https://doi.org/10.29321/MAJ.10.A02799

Madras agric. J. **67** (1) : 39 – 41, Jan. 1980

Microbiological Changes Accompanying Degradation of Water Hyacinth in an Anaerobic Digester

P. RAJASEKARAN[1]

It is well known that certain aquatic plants like *Eichhornia crassipes* (Water hyacinth), *Ipomoea repens*, *Salvinia biloba* and *S. auriculata* (the floating ferns) and certain other grasses that grow in waste water have not only the ability to proliferate profusely in a short period but also the capacity to absorb considerable amounts of nutrients. The chopped materials, if properly blended with cow-dung and allowed to ferment anaerobically, could generate methane rich biogas for cooking, lighting and other purposes (Singh, 1978). Since water hyacinth is very rich in protein and nutrients, it has considerable promise in the area of biogas production. It is of interest to study the distribution of various microbial populations in an anaerobic digester incorporated with this weed along with cowdung and old slurry in relation to biogas generation. Hence this experiment was carried out to study the role played by microorganisms in the bioconversion of digestive waste materials.

MATERIAL AND METHODS

The experiment was carried out in 5 litre capacity tin digestors with arrangement for measuring the gas output at 24 hours intervals. The composite slurry samples from the anaerobic digestors were collected in 250 ml capacity sterile, wide-mouthed, ground-in stoppered glass containers for carrying out the microbiological examination. The various microbial populations were estimated following the serial dilution technique (Rajasekaran and Lakshmanan, 1978). The coliforms and focal streptococci were enumerated by the multi-tube dilution technique as discribed in Standard Methods (Anon, 1965). The methanogenic bacteria were enumerated by employing a suitable medium that favoured the growth of these organisms with a mixture of 80% H_2 and 20% CO_2 (Balch and Wolfe, 1976). The slurry samples after biodigestion over a period of 8 weeks were collected and analysed for its N, P and K contents as per standard methods (Anon., 1965).

RESULTS AND DISCUSSION

The discussion of various organisms in the slurry samples collected and examined from the water hyacinth incorporated treatments at different proportions contained in the anaerobic digestors are presented in Table I. The relative volume of gas generated in the various digestors incorporated with varing quantities of water hyacinth is given in Table II. The manurial value of the slurry digested along with water hyacinth is presented in Table III.

1 Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore-641 003.

TABLE I Distribution of Microbial poulation in the cow-dung slurry treated with water-hyacinth (*Eichhornia grassipes* (Mart) Solms)
(Expressed per g on over dry basis)

S. No.	Combination of cow-dung : old slurry : water hyacinth (V/V)	Bacteria ($\times 10^6$)	Fungi ($\times 10^3$)	Actinomycetes ($\times 10^3$)	cellulclytic organisms ($\times 10^3$)	Methanogenic bacteria ($\times 10^4$)	Coliforms ($\times 10^3$/ 100 ml)	Faecal streptococci ($\times 10^2$/ 100 ml)
1.	1 : 1 : 1	1.0	0.5	0.5	375	—	1100	15
2.	1 : 1 : 0	2.5	1.0	2.5	205	—	460	11
3.	1½ : 1 : ½	1.5	15.0	10.0	68	2.0	1100	15
4.	1½ : 1 : 0	0.5	5.0	5.0	52	3.5	180	15
5.	2 : ½ : ½	10.5	0.5	6.0	105	18.5	460	11
6.	2 : ½ : 0	2.0	1.0	1.5	65	5.90	1100	15

TABLE II Gas production at different proportions of cow-dung, old slurry and water hyacinth

S. No.	Combination of cowdung: old slurry water hyacinth	Average gas production in cc/day						Overall average gas production in cc/day
		I week	II week	III week	IV week	V week	VI week	
1.	1 : 1 : 1	1578.57	1164.28	2100.00	1385.71	700.00	657.14	1264.28
2.	1 : 1 : 0	300.00	583.33	933.33	857.14	700.00	600.00	668.30
3.	1½ : 1 : ½	1700.00	1192.85	1600.00	1300.00	700.00	421.43	1152.38
4.	1½ : 1 : 0	1071.42	1150.00	1350.00	1228.57	700.00	700.00	1033.33
5.	2 : ½ : ½	900.00	1300.00	1700.00	1200.00	1350.00	1326.00	1296.00
6.	2 : ½ : 0	1507.14	1250.00	1800.00	1200.00	700.00	571.00	1171.36

TABLE III Manurial value of the digested slurry in the water hyacinth incorporated treatment

S. No.	Treatment * CD : OS : WH	N	Percentage increase over control	P_2O_5	Percentage increase overcontrol	K_2O	Percentage increase over
1.	1 : 1 : 0	1.8	—	0.50	—	0.52	—
2.	1 : 1 : 1	1.23	4.23	0.61	22.00	0.59	13.46
3.	1½ : 1 : 0	1.09	—	0.58	—	0.54	—
4.	1½ : 1 : ½	1.30	19.27	0.62	6.70	0.51	5.56
5.	2 : ½ : 0	1.18	—	0.61	—	0.55	—
6.	2 : ½ : ½	1.31	11.02	0.64	4.92	0.57	3.64

* CD = Cow-dung OS = Old slurry WH = Water hyacinth (chopped)

The total bacterial populatoin varied with the different treatments, the maximum recorded being 10 5 ($x10^6/g$) in the digestor with cow-dung and old slurry mixed (V/V) with water hyacinth in the proportion of 2:½:½. The maximum cellulolytic population was recorded in yet another digester 275 ($x10^3/g$) wherein the mixing of cow-dung : old slurry : chopped water hyacinth was in the proportion of 1 : 1 : 1 by volume. However, the methanogenic bacteria prevailed to a maximum extent viz. 18 5 ($x10^4/g$) in the treatment where the bacterial population was recorded maximum. (Variations were observed with regard to the fungal, coliform and feacal streptococcai populations). It is in this digestor, the maximum gas generation of 1296°C was recorded, thus indicating a positive correlation with the bacterial populations. The use of water hyacinth as an additive to enhance biogas generation has also been indicated by Deshpande *et al.* (1979). It has also been estimated that on an average, the water hyacinth harvested annually from one acre of pond could generate 2 million cubic feet (cft) of gas (Anon., 1978). In addition, the residue obtained from such a biogas digestor can provide organic matter rich in N, P and K to be used as an efficient organic manure. The manurial content (N, P_2O_5 and K_2O) of the water hyacinth incorporated digested slurry was found maximum in the treatment containing cowdung : old slurry : water hyacinth in the proportion of 2:½:½ when the maximum quantity of gas generation was also recorded. Proper utilization of the aquatic weed for both fuel and organic manure production through biofermentation appears to open up new possibilities of its management in avoiding secondary pollutional effects from the dead and decaying plants.

REFERENCES

ANONYMOUS, 1965. Standard Methods, 12th Edition, APHA Inc., New York.

ANONYMOUS. 1978. Newsletter — Biogas... Nepal, 1, p. 5.

BALCH E. W. and R. S. WOLFE 1976. New approach to the cultivation of methanogenic bacteria : 2 - Mercaptoethanesulphonic acid (HS-CoM)—Dependant growth of *Methanobacterium ruminantium* in a Pressurized atmosphere. Appl. Environ. Microbio. 32 : 781-91.

RAJASEKARAN, P. and M. LAKSHMANAN. 1976. Studies on the distribution of micro-organisms in some soil types of Tamil Nadu. Biology 1 : 9-12.

SINGH, R. A. 1978. Imported Weeds : The water hyacith. Kisan World. 5 : 36-6.