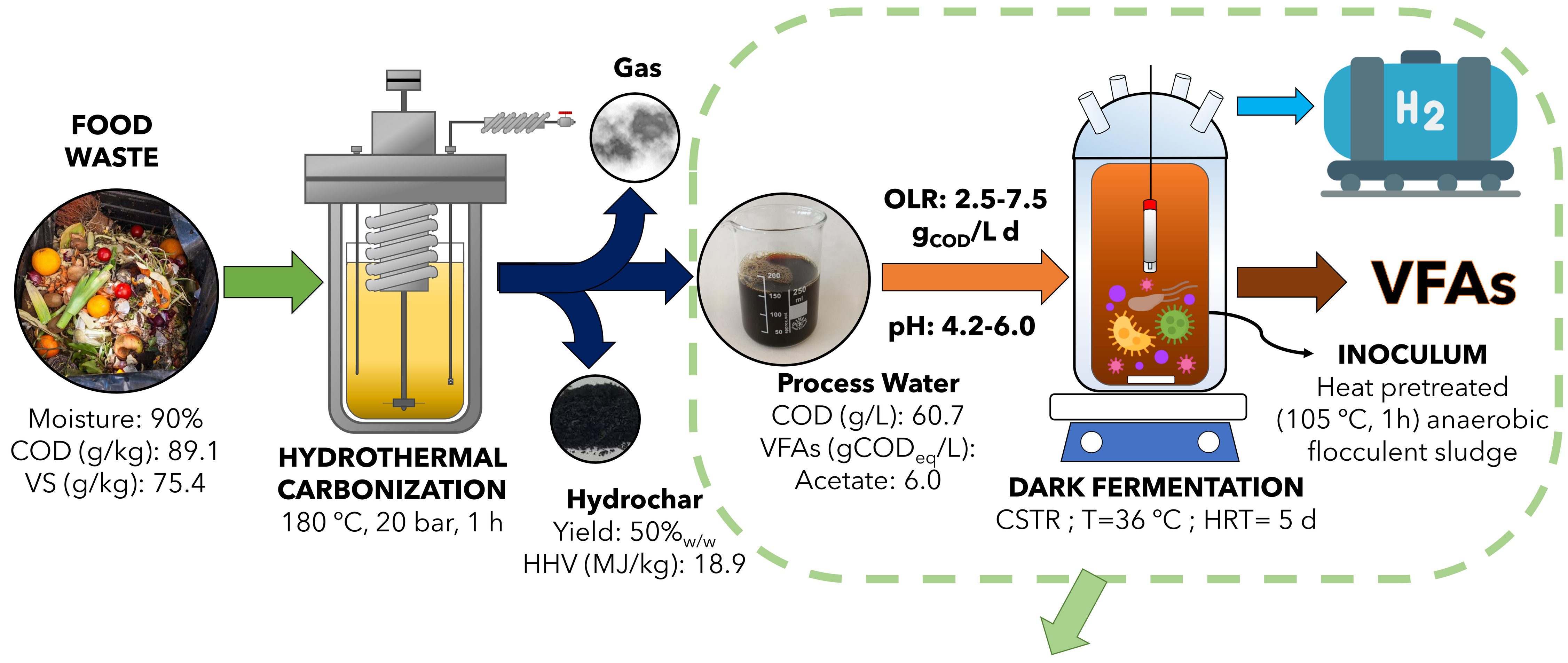
VALORIZATION OF PROCESS WATER OF FOOD WASTE FROM HYDROTHERMAL CARBONIZATION BY DARK FERMENTATION

M. P. Díez, E. Barahona, M.A. de la Rubia, A.F. Mohedano, E. Diaz.
Department of Chemical Engineering, Faculty of Sciences, Universidad Autonoma de Madrid, Campus de Cantoblanco, 28049, Madrid (Spain)
e-mail: mario.perez@uam.es

INTRODUCTION

Wastes valorization and seek of alternative for clean energy sources are two of the major challenges of short-term future. A combination of hydrothermal carbonization (HTC) and dark fermentation (DF) is proposed as waste valorization strategy to obtain high energy recovery and value-added products.
Hydrothermal carbonization is a thermochemical process (180 – 230 °C, 5 – 60 min) interesting to treat biomass wastes with high moisture content to obtain a carbonaceous solid fraction called hydrochar, a process water, and a gaseous minority fraction [1].
Dark fermentation is presented as an anaerobic fermentation process where organic matter is transformed, mainly into H_2, CO_2 and volatile fatty acids (VFAs), being microbial community, pH and organic loading rate (OLR) some of the key factors to achieve high efficiency of the process [2].

MATERIALS & METHODS



The aim of this work is to evaluate the performance of Dark Fermentation of Process Water obtained from Hydrothermal Carbonization of Food Waste, assessing the effect of pH and organic loading rate on the H_2 and VFAs production and microbial community evolution.

