A DISSERTATION ON

Extraction of Soluble and Insoluble dietary fibre from *Neolamarckia cadamba* fruit powder.

SUBMITTED TO THE
DEPARTMENT OF BIOENGINEERING
FACULTY OF ENGINEERING & INFORMATION TECHNOLOGY
INTEGRAL UNIVERSITY, LUCKNOW

IN PARTIAL FULFILMENT
FOR THE
DEGREE OF MASTER OF TECHNOLOGY
IN BIOTECHNOLOGY

BY
MOHSIN
M. Tech Biotechnology (IV Semester)
Roll No: 2101361007

UNDER THE SUPERVISION OF

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DECLARATION FORM

I, **Mohsin**, a student of **M. Tech Biotechnology** (2^{nd} Year/ 4^{th} Semester), Integral University have completed my six months dissertation work entitled **"Extraction of Soluble and Insoluble dietary fiber from *Neolamarckia cadamba* fruit"** successfully from **Integral University, Lucknow** under the able guidance of **Dr. Khwaja Osama.**

I, hereby, affirm that the work has been done by me in all aspects. I have sincerely prepared this project report and the results reported in this study are genuine and authentic.

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CERTIFICATE

Certificate that **Mr. Mohsin** (1600100951) has carried out the research work presented in this thesis entitled **"Extraction of Soluble and Insoluble Dietary fiber from *Neolamarckia cadamba* fruit"** for the award of **M. Tech- Biotechnology** from **Integral University**, Lucknow under my supervision. The thesis embodies results of original work and studies carried out by the student himself and the contents of the thesis do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution. The dissertation was a compulsory part of his **M. Tech-Biotechnology** degree.

I wish him good luck and bright future.

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CERTIFICATE BY INTERNAL ADVISOR

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TO WHOM IT MAY CONCERN

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I wish him good luck and bright future.

Dr. Alvina Farooqui
Professor and Head
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MOHSIN

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INTRODUCTION

The *Neolamarckia cadamba* is the important medicinal plants belonging to the *Rubiaceae* family. It is of utmost importance since it contains the most phytochemicals and secondary metabolites with pharmacological and biological qualities, such as cadambagenic acid, cadamine, quinovic acid, β-sitosterol, and cadambine. It can be utilised in place of numerous synthetic chemical substances for both the treatment and prevention of a number of fatal disorders. It has taken more than 100 years of research to identify different phytochemicals and their effects. Only 2% of them, or very few of them, have been marketed as a result of the absence of an appropriate model system and numerous related contentious concerns. Another significant issue with phytochemical solubility is the unpredictability of the subsequent response that the solvent chosen would produce. The Cadamba is moreover one of the attractive plants having symbolic religious value. To generate interest that might aid in their commercialization, we have attempted to summarise all phytochemicals and their significance here.

Many different types of flora have been used for ages as medicines. It is commonly known that nations like China, India, and Egypt actively use medicinal herbs to cure a variety of fatal ailments. India is frequently referred to as a botanical paradise since it produces more medicinal herbs than any other country in the world. The ayurvedic sciences have a long history in India and its surrounding nations. Even before the Middle Ages, when humans had limited knowledge of science, it was developed. India has evolved a number of traditional treatment techniques based on medicinal plants (Zaidan., 2005; Ahmad., 1998; Bhakuni., 1969). They can treat a wide range of illnesses and conditions, including diabetes, cancer, cardiovascular problems, and liver damage (J L Ríos and M C Recio., 2005; Alekhya et. al.,2013; Chandra Kirana., 2003). Various plants, either whole or in specialised sections (bark, root, leaves, fruit, flowers and seeds), are dried and used as medicines. These are consumed with water, sugar, salt, honey, and other ingredients. These days, they are created into appropriate formulations including tablets, pills, extracts, tinctures, lotions, ointments, and creams.(Chandra Kirana.,2003; Sandhya et.al.,2006)

In Sanskrit, Hindi, and Bengali, the *Neolamarckia cadamba* is commonly referred to as "Kadamba" and "Kodom," respectively. It is a tropical evergreen tree that can be found in various regions of Australia, Bangladesh, Bangladesh, Myanmar, Sri Lanka, Cambodia, Laos, the Philippines, Malaysia, and Indonesia, as well as Papua New Guinea. Neolamarckia cadamba, Naucleacadamba (Roxb.), Anthocephalus cadamba (Roxb.) Miq.,Samama cadamba (Roxb.) Kuntze, Anthocephalus morindifolius Korth, Nauclea megaphylla S. Moore, Neonauclea megaphylla (S. Moore), etc. are some of the other names for the plant. The species is commonly,

but wrongly, referred to as *Anthocephalus chinensis* because it possesses fragrance orange blooms that are present in thick globe-shaped clusters and are used to make perfumes. It is a decorative plant that is also utilised in the production of paper and lumber. In Indian mythology and religion, it is of utmost importance. Due to the Cadamba tree's immense relevance to humanity, many Indian religions have fervently held that God resides inside of it. According to the Sanskrit shloka **"Ayi Jagadamba Mad-Amba Kadamba Vana-Priyavaasini Haasa-Rate,"** Goddess Durga loves to stay in a forest of Cadamba trees.

The Cadamba is a big tree with a height of around 45 m and a straight cylindrical bole and crown. While it takes 6–8 years to increase in girth, it grows fairly swiftly in length. The trunk has a diameter of 100 to 160 cm, While the leaves range in length from 13 to 32 cm,. Around the age of 4-5, the tree normally starts to flower. The *Cadamba's* little fruits are packed tightly with fleshy capsules to create a yellow-orange infructescence. It has been reported that many medical conditions can be cured by the use of *Neolamarckia cadamba*; however, the bark and leaf extract is the most effective.(M J Bhandary.,1995)Many scientists have focused their research on the Cadamba in order to identify a variety of phytochemicals as well as secondary metabolites (saponins, indole and quinoline alkaloids, secoiridoids, and triterpenes) of therapeutic value.(Sanjay Prahalad Umachigi et. al. 2007)(M. AshrafulAlam et.al.,2008)(Banerji n; Dutta nl.,1976)

The objectives of this study are:

- Extraction of Soluble from *Neolamarckia cadamba* fruit powder.
- Extraction of Insoluble Dietary fiber from *Neolamarckia cadamba* fruit powder.
- Estimation of functional properties of the extracted dietary fiber
- Physical and chemical characterization of the extracted dietary fiber.

REVIEW OF LITERATURE

Neolamarckia cadamba is a large tree that is frequently found in southern tropical semi-evergreen forests, tropical moist deciduous forests, and tropical fresh water swamp forests. It is also widely distributed throughout most of India, including the Western Ghats in the south, the Terai in the north, the Bihar and Orissa plains, the lower hills of Darjeeling, and the Andaman Islands. It grows in dry locations with as little as 200 mm of rain per year and is typically found below 1000 m altitude and in areas with more than 1500 mm of annual precipitation. It is a highly delicate plant that is sensitive of frost. It tolerates sporadic flooding and may thrive on a variety of soils. An abundant and naturally occurring tropical tree species, *Neolamarckia cadamba*, can be found from South Asia, Southeast Asia, and Australia. It has a long history of cultivation and farming in its own region because of its use for general-purpose timber and traditional medicine. Outside of its native habitat, it was also successfully introduced into tropical and subtropical regions. It has good silvicultural traits, can grow in a variety of soil types, grows quickly, and is free of harmful pests and diseases. As smallholders and plantation businesses increase their plantings in the area, the species is becoming more significant for various wood-based industries.

There have been no tree improvement initiatives in India. Institute of Forest Genetics and Tree Breeding (IFGTB) has started improving trees by choosing the best trees. In Maramalai Nagar, Chennai, a progeny trial with 45 progenies has been established, and a few additional progeny trials with more than 60 progenies will be formed soon. To create clonal plantations, around six clones have been chosen, and mass multiplication is currently being carried out. From September through December, workers shake or climb the branches of the trees to harvest the orange-colored ripe fruits that have been strewn out on the ground. The fruits can be allowed to decay for three to four days before the pulp and seeds are removed from the bottom of the bucket and thoroughly dried. The fruits are rubbed to create a paste-like slurry, which is then quickly agitated before being poured through a 0.50 mm sieve plate. To extract seeds, the blackish paste collected in the pan after being sieved through the plate is dried. Another process involves slicing the fruits into tiny pieces, letting them dry for a few days, then crushing the pieces to extract the seeds. About 23,000–25,000 seeds per gram. The separated seeds are placed in a shaded area to dry and can be kept for nine months in an airtight container.

The wood is widely used for planking, ceiling boards, packing boxes, light construction, carving, and turnery. The wood produces high-quality veneers and plywood that can be used to make tea chest plywood and commercial-grade plywood. In Assam, plywood production uses wood

mostly. Additionally, it can be used to make splints, matchboxes, and pencils. Suitable for writing and printing, with a 48.6% yield and a breaking length of more than 6000 m. The sulphate technique can also be used to make brown wrapping paper. Fruits can be eaten. Bark that reduces fever and leaf extract are both used as mouth rinses.

Figure 1: The Kadam Fruits

LOCATION:

The *Neolamarckia cadamba* tree grows naturally throughout the Malesian region, including Sri Lanka, India, Nepal, Bhutan, Bangladesh, southern China, Indo-China, Papua New Guinea, and Australia. It was successfully introduced as ornamental and commercial plantation trees to nations in Africa and Central America. Laran is a pioneer plant that often develops in broad-leaved primary and secondary forests between 100 and 1000 metres in elevation. It can flourish along riverbanks, in the liminal space between perennially marshy areas and dry loams, as well as in intermittently swamped locations. It may, however, also thrive in regions with only 200 mm of yearly precipitation.

