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MACERATION OF WOOD AND NANOCELLULOSE EXTRACTION IN ALANGIUM SALVIIFOLIUM (L. F.) WANGERIN

Vasanthakumar S.[1]* and Priya V.[2]

[1]PG Student, PG & Research Department of Botany, PSG College of Arts & Science, Coimbatore, India.
[2]Assistant Professor, PG & Research Department of Botany, PSG College of Arts & Science, Coimbatore, India.

***Corresponding Author: Vasanthakumar S.**
PG student, PG & Research Department of Botany, PSG College of Arts & Science, Coimbatore, India.

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ABSTRACT
The *Alangium salviifolium (L. F.) Wangerin*. It is native to India and is found throughout tropical Asia, including India, China, Thailand, the Philippines, Indonesia, and Papua New Guinea. It is drought-tolerant . Traditional healers have employed *Alangium salviifolium* to treat skin malignancies through topical application of the root.The maceration of wood and nano cellulose extraction in *Alangium salviifolium* demonstrates the complete maceration of its wood fibres during the fibre analysis process. Wood core samples were taken from *A.salviifolium* trees growing in Ramasamy hills in the Salem district, and their fibres were macerated with various concentrations of macerating agent (nitric acid). The use of 50% nitric acid was found to be quite effective in separating all of the fibres. This maceration process resolves all compact fibres and simplifies their measurement. The method could be beneficial for studying wood fibres. The present studies of *Alangium salviifolium* is used to prepare and extract nano cellulose, which is utilised to make flexible batteries, lightweight armour, and windmill blades with high tensile stuctures.The nature of the nanocellulose was determined by FT-IR Spectroscopy and the amorphous nature of the substance was determined by the X-Ray Diffraction.

KEYWORDS: Maceration, Nanocellulose, Cellulose.

INTRODUCTION
The Wood from many different trees has been used frequently for fine furniture as well as in the pulp and paper business. The breaking strength of wood fibres affects a product's power and durability. Sapwood typically has longer cellulosic fibres than heartwood, and these fibres make up between forty and forty-five percent of the dry weight of the wood's fibre wall which qualifies it for pulping.[1]

Cellulose is a major element of almost all plants, making it one of the most abundant natural resources on the planet. It is constantly renewed by photosynthesis and thus accounts for around half to one-third of plant tissues. Cellulose is a biopolymer that is biodegradable, low in cost, and renewable, as well as non-toxic. Because of its qualities and availability, cellulose has been employed in a variety of forms for a wide range of purposes. Nano-cellulose, or nitrocellulose with diameters ranging from 10 nm to 350 nm, has received a lot of study attention in recent year.[2]

Maceration was a widely used and affordable homemade method for making tonic. Additionally, this method was applied to the extraction of plant materials active ingredients and essential oils. Fiber maceration technique described by was also compared in this study. An aggregation of fibers will develop from the maceration process since a single fiber unit won't separate from the process. These fiber aggregations resemble a single fiber in appearance. The term "test-tube pulping" is occasionally used to refer to the maceration process, which is essentially small-scale pulping. Some procedures lead to both bleaching and maceration.[1]

The most abundant natural polymer, cellulose, has been used to propose rational solutions to these problems. Because of the unique chemical and physical properties of these materials, interest in nanostructured celluloses, or nanocellulose, has skyrocketed in recent decades. Nanocelluloses are typically classified into two types: i) those obtained through acid treatment, known as cellulose nanocrystals (CNCs), and ii) those produced primarily through mechanical disintegration, known as cellulose nanofibers (CNFs).[3]

The natural fibre that can be made from cellulose is called nanocellulose. The size of nanocellulose fibre, which typically has a diameter of less than 100 nm and a length of several micrometres, deserves special attention.

A biodegradable nanofiber with a low density (about 1.6 g/cm^3) and exceptional strength is called nanocellulose. In particular, it has higher rigidity than Kevlar fibre, with an elastic modulus of up to 220 GPa. Moreover, nanocellulose has a strength-to-weight ratio that is eight times greater than stainless steel and has a high tensile strength of up to 10 GPa, which is greater than cast iron. Moreover, nanocellulose is transparent and rich in hydroxyl groups that have a reactive surface and can be functionalized to have different surface properties.[4]

Nanocrystalline cellulose, Nanofibrillated cellulose, and Bacterial nanocellulose are the three types of nanocellulose. Although all types are chemically similar, they differ in morphology, particle size, crystallinity, and some properties due to differences in sources and extraction methods.[4]

MATERIALS AND METHODS

Wood core samples were taken from *Alangium salviifolium* trees in Ramasamy Hills at salem district.

