PHYCOSOL- A NOVEL SUSTAINABLE WINERY WASTEWATER TREATMENT FOR ENHANCING CIRCULAR ECONOMY

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Introduction

- Winery Wastewaters (WWW) are released from different activities of the wine making process, namely tank washing, transfer, bottling and filtration (Fig.1).
- WWW contains High organic content (alcohol, sugars, organic acids, polyphenols, lignins and tannins) and cleaning and disinfectants chemicals may present in smaller quantities depending on the process and location (Table 1)
- Current practices involve enormous capital investments, demand higher electricity and chemical usages that tend to create an environmental burden through GHG emissions.

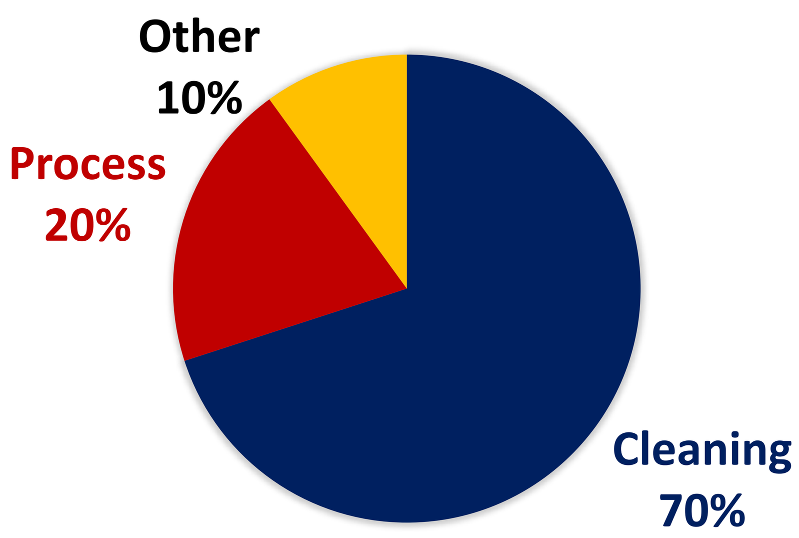


Fig 1. Contribution to wastewater from Winery

Table 1. Comparison of Winery wastewater

Parameters mg/L	Australia Avg.	Sample collected
pH	4-5	4.50
COD	4000-15000	6900
Total Nitrogen	12 – 110	54
Total Phosphate	3 -52	97

(Ganesh kumar et al., 2018, Liu et al., 2016, Mosse et al., 2011)

