

**ISOLATION OF CELLULOSE FROM WATER HYACINTH FOR
PREPARATION OF CELLULOSE ACETATE MEMBRANE
INCORPORATED WITH SPIONS**

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Technology degree in Biotechnology

by

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**DEPARTMENT OF BIOTECHNOLOGY
SCHOOL OF BIO AND CHEMICAL ENGINEERING**

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 **SUBBULAKSHMI K (38230034)** who carried out the project entitled "**ISOLATION OF NANO CELLULOSE FROM WATER HYACINTH FOR MEMBRANE PREPARATION AND ITS APPLICATION ON WATER PURIFICATION**"

under our supervision from **January 2022 to april 2022**


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_ Submitted for Viva voice Examination held on _____ 2020

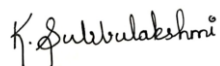
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DECLARATION

SUBBULAKSHMI K (38230034) hereby declare that the Project Report entitled “**ISOLATION OF NANO CELLULOSE FROM WATER HYACINTH FOR MEMBRANE PREPARATION AND ITS APPLICATION ON WATER PURIFICATION**”

done by us under the guidance of **Dr.PRAKASH P** is submitted in partial fulfillment of the requirements for the award of Masters of Technology degree in Biotechnology.



DATE:21.04.2022

PLACE: Chennai

SIGNATURE OF THE CANDIDATE

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ABSTRACT

Water hyacinth (*Eichhornia crassipes*) is a free-floating perennial aquatic plant. This paper describes the extraction and characterization of water hyacinth fibre (*Eichhornia crassipes*) nanocellulose. The research was unusual in that it looked at a larger range of characteristics of highly filtered water. WHF samples were obtained in greater detail at each stage of production. It has grown to be a big issue in many places because it affects the oxygen level in water by slowing the flow of water, resulting in the death of fish and the impossibility of boating, among other things. If not regulated, water hyacinth will completely blanket lakes and ponds, posing a major danger to bio diversity. It is fortified with extra chemical ingredients, which increases the fiber's quality. In this work, cellulose is extracted from water hyacinth and water hyacinth fibre is created by hand layup. The influence of process factors such as thrust force on drilling and reaming performances of water hyacinth fibre will be studied. The results of the experiment demonstrate that composites containing 9 percent water hyacinth cellulose had greater strength than composites containing 6 percent and 3 percent water hyacinth cellulose. The water hyacinth (*Eichhornia crassipes*) has received a lot of attention as the world's worst invasive aquatic plant due to its unusually fast proliferation and congested development, creating significant challenges in navigation, irrigation, and power production. Using classical and competitive models, the effect of physical and chemical treatment, pH, temperature, and beginning metal concentration dose on metal removal by water hyacinth is investigated.

LIST OF ABBREVIATIONS:

- FTIR: Fourier transform infrared spectroscopy
- SEM: Scanning electron microscope
- WHF: Water hyacinth fiber
- DP: Degree of polymerization
- PSR: Particle size analyzer
- LVEMP: Lake Victoria Environment Management Project
- TGA: Thermogravimetric analysis
- FRP: Fiber-Reinforced Polymer
- SPIONS: Superparamagnetic iron oxide nanoparticles

CHAPTER 1

INTRODUCTION

1.1 COMPOSITES

Plant-determined regular fiber can be utilized as a building up fixing in biopolymer composites. Water hyacinth is one such fiber source that is regularly accessible for nothing in the jungles, and its expulsion from tropical streams has natural advantages. Normal fiber is comprised of three essential parts: cellulose, hemicellulose, and lignin [1-3]. Hemicellulose and lignin are shapeless materials that biodegrade, ingest water, and deteriorate within the sight of hotness. Cellulose is a vital part of regular fiber and is answerable for its mechanical characteristics. More grounded mechanical characteristics are related with a more noteworthy cellulose content. Cellulose is a translucent design comprised of monomers of - D-glucopyranose. It is a polymer chain with a polymerization degree (DP) of approximately 10000. The fluctuating DPs of celluloses meaningfully affect their qualities. Prevalent mechanical and warm characteristics are related with a higher DP. Composite materials are astounding dampers and can limit shocks and sounds since they have more grounded sway properties than metals. Thus, composite materials are presently utilized in vehicles, aviation parts, and even tennis rackets and golf clubs. In a large number of our industry's items, polyester pitch goes about as the framework and glass fiber fills in as support. Be that as it may, a wide range of pitches and fortifications are utilized in composites, and every material adds to the exceptional elements of the completed item: Fiber, which is both solid and fragile, gives strength and firmness, while more adaptable sap shapes and safeguards the fiber. Composites, otherwise called Fiber-Reinforced Polymer (FRP) composites, are made out of a polymer framework built up with a fake, man-made, or normal fiber (like glass, carbon, or aramid) or other supporting material. The framework shields the strands from outside and natural corruption while likewise sending weight among the filaments. The filaments, thusly, add strength and firmness to the network, so reinforcing it and making it more impervious to breaks and cracks. Throughout the course of recent years, the utilization of composite materials and their subordinates has extended. The assortment of composite materials that might be

utilized has consistently expanded and has verifiably impacted the contemporary business. The recently made composite materials are utilized in a wide scope of specialized applications, from unrefined things to profoundly refined ones. Composite materials are utilized in designing applications in light of their weight-saving properties and cost-adequacy. As of late, these properties have expanded the use of composite materials for aviation applications and other worthwhile purposes. The composite materials are comprised of support, which is a weighty substance, and a network, which is a light material wherein the support is inserted. The support in a composite material advances the improvement of the framework's mechanical attributes.

The natural or inorganic framework helps with the support's arrangement. The singular constituents of the composite material don't contrast in their mechanical and warm characteristics, yet the consolidated advantage of their elements outflanks the lack of ability of producing alone. The covering is put over the metallic parts to shield them from erosion and wear. Layered soundness is given by the composite material's insignificant co-effective of warm development. The advantage of composite materials over metallic parts is the diminished assembling time and adaptability underway of composite materials in different structures with smooth surfaces. Thus, additional time might be saved in the creation of multipart and muddled parts.

The required characteristics of the material can be expanded by artificially joining various parts to create another material while keeping the singular properties unaltered. The blend of at least two materials can be valuable in making and meeting the imperative characteristics. Composite materials have unforeseen applications. A solitary composite material can fix more metal pieces with more noteworthy weight. The advantage of composite materials over metallic parts is the diminished assembling time and adaptability underway of composite materials in different structures with smooth surfaces. Therefore, additional time might be saved in the manufacture of multipart and convoluted parts. Since composite materials have higher effect attributes than metals, they are prevalent dampers and can decrease shocks and commotions.

Accordingly, composite materials are utilized in cars, aeronautics parts, and even tennis rackets and golf clubs. Polyester pitch fills in as the grid and glass fiber fills in as support in a significant number of our industry's merchandise. FRP However, a wide range of saps and fortifications are utilized in composites, and every material adds to the extraordinary elements of the completed item: Fiber,

which is both solid and weak, gives strength and firmness, while more adaptable pitch shapes and safeguards the fiber. Fillers, added substances, center materials, and surface medicines may likewise be consolidated in FRP composites coatings to further develop the assembling system, the appearance, and the exhibition of the finished item.

1.2 CELLULOSE FIBER

In view of elements like its simplicity of availability, non-poisonousness, biocompatibility, hydrophilicity, and biodegradability, cellulose has a wide scope of purposes (Dai H. et al. 2017; Liu Z. also, Huang H. 2016). Cellulose is gotten from assorted natural sources and is generally utilized in the making of biodegradable layers, adsorbents, and channels, in addition to other things (Sundari M.T. furthermore, Ramesh A., 2012). Cellulose is comprised of lignocellulosic filaments that are made by lignin, cellulose, and hemicellulose. The compound's monomers are consolidated by - 1,4- glycosidic linkages (Oliveira J.P. et al. 2017). Cellulose biomass is extricated from wood-based and non-wood sources utilizing substance or actual extraction procedures fit for dissolving lignocellulosic linkages without annihilating the cellulose fibrils. Water orchids are one of the organic normally happening wellsprings of cellulose that contain critical amounts of cellulose (Setyaningsih L. et al. 2017). The use of cellulose as a potential polymer for the making of nanocomposites is the focal point of our examination. We researched various plant hotspots for cellulose prior to performing consecutive cellulose extraction and utilizing it in the production of nanocomposites.

