Utilization of jackfruit waste for composite briquettes and biogas production as alternative cooking fuels

FruVaSe

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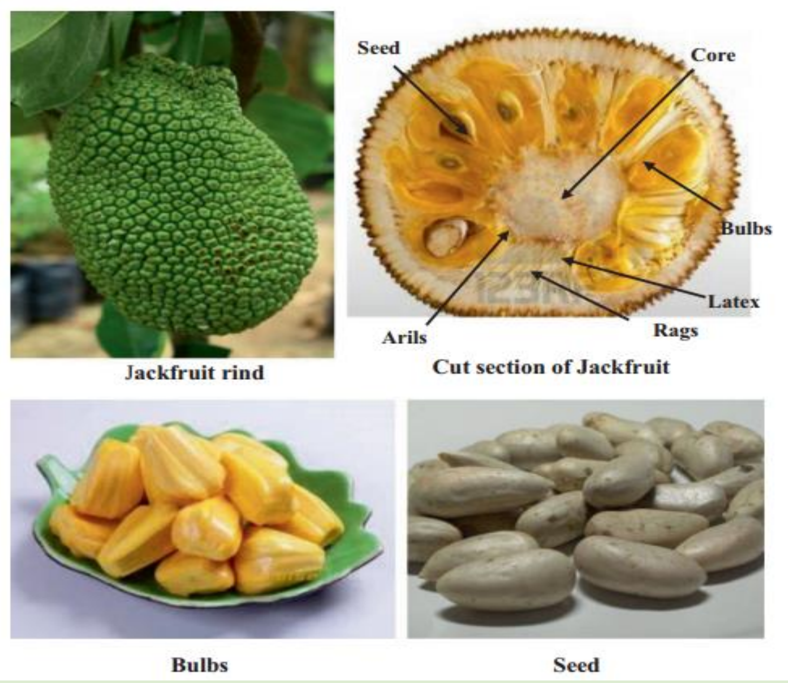


Figure 1: Different parts of jackfruit (Swami *et al.*,


Figure 2: Reducing the jackfruit waste size before anaerobic digestion


Figure 3: Mixing cow dung with water before anaerobic digestion


Figure 4: Biogas from the jackfruit waste and cow dung ready for cooking


Figure 5: Sun Drying Jackfruit waste-based briquettes


Figure 6: Jackfruit waste-based briquettes ready for cooking

Introduction

Biomass is the primary source of cooking fuel in Uganda comprising 78.6% firewood, 5.6% charcoal, 4.7% crop residues, with additional use of 1.4% electricity and 9.6% oil products (MEMD, 2015). Available alternative energy sources are briquettes and biogas from organic raw materials (Figure 1, Figure 2). The objective of this study was to explore the potential of biogas and briquettes production when mixed with other substrates

