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EFFECT OF CASTOR CAKE ON BIOGAS PRODUCTION BY ADDING WITH CATTLE DUNG

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Abstract: Biogas programme has gained roots as an alternative, efficient and to some degree cheap source of fuel in rural areas. A research work has been initiated on the effect of additives for increasing biogas yield including water hyacinth, de-oiled cakes, agricultural residues, etc. Among de-oiled cakes, castor cake is a non-edible cake available in plenty. Investigations were carried out at Anand Agricultural University on the effect of castor cake on biogas production. The mixture of castor cake with cattle dung in three proportions on dry weight basis was used i.e. T1-90 % cattle dung + l0 % castor cake, T2 -80 % cattle dung + 20 % castor cake, T3 -70% cattle dung + 30% caster cake. The biogas output was recorded with the help of gas flow meters, one for each plant. The spent slurry was analyzed for both quantity and quality in terms of organic matter, nitrogen and phosphorus periodically. The biogas production in a cattle dung fed plant could be boosted up by about 13 - 18 % on adding castor cake powder @ 20 % of cattle dung in the daily feed. The quality analysis of the gas produced in terms of its methane concentration indicated that there was no significant difference among the treatments as far as quality of gas generated is concerned. Addition of castor cake did not affect the normal operation and maintenance of the biogas plant.

Keywords: Castor cake, biogas production, KVIC plant, cattle dung, methane.

Introduction

Biogas production has gained cheap source of fuel in rural areas. Over one million biogas plants have already been set up in the country. It is increasingly being felt that biogas production has an important role to play in the national dimension of the fuel problems. Presently, available popular designs of biogas plants are based on cattle dung. However, cattle dung availability is limited now due to mechanization of farming, which results in under feeding of the plants.

A research work has been initiated in the country to study the effects of different additives such as water hyacinth, de-oiled cakes, agricultural residues, vermiculture, etc. for increasing biogas yield. Geeta (1986) studied the impact of adding inert materials like

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vermiculture, charcoal and lignite to bovine excreta as feed on biogas yield. These additives were found to increase biogas yield by 15 to 30 %. Addition of 5 % commercial charcoal to cattle dung slurry on dry weight basis raised the yield by 17 and 35 per cent in batch and semi- continuous process of biogas production, respectively (Kumar, 1987). Sohani (1991) reported that anaerobic digestion of castor cake produces higher gas production compared to cattle dung alone. Ali *et al.* (2010) concluded from study that it is a unique and novel approach wherein *Jatropha* defatted waste is used for biogas production, an efficient renewable fuel thereby allowing its safe disposal. Also its effluent slurry provides good organic manure with rich manorial properties. The study reveals that a combination of 75% cattle dung and 25% *Jatropha* oil cake has enhanced biogas production up to abour 25%. Total biogas generation potential from *Jatropha curcas* cakes in india has been estimated as 2550 million m3 from 10.2 lakh metric ton of *Jatropha curcas* oil seed cakes (Ram *et al.,* 2006). Among the de-oiled cakes, castor cake is non-edible by product of the industry and is available in plenty. The present use of castor cake is only as manure for agricultural crops.

Looking to the huge quantity of the castor cake available as the byproduct of the oil milling industry, it is advisable to explore its better economic utilization. Keeping above facts in mind the scientific investigations were carried out at Anand Agricultural University to enhance the biogas production with addition of castor cake to the cattle dung.

Objectives:

1. To evaluate the effects of castor cake addition to cattle-dung feed on biogas production from existing popular design of biogas plants.
2. To standardise the proportion of castor cake to cattle-dung in order to achieve higher biogas production.

Materials and Methods:

The biogas plants of standard KVIC floating dome type having 2 cum/day biogas production capacity were used for conducting the trials. The plants were operated normally with cow dung for 69 days for establishing uniform steady state conditions. The de-oiled castor cake was procured from local market. The mixture of castor cake with cattle dung in the following three proportions on dry weight basis were prepared.

T_1 -90 % cattle dung + l0 % castor cake

T_2 -80 % cattle dung + 20 % castor cake

T_3 -70% cattle dung + 30% caster cake

T_4- only cattle dung (l00 %) @ 50 Kg/day (Control)

Fig. 1: KVIC biogas plant

Each sample so prepared was fed to separate biogas plants @50kg mixture/day with 50 litre of water in the form of slurry. The daily biogas output was recorded with the help of gas flow meters, one on each plant. The spent slurry output was also was analysed for both the quantity and quality in terms of organic matter, nitrogen and phosphorus content periodically for each of the above mentioned feeding levels. The quality of gas obtained from each plant was also determined in terms of its methane content.

Results and Discussion

The weekly average data collected on the daily biogas production from all the set-ups with different proportions of castor cake are given in fig-2 for three consecutive years.