1.3 PREPARATION OF NANOCELLULOSE

Cellulose would be removed from plant strands utilizing compound and mechanical techniques, and it very well may be recuperated in nano and miniature structures through alkalization, dying, and corrosive hydrolysis. This paper portrays the extraction and portrayal of water hyacinth fiber (*Eichornia crassipes*) nanocellulose. The creativity was in plunging further into a bigger scope of characteristics of exceptionally unadulterated examples of WHF after each progression of production. Segregation was achieved by the utilization of digester pulping and sonication. SEM was used to exhibit morphological changes when treatment (SEM). The groupings of lignin and hemicellulose were brought down after compound treatment. Transmission electron microscopy (TEM) and a molecule size analyzer were utilized to examine the morphology of WHF following 1 hour of sonication (PSA). TEM was utilized to decide the width and length of nanocellulose WHF, which were 15.61 and 147.4 nm, separately. The crystallinity list and translucent space region expanded

fundamentally after synthetic treatment. The most elevated crystallinity file after corrosive hydrolysis was 84.87 percent. More prominent crystallinity prompts expanded warm steadiness. When treatment, WHF dampness ingestion tests were done. The cellulose fiber showed the least dampness ingestion after sonication (nanocellulose). Cellulose would be extricated from plant strands utilizing synthetic and mechanical methodology, and it very well may be recuperated in nano and miniature structures through alkalization, fading, and corrosive hydrolysis.

1.4 NATURAL FIBER REINFORCED COMPOSITES

Due to their eco-neighborliness and supportability, regular filaments are acquiring bid among analysts and scholastics for utilization in polymer composites. Plant-determined strands and a polymeric network consolidate to frame normal fiber composites. The regular fiber part may be wood, sisal, hemp, coconut, cotton, fleece, flax, jute, abaca, banana leaf filaments, bamboo, wheat straw, or any stringy material, while the network could be polymeric. Normal fiber composites give advantages like low energy age and carbon dioxide sequestration (bringing down the "nursery impact"). Some creation can be 'cultivated out' to semi-gifted native work, which has political/social advantages. The replacement of regular fiber for fiberglass mitigates stresses over lung infection brought about by the previous and establishes a stage toward long haul development. The drawbacks of normal strands were higher water ingestion, lesser imperviousness to fire, and sub-par mechanical characteristics, which restricted their application. The impacts of synthetic treatment on regular fiber composite water ingestion, tribology, viscoelastic way of behaving, unwinding conduct, energy assimilation, fire retardancy, and biodegradability were likewise explored. Regular fiber composites are utilized in the auto and development enterprises, as well as in an assortment of different applications. Compound treatment of normal assets was viewed as fundamental.

1.5 ISOLATION OF NANOCELLULOSE:

Water hyacinth is purified with faucet water, cut into little pieces, and dried at 80 degrees Fahrenheit for 96 hours. An example of 10g and 450 ml of ethanol and toluene in a 1:2 proportion is taken and warmed for 6 hours and dried to acquire water hyacinth extricate and dewaked fiber, and 1litre of refined water is mixed for an hour and separated, and 100ml of 5c/o NAOH 100ml of 11%, dried and fading followed filtration and this cycle was rehashed for twice and dying interaction is trailed by filtration and wash the buildup sodium hydrochloride 50ml and the example become white and the

pellet structure substance got and it was sifted by channel paper and the example is dried for 92hours.

1.6 WATER HYACINTH



The Pontederiaceae water hyacinth *Eichhornia crassipes* (Mart) Solms was found in Lake Victoria in 1989. The weed extended lastly covered more than 80% of Lake Victoria's Ugandan coastline. Water hyacinth's quick expansion has been associated with decimating social and ecological repercussions. In view of the worries demonstrated over, the Ugandan government formulated a coordinated system to oversee water hyacinth invasions, which incorporated the utilization of organic control weevils - *Neochetina eicchornia* (Hustache) and *Neochetina bruchi* (Warner), as well as manual and mechanical techniques. By 1998, water hyacinth has been pronounced controlled in the Ugandan piece of the lake. Weed biomass was fundamentally diminished, with organic control representing

the huge heft of the decrease. The weevil populace fell because of the weed's fast passing, as it does in each host-bug collaboration. The Lake Victoria Environment Management Project (LVEMP), which allowed significant local area based weevil raising and delivery around Lake Victoria, reached a conclusion in 2005, and no more deliveries were made after that. Moreover, no equivalent weevil recuperation studies were done, demonstrating that a comprehension of the organic control process in overseeing resurgence cycles stays an information hole, as recognized at the conclusion of LVEMP in 2005.

The objective of this examination was to all the more likely comprehend resurgence cycles and weevil recuperation in the water hyacinth focal points of Bunjako, Murchison, Fielding, and Thruston inlets, among different spots. The review's definitive objective was to assess the effect of natural circumstances on weevil populace and herbivory in Lake Victoria and the contiguous waterway Kagera to figure and control water hyacinth resurgence cycles. The lake supplement levels in the water and silt, water hyacinth plant biometric attributes, water hyacinth plant supplements, and their communication with the *Neochetina* weevil populace and herbivory were the review's key parts. Ecological lake observing evaluations were led in huge water hyacinth areas of interest, including the coves of Bunjako, Murchison, Fielding, and Thruston, as well as in different areas.

pH, temperature, nitrogen, and phosphorus are completely checked in water and residue. Metal follows copper, lead, iron, and zinc were recognized in water hyacinth plant parts (petioles, residue, leaves, and roots). The Green House and Lake Cage. Preliminaries were led between July 2008 and April 2009 to enhance the discoveries. in view of broad lake checking overviews All of the previously mentioned measures were dissected in both Lake studies and testing, and they were associated with water hyacinth development factors. Plant weight, leaf length, leaf width, root length, and number of living leaves are for the most part factors to consider. On water hyacinth plants, the presentation of *Neochetina* weevils as far as herbivory and populace elements was additionally assessed.



CHAPTER 2

LITERATURE

REVIEW

2.1 *NANOCELLULOSE:*

Bibi Mathew Cherian et al. (2010) assessed the viability of the great strain aqueous procedure on pineapple leaf fiber after cellulose seclusion to individualize the implanted cellulose from full scale to nano size. The steam blast approach isolated PALF nanofibers with distances across going from 5 to 60 nm. The uncommon type of nanofibers' connected web-like construction was brought about by high-pressure defibrillation. Synthetic assessment of PALF after each phase of filtration exhibited an expansion in cellulose content and a decline in lignin and hemicellulose content. The decontamination of cellulose was helped by a progression of blanching steps.

2.2 *NANOPARTICLE INCORPORATED MEMBRANE*

J.XSun and XF Sun et al. extricated cellulose from sugarcane bagasse (2004). The general crystallinity of the six isolated cellulose tests was resolved utilizing both corrupted strategies like corrosive hydrolysis and hotness examination, as well as non-debased procedures like FT-IR and CP/MAS ¹³C-NMR spectroscopy. A nanoparticle is a nano-object with three outside nanoscale aspects. When a nano-longest item's and briefest hub lengths contrast, the terms nanorod or nanoplate are utilized rather than nanoparticle (NP).

