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Impact of various cultural conditions on photo production of hydrogen from Kanyakumari photosynthetic bacteria

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Abstract
Biofuel production is a promising energy source since it is clean and renewable. Nowadays the growing interest in alternative fuels is motivated by several finite fossil-fuel resources and generally produces vehicle emissions that contribute to smog, air pollution or global warming. The most efficient way than the known biological routes for Hydrogen Production from Purple Non-Sulphur Bacteria (PNS) of which is a major field of research improved by optimization of culture conditions. Therefore, the present study for Hydrogen production reveals that the influence of consortium purple non sulphur bacteria isolated from Kanyakumari marine Water. The different parameters like various Carbon, Nitrogen, Growth factors and P_H variation was identified for hydrogen production by the anoxygenic bacteria. The amount of hydrogen produced varies with various carbon, nitrogen, growth factors and P_H used in the medium. The bacterial culture was cultured in 50 ml vessel within 30ml of culture to produce hydrogen in anoxygenic conditions and incubated in 2000 lux light intensity for 196 hours. The best result for highest hydrogen productivity was 6ml/30ml vessel of sodium benzoate, ammonium chloride, biotin and at P_H 7.5 to purple non sulphur bacteria isolated from Kanyakumari marine water.

Keywords: Purple non sulphur bacteria, Hydrogen production, carbon, nitrogen sources, growth factors, P_H.

1. Introduction
Anoxygenic phototrophic bacteria, especially purple non sulphur photosynthetic bacteria (PNSB) are widely distributed in soil, water, and wastewater [1, 2, 3]. Purple non-sulfur anoxyphototrophic bacteria (PNSAB) have a wide range of growth modes and are able to grow under photoautotrophic, photoheterotrophic and chemoheterotrophic conditions [4]. These groups of microbes are a cosmopolitan group located in water bodies below the layer of oxygenic photosynthetic organisms such as: algae, aquatic plants and cyanobacteria [5]. They can also be found in habitats such as: waste water ponds, sediments, moist soils, seawater pools, hypersaline environments [6]. Purple non sulfur bacteria are found in various marine habitats like mangroves [7, 8]. Hydrogen is designed as a budding fuel for the future because it is sustainable, ecofriendly, economical which has high energy content per unit mass of any common fuel, it is easily adaptable to electricity by fuel cells, and on combustion it gives water as the only by-product. The peculiar substrates such as acetate, lactate, benzoate, malate, mannitol and starch are outlined by phototrophic bacteria as an electron donors for hydrogen production. Impact of various cultural conditions on hydrogen production is expressed [9-12]. Specially from hydrogen production multifold by-products are produced from photosynthetic bacteria makes a continuity for our earlier work on biotechnological applications [13-23]. The present aspects of the above data, reveals the impact of cultural conditions like various carbon, nitrogen, growth factors and pH variation on hydrogen production by anoxygenic bacterial consortium isolated from Kanyakumari marine water was examined and explained.

2. Materials and Methods
Purple non Sulphur an oxygenic Phototrophic bacterium was isolated from marine water samples by enrichment techniques by inoculating into the medium and incubated an aerobically under 2000lux light intensity. A selected consortium isolate from Kanyakumari marine water that had passed both screening tests was characterized using both morphological and physiological properties and identified according to Bergey's Manual of Systematic Bacteriology (1994). Growth conditions were measured at 660nm Optical density under UV-VIS Spectrophotometer.

