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Production of phycocyanin from marine cyanobacteria in Open raceway pond

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Abstract

- Phycocyanin is one of the major light harvesting accessory pigment present in microalgae and cyanobacteria.
- This water-soluble pigment protein exhibits antioxidant, anti-inflammatory, and neuroprotective effects.
- Application of this pigment also been used in dietary nutritional supplements in many food, nutraceutical, cosmetic, and biotechnology industries.
- In the present study phycocyanin was extracted from locally isolated marine cyanobacteria *Geitlerinema* sp.
- *Geitlerinema* sp. showed a higher growth during the summer perioed of 0.75 g/L and 0.54 g/L
- Similarly the maximum Phycocyanin obtain was up to 7.1% in during summer period.

Background Study

- High-value compounds with nutraceutical property from microalgae attract many food and biotechnology industries. (C.Bermudez et al., 2015)
- Phycocyanin producing strains were wildly studied for their functional property, which has various applications in food, drug, and medicine, and for cosmetics. (R.Thangam et al., 2013)
- Often due to the overall costly production process, alternative sources of growth media and harvesting technics nutrient sources such as seawater and nutrients from a different waste industrial stream can be used. (P.Das et al., 2019).

Objectives of the study

- The objective of this research is to find out the seasonal productivity of phycocyanin production in outdoor raceway tanks.

Methodology

Outdoor Cultivation:

- *Geitlerinema* sp. grown outdoor when the maximum light intensity was 2400 µmol E/m²/s, and maximum temperature of 48°C during summer time.
- *Geitlerinema* sp were grown in 1000L raceway tanks; the culture depth was maintained to 20cm while the evaporation water loss was balanced by adding seawater.
- Due to added seawater with time salinity was increasing
- Nutrients guillard 10 x f/2 media were added for this strain.
- Pure CO2 were added to maintain the culture pH in the open tanks.

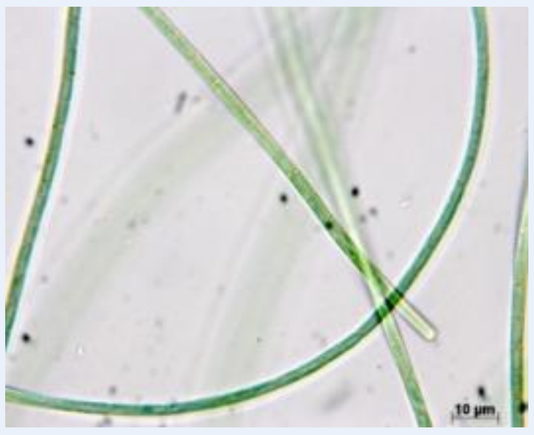


Figure:1 *Geitlerinema* sp. 100x magnification

Figure:2a *Geitlerinema* sp. Growth in 1000 L (during summer)

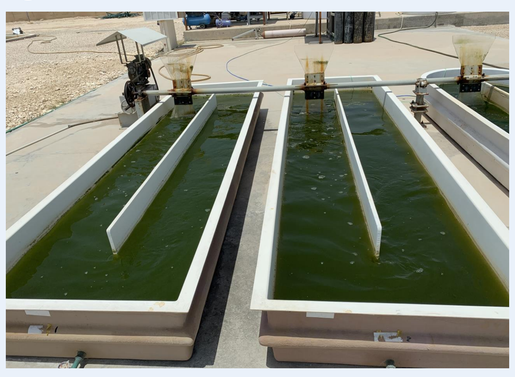


Figure:2b *Geitlerinema* sp. Growth in 1000 L (during winter)

Harvesting Method:

- All the experiments were conducted with 1000 L culture and the both of the strain were harvested with TFF unit.
- Harvesting was done twice, using a mass filter shown below.
- 1 liters of culture were collected and centrifuge daily to calculate biomass density.

Phycocyanin Extraction:

- Harvesting: 2x 10 mL of each culture was centrifuged in 15 mL falcon tubes for 10 minutes at 5000 RPM. Supernatant was discarded, and pellet was stored at -80˚C until further processing (20 hours)
- thawed pellets were re-suspended in 5mL of Phosphate buffer
- Samples were placed in -20˚C for 2 hours – when after 2 hours the samples had not completely frozen yet, placed them in -80˚C for 2 more hours until solid
- Removed samples from -80˚C, covered in Aluminum foil (to keep dark), and placed in 4˚C. After20 hours, vortexed the samples and placed back at 4˚C. After 48 h, centrifuged the samples (30 min at 5000 RPM), and measure OD 620 and 750 of the supernatant

