Treatment of High Salinity Food-Processing Waste and Lipid Production Using a Thraustochytrid

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1. Introduction

Biological treatment such as anaerobic digestion has been widely applied for treatment of organic waste. Although many papers reported the successful application of anaerobic digestion for wide variety of food waste in terms of removal of organic compounds and specific byproduct production[1,2)], the methodology may not readily be applied for saline liquid waste due to inhibition by possible cellular plasmolysis from increased osmotic pressure and ineffectiveness of flocculation/sedimentation less due to increased buoyancy force.[3)] In this study, we focused on use of thraustochytrids for treatment of saline liquid wastes and simultaneous production of lipids. Certain strains of thraustochytrids are halophilic and known to produce lipids including polyunsaturated fatty acids (PUFAs)[4)]. In the present study, we investigated the potential of a thraustochytrid in removal of organic carbon and nitrogen from saline liquid food waste and production of lipids.

2. Methods

Saline liquid food waste and thraustochytrid

Three saline liquid food waste samples (Samples A-C) were collected from a food factory in Japan. After settled overnight, the liquid waste samples were used for cultivation of a thraustochytrid. The salinity and organic carbon and nitrogen contents in the liquid waste are summarized in **Table 1**. As the thraustochytrid for testing, *Aurantiochytrium* strain L3W was used.

Table 1. Quality data of the three liquid waste samples.

Sample	pH	Salinity [psu]	TOC [mg/L]	TN [mg/L]
A	4.2	28	277500	5500
B	4.5	20	272500	5250
C	3.7	11	387500	300
Control (790By+)	7	30	4500	400

Cultivation of strain L3W

The samples A—C were diluted 25 times with sand-filtered sea water and adjusted to pH4 or pH7 at which *Aurantiochytrium* strain L3W can grow. After autoclave treatment, 100 ml of each sample was poured into 500 ml Erlenmeyer flasks, and then the precultured strain L3W was inoculated at 10^4 cells/ml. The culture flasks were incubated in triplicates in dark at 25℃ using a rotation at 70 rpm. In the control experiments the 790 By+ medium was used, while the samples A—C were also tested without autoclave treatment.

Analysis

The biomass production was measured by the filtration method and total lipid production was determined by the Folch method. Carbon and nitrogen contents in the culture solution were analysed using a total organic carbon analyzer (TOC-VSCN, Shimadzu) to investigate removal of organic carbon and nitrogen from the saline liquid food wastes. The fatty acids in the biomass of strain L3W was analyzed using GC/FID.

3. Results and discussion

Figure 1 indicates cell growth of the strain L3W in the liquid waste samples A—C after 72 h of the cultivation period. In sterilized condition, pH4 and pH7 comparable cell growth and biomass/lipid production. Since pH4 is the original pH of the wastewater samples, the result confirmed that these wastewater samples can be applied for cultivation of the strain L3W without pH adjustment. **Figure 2** shows the removal of dissolved organic carbon (DOC) and dissolved nitrogen (DN) by the strain L3W, where DOC and DN removal was found to be highest from the sample A; however the high DOC and DN concentrations remained. In addition**,** as shown in **Table 2**, the fatty acids production was confirmed by the strain L3W in the culture solution to which the sample A was added. The fatty acids were successfully produced by the strain L3W, though the unsterilized condition might not be good for this microorganism.

4. Conclusions

The saline liquid waste A and B can be used as the substrate for *Aurantiochytrium* sp. strain L3W. The removal of DOC and DN in parallel with fatty acids production was confirmed, though these might be affected by the cultural conditions.

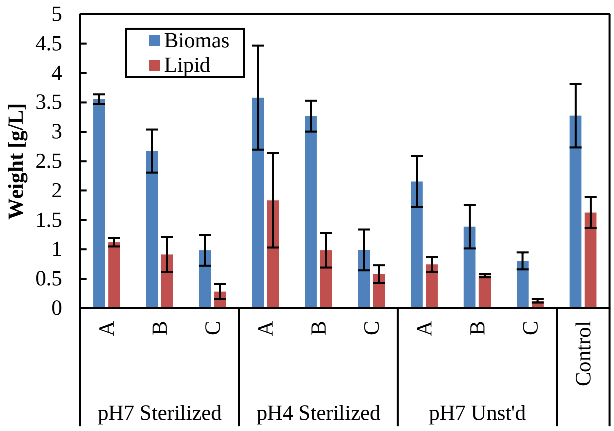

Figure 1. Biomass/lipid production of the strain L3W in the liquid food waste media under sterilized and unsterilized conditions. Bars indicate standard deviation (n=3).

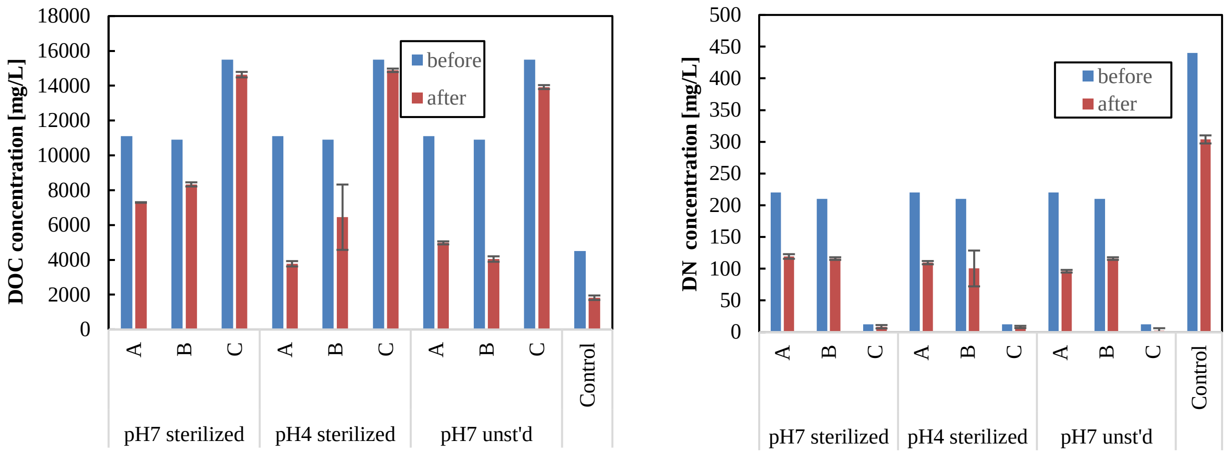

Figure 2. Concentrations of DOC (a) and DN (b) in the liquid food waste media before and after cultivation of the strain L3W. Bars indicate standard deviation (n=3).

Table 2. Production of fatty acids by the strain L3W using the sample A [mg/g-biomass]

Components	Sterilized sample A (pH7)	Sterilized sample A (pH4)	Unsterilized sample A (pH7)
Total fatty acids	339.114	376.490	236.525
Docosahexaenoic acid	143.648	187.798	105.912
Eicosapentaenoic acid	0.145	0.189	0.107

References

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