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Fermentation of Municipal Solid Waste to Lactic Acid using Lactobacillus Salivarius

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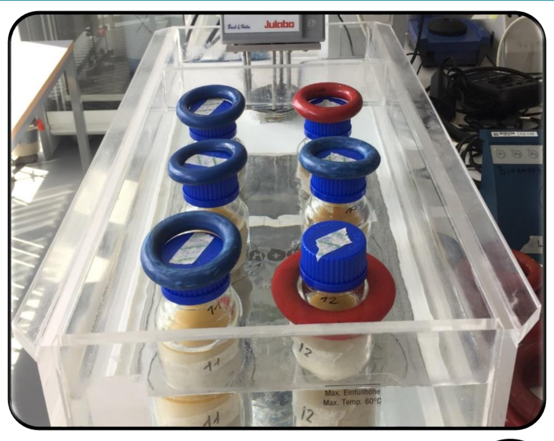
INTRODUCTION

'For the sustainable development of our society, proper waste management is crucial to minimize environmental degradation and to recover valuable resource' [1]. The production of Lactic Acid from OFMSW (Organic Fraction of Municipal Solid Waste) can help give value to organic waste by exploiting its potential as raw material and reducing its impact on the environment and human health. The aim of this study is to quantify the production of Lactic Acid from OFMSW using the *Lactobacillus salivarius* bacteria through simultaneous saccharification and fermentation (SSF).