The harvested cells were obtained from the 30ml of bacterial culture centrifuged (10,000xg for 30mins) and washed with 0.3% saline and cells were suspended in basal medium. Based on experimental conditions provided at different concentrations of electron donors, nitrogen sources, ten days old cultures of phototrophic bacteria of 1% (v/v) concentration into the basal medium were inoculated containing carbon sources Sodium benzoate, Glucose, Galactose, Mannose, Arabinose, Lactose, Mannitol, Malic acid, Citric acid, Sodium succinate with ammonium chloride as nitrogen source. Ammonium chloride, ammonium nitrate, glycine, sodium glutamate, histidine, tryptophan, tyrosine, threonine, alanine with sodium benzoate as carbon source, different growth factors like panthothenic acid, nicotinic acid, biotin, folic acid, riboflavin, cyanocobalamine and basal medium at different PH variations from 6.5, 7, 7.5, 8, 8.5, 9, 9.5 were also explored. The incubation period was 196 hours after inoculation of the consortium. The technique used for hydrogen measurement was water displacement method where as Gas Chromatography was used for gas analysis.

3. Results and Discussion

Ten day active cultures were used to assess their probability of producing hydrogen was shown in Table 1 and Figure 1. Photosynthetic bacterial consortium produced varying amounts of hydrogen with various carbon, nitrogen, growth factors and variation in P_H under anaerobic light. Sodium benzoate, glucose, mannitol and sodium succinate were good carbon sources for production of hydrogen by photosynthetic bacterial consortium. Sodium benzoate, Glucose, Mannitol and Sodium succinate induced almost equal amounts of hydrogen. Maximum production of hydrogen was 6 ml /30ml culture was produced in presence of Sodium benzoate. Effect of various nitrogen sources on hydrogen production was shown in Table 2 and Figure 2. In the presence of anaerobic conditions, ammonium chloride produces 6ml/30ml culture which shows a maximum amount of hydrogen followed by sodium glutamate and alanine. Thus, maximum hydrogen production of both the carbon and nitrogen sources was observed in sodium benzoate and ammonium chloride. Carbon sources like galactose, mannose, arabinose, lactose, glycine, tryptophan, tyrosine and threonine has shown the equal volumes of hydrogen production. Impact of P_H variation on hydrogen production was described in Table 3 and Figure 3. Maximum amount of hydrogen production was observed in 7.5 and 8 P_H. Panthothenic acid, nicotinic acid and cyanocobalamine showed the equal amounts and maximum hydrogen production was observed in Table 4 and Figure 4.

Table 1: Effect of various Carbon Sources on Hydrogen Production (ml/30ml culture)

Carbon /Electron Donor	Optical Density (in OD)	Hydrogen (in ml)
Sodium Benzoate	1.7211	6.0±0.1
Glucose	0.9264	6±0.1
Galactose	1.0278	5.5±0.2
Mannose	0.9816	5.5±0.3
Arabinose	0.9936	5.5±0.1
Lactose	1.0031	5.5±0.1
Mannitol	0.8388	6±0.1
Malic acid	0.9237	5.5±0.2
Citric acid	0.3442	5.5±0.2
Sodium succinate	0.4844	6±0.1

