

## Anaerobic Co-Digestion of Date Palm Waste and Cow Manure for Enhanced Biogas Production Using Bench-Scale Cylindrical Digesters

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### Abstract:

This study examines the improvement of biogas production through the anaerobic co-digestion of sodium hydroxide-pretreated date palm waste (DPW) and cow manure (CM) under mesophilic conditions. Despite the large availability of date palm residues in arid regions, their high lignocellulosic structure and unbalanced C/N ratio limit their direct anaerobic biodegradability and methane yield. An optimized co-digestion strategy is therefore required to improve conversion efficiency and energy recovery. The primary objective was to identify the optimal mixing ratio that maximizes biogas yield. Experiments were conducted in bench-scale cylindrical digesters operated at 31–35°C over 64 days. Five substrate mixtures were tested, with cow manure to date palm waste ratios of 100:0, 65:35, 45:55, 25:75, and 0:100 of the total solids. Results demonstrated that co-digestion significantly improved biogas production compared to mono-digestion of either substrate. The mixture containing 45% cow manure and 55% date palm waste (A3) yielded the highest cumulative biogas volume of 52.5 L, which was approximately 15.6% greater than the yield from CM alone (45.4 L) and 28.4% greater than DPW alone (40.9 L). This optimal mixture also produced biogas with improved methane content (62%). Statistical analysis confirmed significant differences in biogas production among the mixtures ( $p < 0.05$ ). The findings suggest that co-digestion of pretreated agricultural residues with nutrient-rich animal manure is a technically viable approach for enhancing renewable energy generation and promoting sustainable waste management in arid regions.

### Keywords:

Anaerobic digestion, biogas, co-digestion, cow manure, date palm waste, mixing ratio, renewable energy, waste valorization.