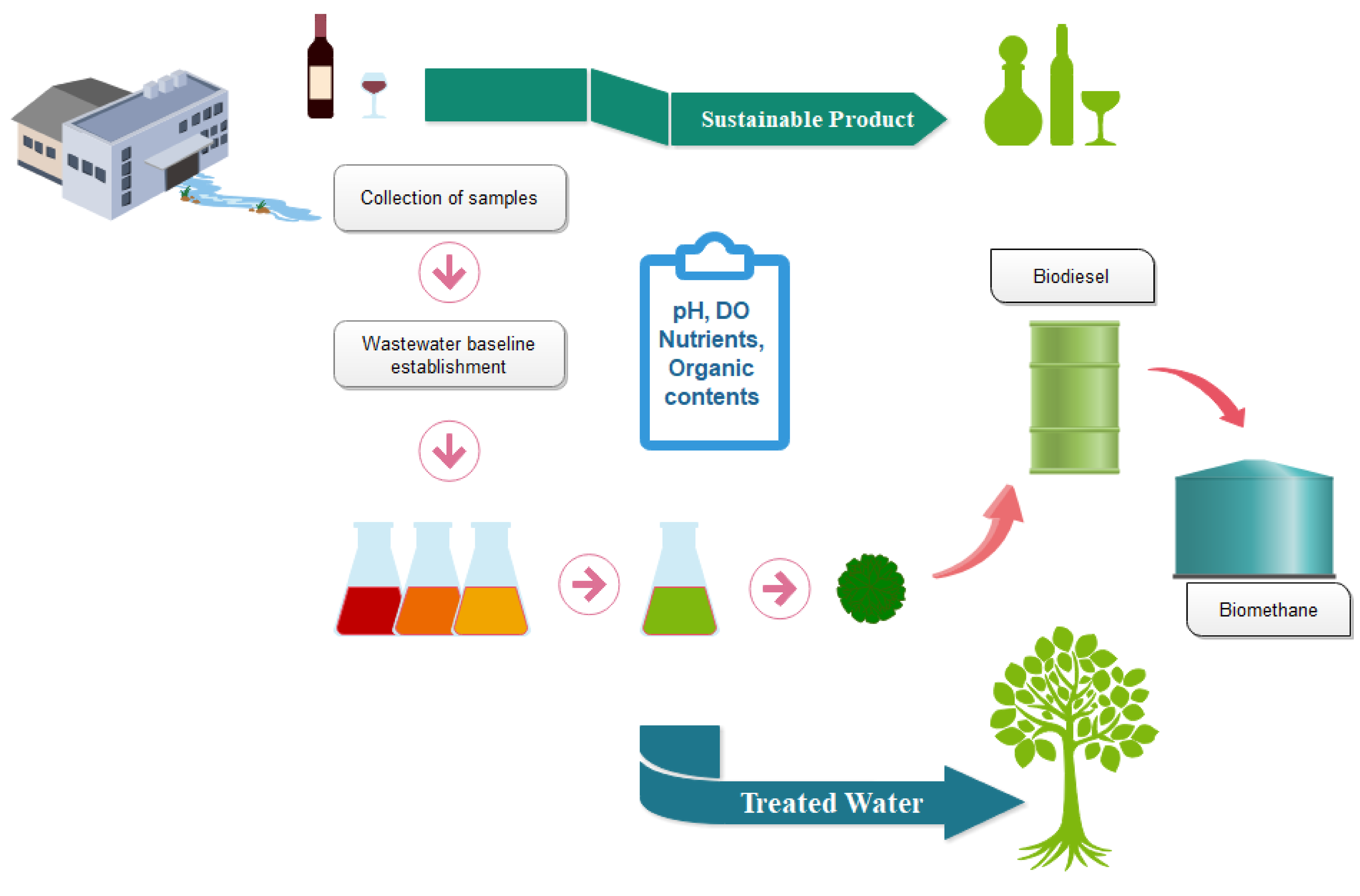
Aims

- ❖ To assess the remediation efficiency at identified WWW strength using microalgae *Desmodesmus* sp. MAS1, *Heterochlorella* sp.MAS3.
- ❖ The ability to generate value-added products from biomass produced from WWW samples through a circular economy model was investigated.

Methods

- ❖ WWW was collected from local winery and the physio-chemical properties analysed.
- ❖ WWW samples were filtered and inoculated with microalgae strains MAS1 and MAS3 at concentration of $10x10^5$ to evaluate the nutrient removal capacity.
- ❖ Microalgae growth was measured in terms of chlorophyll fluorescence (Abinandan et al., 2019).
- ❖ Biodiesel was produced from algal biomass through Transesterification process.
- ❖ Finally, biomethane potential was estimated from the lipid extracted biomass for a circular economy model.