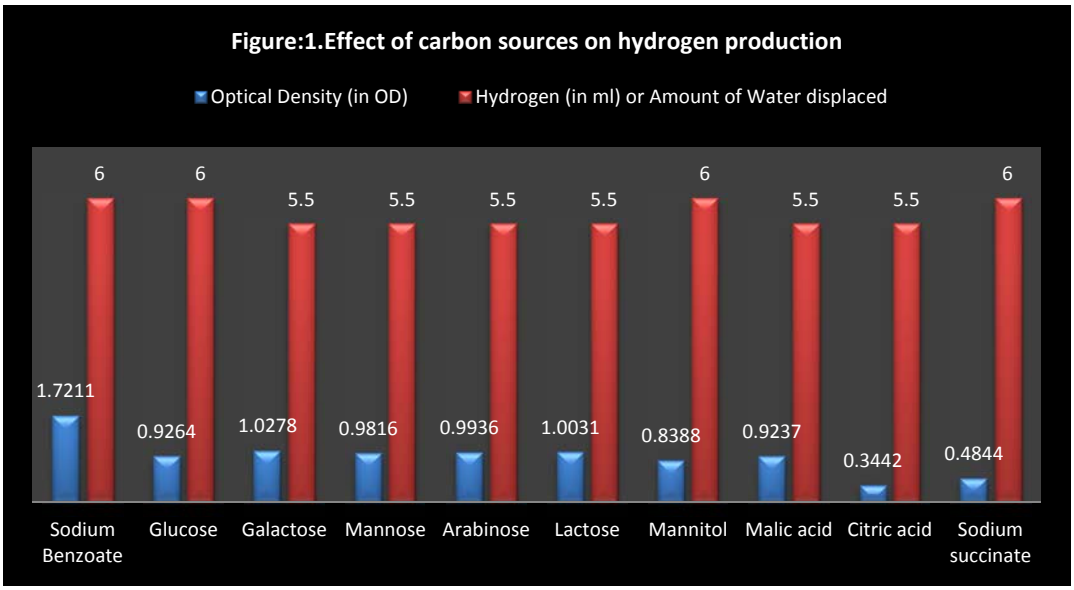


Table 2: Effect of various Nitrogen sources on Hydrogen production (ml/30ml)

Nitrogen Source	Optical Density (in OD)	Hydrogen (in ml)
Ammonium Chloride	1.9077	6.0±0.1
Ammonium Nitrate	1.1207	5.0±0.2
Glycine	1.1744	5.5±0.1
Sodium glutamate	0.6612	6.0±0.1
Histidine	1.0629	5.0±0.3
Tryptophan	0.5419	5.5±0.1
Tyrosine	0.8377	5.5±0.2
Threonine	1.1364	5.5±0.1
Alanine	0.9507	6±0.2

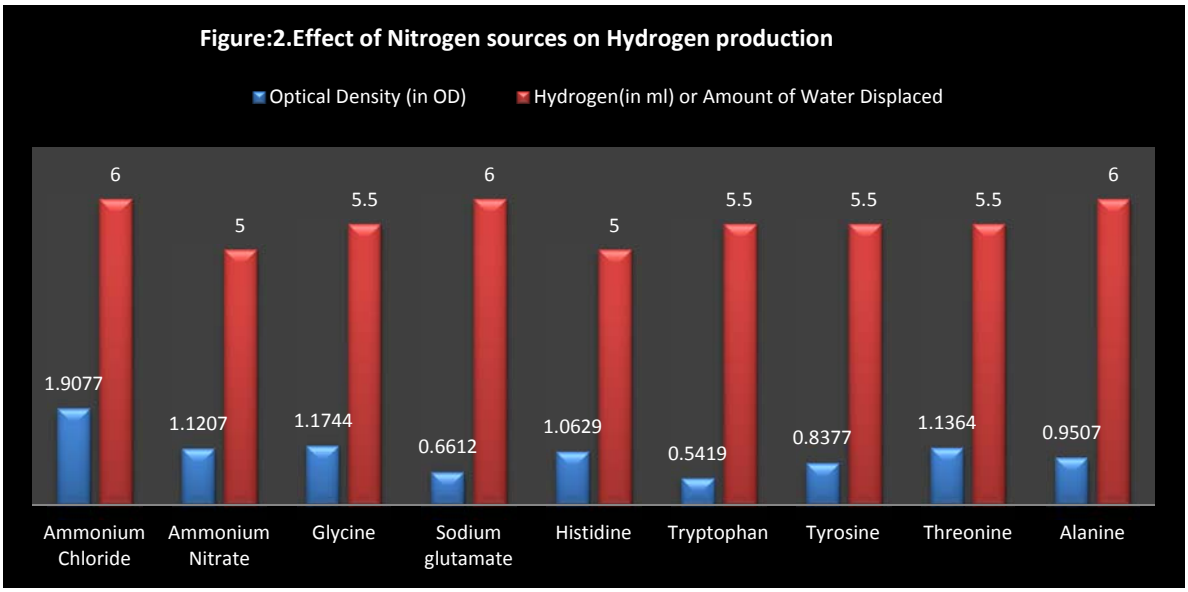


Table 3: Effect of various P_H on Hydrogen Production (ml/30ml)