In India it can be found in the temperate Himalayas, which extend from Kashmir to Bhutan, as well as in the states of Garhwal, Himachal Pradesh, Sikkim, Assam, and Manipur. In Himachal Pradesh, it is common in the districts of Chamba, Kangra, Manipur, Bilaspur, Kullu, Sirmour, and Shimla at an elevation of around 2 km, while it is mostly dispersed in the temperate zones of Pauri, Tehri, Chamoli, and Uttarkashi in Garhwal. The Cadamba can also be found in Nepal, Myanmar, and western China in addition to India.(Patel et.al.,2008)(Atul_Dubey et.al.,2011). It is

also found in the states of Tripura, Tamil Nadu, Maharashtra, Andhra Pradesh, Haryana, Kerala and Karnataka in India.(Preethi Shree et. al.,2018)

COMPOSITION:

The fruit of *Neolamarckia cadamba* is abundant in minerals like Iron (28.3 mg/100 g), Calcium (123.7 mg/100 g), Zinc (11.05 mg/100 g), Copper (4.19 mg/100 g), Magnesium (71.04 mg/100 g), Potassium (36.7 mg/100 g), Sodium (10.7 mg/100 g), and Manganese (13.7 mg/100 g).(Arti Pandey et al.,2018)

Neolamarckia cadamba plant has Heartwood, Sapwood, Stem, Stem bark, Rootbark, Root, Seed, Branches and Leaves which contains very essential secondary metabolites they are as follows-

Heartwood

It contains Dihydrotectochrysin, dihydrowogonin, pinocembrin, chrysin, naringenin, kaempferol, aromadendrin, quercetin, taxifolin, 7-hydroxy-5, 2′, 4′-trimethoxyflavanone, 2′-hydroxy 2, 4, 4′, 6′- tetramethoxychalcone, 2′, 4′ dihydroxy-2, 4, 6′- trimethoxychalcone. (Ganjewala et.al.,2013 ; Brown et.al.,1974 ; Brown et.al.,1976 ; Banerji .,1977)

Figure 2: Heart wood

Stem

It contains Narigenin, apigenin, β-sitosterol, sakuranetin, prunetin, genkwanin.(Ganjewala et.al.,2013 ; Brown et.al.,1974 ; Brown et.al.,1976 ; Banerji .,1977)

Sapwood

It contains 7-O-(*β*-D-glucopyranosyl)-5-O-methylnaringenin, Genistein, prunetin, n-pentacosane, triacontane, noctacosanol, *β*-sitosterol, ursolic acid, oleic, palmitic, stearic acids, afzelin, kaempteritrin, naringenin, *β*-sitosterol glucoside. (Ganjewala et.al.,2013 ; Brown et.al.,1974 ; Brown et.al.,1976 ; Banerji .,1977)

Stem bark

It contains Padmakastein and its derivatives, *β*-sitosterol behenate, tectochrysin, genistein, leucocyanidin, 4′-glucoside of genkwanin, chrysophenol, emodin, 8 *β*-D glucosides, orientalone, physcion, *β*-sitosterol glucoside, amygdalin, prunasetin, sakuranetin, puddumetin, flavanone, sakuranetin (5, 4′-dihydroxy-7-methoxy flavone) and its 5-glucoside, neosakuranin (2, 4′-dihydroxy-4-methoxy-6-glucosidoxychalcone), leucocyanidin, puddumin B, naringenin-4′-methylether-7-O- *β*-D-galactoside), taxifolin(Ganjewala et.al.,2013 ; Brown et.al.,1974 ; Brown et.al.,1976 ; Banerji .,1977)

Root bark

It contains Ursolic acid, stigmasterol, prunetinoside, glucogen kwanin. (Ganjewala et.al.,2013 ; Brown et.al.,1974 ; Brown et.al.,1976 ; Banerji .,1977)

Seed

It contains Naringenin-5-O-α-L-rhamnopyranoside, 4′-O-methylliquiritigenin-7-O-α-L-rhamno pyranoside, naringenin 4′-methylether 7-xyloside, *β*-sitosterol-3-O-D-galactopyranoside. (Ganjewala et.al.,2013 ; Brown et.al.,1974 ; Brown et.al.,1976 ; Banerji .,1977)

Figure 3: Seeds

Branches

It contains Substitute of hydrocyanic acid, amygdalin (Ganjewala et.al., 2013; Brown et.al.,1974; Brown et.al.,1976 ; Banerji .,1977)

Leaves

It contains Quercetin-3-rhamnoglucoside, kaempferol. (Ganjewala et.al.,2013; Brown et.al.,1974 ;Brown et.al.,1976 ; Banerji .,1977)

APPLICATION

Neolamarckia cadamba is one of such ayurvedic remedy that has been mentioned in many Indian medicinal literatures. The phytochemistry of *Neolamarckia cadamba* and its application in the treatment of various ailments like diabetes mellitus, diarrhoea, fever, Inflammation, haemoptysis, Cough, Vomiting, Wounds, ulcers, debility, and antimicrobial activity. The major constituent of the plant are triterpenes, triterpenoid glycosides, flavonoids, saponins, indole alkaloids, cadambine, cadamine, isocadamine, isodihydrocadambine.

ANTIVENOM ACTIVITY

One of the main factors responsible for India's and other developing nations' high mortality rates is snake bites. Different antivenom immunotherapies have been developed with the purpose of treating individual cases of snake venom envenomation. Such therapy can have a variety of side effects, including serum sickness, pyrogen reaction, and anaphylactic shock. The majority of these symptoms might be brought on by the action of more non-immunoglobulin proteins seen in commercially available hyperimmune antivenom's greater concentrations.

There have been numerous attempts throughout the years to create snake venom antagonists, particularly those with plant origins. The use of plant medicines for the treatment of snakebites has been addressed in a number of ethnobotanical survey reports and books. (Sarang P Lakhmale et.al.,2012)For the treatment of snakebite, many Indian medicinal plants are suggested. It has been discovered that a methanolic extract of the Cadamba tree's root bark can be used as a remedy for snakebites. It is used to neutralise the venom of *Naja kaouthia* and *Vipera russellii*, which can cause inflammation, haemorrhage, cardiotoxicity, and neurotoxicity. Pentacyclic triterpenes, whether free or in the form of glycosides, play a significant role in offering 20% protection from snake venom. (Sarang P Lakhmale et.al.,2012)

ANTIOXIDANT ACTIVITY

A. cadamba plant dealing with several health hazards. These antioxidant activity possessing phenolic compounds contains at least one benzene ring attached with one or more hydroxyl groups and range from simple molecule to highly polymerized compound with high molecular weight polymers(Lin et al. 2016).In addition to helping the plant fight itself, these phenolic chemicals and flavanoids also alter the conformation, substitution, functional group arrangement,

and number of hydroxyl groups(Yanti et al. 2018). A. cadamba plant exhibit antioxidant property by generating O2 and OH free radicals in both enzymic and non-enzymic systems in In Vitro conditions. Chemical investigations of plant suggested the presence of cadambine, 3a and 3b isomers of dihydrocadambine and isodihydrocadambine in leaves and heartwood; cadambagic acid, quinovic acid and b-sitosterol in stem and chlorogenic acid from whole plant. (Brown et al. 1974; Brown and Chapple 1976)

BIOLOGICAL SIGNIFICANCE

ANTIHELMINTHIC ACTIVITY

According to George et al.'s investigation, the adult bark of *Neolamarckia cadamba* has been observed to have anthelmintic activity against roundworms, tapeworms, and earthworms. Neolamarckia cadamba (Roxb) stem extract in methanol demonstrated cytotoxic, thrombolytic, and anthelmintic action, according to Mali RG et al. The study used thrombolytic activity utilizing human red blood cells, cytotoxic activity using brine shrimp lethality, and anthelmintic activity using aquarium worm.

ANTIFUNGAL ACTIVITY

The fruits of this plant were reported to have significant antifungal activity against the following organisms: *Trichophyton rub rum, Candida albicans, Microsporum, and Aspergillus Niger*, with zones of inhibition against Trichophyton rub rum for ethanolic and hot water extracts, respectively, of up to 15.0 mm and 12.0 mm. The MIC against *Trichophyton rubrum* and *Aspergillus niger* was found to be as low as 2.10 mg/ml and 2.5 mg/ml for ethanolic extracts of ripened fruit of A. cadamba, respectively.

ANTIFILARIAL AND ANTIMALARIAL ACTIVITIES

According to research by Patel et al, mosquito-borne illnesses such malaria, dengue, chikungunya, filariasis, and Japanese encephalitis result in thousands of fatalities each year in India and other poor nations. Therefore, mosquito management is a major issue and is required to improve the health and standard of living of the nation's citizens and visitors. The growing resistance and resurgence of vector-borne diseases to synthetic pesticides has made management of many illnesses ineffective. In order to improve the health and quality of life of the nation's citizens and visitors, mosquito control is a critical issue. The growing resistance and resurgence of vector-borne diseases to synthetic pesticides has made management of many illnesses ineffective. Several reports have been made about the use of plant extracts to kill mosquito

larvae. Recently, it was discovered that Cadamba leaf extract, even at low concentrations, exhibits good larvicidal and pupicidal properties against the filarial vector *Culex quinquefasciatus*.(Kumar et al.,2013)

ANTIBACTERIAL ACTIVITY

The alcoholic and aqueous extracts of Cadamba fruits have shown significantly higher antibacterial activity against microorganisms (*Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Micrococcus luteus, Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella typhi, Klebsiella pneumonia, Proteus mirabilis, Candida albicans, Trichophyton rubrum, Asperagillus niger, Asperagillus flavus, and Asperagillus nidulans*). Mishra et al.'s experiment, which they presented. (Mishra et al.,2011) the minimum inhibitory concentration (MIC) of Cadamba, at 1.00 mg/ml, results in zones of inhibition against E. coli and P. aeruginosa of 22.0 cm and 24.0 cm, respectively. Animals with foot and mouth illness responded favourably to the Cadamba extract as well (Bhardwaj et al.,2007). The aqueous extract of *Cadamba* was effective against *Rathyibacter tritici*, a causal organism of tundu disease of wheat. (Chandrashekar et.al., 2009)

ANTIDIABETIC ACTIVITY

A metabolic condition called *Diabetes mellitus* causes hyperglycemia and changes to how carbohydrates, fats, and proteins are metabolised. For the treatment of diabetes mellitus, a variety of oral hypoglycemic medications are offered on the market. Due to the different adverse effects connected with these therapeutic medicines, interest in herbal therapies is developing. Herbal medications are more effective, have less adverse effects, and cost less than conventional medications. In an experiment to ascertain Cadamba's antidiabetic properties, Acharyya(Suman Acharyya et al.,2011) observed hypoglycaemic action at dose levels of 100, 200, and 400 mg/kg, respectively in normoglycaemic and alloxan-induced hyperglycaemic rats. In addition, normal rats were given the extract and tested for oral glucose tolerance. With reference drug glibenclamide (2.5 mg/kg), the root's hypoglycaemic action was evaluated. At the tested dose levels and in a dose-dependent manner, the study of the roots extract reduced the blood glucose level in neither normoglycaemic nor alloxan-induced diabetic rats. The extract also lowered the increased blood sugar levels in the animals who had been given a glucose overload.