2.3 *APPLICATION OF MEMBRANE*

Qi Liu and Yun Lu et al. (2017) led research on high-immaculateness cellulose nanofibers acquired from wheat straw utilizing a naturally amicable, multistep treatment strategy including steam blast, microwave-helped hydrolysis, and miniature fluidization. The cellulose content of the treated nanofibers developed from 44.81 to

94.23 percent, while the hemicellulose and lignin levels fell

decisively. The impacts of the detachment medicines on fiber shape and width were shown involving checking electron microscopy. The varieties in the parts, surface harshness, and crystallinity of the filaments were noticed utilizing nuclear power microscopy. Transmission electron microscopy uncovered extended, free nanofiber groups with a typical individual width of 5.42 nm that were 10-40 nm expansive. Cellulosic parts were not effectively dispensed with, as indicated by Fourier change infrared spectroscopy. The upgraded crystallinity of the treated filaments, as well as the incomplete translucent progress of cellulose I to cellulose II, were shown by X-beam diffraction investigation. Thermogravimetric review and subsidiary thermogravimetric information uncovered that the nanofibers had worked on warm qualities. The disposal of hemicellulose and lignin upgraded the crystallinity of the strands, working on their warm qualities. The outcomes showed that the multistep treatment method is proficient and naturally cordial, yielding nanofibers with expected progressed applications.

Marimuthu and Thiripura Sundari et al. (2011) examined the successful readiness of cellulose nanofibers from the water-hindering amphibian weed — water hyacinth. The unrefined and unadulterated cellulose microfibers were extricated from the weed plant utilizing compound medicines, for example, fading, basic, and sodium chlorite responses. The micron-sized filaments removed from the stems were cry crushed with fluid nitrogen to free heaps of nanofibers and afterward sonicated for fiber individualization. Fourier Transform Infrared Spectroscopy (FTIR) was utilized to approve the end of foreign substances from the treated filaments. Filtering electron microscopy (SEM) and transmission electron microscopy (TEM) were utilized to look at the surface morphology of the fluid arrangement when cry squashing and sonication (TEM). The warm security of the fiber worked on following compound treatment, as proven by thermogravimetric estimations (TGA). As indicated by the SEM, the nanofibers were 20-100 nm in distance across and 25 nm in width as per the TEM assessment.

CHAPTER 3

AIM AND SCOPE

The current exploration is centered around the improvement of a composite plate made of water hyacinth fiber, epoxy pitch, and zirconium oxide. The cellulose from the plant was eliminated to isolate

the filaments from water hyacinth. The substance cosmetics and useful not entirely set in stone. The mechanical way of behaving of different fiber mixes in a composite plate will be explored. The significant object was to lead an exploratory investigation of machining boundaries during boring and reaming procedure on water hyacinth fiber built up polymer composite materials.

The current review's objective and points are to isolate cellulose from water hyacinth to construct a cellulose acetic acid derivation film related to spions.

CHAPTER 4

MATERIALS AND METHODS

4.1. MATERIALS

4.1.1 *COLLECTIONS OF PLANTS AND CHEMICALS*

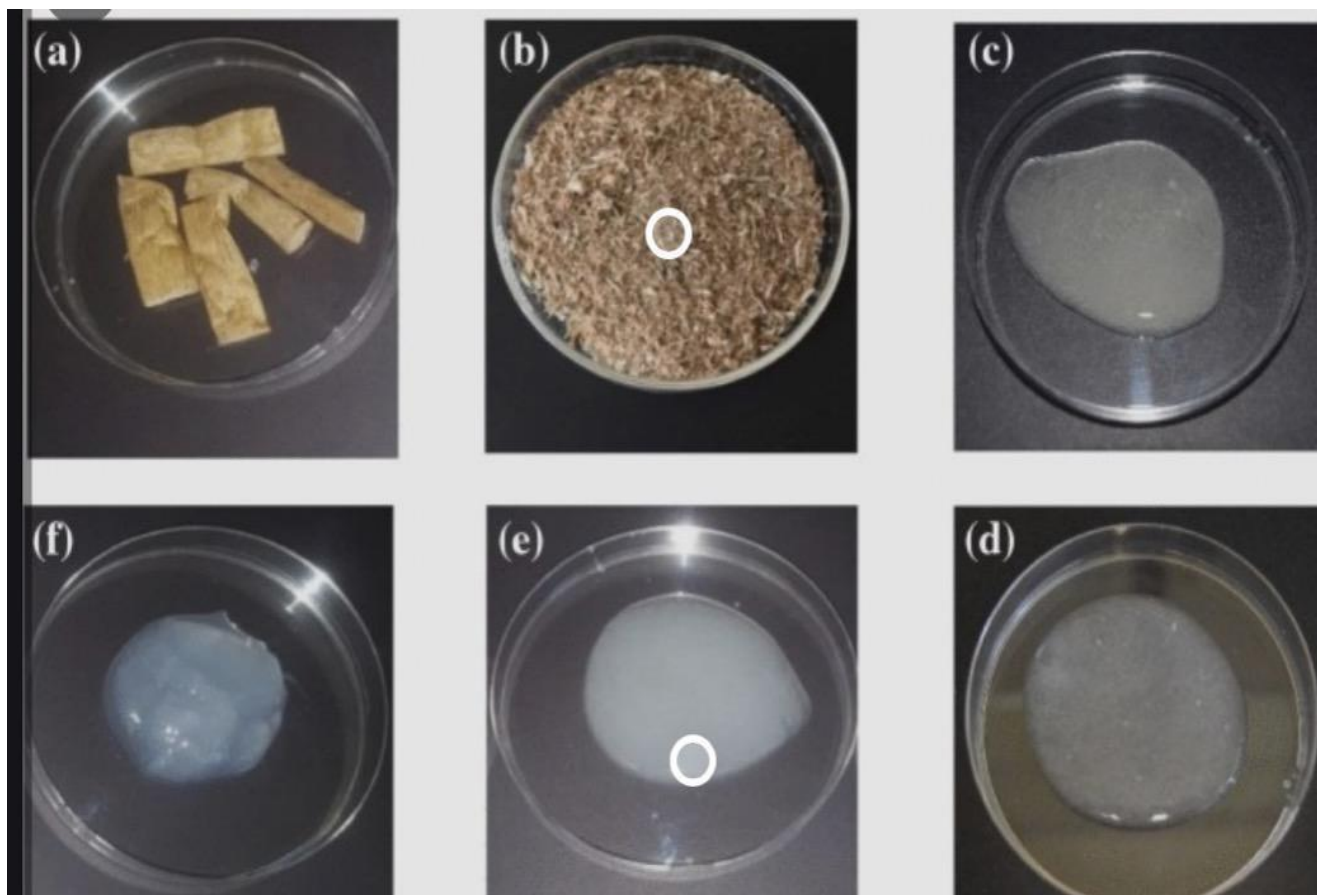
The lake offered dry fibre from water hyacinth. Water hyacinth, one of the fastest-growing plants,

reproduces mostly by runners or stolons, which create daughter plants. Every year, each plant may produce hundreds of seeds, and these seeds can live for more than 28 years. Toluene, ethanol, acetone, $(\text{CH}_3\text{CO})_2\text{O}$ (acetic anhydride), NaOH , glacial acetic acid, sodium hypochlorite, oxalic acid, and hydrogen peroxide are some of the chemicals used.

4.2. METHODS

4.2.1. CELLULOSE ISOLATION

The lake offered water hyacinth as dry fiber. Water hyacinth, one of the quickest developing plants, replicates generally by sprinters or stolons, which in the long run make little girl plants. Each plant may likewise create great many seeds consistently, and these seeds can live for over 28 years. Toluene, ethanol, $\text{CH}_3)_2\text{CO}$, $(\text{CH}_3\text{CO})_2\text{O}$ (acidic anhydride), NaOH , glacialacetic corrosive, sodium hypochlorite, oxalic corrosive, and hydrogenferoxide.



