Reducing Fossil Fuel Dependence in American Samoa: Evaluating Artocarpus altilis (Breadfruit) as a Sustainable Bioethanol Feedstock

Park, Rachael (School: Manumalo Academy)

American Samoa’s reliance on imported fossil fuels increases vulnerability to price volatility and supply disruptions, highlighting the need for locally sourced renewable energy. This study evaluates Artocarpus altilis (breadfruit) as a feedstock for bioethanol production, leveraging its local abundance and high starch content. Ethanol was produced from breadfruit pulp and peel using simultaneous saccharification and fermentation (SSF), followed by distillation. From 2000 g of pulp, 370 mL of ethanol distillate was obtained, while 600 g of peel yielded 60 mL. Conversion efficiencies were 43.93% for pulp and 41.76% for peel, with post-distillation ethanol concentrations of 46% v/v and 36% v/v, respectively. Fuel characterization tests, including flammability, density, and burn rate, indicate that both distillates possess properties suitable for use as alternative fuels, although further refinement is required to meet commercial fuel standards. To evaluate large-scale potential, a scenario-based model was developed to estimate the contribution of breadfruit-derived bioethanol to local energy supply. Results suggest that, under feasible production conditions, this biofuel could replace over 11% of imported fossil fuels in American Samoa. These findings demonstrate that breadfruit-derived bioethanol is a viable and sustainable local energy source that can enhance energy security while adding value to existing agricultural resources.

Awards Won:
Fourth Award of $600