Plant discription

It is a small to medium-sized thorny tree or deciduous shrub with a height of up to 18 metres. The bark is rough and pale brown, and the twigs are grey or purple-brown, glabrous or pubescent, and frequently have spines up to 12 millimetres long. Leaves are alternating, simple, and stipule-free; petiole is up to 1.5 cm long and hairy; blade measurements are 3-23 cm 1.5-9 cm, base rounded or cuneate, apex rounded to obtuse or acute, and there are 3–9 veins radiating from the base. Axillary cymes with sessile or very sessile golden-brown pubescent inflorescences. Flowers are bisexual, regular, 5-10-merous, white, cream-colored with a hint of orange, and fragrant. Buds are cylindrical; pedicel is 2-8 mm long; calyx tube is urn-shaped; lobes are triangular; and petals are strap-shaped, 12-28.5 mm 1-2.5 mm, thickly glandular outside.[5]

Wood maceration

Wood core samples were immersed in a 37% formaldehyde solution. Nitric acid concentrations of 40% and 50%were used. Wood core samples were placed in test tubes, completely immersed in nitric acid solution, and kept in a 70℃ water bath for 2-3 hours.

The maceration process takes 5-6 hours and results in the separation of white-coloured fibres. Macerated fibre test tubes were removed from the water bath and allowed to cool at room temperature. After cooling, the nitric acid was drained and the macerated fibres were washed three times with distilled water and separated using Whatman Grade 1 filter paper. Precautions for well-draining formaldehyde solution are required before immersion in nitric acid, as the fumes contain nitrogen oxide, carbon dioxide, and nitric acid (when formaldehyde-preserved samples are immersed in nitric acid, an exothermic reaction occurs due to formaldehyde oxidation).

Fibres were stained with a 20% safranin solution for slide preparation and then washed with distilled water to remove excess safranin. I used an ink/medicine dropper to place some fibre suspension on a standard glass slide and let it air dry. A cover glass was used for mounting in Canadian balsam. The use of glycerol improves the visibility of fibres.[1]

Preparation of nanocellulose

The stem of *Alangium salviifolium* is dried in the sun for about 36 hours before being powdered. Powdered *Alangium salviifolium* stem bark was treated with 1% NaOH solution in a magnetic stirrer at 70 °C for 60 min. The stem powder to alkali solution ratio was 1:4. Following treatment, the material was centrifuged for 30 min at 4000 rpm. The precipitate was collected, washed several times with distilled water, and dried at 60 °C for 24 hours. The cellulose-rich part was then used to extract nanocellulose.[2]

Extraction of nanocellulose

The process for extracting nanocellulose was identical to the protocol used by Johar, with minor adjustments. To summarise, the cellulose was processed to remove lignin and hemicelluloses before being alkali treated with sodium hydroxide (4%). The bleaching procedure was carried out for 3 hours at 60 °C with the addition of acetic acid, sodium hypochlorite, and distilled water in the proportions of 0.15ml: 0.30g: 75ml per gramme of stem. Excess distilled water was used to chill and filter the mixture. The dried filtrate was then treated for 30 minutes in 10 mol-1 L H_2So_4. with continuous stirring. The previously mentioned mixture was rinsed with distilled water for 10 minutes at 10,000 rpm 10 °C until the pH was between 5-6. To obtain the resultant suspension, it was sonicated for 30 minutes and freeze-dried.[4]

RESULTS AND DISCUSSION

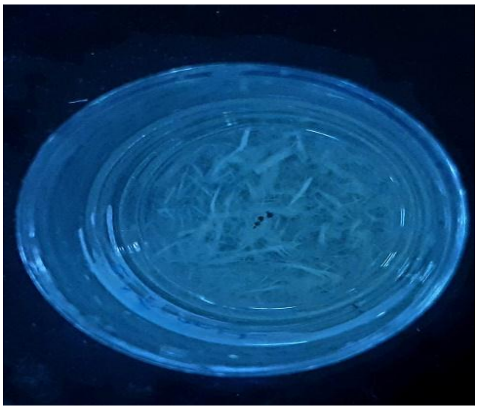

Fig. 1: White coloured fibers obtained by maceration.

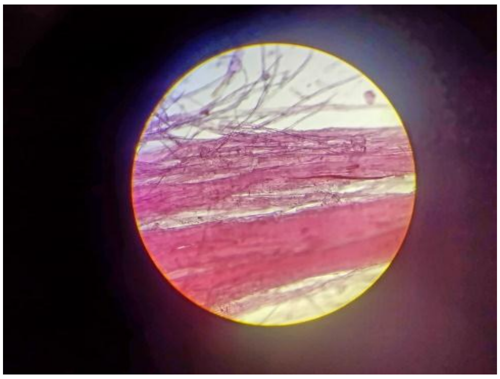

Fig. 2: The macerated wood fibers of *Alangium salviifolum* observed under the light microscope.

Fig. 3: The Nanocellulose particles of the plant *Alangium salviifolium*.