P_H	Optical Density (in OD)	Hydrogen (in ml)
P_H 6.5	0.5257	4.5±0.2
P_H 7.0	0.5086	5.0±0.1
P_H 7.5	1.1693	6.0±0.1
P_H 8.0	1.5414	6.0±0.1
P_H 8.5	1.4556	5.5±0.2
P_H 9.0	1.6458	5.5±0.2
P_H 9.5	1.3679	5.0±0.3

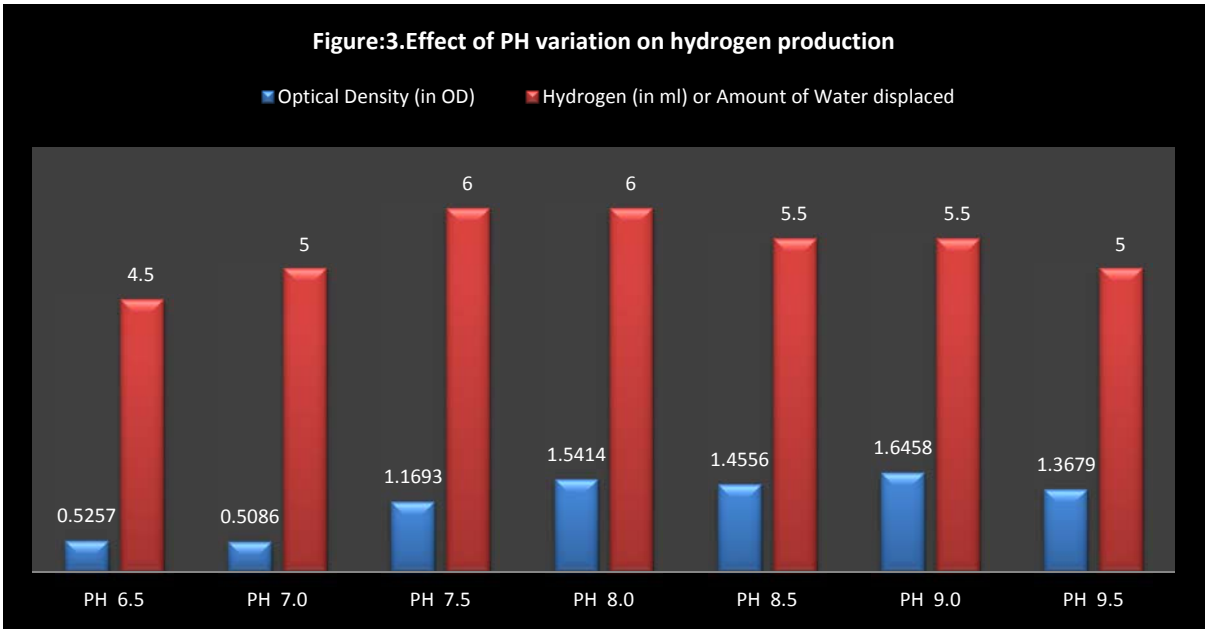
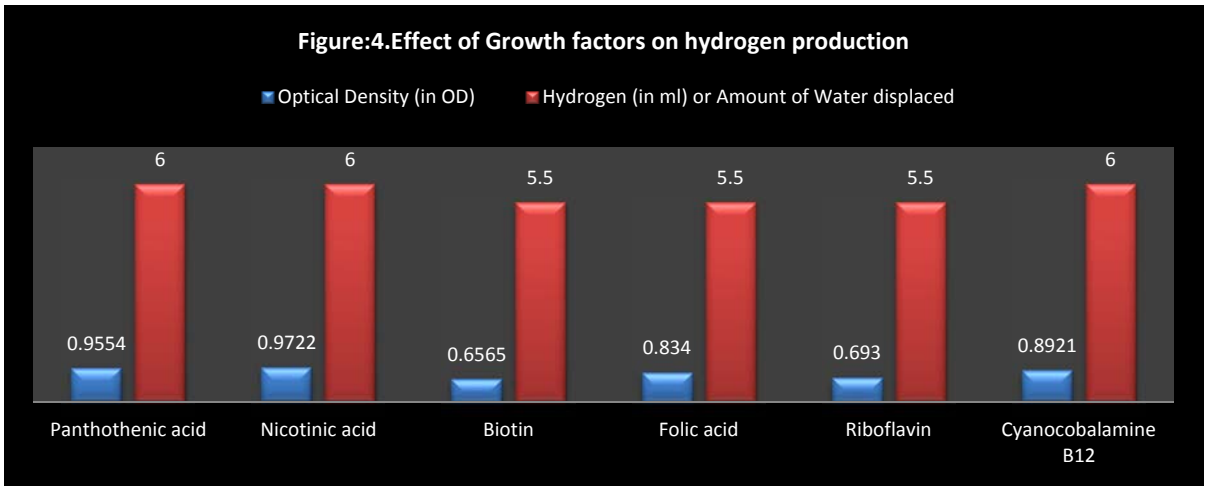


