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Hydrogen production from supercritical water gasification of fruit wastes and agricultural food residues

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Significant amount of fruit wastes and agro-food residues are generated worldwide as a result of food processing. Fruit residues contain numerous bioactive components, such as carbohydrates, lipids, fats, cellulose, hemicellulose and lignin that have tremendous potentials to be converted into biofuels. This study highlights the characterization and hydrothermal gasification of several fruit wastes and agro-food residues such as aloe vera rind, banana peel, coconut shell, lemon peel, orange peel, pineapple peel and sugarcane bagasse. The fruit wastes and agro-food wastes were gasified in supercritical water to study the impacts of temperature (400-600°C), feed concentration (1:5 and 1:10 biomass-to-water ratio) and reaction time (15-45 min) at a pressure range of 23-25 MPa. The catalytic effects of NaOH and K_2CO_3 were also investigated to maximize the hydrogen yields and selectivity. The elevated temperature (600°C), longer reaction time (45 min) and lower feed concentration (1:10 biomass-to-water ratio) were optimal for higher hydrogen (0.91 mmol/g) and total gas yields (5.5 mmol/g) from orange peel. However, coconut shell with 2 wt% K_2CO_3 at 600°C and 1:10 biomass-to-water ratio for 45 min of gasification revealed superior hydrogen yield (4.8 mmol/g), hydrogen selectivity (46%) and total gas yields (15 mmol/g) with enhanced lower heating value of gas products (1595 kJ/Nm_3). The overall findings imply that supercritical water gasification of fruit wastes and agro-food residues could serve as an effective organic waste management technology with regards to bioenergy production.

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Innovative integration of bioenergy and food systems for rural communities

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Sustainable bioenergy systems have a major role to play in unlocking populations from the vicious and often inter-linked cycles of energy and food poverty that are manifested in many parts of Africa. Its lack of real development has increased the vulnerability of farmers to rising and increasingly volatile energy input costs to agriculture and in getting surplus harvested crops safely stored and transported on to markets. Consequently, smallholder farmers are faced with a "double penalty" due to increasing fossil fuel costs throughout the agricultural value chain. Bioenergy systems if integrated with food production systems can enhance food production by providing alternative markets and improving efficiencies in the value chain, as well as helping to phase out dependence on fossil fuels. This paper discusses the integration of bioenergy directly into food systems to help ensure both energy and food securities for the poor. Bioenergy and food systems can be integrated through innovative food value chain management. Agricultural residues (agro-residues) currently receive low economic returns and experience disposal problems. The food production and processing is often not configured to supply agro-residues for production of bioenergy needed in food processing. The feasibility of utilising agro-residues through advances in postharvest technology for sustainable bioenergy conversion was reviewed. Agro-residues from maize, sugarcane and potatoes in five African countries were assessed from secondary data to identify suitable conversion technologies, energy products and configurations of bioenergy plants for applications in postharvest food processing. Strategic alignment of postharvest technology to bioenergy production systems is vital to advancing both food production and bioenergy that benefit rural communities in Africa. High economic returns are possible when the bioenergy plants are either annexure to existing agro-processing operations or operate as a biorefinery. However, Agro-residues for bioenergy production require investments in infrastructure for storage, transportation and processing of the residues, and development of new risk management techniques.

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