Frontiers of Agri and animal Innovation (FAAI), Vol 1, Issue 1, 2025

Contents lists available at Curevita Journals

Frontiers of Agri and animal Innovation

journal homepage: www.curevitajournals.com

Influence of different cultural parameters in the production of biogas using university food waste in Telangana State of India

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Articalinfo

Article history: Received 22 June 2025, Revised 18 Aug 2025, Accepted 20 Aug 2025, Published Sept 2025

Keywords: Biogas, Methane, Anaerobic, food waste, cow dung.

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Citation: Sharnagat Punam,2025.Influence of different cultural parameters in the production of biogas using university food waste in Telangana State of India.Frontiers of Agri and animal Innovation, 1,1, 79-87.

Publisher: Curevita Research Pvt Ltd

Abstract

In the present study effect of pH and incubation period on the production of biogas using three different wastes, including the food waste of a University, was compared. Among the three inocula with food wastes compared at a ratio of 1: 4, it was found that cow dung and sheep waste were found to performed better compared to other food wastes. Biogas (20ml/72hours) was produced from food waste (100 g) and cow dung (25gm) slurry. Similarly, (15ml/72hours) of biogas was produced using sheep manure.

Introduction

Deforestation and reliance on the importation of fossil fuels have lead to severe balance of payment problems. Although biogas has the potential to reduce deforestation and the importation of fossil fuels, reliable data to show this effect quantitatively have not yet been obtained. In India, families who purchase 15% or more of their total firewood requirements are finding biogas units economical. Biogas use would reduce the practice of indiscriminate felling of trees and consequent soil erosion and resulting floods. The byproduct of anaerobic digestion of organic materials is commonly referred to as 'biogas' because of the biological nature of gas production. Biogas technology refers to the production of a combustible gas (called biogas) and a value-added fertilizer(called slurry or sludge) by the anaerobic fermentation of organic materials under certain controlled conditions of temperature, pH,C/N ratio etc. Anaerobic digestion is used in the treatment of various wastes such as municipal sewage sludge, solid waste, animal manure and food waste [Li et al. 2009]. This treatment comprises of organic material decomposition with methane, carbon dioxide, and ammonia production [Lopes et al, 2004]. Nielsen and Angelidaki (2008) suggested strategies for recovery of the biogas process following ammonia inhibition. Anaerobic digestion of swine manure from a farm-scale biogas plant in Korea was reported by Chae et al (2011). Castrillon et al (2002) investigated anaerobic thermophilic treatment of cattle manure in UASB reactors. Rao et al (2000) assessed the bioenergy production potential of municipal garbage. Solid anaerobic digestion of chicken manure was investigated by Bujoczek et al (2000).

Angelidaki and Ahring (1993) studied the effect of ammonia on thermophilic anaerobic digestion of livestock waste. A study by Orji et al. (2012) highlights the importance of cow dung isolates, both bacterial and fungal, for reducing total petroleum hydrocarbons to 0 % in polluted mangrove soil. The bacterial isolates involved in the process belonged to genera *Pseudomonas*, *Bacillus*, *Citrobacter*, *Micrococcus*, *Vibrio*, *Flavobacterium* and *Corynebacterium*, whilst fungal isolates were the species from *Rhizopus*, *Aspergillus*, *Penicillium*, *Fusarium*, *Saccharomyces* and *Mucor*.

Material and Methods:

The University's food waste was collected from a local University. The effect of different pH and incubation period was studied using a 500ml water with the inoculum and water at a ratio of 1: 4 (25g, 100g). The three inocula were collected from three different sources around the University campus. The amount of biogas produced was measured using the water displacement technique.

Results and Discussion:

Cow dung and sheep waste were found to produce more amounts of biogas compared to other poultry waste. In comparison to anaerobic light, anaerobic dark conditions were better for the production of biogas. The pH of alkaline nature was observed and was found to produce more amounts of biogas. Acidic pH is known to inhibit the production of biogas compared to basic pH.

Gupta et al (2016) have reviewed the status of cow dung as a resource for sustainable development. Cow dung contains a diverse group of microorganisms such as *Acinetobacter*, *Bacillus*, *Pseudomonas*, *Serratia* and *Alcaligenes* spp., which makes them suitable for microbial degradation of pollutants (Adebusoye et al. 2007; Akinde and Obire 2008; Umanu et al. 2013). Cow dung slurry maintained in the ratio of 1:10 or 1:25 is able to degrade the rural, urban and hospital wastes, including oil spillage to five basic elements (Randhawa and Kullar 2011). Umanu et al. (2013) suggested that the application of cow dung in an appropriate concentration may prove very efficient in the biodegradation of water contaminated with motor oil. The natural ability of cow dung microflora to degrade hydrocarbons in soil contaminated with engine oil is recently being investigated by Adams et al. (2014) where total petroleum hydrocarbon was reduced up to 81 % by the metabolic activities of cow dung microorganisms such as *Bacillus*, *Staphylococcus, Pseudomonas*, *Flaviobacterium*, *Arthrobacter*, *Enterobacter*, *Trichoderma*, *Mucor* and *Aspergillus* spp.

