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Salinity effects on *Symbiodinium* sp growth rate in controlled conditions and produced biomass biochemical characterization

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ABSTRACT

Salinity is an important factor affecting the growth of the algal symbiont *Symbiodinium*. Increments in salinity from 30 psu to 70 psu showed a significant ($p<0.05$) decrease in cell density with time and a significant decrease in the growth rate at 70 psu. The photosynthetic efficiency (F_V/F_M) was significantly ($p<0.05$) decreased at 50, 55, 60 and 70 psu treatments compared to 40 psu. Biochemical characterization of biomass indicated a large increase in lipid content at 70 psu.

OBJECTIVES

- Enhance and maintain existing *Symbiodinium* culture in laboratory conditions
- Investigate the effect of salinity range on *Symbiodinium* biomass, growth rate, and photosynthetic efficiency.
- Perform basic biochemical valorization to identify changes in biochemical composition.

LITERATURE REVIEW

- Coral reefs are ecologically diverse and important as a breeding ground and shelter for 25% of all known marine species (Cesar et al., 2003).
- Symbiodinium and the coral poly exist in symbiotic relationship wherein the algae provides organic compounds for growth and survival for which it receives hostage and inorganic raw materials for photosynthesis from the coral (Hoegh-Guldberg et al., 2019).
- However, factors such as drastic change in temperature, salinity, toxins, anthropogenic intervention can cause stress on the coral reef leading to the expulsion of the algae from the coral resulting in coral bleaching.
- The Arabian Gulf surrounding Qatar is a shallow sea geographically located in the hyper-arid sub tropical-region of the world with extreme sea surface temperatures and salinities reaching up to 50-70 psu.
- Qatar's offshore salinity is recorded to be between 39-41 psu (Sheppard et al., 2010; Al- Ansari et al., 2015).
- Desalination plants cause increase in the salinity and temperature of the coastal waters which is a cause of concern in Qatar due to its heavy reliance on desalination for fresh water.

METHODOLOGY

1. Coral reef and sea water sampling site

Symbiodinium sp culture was extracted from *Platygyra daedalea* sampled at Fasht Al Hurabi Coral Reefs in Qatar's Exclusive Economic Zone. The seawater for culture media was sampled in Lusail.

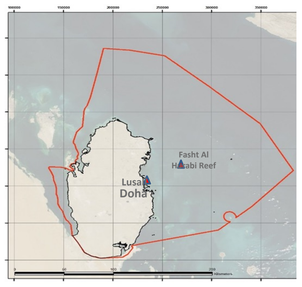

Figure 1. Map of the study area where corals (Fasht Al Hurabi Reef) and seawater (Lusail) for culture have been sampled.

2. Culture maintenance of *Symbiodinium*

High density of zooxanthellae cells were extracted and kept under 12:12 dark/light conditions, at 40 psu, 26°C and 130 µmol.s^{-1} light intensity corresponding to an illuminance of 12,500 Lx in a Panasonic MLR-352H-PE incubator.

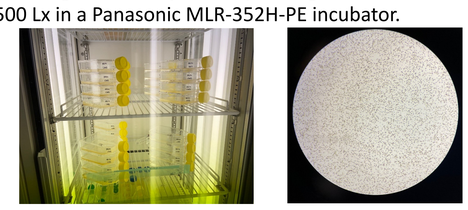

Figure 2. Incubator with culture replicates (left). *Symbiodinium* sp culture growth at 40 psu observed under inverted microscope (right).

3. Determination of cell density of *Symbiodinium* sp

The cells were maintained and grown as triplicates (another replicate for biochemical analysis) at salinities 30, 40, 45, 50, 60 and 70 psu for 11 days in f/2 media. 500 µL aliquots sampled and counted using hematocytometer.

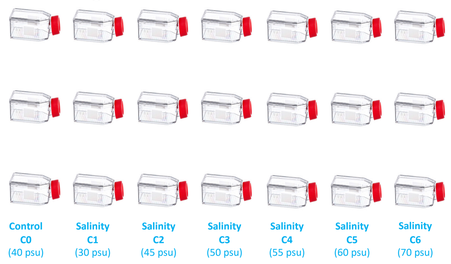

Figure 3. Experimental design

4. Determination of growth rate

Growth rate of triplicates were calculated according to Guillard (1973): GR = (LnN1 −LnN0) / (T1 −T0) and Final growth rate = 3.322 x regression curve slope

5. Photosynthetic efficiency of *Symbiodinium* sp

Efficiency was measured as F_V/F_M using AquaPen and OJIP protocol by acclimating the culture to dark conditions for 10 mins before measurement.

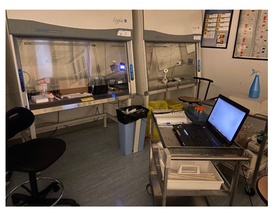

Figure 4. Experimental setup for photosynthetic efficiency

6. Determination of Chlorophyll a

Measurements were done following Lorenzen method of incubating filtered sample's filter paper in acetone for 24 hours before measuring at 665 and 750 nm using a UV/Vis spectrophotometer.

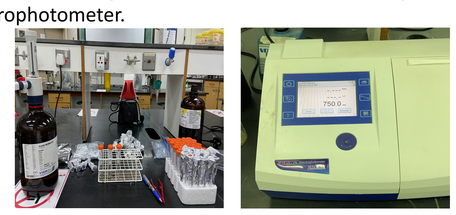

Figure 5. (left) preparation of samples for measurements, (right) measurement using UV/Vis spectrophotometer.

