

Comparison of polyhydroxyalkanoates production efficiency from acidified kitchen biowastes in Sequential batch and Fed batch mode



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Polyhydroxyalkanoates (PHAs) are microbial polymers with immense potential as sustainable alternatives to fossil plastics, contributing thus to the reduction of plastic pollution. However, one of the main problems for their commercialization remains their high production cost, to which the cost of raw materials contributes significantly. Food waste, FW, on the other hand, is generated at large quantities in all stages of the food production chain and their treatment constituting a major environmental concern globally. Using FW as a feedstock for PHA production may thus provide a dual benefit i.e. the sustainable management of FW with simultaneous valorization and reduction of PHA production cost.



Development of PHAs in Sequence Batch Reactor (SBR)

- ✓ Valorization of acidified kitchen biowastes,
- ✓ Develop MMC in batch mode and in Fed Batch mode
- ✓ Select optimal operation condition for PHAs production

INTRODUCTION

SCOPE



Sequence Batch reactor (SBR)

Selection of Optimal Operational Conditions

Batch Mode Exp.

- Carbon to Nitrogen ratio:
100 mg COD/ mg TN
50mg COD/mg TN
- Substrates Initial Concentration:
10 g COD/L
15 g COD/L
20 g COD/L

Fed- Batch Mode Exp.

- Substrates Initial Concentration:
15 g COD/L
20 g COD/L

PHAs-Producing microorganisms via nutrient limitation

SBR Operational Protocol

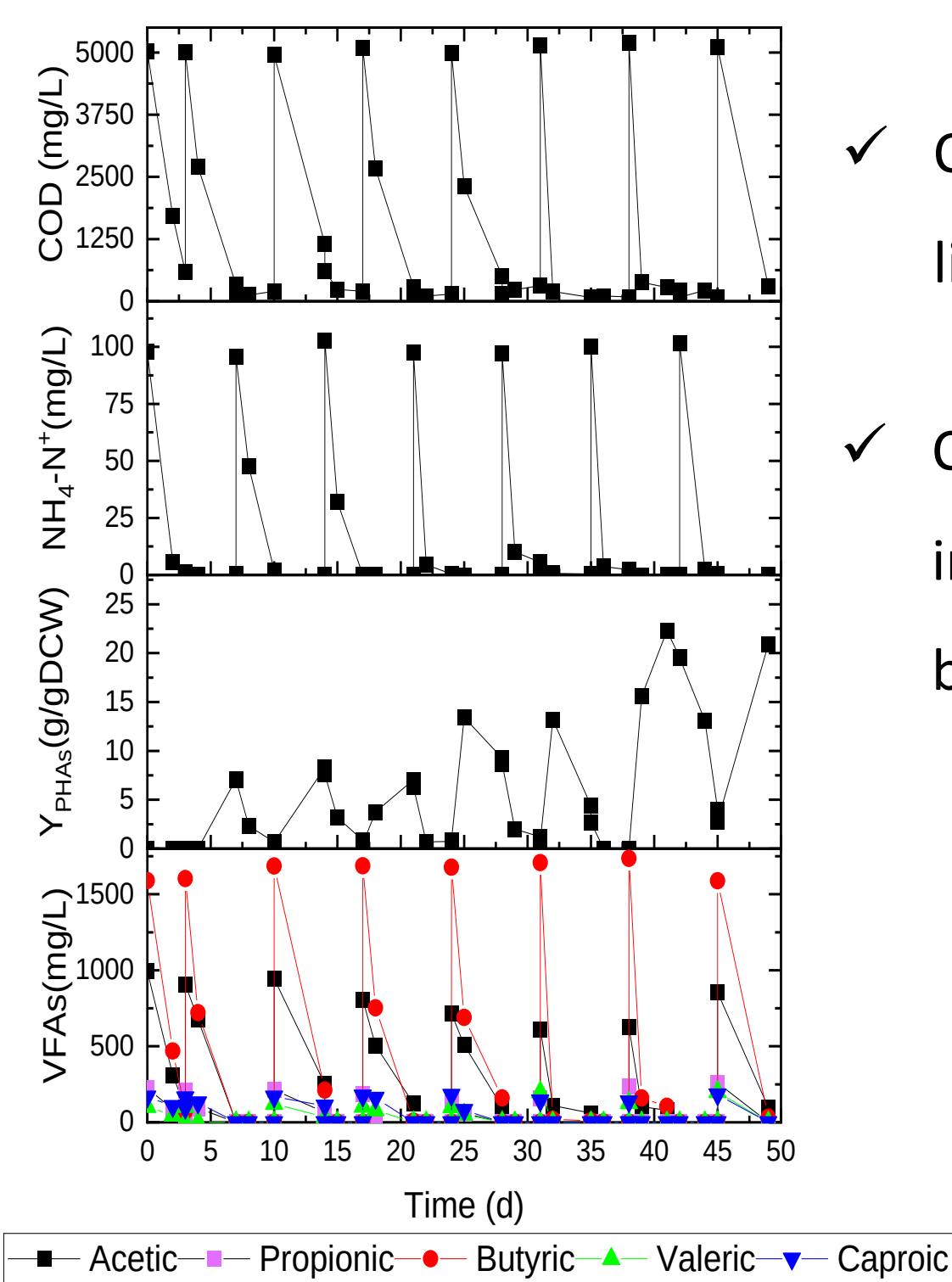
- ✓ Vw : 3000 mL
- ✓ COD: 5000 mg/L
- ✓ N-NH₄⁺: 100 mg/L
- ✓ C/N: 100 mg COD/mg TN
- ✓ Feeding Mode: 3d-4d

