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BIO PROCESSING OF CERTAIN WASTES IN RELATION TO ENERGY

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Anaerobic biodigestion of various wastes such as groundnut shell, press mud, and paddy husk a long with cowdung using biodigested slurry as a source of microbial inoculum was studied with respect to gas generation and microbiological activity. The maximum gas output of 12, 173 ml besides maximum methanogenic activity (222.3 x 10^3/g) was observed in pressmud incorporated with cowdung, treatment followed by groundnut shell mixed with cowdung of 11962 ml and 189.66 x 10^3/g during the final stage of digestion, respectively, over a period of 12 weeks. The data obtained indicated the suitability of mixing pressmud and groundnut shell as supplementary feedstocks for biogas production.

Animal dung has hitherto been employed as a feed material for biogas production. Various kinds of wastes arising out of processing of different agricultural - commodities could profitably be utilized for biogasification process which otherwise poses threat to environmental hygiene and sanitation. An attempt has been made in this study to find out as to how best the groundnut shell, paddy husk and sugar factory waste like pressmud could profitably be supplemented along with cowdung to yield energy rich methane gas.

MATERIALS AND METHODS

The agricultural wastes such as groundnut shell and paddy husk and the sugar factory waste like pressmud were used along with cowdung for this study. The total organic carbon content was estimated by the wet digestion method as described by Piper (1950) and the total nitrogen content by using the method outlined by Humphries (1956). The above wastes were incorporated with cowdung and biodigested slurry in the proportion of 4 : 1 : 1 (wt/wt) and control was maintained without the addition of any waste material i. e. only cowdung and biodigested slurry were mixed in the proporation of 4:1 (wt/wt).

The anaerobic digestion of the above treatments was carried out in 5

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litre containers at room temperature. The gas generated from various treatments were recorded daily over a continuous period of 12 weeks. The gas was measured daily by the water displacement method as described by Mishra (1954).

The moisture content of the various wastes was estimated as described by Johnson and Ulrich (1960). The pH of the materials was determined using Systronic pH meter.

Microbiological Examination : The microbial population such as acid-forming bacteria and methanogens were estimated in the wastes incorporated treatments. The standard serial dilution plate technique of Parmer and Schmidt (1965) was employed, for the estimation of acid – forming bacterial population as described by Chynoweth and Mah (1977). The methanogens were enumerated as per the method described by Siebert and Hatting (1967) using the most probable number (NPN) technique.

RESULTS AND DISCUSSION

The waste materials used were groundnut shell, pressmud and paddy husk and the physico-chemical properties of the above waste materials were shown in Table-1. The pH of the waste materials varied from 6.9 to 7.3.

The gas production in the anaerobic digestion has been found to vary significantly with the nature of the waste materials used and the physico-chemical composition of the waste materials incorporated. The effect of incorporation of waste such as groundnut shell,pressmud and paddy husk in relation to gas generation was shown in Table 2. The gas production was maximum in the case of pressmud incorporated treatment which gave the maximum gas output of 12173 cc when compared to that of control which recorded 6992 cc over 12 week period. The nitrogen content of pressmud might have influenced the microbial communities resulting in enhanced gas output. The amount of biogas generated in the process of anaerobic digestion is primarily a function of the nature and type of waste materials incorporated (Anonymous, 1977). In all the wastes incor porated treatments,the gas production was higher when compared to that of control. Reports on the addition of organic materials to increase gas production by several authors (Rajasekaran and Nagarajan, 1979) lend support to the present finding.

The distribution of acid forming bacteria and the methanogenic bacterial population in the initial and final stages of digestion in various wastes incorpo rated tretments were enumerated and the results are preseted in Table-2. The population was less in the initial stage when compared to that of the final stage. The distribution of microbial population in the verious wastes

Table 1 Physico - Chemical Properties of waste materials

Waste Materials	pH	Moisture %	Carbon %	Nitrogen %	C:N ratio
Groundnut shell	7.1	4 2	18.79	0.52	35.9 : 1
Pressmud	6.9	4.3	25.23	2.14	11.76 : 1
Paddy husk	7.2	3.1	40.30	0.37	109.2 : 1
Cowdung	6.9	81.6	21.57	1.01	27.29 : 1
Old slurry	7.3	82.3	20.12	1.81	11.10 : 1

Table 2 Effect of incorporation of groundnut shell, pressmud and paddy husk in relation to Gas Generation

Treatments	Total quantity of gas procuced over 12 weeks (in cc)	Per day gas production (cc)	Microbial population			
			Acid forming bacteria ($X10^3$/g)		Methanogenic bacteria ($X10^3$/g)	
			I	F	I	F
GS : CD : OS 4:1:1(T_1)	11962	997	35.3	54.0	43 7	189.66
PM : CD : OS 4:1:1(T_2)	12173	1014	54.7	118.3	12.0	222.3
PH : CD : OS 4:1:1:(T_3)	8304	692	26.3	70.3	33.0	99.0
CD :OS (Control) 4:1 (T_4)	6992	583	33.7	63.0	43.7	65.3

CD—Cowdung GS—Groundnut shell OS—Old Slurry PM—Pressmud

PH—Paddy husk I —Initial F —Final

incorporated treatments varied with the type of wastes incorporated.

The maximum gas generation in the pressmud incorporated treatment may be due to narrow carbon/nitrogen ratio and higher quantity of volatile fatty acid production-contributing towards maximum microbiological activity. The groundnut shell incorporated treatment gave the next best gas output because of the carbon nitrogen ratio 35:1 which is supposed to be ideally suited for microbiological activity. Among the various wastes incorporated treatments lesser gas output was recorded in the paddy husk incorporated treatment. This may be due to wider carbon nitrogen ratio of the material, presence in higher quantities of silica. The variation in the distribution of the organisms may be due to preferen tial stimulation of the microorganisms by the constituents of the added carbonaceous materials (Alexandar, 1961). There is a close correlation between mathanogenic population and gas genera tion. The rate of gas generation is attributable to relative higher cell densities indicating the significant role played by the mathanogenic bacteria in the generation of methane-rich biogas. The data obtained from the above study indicate the suitability of pressmud and groundnut shell as a supplementary feed material along with cowdung for bio-processing through biogas digesters.

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