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POTENTIAL OF *SALVINIA MOLESTA* (AFRICAN PAYAL) AS AN ALTERNATIVE AND SUPPLEMENTAL FEED STOCK TO CATTLE DUNG FOR BIOGAS PRODUCTION

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In early days, cowdung was the major charging raw material for the production of biogas for cooking needs. But nowadays the technology of producing biogas using all organic wastes such as animal wastes, human wastes and agricultural wastes has made significant progress. Use of these wastes for producing biogas would also yield good quality manure (Mahajan, 1987). A wide variety of terrestrial and aquatic plants is recently being studied for their potential in biogas production. Among the aquatic plants, water hyacinth, algae, salvinia (African payal), duck weed, water lettice etc. have shown great potential for biogas production (Anon, 1985b). In India biogas production from aquatic weeds like salvinia and water hyacinth has been tried mainly only in a few laboratories. Therefore, the present investigations were undertaken to understand the feasibility of utilisation of *Salvinia molesta* for the biogas production using modified version of constant pressure type biogas plant.

Materials and Methods

A constant pressure type pilot biogas plant was fabricated with the easily available local materials. An oil drum having 250 litres capacity (0.6m diameter and 0.9 m height) was used as the digester and almost the full volume was used to accommodate the feeding material. Fresh drip dry salvinia was sun dried for two days so that its weight was reduced to about five per cent with 4.51 per cent total solids, still retaining its green colour. Since the volume size was also greatly reduced the size of the digester could also be reduced. For gas holder, a drum having 0.56 m diameter and 0.6 m height was fabricated with 16 g MS sheet. The gas holding capacity was about 120 litres. This gas holder was made to float inside the digester by using pully and dead weight arrangements. Due to this arrangement, the self weight of the gas holder did not any way affect the gas production. Moreover, when the dead weight was removed, the self weight of the drum helped for taking out the gas through the outlet pipe by giving a pressure on the gas. The iron rods and weld meshes provided inside the floating drum helped in the agitation of the weed water mixture rotating the gas holder drum manually. This arrangement of rods and weld mesh also prevented the weed from floating. In order to take out the gas, a 15 mm diameter GI pipe was welded inside the digester with suitable length and a valve was provided at the outer projected end. This pipe also served as a guide for the gas holder to prevent it from titling. For this, a MS rod was welded inside the gas holder which moved inside this guide pipe.

The design of the plant was based on the anaerobic digestion of waste material to generate the gas that contains 50-70 per cent methane. The time and degree of digestion and gas generation depend on many physicaj, chemical, biological and environmental factors like ambient temperature, loading, retention time, stirring etc. (Khandelwal, 1977). Hence the dimensions of the gas holder and the feeding quantity of the material were based on the data on various design and performance of other prevailing dung gas plants.

The outside portion of the plant was completely painted with black board paint so that maximum solar energy was absorbed. This helped in avoiding the chances of reflecting traces of solar energy by enamai paint. A gas flowmeter with high density polythene pipe connection was used to measure the quantity of gas generated. The maximum ambient temperature and the temperature on the top of the gas holder were noted. The period of gas generation was also noted owing to the fact that the biological activities of the bacteria and hence the gas generation are highly sensitive to temperature fluctuations and seasonal variations. The schematic diagram of the specially fabricated pilot plant is shown in Fig. 1.

Sun-dried salvinia was mixed with fresh cowdung in the ratio (weight) 1:0 2:1, 1:1, 1:2 and 0:1 and loaded separately into the fermentation tank of the plant and corresponding readings of gas production were noted at 5 pm. In order to speed up the initial decomposition, cattle dung was added as starter with all the mixtures.

Results and Discussion

The gas production was minimum when salvinia alone was used (Table 1). This is 15 l/kg of sun dried salvinia or 336 l/kg of over dried weed. This result is very much comparable with the reported value of 325 litres of biogas per kg of dry water hyacinth (Sharma and Panwar, 1985). The gas production could even be made 100 per cent more when a mixture of sun dried salvinia and fresh cattle dung was used as the.feed material in the ratio 1:1. But with the use of more cowdung in the mixture, i. e., two portion cowdung and one portion salvinia, the increase in gas production was not significant. Hence the ratio 1:1 may be taken as optimum for the mixture. The comparative gas productions for all samples are shown in Fig. 2.