ANTITUMOR ACTIVITY

According to (Chandra et al.,2009) the cadamba exhibits considerable anticancer activity. It is used to treat a variety of cancers, such as Oesophageal, breast, and colon cancer. The term

"cancer" refers to a condition in which aberrant cells frequently proliferate uncontrollably and occasionally spread to other parts of the body. There has been a lot of study done to develop cancer therapeutic therapies. The term "cancer" refers to a condition in which aberrant cells frequently proliferate uncontrollably and occasionally spread to other parts of the body. (Young-JoonSurh and Lynnette R Ferguson.,2003)Finding therapeutic cancer treatments has been the subject of extensive investigation. The possibility of plant-based compounds as anticancer treatments has frequently been investigated. Numerous bioactive chemicals that are efficient chemo preventive as well as chemotherapeutic drugs have been discovered through the screening of numerous medicinal plants. Lupeol and triterpenes of the betulinic acid type, which have anti-cancer properties, were found in Cadamba after a phytochemical screening (Devgan M.,2013).

ANALGESIC AND ANTI-INFLAMMATORY ACTIVITIES

There are several flavonoids in cadamba known to have analgesic and anti-inflammatory properties, including quercetin, silymarin, apigenin, daidzein, and genistein. (Bachhav et.al., 2009 ; Ambujakshi et.al.,2009). More and more active components in cadamba with anti-inflammatory properties are being found through research. Utilising active lipoxygenase and cyclooxygenase enzyme expressions, cadamba's anti-inflammatory properties are investigated. Additionally, a healthy lysosomal membrane is crucial because tissue inflammation causes active neutrophils to release lysosomal components such bacterial enzymes and proteases. According to research, the ethanolic extract of cadamba leaves showed notable membrane durability when tested against erythrocyte membranes that had been hemolyzed by heat.(Pant K et.al.,2012)

ANTIDIARRHEAL ACTIVITY

Castor oil-induced diarrhoea in mice has shown a dose-dependent reduction in the frequency of faecal excretion in response to a dry hydroethanolic extract of the Cadamba flowering tops. Intestinal fluid build-up was also reduced by the extract in a dose-dependent manner. (Ashraful Alam. et .al., 2008)

HYPOLIPIDEMIC ACTIVITY

Experimental investigations have shown that alloxan has the ability to reduce cholesterol levels by 30%, as seen in diabetic mice. When given orally to dyslipidemic animals for 30 days, the root extract of the cadamba caused a considerable 80% decrease in total cholesterol, phospholipids, triglycerides, and lipid peroxides, along with a decrease in lipid levels in diabetic mice.(Kumar Vishnu. et.al.,2010)

ANTIHEPATOTOXIC EFFECTS

According to reports, the cadamba is used for its hepatoprotective properties. Chlorogenic acid (CGA), which was isolated from the Cadamba plant, is what gives the compound its hepatoprotective properties. Additionally, it was discovered that mice given 100 mg/kg of CGA intraperitoneally every day for eight days had superior liver protection than mice given silymarin (SM) in CCl4. Surprisingly, the study found that CGA prepared in CCl4's antioxidative activity is what gives it its hepatoprotective properties in mouse models of liver injury. (Kapil. et.al., 1995)

DIURETIC AND LAXATIVE ACTIVITIES

The diuretic and laxative properties of Cadamba bark extracts have been examined by Mondal et al. in various doses and solvents. They claim that as compared to water, chloroform, and petroleum ether extracts, the methanolic extract of cadamba bark demonstrated a considerable increase in urine output. Additionally, the chloroform extract had greater laxative efficacy than the methanol, petroleum, and aqueous extracts. (Mondal et. al., 2009)

INSTRUMENTATION

While performing the experiments on *Neolamarckia cadamba* I have used many instruments these instruments are listed below: -

1. Digital pH Meter.
2. Refrigerated Centrifuge.
3. Hot Air Oven.
4. Distillation Unit.
5. Scanning Electron Microscope.
6. Fourier Transform Infrared. (FTIR)

Digital pH Meter

An instrument known as a pH metre is used in science to determine the acidity or alkalinity of water-based solutions by measuring the hydrogen-ion activity in the solution. A "potentiometric pH metre" is a term that refers to a pH metre that detects the difference in electrical potential between a pH electrode and a reference electrode. The pH or acidity of the solution has an impact on the electrical potential difference. Numerous uses, from laboratory experiments to quality control, call for the measurement of pH with pH metres (pH-metry).

APPLICATIONS

Knowing the acidity of the water, which is commonly measured using a pH metre, is helpful since the rate and outcome of chemical processes occurring in water frequently depend on the acidity of the water. In many instances, including chemical laboratory analyses, understanding pH is helpful or essential. In addition to measuring soil in agriculture, water quality in municipal water supplies, swimming pools, and environmental cleanup, pH metres are also utilised in industry, healthcare, and clinical settings like blood chemistry.

Figure 4: Digital pH meter

CENTRIFUGE

A centrifuge is a device that uses centrifugal force to apply a certain constant force to a specimen, such as to separate different fluid components. This is accomplished by rapidly spinning the fluid inside a container to separate liquids from solids or fluids with varying densities (such as cream from milk). Denser materials and particles travel outward in a radial direction as a result of its action. Less dense objects are also transported to the core and dispersed at the same time. Denser particles sink to the bottom of sample tubes used in laboratory centrifuges while low-density materials rise to the top due to radial acceleration. A centrifuge can be a very effective filter that separates contaminants from the main body of fluid.

Centrifuges on an industrial scale are frequently employed in manufacturing and waste processing to separate immiscible liquids or to sediment suspended materials. Dairies' cream separator is one illustration. Fine particles down to the nanoscale and molecules of various

masses can be separated using ultracentrifuges and centrifuges operating at extremely high speeds. To imitate high gravity or acceleration situations (such as high-G training for test pilots), large centrifuges are employed. To remove water from clothes, medium-sized centrifuges are utilised in some swimming pools and washing machines. For isotope separation, such as to enrich nuclear fuel for fissile isotopes, gas centrifuges are employed.

In this experiment we use centrifuge for washing the insoluble dietary fibre which is isolated from Kadam powder at 4800 rpm for 15 min. This washing step is performed several time for washing. Washing process is performed to remove the acid from the insoluble dietary fibre by which we have isolated the insoluble dietary fibre from kadam powder.

Figure 5: CENRIFUGE

HOT AIR OVEN

A hot air oven, commonly referred to as a forced air circulation oven, is a laboratory tool used to sterilise other materials and lab equipment using dry heat. It works especially well to sterilise objects that cannot be exposed to moisture or materials that won't melt, catch fire, or change shape at high temperatures. A hot air oven's primary function is to offer a controlled setting where high temperatures may be reliably maintained. The oven accomplishes this by providing even heat distribution throughout the chamber through air circulation.

While some materials, such as surgical dressings, rubber products, and some plastics, are not appropriate for sterilisation in a hot air oven, there are many others that can be sterilised successfully. Petri dishes, flasks, pipettes, test tubes, powders like starch, zinc oxide, and sulfadiazine, materials containing oils, and metal tools like scalpels, knives, and blades are some examples of this glass and metal equipment.

Hot air ovens use extremely high temperatures for a long time to kill germs and other microbes. 170 degrees Celsius for 30 minutes, 160 degrees Celsius for 60 minutes, and 150 degrees Celsius for 150 minutes are common temperature-time ratios for sterilisation in hot air ovens.

Hot air oven is used in this experiment for drying the isolated insoluble dietary fibre which was isolated from kadam powder. The isolated dietary fiber which was isolated is kept in hot air oven for overnight at 50°C.

Figure 6: Hot air oven

DISTILLATION UNIT

The main component of the distillation apparatus is a distillation flask, typically fitted with a vertical fractionating column (which may be empty or filled with suitable materials such as glass helices or stainless-steel wool), to which is attached a condenser leading to a receiving flask. Just below where the condenser connects to the column, the bulb of a thermometer extends into the vapour phase. The distillation flask is heated so that boiling occurs, gradually vaporising the contents. The vapour rises into the column, where it first condenses and eventually returns to the flask. With increased enrichment of the more volatile component, the vapour phase-liquid boundary moves up the column as a result of the ensuing heat transfer, which gradually warms the column. Due to this fractionation, the system's lowest-boiling components are often the vapour that eventually flows into the condenser (where it condenses and flows into the receiver). Once all of the low-boiling material has been distilled, the circumstances remain in effect until

the column temperature is high enough to allow distillation of the subsequent component. Typically, this causes the thermometer's reading of the temperature to temporarily drop.

Here we use this Distillation Unit to obtain the distilled water for the purpose of washing the insoluble dietary fibre.

SCANNING ELECTRON MICROSCOPE

An electron microscope called a scanning electron microscope (SEM) scans a sample's surface with a concentrated beam of electrons to create images of the material. As the electrons contact with the sample's atoms, different signals emerge that reveal details about the sample's surface topography and composition. A raster scan pattern is used to scan the electron beam, and an image is created by combining the detected signal's strength with the beam's position. In the most popular SEM mode, secondary electrons—emitted by excited atoms by the electron beam—are detected using an Everhart-Thornley detector, a secondary electron detector. The specimen topography affects, among other things, the quantity of secondary electrons that may be detected and, consequently, the signal intensity.

Specimens are observed in high vacuum in a conventional SEM, or in low vacuum or wet conditions in a variable pressure or environmental SEM, and at a wide range of cryogenic or elevated temperatures with specialized instruments.

In order for SEM samples to resist the high vacuum conditions and the high intensity electron beam, they must be tiny enough to fit on the specimen stage and may need specific processing to improve their electrical conductivity and stabilise them. Typically, a conductive adhesive is used to fix samples rigidly on a specimen holder or counterfoil. Manufacturers produce machines that can look at any area of a 300 mm semiconductor wafer, and SEM is widely used for defect analysis of semiconductor wafers. Many devices feature chambers that can continuously rotate 360° and tilt an object of that size to a 45° angle.

