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Effect of physico-chemical parameters on biohydrogen production and growth characteristics by batch culture of *Rhodobacter sphaeroides CIP 60.6*

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a r t i c l e i n f o

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In this paper, *Rhodobacter sphaeroides CIP 60.6* strain was newly used for the biohydrogen production in a perfectly shaken column photobioreactor, grown in batch culture under anaerobic and illumination conditions, to investigate the effects of some physico-chemical parameters in microbial hydrogen photofermentation. Luedeking–Piret model was considered for the data fitting to find out the mode of hydrogen generation and the relationship between the cell growth and hydrogen production. The results show that, both growth cells and resting cells can produce hydrogen at light intensities greater or equal to 2500 lux, however, at the weak intensities hydrogen is a metabolite associated to growth. Growth rate and hydrogen production rate increase with the increasing of light intensity. Moreover, hydrogen production rate become higher in stationary phase than that in logarithmic phase, with the enhancement of light intensity. Maximum hydrogen production rate obtained was 39.88 ± 0.14 ml/l/h, at the optimal conditions (4500–8500 lux). Modified Gompertz equation was applied for the data fitting to verify the accuracy and the agreement of the model with experimental results. It is revealed that, in the modified Gompertz equation, the lag time represents time for which hydrogen production becomes maximal, not the beginning time of hydrogen production. The stop of stirring reduced hydrogen production rate and created unstable hydrogen production in reactor. The pH ranges of 7.5 ± 0.1 were the favorable pH for hydrogen production.

1. Introduction

Energy and environment are the two important concerns of the current day industrial world. The increasing gap between the energy requirement of the industrialized world and inability to replenish such needs from the limited sources of energy like fossil fuels, causing ever increasing levels of greenhouse pollution from the combustion of fossil fuels in turn aggravate the perils of global warming and energy crisis [1]. However, during the last few years, bio-fuel production [2], such as Biogas [3,4], biodiesel [5], bio-oil [6] and biohydrogen [7], received a considerable attention by many researchers in the world. Hydrogen gas is a clean and high energy fuel (122 kJ/g) which can be produced in fuel cells for electricity generation. Hydrogen is considered as the major energy carrier of the future. Unlike fossil fuels, hydro- gen is not available in nature and requires expensive production methods [8]. Biological production of hydrogen, via either non phototrophic or phototrophic fermentation, is a much less capital and energy-intensive process [9]. It is considered the most envi- ronment- friendly route of production of hydrogen, which is the most promising alternative to fossil fuels because it is clean, efficient, and renewable [7].

The hydrogen production by the photosynthetic purple non-sulfur bacteria (PNS) was catalysed by the nitrogenase enzyme system under nitrogen-limited conditions using light energy and simple organic acids or sugar substrates [10].

Among these bacteria, *Rhodobacter sphaeroides* is to be mentioned. It is favorable candidate for large-scale production because of its high activity in the hydrogen production under anaerobic conditions and its capacity of using a wide variety of substrates, either for the growth or hydrogen production. It is most promising bacteria [7,8,11].

Over the years, many researchers have examined various aspects of different strains of *Rhodobacter sphaeroides* such as *R. sphaeroides O.U.001* [7,12], *R. sphaeroides RV* [13,14] and *R. sphaeroides KD 131* [15] to study and improve the efficiency of biological hydrogen production. The hydrogen production capacity varies among different strains of the same species.

To the best of our knowledge, the hydrogen producing potential of *R. sphaeroides CIP 60.6* has not been reported in literature. Therefore, this work is carried out to investigate the effect of physico-chemical parameters on growth characteristics and hydrogen production by this bacterium strain and to evaluate its production capacity compared with other *R. sphaeroides* strains.

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