When cowdung alone was used as the feeding material, the gas production was 2421 litres within 50 days and the weight of cowdung used was 75 kg. This gives a result of 31.85 litres of gas per kg of fresh cowdung used. This is comparable with the reported value of 25 to 43 litres of biogas per kg of fresh cowdung (Anon, 1985a) and also comparable with the reported standard results (Anon,1986). When the salvina weed was added to the cowdung, the gas generation was reduced, but the reduction was very small, oniy 10 percent when 1:1 ratio mixture was used. The advantage of using the mixture is that the use of cowdung for biogas production could be reduced. The initial gas production from salvina and

Table 1

Pattern of weekly cumulative gas production of salvinia and cowdung mixed in different proportions

Week	Sundried salvinia only: Total gas (l/kg)	MAT (°C)	MTCT (°C)	MxDG (l/kg)	MiDG (l/kg)	Salvinia : Cowdung = 2:1: Total gas (l/kg)	MAT (°C)	MTCT (°C)	MxDG (l/kg)	MiDG (l/kg)	Salvinia : Dung = 1:1: Total gas (l/kg)	MAT (°C)	MTCT (°C)	MxDG (l/kg)	MiDG (l/kg)
1	26	35	48	12	0	38	35	45	16	0	51	36	49	24	0
2	132	35	49	22	15	134	34	43	22	16	209	36	48	37	25
3	177	32	40	27	23	252	35	47	51	24	381	38	50	64	43
4	235	35	52	36	28	401	35	45	49	54	479	36	49	70	66
5	225	36	47	35	29	352	36	47	54	45	450	35	48	67	61
6	172	34	51	28	21	301	36	41	45	40	346	38	52	58	43
7	151	35	45	21	16	220	36	40	37	18	250	36	50	41	25
Total	1118					1704					2166				
Period	14-11-86 to 2-1-87					14-1-87 to 4-3-87					11-3-87 to 29-4-87				

Week	Salvinia : Dung = 1.2: Total gas (l/kg)	MAT (°C)	MTCT (°C)	MxDG (l/kg)	MiDG (l/kg)	Fresh cowdung only: Total gas (l/kg)	MAT (°C)	MTCT (°C)	MxDG (l/kg)	MiDG (l/kg)
1	50	36	49	24	0	59	30	45	28	0
2	267	37	50	52	24	300	30	45	54	34
3	450	36	48	71	57	480	32	48	77	48
4	505	36	49	74	70	534	32	48	78	72
5	415	35	49	70	53	461	33	48	70	60
6	331	32	46	50	44	352	31	45	56	43
7	222*	30	45	40	24	235	31	45	40	19
Total	2240					2421				
Period	1-5-87 to 20-6-87					22-9-86 to 10-11-86				

MAT = Maximum atmospheric temperature,
MTCT = Maximum top cover temperature
MxDG = Maximum daily gas,
MiDG = Minimum daily gas
* Rainy week

