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# Experimental Production of Biogas and Biodiesel from Organic Waste and Waste Cooking Oil Generated at the University of Tolima Restaurant

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## Abstract

The increasing generation of organic waste and waste cooking oil in educational institutions and food service facilities poses environmental and logistical challenges when energy recovery strategies are not implemented. This study evaluates the experimental production of biogas and biodiesel from organic residues and residual cooking oil generated at the University of Tolima restaurant, proposing an integrated circular economy model at institutional scale. Biogas production was carried out using two small-scale biodigesters operating under anaerobic conditions. Food waste was co-digested with pig manure at five mixing ratios (100:0, 75:25, 50:50, 25:75 and 0:100), monitoring pH, temperature, hydraulic retention time, pressure (cm H2O) and daily gas volume (L $day^{-1}$). Biogas, primarily composed of methane ($CH_4$) and carbon dioxide ($CO_2$), represents a renewable energy source capable of reducing greenhouse gas emissions and improving waste management efficiency (Corrales, 2015; TECSOL, 2017). In parallel, waste cooking oil was subjected to alkaline-catalysed transesterification to produce biodiesel, controlling alcohol-to-oil molar ratio, catalyst concentration, reaction temperature and mixing time. The oil was characterised prior to reaction, including moisture content and free fatty acid levels, as these parameters significantly influence conversion efficiency (Demirbas, 2005; Mittelbach and Remschmidt, 2004). The integrated approach aims to determine optimal biogas yield conditions and assess biodiesel feasibility from institutional waste streams, demonstrating that combined bioenergy production can reduce disposal volumes, mitigate environmental impacts and contribute to local energy transitions within university campuses.

**Keywords:** Biogas, biodiesel, organic waste, waste cooking oil, anaerobic digestion, transesterification, renewable energy, circular economy

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