Acidified kitchen biowaste

Composition

- ✓ COD: 50147.7 mg/L
- ✓ Acetic Acid: 9469.9 mg/L
- ✓ Propionic Acid: 2183.3 mg/L
- ✓ Butyric Acid: 15783.2 mg/L
- ✓ Valeric Acid: 1415.8 mg/L
- ✓ Caproic Acid: 2274.2 mg/L
- ✓ Total Nitrogen: 81.6 mg/L

METHODOLOGY



- ✓ Complete C and N limitation
- ✓ Continuing increase in PHAs bioaccumulation

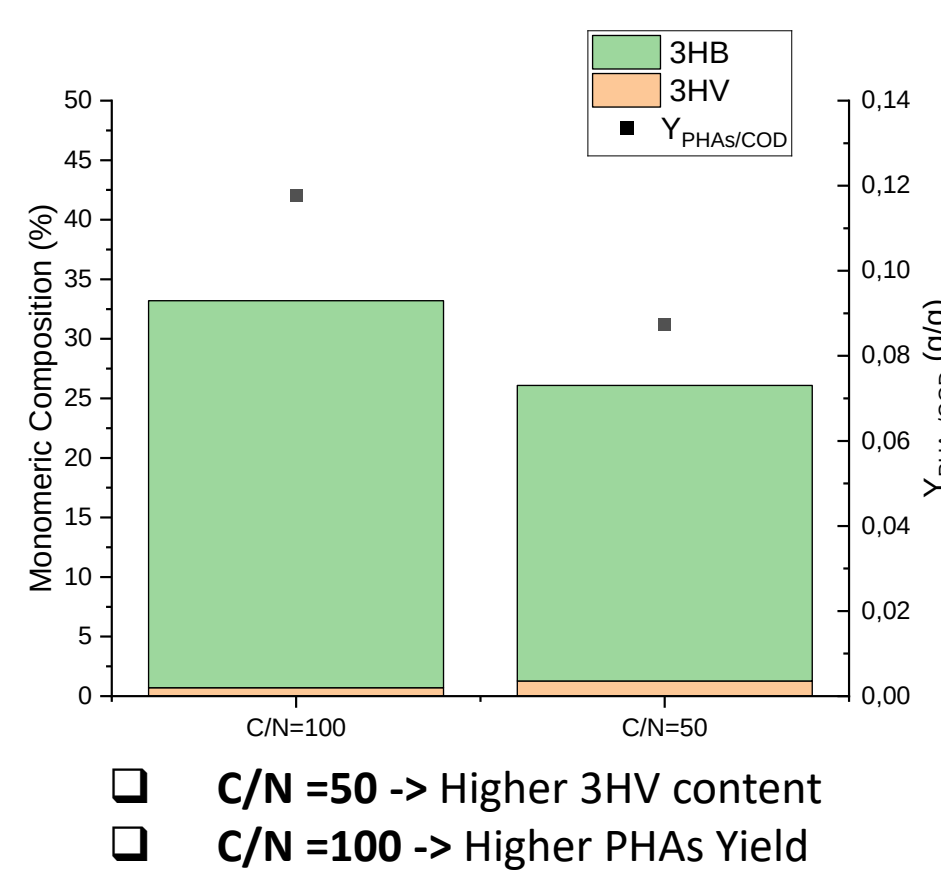
SBR Operational Results

Further investigation in fed batch optimal operational mode is needed in terms of:

