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***Short Communication***

# Production of regenerated cellulose polymeric films from plantain pseudostem

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## Abstract

*Regenerated cellulose was prepared from plantain pseudo stem obtained in Uyo, Akwa Ibom State. The pulp prepared with 12% NaOH had moisture content of 8.8% and a yield of 36.9% on the average. The pulp was bleached and exposed to air to form "white crumbs". The aged crumbs was mixed with carbon disulphide at a controlled temperature of $30^0C$ to form cellulose xanthate $(C_6H_9O_4 - S - SNa)_n$ which was then converted to regenerated cellulose on further treatment with tetraoxosulphate (VI) acid at a yield of 36.4%. This work has revealed that plantain pseudo stem waste can be converted to regenerated cellulose for diverse applications.*

**Keywords:** Cellulose, Plantain pseudostem, Regenerated cellulose, Pulp.

## Introduction

Cellulose is an organic compound with the formula $(C_6H_{10}O_5)_n$, it is a polysaccharide consisting of a linear chain of several hundred to over ten thousand of beta[1-4] linked D-glucose units[5]. For industrial use, cellulose is mainly obtained from wood pulp and cotton. To a smaller extent, it is converted into a variety of derivatives like cellophane, nitrocellulose, cellulose acetate, etc.

Regenerated cellulose is a pure cellulose which has been treated in a chemical bath for better performance. It usually has a lower molecular weight and a less orderly structure than the cellulose from which it is formed. Regenerated cellulose has found applications in the manufacturing industry as syringe filters, mobile phases in HPLC, bioplastic films, automotive filters, ropes, abrasive materials, bandages and protective suiting material. It is primarily found in the garment industry, particularly in women's clothing.

Pseudostem is a false stem formed of the swollen leaf bases found in plantain and banana. Plantain pseudo stem has been used as a natural sorbent and has high potential in absorbing spilled oils in refineries[3]. With fairly low amount of ash, lignin and high amount of hollocellulose, pseudo stem and petioles of plantain and banana are suitable for making paper pulps[2]. Plantain pseudo stem can be considered a natural fiber.

Natural fibers today are a widespread choice for applications in composite engineering. Based on the sustainability benefits, bio-fibers such as plant fibers are substituting synthetic fibers in composites. These fibers are used to manufacture numerousbio-composites. The chemical composition and properties of each of the fibers changes, which demands the detailed comparison of these fibers. Today, high performance bio-composites are produced from several years of research. Plant fibers, particularly bast and leaf, find applications in automotive industries. While most of the other fibers are explored in laboratory scales, they have not yet found large-scale commercial applications. It is necessary to also consider other fibers such as ones made from seed (coir) and animals (chicken feather) as they are secondary or made from waste products. Few plant fibers such as bast fibers are often reviewed briefly but other plant and animal fibers are not discussed in detail. This review paper discusses all the six types of plant fibers such as bast, leaf, seed, straw, grass, and wood, together with animal fibers and regenerated cellulose fibers[6]. This research is aimed at converting plantain pseudo stem waste to useful products such as pulp and regenerated cellulose fibers.

## Materials and methods

**Collection of samples:** The unbleached soda pulp of plantain pseudostem whose ripe fruits have been removed was collected from a local farmer in Uyo LGA, Akwa Ibom State. The samples were collected fresh, cut into chips, airdried for 3 days and stored for analysis.

**Determination of moisture content:** The moisture content of the pulp was carried out according to the method described by Browning[1]. One gram of the dried sample was dried in the oven at $105^0C$ for 24 hours and reweighed. The moisture content was calculated using the formula below:

$$Moisture\ content\ (\%)\ \frac{W_1 - W_2}{W_2}\ X\ 100 \quad (1)$$

Where: W1= weight of the pulp before drying in the oven, W2= weight of the pulp after drying in the oven.

**Preparation of the pulp:** The dried sample (15g) was dissolved in 12% NaOH, this solution was poured into a metal pot and cooked for 3hours until formation of bubbles. On cooling, the sample was washed until neutral and ground to obtain a paste.

**Bleaching of the pulp:** The pulp was bleached with 200ml of Sodium Hypochloride (NaOCl) and allowed to stand for 12 hours, then washed with excess water until it became white. The pulp yield was determined using the formula below:

$$Bleached\ pulp\ yeild = \frac{Weight\ of\ air\ dried\ sample\ (15g)}{weight\ of\ white\ pulp} X100 \quad (2)$$

**Preparation of regenerated cellulose:** One gram of the bleached pulp was weighed and placed in a beaker. The weighed sample was treated with 10ml of NaOH and 20ml of carbon disulphide ($CS_2$). The resulting solution was allowed to stand until the appearance of yellow crumbs of cellulose Xanthate was seen. The presence of cellulose xanthate was confirmed by adding 1ml of $H_2SO_4$ which produced a viscous liquid with a sparkling sound.

## Results and discussion

Moisture content of the plantain pseudostem was 10%. While the moisture content of the regenerated cellulose was 1.3%. One gram of the sample yielded 0.98 gram of cellulose which is a 98.98 yield. Similar result has been reported by Liu, Pang, Zhang, Wu and Sun[4] whose study focused on the Regenerated cellulose film with enhanced tensile strength prepared with ionic liquid 1-ethyl-3-methylimidazolium acetate (EMIMAc). The morphology from scanning electron microscopy and atomic force microscopy showed that cellulose films possessed homogeneously, and exhibited smooth structure. 13C CP/MAS NMR spectra showed that the regenerated cellulose films were transferred from cellulose I to cellulose II. Moreover, the incorporation of plasticizer agents, especially in the presence of glycerol, significantly improved the tensile strength of cellulose film (143 MPa) as compared to the controlled sample. The notable properties of the regenerated cellulose films are promising for applications in transparent packaging.

## Conclusion

The research reveals that plantain pseudostem which is thought of as an agricultural waste and a threat to the environment can be reused in the production of regenerated cellulose. Thus, plantain pseudostem can serve as a raw material in the production of photographic film, protective coatings, magnetic tapes, and bioplastics. However, further studies should be carried out on the utilization of plantain pseudostem in the production of other cellulose derivatives such as nitrocellulose, cellulose acetate, catboxy methyl cellulose (CMC), etc.

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