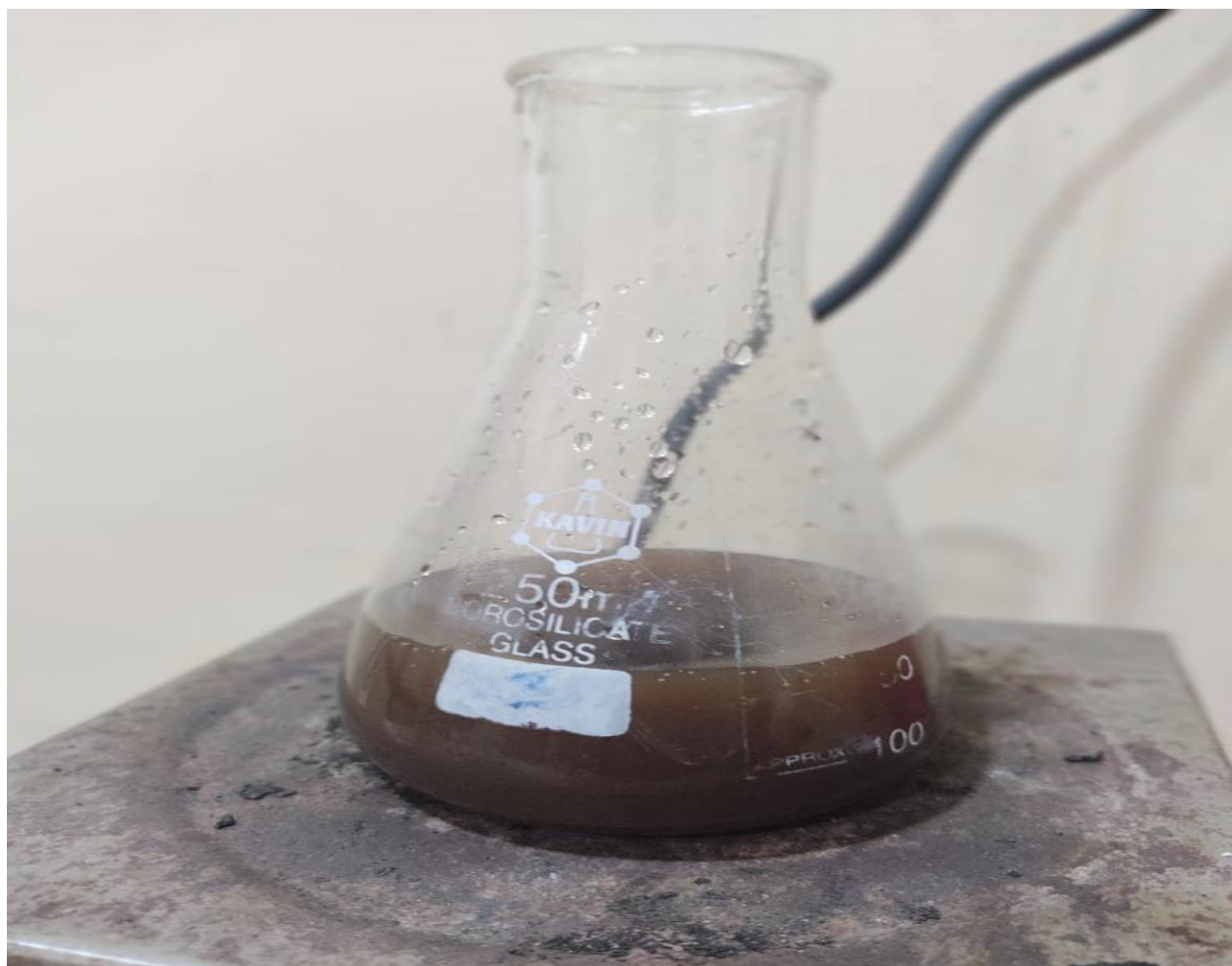
4.2.2. ISOLATION OF NANOCELLULOSE:

Water hyacinth is cleaned with regular water, cut into little pieces, and dried for 96 hours at 80 degrees. An example of 10gram and 450 ml of ethanol and toluene in the proportion of 1:2 is taken and warmed for 6 hours and dried to get water hyacinth separate and dewaked fiber, and 1litre of refined water is blended for an hour and sifted, and 100ml of 5c/o NAOH 100ml of 11% mixed for 10 minutes and broke up the example. furthermore, powdered the example with sodium hydrochloride 50ml and the example become white and the pellet structure substance acquired and it was separated by channel papaer and the example is dried for 92hours.

4.2.3. CELLULOSE ACETATE MEMBRANES

Cellulose diacetate arrangements containing 13-15 percent cellulose acetic acid derivation were delivered utilizing acetone as the dissolvable and disturbed for 3 hours until all of the cellulose acetic acid derivation was broken down. Drop by drop, polyethylene glycole (5%) was applied. The homogeneous polymer arrangement was kept undisturbed until no air pockets were seen.

The polymer arrangement was projected utilizing a steel projecting blade with a thickness of 200 m on a glass substrate, then, at that point, left in free air contact for fluctuating times, for example 0, 5, 10, and 15 seconds. The proto-film was then set by submerging it in a water-based coagulation shower for one day at room temperature. The films that came about were washed to take out abundance dissolvable.



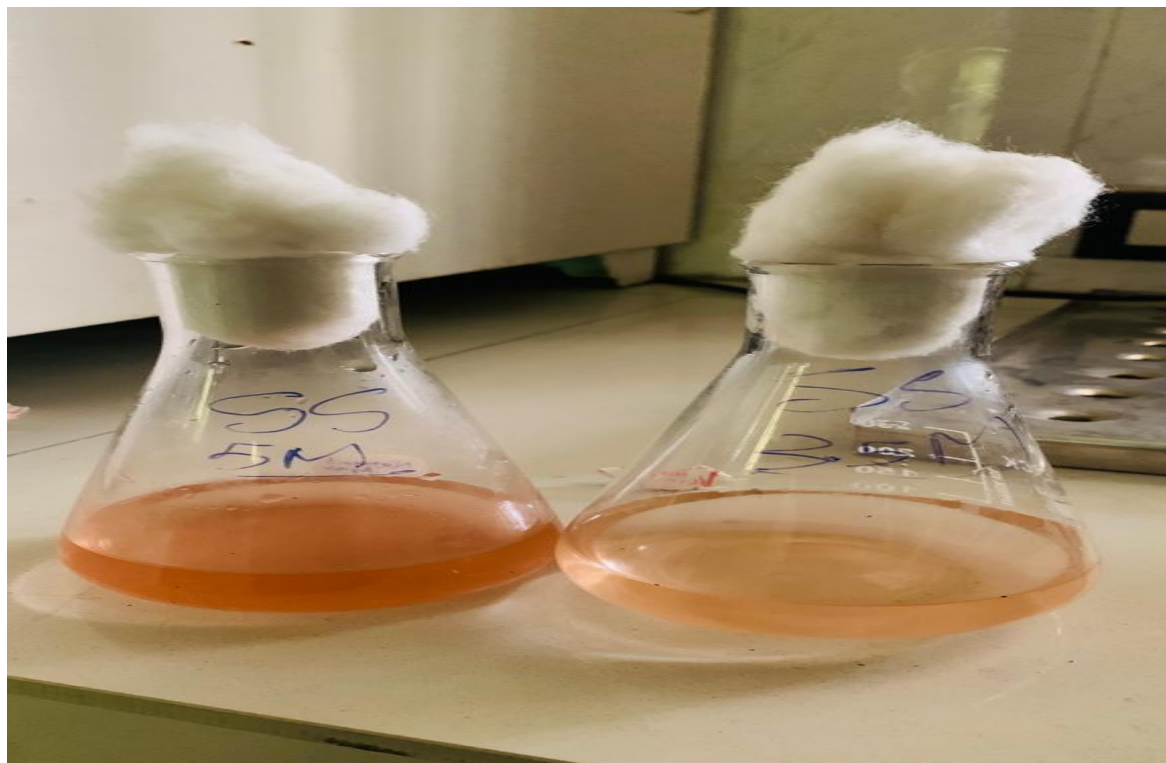
4.2.4 ACID HYDROLYSIS

Destructive hydrolysis was completed in two stages to deliver more unassuming and homogenous cellulose fibers. The objective of the cycle was to work on the crystallinity of WHF cellulose. WHF was hued for 20 hours with 5M hydrochloric destructive at 60 C and 500 rpm. 5 m Hcl and 3.5 m Hcl were produced. To make 5ml hcl, take 40ml of refined water and cautiously blend in 43.64ml of hcl with 100ml of refined water. The fiber was then hydrolyzed again for 20 hours at 60 C and 500 rpm with 3.5M hydrochloric destructive.