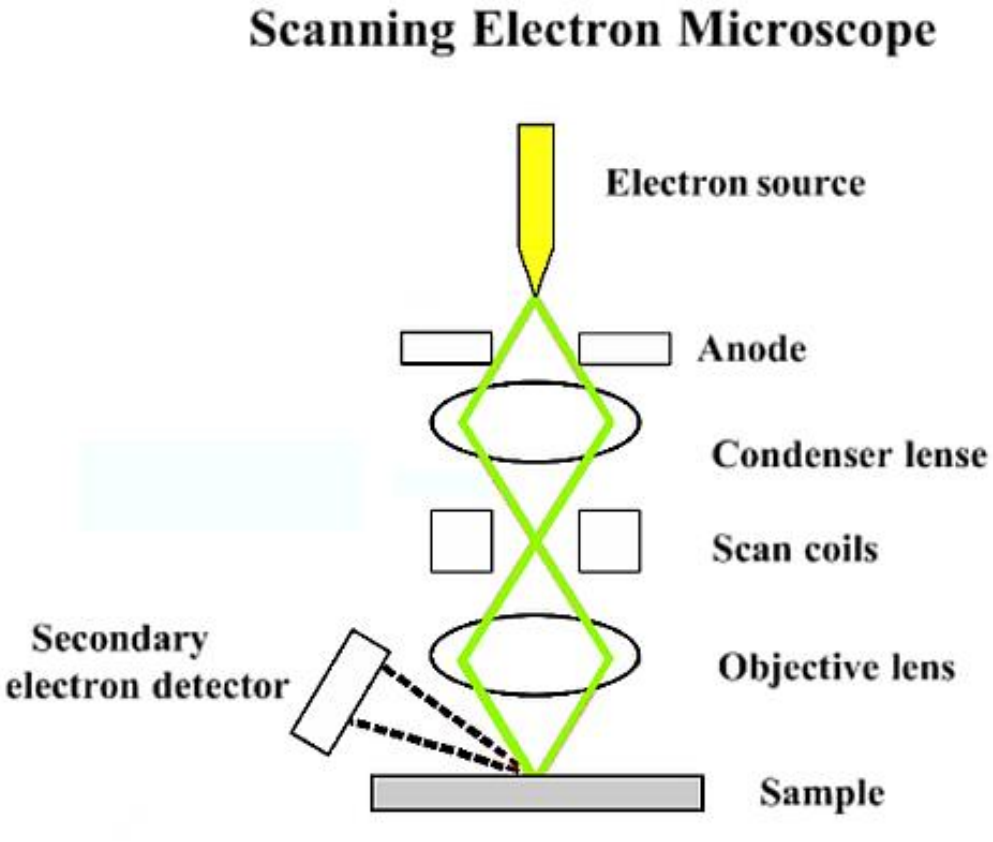


Figure 7: Scanning Electron Microscope

WHAT ARE DIETRY FIBRES?

The term Dietary Fibre (DF) used to describe the total plant cell wall content of a particular plant species. DF is an eatable plant part or analogous carbohydrates that are not digested by the intestines of the human being and they does not absorbed in the human intestines also and with partial and full process of fermentation in the caecum, colon and rectum. The composition of DF has polysaccharides, oligosaccharides, lignin and associated plant substances. The majority of in-depth research on the morphological evolution and ultrastructure of plant cell walls has been conducted on woody plant cells as opposed to food plant cells, and knowledge regarding the bonding and distribution of polymers within the cell wall is still lacking. The emergence of the middle lamella, which results from a thick plate between divided nuclei and is rich in pectic compounds, marks the beginning of the development of the cell wall. The primary wall, which is composed of cellulose fibrils embedded in a ground material of pectic substances and hemicellulose, is created on the inner surface of the middle lamella by layering. The secondary cell wall develops later and is made up of numerous layers that are rich in cellulose fibrils and low in pectin, which are oriented parallel to one another in a matrix of hemicellulose.

DF can be separated into two basic types based on its properties and effects on the body. These two types are insoluble and soluble fibre. Insoluble fibres, such as cellulose, hemicellulose, and lignin, do not dissolve in water. Insoluble fibres are found in foods such as wheat bran, whole grains, and vegetables. Insoluble fibres absorb water and increase the intestinal bulk, which helps the intestine function properly. Soluble fibres, such as gum and pectin, dissolve in water and are found in beans, oats, barley, some fruits and vegetables. Soluble fibres may play a role in lowering blood cholesterol and in regulating the body's use of sugar.

Structural aspects of dietary fibre

DF includes primarily polysaccharides, but also oligosaccharides and substances from plant cell walls associated with the Non- starch polysaccharides (NSP). The common characteristics are that these escape digestion in the small intestine and reaches the large intestine, where a proportion undergo fermentation; hence the intrinsic effect on metabolism and disease risk are likely to be mediated through their properties as they pass through the gastrointestinal tract. The majority of DF constituents are represented by carbohydrates: poly and oligosaccharides (Robertson et al., 2000). Similar to oligosaccharides, polysaccharide molecules are composed of glycosil units in linear or branched arrangements. The degree of polymerisation (DP) varies from less than 100 (only a few of them) to 10,000–15,000 (cellulose) with the majority of DF having a

DP ranging between 200 and 3,000. Each type of polysaccharide is characterised by its monosaccharide unit and the nature of linkages between them.

The physical properties of polysaccharides are dominated by their and the way they interact with one another. The chemical structures and chain conformations of DFs dictate their physical characteristics, which may have profound effects on their physiological role as constituents of digest, and may induce both local and systemic responses. Some of the most important physical characteristics of DF include: hydration properties, solubility/dispersability in water, rheological properties, bulk due to non-digestibility, the ability to adsorb bile acids, fermentability by gut microflora and surface area characteristics.

Physiological effects of dietary fibre

DF has important benefits in nutrition and health. DF has preventive health benefits for many conditions, including diverticular disease, colon cancer, heart disease, and diabetes. Interestingly, a multi-centric case-control study conducted in Italy manifested a beneficial role of dietary fibres on renal cell cancer risk (Galeone, 2007). Health benefits of isolated and intrinsic DF have been discussed in numerous reviews and books published during the two decades. (Carnovale et al., 1995; Champ et al., 2003; Cherbut et al., 1995; Guillon et al., 1998; Mälkki and Cummings, 1996; McCleary and Prosky, 2001)

Effect of fibre on digestive system

DF has health benefits through its effect on the digestive system. A high-fibre diet helps relieve constipation. Both types of fibre play important roles in the digestive tract. Insoluble fibre draws water from the system and increases the bulk and softness of the food mass in the intestine. This decreases the time it takes to travel through the digestive system, making elimination easier. Soluble fibre seems to delay the digestion and absorption of nutrients and alters the action of digestive enzymes and hormones.

Fibre, colonic motility and faecal energy excretion

The most convincing evidence, that dietary fibre has an important role in the maintenance of normal health, relates to its effects on colonic motility. The various components of dietary fibre, especially those associated with resistant starch, reach the large intestine virtually unchanged (Baghurt et al., 2001). Fibre has been shown to speed up intestinal transit time when it is slow, slow it down when it is fast, and enlarge small stools and moderate high pressures. Increasing the fibre content of the diet increases the faecal energy excretion, principally in the form of fat and nitrogen. By virtue of its water holding capacity, fibre also helps in the formation of soft stools

with bulk, which can be easily evacuated. Research suggests that fibre from different sources differ in its ability to increase stool weight. Cereal fibre in the form of bran increases stool weight more than most other fibre sources. The larger the particle size of the bran, the more effective it is. In old age constipation problems increased dietary fibre intake is recommended for smooth colon functioning. (Hsieh, 2005)

High-fat intake has been correlated to the incidence of colon cancer. A high-fibre, low-fat diet may reduce the risk of colon cancer in several ways. First, fibre absorbs water, lowering the concentration of potential carcinogenic (cancer causing) substances in the intestine. Second, since insoluble fibre speeds up the movement of waste material in the intestine, the colon is exposed to any cancer-causing substance in the intestine for a shorter length of time. Finally, fibre is adjuvant to better gastro-intestinal movement and results to better defecation with constipation relief and less opportunity of large intestinal cancer. (Jitpukdeebodintra and Jangwang, 2009).

Fibre and weight reduction

An increased intake of DF appears to be useful for the treatment of both obesity and diabetes mellitus (Mehta, 2005, 2009). Fibre-rich food is usually satisfying without being calorically dense. Supplementing a normal diet with gel-forming fibres, such as guar gum, leads to an increased satiation probably due to a slower gastric emptying (Smith, 1987).

Recent long-term studies have confirmed the usefulness of viscous fibres as an adjunct to the regular dietary management of obesity (Mors et al., 2000). Apart from the beneficial effect of caloric restriction, DF may improve some of the metabolic aberrations seen in obesity (Mälkki, 2004). Gel forming fibres are particularly effective in reducing elevated LDL-cholesterol without changing the HDL-fraction. The impaired glucose tolerance of diabetes manifest is also improved. These effects are probably in part associated with the gelling property of the fibre, which leads to an increased viscosity of the unstirred layer thereby delaying the absorption process (Smith, 1987). However, it has been shown that dietary guar gum supplementation is unable to reduce insulin resistance in gross obesity if the overweight status is constantly maintained. (Cavallo-Perin et al., 1985)

MATERIAL and METHODS

Sample collection: Sample was collected from Integral University campus. The sample was first collected then dried and then sample was finely crushed into fine particles in the form of powder. The chemicals utilized in the present work were analytically pure.

Dietary Fibre Extraction from Kadam Fruit: First of all, the peel of Kadam fruits was removed, and then the fruits were chopped, followed by Tray drying. Later, the Tray-dried samples dried overnight in an oven (40°C). Finally, the dried samples were ground and sieved (150 μm) to obtain Kadam fruit powders (KP), and then the KP was stored in a dryer prior to extraction.