RESULTS & DISCUSION

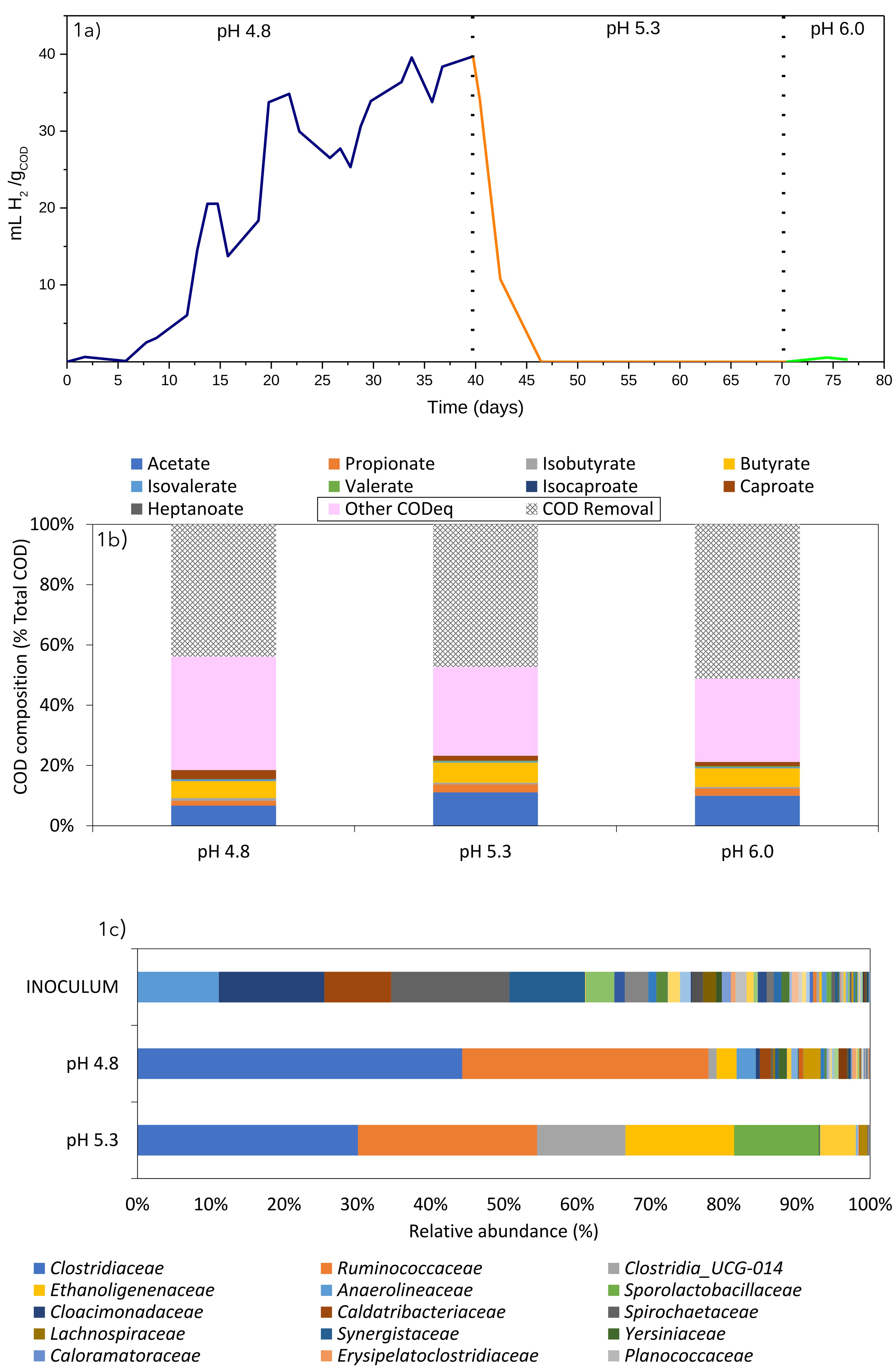


Figure 1. a) pH effect over H_2 production (mL/g_{COD}); b) pH effect over VFAs composition at stationary phase and COD removal related to the to the feedstock, both in terms of g_{CODeq}/L; c) Microbial taxonomy analysis of different effluents by family; (OLR 5 g_{COD} /L).

