EVALUATION OF BIOGAS PRODUCTION BY CO-DIGESTION OF PRE-TREATED FODDER RESIDUE WITH COW DUNG

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ABSTRACT

The increased use of fossil fuel for energy consumption poses threat to the environment both locally and globally. Fodder residues rich in lignocellulose often form a major portion of farmyard waste. The present study investigates the suitability of co-digestion of pre-treated fodder residues in anaerobic digestion for production of biogas. This study was conducted to find out the biogas production potential of different pre-treated fodder residues co-digested along with cow dung. The trials were carried out by loading the substrates, in portable floating drum biogas plants of 0.5 m^3 capacity. Daily gas yield from the plant was recorded for a period of 42 days. The study recommends that biogas is not just a renewable energy source but also an appropriate way of managing waste, having potential to replace fossil fuel.

Keywords: Biogas, anaerobic digestion, co-digestion, fodder residue

INTRODUCTION

Biogas is a mixture of different gases produced as a result of the action of anaerobic microorganisms on domestic and agricultural waste (Deshmukh, 2012). Anaerobic digestion is a promising method for biogas production in which organic substances are converted into biogas through the sequential involvement of different groups of bacteria. The benefits of biogas production technology is that it offers an alternative fuel, capable of producing heat and electricity along with the production of slurry which is having good fertilizer value. The recycling of wastes, greenhouse gas reduction and environmental protection are added advantages. Co-digestion is the simultaneous digestion of more than one type of waste in the same unit (Agunwamba, 2001), which helps in increased biogas yield. Fodder residues, which are rich in lignocellulose needs pretreatment for microbial breakdown.

MATERIALS AND METHODS

The study was conducted at University Livestock Farm and Fodder Research and Development station (ULF&FRDS), Mannuthy, Thrissur which is situated 22.25 m above mean sea level at 10° 53'' N Latitude and 76° 26'' E Longitude.

The experiment was conducted from February to March, 2015. The observations were taken for a period of 42 days. The Portable floating drum biogas plants

of 0.5 m^3 capacity, designed by Agro Biotechnology Agency for Rural Employment Development (ABARD), Kerala Agricultural University, Vellanikara were utilised for the study.

The cattle dung and fodder residue from the ULF&FRDS were used as substrates for biogas production.

- **T1** - One kg cow dung with one kg chopped fodder residue along with two liters of water were loaded daily for co-digestion.
- **T2** - One kg cow dung co-digested with one kg chopped fodder residue soaked in two liters of water for seven days were loaded daily
- **T3** - One kg cow dung co-digested with one kg chopped fodder residue soaked in two liters of slurry for seven days were loaded daily.
- **T4** - One kg cow dung co-digested with one kg chopped fodder residue soaked in two liters of one percent NaOH for seven days were loaded daily.

One kilogram of fresh excreta of cattle mixed with the pre-treated fodder residue which was diluted with water to achieve 10 percent dry matter level and loaded daily in the morning (8 am) to four different digesters. Volume of biogas produced was recorded daily at constant pressure for the following days (Paudel, 2012) till a constant gas production was obtained (42 days).

The volume of gas produced in each treatment was measured daily in the morning (8 am) before loading. This was done by measuring the increase in height of gas holder and then the volume was calculated using the equation (Paudel, 2012) given below.

Volume of the biogas, $V = \pi r^2 h$

Where, r denotes radius of gas holder and h denotes the increase in height after gas production.

RESULTS AND DISCUSSION

Table 1. Biogas production by cow dung under different treatments

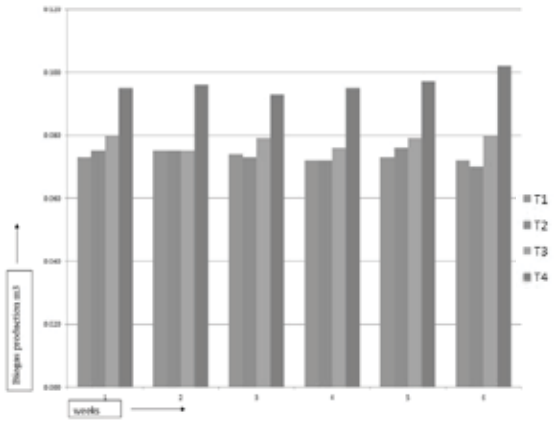
Sl. No.	Substrate	Gas production (m^3)
1	**T1 (C)**	0.073 ± 0.001^{c}
2	**T2 (D+W)**	0.074 ± 0.001^{c}
3	**T3 (D+S)**	0.078 ± 0.001^{b}
4	**T4 (D+N)**	0.096 ± 0.001^{a}

Means bearing the different superscripts within the same column differ significantly ($P<0.05$)

Trend in biogas production during the observation period

The trend in the biogas production during the observation period is given in Table 1 and Fig. 1. Biogas production became stabilized when hydraulic retention time (HRT) was achieved. The T4 (D+N) had shown the highest gas production than the other treatments during the observation period.

Fig. 1. Trend in biogas production during the observation period



The biogas production was found to be highest for T4 (0.096 ± 0.001) followed by T3 (0.078 ± 0.001), T2 (0.074 ± 0.001) and T1 (0.073 ± 0.0005). The results were in

line with that of Hassan (2004), he studied the relationship between different fodder types and their biogas production. The gas production was highest for NaOH treated (0.0538 m^3 biogas per kg dung) followed by the slurry treated (0.0487 m^3 biogas per kg dung). Zoabi (2010) suggested that fodder residue were suitable for anaerobic digestion and higher biogas production. Shejir (2014) reported that average biogas production potential of cattle excreta during summer and winter season was 0.0739 m^3 in a potable bio digester of 0.5 m^3 capacity. The higher production of biogas in alkali treated fodder may be attributed to the breakage of lignocellulosic bonds and the optimization of total solids. The enhanced production in slurry treated fodder residue could be due to the microbial action. The other factors for biogas production including temperature and pH were optimal for all the treatments.

SUMMARY

From this result, it can be summarized that biogas production of NaOH pre-treated fodder residue was having a higher production potential than the other treatments. The higher gas production observed could be due to the breakage of lignocellulosic bonds by the alkaline treatment and also due to interaction of various factors like higher total solids level of substrates, dilution factor of substrate, microbial load and difference in crude fibre digestion. The study was conducted in summer season which is suitable for increased biogas production for the agro climatic conditions of Kerala. More research has to be done in this area to tap the vast potential of fodder and other agricultural residues for biogas production.

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