FLOW CHART OF POWDER FORMATION

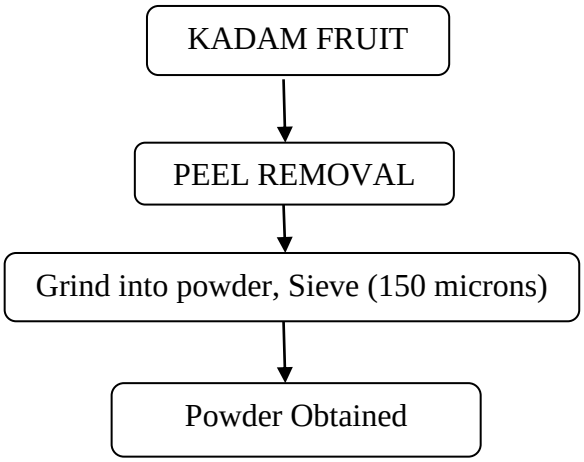


Fig: 1

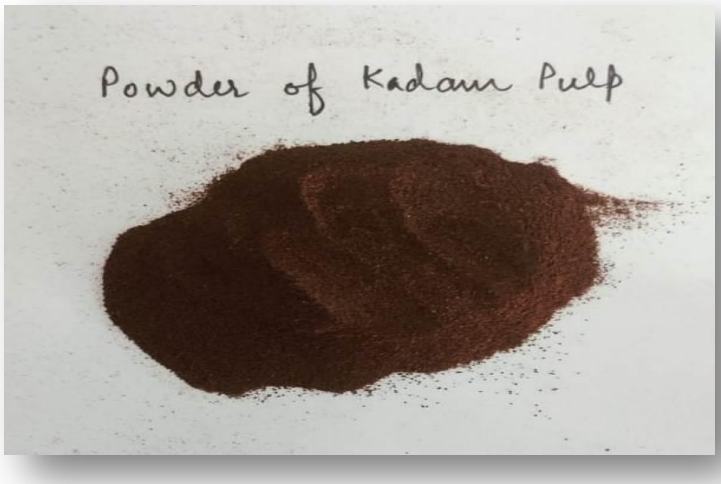
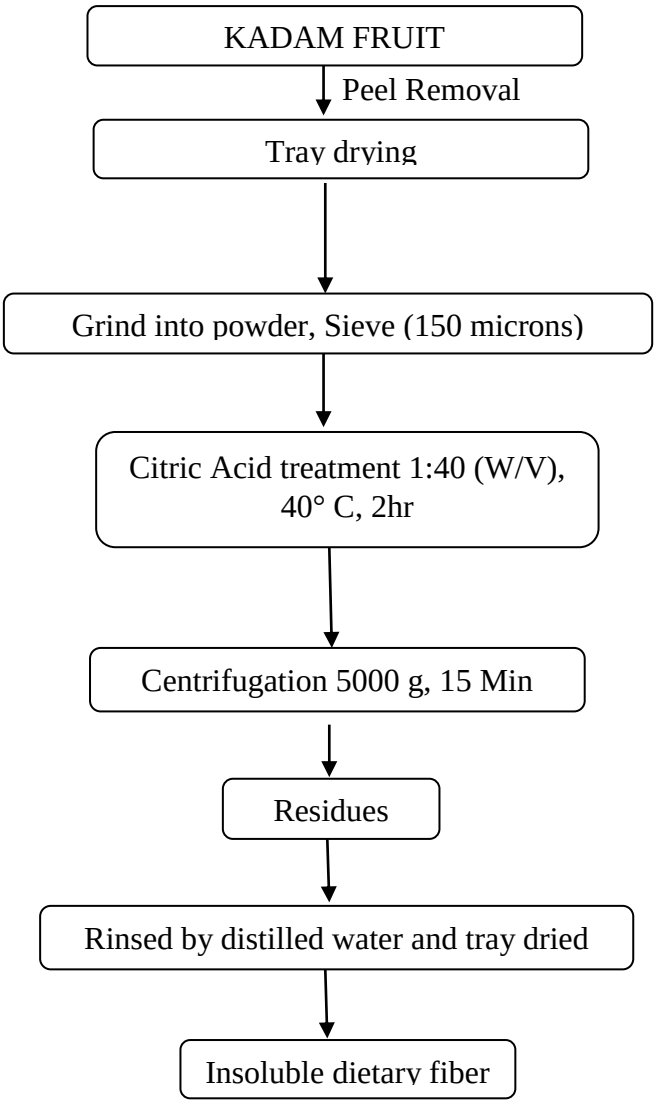


Figure 8: Kadam powder

Acid- treatment Extraction of Insoluble dietary fibre from Kadam Fruit Powder.

The citric acid was used to extract the acid-extracted IDF (AE-IDF) and acid-extracted SDF (AE-SDF) in accordance with the method proposed by Yuliarti, G, Matia-Merino, Mawson, and Brennan (2015) after certain modifications (Fig. 1). In Acid Extraction (AE), Kadam Powder KP) was mixed with citric acid at a ratio of 1:40 (w/v) for 2 h of extraction on the 40 °C water bath. Afterwards, the resultant acidic solution was subject to 15 min of centrifugation at 5000 g for 15 min, and the residues and supernatants were collected, respectively.

Flow Chart of Isolation of Insoluble dietary fibre from Kadam Fruit powder.



Flow chart of Isolation of Soluble dietary fibre from Kadam powder.

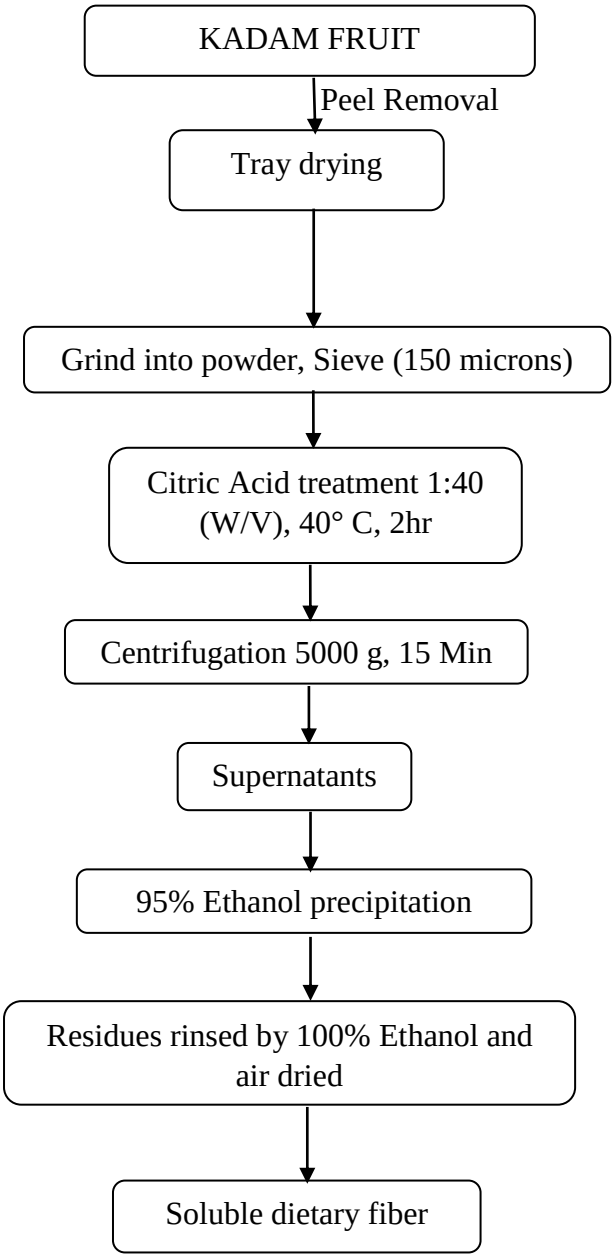


Figure 9: Soluble Dietary Fiber

Procedure for Isolation of Insoluble Dietary Fibre by Acid treatment method.

1. Take 500 ml distilled water in 1000 ml beaker.
2. Add 25 gm Citric acid Powder.
3. Add 10 gm of dried Kadam powder in 500 ml distilled water that is already contain Citric acid.
4. Measure the pH through digital pH meter.
5. The solution is then kept for 2 hr incubation in the water bath at 40° C ± 2° C.
6. After incubation washing is performed by using distilled water.
7. Firstly centrifugation is done to obtain the pellet of the insoluble fibre.
8. After centrifugation washing is performed on the pellet which is obtained after centrifugation for 15 min at 4800 rpm in the refrigerated Centrifuge.
9. At each step pH is checked by the use of pH paper.
10. The process is continued.
11. When the pH paper gives neutral reading the process of washing is stop and the pellet is collected in the petri dish for drying.
12. The drying is done in the hot air oven at 50° C for overnight.

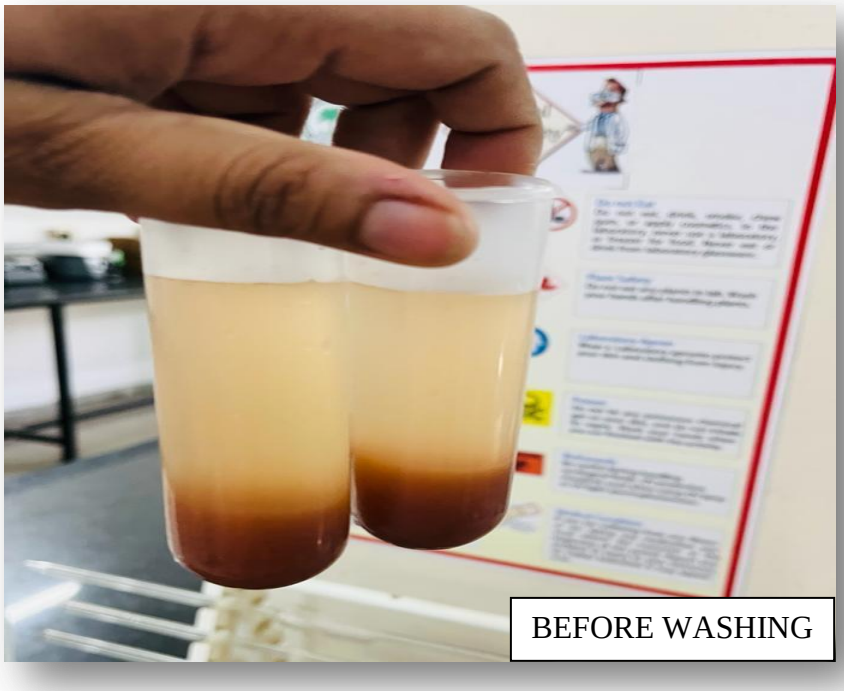


Figure 10: Step of isolation of Insoluble Dietary Fiber before washing.

