Advancing *Chlorella sorokiniana* BSL as a Carbon-Neutral Platform for Sustainable Aviation Fuel (SAF) Production

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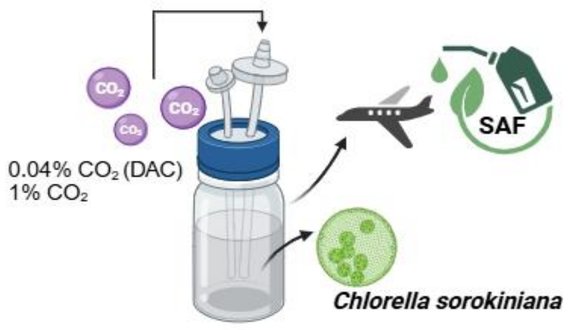
The opportunity of microalgae to SAF

With the growing importance of sustainable development and carbon neutrality, carbon reduction in the aviation industry has also drawn significant attention. As a response, the aviation industry has proposed the use of Sustainable Aviation Fuels (SAF), aiming to produce aviation fuels from renewable resources to achieve carbon reduction goals. **Among various options, microalgae have shown great potential due to their rapid growth and strong environmental adaptability. Among different microalgal species, *Chlorella sorokiniana* stands out for its high lipid content.** Therefore, this project investigates the feasibility of using *Chlorella sorokiniana* BSL as a sustainable aviation fuel. By utilizing the strains developed in our laboratory, we aim to identify the optimal cultivation conditions, i.e., direct air capture (DAC) and 1% CO_2 or different devices including tube or photobioreactor (PBR), evaluate the effects of monosodium glutamate (MSG) and sodium chloride supplementation on biomass and metabolites production. The goal is to scale up the production of high-lipid *Chlorella sorokiniana* BSL.

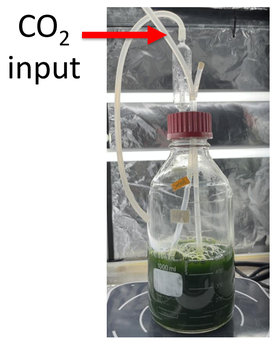
Keywords: *Chlorella sorokiniana*, carbon dioxide capture, lipid production, sustainable aviation fuel, MSG

Total of concept



Critical issue is to
(1) Find the best cultural conditions.
(2) Analysis of the composition

