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A Research on Edible De-Oiled and Non Edible De-Oiled Cakes in Anaerobic Co-Digestion Production of Biogas

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Abstract: *To explore the plausibility of producing biogas in anaerobic co-absorption of eatable and non eatable cakes, were assessed with the impact of working parameters with methane potential was examination. De-oiled cake, for example, groundnut (GD), cocoanut (CT), mustard (MD) and sesame (SE) are co-processed with non-palatable de-oiled cakes jatropha,(JA) pongamia (PA) mahua (MA) and neem cake (NM). The examination study was done under an anaerobic absorption process as case1 case2 case3 and case4 with GD co substrate with JA, CT with PA, MD co-processed with MA and SE with NM under mesophilic temperature condition. The higher biogas creation capability of case2 was watched 4.80 liters followed by case2, case3 and case4. The combined bio-gas yield more than 21 days of hyro maintenance timespan was found as 32.24 liters with 150 liters of taking care of substrate. Anyway in case1, case3, and case4 all out volume of gas was discovered 28.92, 24.36 and 20.18 liters individually. The watched normal explicit methane yield with GD/JA substrate was accounted for as 48 % - 68% more than 21 days HRT periods.*

I. Introduction

As the by-products of oil production oil cakes are obtained after oil extraction from the seeds called as de-oiled cakes. There are two types of de-oiled cakes, edible and non edible oil cakes. Edible oil cakes have high nutrition, protein, and pepsin is easily digestible [1]. Being rich in protein some of the de-oiled cakes GD, CD,MD, and SE of these have also been consider for food supplementation and also feed application to cattle ,poultry ,fish and swine form.

In developing country like India research where being made for using non-edible oil cake production of bio-diesel. After explication of non edible oilcakes 50% to 60% left as de-oiled cakes which neither be used as cattle feed nor good quality fertilizer as it is toxic some of the non-edible oil cakes such as jatropha, mahua, pongama,and neem oil cake contain high amount of volatile solid, but rich in protein and starch [2], which may degradable under anaerobic digestion process for biogas generation.

India is one of the world largest oil seed producer over 4.3 million tones of oil cakes production. several oil cakes offer potential benefit when utilized as substrate for bio process of fermentation Production of enzymes, vitamins,antibiotics,anti oxidant etc. The present paper evaluates various de-oiled cakes co-digestion [3] of edible and non-edible oil cakes in fermentation and biotechnological process [4].

The annual production of jatropha, pongama de-oiled cake estimated 60000 tonnes. Many studies revised these oil seed cakes are not suitable for animal feeds. Hence the only suggestion used non-edible oil cakes is generation of bio gas through bio-methanation process. Since jatropha and pongama are rich in fat, protein and good feed material suitable biomet hanation. Madhuca indica known mahua is cultivated in southern parts of India for its oil hearing seeds annual production is around 0.5 million tons [5]. After the extraction of oil much of material goes as a waste mahau rich in volatile solids sugar (35%-40%) and protein(25%-30%) to be good feed material for bio-methanation.

II. Methods And Materials

The physiochemical properties of non-edible de-oiled cake such as JA, PA, MA and NM as feed material reported for moisture content oil [6]. Content total solids volatile solid, carbon, hydrogen, nitrogen and C/N ratio of the feed materials as shown in table:

Feed materials	C (%)	H (%)	N (%)	C/N ratio	Moisture content (%)	Oil content	Ts (%)	Vs (%)
JA	48.80	6.20	3.85	12.7	7.5	8.3	92.5	86.4
PA	47.80	6.50	5.50	8.7	10.5	7.2	89.5	85.3
MA	47.28	6.7	2.55	18.9	6.5	35	91.7	74.49