The hydrolyzed fiber was washed with refined water until it arrived at a pH of 7. (nonpartisan). This twofold hydrolysis is gentler on the fiber and made the WHF more straightforward to process with sonication contrasted with a solitary sulfuric corrosive hydrolysis process. Sample was added yo 25ml

of 5Mhcl and it ws kept in plot plate and yhe test ought to be broken down and it was kept in orbital shaker. Orbital shaker the example was taken and the example is sifted two times and 100ml of refined water is added. furthermore, the example is warmed by hot plate for 1hour.

This twofold hydrolysis is gentler on the fiber and made the WHF simpler to process with sonication contrasted with a solitary sulfuric corrosive hydrolysis process. Test was added to 25ml of 5Mhcl and it wss kept in plot plate and the example ought to be broken down and it was kept in orbital shaker. Orbital shaker the example was taken and the example is separated two times and 100ml of refined water is added. what's more, the example is warmed by hot plate for 1hour.



4.2.5 SONICATION

This was finished utilizing 100 ml of refined water and 0.5 percent cellulose WHF (from the corrosive hydrolysis strategy). This suspension was sonicated for 1 hour at 20 kHz and 600 W utilizing a ultrasonic cell smasher SJIA-1200W until the nanocellulose fiber was completely broken down. The temperature of the WHF cellulose suspension was kept up with under 50 degrees Celsius. The nanocellulose WHF suspension that came about.

The example is sonicated for an hour. Sonication is the technique for fomenting particles or broken strands in a fluid by utilizing sound energy. Since ultrasonic frequencies (in excess of 20 kHz) are normally utilized, the procedure is otherwise called ultrasonication. Sonication can be achieved utilizing either a ultrasonic shower or a ultrasonic test (sonicator) Sonication is in many cases utilized in nanotechnology to consistently scatter materials.

It is likewise used to dismantle totals of micron-sized colloidal particles. Sonication can likewise be used to begin crystallization processes and even to direct polymorphic crystallization. Sonication is a method that utilizes sound waves to foment particles in an answer. To isolate substances, it transforms an electrical sign into an actual vibration. These aggravations can blend arrangements, accelerate the breakdown of a strong into a fluid, like sugar into water, and eliminate disintegrated gas from fluids.

Whatsman channel paper was utilized to channel the example. 30ml of refined water and 70ml of hcl were combined as one. A 10ml arrangement of hck is added to the example, which is disintegrated and warmed for 15 minutes. Whenever the example was put into a petri dish The petriplate was set in the fridge for 5 hours. The example was taken out from the cooler and warmed.



4.2.6 PREPARATION OF SPION INCOPRATED MEMBRANE

Cold acidic corrosive is added to cellulose fiber, and the arrangement is held at 60 degrees Celsius to bubble. A layer is produced when a spion nano molecule is placed into a plate. What's more, the covering is now dry. SPIONs (superparamagnetic iron oxide nanoparticles) are a type of MNP that show attractive qualities when presented to an outside attractive field.

4.2.7 SEM (*Scanning electron microscope*)

(SEM) makes an image by anticipating and filtering a concentrated stream of electrons over a surface. conveys high-goal symbolism that might be utilized to examine assorted materials for surface breaks, imperfections, debasements, or erosion. Electrons cooperate with particles in the example, making an assortment of signs that convey data about the example's surface geography and creation. An image is made by examining the electron shaft in a raster check example and consolidating the place of the bar with the power of the got signal.

Optional electrons produced by iotas invigorated by the electron bar are recognized utilizing an auxiliary electron identifier (Everhart-Thornley locator) in the most well known SEM mode. The quantity of optional electrons that might be identified, and henceforth the sign, not entirely settled by a few variables, remembering for example geography. Some SEMs can accomplish goals better than 1 nanometer.

4.2..8 FTIR(*FTIR FOURIER TRANSFORM INFRARED SPECTROSCOPY*)

The FTIR spectroscopy was used to research the progressions in the substance creation of water hyacinth filaments that had been synthetically treated. To deliver the FTIR spectra, dried examples of the first rough and treated filaments were squashed into powder and a flimsy pellet was made by joining with potassium bromide (KBr) and checked in Fourier change infrared spectroscopy (FTIR 8400S).

The range was gathered in transmission mode with a scope of 4000-400 cm at a goal of 4 cm and 40 outputs for every example. The pinnacles are situated at 3,400 and 2,900 cm CH extending vibration. The acetyl and uronic ester delivered a top in the unrefined fiber at 1,735 cm⁻¹ was seen because of the acetyl and uronic ester linkage of carboxylic gathering of the ferulic and coumaric acids of lignin as well as hemicelluloses. This pinnacle was vanished in the nanofibers after the synthetic and mechanical treatment.

CHAPTER 5

MEMBRANE CHARACTERIZATION

5.5.1 *SCANNING ELECTRON MICROSCOPE ANALYSIS*

SEM examination is a solid insightful apparatus that produces mind boggling, high amplification photos of an example's surface geology utilizing a focussed stream of electrons. The location of high energy electrons let out of the outer layer of an example after it has been exposed to an exceptionally focussed stream of electrons from an electron cannon is the premise of SEM. Utilizing the SEM objective focal point, this electron pillar is centered around a minuscule point on the example surface. SEM is regularly used to study the microstructure and science of an assortment of materials.

The SEM's significant parts incorporate an electron source, electromagnetic focal points to focus electrons, electron finders, test chambers, PCs, and screens to see the photos. SEM (Scanning Electron Microscopy): SEM magnifying instruments are generally used to research cellulose filaments and nanofibers. Tests are put on aluminum hits all through the cryocrushing and sonication tasks, then, at that point, covered with platinum/gold utilizing a particle falter coater to stifle accuses prior to being checked of a SEM.

5.2 *Fourier Transform Infrared (FTIR)*

The practical gatherings of crude WHF were resolved utilizing FTIR utilizing a Perkin-Elmer Frontier, then subsequent to pulping, dying, corrosive hydrolysis, and sonication. The FTIR range was recorded from 600-4000 cm^{-1} utilizing 1 cm 1 cm tests blended in with KBr powder and squeezed to frame the straightforward KBr-test pellet. The essential objective of FTIR spectroscopy is to grasp the progressions that happen in the substance structure of filaments got from synthetically treated water hyacinth.

The FTIR spectra is estimated in transmission mode a ways off of 4000-400 cm^{-1} and with a goal of 4 cm^{-1} while keeping an aggregate of 50 outputs for each example that is investigated (Mochochoko T. et al. 2013). Different ones have a scope of 4000-400 cm^{-1} and a goal of 4 cm^{-1} , and are worked in transmission mode with 40 sweeps by drying the examples and isolating the filaments that are squashed into powder, from which a slight pellet is made by blending it in with potassium bromide (KBr), which is then filtered to get the FTIR spectra (Thiripura Sundari M. and Ramesh A. 2012).

CHAPTER 6

RESULTS AND DISCUSSION

RESULTS:

6.1 NANOCELLULOSE MEMBRANE SOURCE

Disengagement of nanocellulose from water hyacinth for film creation and use in water filtration. It is fabricated to segregate nano cellulose planning and cell film arrangement. This paper presents the viable separation and portrayal of water hyacinth for water purging and nanocellulose. To isolate the strands from water hyacinth, the cellulose from the plant was removed. The compound structure as well as the utilitarian gatherings were distinguished. To research the mechanical way of behaving of different fiber blends in a composite plate.



