stimulates secretion of triglycerides from liver to serum and also helps to lower their level in the latter as observed from our recent studies in rats fed with 30% fat diets[15]. The triggering of liver triglyceride secretion is perhaps the first step in the enhancement of lipid metabolism by capsaicin/red pepper observed by us and the Japanese workers[3,6,9,15]. The mechanism by which this process is stimulated is of interest and is engaging our attention at present.

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A NOVEL, MICROBIAL METHOD FOR AUGMENTATION OF BIOGAS

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ATTEMPTS are being made all over the world to increase the calorific value of biogas evolved during anaerobic digestion, which normally contains three volumes of methane (CH_4) and two volumes of CO_2. If this proportion can be changed to four volumes of CH_4 and one volume of CO_2, then the evolved gas-mixture may be used for industrial purposes. In this laboratory, attempts were made earlier to enhance the content of methane, which we term 'augmentation of biogas', by microbial means. A digestor dome was designed[1-3] which would allow penetration of light to promote the growth of phototrophic bacteria (PTB) which could help the digestion process[4,5]. In the present work, we describe a novel method of increasing the methane content by introducing a strain of phototrophic bacterium, *Rhodospirillum rubrum* ATCC 11170 into the anaerobic digestion system, along with the heterotrophic bacteria natural to cowdung.

Cultures used in this study were maintained as follows: *R. rubrum* (ATCC 11170) was maintained anaerobically on a medium described by Ormerod *et al*[6] and under illumination. Subcultures were made every fourth day at 10% strength.

Heterotrophic bacteria (derived from cowdung) were maintained on sterile cowdung and subcultured every tenth day at 10% strength.

Fresh cowdung, mixed with water in the proportion 1:1.2 (w/v), was sterilized by autoclaving and used as substrate. Sterile 5 l aspirator bottles fitted with glass stoppers were used as reaction vessels. Both *R. rubrum* and the heterotrophic bacteria were inoculated at 1% level into the vessels. Vessels inoculated only with heterotrophic bacteria served as controls (C). Those vessels inoculated both with the heterotrophic bacteria and *R. rubrum* served as tests (T). Evolved gases were collected in football bladders and the volume was measured by downward displacement of water held in a 1000 ml graduated cylinder. All reactors were run as batches, each run lasting for 30 days.

Both sets of vessels were maintained in natural solar radiation of illumination level of 2000 lux (averaged over an 8 hr period from 8 a.m. to 4 p.m.) and at the ambient (temperatures max: 38°C; min: 29°C).

Table 1 *Analysis of the quality of biogas*

Period of analysis (days)	Percentage (v/v) fractions			
	C		T	
	CH_4	CO_2	CH_4	CO_2
0–9	42.1	56.9	42.0	57.1
10–15	51.0	48.7	65.0	34.6
16–25	62.3	37.1	82.7	17.0
26–30	58.5	41.0	67.0	32.3

a) H_2S, present in trace quantities, could not be quantified;
b) Percentages do not total 100 because of the presence of H_2S, moisture and other minor components.
C: Inoculated with heterotrophic bacteria (control)
T: Inoculated with heterotrophic bacteria and *R. rubrum*.

Evolved gases were analysed daily on a gas chromatograph ["Chemito 3800" thermal conductivity detector; Porapak Q column; argon carrier (30 ml/min); temperatures: injector: 50°C; oven: 40°C; detector: 150°C].

Results relating to analysis of evolved gases in terms of the CH_4 and CO_2 fractions are presented in table 1 (these results are the averages of three runs with duplicates each time.) The table shows that methane-content from T was enhanced and was over 82% by volume of the gas evolved, whereas this in the case of gas evolved from 'C' (as well as that of gas from the semi-continuous 3 cubic-meter biogas plant[3] which was analysed at the same time) was about 60% by volume (latter results not shown). Another significant observation is that the augmented biogas evolution was not a transient but sustained occurrence, lasting for nearly 15 days. Further, the net quantity of methane evolved was larger in tests (109 l) than in controls (85 l) during the entire period of each run.

Similar results were obtained in an earlier study[7] where *Rhodospirillum sp.*, isolated from the shoot apex of water hyacinth[8] was used in place of *R. rubrum* ATCC 11170. In comprehending the precise role of PTB in bringing about augmentation of biogas as described above, three possible hypotheses are suggested. One of them relates to the microaerophilic nature of PTB[9], which may help provide a more anaerobic system of digestion for the methanogenic bacteria. Another stems from one of our recent observations (not reported here) that *R. rubrum*, when grown as an illuminated, anaerobic culture with cellulose as carbon-source, produces acetic and propionic acids, which are known to be precursors in the process of CH_4 generation[10]. The third one is about the possible role of molecular hydrogen[11] also produced by *R. rubrum* when grown on select organic waste[12]. Current studies in this laboratory are aimed at verification of these hypotheses above.

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