It is clear from the data obtained that the mean daily gas production enhanced on addition of castor cake to the daily feed of cow dung. The biogas production was the maximum (1859.1 lit/day) when 20% castor cake was mixed with the cow dung while the minimum (1655 lit/day) gas production was observed for the feed of cow dung alone (T4). As the proportion of the castor cake was increased from 10 to 20 % in the feed, the gas production also increased. However, on further increase in the proportion of castor cake to 30%, there was some reduction in the gas production. This may be due to the high oil content and resin chemical present in castor cake, which are detrimental to microbes. This also implies that the peak gas production can be obtained only with a definite proportion of the cow dung and castor cake.

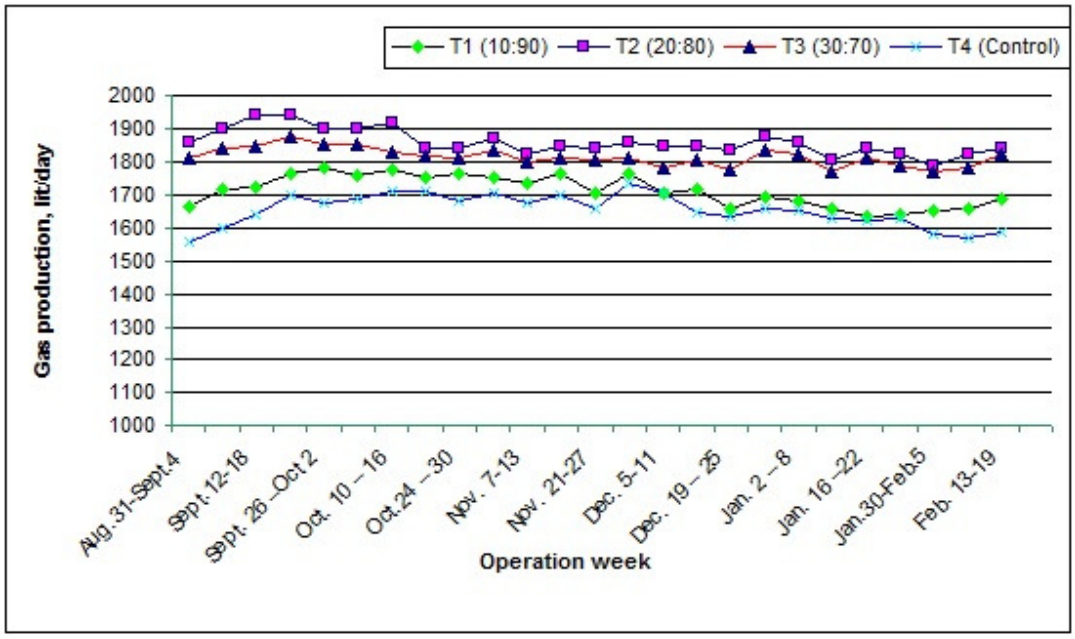

Fig. 2: Weekly pooled average of biogas production (lit/day) with different levels of castor cake addition to cattle dung

Table 1: Statistical analysis of gas production data

Year/ Treatments	I year	II year	III year	Pooled Mean
T1	1754	1682.7	1700.5	1712.5
T2	1887.6	1827.1	1862.6	1859.1
T3	1846.7	1781.5	1818.4	1815.5
T4	1677	1630.4	1657.7	1655
S Em	9.839	9.436	9.872	9.72
CD	27.69	26.55	27.782	17.85
CV %	2.75	2.73	2.8	2.76

The statistical analysis (Table 1) of the gas production data indicated that all the treatments were significantly different. The reduction in the gas production at very high proportion of castor cake (>30%) may be due to the total higher oil content in the feed and the higher residual chemicals present in the cake.

Manure quality

Table 2 shows the manure quality of the spent slurry generated from the biogas plants fed with different proportions of castor cake. It was observed that the manure value of the slurry from all the treatments compared well and is quit high. This gives additional advantage of having superior quality organic manure produced from castor cake after extracting biogas. Ali et. al (2010) reveals that Jatropha defatted waste was used for biogas production, an efficient renewable fuel thereby allowing its safe disposal. Also its effluent slurry provides good organic manure with rich manorial properties.

Table 2: Quality of manure produced as a function of addition of castor cake to cattle dung

S. No.	Treatment details	% N	% P_2O_5	% K_2O	% Organic Carbon	% Organic matter	C/N ratio
1	T_1	1.56	3.2	0.79	42.34	73.65	27.14
2	T_2	1.79	3.58	0.88	41.69	71.87	23.29
3	T_3	1.74	3.44	0.80	43.84	75.54	25.18
4	T_4	1.84	3.40	0.79	41.29	71.19	22.44
5	Castor cake	1.93	3.22	0.71	54.49	93.94	28.23

Conclusions

It can be concluded from above that the biogas production in a cattle dung fed plant could be boosted up by about 18 % on addition of castor cake powder @ 20 % of cattle dung in the daily feed. Addition of castor cake did not affect the normal operation and maintenance of the biogas plant. Similar result was found by Ali *et al*. (2010) that a combination of 75% cattle dung and 25% *Jatropha* oil cake has enhanced biogas production up to about 25%.

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