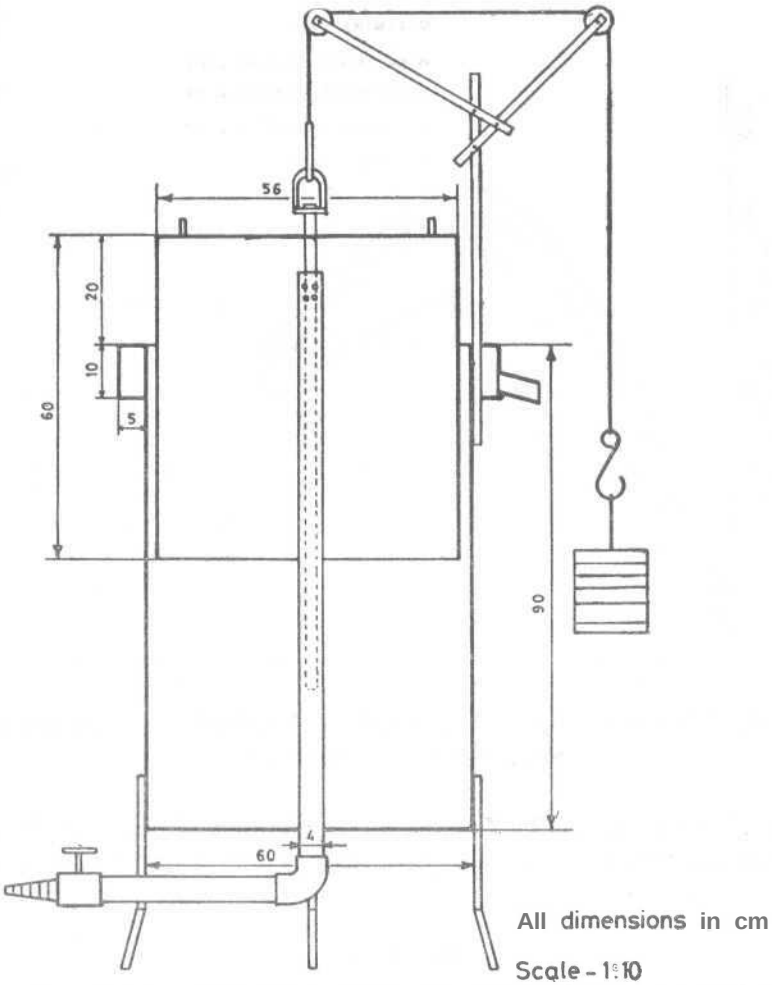

Fig. 1 Pilot salvinia biogas plant

mixture having high per centage of salvinia was slow when compared to the initial gas production of cowdung and mixture having high per centage of cowdung. This is probably because of the slow fermentation process during the initial period. The gas production towards the last days of the retention time was improved by adding salvinia with cowdung. It was also observed that the gas production was comparatively reduced during the rainy days even with the normal maximum atmospherictemperature.

This research work confirms that mixing of cattle dung with salvinia weed in the appropriate proportion, preferably in the ratio 1:1 can help in the production of biogas with less quantity of cowdung. Thus we can make up, to some extent

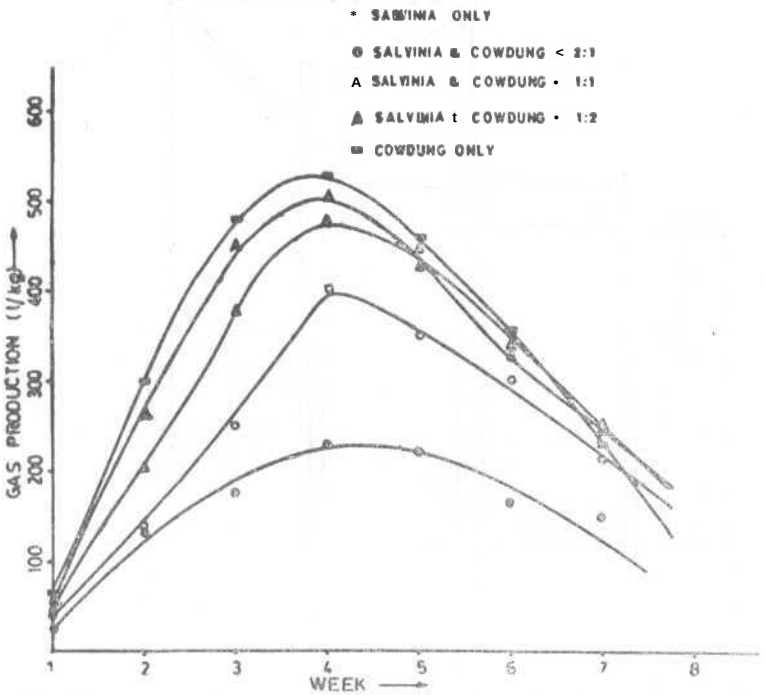

Fig. 2 Weekly cumulative gas production of salvinia and cowdung mixed with different proportions

the shortage of cattle dung. The farmers falling shortage of cattle heads can make use of agricultural wastes and even plant wastes like salvinia weeds for biogas production.

Summary

The floating aquatic weed, *Salvinia molesta* (locally known as 'African payal') could be easily fermented and hence is a very good material for biogas production. The average gas production per kg of oven dried salvinia weed was 336 litres with a retention time of 50 days. The gas generation could be doubled when mixed with fresh cowdung in the ratio 1:1. Thus we can make up the shortage of cowdung with the use of salvinia weed for biogas production, wherever it is available.

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