NM	39.02	7.3	3.45	17.6	8.7	20	93.8	64.73

Table shows the results obtained from the proximate analysis of different non-edible de-oiled cakes interms of its moisture, oil, total soilds and volatile solids [1]. The proximate analysis of feed material revails that jatropha and pongamia has high volatile content when compare to mahua and neem de-oiled cakes. The ultimate analysis shows that the carbon, hydrogen and nitrogen content in jatropha and pongamia de-oiled cake are slightly higher then that of other oil cakes. However, the C/N (carbon to nitrogen) ratio of all the non-edible cakes then that of edible oil cakes. Preparation of efficient inoculums from a fermented biogas plant feed with cattle dung with the delusion ratio of at least 5 to 10% inoculums [7] with non-edible de-oiled cake as cattle dung reported C/N ratio of 22.9 as one of the parameter may increases the bio-methanisation process.
The proximate analysis use to determine a moisture content of the feed material was calculated using standard formula

MC = ((Ws – Wd)/Ws) *100

Where MC is the percentage of moisture content wet sample, Ws is weight of wet sample in gram, Wd is weight of dry sample heated by oven in grams. The sample of 15 gram feed where first heated at 60°C for 24 hours and the dried sample weight with pre-weight moisture boxes were recorded. Similarly total solids content and volatile solids content of feed material where determined as per standard methods. The percentage Ts was calculated by using

TS = (Wd/Ws) *100 and

VS = ((Wd-Wa)/Wd) *100
Where Wd is weight of oven dried sample in grams, Ws is weight of wet sample in grams and Wa is the weight of dry ash left after heating the sample in muffle furnace in grams.

The ultimate analysis of carbon, hydrogen where determined as the method suggested by APHA [8].
The initial and final pH of the slurry was measured using a pen type digital pH meter.

III. Feed Preparation

Edible and non-edible de-oiled cake was collected from the village near by Chidambaram. The seed cake was stored in a plastic bag at a room temperature these oil cakes choppes into small pieces using mortar as pestle and blended prior to experiment as waste/ waste as 50:50. After blending de-oiled cake was mixed with waste/ water as 40:60 by weight to create the slurry. The slurry was stored over night along with 5% inoculums before adding to the digester. This procedure was repeated in all cases as co-digestion of edible and non-edible de-oiled slurry. The initial PH of the slurry was measured and then adjusted to 7 with the suitable agent to maintain the process stability. The anaerobic co-digestion of edible/non-edible de-oiled cakes GD/JA, CT/PA, MD/ME and SE/NM where carried under mesophilic range [9, 10]. In a floating drum biogas digester the feed materials where feeded with various combination of cakes with inoculums cow dung as co-substrate in case 1, 2, 3 and 4. It is clearly evident that the GD/JA de-oiled seed cake has remained intact after being soaked in water with the waste/water for 10:90, 10:90, 12:88 and 15:85 respectively. However, the observation on case 3 and 4 that it become like a paste after hours of choking in water therefore the feeding concentration was slightly increased in these 2 cases [11]. Thus, it is expected that the degradation will be faster.

IV. Experiment Procedure

Biomethanation study was carried in 0.5 m^3 capacity biogas digester by batch feeding of co-digestion edible/non-edible de-oiled cake substrates for 21 days. A schematic diagram of the biogas digester is shown in figure 1. The figure 2 shows the status of biogas digester before feeding of the substrate; the position of floating gas holder is at the lowest. Figure 3 shows the status of the same biogas digester at the peak biogas formation the position of the gas holder is at the maximum height of reach. Table 2 shows co-digestion of different edible/ non-edible de-oiled cakes the feeding level of co-substrate measurement of temperature. The daily biogas production, cumulative biogas yield and the percentage of specific methane production for a time 21 days hydraulic retention period.

