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Tropical waste valorisation for sustainable resources: Developing cellulose-based biodegradable paper from coffee and corn husks

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Abstract

Paper material has been widely used in various applications. However, the high production and excessive usage of paper may have severe environmental consequences, such as deforestation and improper waste management. This situation must be addressed immediately as it could lead to unsustainable natural resource management practices. Tropical agricultural waste with high cellulose content can be a promising alternative source for biodegradable paper production. Coffee (*Coffea canephora*) and corn (*Zea mays* L.) are some of the leading commodities in Indonesia. The high production of both commodities also generates significant amounts of husk waste that potentially contains high cellulose content. Coffee and corn husks are also generally thrown away without proper treatment, which highlights the importance of waste valorisation. This study aimed to develop and characterise cellulose-based biodegradable paper from coffee and corn husks as tropical waste valorisation. This was intended to explore alternative sources of bio-based material for future paper production, as well as to support sustainable natural resource management. Six compositional variations were applied with a mixing percentage ratio (% w/w) consisting of A) 75:25:5; B) 50:50:5; C) 25:75:5; D) 75:25:7.5; E) 50:50:7.5; and F) 25:75:7.5 (coffee husk: corn husk: polyvinyl alcohol/PVA). This study obtained characteristics of cellulose-based biodegradable papers, including thickness (0.19 – 0.70 mm), grammage (38.08 – 129.39 $g\,m^{-2}$), bulk (3.36 – 5.40 $cm^{-3}\,g^{-1}$), whiteness degree (44.86 – 60.99 % ISO), and water content (4.80 – 8.72 %). The mechanical properties of the biodegradable paper were also measured, including tensile resistance (0.04 – 0.30 $kN\,m^{-1}$), strain (0.98 – 2.20 %), and stiffness (2.80 – 13.92 mN m). Based on the soil burial degradability test, all paper variations have experienced gradual weight loss ranging from 37.81 to 59.27 % within 28 days, indicating its potential biodegradability. These findings reveal that coffee and corn husk waste can be potentially utilised for developing biodegradable paper from tropical agricultural biomass. This also contributes valuable insight for creating biodegradable paper as value-added bioproducts, with the potential for continuous development in the future.

Keywords: Biodegradable paper, coffee husk, corn husk, valorisation, waste

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