LONG-TERM BIOHYDROGEN PRODUCTION FROM SOFT DRINK INDUSTRY NON-CONFORMING PRODUCTS

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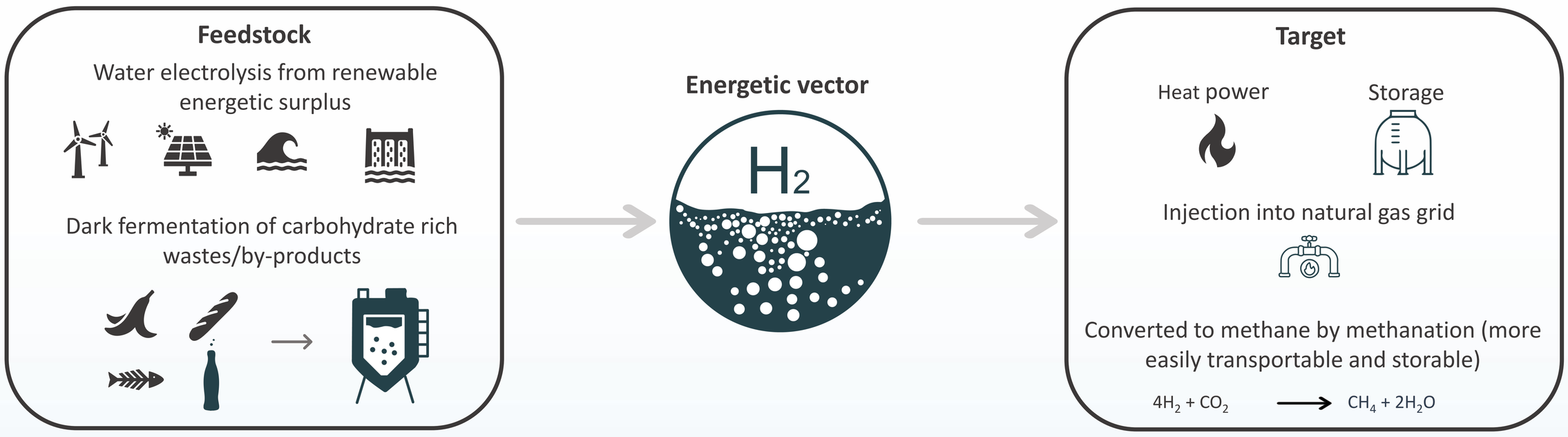
European Hydrogen Energy Conference 2022, Madrid, Spain, May 2022



Objective

- Evaluation of the feasibility of **Biohydrogen** (BH) production from **non-conforming products of soft drink industry** using **untreated mixed inoculum**.

Procedure

- Continuous Stirred Tank Reactor: 4 L
- Temperature (mesophilic): 37 ^{o}C
- Inoculum: anaerobic effluent from a WWTP digester adapted for BH production (Table 1)
- Substrate: Commercial soft drink supplemented with nutrient solution [1]
- Operation time: 142 d, divided into 6 phases
- OLR: 2.9-11.7 $g_{COD}\cdot L_r^{-1}\cdot d^{-1}$ & HRT: 19 h

- BH yield was calculated in terms of percentage according to the theoretical maximum molar yield (4 mol H_2/mol hexose)

Sample	TS ($g\cdot L^{-1}$)	VS ($g\cdot L^{-1}$)	COD ($g\cdot L^{-1}$)
Adapted inoculum	2.47 ± 0.03	1.39 ± 0.08	4.25 ± 0.01
Commercial soft drink	52.56 ± 0.29	51.86 ± 0.31	113.53 ± 0.26

Table 1. Physical-chemical characterization of inoculum and commercial soft drink (carbohydrate substrate).

Results

➢ Gas composition

- The BH concentration in the produced gas during Phase 0 and 1 presented variable values (13-23% v/v, Figure 1a)
- From day 44 to the end**, BH accounted for 38.97%** of the total gas composition (v/v). These values are in accordance with the results of other authors who used mixed inoculum and carbohydrates rich-substrates, ranging 30-50% [2]
- The **low CH_4** concentration recorded (1.14%) demonstrated a **reduced methanogenic activity.**

➢ BH productivity

- The higher the OLR tested, the higher the productivity achieved, from **345.57 to 618.50** mL $H_2\cdot L_r^{-1}\cdot d^{-1}$ in Phase P.2 and P.6, respectively (Figure 1b and Table 2)
- At P.0, BH production **was unstable**, and P.1 consisted of a **transitional** short period where OLR was increased.
- During P.2 to P.5 BH production achieved a stable performance with a **yield** ranged from **12.62 to 13.32%** (Table 2). These results are similar to those achieved by other authors employing mixed inoculum. [2, 3]
- Comparing with P.5, P.6 did not show **a remarkable productivity increase**, and a **decrease in BH yield** was also detected. These behaviors could be motivated by **the increased OLR**, leading to the development of **competitors microorganisms** and the shift of VFA profile. [4]

