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# Photoproduction of Hydrogen by Photosytnhetic Bacteria Isolated from Oil Contaminated Soil of Mallapur, Hyderabad, India

**Raju Nalvolthula*[1], Ramchander Merugu[2], M.P.Pratap Rudra[1]**

[1]Department of Biochemistry, Osmania University, Hyderabad.
[2]University College of Science, Mahatma Gandhi University, Nalgonda

*Corres.author: rajumerugu01@gmail.com

**Abstract:** In the present study, the ability of hydrogen production by photosynthetic bacteria isolated from oil contaminated soils was studied. Influence of pH, carbon, nitrogen sources and growth factors on hydrogen production by the bacteria was investigated. Photosynthetic bacteria produced maximum amount (6.0 ml/30 ml vessel) of hydrogen under anaerobic light in the presence of the carbon source benzoate, arabinose and nitrogen source ammonium chloride.
**Keywords:** Hydrogen production, Photosynthetic bacteria, pH, carbon sources, nitrogen sources.

## Introduction

Worldwide production of CO2 leading to climate change due to greenhouse effect requires the use of other sources of energy which do not result in CO2 emissions. Hydrogen as a energy carrier helps us in mitigating the risk of green house gases. Among the many methods of hydrogen production, photoproduction is considered to be environmental friendly. Photosynthetic bacteria produce more photobiological hydrogen due to their high conversion efficiency[1] and hence more emphasis is laid worldwide on biological hydrogen production[2-4]. Among these bacteria *Rhodopseudomonas palustris*, *Rhodobacter capsulatus* and *Rhodobacter marinus*, *Rhodobacter sphaeroides* and *Rhodospirillum rubrum* [5-12] are being investigated for hydrogen production. Different electron donors and nitrogen sources like acetate, lactate, benzoate, malate, mannitol, starch, nitrates and amino acids are utilized by photosynthetic bacteria for hydrogen production. Optimization of various parameters for hydrogen production has been reported by various researchers[13-16]. In continuation of our earlier work[17-33], hydrogen production by the phototrophic bacterial consortium isolated from Mallapur, Industrial area, Hyderabad, South India was evaluated under different cultural conditions and the results are communicated.

## Materials and Methods

The phototrophic bacteria were identified using the Bergey's Manual of Systematic Bacteriology (1994) [34]. Oil contaminated soil was collected from Mallapur, Industrial area, Hyderabad. Growth and effect of pH, carbon, nitrogen and growth factors was determined as reported in our earlier studies [24]. The technique used for hydrogen measurement hydrogen displacement technique.

## Results and Discussion

Among the various hydrogen production processes, photoelectrochemical, photochemical, thermo chemical, and photobiological processes are being explored for commercial viability compared to conventional methods of hydrogen production. Photosynthetic bacterial hydrogen production represents a method with appreciable efficiency for hydrogen evolution when compared to other methods. Ten day grown cultures of photosynthetic bacteria was used to assess their hydrogen potential. Photosynthetic bacterial consortium produced varying amounts of hydrogen under different cultural conditions. Perusal of Table 1 showed that pH of 7.5 induced maximum amount of hydrogen and gradually decreased as the pH increased. Benzoate and arabinose induced equal amounts of hydrogen when compared to other carbon sources (Table 2). Highest production of 6.0 ml /30ml culture of hydrogen was produced in presence of Benzoate and arabinose. In the presence of citrate, the consortium produced the lowest amounts of hydrogen. Intermediate production of hydrogen was seen when tested with other carbon sources. Effect of various nitrogen sources on hydrogen production are listed in Table 3. Ammonium chloride followed by glutamate produced more amounts of hydrogen under anaerobic light.Tryptophan, tyrosine and alanine induced lowest amounts of hydrogen production than other sources. In Other nitrogen sources tested intermediate levels of hydrogen production was tested. Carbon sources showed more production of hydrogen when compared to different nitrogen sources. Effects of growth factors on hydrogen production were tested and the results are presented in Table 3. Vitamin B12 promoted more amounts of hydrogen when compared to other growth factors. Pantothenic acid and riboflavin promoted equal amounts of hydrogen when used as growth factors. Lower amounts of hydrogen were recorded when folic acid was tested.

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

| pH | O.D Values | Hydrogen Production (Ml/30ml Vessel) |
|---|---|---|
| 6.5 | 1.1177 | 4.5±0.45 |
| 7.0 | 1.1398 | 5.5±0.65 |
| 7.5 | 1.8778 | 6.0±0.5 |
| 8.0 | 1.2339 | 5.5±0.75 |
| 8.5 | 1.2281 | 5.0±0.70 |
| 9.0 | 1.1537 | 4.0±0.55 |
| 9.5 | 1.1657 | 4.0±0.60 |

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

| Carbon Sources | O.D Values | Hydrogen Production (Ml/30ml Vessel) |
|---|---|---|
| Sodium Benzoate | 1.1468 | 6.0±0.85 |
| Glcose | 0.6783 | 5.0±0.55 |
| Galactose | 0.7843 | 5.5±0.20 |
| Manose | 0.7127 | 5.5±0.30 |
| Arabinose | 0.901 | 6.0±0.60 |
| Lactose | 0.9166 | 5.0±0.75 |
| Manitol | 0.5114 | 5.0±0.20 |
| Malic acid | 0.4979 | 4.5±0.60 |
| Citrate | 0.6712 | 4.0±0.55 |
| Sodium succinate | 0.6442 | 4.5±0.70 |

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

| Nitrogen Sources | O.D Values | Hydrogen Production (Ml/30ml Vessel) |
|---|---|---|
| Ammonium chloride | 0.8732 | 6.0±0.50 |
| Ammonium nitrate | 0.4729 | 4.5±0.65 |
| Glycine | 0.5753 | 4.5±0.75 |
| Sodium glutamate | 0.7761 | 5.5±0.60 |
| Histidine | 0.5495 | 4.5±0.25 |
| Tryptophan | 0.4832 | 4.0±0.30 |
| Tyrosine | 0.6063 | 4.0±0.40 |
| Threonine | 0.5567 | 4.5±0.50 |
| Alanine | 0.6128 | 4.0±0.60 |

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

| Growth Factors | O.D Values | Hydrogen Production (Ml/30ml Vessel) |
|---|---|---|
| Pantothenic acid | 1.7866 | 5.5±0.25 |
| Nicotinic acid | 1.6464 | 4.5±0.30 |
| Biotin | 1.2577 | 5.0±0.50 |
| Folic acid | 1.5291 | 3.5±0.60 |
| Riboflavin | 1.0279 | 5.5±0.40 |
| $B_{12}$ | 1.3536 | 6.0±0.20 |

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