International Journal of ChemTech Research
CODEN (USA): IJCRGG ISSN: 0974-4290
Vol.8, No.3, pp 1365-1368, 2015

Biohydrogen Production by Photosynthetic Bacteria Isolated from Oil Contaminated Soils of Delhi, India

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Abstract: A consortium of phototrophic bacteria isolated from oil contaminated site in Delhi was studied for their ability to produce hydrogen. The influence on the production of hydrogen by various carbon, nitrogen sources and growth factors by the bacteria was investigated. Production of hydrogen produced varied with different carbon, nitrogen and growth factors used in the medium. Benzoate followed by galactose and arabinose were good carbon sources for production of hydrogen. Tryptophan induced less amounts of hydrogen when compared to other nitrogen sources used. B12 induced more amounts of hydrogen followed by riboflavin and biotin compared to other growth factors.
Keywords: Hydrogen production, bacteria, carbon sources, nitrogen sources.

Introduction

Carbon emissions are leading to climate change due to greenhouse effect and there is a urgent need for fuel sources which do not result in such emissions The energy needs of the present day are increasing day by day and the present fuel sources may dry sooner or later. In this scenario, researchers are investigating the use of solar energy, bioenergy, wind energy and thermal energy as they are more sustainable and ecofriendly. Hydrogen is being considered as the fuel of the future when compared to most other fuels. Hydrogen can be produced by chemical or biological processes. In comparison to chemical methods of hydrogen production, biological production is sustainable and in long term can reduce green house emissions although it is less economical. Hence, biological hydrogen production is being investigated to make the process more efficient and economical. Phototrophic bacterial produce higher amounts of hydrogen compared to other groups of bacteria and have high conversion efficiency of substrates to hydrogen [1]. Different researchers [2-12] are investigating the potential of these bacteria to produce hydrogen, the effect of optimization of substrate sources on hydrogen production are also reported [13, 14, 15, 16]. Improvements in the existing methods have been suggested by investigators [17-18]. Compared to biofuel production from crops, photobiological hydrogen production is high [19]. In continuation of our earlier work on phototrophic bacteria [20-36], hydrogen production by photosynthetic bacterial consortium isolated from oil contaminated soils of Karolbagh, New Delhi, India under different cultural conditions was investigated.

Materials and Methods

Photosynthetic bacteria were isolated from oil contaminated soil of Karolbagh, Delhi by inoculating into Beibl and Pfennigs medium anaerobically in the light (2000 lux). Keys provided in Bergey's Manual of Systematic Bacteriology (1994) [34] were adopted for identification of phototrophic bacteria. Hydrogen estimation was done as per the earlier methods of Merugu *et al* [35].

Results and Discussion

Hydrogen production by Log phase cultures (Ten day old) were used to for estimating hydrogen. Photosynthetic bacterial consortium produced varying amounts of hydrogen using different cultural conditions under anaerobic light. pH of 7.0 to 7.5 was amenable for the production of hydrogen. A highest amount of hydrogen was about 6.0 ml/30ml vessel (Table 1). Benzoate followed by galactose and arabinose were good carbon sources for production of hydrogen. Galactose and arabinose induced almost equal amounts of hydrogen. Maximum production 6.0 ml per 30ml of Biebl and Pfennigs Media of hydrogen was produced in presence of benzoate (Table 2). Effect of different nitrogen sources on hydrogen production are listed in Table 3. In nitrogen sources Histidine followed by alanine and threonine induced 5.5 ml per 30 ml of Biebl and Pfennigs Media. Tryptophan induced less amounts of hydrogen when compared to other nitrogen sources used. Amount of hydrogen produced was comparatively low in the presence of different nitrogen sources. Influence of different growth factors on hydrogen production is presented in Table 4. Among the growth factors B12 induced more amounts of hydrogen followed by riboflavin and biotin compared to other growth factors.

Table 1: Effect of pH on the production of hydrogen by bacterial consortium (ml/30ml medium)

pH	O.D VALUES	BIO HYDROGEN PRODUCTION
6.5	0.6697	4.0±0.65
7.0	0.7441	6.0±0.85
7.5	1.0926	6.0±0.90
8.0	0.9537	5.5±0.75
8.5	1.5298	5.0±0.90
9.0	1.4367	4.5±0.60
9.5	1.4563	4.5±0.40

Table 2: Effect of carbon sources on the production of hydrogen by bacterial consortium (ml/30ml medium)

Carbon sources	O.D VALUES	BIO HYDROGEN PRODUCTION
Sodium Benzoate	0.87	6.0±0.60
Glucose	0.4729	4.5±0.50
Galactose	0.7323	5.5±0.60
Mannose	0.5753	4.5±0.55
Arabinose	0.7761	5.5±0.40
Lactose	0.5495	4.0±0.65
Mannitol	0.3832	4.5±0.75
Malic acid	0.2063	4.0±0.55
Citric acid	0.5567	4.5±0.40
Sodium succinate	0.3128	4.0±0.50

Table 3: Effect of nitrogen sources on the production of hydrogen by bacterial consortium (ml/30ml medium)

Nitrogen sources	O.D VALUES	BIO HYDROGEN PRODUCTION
Ammonium chloride	0.5882	4.5±0.45
Glycine	0.5495	4.5±0.60
Sodium glutamate	0.5562	4.5±0.75
Histidine	0.6271	5.5±0.80
Tryptophan	0.6487	4.0±0.55
Tyrosine	0.6502	4.5±0.60
Threonine	0.6533	5.0±0.45
Alanine	0.6879	5.0±0.55

Table 4: Effect of growth factors on the production of hydrogen by bacterial consortium (ml/30ml medium)

GROWTH FACTORS	O.D VALUES	BIO HYDROGEN PRODUCTION
Pantothenic acid	0.7428	5.0±0.90
Nicotinic acid	0.8394	5.0±0.75
Biotin	1.1458	5.5±0.60
Folic acid	1.2954	4.0±0.75
Riboflavin	0.8855	5.5±0.80
B12	0.6334	6.0±0.40

Acknowledgement:

Authors thank the Department of Biotechnology (DBT, MRP-BT/PR4819/PBD/26/289/2012), Ministry of Science and Technology, India for funding this work.

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