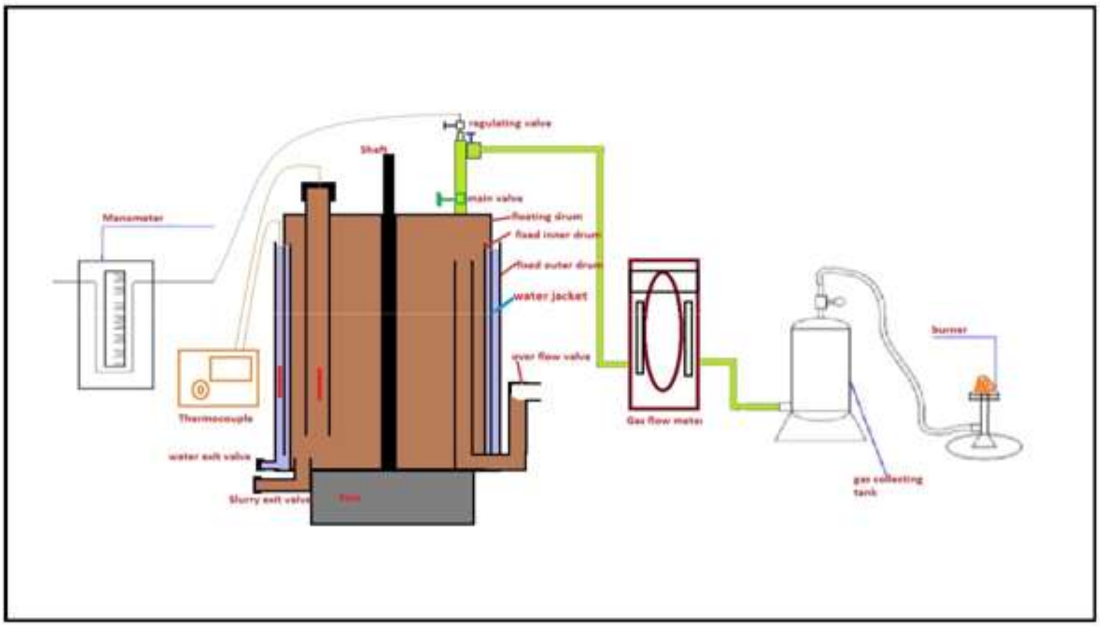

Figure 1 Schematic diagram of biogas digester

Figure 2 Biogas digester initial feeding of the substrate

Figure 3 Biogas digester at the peak biogas formation

Table 2 Co-digestion of different edible/non-edible de-oiled cakes

Particulars	**Case 1 GD/JA**	**Case 2 CT/PA**	**Case 3 MD/ME**	**Case 4 SE/NM**
Volume of the slurry (liters)	150	150	150	150
Waste / Volume	40:60	40:60	40:60	40:60
Waste / Waste	50:50	50:50	50:50	50:50
Inoculum (%)	5	5	5	5
Temperature (^{o}C)	28–39	30–38	28-36	27-34
HRT (days)	21	21	21	21
Daily biogas yield (liters)	0.52 - 4.37	0.95 – 4.80	0.35 – 3.94	0.86 – 2.98
Total biogas yield (liters)	28.92	32.24	24.36	20.18
Methane Yield	48 – 68%	37–62%	30 – 42%	28 – 48%

V. Result And Discussion

In this study, the analysis of the edible de-oiled cake shows the high value of crude protein and carbon/nitrogen ratio but low volatile solids [12]. These edible cakes co-digester with non-edible de-oiled cakes which have less then 8% moisture and around 91% total solid of which 95% was volatile solid. The cake was fairly high in organic matter and significant percentage of nitrogen and phosphorus are the major biological nutrients in the co-digester seed cake has good potential for biogas generation. It has been observed the cumulative biogas yield more in case 2 CT/PA co-digestion as 32.24 liters followed by case 1 GD/JA co-digestion as 28.92 liters and case 3, case 4 reported the cumulative co-digestion as 24.36 and 20.18 liters. Hence less protein, nutrient and more fiber are affects the biodegradable process. The cumulative total biogas, measure in liters is shown in Figure 4. The reduction in gas production due to high oil content in mustard and sesame feed which are detrimental to microbial activities.