Figure 11: Step of isolation of Insoluble Dietary Fiber after washing.

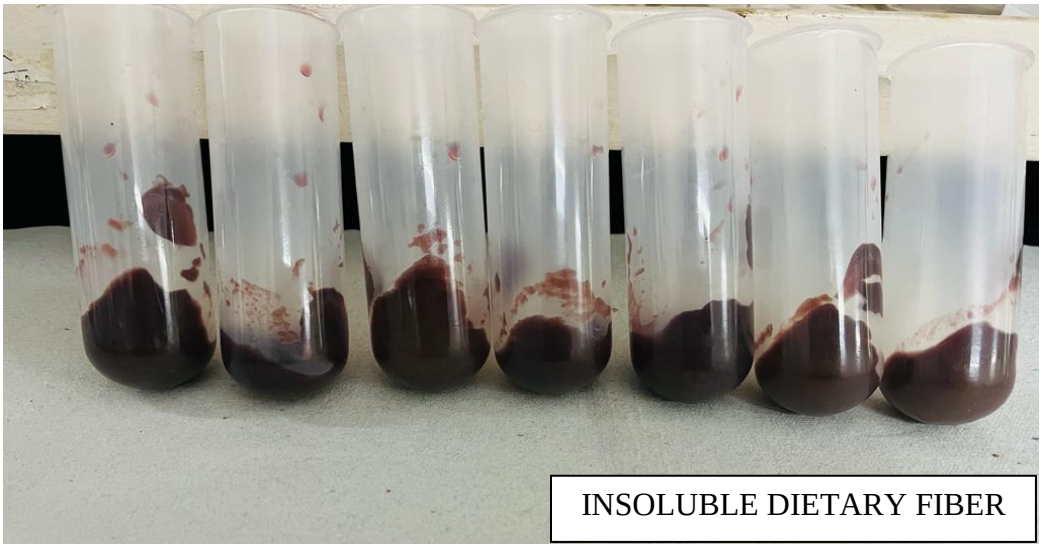


Figure 12: Insoluble Dietary Fiber after centrifugation.

Figure 13: Drying process for extraction of insoluble dietary fiber.

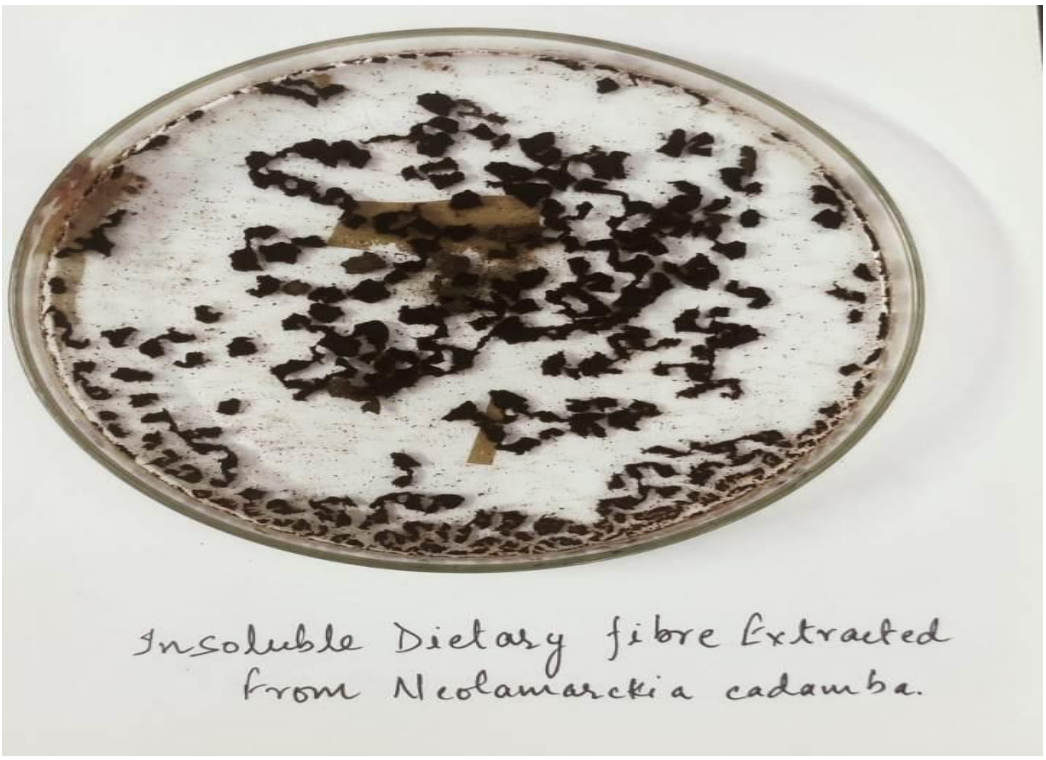


Figure 14: Extracted dietary fiber after drying process.

Water Holding Capacity (WHC)

Water holding capacity (WHC) was determined according to the approach put forward by Wang et al. with minor modification (L. Wang, H. Xu, F. Yuan, R. Fan, & Y. Gao, 2015). First of all, 1.0 g IDF or SDF sample (W1) was added into 25 mL distilled water, separately, followed by 2 h of equilibration under the temperature of 37 °C. After 10 min of centrifugation at 4800 rpm, the residues were extracted at once and the weight (W2) was measured. Finally, WHC was determined by the equation below.

$$\mathbf{WHC(g/g)} = \frac{W_1 - W_2}{W_1}$$

Figure 15: Water holding capacity (1)

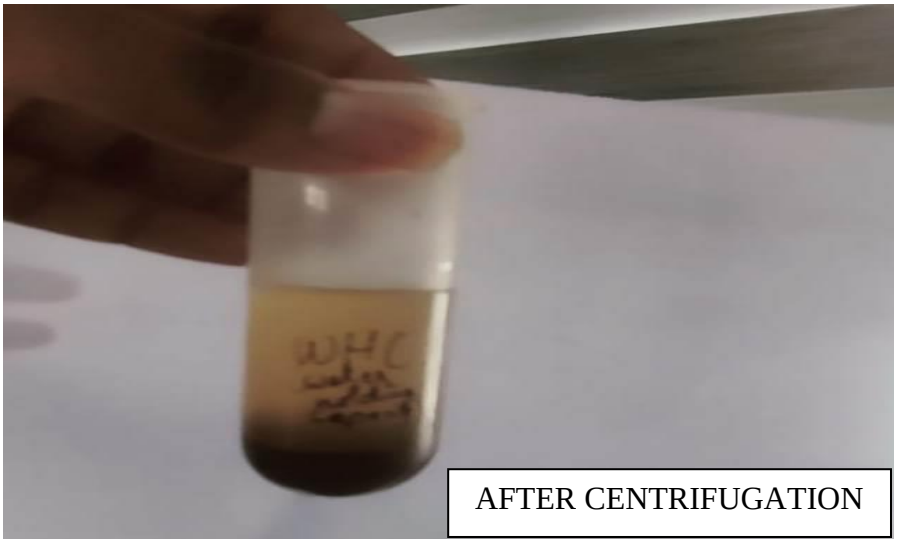


Figure 16: Water holding capacity (2)

Oil holding Capacity(OHC)

One g freeze-dried IDF or SDF sample (O_1) was added into 25 mL soybean oil for 2 h under ambient temperature. The sediments were extracted following 10 min of centrifugation at 4800 rpm, and then the weight (O_2) was measured at once. OHC was determined according to the following equation.

$$\textbf{OHC (g/g)} = \frac{O_2 - O_1}{O_1}$$

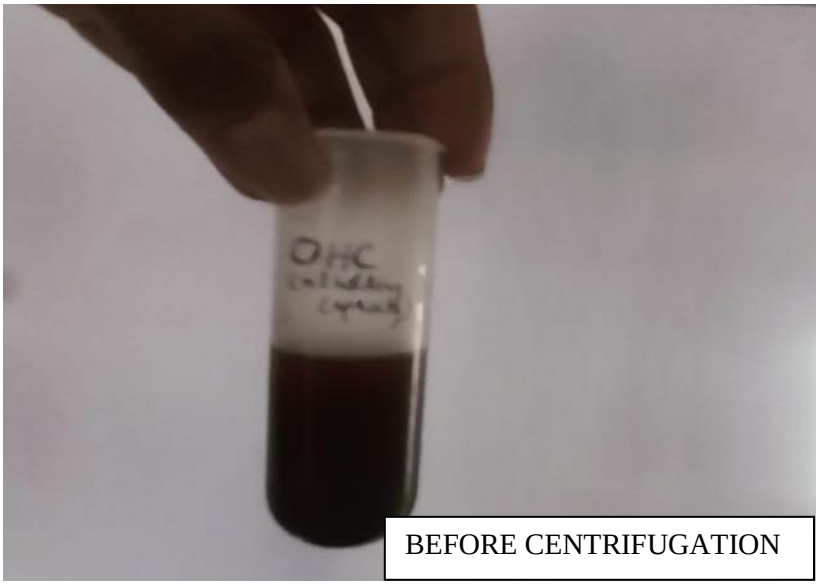


Figure 17: Oil holding capacity (1)

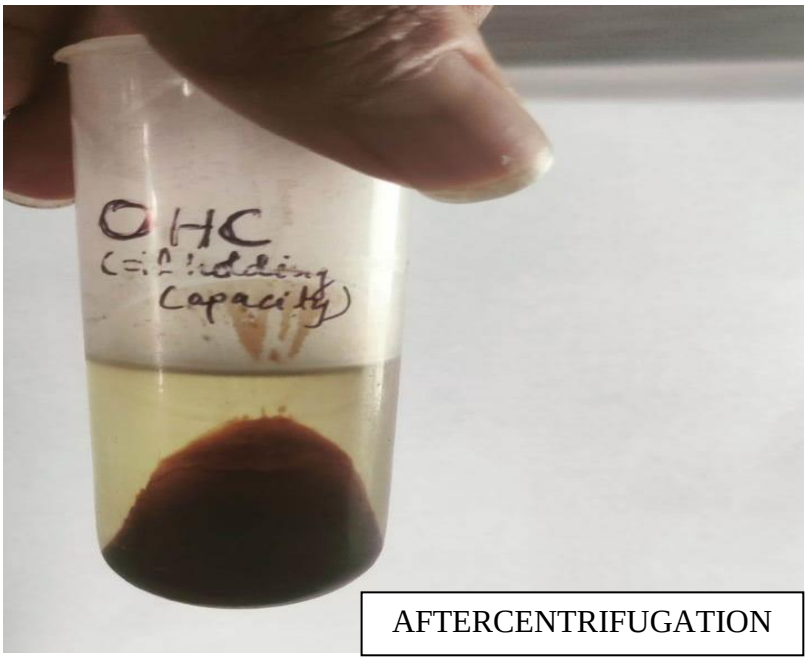


Figure 18: Oil holding capacity (2)

Cholesterol adsorption capacity. (CAC)

CAC was determined by the method (Jia, et al., 2019) with some modifications. The egg yolk (10 mL) was mixed with distilled water (90 mL) and then whipped it into an emulsion. The SDF sample (0.1 g) was mixed with 5 mL emulsion and shaken at the room temperature for 2 h. After centrifugation at 4800 rmp for 10 min, 1 mL of the supernatant was collected and diluted 10 times with glacial acetic acid. Then 0.4 mL solution was taken to determine the cholesterol content. 5mL egg yolk emulsion without the SDF sample was used as the blank. The CAC was calculated using the following Equation.

$$\textbf{CAC (mg/g)} = \frac{\mathbf{M_1 - M_2}}{\mathbf{W_1}}$$

Swelling power and Solubility index.