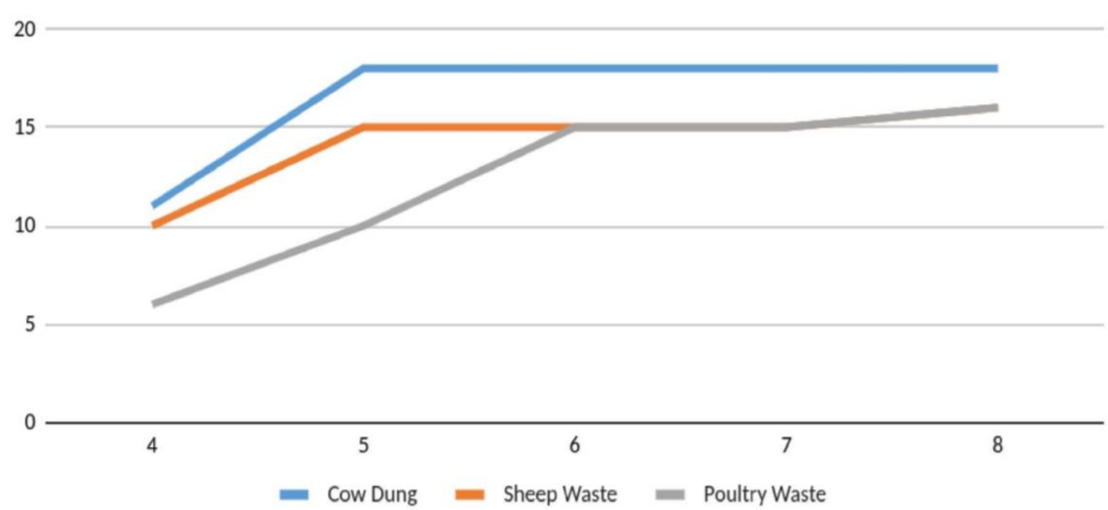

Fig-1: Amount of gas produced in anaerobic light conditions at different pH

Table 1: Effect of pH on production of biogas in anaerobic light conditions after two days of incubation

Type of manure	pH	Amount of gas produced in anaerobic light conditions (ml/500ml)	Amount of gas produced in anaerobic dark conditions (ml/500ml)
Cowdung	4.0	11	14
	5.0	18	20
	6.0	18	21
	7.0	18	21
	8.0	18	22

Table 2: Effect of incubation period on production of biogas in anaerobic light conditions

Type of manure	Incubation period	Amount of gas produced (ml/500ml)	Amount of gas produced in anaerobic dark conditions (ml/500ml)
Cowdung	12	8	9
	24	20	20
	36	20	26
	48	30	32
	72	37	42

Table 3: Effect of pH on production of biogas in anaerobic light conditions after two days of incubation

Type of manure	pH	Amount of gas produced (ml/500ml)	Amount of gas produced in anaerobic dark conditions (ml/500ml)
Sheep waste	4.0	10	10
	5.0	15	12
	6.0	15	16
	7.0	15	18
	8.0	16	19

Table 4: Effect of incubation period on production of biogas in anaerobic light conditions

Type of manure	Incubation period	Amount of gas produced (ml/500ml)	Amount of gas produced in anaerobic dark conditions (ml/500ml)
Sheep waste	12	8	10
	24	19	22
	36	24	26
	48	34	38
	72	38	42

Table 5: Effect of pH on production of biogas in anaerobic light conditions after two days of incubation

Type of manure	pH	Amount of gas produced (ml/500ml)	Amount of gas produced in anaerobic dark conditions (ml/500ml)
Poultry waste	4.0	6	5
	5.0	10	10
	6.0	15	14
	7.0	15	16
	8.0	16	17

Table 6: Effect of incubation period on production of biogas in anaerobic light conditions

Type of manure	Incubation period	Amount of gas produced (ml/500ml)	Amount of gas produced in anaerobic dark conditions (ml/500ml)
Poultry waste	12	6	10
	24	17	19
	36	20	22
	48	25	28
	72	32	34

Conclusion

This study demonstrates that cultural parameters such as pH and incubation period significantly influence biogas production from university food waste in Telangana. Among the tested inocula, cow dung and sheep manure proved to be the most effective substrates, with cow dung yielding the highest biogas production (20 ml/72 hours) followed by sheep manure (15 ml/72 hours). These findings highlight the potential of integrating animal manure with institutional food waste for efficient anaerobic digestion and sustainable energy generation. Optimizing key process parameters can further enhance methane yield, offering a viable waste-to-energy solution for universities and similar establishments.

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