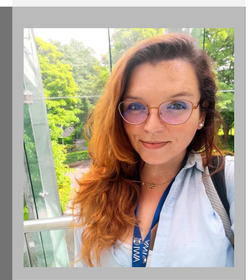
Salinity as a key factor for strain selection and optimization of *Ulva* spp. for land-based cultivation



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Introduction

The mission of the Mak-Pak Scale-Up project (2021-present) is to develop a seaweed-based food packaging material and to sustainably scale-up the production of seaweed, including *Ulva* spp., in a recirculating land-based facility supplemented with artificial seawater that requires a selection and optimization of the seaweed of interest. The *Ulva* genus has previously shown high plasticity and capacity to acclimate and develop under broad ranges of environmental conditions, suggesting this may be a promising candidate for production in a RAS with low salinity artificial seawater. Selecting an *Ulva* strain well adapted to such conditions will help reduce the costs of salt and, therefore, optimize production. The aim of this study was to determine how salinity can be used and adapted throughout the entire *Ulva* production to define several key points: 1) strain selection 2) nursery and seeding 3) optimized production in adult *Ulva* and 4) increasing functionality (e.g., high antioxidant activity). Based on the results of three different experiments, it was possible to conclude how salinity impacts different strains of *Ulva* (tubular and blade species) from warm temperate environments, during three key moments of their development and with that, conclude which strains would be more suited to be scaled up within the scope of land-based production. At the same time, the data presented serve as a baseline for further work with *Ulva* under different cultivation conditions.

1. Salinity influence on *Ulva* Germlings - Relative Growth Rate

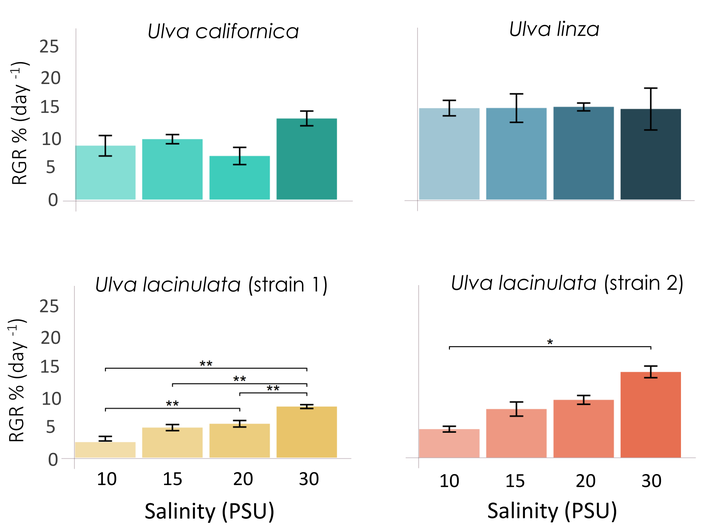
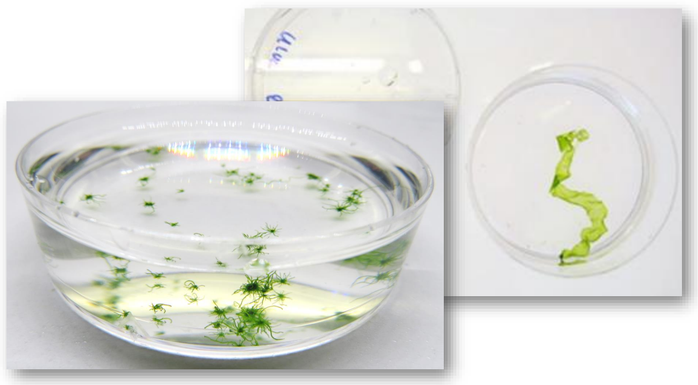


Fig. 1 - Relative Growth Rate *(% day $^{-1}$)* **of Ulva germlings after 3 weeks under different salinity conditions (mean ± SE). Results of PERMANOVA test showing the significance of differences between mean RGR of the different Ulva strains ($p < 0.05$).**



Adapted from Sawicki, 2022

2. Salinity influence on *Ulva* Adults - Relative Growth Rate

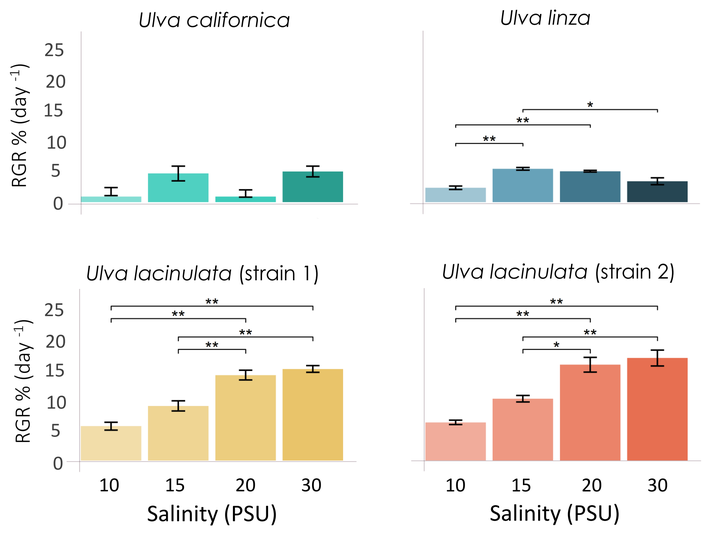


Fig. 2 - Relative Growth Rate *(% day $^{-1}$)* **of adult Ulva after 2 weeks under different salinity conditions (mean ± SE). Results of PERMANOVA test showing the significance of differences between mean RGR of the different Ulva strains ($p < 0.05$).**

