Indoor versus outdoor biohydrogen photoproduction by *Rhodopseudomonas palustris* 42OL

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Hydrogen is a promising energy carrier of the future, nevertheless biohydrogen technologies are still in their infancy. If biohydrogen systems are to become commercially competitive, they must be able to synthesize hydrogen at rates that are sufficient to power fuel cells of a sufficient size to carry out practical work [1]. Before the concept of hydrogen economy becomes a reality, a safe, economical, sustainable way of production needs to be developed [2]. Biological hydrogen photoproduction by photosynthetic bacteria could be a promising process for solar energy conversion. Advancements in hydrodynamic aspects, bioreactor design, gas separation, light intensity and its distribution through culture thickness are the key points for improving the hydrogen yield [3]. Besides, the growth strategy could be a relevant way to attain high hydrogen yield. We investigated the hydrogen photoproduction by *Rhodopseudomonas palustris* 42OL cultured under both artificial and natural light radiation. For indoor experiments, four cylindrical photobioreactors (PBR) of different internal diameters (i.d. of 4.0 cm; 7.6 cm; 9.6 cm and 13.0 cm) were used. Indoor experiments were carried out at the irradiance of 480 W/m² and at constant temperature (30 °C); outdoor investigations were performed in autumn using an underwater tubular photobioreactor (UwTP) with a pipe i.d. of 4.8 cm. The organic carbon source was malic acid, which is a compound of wine-distillery waste [4]. In the future, the use of cheaper materials would undoubtedly make hydrogen production process more competitive than the conventional hydrogen generation process [5]. Nevertheless, the high hydrogen yield remains the ultimate goal and the main challenge for the biohydrogen research and development [6]. We used two growth strategies: (i) batch and (ii) semi-continuous regime. The daily average hydrogen production rate (HPR) attained under batch-growth operation was $222 \pm 18 \text{ ml(H}_2\text{/l/day}}$, which increased to $655 \pm 85 \text{ ml(H}_2\text{/l/day}}$ under semi-continuous regime, corresponding to $27.3 \pm 3.5 \text{ ml(H}_2\text{/l/h}}$. This rate reduced drastically outdoors ($9.8 \text{ ml (H}_2\text{/l/h}}$). Peaks of $32.7 \text{ ml (H}_2\text{/h}}$ and $15.5 \text{ ml (H}_2\text{/l/h}}$ were obtained indoors and outdoors respectively. The hydrogen yield of $3.03 \text{ mol H}_2$/mol malic acid was achieved indoors under the semi-continuous regime. Our study demonstrated that the hydrogen production rate (HPR) is greatly affected by the diameter of photobioreactors and an inverse relationship links the HPR to the diameter of the reactor.

**Keywords** *Rhodopseudomonas palustris*; hydrogen production rate; photobioreactors

**References**


