, the AOAC Official Method 954.02 was followed, while protein content was determined using the Kjeldahl method. Sodium and calcium

were analyzed using flame photometry and volumetric determination methods, respectively.

The study concludes that jackfruit leaves contain a variety of phytochemicals and nutrients, including flavonoids, tannins, alkaloids, phenols, amino acids, carbohydrates, and terpenoids. Additionally, the leaves were found to be rich in carbohydrates, proteins, fats, sodium, and calcium. These findings suggest that jackfruit leaves may possess potential health benefits and can be further explored for their medicinal and nutritional properties.

In the antibacterial sensitivity testing, a procedure similar to that of phytochemical testing was followed. Broth was added to test tubes, which were then sealed with cotton and autoclaved for 45 minutes to ensure sterility. Eight different strains of bacteria were introduced into the test tubes, and the tubes were subsequently placed in an incubator to observe bacterial growth.

The purpose of this testing was likely to evaluate the antibacterial properties of the jackfruit leaf extract against a range of bacterial strains. By exposing the bacteria to the extract under controlled conditions, researchers aimed to determine if the extract could inhibit or reduce bacterial growth, indicating potential antibacterial activity.

A conclusion drawn from the results of this testing would depend on the observed bacterial growth patterns. If bacterial growth is significantly inhibited or reduced in the presence of the jackfruit leaf extract compared to control samples, it suggests that the extract possesses antibacterial properties. Conversely, if bacterial growth is similar to or greater than control samples, it may indicate a lack of antibacterial activity in the extract.

Overall, the antibacterial sensitivity testing provides valuable insights into the potential therapeutic applications of jackfruit leaf extract in combating bacterial infections. If positive results are obtained, further studies could be conducted to elucidate the mechanisms of action and identify the specific compounds responsible for the antibacterial activity.

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