Pathogenicity test was carried out by inoculating the fruit by Granger and Horne[1] method. To provide the maximum humidity, a pad of sterilized cotton was put on inoculated region (26). After 4–5 days typical symptoms were observed and reisolations proved the same pathogen.

The culture has been deposited in Commonwealth Mycological Institute, Kew-Surrey, England, (I.M.I. 234471).

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GROWTH POTENTIAL OF *SPIRULINA PLATENSIS* IN ANIMAL WASTES

COWDUNG gas plant is a one-step recycling system in which the dung is fermented to produce combustible fuel (methane) and the resultant slurry is of good manurial value. In an integrated system as suggested in Fig. 1, part of this slurry can be further recycled by interpolating algal biomass and fish production.

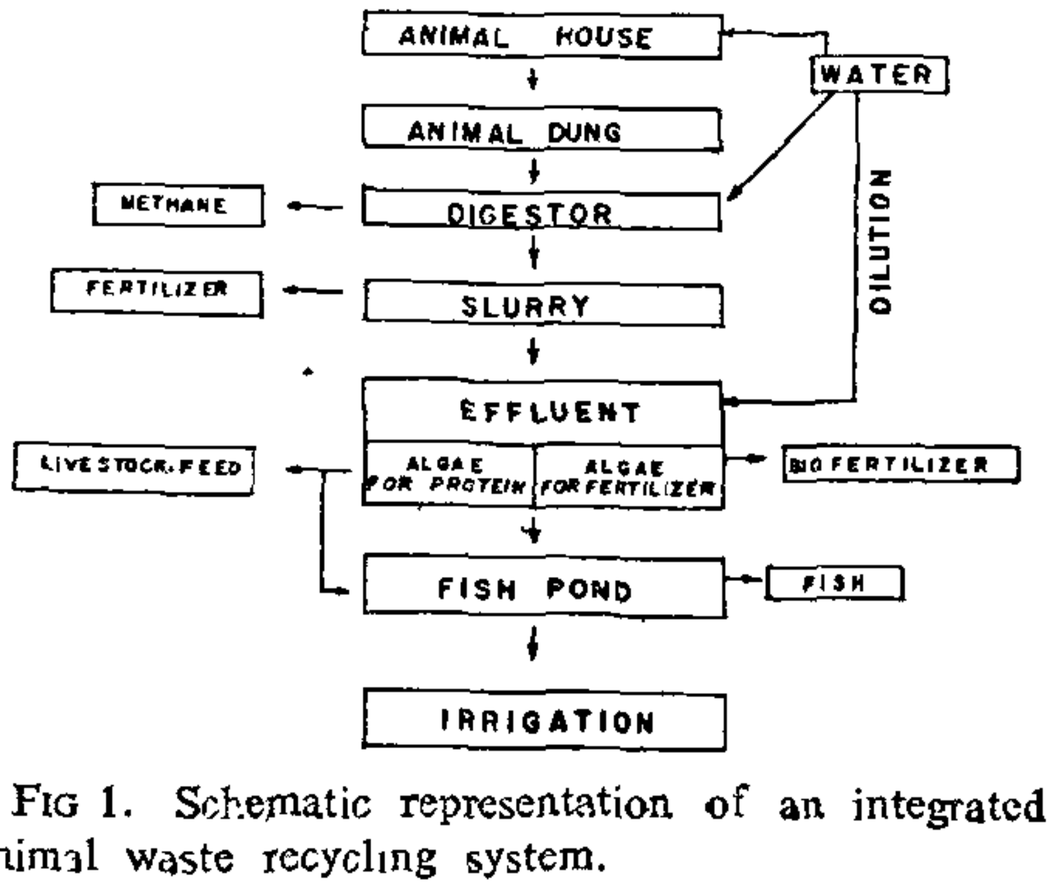

FIG 1. Schematic representation of an integrated animal waste recycling system.

The present report deals with the growth potential of the protein rich blue-green alga *Spirulina platensis* in the diluted slurry effluent from the cowdung gas plant and also in cattle urine. *S. platensis* contains 60–65% protein and all essential amino acids and vitamins with BV, TD, NPU and PER values of 68, 75, 52 and 2·07 respectively (*unpublished*). This alga has a safe history of usage and the biomass is amenable to simple cloth filtration.

Digested slurry effluent from a cowdung gas plant was filtered through cotton pads to remove the coarse suspended solids. It was diluted to 1, 2, 3, 5, 7 and 10% levels with water. Cattle urine was also similarly filtered and diluted. One set of flasks at each concentration level was supplemented with 18 g $NaHCO_3$/l. One ml suspension from an actively growing culture of *S. platensis* was inoculated into 50 ml medium contained in 250 ml flasks and the cultures were aerated at 32 ± 1° C for 10 days at 4,200 lumens/m². Growth was measured in terms of dry weight, after making necessary corrections for the blanks. All the cultures were unsterile.

