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Biohydrogen Production by Photosytnhetic Bacteria Isolated from Oil Contaminated Soil of Nacharam, Hyderabad, India

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Abstract: In the present study, influence of pH, carbon, nitrogen sources and growth factors on the production of hydrogen phototrophic bacteria isolated from Nacharam, Industrial area, Hyderabad, Telangana, South India was investigated. The amount of hydrogen produced varied with different cultural conditions used in the medium. Nitrogen sources were less amenable than carbon sources for production of hydrogen. Photosynthetic bacteria produced maximum amount (6.0 ml/30ml vessel) of hydrogen under anaerobic light in the presence of the carbon source galactose and lactose.
Keywords: Hydrogen production, Photosynthetic bacteria, carbon sources, nitrogen sources

Introduction

Depletion of fossil fuels has led us to investigate into the use of renewable energy sources as primary sources of energy. Global utilization of non renewable energy sources results in environmental pollution. In the present scenario, hydrogen appears to be the source of Energy which can reduce the risks of green house gases. Hence, there is an urgent need for implemention of Hydrogen Economy. Phototrophic bacterial hydrogen production is higher when compared to hydrogen production by other hydrogen producing bacteria. Higher conversion efficiency of substrates to hydrogen is more in photosynthetic bacteria when compared to other groups of bacteria [1]. A lot of research in this area has been reported world wide [2-12]. The various Factors influencing hydrogen were optimized by investigators for enhancing hydrogen production [13-16]. Studies on phototrophic bacteria for their biotechnological applications have been reported by our group in previous studies [20-36]. In the present study, photosynthetic bacterial consortium isolated from Nacharam, Industrial area, Hyderabad, Telangana, South India was investigated for its hydrogen production potential under different cultural conditions and the results are communicated.

Materials and Methods

Bergey's Manual of Systematic Bacteriology (1994) [37] was adopted for identification. Phototrophic bacteria were isolated from the oil contained source in Nacharam industrial area, Hyderabad by inoculating into the medium anaerobically in the light of intensity of 2000 lux. Growth was determined by optical density (at 660 nm) using UV-Vis spectrophotometer. Bacterial culture was centrifuged at 10,000xg for 10 min and the harvested cells were suspended in the basal medium devoid of electron donors, nitrogen sources and growth factors. They were added at required concentrations. Ten day old cultures of photosynthetic bacteria were inoculated (1% v/v) into basal medium containing seven carbon sources, eight nitrogen sources and some growth factors. The incubation period was 196 hrs after inoculation of the consortium. The technique used for hydrogen measurement was water displacement technique.

Results and Discussion

Water electrolysis for hydrogen production is being investigated widely. Alkaline, polymer membrane and ceramic oxide electrolyte are the three methods which are being explored for water electrolysis. Scaling up the process for larger production of hydrogen through water dissociation has not reached a stage where it is practically feasible. Hence, among the different approaches, photohydrogen production using bacteria has received much attention for larger scale production of hydrogen. Log phase cultures (Ten day old) of phototrophic bacteria were used to assess the potential of producing hydrogen. Photosynthetic bacterial consortium produced varying amounts of hydrogen using different cultural conditions under anaerobic light. In Table 1 the effect of pH on hydrogen production is presented showing pH 7.0 and 7.5 were amenable for the production of hydrogen. Lactose and galactose were good sources of carbon for production of hydrogen. Mannose and Arabinose induced almost equal amounts of hydrogen. Maximum production of 6.0 ml per 30ml of Biebl and Pfennigs Media of hydrogen was produced in presence of Lactose and galactose. Effect of different nitrogen sources on hydrogen production are listed in Table 3. In nitrogen sources ammonium chloride and threonine induced 6ml per 30 ml of Biebl and Pfennigs Media. Glutamic acid Histidine induced equal amounts of hydrogen when compared to other nitrogen sources used. Influence of different growth factors on hydrogen production is presented in Table 4. Among the growth factors B12, nicotinic acid and biotin induced more amounts of hydrogen compared to other growth factors. Pantothenic acid as a growth factor stimulated lower amounts of hydrogen compared to other growth factors.

Table 1: Effect of pH on production of hydrogen by phototrophic consortium

pH	Optical density	Hydrogen production (ml/30ml vessel)
6.5	0.9567	5.0±0.50
7.0	1.1126	6.0±0.35
7.5	1.3758	6.0±0.60
8.0	1.474	5.5±0.75
8.5	1.6311	4.5±0.55
9.0	1.8079	4.5±0.40
9.5	1.5897	4.5±0.25

Table 2: Effect of carbon sources on production of hydrogen by phototrophic consortium

Carbon sources	Optical density	Hydrogen production (ml/30ml vessel)
Sodium Benzoate	0.5925	4±0.25
Glucose	0.6301	4.5±0.35
Galactose	0.9676	6.0±0.75
Mannose	0.7251	5.5±0.55
Arabinose	0.7206	5.5±0.40
Lactose	0.9046	6.0±0.40
Mannitol	0.5647	4.5±0.30