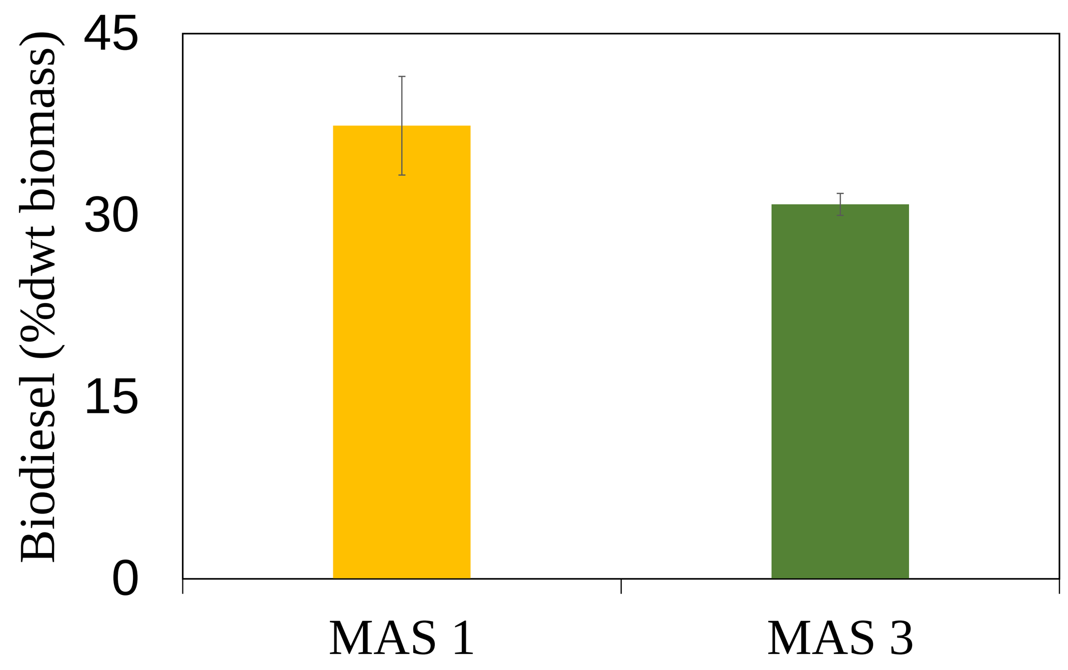
Overview



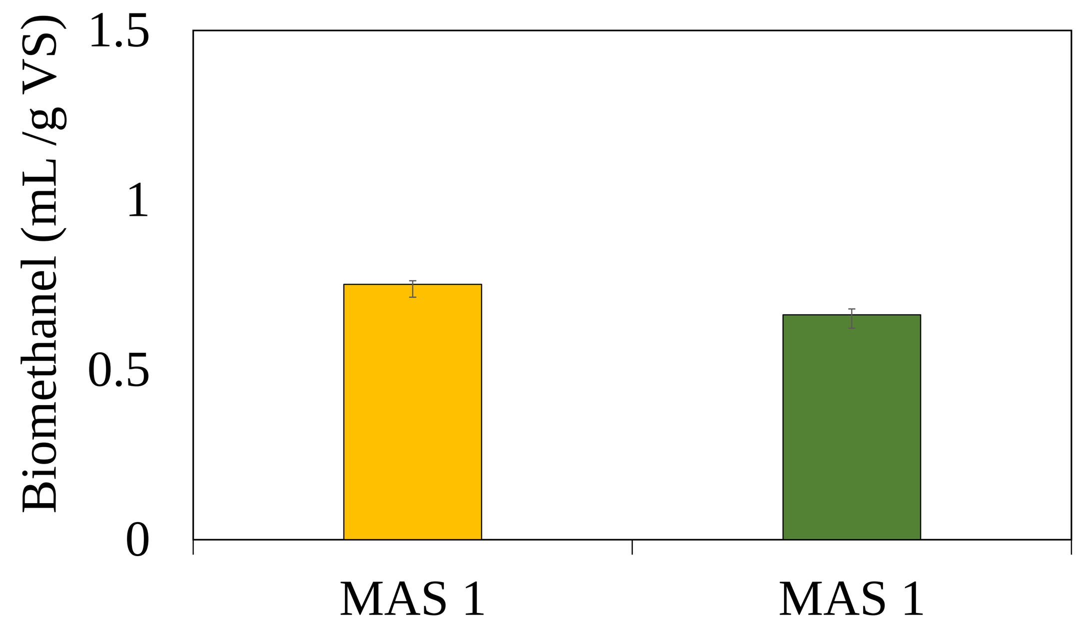
Results

- ❖ The acid tolerant algal strains produced 1.6-1.8g L^{-1} biomass by the end of day 14 in WWW.
- ❖ The strains *Demsodesmus* sp. MAS1 and *Heterochlorella* sp. MAS3 exhibited removal efficiency of 90% for TOC and above 80% for TP and TN in WWW at pH 4.5.
- ❖ Subsequently, when subjected to biodiesel production MAS1 showed yield of 40% (dwt biomass) whereas the MAS3 showed 32% (dwt biomass) in WWW sample (Fig. 2a).
- ❖ Biomethane potential of lipid extracted microalgae strains ranged between 0.78mL CH_4/g VS (MAS1) and 0.68mL CH_4/g VS (MAS3) showing the potential for efficient resource recovery (Fig. 2b).

Fig 2.



(a)Biodiesel Yield of strains



(b) Biomethane Potential of Residual biomass

Conclusions

- ❖ MAS1 & MAS 3 strains tested for their Nutrient Removal potential in Winery wastewater have shown significant biomass productivity.
- ❖ Our study suggests that adapted acid tolerant microalgae strains have great potential as candidate for generation of high value-added products such as biodiesel and biomethane enhancing circular economy model.

References

- ❖ Ganeshkumar, V., Subashchandrabose, S. R., Dharmarajan, R., Venkateswarlu, K., Naidu, R., & Megharaj, M. (2018). Use of mixed wastewaters from piggery and winery for nutrient removal and lipid production by Chlorella sp. MM3. Bioresource technology, 256, 254-258.
- ❖ Liu, C., Subashchandrabose, S., Ming, H., Xiao, B., Naidu, R., & Megharaj, M. (2016). Phycoremediation of dairy and winery wastewater using Diplosphaera sp. MM1. Journal of Applied Phycology, 28(6), 3331-3341.
- ❖ Mosse, K. P. M., Patti, A. F., Christen, E. W., & Cavagnaro, T. R. (2011). Winery wastewater quality and treatment options in Australia. Australian Journal of Grape and Wine Research, 17(2), 111-122.
- ❖ Abinandan, S., Subashchandrabose, S.R., Cole, N., Dharmarajan, R., Venkateswarlu, K. and Megharaj, M. 2019 Sustainable production of biomass and biodiesel by acclimation of non-acidophilic microalgae to acidic conditions. Bioresource technology, 271,316-324.

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