Research Article

Synthesis of CNCs from Selected Tropical Fruit (Pine apple & Pomegranate) Waste and Their Application

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ABSTRACT

Rapid increase in world's population has great impact in increasing rate of food demands. Nowadays, research trend among scientists is to minimize fruit waste and better utilization of waste by recycling. Tropical fruit waste including the seed, flower, leaf, peel, and part of the fruit discarded after consumption are usually being studied. In present study, the peels of banana, pomegranate, and pineapple were used for the isolation of nanocellulose using alkaline and bleaching treatment. So formed carbon nano cellulose (CNC) were observed to be good adsorbent for leadmetal ions from waste water. It adsorbed 98 to 100percent heavy metals ions on varying the concentration of CNC in waste water.

Key words: *Carbon nano cellulose, CNC, Tropical Fruit, Pine apple & Pomegranate, Waste.*

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INTRODUCTION

Nanotechnology is the engineering of matter on a molecular or even atomic scale, in the length scale of approx. 1-100 nm range**[**1**]**. It is the understanding and control of matter at the nanoscale. Today, scientists are able to create carbon nano tubes for a wide range of applications requiring strength enhancements. Nano particles have applications in a wide variety of fields like textiles, biomedical, healthcare, food, agriculture, industrial, electronics, environment, or renewable energy**[**2**]**. Fruit waste is the major issue for health problems and pollution. Many researches have been done to reduce fruit waste by converting it into beneficial products**[**3-5**]**. Fruit waste can be used as a source of starch, pectin, and cellulose that can be used in baking or for the generation of bio-ethanol. It can also be used as a source of fibre and pulp for the production of composite materials, textiles and paper or for the removal of heavy metals and dyes from wastewater and many more uses. Cellulose is found in plant cell wall and is the most abundant and natural renewable polymer in the world. It can be extracted from wood, grasses, fruit waste, vegetable waste, agriculture residue, seed fibres, bast fibres, algae, marine animals, etc. Cellulose microfibrils are bound together by lignin and hemicellulose, which are removed during the delignification and bleaching process to obtain cellulose. Cellulose can be used as manufacturing material in wide range for several products in pharmaceutical industries, textiles, paints, food packaging, etc**[** 6-7**]**.

In recent years, nanocellulose synthesised from cellulose fibres has gained remarkable interest due their nano size i.e. 1-100 nmand having wide range of applications in science field due to its outstanding mechanical properties, good biocompatibility, renewable nature, interesting optical properties, and

bearable surface chemistry, etc. Cellulose Nanocrystals [CNCs] can be isolated from cellulose fibres by acid hydrolysis, having short rod like shape and is usually 2-20 nm in diameter & 100-500 nm in length. Nanocomposites have applications in the field of medical, electronics, construction, automotive, packaging, and for waste water treatment. Nanocomposites based materials are non-toxic, renewable, sustainable and carbon neutral.[8-10]

The aim of this study is to compare the CNCs extracted from selected tropical fruit waste peel i.e. pineapple peel, banana peel, and pomegranate peel, by using one extraction method for thrice of these fruit waste peels. The comparison of nanocellulose formed is done on the basis of size, strength, etc., and also on basis of absorption of heavy metals.

MATERIAL AND METHODS

Materials

The peels of pineapple and pomegranate were collected and then dried. The dried peels were milled to a fine size and passed through 60 mesh sieve.

Chemicals: Sodium hydroxide [NaOH], sodium hypochlorite [NaClO], glacial acetic acid [CH3COOH].

Equipment's: Magnetic stirrer, magnetic bead, vacuum pump, whatman filter paper, oven, sonicator.

Distilled water was used for all the experiments.

METHODS

Extraction of cellulose:

Cellulose was extracted from peels of pineapple, and pomegranate with 2% NaOH. 10g of each sample was taken in 3 different conical flasks respectively and transfer 200 ml of NaOH solution in each of the conical flask, and kept the conical flasks on magnetic stirrer for 3 h at 80 °C. The samples was filtered and washed with distilled water for complete removal of alkali and then dried at 50 °C in an air-circulating oven for 6 h. After this treatment, the delignification process is carried out, samples were treated with the bleaching solution of sodium hypochlorite and glacial acetic acid [in 1:1] for 2 h at 80 °C under mechanical stirring. The resulting fibres were then filtered and washed with distilled water to maintain pH [i.e. neutral pH] and then dried in an air-circulating oven for 6 h. The resulting fibres are shown below: [a] cellulose composite of pineapple peels, [b] [c] cellulose nanoparticleof pomegranate peels.

Figure [a]

Figure [c]

Isolation of CNCs :

The dried cellulose fibres were grinded to a fine powder and hydrolysis treatment is done to form nano composites of cellulose. The cellulose fibres were treated with 64% H2SO4 in 1:20 g/ml at 60 °C under mechanical stirring for at least 45 minutes. After this process, cold water is added to the solutions [cellulose fibres of pineapple and pomegranate after the treatment with H_2SO_4] and then all the solutions were centrifuged

at 5000 rpm for 10 min. After discarding the supernatant, pallets were collected and washed with distilled water and centrifuged again and again for the complete removal of acid. Then collect the suspension and put it in the dialysis membrane tube and kept it in the water tub for 72 h at replace the water time to time. Take the suspension out after 72 h and sonicate the suspension for 30 min. The nano composite of cellulose obtained from pineapple and pomegranate peels were lyophilized at -50 °C for 24 h.

Nanocomposite formation- In the above method, fruit waste of pomegranate and pine apple were taken simultaneously which were centrifuged after adding all reagents for about 15 mins and then sonication was done for 30 mins. So obtained slurry was lyophilized till thick solution obtained and then dried at 35-45°C .So formed nanocomposite was analysed by SEM for morphological structure and then application study was done in synthetic waste water.

RESULT & DISCUSSION

Synthetic waste water was obtained by using lead sulphate solution. Its 10 ppm stock solution was prepared in which different dosage of so prepared CNC were added mixed for 1 hr and allowed to settle for one hour. Then filtered with whatmann filter paper-1.Results are given in table-1.

Table-1: Synthetic waste water

Waste water [lead- ppm]	% Reduction when Conc of CNC [1gpl]	% Reduction Conc of CNC [2gpl]	% Reduction Conc of CNC [5gpl]
10	90%	98 %	100%
20	75%	88%	100%
40	60%	70%	96%

In this study carbon nano cellulose **[**CNC**]** particles were synthesised fom peels or fruit waste of pineapple and pomegranate were successfully, which was also confirmed by its SEM analysis.SEManalsyis showed cluster of nano particles below 100 nm. When so formed particles were used for adsorption of heavy metals they showed very good results. Waste water sample containing lead was prepared synthetically and when we added different concentration of CNC then almost 100percent lead could be adsorbed. It was confirmed through AAS analysis. Percent reduction is shown in table-1. Many other researcher have synthesised CNC particles by different methods from fruit waste and they did experiment of heavy metals removal they also observed good reduction.**[**11-12**]**. Ajay singhetal **[**2019**]** and Naveen Joshi et al **[**2019**]** synthesised nanopartciles and they removed heavy metals Pb, Zinc, and cadmium from pharma industrial effluent and other waste water[14-15].

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