Nutrient source: 55,5.µmol/L of Blaukorn (COMPO SANA®, Germany)

3. Salinity influence on *Ulva* Adults - Antioxidant Activity

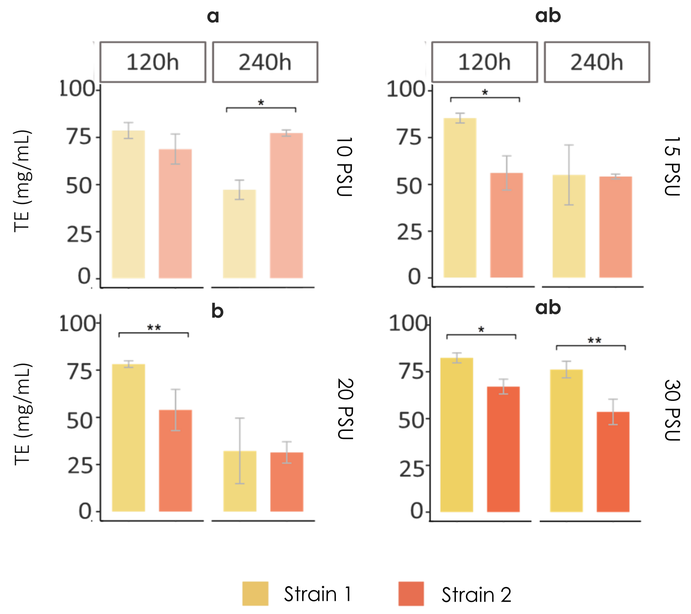


Fig. 3 - Antioxidant concentration *(Trolox Equivalent in mg/mL)* **of adult U. lacinulata (strain 1 and 2) under different salinity conditions over a period of 240 hours (mean ± SE). Results of PERMANOVA test showing the significance of differences between mean TE of the two Ulva strains ($p < 0.05$). Letters "a", "ab", and "b" represent the comparison between treatments for U. lacinulata (strain 2) at 240h.**

Biological material: *U. lacinulata* (strain 1 and 2)
Duration: 10 days
Nutrient source: 55,5.µmol/L of Blaukorn (COMPO SANA®, Germany)

Adapted from Meissner, 2022

Methodology

Biological material

Tubular species: *U. linza*
U. californica

Blade species: *U. lacinulata*
(strain 1 and strain 2)

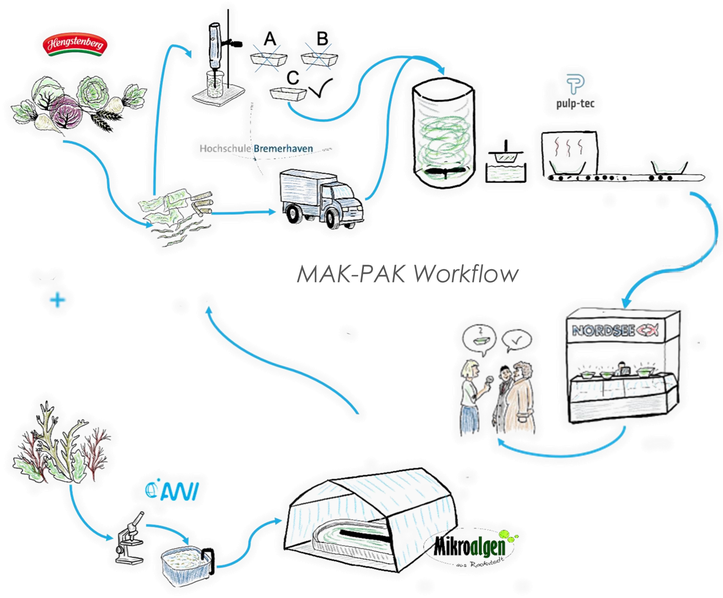
Treatments

10, 15, 20, 30 PSU
(n=3)

Duration: 3 weeks

Culture conditions

Light intensity: 100 µmol photons.m^{-2}.s^{-1}
Daylength: 16:8h LD
Nutrient source: ½ strength Provasoli's
Temperature: 15 °C
Artificial seawater



Conclusion

1 Salinity influence on *Ulva* Germlings
- *U. linza* and *U. californica* (tubular) grew the same in all treatments while the two strains of *U. lacinulata* (blade) preferred higher salinities (30 PSU).

2 Salinity influence on *Ulva* Adults
- In contrast with the *Ulva* germlings, adult *U. linza* (tubular) showed a preference for lower salinities (15-20 PSU).

3 Salinity influence on *Ulva* Adults - Antioxidant Activity
- Antioxidant activity changed over time and the response between strains was different.
- Salinity did not have an impact on the antioxidant activity (except for strain 2, at 240h).

Production of Higher Biomass:
Ulva lacinulata
(blade)

Preference for Lower Salinity:
Ulva linza
(tubular)

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Acknowledgements

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References

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