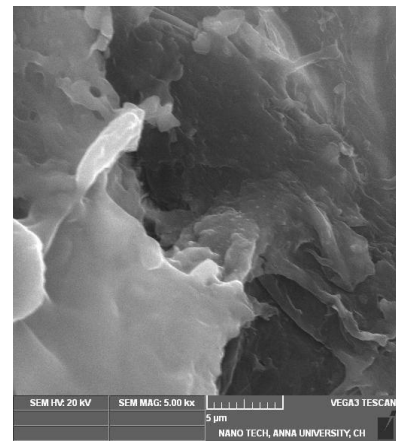
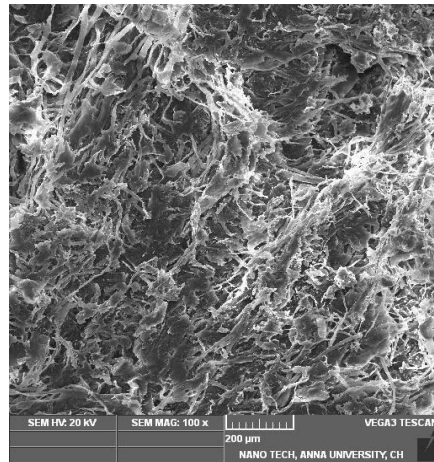
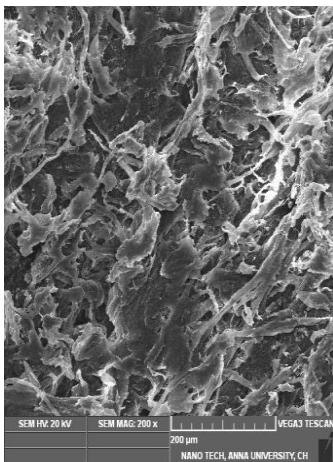
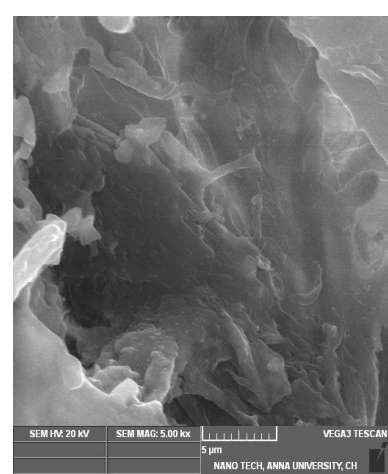
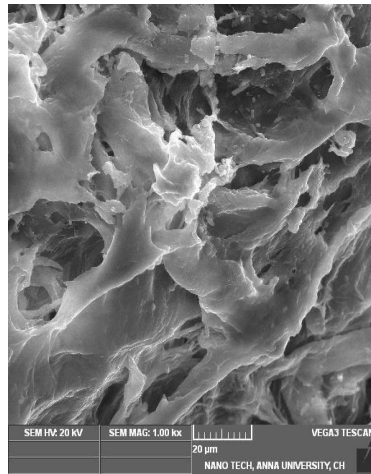
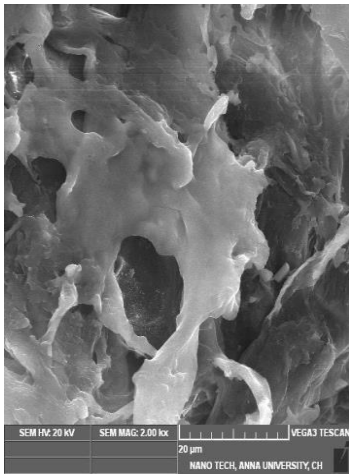
6.2 MEMBRANE PREPARATION

Sample is poured in petri plates and it was kept in fridge for 5 hours. Membrane layer is formed.



6.3 *SCANNING ELECTRON MICROSCOPY* (SEM)

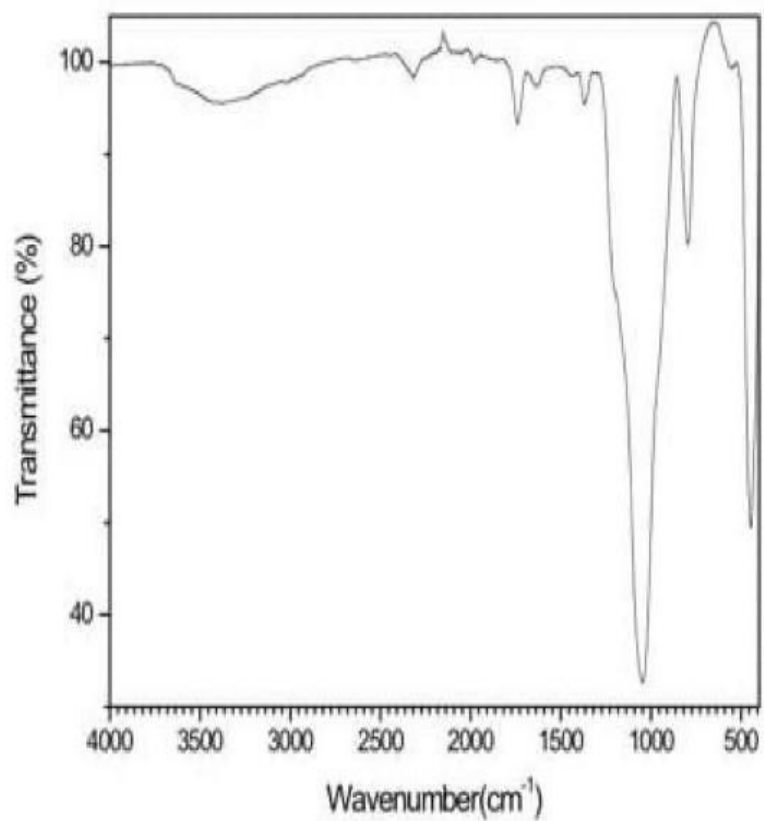
WITHOUT SPIONS:



6.4 **FOURIER TRANSFOR INFRARED SPECTROSCOPY (FTIR)**

WITHOUT SPIONS:

FTIR graph



DISCUSSION:

CELLULOSE ACETATE MEMBARANE

Water hyacinth was washed with refined water and cut into uniform 10 mm pieces. In an autoclave,

the cleaved water hyacinth filaments were treated with 2% NaOH (fiber to fluid proportion 1:10) and held at 20 lb pressures for additional 60 minutes. The tension was in a split second feeling better. The strands were taken from the autoclave and flushed in refined water to eliminate the salt. The steam detonated filaments were dyed utilizing a combination of NaOH and acidic corrosive (27 and 78.8 g, individually) and a combination of 1:3 sodium hypochlorite arrangements. On account of shade misfortune, the water hyacinth fiber changes tone from green to white with the expansion of sodium hypochlorite. The dying system was completed multiple times. In the wake of blanching, the strands were entirely washed and dried in refined water. In an autoclave, the steam exploded hues fibers were treated with 11% oxalic destructive till a pressure of 20 lb was gotten. The stress was quickly relieved. The autoclave was set to 20 pounds. The strands were kept there for 15 minutes under pressure. Once the tension was given, the conversation was repeated many times. To guarantee that the washings were non-corrosive, the strands were removed and flushed in a potassium permanganate arrangement till the washings were no longer decolorized. The Nano fibrils were suspended in water and disturbed for something like 4 hours at 8000 rpm with a mechanical stirrer of type RQ-1.27 An until the strands were similarly circulated. The isolated cellulose from water hyacinth was kept at a high temperature. The isolated water hyacinth cellulose was kept up with in a hot air stove to altogether dispose of its dampness content. Getting dried water hyacinth cellulose is conceivable.



