An indigenous purple non-sulfur bacteria Rhodopseudomonas palustris PBUM001 was used to produce hydrogen gas via batch photofermentation of palm oil mill effluent (POME). The photofermentation hydrogen production was carried out in a 5-l reactor (B. Braun Biostat® B) with a working volume of 3.5 l (height: 39 cm and diameter: 16 cm) under anaerobic condition. The stirred tank reactor (STR) was conducted at temperature, 30 ± 2 °C, POME concentration, 100% (v/v), light intensity, 4.0 klux, pH 6, inoculum size, 10% (v/v), agitation rate, 250 rpm, and operated for 66 h. Two sets of experiments were run in STR (R1 and R2) and the data obtained were used for kinetic study of photofermentation hydrogen production. Unstructured models were used to describe the bacterial growth, substrate consumption, and hydrogen gas production by R. palustris PBUM001. The discrepancy between the proposed model and the experimental data in simulating hydrogen production from POME by R. palustris PBUM001 was measured by using residual sum of squares (RSS). Logistic model could be adopted to describe the kinetics of bacterial growth (RSS: 0.3039, p = 0.2313) and the proposed model for substrate consumption agreed well with the experimental data obtained in this study as shown by its RSS value of 19.1319 and 26.8259 for R1 and R2, respectively. A modified Leudeking-Piret model was applied for the data fitting to determine the relationship between the cell growth and photofermentation hydrogen production (RSS: 1.3267, p = 0.2637).

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