- C/N ratio
- Volumetric flow rate
- Cultivation time

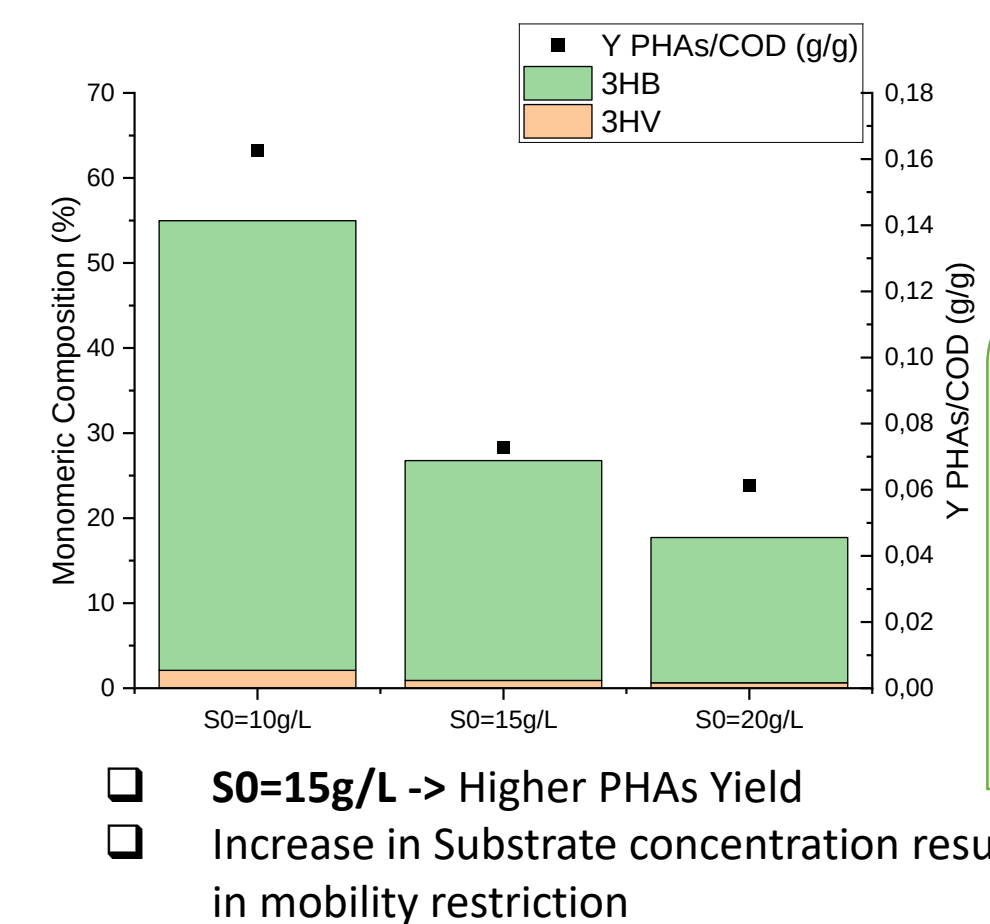
Future work

Carbon to Nitrogen Ratio



- ☐ C/N =50 -> Higher 3HV content
- ☐ C/N =100 -> Higher PHAs Yield

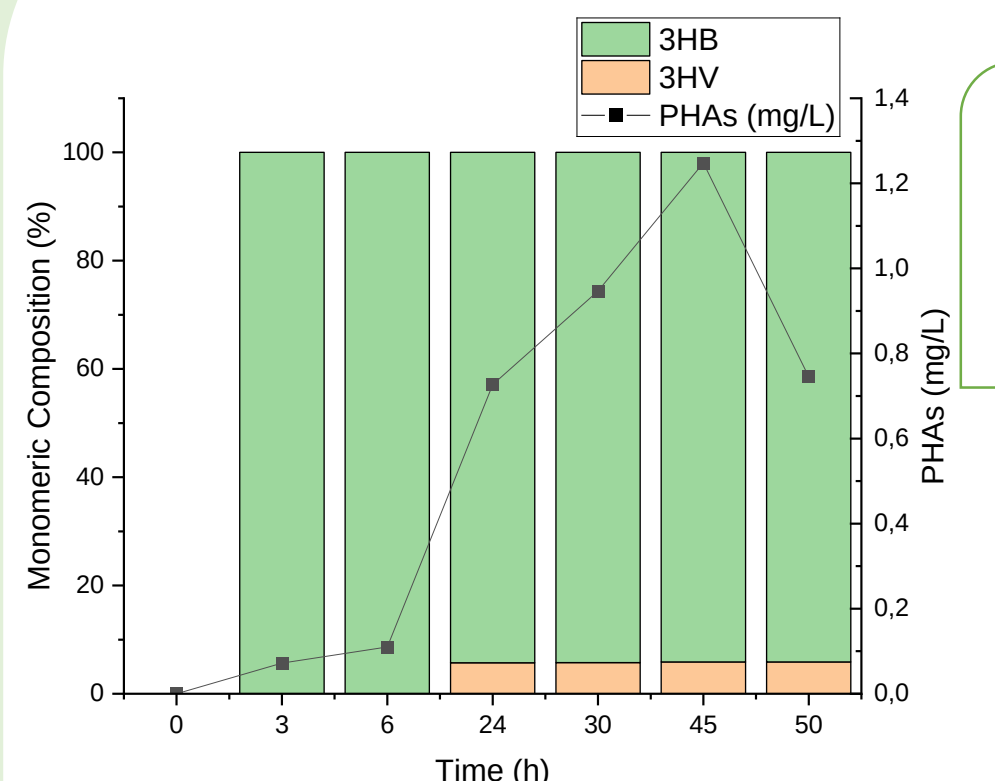
Substrates Initial Concentration



- ☐ S0=10g/L -> Higher PHAs Yield
- ☐ Increase in Substrate concentration results in mobility restriction

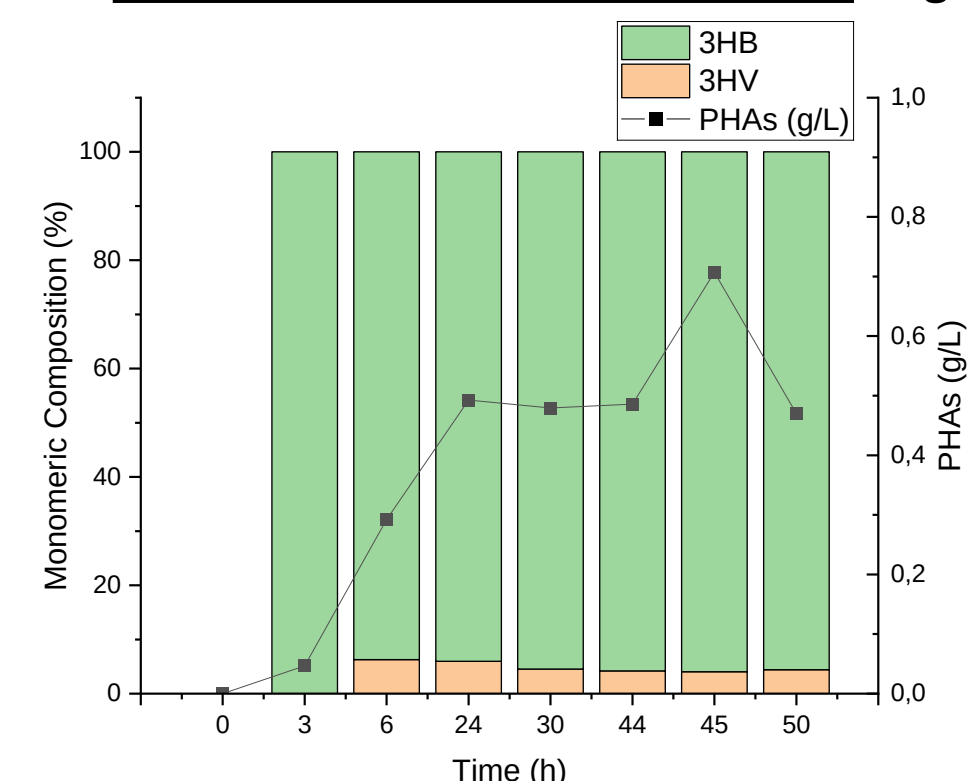
Batch Experiment Results

Substrates Initial Concentration: 15 g COD/L



- ✓ Fed Batch mode increase COD consumption
- ✓ PHAs yield and 3HV content increase

Substrates Initial Concentration: 20 g COD/L



- ✓ Higher COD consumption than the Batch
- ✓ Slight increase in PHAs yield

Batch Experiment Results

Using acidified kitchen waste as a substrate in MMC leads to the development of biocatalysts with distinct characteristics in terms of the PHAs production potential.

In Batch mode experiments it was shown that:

- ✓ By using an appropriate C/N ratio and COD concentration PHAs production yield reached ~55% and COD reduction to ~93%.

In Fed-Batch mode experiments it was shown that:

- ✓ Gradual feeding of acidified kitchen biowastes in the system prevented mobility restriction and increase COD removal and PHAs production.

CONCLUSIONS



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