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DARK FERMENTATION OF PROCESS WATER FROM HYDROTHERMAL CARBONIZATION OF FOOD WASTE

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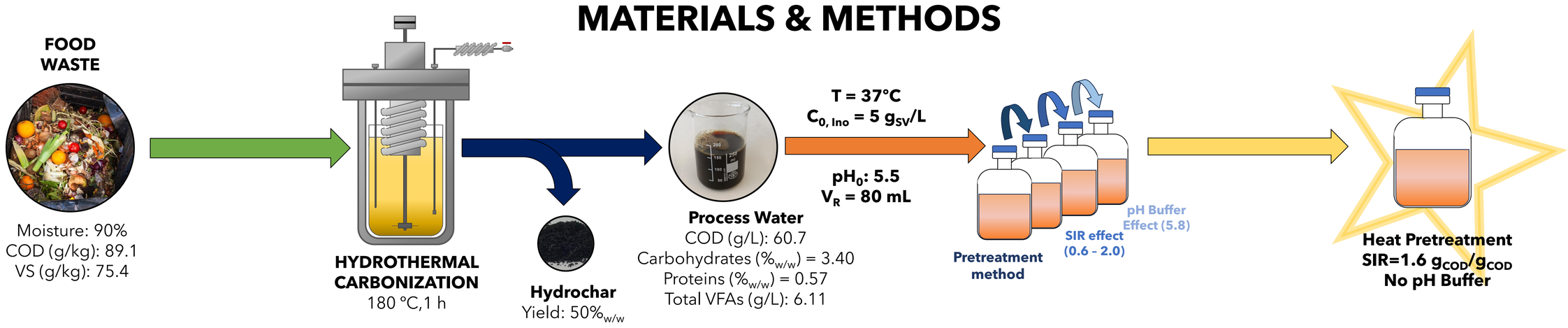
INTRODUCTION

Food waste (FW) valorization is crucial to reduce environmental impact, save resources, and seek of alternative applications by turning discarded food into valuable products. Hydrothermal carbonization (HTC) of FW appears as a promising strategy to obtain added-value products as hydrochar, a carbon-rich material that can be used as a renewable energy source, soil conditioner or catalyst support, and a process water rich in organic compounds like sugars and lactate that can be valorized via anaerobic digestion or nutrients recovery [1,2]. Moreover, dark fermentation (DF) can be also applied to this byproduct to obtain H_2 and volatile fatty acids [3].

In this study, DF of process water from hydrothermal carbonization of food waste (PW) is evaluated via batch tests in terms of inoculum origin, inoculum pretreatment, pH, and substrate-inoculum rate (SIR). In a first stage, the role of the inocula obtained from anaerobic digesters which treat sewage sludge (inocula 1 and 2) and municipal waste (inoculum 3), without pretreatment, on H_2 production using glucose as reference substrate is studied. After that, the three inocula were subjected to several pretreatments (heat pretreatment at 105 °C during 1 h (HP), acid pretreatment at pH 3 during 24 h (AcP), alkali pretreatment at pH 10 during 24 h (AkP) and pretreatment with 10 mmol/L 2-Bromoethanesulfonate (BES) during 4 h, evaluating their effect on H_2 production, with glucose as substrate. Then, the selected inoculum, subjected to each pretreatment was evaluated using PW as substrate. Moreover, the role of pH (pH_0: 5,5 - phosphate pH buffer), and SIR (0.6 – 2.0 g_{COD}/g_{COD}) were also evaluated, considering the VFAs production and COD removal.