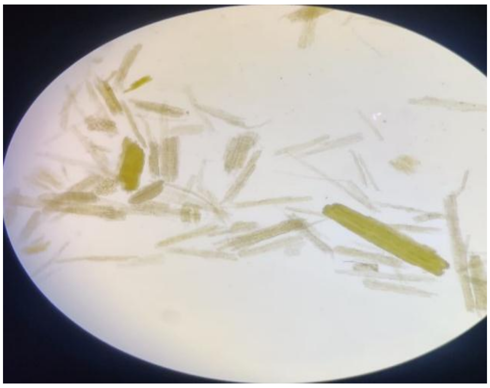

Fig. 4: Nanoparticles observed under the florescence electron microscope.

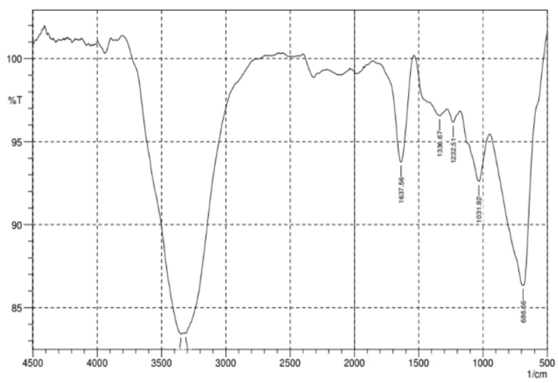

Fig. 5: FT-IR spectra of nanocellulose from *Alangium salviifolium.*

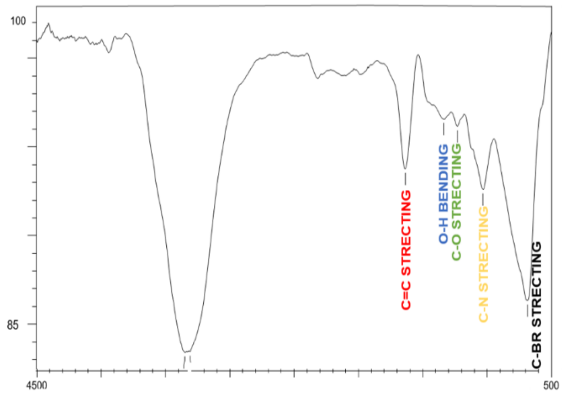

Fig. 6: It shows the presence of phytoconstituents.

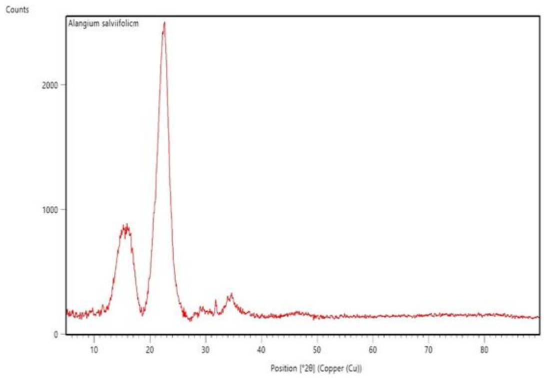

Fig. 7: X-Ray diffraction pattern of nanocellulose from *Alangium salviifolium*.

DISCUSSION

It had been observed that the partial maceration was observed in the 40% nitric acid and results shows that the complete maceration of the wood fibers were observed only in the 50% nitric acid. After the maceration process, white coloured fibers were obtained and after staining with saffranin, they are observed under the light microscope.

The nanocellulose particles obtained were observed under the Florescent electron microscope and it was subjected to FT-IR Spectroscopy and X-Ray diffraction to identify the nature and the amorphous index of the nanocellulose.

The FT-IR was used to analyse spectra of the nanocellulose particles and X-Ray Diffraction was presence of the amorphous material in *Alangium salviifolium.*

The isolated nanocellulose was subjected to FT-IR analysis, and the functional groups of the components were separated based on their peak radiation, as shown in the graph Fig.5. The presence of conjugated alkene, phenol, ethers, amine, and halo functional groups are clearly displayed with bonds in the graph.

The FT-IR spectroscopic analysis showed the presence of phytoconstituents. It gives a broad peak of 1637.56 (conjugated alkene), 1336.67 (phenol), 1232.51(Alkyl aryl ether), 1230.37(ethers), 1031.92 (amine) and 688.59 (Halo compound) as shown in the graph Fig.6. Using these peak values, the functional groups of the active components present in the nanocellulose were identified in the region of IR radiations, which confirmed the production pulp of *Alangium salviifolium.*

The XRD analysis show the presence of amorphous material in isolated nanocellulose from *Alangium salviifolium*.The XRD analysis of amorphous materials do not give clear peaks rather the pattern has noise signals, smeared peak or it can have some short order bumps.

CONCLUSION AND RECOMMENDATIONS

The current study on the analysis of the FTIR spectroscopy and X-Ray Diffraction reveals the spectrum and the amorphous nature of the nanocellulose. Phyto – Nanocellulose and Its derivatives have drawn attention as promising bio-based materials for water treatment applications due to their high surface area, high strength, and renewable, biocompatible nature.

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