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BIODIGESTION OF SILKWORM LARVAL LITTER FOR BIOGAS PRODUCTION

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ABSTRACT

The possibility of utilizing silkworm larval litter (SLL) as an alternative or supplementary feedstock with coudung for biogas production was studied under laboratory conditions. Incorporation of SLL enhancec the generation of biogas in all treatments. Maximum quantity of 1593 ml/day was observed on an average over a period of six weeks in SLL alone incorporated treatment followed by SLL incorporated with coudung (1365 ml/day). However, SLL incorporated with coudung produced maximum quantity of 2450 ml/g of total solid destroyed whereas SLL alone produced 1917 ml/g of total solid destroyed. Maximum methanogenic population was recorded in SLL alone (172 x 10^3/g), followed by SLL incorporated with cowdung (156 x 10^3/g).

KEY WORDS: Biogas, Silkworm Larval Litter, Methanogenic bacteria.

The problem of increasing demand for energy can be solved to a greater extent particularly in rural sector, through biogas production utilizing the biomass generated in agriculture, sericulture as well as poultry and piggery establishments. The wastes from agriculture and animal production units were studied extensively for biogas generation. However, the information available on the utilization of wastes from sericulture is meagre, considering the fast development of this industry in recent times. In addition to energy, the anaerobic digestion process also yields organic manure for improving crop productivity. Judicious combination of nitrogen rich organic sources such as silkworm larval litter (SLL) with cowdung might help in augmenting biogas output besides enriching the biodigested slurry. With this in view, an attempt was made to investigate the possible potential of SLL along with cowdung for biogas production.

MATERIALS AND METHODS

The feedstock materials such as cowdung and SLL were obtained from Tamil Nadu Agricultural University Campus and

were analysed for their proximate properties. Moisture content was determined following the procedure outlined by Johnson and Ulrich (1960). The total solids and volatile solids were determined as per standard procedure. The total organic carbon was determined by the method of Walkby and Black as described by Piper (1950). The total nitrogen was estimated by micro-kjeldahl method described by Humphries (1956). The phosphorus and potassium contents were determined as per the method of Jackson (1962).

The treatments included in the study were:

Cowdung alone (T_1): The slurry was prepared by mixing 740 g of cowdung with equal quantity of water in 1: 1 Wt/Wt proportion to obtain a total quantity of 1.5 kg.

Cowdung + biodigested slurry (T_2): In addition to the contents of T_1, 50 ml of biodigested slurry was added.

Silkworm larval litter alone (T_3): The slurry was prepared by mixing 166.7 g of SLL and 133.3 g of water (1:8 Wt/Wt) to obtain a total quantity of 1.5kg.

Silkworm larval litter + cowdung (T_4): The SLL slurry was prepared by mixing 83.5 g of SLL with 666.5 g of water (1:8 Wt/Wt). The cowdung slurry was prepared by mixing 375 g of cowdung with 375 g of water (1:1 Wt/Wt). The above two slurries were mixed to obtain a total quantity of 1.5 kg.

Silkworm larval litter + biodigested slurry (T_5): In addition to the contents of T_3, 50 ml of biodigested slurry was added.

Silkworm larval litter + cowdung + biodigested slurry (T_6): In addition to the contents of T_4, 50 ml of biodigested slurry was added.

The slurry samples, prepared by mixing above materials, were poured into 2.5 litres capacity amber coloured bottles. The bottles were sealed air tight and the gas output was measured daily by water displacement method described by Mishra (1954).

Acid forming bacteria were enumerated by adopting the method of Chynoweth and Mah (1977) and methanogenic bacteria by the method of Smith and Hungate (1958).

Table 1. Physico-chemical properties of feedstock materials

Properties	Cowdung	Silkworm larval litter
I. Physical		
Moisture content (%)	85.87	36.20
Total solids (%)	14.13	63.80
Volatile solids (%)	11.43	56.94
II. Chemical		
Carbon (%)	31.22	32.16
Nitrogen (%)	1.25	3.47
Phosphorus (%)	0.78	0.93
Potassium (%)	0.76	1.50
C:N ratio	24.97	9.26

RESULTS AND DISCUSSION

The proximate analysis of cowdung and SLL employed in this study is presented in Table 1. The total solids and volatile solids were found more in SLL as compared to cowdung. In addition, the total nitrogen content was also found significantly more in SLL than cowdung. These data helped in proper blending of feedstock materials with a view to maximise the gas output.

The gas output, total and volatile soilds destroyed and microbiological properties of different treatments are presented in Table 2. The SLL alone incorporated treatment recorded the maximum biogas of 1593 ml/day on an average over a period of six weeks followed by SLL incorporated with cowdung of 1426 ml/day over a period of six weeks. The cowdung alone gave 812 ml/day only. However, the quantity of gas produced per g of total solid destroyed was maximum in SLL incorporated with cowdung (2450 ml/g) whereas cowdung alone incorporated treatment produced 1910 ml/g only. Shivappa Shetty et al. (1978) evaluated the biogas production potential of silkworm wastes and reported that the fermentation proceeded rather rapidly. Similar report of Rajasekaran and Oblisami (1981) that maximum quantity of gas produced in silkworm wastes incorporated treatments, lends support to these findings.

The percentage degradation of total solids was maximum (57.76) in SLL alone incorporated treatment that recorded the maximum gas output. Similar findings were reported by Murugesan (1982).

The methanogenic bacterial population was maximum in the slurry of SLL alone incorporated treatment of 172×10^3/g, whereas cowdung alone incorporated treatment recorded 137×10^3/g. The results indicated a positive correlation between the gas output and methanogenic population. The variation observed in acid forming bacteria might be due to the nature of feedstock material. Similar observations were made by Ranade et al. (1980) in the studies on the cowdung digestion.

This study has provided evidence to the fact that sericultural wastes, if supplemented with cowdung, could help in

Table 2. Biogas output, total and volatile solids destruction and microbiological properties various treatments

Treatment	Average gas output per day over 6 weeks (ml)	Quantity of gas(ml)per g of totalsolid destroyed over 6 weeks	Percentage of destruction		Microbial population (x 10^3/g)	
			Total solids	Volatile solids	Acid forming bacteria	Methanogenic bacteria
T_1 Cowdung alone	812.00	1910.50	35.08	73.52	34.0	137.0
T_2 Cowdung + biodigested slurry	744.50	994.21	53.68	80.20	37.0	132.0
T_3 Silkworm larval litter alone	1593.60	1917.00	57.76	79.20	72.0	172.0
T_4 Silkworm larval litter + Cowdung	1426.00	2450.58	43.51	46.92	67.0	156.0
T_5 Silkworm larval litter + Biodigested slurry	1365.00	1968.50	48.33	55.84	46.0	151.0
T_6 Silkworm larval litter + Cowdung + Biodigested slurry	1274.66	1902.00	49.48	70.59	70.0	121.0

maximising biogas output and improve the manurial value of digested slurry.

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