MATERIALS & METHODS



RESULTS

Table 1. H_2 cumulative production (mL/g_{COD}) under discontinuous operation with different inoculum sources and pretreatments using glucose as substrate. (SIR=1.6).

mL H_2/g_{COD}	NP	HP	AcP	AkP	BES
Inoculum 1	68.7 ± 8.8	**194.6 ± 5.3**	91.6 ± 13.3	122.6 ± 16.4	206.4 ± 27.3
Inoculum 2	38.9 ± 3.9	102.5 ± 6.1	52.0 ± 3.3	95.9 ± 12.0	112.5 ± 9.9
Inoculum 3	2.5 ± 1.0	94.0 ± 5.5	15.9 ± 2.4	68.6 ± 9.8	91.2 ± 12.1

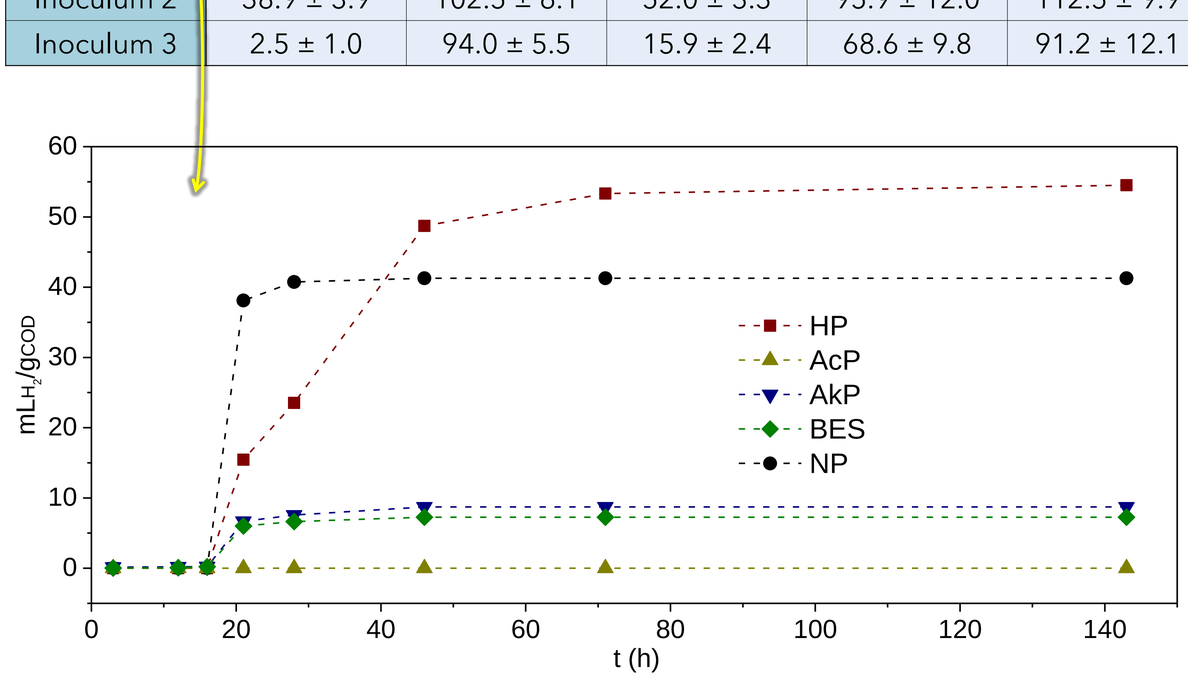


Figure 1. Time course of H_2 production (mL_{H2}/g_{COD}) from PW, using inoculum 1 (SIR=1.6; pH_0= 5.5; No buffer).