Table 3: Effect of nitrogen sources on production of hydrogen by phototrophic consortium

Nitrogen Sources	Optical density	Hydrogen production (ml/30ml vessel)
Ammonium chloride	0.926	6.0±0.50
Ammonium nitrate	0.3814	4.0±0.65
Glycine	0.5859	4.0±0.40
Sodium glutamate	0.8139	5.5±0.35
Histidine	0.8830	5.5±0.50
Tryptophan	0.4761	4.0±0.20
Tyrosine	0.7714	5.0±0.30
Threonine	0.9129	6.0±0.35
Alanine	0.5869	4.0±0.40

Table 4: Effect of growth factors on production of hydrogen by phototrophic consortium

Growth Factors	Optical Density	Hydrogen Production (Ml/30ml Vessel)
Pantothenic acid	1.2293	4.0±0.20
Nicotinic acid	1.1775	5.5±0.40
Biotin	1.1527	5.5±0.45
Folic acid	1.0458	5.0±0.60
Riboflavin	1.1229	4.5±0.50
B12	1.1498	5.5±0.20

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References:

1. Harun Koku, Inci Ero,glu, Ufuk Gunduz, Meral Yucel, Lemi Turker, 2002. International Journal of Hydrogen Energy 27 (2002) 1315 – 1329.
2. Yongzhen Tao, Yang Chen, Yongquian Wu, Yanling He and Zhihua Zhou. International Journal of Hydrogen Energy, ISSN 0360 – 3199. 2007. vol 32, pp 200 -206.
3. Chun-Yen Chen, Mu-Hoe Yang, Kuei-Ling Yeh, Chien-Hung Liu, Jo-Shu Chang, Inte rnational Journal of Hydrogen energy 3 3 (2 0 0 8) 4 7 5 5 – 4 7 6 2.
4. Chun-Yen Chen, Chia-Hsien Liu, Yung-Chung Lo, Jo-Shu Chang. Bioresource Technology, 2011. Vol 102, issue 18 pp 8484–8492.
5. Gabrielyan,L., H. Torgomyan, A. Trchounian, International Journal of Hydrogen Energy 35 (2010) 12201 – 12207.
6. Obeid,J., J.-P. Magnin, J.-M. Flaus, O. Adrot, J. C. Willison, R. Zlatev, International Journal of Hydrogen Energy 34 (2009) 180 – 185.
7. Burgess,J.G., R. Kawaguchi, A. Yamada, T. Matsunaga, Microbiology, 140 (1994) 965–970.
8. Chen,C.Y., W.-B. Lu, J.-F. Wu, J.-S. Chang, International Journal of Hydrogen Energy 32 (2007) 940 – 949.
9. Azbar,N., F. C. Dokgoz, International Journal of Hydrogen Energy 35 (2010) 5028 – 5033.
10. Jamil,Z., M. S. M. Annuar, S. Ibrahim, S. Vikineswary, International Journal of Hydrogen Energy 34 (2009) 7502 – 7512.
11. Oh,Y.K., E.-H. Seol, M.-S.-S. Kim, S. Park, International Journal of Hydrogen Energy 29 (2004) 1115 – 1121.
12. Salih,F.M., M. I. Maleek, Journal of Environmental Protection 1 (2010), 426–430.
13. Koku,H., I. Eroglu, Ufuk Gunduz, Meral Yucel, Lemi Turker. International Journal of Hydrogen Energy 28 (2003) 381 – 388.
14. Zheng,G., L. Wang, Z. Kang, Renewable Energy 35 (2010) 2910 – 2913.
15. Hawkes,F.R., R. Dinsdale, D. L. Hawkes, I. Hussy, International Journal of Hydrogen Energy 27 (2002) 1339 – 1347.
16. Melnicki,M.R., E. Eroglu, A. Melis, International Journal of Hydrogen Energy 34 (2009) 6157 – 6170.
17. Tsygankov, A.A., 2004. Biohydrogen III. Renewable Energy System by Biological Solar Energy Conversion. Pages 57-71.
18. Melis,A, M. R. Melnicki, International Journal of Hydrogen Energy 31 (2006) 1563 – 1573.
19. McKinlay,J.B, C. S. Harwood, Current Opinion in Biotechnology 21 (2010) 244 – 251.
20. Ramchander, M., Pratap, M. P., Nageshwari, B., Girisham, S., and Reddy, S. M. (2012). Factors influencing the production of hydrogen by the hydrogen by the purple non-sulphur phototrophic bacterium *Rhodopseudomonas acidophila* KU001. *Microb. Biotechnol.*, 5: 674-678.
21. Ramchander Merugu , Vasantha Mittapelli , M.P. Pratap Rudra , S. Girisham , S.M. Reddy (2012) . Photoproduction of Hydrogen by Alginate Immobilized *Rhodobacter capsulatus* KU002 under Sulphate and Phosphate Limitations. International Journal of Environment and Bioenergy, 4(3): 141-146.