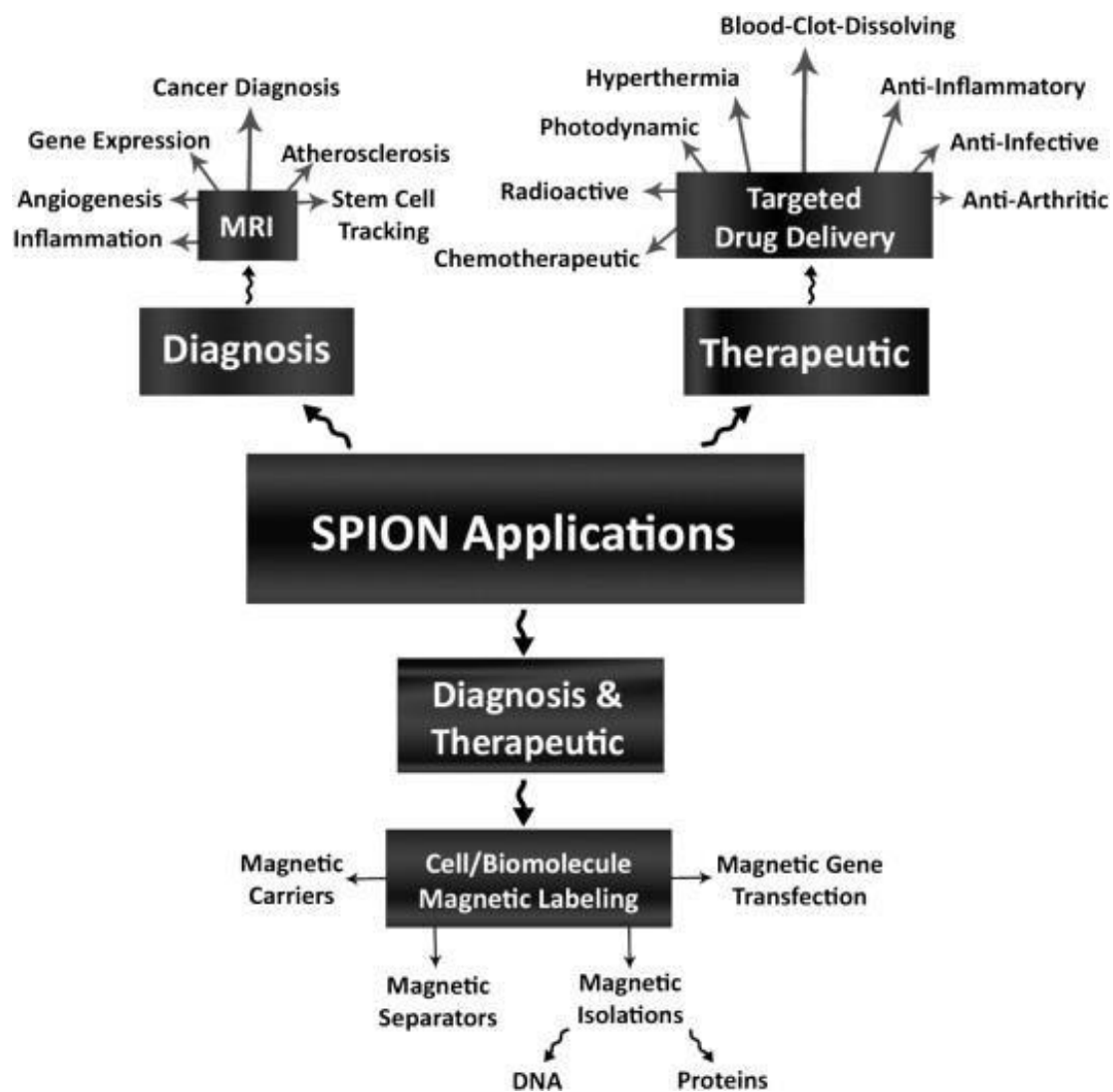
SUPERPARAMAGNETIC IRON OXIDE NANOPARTICLES (SPIONs):

Superparamagnetic iron oxide nanoparticles (SPIONs) were created in an ecologically friendly manner. SPIONS with mostly sugar coatings were easily created by employing a common, zero- calorie sugar extract (Stevia) (as both decreasing and settling specialists). X-beam diffraction (XRD), field discharge examining electron microscopy (FESEM), high-goal transmission electron microscopy (HRTEM), warm gravimetric investigation (TGA), X-beam photoelectron spectroscopy (XPS), vibrating-test magnetometer (VSM), and the Zeta expected test were used to describe the following SPIONs.



MEMBRANE LAYER IS FORMED

SPIONS



CHAPTER 7

SUMMARY AND CONCLUSION

SUMMARY

The present research is centred on extracting nanocellulose from water hyacinth fibre in order to build a cellulose acetate membrane injected with spions. The water hyacinth has been chopped up and dried. The membrane layer is formed, and the SEM/FDIR analysis is shown.

CONCLUSION

Membrane cellulose was successfully generated from WHF after a series of mechanical and chemical treatments. SEM and FDIR are used to document the morphological changes in the WHF before and after treatment. WHF disintegrated during dyeing and was depolymerized during corrosive hydrolysis. As indicated by SEM and molecule size studies, sonication delivered nano-sized filaments. Corrosive hydrolysis was demonstrated to be compelling in diminishing lignin and hemicellulose levels. Now, the crystallinity index was very high (84.87 percent), but after sonication, the crystallinity index fell. The low moisture retention and high crystallinity index values acquired suggest that sonicated WHF so treated may be a helpful supporting material for biocomposite film and in this way be utilized in the manufacture of naturally agreeable bundling related to an appropriate starch.

CHAPTER 8

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and portrayal of water hyacinth fiber (Eichornia crassipes) nanocellulose. The creativity was in plunging further into a bigger scope of characteristics of exceptionally unadulterated examples of WHF after each progression of production. Segregation was achieved by the utilization of digester pulping and sonication. SEM was used to exhibit morphological changes when treatment (SEM). The groupings of lignin and hemicellulose were brought down after compound treatment. Transmission electron microscopy (TEM) and a molecule size analyzer were utilized to examine the morphology of WHF following 1 hour of sonication (PSA). TEM was utilized to decide the width and length of nanocellulose WHF,

and characterization of water hyacinth fiber (Eichornia crassipes) (WHF) nanocellulose is presented in this study. The novelty was in exploring a wider range of properties of highly purified samples of WHF after each stage of production in more depth. The isolation was accomplished by pulping in a digester and sonication. Morphological changes before and after treatment were demonstrated by scanning electron microscopy (SEM). The lignin and hemicellulose content decreased during chemical treatment. Transmission electron microscopy (TEM) and particle size analyzer (PSA) were used to determine the morphology of WHF after sonication for 1 h. TEM shows that the diameter and length of nanocellulose WHF

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<https://link.springer.com/article/10.1007/s12221-018-7953-1>

3/20

SUBMITTED TEXT

23 WORDS

56%

MATCHING TEXT

23 WORDS

cellulose nanofibers from the water-hindering amphibian weed – water hyacinth. The unrefined and unadulterated cellulose microfibrils were extricated from the weed plant

cellulose nanofibers from the water blocking aquatic weed—water hyacinth was successfully prepared. The crude and pure cellulose microfibrils were initially obtained from the weed plant

W

https://www.researchgate.net/publication/337872189_Cellulose_extracted_from_water_hyacinth_and_th...

