Madras agric. J. 68 (7) 444—449 July, 1981

Effect of Fish and Chicken Wastes on the Microbial Population and Biogas Generation

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An experiment was conducted to study the effect of incorporation of fish and chicken wastes on comparative biogas production and distribution of microorganisms. The treatments had equal quantity of cattle dung and water mixed with old slurry and fish and chicken wastes in to proportion of 4: 1: 1. Two sets of experiments were conducted ie., one set kept above ground and the other kept burried in soil, for 12 weeks and gas generated were measured for every 24 hours. The fish wastes incorparated above ground (4: 1: 1) gave the maximum average gas output of 1088 cc/day over 12 weeks compared to 899 cc/day of chicken wastes. Similarly the maximum bacterial population of 47.0 × 10^6/g was estimated in fish wastes kept on the ground compared to chicken slurry (33 8 × 10^6/g) fish slurry was to found to have fish celluloytic activity and also produced fish methanogenic activity.

Bioconversion of organic wastes through anaerobic digestion offers high degree of waste stabilization and production of biogas. The biogas generation using cattle dung has been studied by Desai and Biawas (1945) and Acharya (1958). Any reduction in the consumption of dung and its substitution with various wastes will certainly benefit the small farmers in several ways. Judicious combination of various wastes along with cow dung could not only maximise biogas production at a cheaper cost but also provide organic manure rich in N, P, K content. The utilization of other livestock excreta viz; pig, goat and poultry has also been studied by Bansal *et al* (1976). Hence an investigation was carried out to study the effect on incorporation of fish and chicken wastes on comparative biogas production and the distribution of microorganisms.

MATERIAL AND METHODS

The cattle dung and old slurry utilised in this study were obtained locally from the Tamil Nadu Agricultural University dairy farm. The chicken wastes i.e. the intestine along with its contents and the feather removed unwanted skin were obtained from the poultry section. The fish wastes viz; the intestines, the skin scrapings and caudal fin were obtained from the local market. The chicken and fish wastes were chopped into one to two inch bits before they were mixed with cow dung.

The cattle dung slurry was prepared by mixing equal quantity of water and dung (v/v). Measured quantity of dung slurry was taken in an empty, clean

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five litre capacity tin digesters and to which the old slurry and the wastes (fish and chicken wastes) were added in the proportion of 4:1:1 (v/v) respectively. Two sets of experiments were carried out. One set of treatments was kept above ground and the other kept burried in soil to study the effect. The experiment was allowed to progress continuously for a period 12 weeks and the gas generated over every 24 hours was measured daily by the water displacement method.

The biodigested slurry specimens from the above ground and below ground, wastes incoroporated treatments were collected and screened for the distribution of various organisms viz; bacteria, acid forming bacteria, cellulolytic organisms, methanogenic bacteria, coliforms and fecal streptococci following standard procedures. The bacterial colonies were enumerated on the third day employing nutrient agar media. The acid forming bacteria were enumerated as per the method of chynoweth and Mah (1977). The cellulolytic organisms were screened by employing Dubo's cellulose medium. The coliforms and fecal streptococcal counts were taken on the second day after incubation at 37° and 44°c respectively by employing the multi-tube dilution technique, as described in Standard Methods. (Anon, 1976). The methanogens were enumerated as per the method of Siebert and Hattingh (1966).

RESULTS AND DISCUSSION

The relative distribution of various organisms and the quantity of gas generated in the fish and chicken wastes incorporated above and below ground level treatments are presented in Table I and II respectively.

The fish wastes incorporated above ground 4:1:1 treatment on an average gave the maximum gas output of 1088 cc/day over a 12 weeks period compared to 899 cc/day of chicken wastes incorporated treatment. Probably balanced proportion of carbon and nitrogen in these wastes might have stimulated the desired type of organisms resulting in maximum quantity of gas generation. The results obtained are in agreement with Mishra (1954) and Acharya (1958). In both the wastes incorporated treatments, the ones that were kept above ground in general recorded more gas output when compered to treatments kept burried in soil. Variations were observed with regard to above ground and below ground temperatures. The above ground treatments have had access to direct absorption of solar radiation and this might have enhanced the gas generation.

