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Utilization of Waste Banana Pseudostem for Paper Production via Organosolv Pulping

Pannala N.M., Karunarathne P.K.D.M.C.*

Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**mck@sjp.ac.lk*

Abstract

Banana (*Musa sapientum*) is a predominant fruit crop grown in Sri Lanka which occupies nearly 60,000 ha of land, accounting for 54% of the total fruit cultivation land utilization in the country. The banana tree has a ten months cycle to bear fruits and after its harvesting, the stems are thrown away and left to decay and rot. The waste produced by a single banana plant can make up to 80% of the total plant mass and it is estimated that 220 tons of post-harvest biomass wastes are produced per hectare annually. This has led to waste disposal problems and serious environmental issues. Management of such a vast amount of agricultural waste promotes the use of this biomass for value addition processes. In this research work, an organosolv process based on a mixture of formic acid, acetic acid, and water was adapted and optimized to pulp banana pseudostem fiber and investigate its potential, as a raw material for pulp and paper production through chemical, morphological and mechanical characterization. The global consumption of paper totals more than 400 million tons, cutting down about 7.2 billion trees each year to meet its demand for printing, packaging, and writing purposes. Therefore, the initiative in utilizing available banana waste as an alternative raw material for paper production could further offer a great potential in reducing the dependence on natural timbers, which in turn reduces the demand for global deforestation in the long run. Banana pseudostem fiber is characterized by a high cellulose content and a low lignin content, which is desirable for better pulp yield and papermaking properties. However, it has a high ash content and its interference in the recovery of black liquor was overcome with the selected pulping method. It resulted in a high pulp yield (48.2%) with a kappa number of 32.4. A shorter fiber length (1.12 mm) contributed to a highly uniform paper structure with a smooth surface. Furthermore, the pulp fibers showed an increased crystallinity and a higher slenderness ratio, which is favorable for paper making. The papers produced were heavier weight boards with a grammage of 272 g/m^2 and showed higher tensile index (43.16 Nm/g) and tear index (2.08 mNm^2/g) compared to other published non-wood fibers.

Keywords: Banana pseudostem, Organosolv, Cellulose, Pulp, Lignin