Swelling powder and solubility index was done as given by Ikegwu, Okechukwu, and Ekumankana (2010). A total of 1 g of sample was taken in a test tube and weighed (W_1). Distilled water 50 cm^3 was added to it and was mixed. The slurry was heated at 85°C for 30 min in water bath. After cooling, the sample was centrifuged at 2,200 rpm for 15 min. The supernatant was collected in a dish and 5 ml of it was poured on tarred evaporating dish (A_1) and was dried at 100°C for 4 h and weighed again (A_2). Then, the weight of sediment was taken as (W_2).

$$\text{Swelling power of sample (\%)} = \frac{W_1 - W_2}{\text{Weight of the sample}} \text{X } 100$$

$$\text{Solubility index (\%)} = \frac{A_1 - A_2}{\text{Weight of the sample}} \text{X } 100$$

Emulsion activity and Emulsion stability

To estimate emulsion activity 500mg of the sample was dissolved in 50ml of distilled water. Five millilitres of sunflower oil were added to the suspension. The mixer was homogenized at 20.000rpm for 1 min. The emulsion was centrifuged at 11000g for 5min, and the height of the emulsified layer was determined. The emulsifying activity was estimated by taking the ratio of the height of the emulsified layer to the height of the total content.

$$\text{Emulsifying activity (\%)} = \frac{\text{Height of the emulsified layer}}{\text{Height of the total content}} \text{X } 100$$

The emulsion stability was estimated by heating the emulsion at 80° C for 30min after the homogenization process described earlier in this process.

$$\text{Emulsion Stability} = \frac{\text{Height of the layer after heating}}{\text{Height of emulsion layer before heating}} \text{x } 100$$

Scanning Electron Microscopy (SEM)

For assessing the impacts of different extraction methods on DF structure, SEM was conducted to examine the IDF and SDF samples for their microstructure and morphology. To be specific, Dietary Fibres (DF) were fixed onto the specimen holder, covered using the gold powders, and monitored at 100x and 1000x magnification (Gan, Huang, Yu, Peng, Chen, Xie, et al., 2020).

Fourier transform infrared spectroscopy (FTIR)

The Nicolet Nexus FT-IR spectrometer was used for FT-IR, and the absorption spectra were recorded at 4000-400 cm 1 wavelengths. IDF and SDF samples were grinded using the KBr powders, followed by pressing to pellets (bib_Wang_et_al_2018Wang et al., 2018)

RESULT AND DISSCUSION

Water Holding Capacity. (WHC)

WHC indicates the ability of a wet material to retain water under compression or centrifugal force, including physically trapped water, connected water, and hydrodynamic water. WHC is related to different DF surface areas, densities, and architectures, as well as the chemical composition and amount of the hydrophilic site. The WHC values of our samples ranged from 5.658 to 6.986 ± 1.56. AE- IDF (6.4399 ± 0.5698) and AE- SDF(7.5642 ± 0.4567). WHC values of insoluble dietary fiber samples extracted by ACE has more value than the AE-SDF Generally, dietary fiber samples with high WHC could prevent the shrinkage of foods and alter its viscosity.

$$\textbf{WHC (g/g)} = \frac{W_1 - W_2}{W_1}$$

$$= \frac{7.4399 - 1}{1}$$

$$= \mathbf{6.4399 g/g}$$

The Water Holding Capacity of Kadam fruit powder (IDF) was 6.4399 g/g.

The Water Holding Capacity of Kadam fruit powder (SDF) was 12.6589 g/g

Oil Holding Capacity. (OHC)

The OHC of SDF plays a vital role in diverse food applications, like the prevention of fat losses in the case of cooking, or the removal of excessive fat out of human body. OHC depends on the hydrocolloid surface property, overall electrical charge density, and the hydrophobicity. AE-SDF (21.00 ± 0.06) has higher OHC capacity than AE-IDF. SDFs showed superior WHC and OHC over IDFs extracted by the same method, which was ascribed to the looser structure of AC-SDF than AE-IDF. Typically, the high WHC and OHC indicate that dietary fiber samples extracted from kadam fruit may be a good dietary resource for related food products, which avoid water syneresis in formulated foods and act as the emulsifier for foods with a higher fat content.

$$\textbf{OHC (g/g)} = \frac{O_2 - O_1}{O_1}$$

$$= \frac{9.564 - 1}{1}$$

$$= \mathbf{8.564 g/g}$$

The Oil Holding Capacity of Kadam fruit powder was evaluated 8.564 g/g.

The Oil Holding Capacity of Kadam fruit powder was evaluated 22.8976 g/g

Cholesterol Adsorption Capacity. (CAC)

CAC is an important functional property of SDF, which has been proven to be Journal Pre-proof able to decrease the cardiovascular disease risk and serum cholesterol levels in human body (Nsor-Atindana, Zhong, & Mothibe, 2012). CAC was of the untreated Soluble Dietary Fibres (SDF) were showed lowest (2.59 ± 0.12 mg/gm) CAC as compared to treated Soluble Dietary Fibers (SDF) and the value is (11.45±0.09 mg/gm).

Swelling power and Solubility index.

The swelling power and solubility index of kadam fruit powder was found to be 705±0.72 and1.88 ± 063 respectively.

Emulsion activity and Emulsion stability.

The emulsion activity and emulsion stability were 12.5% and 80%, respectively. Both emulsion activity and stability were found to be less than the powder of apple and pineapple pomace (Younis & Ahmad, 2015; Younis & Saghir, 2017). This may be due to the difference in chemical composition.

Scanning Electron Microscopy (SEM)

SEM was carried out in the current study to investigate the Kadam fruit derived IDFs and SDFs microstructures. As shown in Fig. 2, AE-SDF had more pores on their surface than and AE-IDF, and the pores of AE-IDF were more compact and irregular than those of AE-SDF. As for SDFs, AE-SDF had a more three-dimensional structure, with lots of pores on its surface. Compared with AE-IDF, the structure of AE-SDF was shrinking and AE-SDF had less pores on its surface. As clearly observed from Fig. 2(B), AE-SDF structure was severely impaired in the alkaline environment during the extraction process, which turned to be a sheet like structure and the pores were basically disappeared. The results suggested that, acidic environments affected the microstructures of IDFs and SDFs. DF with a looser spatial structure had a higher specific surface area, which might affect its adsorption capacities of water and oil. Therefore, based on our SEM findings, extraction method might alter those functional properties of dietary fiber samples from Kadam Fruits.

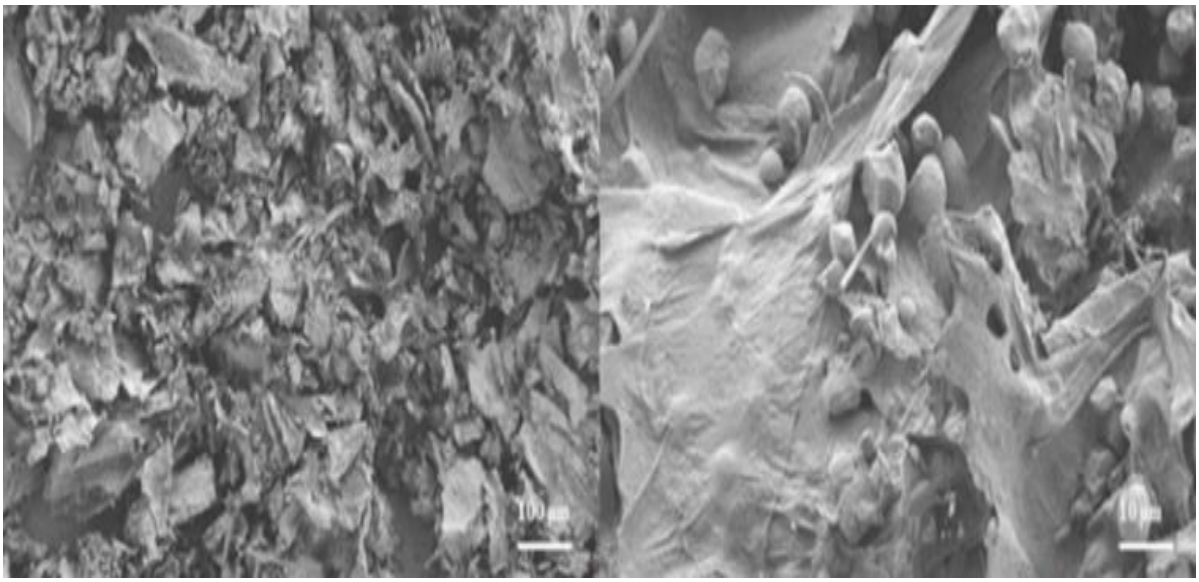


Figure 19: SEM of Soluble Dietary Fiber.