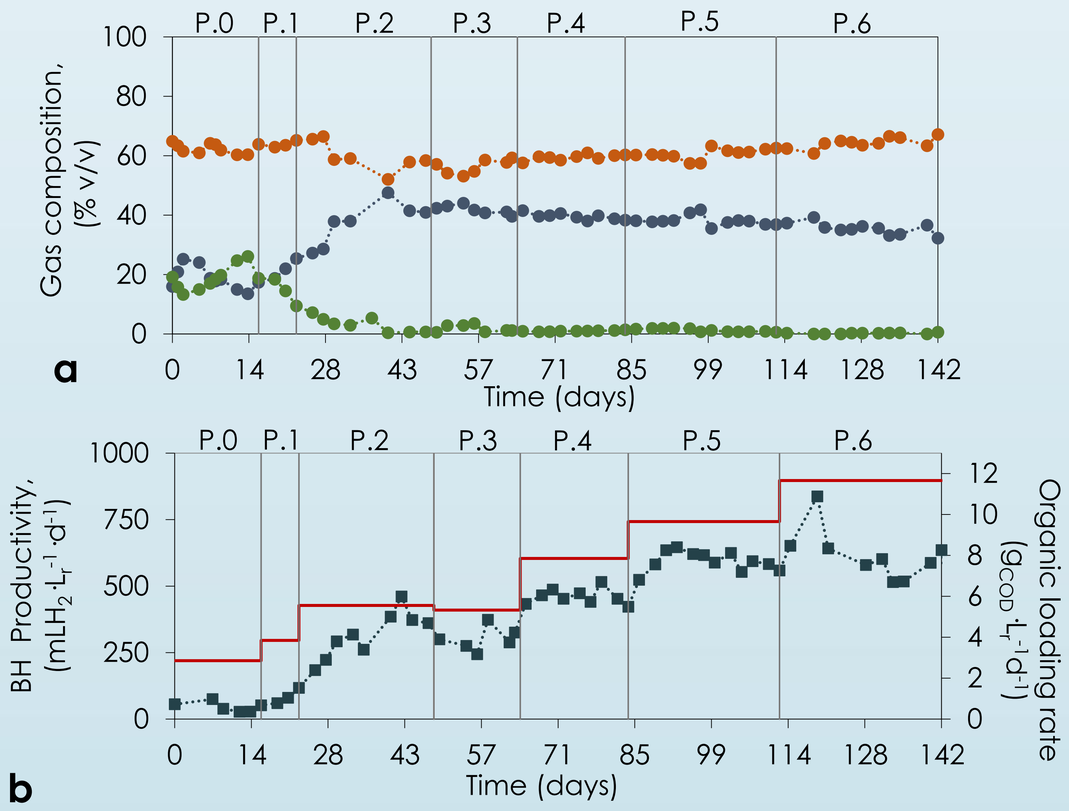


Figure 1. H_2 (●), CO_2 (●) and CH_4 (●) composition in gas outlet **(a)** and biohydrogen productivity evolution (■) and OLR (-) **(b)**

Phases	OLR ($g_{COD}\cdot L_r^{-1}\cdot d^{-1}$)	Productivity (mL $H_2\cdot L_r^{-1}\cdot d^{-1}$)	Yield (%)
P.0	2.86 ± 0.09	31.54 ± 6.36	2.37 ± 0.47
P.1	3.84 ± 0.03	63.84 ± 14.36	3.58 ± 0.83
P.2	5.56 ± 0.62	345.57 ± 39.05	12.75 ± 0.98
P.3	5.33 ± 1.21	300.93 ± 44.69	13.29 ± 2.39
P.4	7.85 ± 0.20	460.06 ± 28.84	12.62 ± 0.76
P.5	9.65 ± 0.42	596.81 ± 36.60	13.32 ± 0.60
P.6	11.66± 0.44	618.50 ± 95.85	11.70 ± 1.56

Table 2. Summary results of biohydrogen productivity and yield in each operational phase (OLR)

Conclusions

- The results achieved **demonstrated the feasibility of BH** production employing **non-conforming products from the soft drink industry**.
- The **methanogenic activity was controlled** by applying the suitable **operational parameters**, avoiding the employment of pretreatments of the mixed inoculum.
- To achieve a realistic approach, future research is required to increase the OLR and the BH productivity .

Acknowledgements

This work is part of the project Renewable Gases Consolidated Joint Unit, co-funded by the European Union within the FEDER Galicia 2014-2020 Operational Program and by the Galician Innovation Agency with the support of Naturgy and the collaboration of EDAR de Bens S.A. (Spain).

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