The maximum bacterial population of 47.0×10^6/g was estimated in the fish wastes incorporated biodigested slurry specimen of above ground treatment compared to 33.3×10^6/g of the same chicken wastes incorporated treatment. The population enumerated were generally high in the above ground when compared to that of below ground level.

The cellulolytic activity, which is the most critical of all the activity

causes the breakdown of complex raw meterials to simple soluble organic compounds. The maximum cellulolytic organisms enumerated were 14.6 and 5.6 ($\times 10^4$/g) in the fish and chicken wastes incorporated treatments respectively.

The acid forming bacteria act on the various substrates added and releases volatile acids, which forms the base substrate for methanogenic activity. The maximum population of acid forming organisms (24.0×10^4/g) were enumerated in the treatments that gave the maximum gas generation. Similar results expressed by Deshpande *et al* (1979) lend support to the findings of the present study.

The rate of gas generation is attributable to relatively higher cell densities indicating the significant role played by methanogenic bacteria in the production of methane rich biogas. In this study, the maximum methanogenic bacteria estimated was 17.0×10^4/g in the fish wastes incorporated treatment compared to others. Thus, there is a close correlation between methanogenic population and gas production. Similar results were obtained by Rajasekaran and Nagarajan (1979) and Ranade *et al* (1980) bear testimony to the findings of this study.

Variations were observed in the distribution of coliforms and fecal steptococci populations, the maximum enumerated being 240.0×10^5/g and 39.0×10^2/g respectively in the fish wastes incorporated 4:1:1 treatment.

This study provides evidence that the fish and chicken wastes accumulating in the market if properly recycled along with cowdung and old slurry could help in generating more quantity of biogas.

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TABLE I Effect of incorporation of fish wastes on the distribution of microbial population and biogas generation.

Treatment	Proportion (v/v)	Microbial population (Population expressed per g on even dry basis)					Gas production		
		Bacteria (× 10^6)	Acid-forming organisms (× 10^4)	Cellulolytic organisms (× 10^4)	Methanogenic bacteria (× 10^4)	Califorms (× 10^5)	Fecal streptococci (× 10^2)	Average quantity of gas produced in cc/day 12 weeks period	Percentage increase over control
A. Above ground									
CD:OS:FW	4:1:1	47.0	24.0	14.6	17.0	240.0	39.0	1088	86.0
CD:OS:FW	4:0:1	9.0	7.0	2.0	8.0	94.0	9.0	563	..
CD:OS FW	4:1:0	25.0	8.0	2.0	11.0	79.0	11.0	582	..
B. Below ground									
CD:OS:FW	4:1:1	27.0	11.6	4.6	12.0	141.0	23.0	791	52.0
CD:OS FW	4:0:1	10.6	5.3	5.3	11.0	70.0	..	574	10.4
CD:OS:FW	4:1:0	18.0	7.3	7.3	5.0	63.0	..	520	..

CD : Cow dung OS : Old slurry FW : Fish wastes

TABLE II Effect of incorporation of chicken wastes on the distribution of microbial population and biogas generation

Treatment	Proportion (v/v)	Microbial population (Population expressed per g on over dry basis)						Gas production	
		Bacteria ($\times 10^6$)	Acid-forming organisms ($\times 10^4$)	Celluloytic organisms ($\times 10^4$)	Methano-genic bacteria ($\times 10^4$)	(Coliforms $\times 10^5$)	Fecal strepto-cocci ($\times 10^2$)	Average quantity of gas produced in cc/day over 12 weeks period	Percen-tage increase over control
A. Above ground									
CD:OS:CW	4:1:1	33.3	17.0	5.6	13.0	172.0	28.0	899	108.1
CD:OS:CW	4:0:1	10.6	5.3	2.0	7.0	70.0	3.0	575	33.1
CD:OS:CW	4:1:0	9.3	4.0	1.3	2.0	23.0	4.0	433	..
B. Below ground									
CD:OS:CW	4:1:1	21.3	5.3	5.0	12.0	109.0	21.0	752	35.5
CD:OS:CW	4:0:1	6.0	7.3	3.3	4.0	26.0	3.0	478	..
CD:OS:CW	4:1:0	13.6	7.6	6.0	4.0	73.0	4.0	555	..

CD : Cow dung OS : Old slurry CW : Chicken wastes