11/20	SUBMITTED TEXT	34 WORDS	36%	MATCHING TEXT	34 WORDS
	and sodium chlorite responses. The micron-sized filaments removed from the stems were cry crushed with fluid nitrogen to free heaps of nanofibers and afterward sonicated for fiber individualization. Fourier Transform Infrared Spectroscopy (FTIR)			and sodium chlorite reactions. The micron-sized fibers obtained from the stems were cryocrushed with liquid nitrogen to release the bundles of nanofibers and followed the sonication for individualization of fibers. The treated fibers were screened through Fourier Transform Infrared Spectroscopy (FTIR)	
	W https://www.researchgate.net/publication/337872189_Cellulose_extracted_from_water_hyacinth_and_th ...				
7/20	SUBMITTED TEXT	19 WORDS	58%	MATCHING TEXT	19 WORDS
	of the acetyl and uronic ester linkage of carboxylic gathering of the ferulic a coumaric acids of lignin				
	SA GPAC_A_1478366-2.pdf (D40307642)				
5/20	SUBMITTED TEXT	13 WORDS	100%	MATCHING TEXT	13 WORDS
	Pineapple peel carboxymethyl cellulose/polyvinyl alcohol/mesoporous silica SBA-15 hydrogel composites for papain immobilization.			Pineapple peel carboxymethyl cellulose/polyvinyl alcohol/mesoporous silica SBA-15 hydrogel composites for papain immobilization	
	W https://www.researchgate.net/publication/337872189_Cellulose_extracted_from_water_hyacinth_and_th ...				
6/20	SUBMITTED TEXT	14 WORDS	100%	MATCHING TEXT	14 WORDS
	Preparation and characterization of cellulose composite hydrogels from tea residue and carbohydrate additives.			Preparation and Characterization of Cellulose Composite Hydrogels from Tea Residue and Carbohydrate Additives	
	W https://www.researchgate.net/publication/337872189_Cellulose_extracted_from_water_hyacinth_and_th ...				
10/20	SUBMITTED TEXT	23 WORDS	97%	MATCHING TEXT	23 WORDS
	Polymers 2016, 147: 226-233. 11. Sundari M.T.; Ramesh A.; Isolation and characterization of cellulose nanofibers from the aquatic weed water hyacinth–Eichhornia crassipes.			Polymers 2020, 12, 1704. [Sundari, M.T.; Ramesh, A. Isolation and characterization of cellulose nanofibers from the aquatic weed water hyacinth-Eichhornia crassipes.	
	W https://www.mdpi.com/2071-1050/12/21/9222/pdf				

8/20	SUBMITTED TEXT	21 WORDS	98% MATCHING TEXT	21 WORDS
	Carbohydrate Polymers 2012, 87: 1701-1705. 12. Oliveira J.P.; Bruni G.P.; Lima K.O.; Halal S.L.M.; Rosa G.S.; Dias A.R.G.; Zavarese E.R.;		Carbohydrate Polymers 87, 1701-1705 [4] Oliveira J P, Bruni G P, Lima K O, Halal S L M, Rosa G S, Dias A R G and Zavarese E R 2017	
	W	https://www.researchgate.net/publication/337872189_Cellulose_extracted_from_water_hyacinth_and_th ...		
9/20	SUBMITTED TEXT	20 WORDS	96% MATCHING TEXT	20 WORDS
	Cellulose fibers extracted from rice and oat husks and their application in hydrogel. Food Chemistry 2017, 221: 153-160. 13.		Cellulose fibers extracted from rice and oat husks and their application in hydrogel October 2016 · Food Chemistry •	
	W	https://www.researchgate.net/publication/337872189_Cellulose_extracted_from_water_hyacinth_and_th ...		
12/20	SUBMITTED TEXT	27 WORDS	100% MATCHING TEXT	27 WORDS
	Setyaningsih L.; Satria E.; Khoironi H.; Dwisari M.; Setyowati G.; Rachmawati N.; Kusuma R.; Anggraeni J.; Cellulose extracted from water hyacinth and the application in hydrogel.		Setyaningsih, L.; Satria, E.; Khoironi, H.; Dwisari, M.; Setyowati, G.; Rachmawati, N.; Kusuma, R.; Anggraeni, J. Cellulose extracted from water hyacinth and the application in hydrogel.	
	W	https://www.mdpi.com/2071-1050/12/21/9222/pdf		
13/20	SUBMITTED TEXT	23 WORDS	93% MATCHING TEXT	23 WORDS
	Istirokhatun T.; Rokhati N.; Rachmawaty O.; Meriyani M.; Priyanto S.; Susanto H.; Cellulose Isolation from Tropical Water Hyacinth for Membrane Preparation. Procedia Environmental			
	SA	M-TECH THESIS FINAL-2.pdf (D60399783)		
14/20	SUBMITTED TEXT	16 WORDS	100% MATCHING TEXT	16 WORDS
	The Extraction of Cellulose Powder of Water Hyacinth (Eichhornia crassipes) as Reinforcing Agents in Bioplastic.		The extraction of cellulose powder of water hyacinth (Eichhornia crassipes) as reinforcing agents in bioplastic -	
	W	https://ui.adsabs.harvard.edu/abs/2020AIPC.2219j0003P/abstract		

	SUBMITTED TEXT	38 WORDS	93% MATCHING TEXT	38 WORDS
	and genetics, 517-537. 24. Mochochoko, T., Oluwafemi, O. S., Jumbam, D. N., & Songca, S. P. (2013). Green synthesis of silver nanoparticles using cellulose extracted from an aquatic weed; water hyacinth. Carbohydrate Polymers, 98(1), 290–294. 25.		and Mochochoko, T.; Oluwafemi, O. S.; Jumbam, D. N. and Songca, S. P. (2013). Green synthesis of silver nanoparticles using cellulose extracted from an aquatic weed; Water hyacinth. Carbohydrate Polymers, 98(1): 290–294.	
	W https://ejabf.journals.ekb.eg/article_219997_593d06b1065185c1a04a8b2e949773cb.pdf			

16/20	SUBMITTED TEXT	26 WORDS	68% MATCHING TEXT	26 WORDS
	W. Su, Q. Sun, M. Xia, Z. Wen, and Z. Yao, “The resource utilization of water hyacinth (Eichhornia crassipes [mart.] solms) and its challenges,” Resources,		W., Sun, Q., Xia, M., Wen, Z., and Z. (2018). The Resource Utilization of Water Hyacinth (Eichhornia crassipes [Mart.] Solms) and its Challenges. Resources 7 (3), 46.	
	W https://www.frontiersin.org/articles/10.3389/fphar.2022.842511/full			

17/20	SUBMITTED TEXT	27 WORDS	78% MATCHING TEXT	27 WORDS
	Holm, L.G., D.L. Plucknett, J.V. Pancho and J.P. Herberger. 1977. The World's Worst Weeds. Distribution and Biology. Honolulu, Hawaii, USA: University Press of Hawaii. 50.		Holm, Leroy G., D. L. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. The world's worst weeds: Distribution and Biology. East-West Center/University Press of Hawaii.	
	SA Water Hyanthisis report.rtf (D22854933)			

18/20	SUBMITTED TEXT	28 WORDS	59% MATCHING TEXT	28 WORDS
	Kumar, D., Arun Teja, V., Venkateswarlu, V., Sathish Kumar, M., Rama Rao, N., A Review on Typha angustata. International Journal of Phytopharmacology, 4(4), 2013, 277-281. 63.			
	SA STUDIES ON THE OVICIDAL, LARVICIDAL AND PUPICIDAL EFFICACY OF FIVE HYDROPHYTES AGAINST CULEX QUIN.pdf (D27802485)			

19/20	SUBMITTED TEXT	19 WORDS	93% MATCHING TEXT	19 WORDS
	A process for deriving high quality cellulose nanofibrils from water hyacinth invasive species. Cellulose, 27(7), 3727–3740. doi:10.1007/s10570-020-03038-4. 82.		A process for deriving high quality cellulose nanofibrils from water hyacinth invasive species. Cellulose 27, 3727-3740 (2020). https://doi.s10570-020-03038-4	
	W https://link.springer.com/article/10.1007/s10570-020-03038-4			

SUBMITTED TEXT		16 WORDS	95% MATCHING TEXT	16 WORDS
Vázquez (2008). Extraction of cellulose and preparation of nanocellulose from sisal fibers. , 15(1), 149–159.			Vázquez, A. (2008). Extraction of cellulose and preparation of nanocellulose from sisal fibers.	
SA final revised chapter.docx (D100775480)				