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THE USE OF A VEGETABLE WASTE-DERIVED FERMENTATION PRODUCT FOR H_2 PRODUCTION BY ANOXYGENIC PHOTOTROPHIC BACTERIA

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Abstract

Research on photobiological H_2 production processes is nowadays pointing towards the utilization of low cost substrates as sources of reduced carbon for H_2 generation. In this connection, photofermentation often stands as a downstream process, subsequent to other fermentation processes where carbohydrates are converted to organic acids.
The aim of this study was the evaluation of the feasibility of a two stage process costituited by an acidogenic phase, where the dark fermentation of vegetable residues (raw residues coming from the central vegetable market of Florence) is carried out by the autochthonous chemoheterotrophic microflora residing on the vegetables, followed by a hydrogen photoevolution phase, where the liquid fraction of the fermented residues is utilized by purple non sulfur bacteria for H_2 production.
The dark acidogenic phase produced a fermentation broth mainly containing lactic and acetic acids and ammonia. The fermentation broth was diluted with distilled water until ammonia concentration reached a value of 35 mg L^{-1}; after the dilution, the concentration of the soluble products was: lactic acid 2.6 g L^{-1} and acetic acid 0,7 g L^{-1}.
Three *Rhodopseudomonas palustris* strains were used: strain AV33, isolated from a trophic lake (Averno Lake, Italy) and selected for its interesting capability of using lactate-rich substrates; strain 42OL, used in an up-scale of the process from reactors of 250ml to 3 L to 11 L of volume; a mutant strain (CGA676, insensitive to ammonium) used in order to test the possibility to avoid medium dilution. Under lab conditions, strain AV33 produced H_2 at an average production rate of 9.7 ± 1.3 ml (H_2) L^{-1} h^{-1} (in 0.25 L bioreactors). Strain 42OL produced hydrogen at a rate of about 16mL ml (H_2) L^{-1} h^{-1} (in 0.25 L bioreactors), at a rate of 2–3mL ml (H_2) L^{-1} h^{-1} (in 2.5 L bioreactors) and at an average rate of 11 ml (in H_2) L^{-1} h^{-1} and a maximum rate of about 17 ml (H_2) L^{-1} h^{-1} (11 L bioreactor). Using strain CGA676 (mutant insensitive to ammonium), the production of hydrogen occurred with no need of diluting the fermentation product, reaching an average rate of 3.9 ± 0.8 ml (H_2) L^{-1} h^{-1}.
In conclusion, the two step process seems to be promising for coupling H_2 production with the treatment of vegetable waste-derived fermentation products.

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