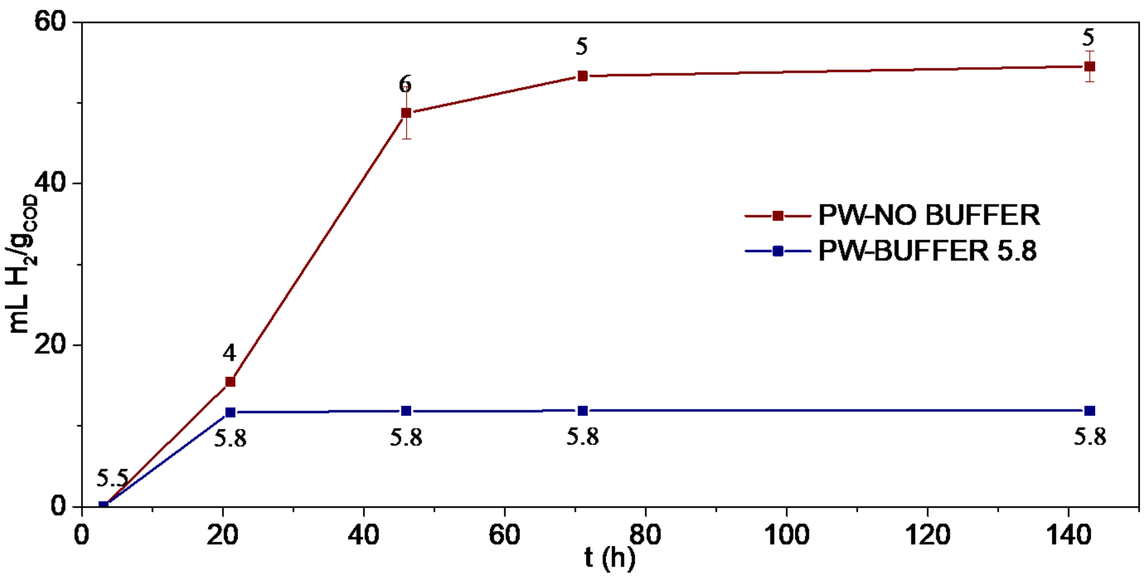


Figure 2. Time course of H_2 production (mL_{H2}/g_{COD}) from PW, using inoculum 1 HP to determine the effect of pH buffer (SIR=1.6; pH_0= 5.5 or pH Buffer).

