Biomass Conversion and Biorefinery
https://doi.org/10.1007/s13399-023-05050-7

ORIGINAL ARTICLE

Non-edible biomass as innovative substrate for lipid biosynthesis: a step towards circular economy

Shafiya Rafiq[1] · Mohd Ishfaq Bhat[1] · Mir Ishfaq Ahmad[1] · Syed Junaid Rashid[1] · Insha Fayaz[1] · Sajad Ahmad Sofi[1] · Khalid Muzaffar[1] · M. J. Mir[2] · Darakshan Majid[1] · Tawheed Amin[3] · Rayees Ul Islam[4] · B. N. Dar[1] · H. A. Makroo[1]

Received: 13 July 2023 / Revised: 17 October 2023 / Accepted: 22 October 2023

Abstract
In the realm of food security, there is growing recognition of lignocellulosic biomass as a valuable resource for meeting various food production needs. To advance the design of efficient processes for converting biomass into food-related value-added products, it is vital to gain a deep understanding of its distinctive properties. This research study was conducted for extensive physico-chemical analysis of non-edible and waste lignocellulosic biomass sources, all with the overarching objective of enhancing their utilization as potential feedstock in biolipid production. The present study revealed that both apricot kernel shell (AKS) and almond green husk (AGH) have high polysaccharides and low lignin content. FTIR spectra showed the existence of functional groups attributed to cellulose, hemicellulose, and lignin. The weight loss of 51.32% and 57.17% in AKS and AGH, respectively, was observed in the temperature range of 250 to 400 °C. Calorimetry analysis found that hemicellulose was relatively more thermally stable than cellulose. AKS has a lower crystallinity index (66.6%) compared to AGH (70.1%). The compositional as well as SEM/EDX analysis supports the suitability of AKS as a potential feedstock for microbial lipid production than AGH. Furthermore, flow behavior patterns showed a sharp decline in viscosity at solid loading from 10–14%. The present study could significantly advance knowledge of the possible uses of AKS and AGH for the techno-economic viability of biomass produced as food waste or byproduct.

Keywords Cellulose · Lignin · Microbial lipid · Thermal analysis · Valorization

1 Introduction

In response to the pressing global challenges of environmental pollution, global warming, and rapid population growth, the bioconversion of agricultural and food waste has emerged as a dynamic and rapidly advancing field of research and technology [1]. Among the various types of biomass under investigation, lignocellulosic biomass (LCB) stands out due to its abundance, renewability, and limited competition with edible biomaterials. LCB holds significant promise for conversion into value-added novel materials, contributing to sustainable solutions. Astonishingly, out of the vast annual production of 181.5 billion tonnes of lignocellulosic biomass, only approximately 8.2 billion tonnes are effectively utilized, with 42% originating from grasslands, 43% from dedicated forests and agricultural lands, and the rest comprising agricultural waste [2]. Regardless of their source and composition, lignocellulosic biomass primarily consists of homopolymers (cellulose), heteropolymers (hemicellulose), complex organic polymers, proteins, and extractive components like waxes [3, 4]. Polysaccharides extracted from LCB are being converted into high-value ingredients, including bioethanol, biobutanol, triacylglycerol, and other organic acids, using various physical, biological, biochemical, and thermal processes [3]. However,

✉ Shafiya Rafiq
shafiyarafiq3@gmail.com

✉ B. N. Dar
darnabi@gmail.com; dar.nabi@iust.ac.in

✉ H. A. Makroo
hilalmakroo@gmail.com; hilal.makroo@iust.ac.in

1 Department of Food Technology, Islamic University of Science and Technology, Awantipora 192122, India

2 Department of Mechanical Engineering, Islamic University of Science and Technology, Awantipora 192122, India

3 Division of Food Science and Technology, SKUAST-K, Shalimar, Srinagar 190025, India

4 Department of Post-Harvest Engineering and Technology, Aligarh Muslim University, Aligarh, India

Published online: 15 November 2023