Figure 5 shows the rate of CH_4 production gradually increased after the first weeks of digestion then sharply increased reaches the highest peak biogas production. The maximum and minimum value of methane in case 1 GD/JA co-digestion where found to vary from 48 – 68% and case 2 CT/PA co-digestion where found to vary from 37 – 62%. The observed value of methane concentration in generated biogas is due to the fact that the degradation of fat, protein gives more methane content in case 1 and 2.

Figure 6 shows the observation of biogas through the batch process for the HRT 21 days. It has been observed that the biogas yield as 4.37, 4.80, 3.94 and 2.98 liters for case 1, case 2, case 3 and case 4 respectively. as the peak gas production reported on daily gas yield all these values are lies between the seventh day of digestion to thirteen day of digestion process and then the gas yield decreases due to the volatile substrate availability and reduction in methanogene activities. This study reviles the importance of pH the feeding of inoculums enrich the degradable process.

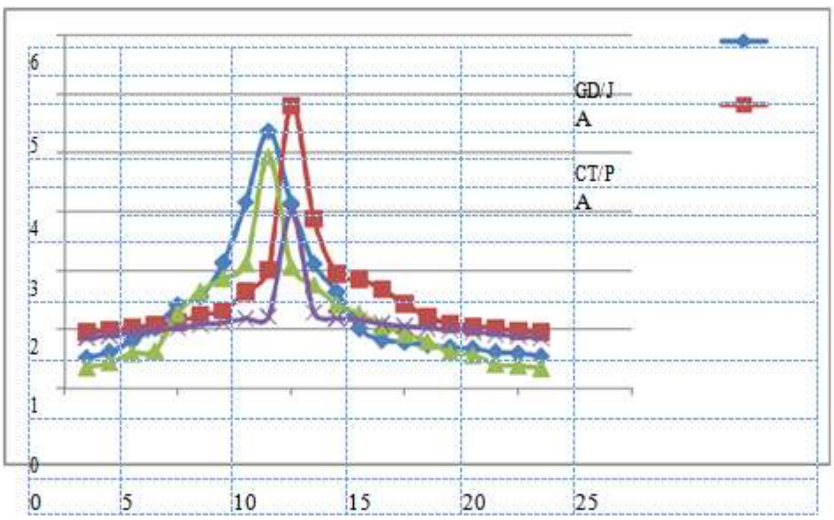

Figure 5 Daily biogas production Vs HRT

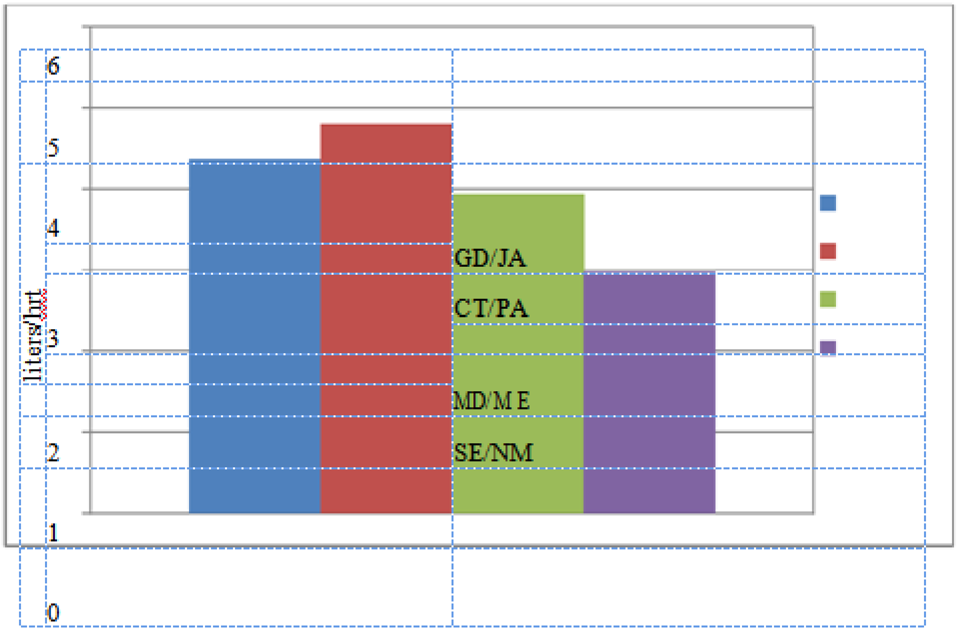