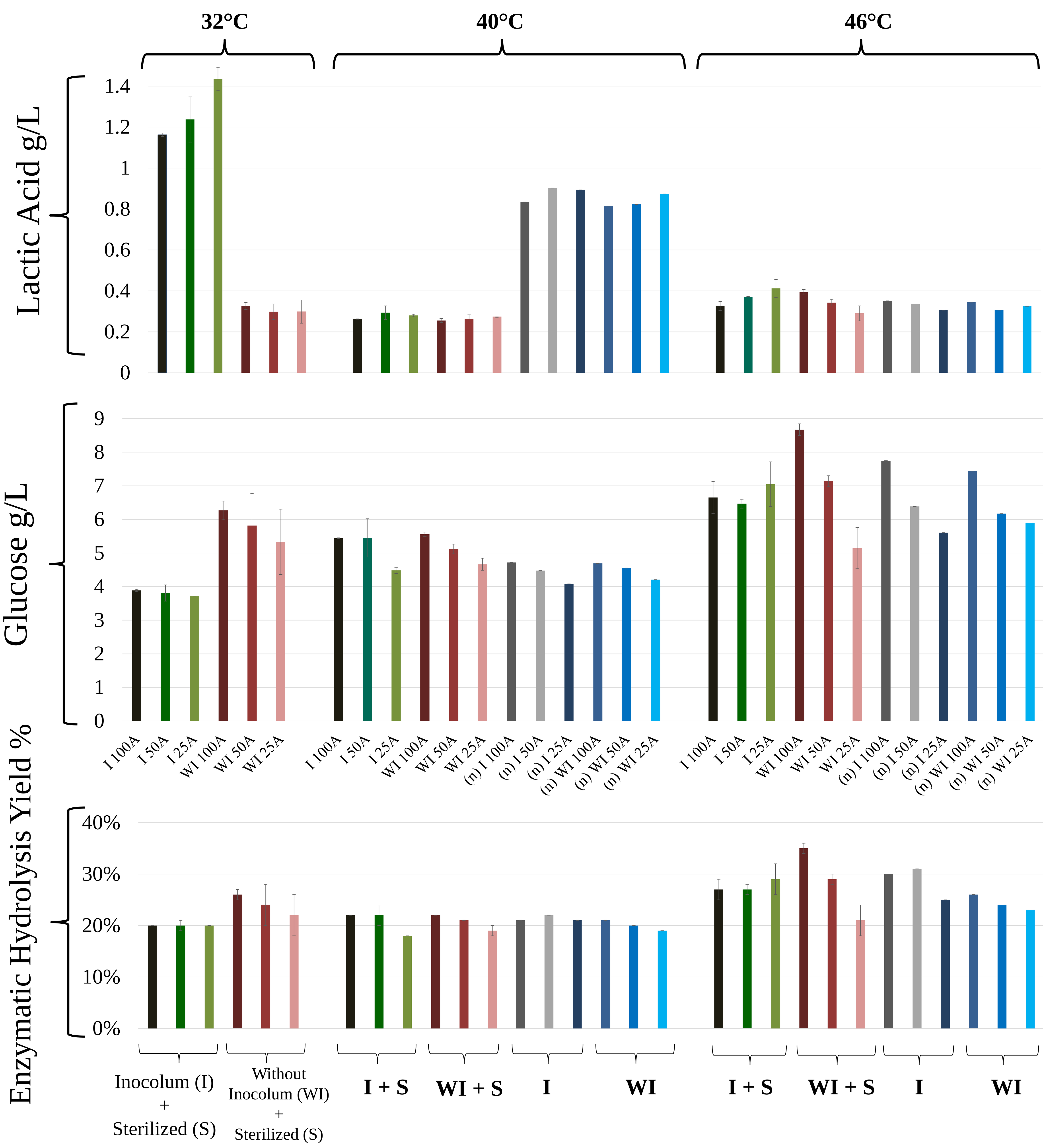
MATERIALS AND METHODS

A pre-defined composition of the OFMSW is fed into a food processor for size reduction [2]. Dry matter content of the OFMSW was 31.6 % and added to flasks with a 30% w/w loading. The sterilized samples are autoclaved at 85°C for 1 hour before the addition of the inoculum. Simultaneous saccharification and fermentation (SSF) was carried out using baker's yeast and *Lactobacillus salivarius BC 1001* [3,4]. Enzymatic hydrolysis of the samples was carried out using commercial enzymes at constant loading (weight percent per total solids) in the ratio of cellulase : amylase : hemicellulase : pectate lyase : lipase : protease = 1:1:1:0.2:0.2:0.2:0.2. This mixture is referred to as loading A. SSF was performed for 215 hours (almost 9 days) at three temperatures (32, 40, and 46°C). The concentration of glucose and lactic acid was analyzed using HPLC upon the completing of the experiments.

RESULTS

- The graphs show the production of lactic acid, glucose, and enzymatic hydrolysis as a percentage of the total theoretical yield at the different temperature and enzyme loadings.
- The highest lactic acid production, 1.43g/L, takes place at 32°C and with the lowest enzyme loading (I 25A) in the presence of *L. salivarius.*
- At 32°C, sterilized samples with inoculum gave the highest lactic acid yield.
- At 40°C the highest lactic acid production, 9.02g/L, takes place with the 50% enzymes loading, without sterilization. Infact, the highest yields were in the cases when sterilization is not performed, thus suggesting an optimization from a process stand point by skipping a heating step.
- At 46°C the highest amounts of glucose were present however the lactic acid production is low. It can be inferred that most of the available glucose is not converted into lactic acid. However literature suggest that this is the ideal temperature for lactic acid production, thus suggesting either the presence of a weak *L.salivarius* strain or incomplete hydrolysis.
- At 46°C, enzyme loading does not have a significant effect on the sterilized samples. Whereas at 40°C sterilization itself does not have an effect, since all the samples with and without inoculum have similar glucose production.

GRAPHS



CONCLUSIONS

The HPLC results analyzed for glucose, acetic acid, and lactic acid. Some peaks in the chromatogram were unidentified, suggesting that certain disaccharides and oligosaccharides were not been presented in these results. These yield strongly indicate that a complementary process model optimization study of MSW to lactic acid production must be performed to fully understand economic potential of these results. In several cases the absence of a sterilization step delivers higher yields thus reducing operating costs. However costs associated with recovery of lactic acid and varying enzyme loading can play a pivotal role in tilting the economics. Both lactic acid and glucose can serve as products streams in a biorefinery, however the importance of one over the other depends on the type of biomass processed in the biorefinery

REFERENCES

[1] Mi-Sun K., Jeong-Geol N., Mo-Kwon L., Hoyoung R., Yong-Keun C., Jin M. T., Yeo-Myeong Y., Dong-Hoon K., (2016), More value from food waste: Lactic acid and biogas recovery, Water Research 96; 208-216
[2] A. Nwobi, I. Cybulska, W. Tesfai, Y. Shatilla, J. Rodríguez, and M. H. Thomsen, Simultaneous saccharification and fermentation of solid household waste following mild pretreatment using a mix of hydrolytic enzymes in combination with Saccharomyces cerevisiae.(2014) Applied microbiology and biotechnology, vol. 2018, pp. 1–10
[3] Jensen JW, Felby C, Jørgensen H, Rønsch GØ, Nørholm ND (2010).Enzymatic processing of municipal solid waste. Waste Manag 30:2497–2503
[4] Jørgensen H, Vibe-Pedersen J, Larsen J, Felby C (2006) Liquefaction of lignocellulose at high-solids concentrations. Biotechnol Bioeng 96(5):862–870