7. Biochemical analysis

Biomass from the 4th replicate was analyzed using Folch (1957), Lowry (1951) and Dubois (1956) method for lipids, protein and carbohydrates respectively in collaboration with CSD.

RESULTS and DISCUSSION

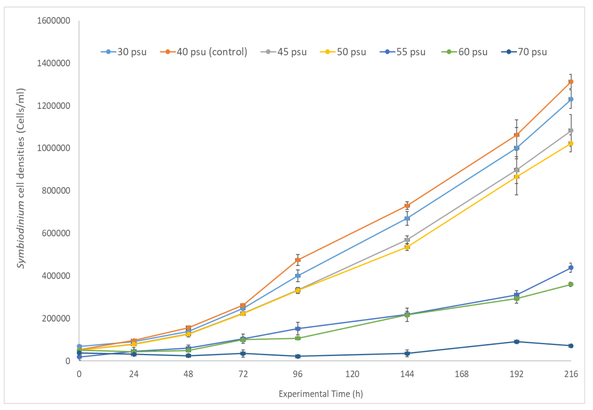

Figure 6. *Symbiodinium* sp. cell densities at salinity treatments

- *Symbiodinium* sp. cell densities at all treatment salinities showed significant decrease. 70 psu barely registered an increase.

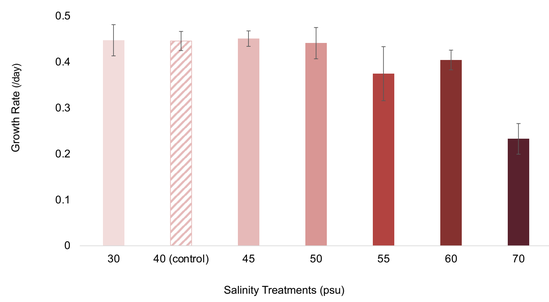

Figure 7. *Symbiodinium* sp. growth rate at salinity treatments

- *Symbiodinium* sp. growth rate from 30-50 psu are similar. 50 and 60 psu show decline but not statistically significant
- 70 psu statistically significant decline of almost 50%.

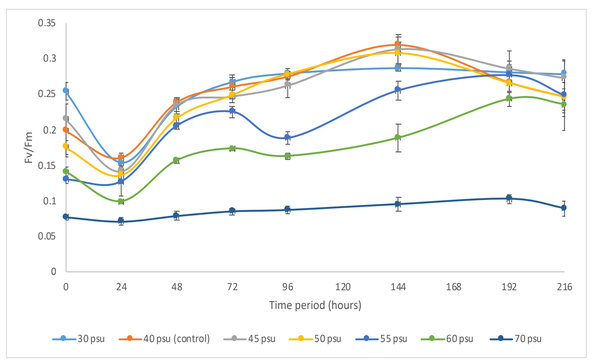

Figure 8. *Symbiodinium* sp. photosynthetic efficiency at salinity treatments

- *Symbiodinium* sp. F_V/F_M values show statistically significant decline from 50-70 psu.

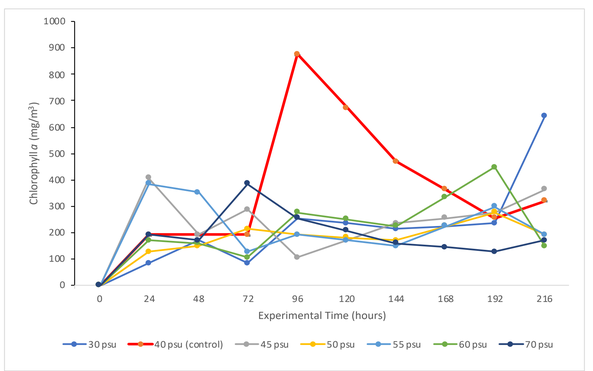

Figure 9. *Symbiodinium* sp. chlorophyll a levels at salinity treatments

- *Symbiodinium* sp. chlorophyll *a* levels are not interpretable due to experimental errors.
- Significant levels detected at 40 psu.

RESULTS and DISCUSSION

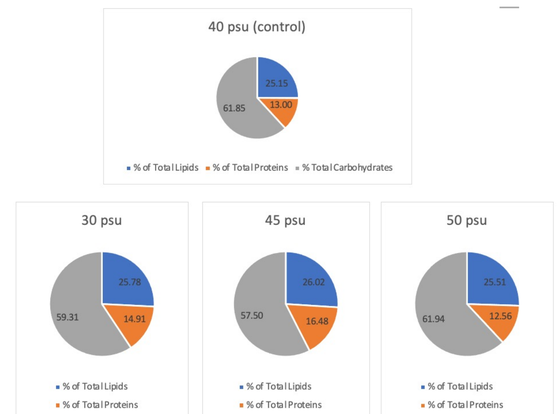

Figure 10. *Symbiodinium* sp. biochemical analysis at salinity treatments

- 55 psu has the highest carbohydrate contents.
- 70 psu has high lipid content than at 40 psu showing the impact of salinity stress at the physiological level.

CONCLUSION

- High salinity especially at 70 psu, shows statistically significant severe suppression in cell densities, growth rate and photosynthetic efficiency.
- 70 psu marks high lipid production as a response to salinity stress.
- Data from growth rate and photosynthetic efficiency indicate the plasticity of the *Symbiodinium* sp. to salinity changes up to 50 psu.

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