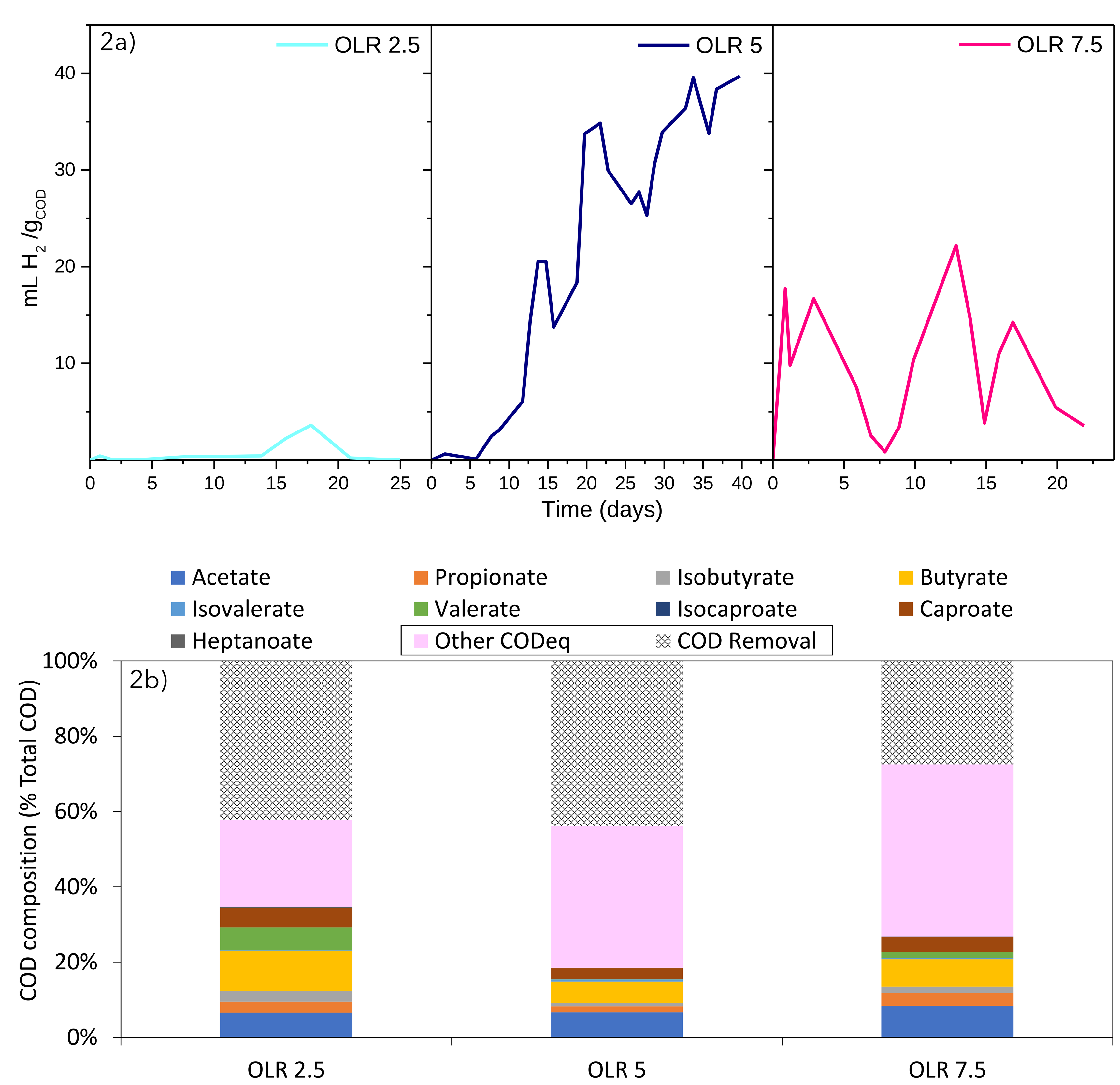


Figure 2. a) OLR (g_{COD}/L d) effect over H_2 production (mL/g_{COD}); b) OLR effect over VFAs composition at stationary phase and COD removal related to the feedstock, both in terms of g_{CODeq}/L; (pH 4.8).

CONCLUSIONS

Studies revealed that Dark Fermentation of Process Water using a heat pretreated anaerobic flocculent sludge as inoculum gives optimal performance on H_2 production at pH=4.8 and OLR=5 g_{COD}/L d, reaching 40 mL H_2/g_{COD} and a 45% of H_2 of total gas composition. Higher pH caused a decrease of H_2 production, whereas the gas production was negligible at pH 4.2. Microbial community analysis reveals that initial inoculum evolved to *a Clostridiaceae* and *Ruminococcaceae* dominant community when the process moves towards. These families are well-known hydrogen-producing bacteria, capable to perform acetic and butyric pathways on dark fermentation process [3]. At OLR=7.5 g_{COD}/L d and pH=4.8, it is produced the lower COD removal, and the VFAs concentration achieved 10.0 g_{CODeq}/L, 2-fold higher than that at OLR 5 g_{COD}/L d (4.6 g_{CODeq}/L).

References

[1] Ipiales R.P. et al., Energy and Fuels, 2021, 35, 17032-17050. [2] Dahiya, S. et al., Bioresource Technology, 2021, 321, 124354. [3] Su, X. et al., Biotechnology for Biofuels, 2018, 11, 245.

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