Figure 6 Cumulative total biogas, measure in liter

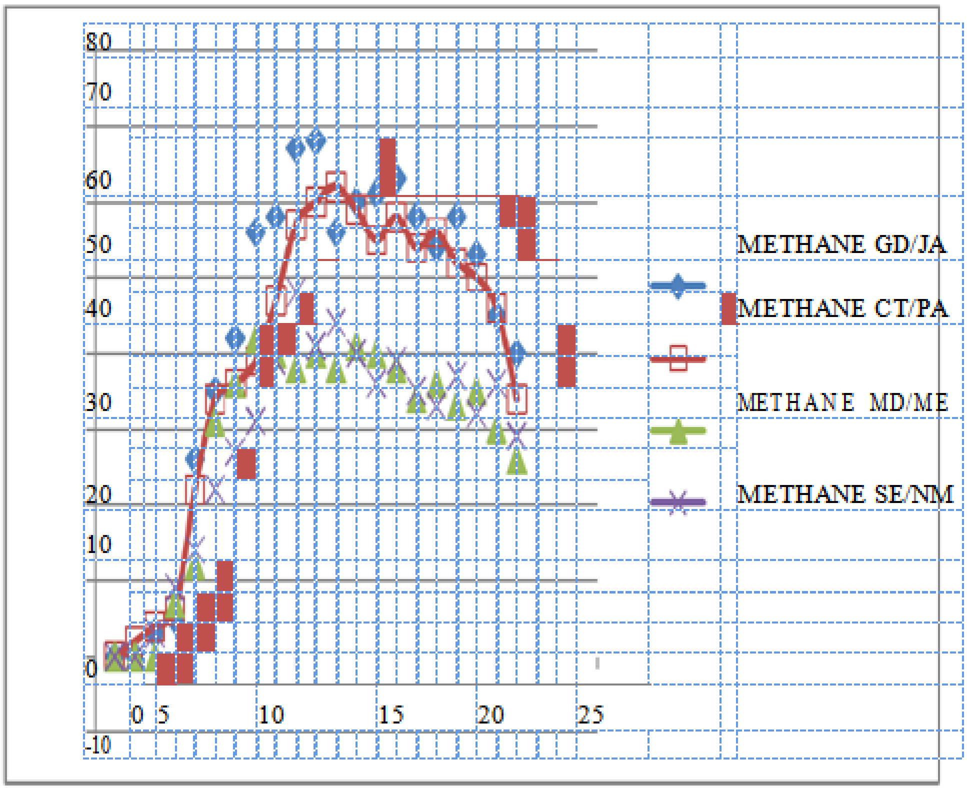

Figure 5 CH_4 production

VI. Conclusion

It was observed that the increase in biogas yield co-digestion of edible co-substrate with de-oiled cake mixed with the active fermented inoculums due to positive synergism. Further, the increase in biogas yield depends on the high volatile solids of non-edible de-oiled cake like jatropha, pongamia co-substrate with high protein and nutrient rich groundnut and coconut de-oiled cake. The observed result shows that the feed coconut/pongamia has higher bio-degradability then the other feed, possibly due to higher concentration of long chain fatty acid. The average specific methane potential was observed as high in case 1 with groundnut/jatropha de-oiled cake reported as 48 – 68% of methane. The experiment studies carried out that the case 1 and case 2 combination of feed have favorable property to be used as co-substrate for anaerobic digestion. Massive cultivation of jatropha and pongamia when co-digester with edible de-oiled cake offer a very high potential of methane production.

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