22. Ramchander Merugu, Vasantha Mittapelli, Pratap Rudra Manthur Padigya, Girisham Sivadevuni, Reddy Solipuram Madhusudhan (2013). Photoproduction of Hydrogen by Alginate Immobilised Cultures of *Rhodobacter capsulatus* KU002 Isolated from Tannery Effluents. Journal of Biofuels. 4 (2) : 56-60.
23. Ramchander Merugu, M. P. PratapRudra, B.Nageshwari, A. Sridhar Rao, and D.Ramesh. Photoproduction of Hydrogen under Different Cultural Conditions by Alginate Immobilized *Rhodopsedomonas palustris* KU003. ISRN Renewable Energy. Volume 2012, Article ID 757503, 5 pages doi:10.5402/2012/757503.
24. Ramchander Merugu, M.P.Pratap Rudra, S.Girisham and S.M.Reddy (2013). Bioproduction of hydrogen by alginate immobilized *Rhodopsedomonas acidophila* KU001. International Journal of Chemical Engineering and Applied Sciences 3(1): 7-9.
25. Ramchander, M., M.S.K.Prasad, Vasavi,D S. Girisham and S.M. Reddy (2007). Bioremediation of waste water by two Anoxygenic Phototrophic bacteria *Nat.Acad. Sci*. Lett.30:223-227.
26. Ramchander Merugu, M.S.K. Prasad, S. Girisham and S.M.Reddy (2008). Effect of trace elements on the growth of two Anoxygenic phototrophic bacteria *Ecol. Envi. Con.* 14*;* 367-369.
27. Ramchander Merugu, M. P. Pratap Rudra, A. Sridhar Rao, D. Ramesh, B. Nageshwari, K. Rajyalaxmi, S. Girisham, and S. M. Reddy (2011). Influence of Different Cultural Conditions on Photoproduction of Hydrogen by *Rhodopseudomonas palustris* KU003. *ISRN Renewable Energy* , 328984-90.
28. Ramchander Merugu, M.P.Pratap Rudra, Atthapu Thirupathaiah and Veerababu Nageti (2011). Hypocholesterolemic effect of the anoxygenic phototrophic bacterium *Rhopseudomonas palustris* MGU001 in hen laying eggs. International Journal of Applied Biology and Pharmaceutical Technology. 2 (2): 463 to 466.
29. Ramchander Merugu, M.P.Pratap Rudra, Atthapu Thirupathaiah, S.Girisham and S.M.Reddy (2011). Optimisation of Indole Acetic Acid Production by two Anoxygenic Phototrophic bacteria Isolated from Tannery effluents. Journal of pure and applied Microbiology. 5(2) : 34-37.
30. Ramchander Merugu, M.P.Pratap Rudra, Atthapu Thirupathaiah, S.Girisham and S.M.Reddy (2011). Chromate Reduction by a Purple non Sulphur Phototrophic Bacterium *Rhodobacter capsulatus* KU002 Isolated from Tannery Effluents. Journal of Pure and Applied Microbiology. 5(2): 66-69.
31. Ramchander Merugu, M.S.K. Prasad, S. Girisham and S.M. Reddy (2010). Bioproduction of hydrogen by *Rb.capsulatus* KU002 isolated from leather industry effluents. International Journal of Hydrogen energy, 35 (18) : 9591-9597.
32. Ramchander Merugu, M.S.K. Prasad, S. Girisham and S.M. Reddy (2008). Phosphate Solubilisation by Four Anoxygenic Phototrophic Bacteria Isolation from leather Industry. *Nat. Env. Pol. Tech.* 7; 597-599
33. Ramchander Merugu, M.S.K. Prasad, S. Girisham and S.M.Reddy (2008). Production of Indole acetic acid and free amino acids by two Anoxygenic phototrophic bacteria. *Bioinfolet 5;* 82-84 .
34. Ramchander Merugu, S. Girisham and S.M.Reddy (2010). Production of PHB (Polyhydroxybutyrate) by *Rhodopseudomonas palustris* KU003 under nitrogen limitation. *International Journal of Applied Biology and Pharmaceutical Technology* 2:686-688.
35. Ramchander Merugu, S. Girisham and S.M.Reddy (2010). Production of PHB (Polyhydroxybutyrate) by *Rhodopseudomonas palustris* KU003 and Rhodobacter capsulatus KU002 under phosphate limitation. *International Journal of Applied Biology and Pharmaceutical Technology.* 3: 746-748.
36. Ramchander Merugu, Y.Prashanthi, T. Sarojini, Nageshwari Badgu. Bioremediation of waste waters by the anoxygenic photosynthetic bacterium *Rhodobacter sphaeroides* SMR 009. International Journal of Research in Environmental Science and Technology 2014; 4(1): 16-19.
37. Bergey's Manual of Systematic bacteriology (1994). "Enrichment and isolation of purple non sulphur photosynthetic bacteria". Eds:J.T.Staley, M.P.Byrant, N.Pfennig and J.C.Holt.

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