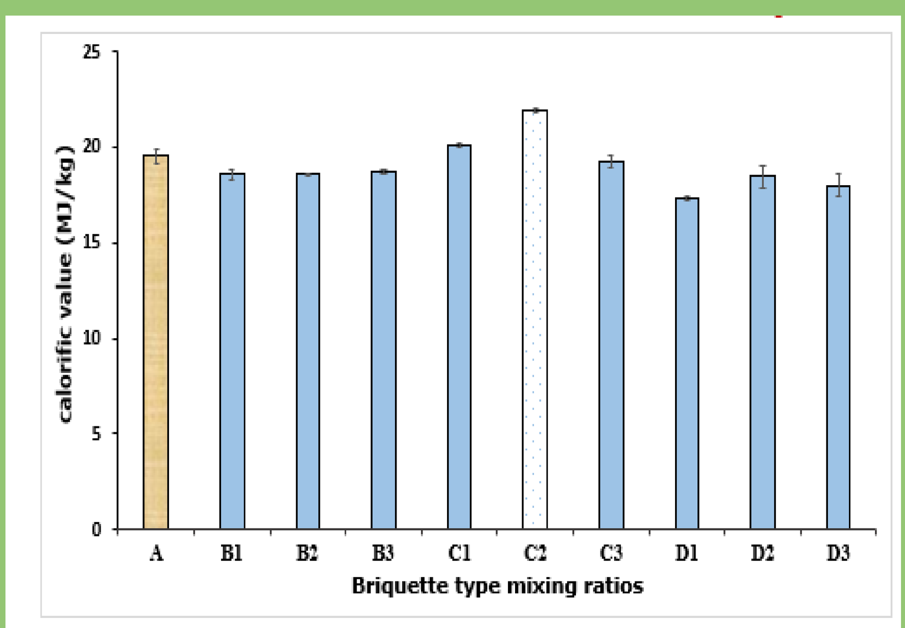
Methodology

- Proximate analysis, calorific value and compositional analyses were conducted using Eltra Thermostep thermo gravimetric analyser (Eltra Elemental Analyzer, 2018), Bomb calorimeter and Anthrone method (Clegg, 1956) respectively
- Composite briquettes (Figure 5, Figure 6) were produced through pyrolysis and mixing the biochar from jackfruit waste with jackfruit and banana leaves
- Biogas was produced by anaerobic digestion using a lab-scale experimental set up (Iqbal *et al.,* 2014) (Figure 7) and an underground digester with jackfruit waste co-digested with cow dung, banana and pineapple peels
- The volume of biogas produced was determined by displacement method

Figure 7: Lab-scale anaerobic digestion experimental set-up for biogas production

Results

- The briquette type, mixing ratio and the interaction between the two significantly affected the calorific values of the composite briquettes (p=0.000)
- Jackfruit waste alone (control) yielded a calorific value of 19.513 MJ/kg. (Figure 8). Blending jackfruit waste with banana and jackfruit leaves changed the calorific values of the resulting briquettes.
- The composite briquette C2 (70% jackfruit waste, 30% jackfruit leaves and 0% banana leaves) produced the highest calorific value of 21.98 MJ/kg compared to the control (100% jackfruit) – **Figure 8**. Briquettes types A, B1, B2, B3, C1, C2, C3 D1, D2, D3 are explained in **Figure 8.**



Briquette type	Feed stock		
	Jackfruit Waste	Jackfruit Leaves	Banana Leaves
A (Control)	100	00	00
B_1	90	10	00
B_2	70	30	00
B_3	50	50	00
C_1	90	10	00
C_2	70	30	00
C_3	50	50	00
D_1	90	05	05
D_2	70	15	15
D_3	50	25	25

Figure 8: Calorific values of different composite briquettes and explanation of abbreviations

- Jackfruit waste, banana and pineapple peels when co-digested individually, produce the lowest volume of total biogas **(Figure 10)**
- Co-digestion of jackfruit peels (JF) with 50% cow dung generates a total biogas production of 241.6 ml/gVS
- Pineapple peels co-digested with 50% cow dung yielded the highest total biogas production of 510.7 ml/gVS **(Figure 10)**
- At both 25% and 50% co-digestion with cowdung, pineapple yielded the highest volume of total biogas


Figure 9: Boiling water using biogas from anerobic co-digestion of jackfruit waste with cow dung