TABLE I

Growth potential of Spirulina platensis *in the slurry effluent with and without added bicarbonate* (18 g/l)

Conc. slurry effluent	pH	Solids (g/l)	Nitrogen (mg/l)	Dry wt. alga (g/l)
1%	8·7	0·0684	25	0·23
1% + $NaHCO_3$	9·2			0·63
2%	8·7	0·1368	50	0·27
2% + $NaHCO_3$	9·3			0·74
3%	8·7	0·2052	75	0·33
3% + $NaHCO_3$	9·1			0·87
5%	8·7	0·3420	125	0·32
5% + $NaHCO_3$	9·1			1·08
7%	8·7	0·4788	175	0·38
7% + $NaHCO_3$	9·2			0·84
10%	9·7	0·6840	250	0·37
10% + $NaHCO_3$	9·1			0·94
Control	9·2		400	0·90

Tables I and II summarize the growth potential of the alga in the slurry effluent and cattle urine. The slurry effluent supported the algal growth at all dilutions even in the absence of any added bicarbonate, although bicarbonate addition stimulated the growth to the extent of that in the synthetic inorganic nutrient medium (control) (Table I). The reduction in the growth at higher concentration levels may possibly be due to the limitation in light penetration. Growth of *Chlorella*, *Scenedesmus* and *Euglena* has been observed to be supported by hog manure (3 g dry wt./l) and an yield of 3·2 g/l reported for *Chlorella*[1] is ten times more than any known record. Tchan and Webster[2] have advocated the use of a continuous

treatment of animal wastes with photosynthetic bacteria to reduce the B.O.D. The outflow after adjusting the pH encourages the growth of *Euglena*. The algal cells together with the bacteria constitute a high grade protein.

TABLE II

Growth potential of Spirulina platensis *in cattle urine with and without added bicarbonate* (18 *g/l*)

Conc. urine	pH	Dry wt. alga (g/l)
1%	7·90	..
1% + $NaHCO_3$	8·80	1·33
3%	8·6	..
3% + $NaHCO_3$	8·80	0·88
5%	8·7	..
5% + $NaHCO_3$	8·80	..
7%	8·80	..
7% + $NaHCO_3$	8·80	..
Control	9·2	0·91

Unlike the slurry effluent, cattle urine failed to support the growth of the alga in the absence of bicarbonate (Table II), presumably because of the absence of available carbon source. Supplementation of cattle urine with bicarbonate supported the algal growth upto a level of 3% urine, beyond which urine *per se* was inhibitory. Microscopic examination revealed heavy cell damange at higher concentration levels of urine. This may possibly be due to an increase in the internal pH of the cells due to the penetration of undissociated ammonium hydroxide molecules resulting in the precipitation of the intracellular proteins[3] or volatilization of ammonia at high pH resulting in contact injury to the cells. Parallel sets of experiments with ammonium chloride and urea also showed such cell damage. Urea is known to be utilized by a wide range of algae as a source of nitrogen through urease or through urea : ATP amido lyase[4]. The mechanism of urea utilization by *S. platensis* is not known and deserves further investigation.

Table III suggests that the contribution of urine at 1% level is only towards nitrogen and there was no growth either in urine or $NaNO_3$ or $NaHCO_3$ alone.

TABLE III

Growth of Spirulina platensis *in cattle urine supplemented with* $NaHCO_3$ (18 *g/l*) *and* $NaNO_3$ (2·5 *g/l*)

Treatment	Dry wt. alga (g/l)
1% urine	..
$NaHCO_3$	..
$NaNO_3$	..
Urine + $NaNO_3$	..
Urine + $NaHCO_3$	1·07
$NaHCO_3$ + $NaNO_3$	1·12
Urine + $NaHCO_3$ + $NaNO_3$	1·31

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OCCURRENCE OF PALYNOFOSSILS FROM THE PINJOR FORMATION (UPPER SIWALIK) EXPOSED NEAR CHANDIGARH

THE Siwalik Group, bordering the northern limit of Indo-Gangetic Plain and extending from Potwar Plateau in the west to Burma in the east, constitutes a very important and interesting stratigraphic unit. Very little work on the palynology of this group has so far been done[1-5]. Nandi[6] and Ghosh[2], for the first time, attempted a palynostratigraphic zonation of the Siwalik Group exposed in the Jawalamukhi Unit of Punjab. A perusal of the published literature on the Siwalik palynology reveals that these studies have mainly been restricted only to the Lower and Middle Siwaliks. A systematic description of the Upper Siwalik palynoflora has, however, not been published though Nandi[6] and Ghosh[2] mentioned names of a few palynotaxa occurring in Upper Siwalik. These are: *Cyathidites, Alsophilidites, Leptolepidites, Pinuspolle-*