Table 4: Effect of various Growth Factors on Hydrogen production (ml/30ml)

Growth Factors	Optical Density (in OD)	Hydrogen (in ml)
Panthothenic acid	0.9554	6.0±0.1
Nicotinic acid	0.9722	6.0±0.1
Biotin	0.6565	5.5±0.2
Folic acid	0.8340	5.5±0.2
Riboflavin	0.6930	5.5±0.1
Cyanocobalamine B_{12}	0.8921	6.0±0.1



4. Conclusion

The present study reveals that impact of various carbon, nitrogen, P_H variation and growth factors shown that equals and maximum amounts of hydrogen production was shown in sodium benzoate, ammonium chloride, and at PH 7.5, 8.0 and panthothenic acid, nicotinic acid and cyanocobalamine and less amounts of hydrogen production in ammonium nitrate, histidine and at PH 6.5.

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6. References

1. Holt JG, Krieg NR, Sneath PHA, Staley JT, Williams ST. *Bergey's manual of determinative bacteriology*. 9th. Baltimore; The Williams and Wilkins Co 1994, 787.
2. Zhu H, Ueda S, Asada Y, Miyake J. Hydrogen production as a novel process of wastewater treatment-studies on tofu wastewater with entrapped *R. sphaeroides* and mutagenesis. International Journal of Hydrogen Energy 2002; 27(11-12):1349-1357.
3. Hoogewerf GJ, Jung DO, Madigan T. Evidence for limited species diversity of bacteriochlorophyll *b*-containing purple nonsulfur anoxygenic phototrophs in freshwater habitats. FEMS Microbiology Letters 2003; 218(2):359-364.
4. Imhoff JF, Trüper HG. Bergey's Manual of Determinative Bacteriology. Vol. 2. 2nd ed. Michigan State University, 2005.
5. Oda Y, Wanders W, Huisman LA, Meijer WG, Gottschal JC, Forney LJ. Genotypic and Phenotypic Diversity within Species of Purple Nonsulfur Bacteria Isolated from Aquatic Sediments. Applied and Environmental Microbiology 2002; 68:3467-3477.
6. Okubo Y, Futamata H, Hiraishi A. Characterization of phototrophic nonsulfur bacteria forming colored microbial mats in a swine wastewater ditch. Applied and Environmental Microbiology 2006; 72:6225-6233.
7. Vethanayagam RR. Purple photosynthetic bacteria from a tropical mangrove environment. Mar Biol 1991; 110:161-163.
8. Vethanayagam RR, Krishnamurthy K. Studies on anoxygenic photosynthetic bacterium *Rhodopseudomonas* sp. From the tropical mangrove environment. Indian J Mar Sci 1995; 24:19- 23.
9. Koku H, Eroglu I, Gndz U, Ycel M, Trker L. International Journal of Hydrogen Energy 2003; 28:381 – 388.
10. Zheng G, Wang L, Kang Z. Renewable Energy 2010; 35:2910 – 2913.
11. Hawkes FR, Dinsdale R, Hawkes DL, Hussy I. International Journal of Hydrogen Energy 2002; 27:1339 – 1347.
12. Melnicki MR, Eroglu E, Melis A. International Journal of Hydrogen Energy 2009; 34:6157 – 6170.