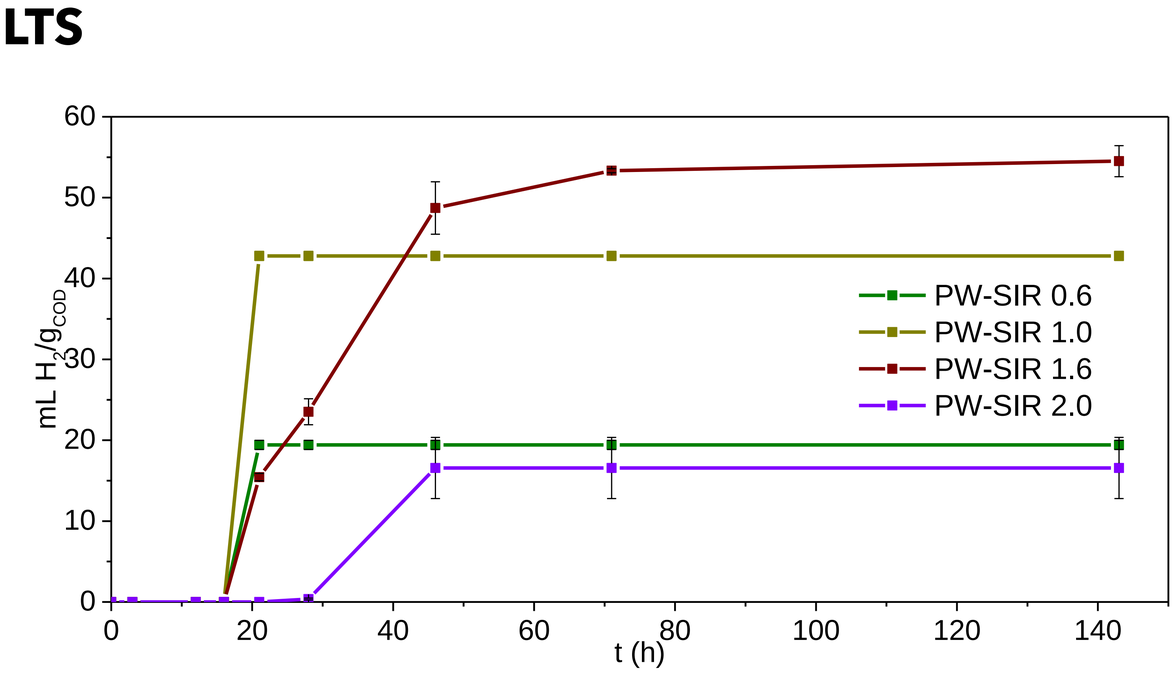


Figure 3. Time course of H_2 production (mL_{H2}/g_{COD}) from PW using inoculum 1 pretreated at different SIR (HP; pH_0= 5.5)

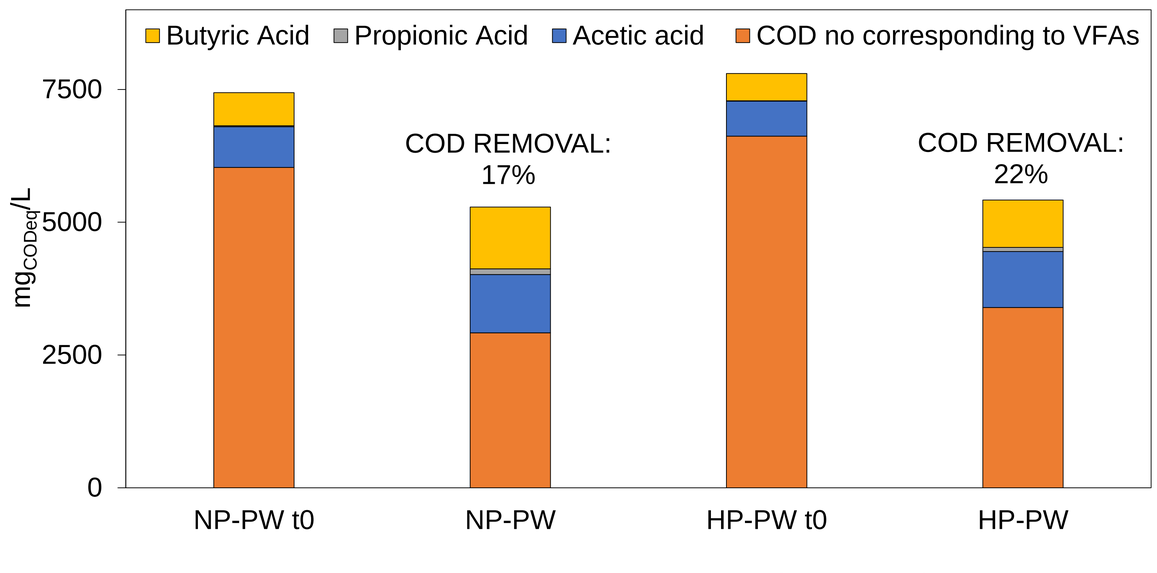


Figure 4. COD (mg/L) distribution comparison at initial and final time of experiments carried out with inoculum 1 (NP and HP) (SIR=1.6; pH_0= 5.5).

CONCLUSIONS

Heat-pretreated inoculum 1 was selected as optimal one according to results of H_2 production from glucose and PW. DF of PW revealed that phosphate pH buffer at 5.8 affected negatively the H_2 production, being this higher when the medium was not buffered. SIR of 1.6 was determined as the optimal to avoid substrate inhibition but assuring organic matter availability for microorganisms. COD removal is slightly higher (17% vs. 22%) when the inoculum was heat pretreated. Acetic acid concentration increases 43% and 60%, reaching 1098 and 1054 mg_{CODeq}/L on NP and HP experiment each, while butyric acid concentration rose 87% and 74% to 1164 and 892 mg_{CODeq}/L in them. It can be concluded that PW is a suitable feedstock to DF process to produce H_2 and VFAs.

References

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