Experimental methods

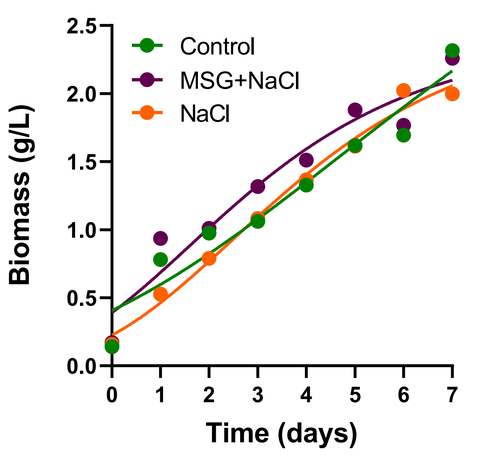


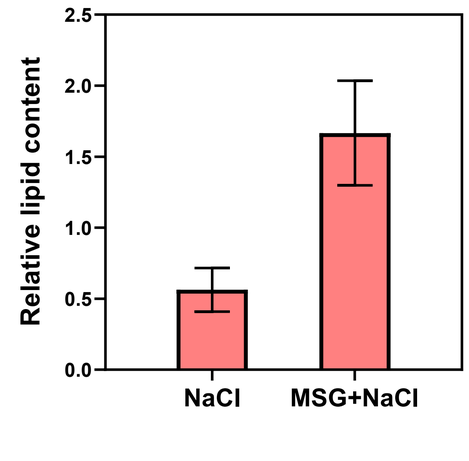
Starch analysis: phenol-sulfuric acid

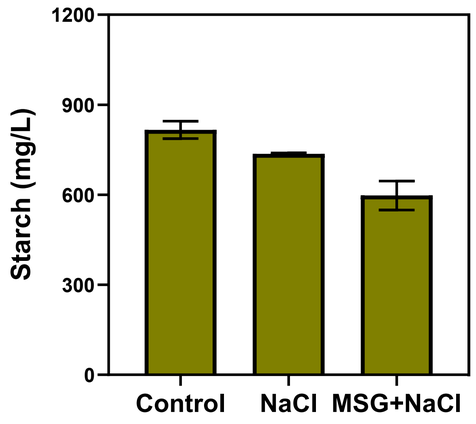
Protein analysis: BioRad reagent

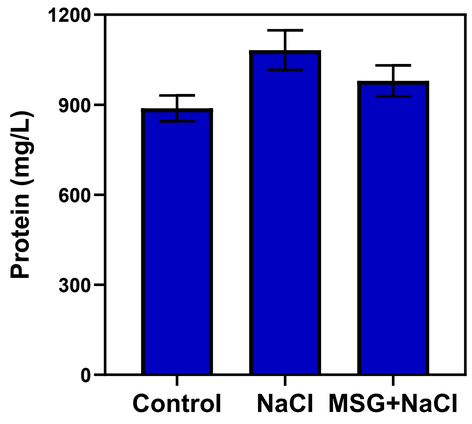
Lipid analysis: Nile red stainning

Cultivation in tubes under DAC condition



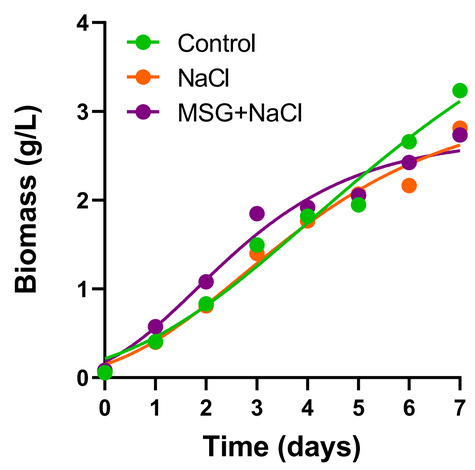


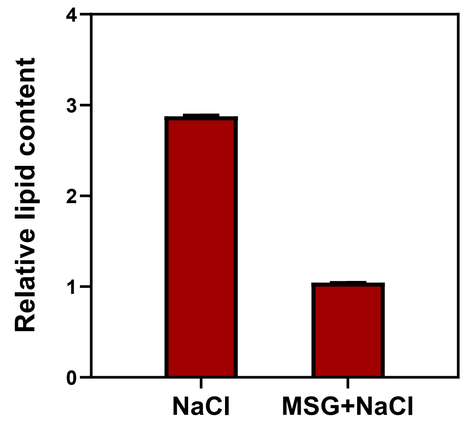


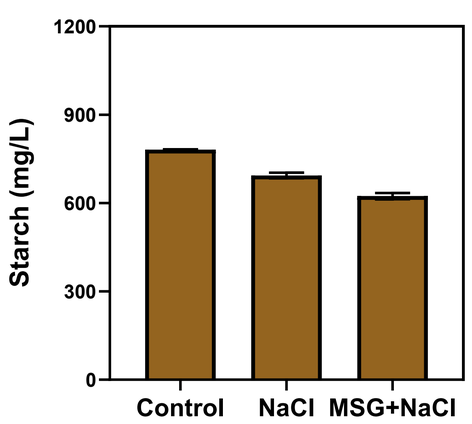


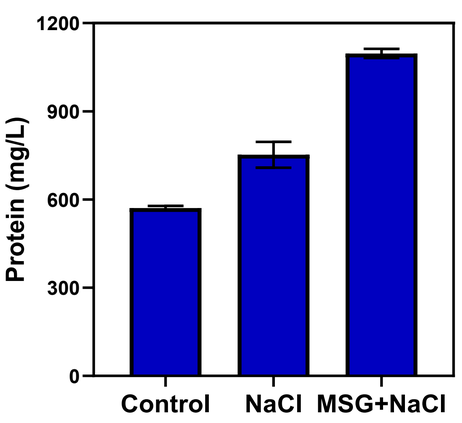
Culture method	Treatment	Starch yield (%)	Protein yield (%)
Cultivation in **tubes** under **DAC** condition	Control	**32.52**	14.16
	NaCl (10 g/L)	24.55	**14.43**
	MSG (10mM) +NaCl (10 g/L)	17.68	11.59
Cultivation in **PBR** under **1% CO_2** condition	Control	**36.53**	10.67
	NaCl (10 g/L)	25.69	11.14
	MSG (10mM) +NaCl (10 g/L)	18.56	**13.06**

Scale-up cultivation in PBR under 1% CO_2 condition









After seven days of cultivation, the biomass of the control group reached **2.32 g/L**. The addition of NaCl reduced cell growth by **14%**, whereas supplementation with MSG restored biomass to the control level. Under salt stress, starch content decreased, but **the addition of MSG enhanced both protein and lipid production, with a particularly notable increase in lipid content**. However, strong evaporation effects in tube cultures introduced variability, prompting the use of large-scale PBR systems for improved stability and greater cultivation volumes. In the PBR experiments, biomass performance under salt stress and with MSG supplementation was comparable, and both were lower than the control. The MSG + NaCl treatment achieved the fastest growth during the early cultivation stage. **Both NaCl and MSG + NaCl treatments reduced starch content while increasing protein and lipid production. Salt stress increased lipid content by 2.87-fold, whereas MSG supplementation primarily promoted protein synthesis.**

Conclusion

Compared with the control, either MSG + NaCl or NaCl treatment resulted in reduced starch production, while protein and lipid contents increased in both cultivation systems. This approach aligns with our objective of producing high–lipid-content microalgae. **Future work will focus on heat value and lipid composition analysis to promoting the use of microalgae for SAF production**.

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