13. Ramchander M, Pratap MP, Nageshwari B, Girisham S, Reddy SM. Factors influencing the production of hydrogen by the hydrogen by the purple non-sulphur phototrophic bacterium *Rhodopseudomonas acidophila* KU001. Microb. Biotechnol 2012; 5:674-678.
14. Ramchander Merugu, Vasantha Mittapelli, Pratap Rudra MP, Girisham S, Reddy SM. Photoproduction of Hydrogen by Alginate Immobilized *Rhodobacter capsulatus* KU002 under Sulphate and Phosphate Limitations. International Journal of Environment and Bioenergy 2012; 4(3):141-146.
15. Ramchander Merugu, Vasantha Mittapelli, Pratap Rudra Manthur Padigya, Girisham Sivadevuni, Reddy Solipuram Madhusudhan. Photoproduction of Hydrogen by Alginate Immobilised Cultures of *Rhodobacter capsulatus* KU002 Isolated from Tannery Effluents. Journal of Biofuels 2013; 4 (2):56-60.
16. Ramchander Merugu, Pratap Rudra MP, Nageshwari B, Sridhar Rao A, Ramesh D. Photoproduction of Hydrogen under Different Cultural Conditions by Alginate Immobilized *Rhodopsedomonas palustris* KU003. ISRN Renewable Energy, 2012, Article ID 757503, 5.
17. Ramchander Merugu, Pratap Rudra MP, Girisham S, Reddy SM. Bioproduction of hydrogen by alginate immobilized *Rhodopsedomonas acidophila* KU001. International Journal of Chemical Engineering and Applied Sciences 2013; 3(1):7-9.
18. Ramchander M, Prasad MSK, Vasavi DS, Girisham, Reddy SM. Bioremediation of waste water by two Anoxygenic Phototrophic bacteria. Nat Acad Sci Lett 2007; 30:223-227.
19. Ramchander Merugu, Prasad MSK, Girisham S, Reddy SM. Effect of trace elements on the growth of two Anoxygenic phototrophic bacteria. Ecol Envi Con 2008; 14:367-369.
20. Ramchander Merugu, Pratap Rudra MP, Sridhar Rao A, Ramesh D, Nageshwari B, Rajyalaxmi K *et al.* Influence

of Different Cultural Conditions on Photoproduction of Hydrogen by *Rhodopseudomonaspalustris* KU003. ISRN Renewable Energy 2011; 328:984-90.
21. Ramchander Merugu, Pratap Rudra MP, Atthapu Thirupathaiah, Veerababu Nageti. Hypocholesterolemic effect of the anoxygenic phototrophic bacterium *Rhopseudomonas palustris* MGU001 in hen laying eggs. International Journal of Applied Biology and Pharmaceutical Technology 2011; 2(2):463 to 466.
22. Ramchander Merugu, Pratap Rudra MP, Atthapu Thirupathaiah, Girisham S, Reddy SM. Optimisation of Indole Acetic Acid Production by two Anoxygenic Phototrophic bacteria Isolated from Tannery effluents. Journal of pure and applied Microbiology 2011; 5(2):34-37.
23. Ramchander Merugu, Pratap Rudra MP, Atthapu Thirupathaiah, Girisham S, Reddy SM. Chromate Reduction by a Purple non Sulphur Phototrophic Bacterium *Rhodobacter capsulatus* KU002 Isolated from Tannery Effluents. Journal of Pure and Applied Microbiology 2011; 5(2):66-69.