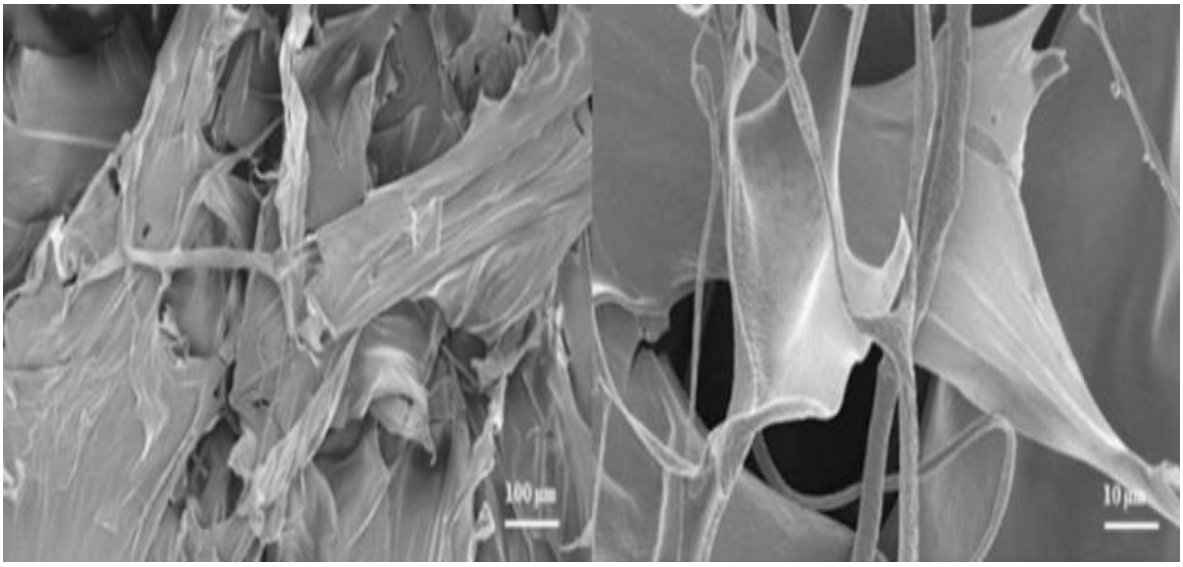


Figure 20: SEM of Insoluble Dietary Fiber.

Fourier transform infrared (FTIR)

FT-IR was carried out to analyse spectroscopic features of IDFs and SDFs. A broad peak near 3371 cm^{-1} is the stretching vibration of OH, and the absorption peak near 3371 cm^{-1} is the stretching vibration of Normal polymeric OH on the sugar methyl group and methylene group. The peak near 2924 is due to the presence of asymmetric CH methylene (Ikram, Ullah, Tao, Yin, Shanbai, Xiong, et al., 2017) The thicker peak near 2112 cm^{-1} is due to presence of Carbon Carbon($C \equiv C$) terminal Alkyne(Monosubstituted) group. The peak in the range 1690-1590 cm^{-1} is due to presence of open chain imino group(C-C=N) . the peak in the range of 1200-1400 cm^{-1} may be due to the variable angle vibration of CH, the absorption peaks in these regions are characteristic absorption peaks of saccharides from IDF and SDF. The absorption peak at 1300–

1000 cm^{-1} is the contraction vibration of ester C–O, while the absorption peak at 1000–700 cm^{-1} is the characteristic peak formed by α-and β-pyran monosaccharides. (Li, Feng, Niu, & –Yu, 2018). The peak and morphology of the two are the same in the range of 1800–1600 cm^{-1}, no new functional groups are produced, but the intensity of the absorption peak is weakened near 1700 cm^{-1}. The peak near 480 cm^{-1} is due to the presence of stretches of Polysulphides(S-S). The peak at 1000 cm^{-1} is the C–O stretching vibration peak on the C-O-C bond, which is a typical xylan absorption peak indicating that the dietary fiber component contains xylan hemicellulose.

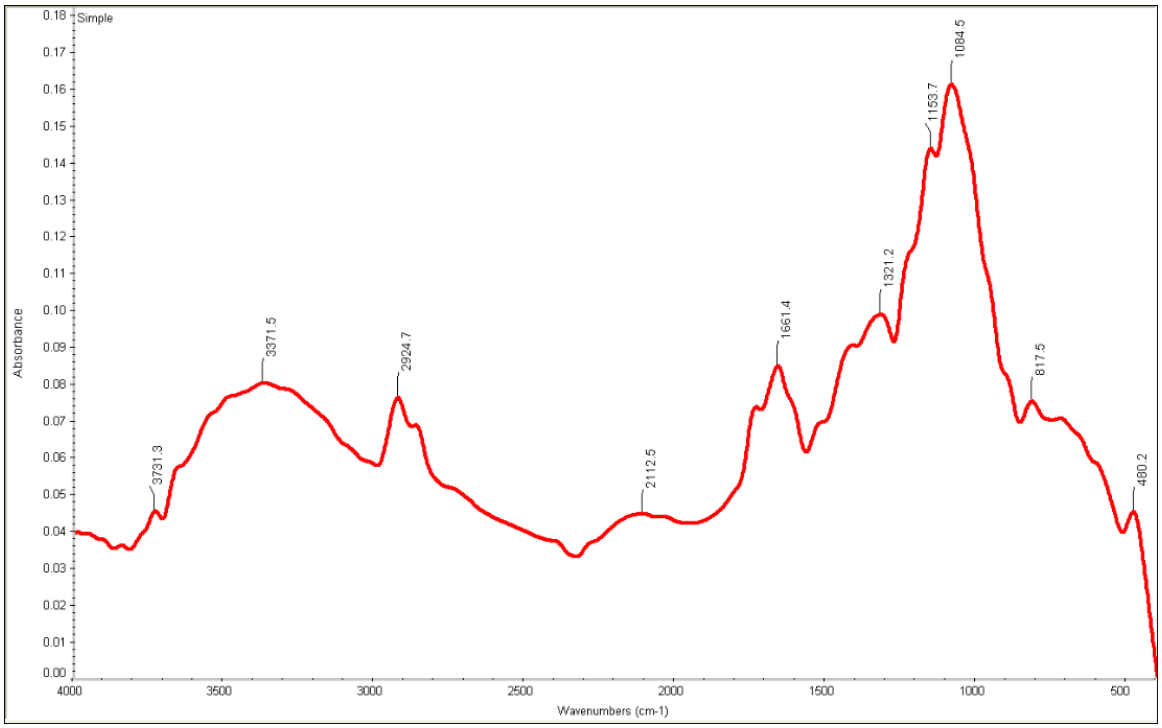


Figure 21: FT-IR of Insoluble Dietary Fiber.

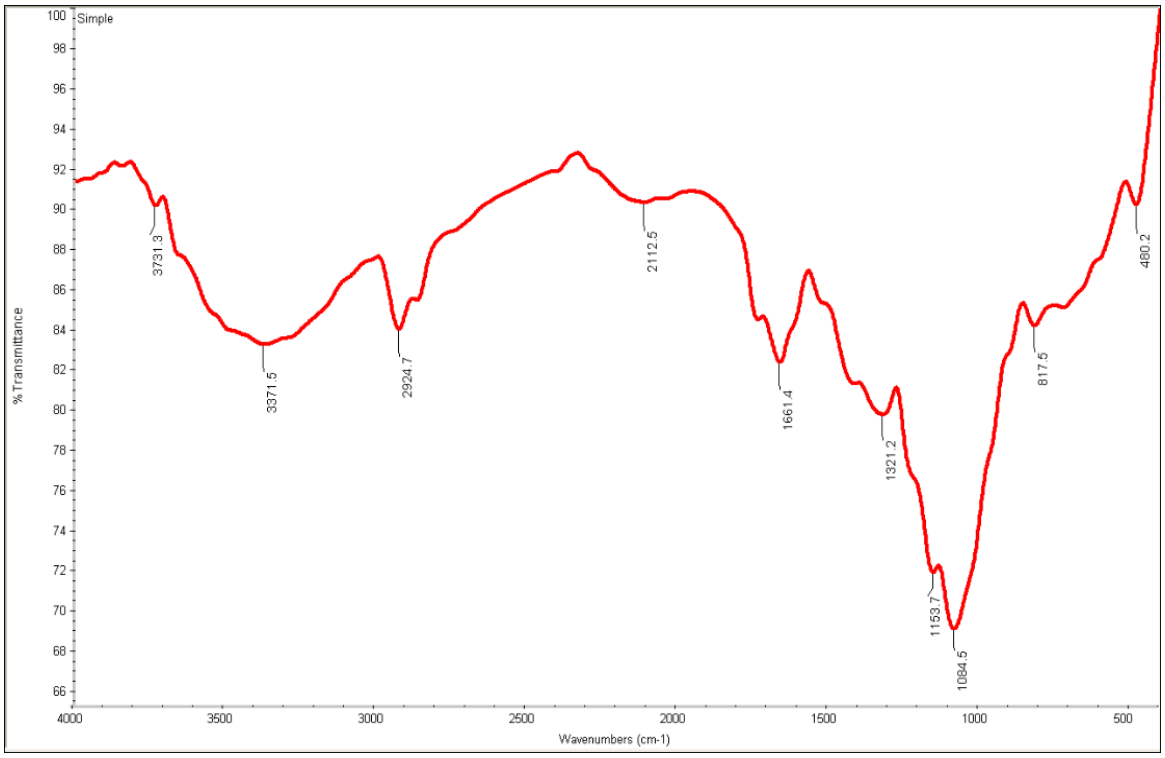


Figure 22: FT-IR of Insoluble Dietary Fiber.

CONCLUSION

From the above research, it has been concluded that Kadam fruit has versatile properties like water holding capacity(WHC), oil holding capacity(OHC), cholesterol absorption capacity, etc. further its high dietary fiber content appeals its utilization in foods like meat which is deficient in dietary fiber. The WHC and OHC of insoluble dietary fiber of Kadam powder was estimated (6.4399 g/g ± 0.066) and (12.6589 ± 0.0042) respectively and WHC and OHC of Soluble dietary fiber was (8.564 ± 0.0030) and (22.8976 ± 0.0003) respectively. The WHC and OHC of Kadam powder of SDF was more as compared to IDF. Generally, dietary fiber samples with high WHC could prevent the shrinkage of foods and alters its viscosity. The high WHC and OHC indicated that dietary fiber samples extracted from Kadam fruit may be a good source of dietary fiber for related food products which avoid water syneresis in formulated food and act as the emulsifier for food with higher fat content.

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