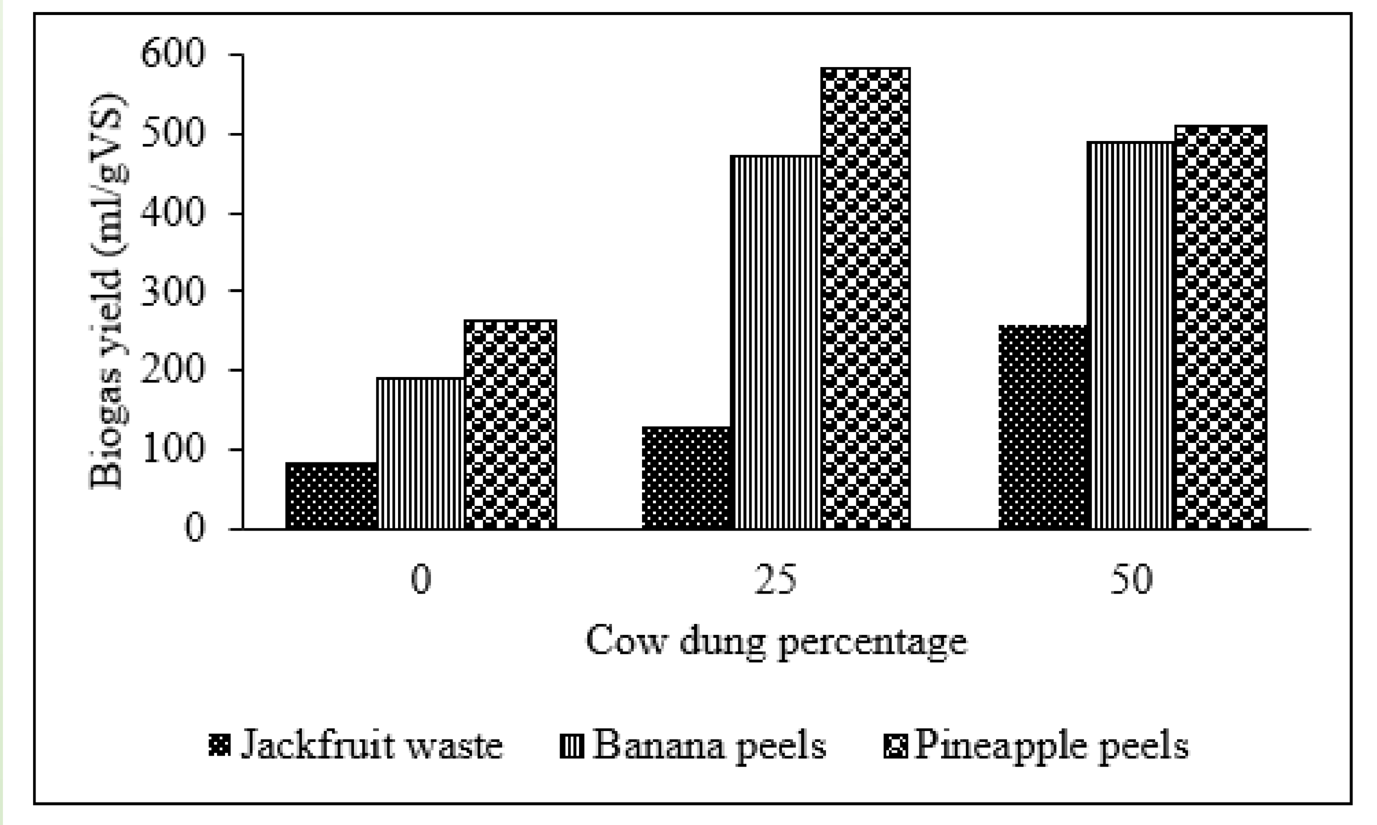


Figure 10: Effect of anaerobic co-digestion on total biogas production

Results – Part 2

- The quality of biogas produced was represented by the methane content which was measured at the end of the hydraulic retention time
- In terms of biogas quality, jackfruit waste co-digested with 25% cow dung produced the highest methane content of 69.6% which can be used for cooking (Figure 9)
- Co-digestion with cow dung (25%, 50%) increased the methane content for jackfruit waste and banana peels **(Figure 11)**
- In terms of methane content, jackfruit waste co-digested with 25% cow dung is the best co-digestion mixture **(Figure 11)**

