ABSTRACT

The bio-conversion of easily accessible agricultural byproducts into high-value chemicals has emerged as a promising path with the growing determination to conversion from fossil fuels to sustainable and renewable energy sources. This work explores the viability of transforming cane molasses, a readily accessible byproduct of sugar manufacturing, into 5- hydroxymethylfurfural (HMF), a flexible platform chemical and possible bioenergy molecule. To help convert complex carbohydrates in cane molasses into HMF, the research uses a multi-step process that combines hydrothermal treatment and enzymatic catalysis. The work creates an effective and long-lasting process for the selective synthesis of HMF from cane molasses by methodically optimizing a number of variables, such as reaction temperature, residence time, molasses concentration and catalyst concentration. The procedure uses certain acid catalyst sulfuric acid (H_2SO_4) in this study to speed up the process of dehydrating the carbohydrates in cane molasses into HMF, improving the final product's yield and purity. Furthermore, to guarantee the chemical integrity and high quality of the produced HMF, the structural characterization of the synthesized HMF is carried out using sophisticated analytical techniques like Thin layer Chromatography (TLC), White's spectrophotometry, high-performance liquid chromatography (HPLC).The cost of the acid catalyst, energy use, and waste treatment are taken into account while analyzing the economic viability and environmental sustainability of the suggested conversion technique. In order to highlight the process's potential for large-scale manufacturing, it is possible scaling and integration into the current industrial infrastructure are also covered. In this way, the research results provide a sustainable alternative for the bioenergy industry's use of agricultural leftovers by helping in the development of an efficient and economical method for turning cane molasses into a valuable bioenergy molecule