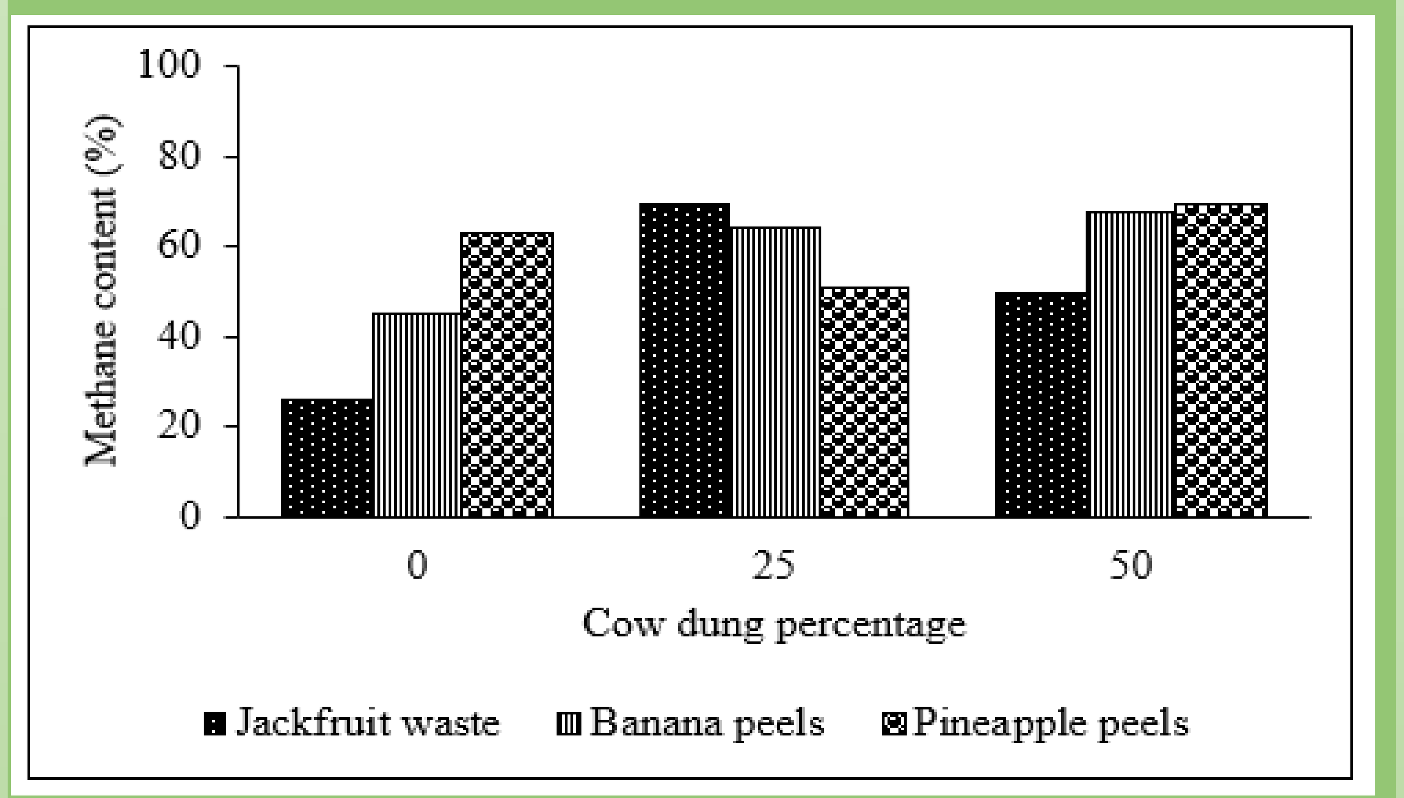


Figure 11: Effect of anaerobic co-digestion on biogas quality

Conclusions

- Briquette type and mixing ratio significantly affects the calorific values of the composite briquettes with the composite briquette of 70% jackfruit waste and 30% jackfruit leaves having the highest calorific value of 21.98 MJ/kg
- Co-digestion improved the total biogas production and methane content with pineapple peals co-digested with 25% cow dung production the highest volume of 581.7 ml/gVS while when jackfruit waste is co-digested with 25% cow dung, the highest methane content of 69.6% is obtained
- Both jackfruit-based composite briquettes and biogas from co-digestion of jackfruit and cow dung can be used as alternative cooking fuels due to their energy content.

References (samples):

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