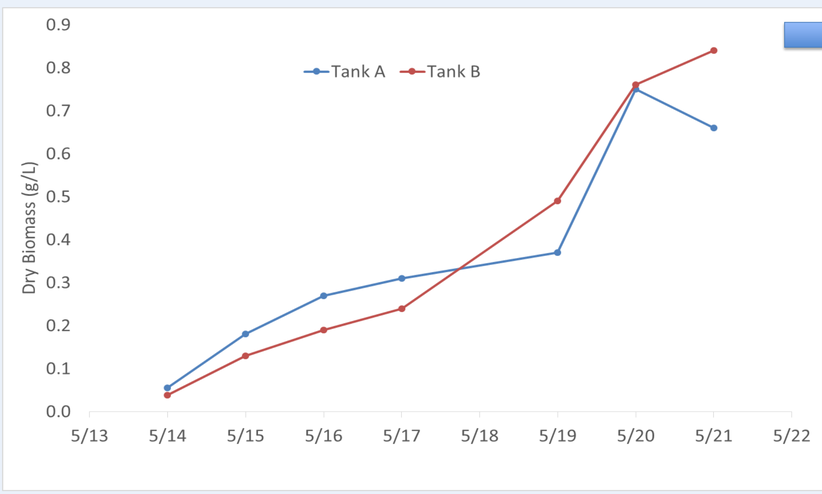
Phycocyanin concentration was calculated by Lawrenz et al., (2011) formula. Given below.

$$C = \{A/ \varepsilon d\} * MW * \{V(buffer)/V(sample)\} * 10^6$$

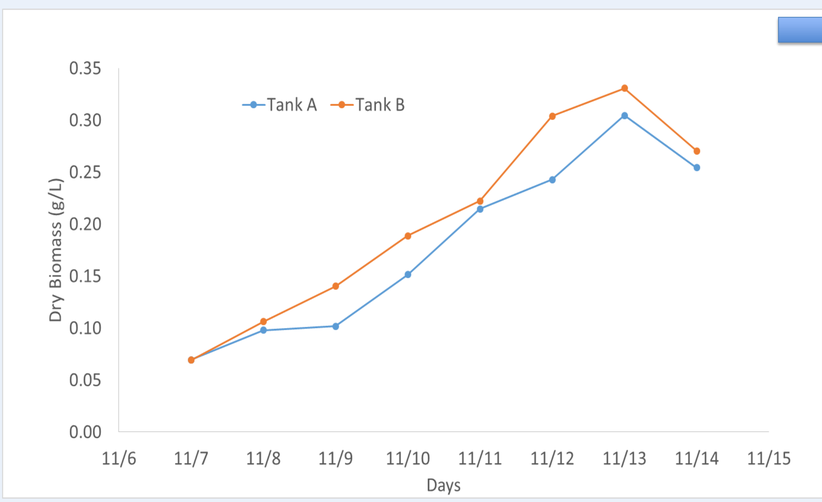
C = Phycocyanin Concentration (µg/L); A = Scatter corrected Absorbance (620-750)
ε = molar extinction coefficient PC (1900000 L/mol/cm);
d = path length of cuvette (1 cm)
MW Molecular weight (264000 g/mol);
V buffer Volume of buffer (0.005 L)
V sample Volume of sample (0.01 L)

Figure: 2c Harvested biomass

Results and Discussion

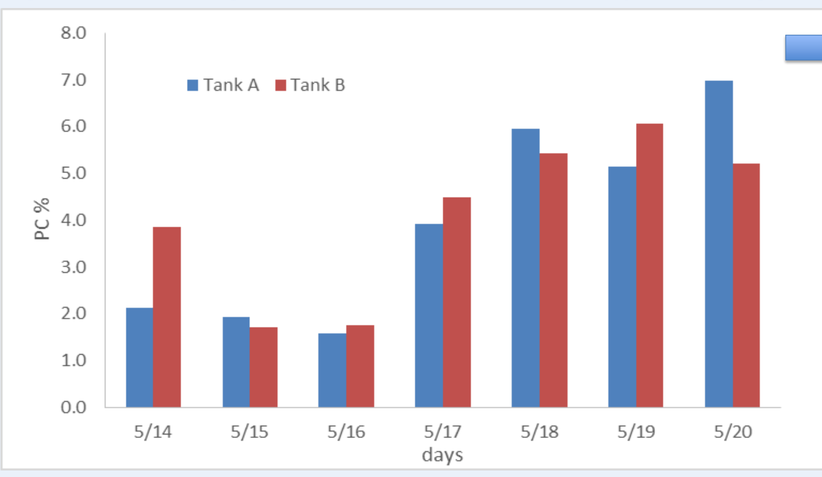


Final biomass density of *Geitlerinema* sp. reached 0.75 g/L (during month of MAY)

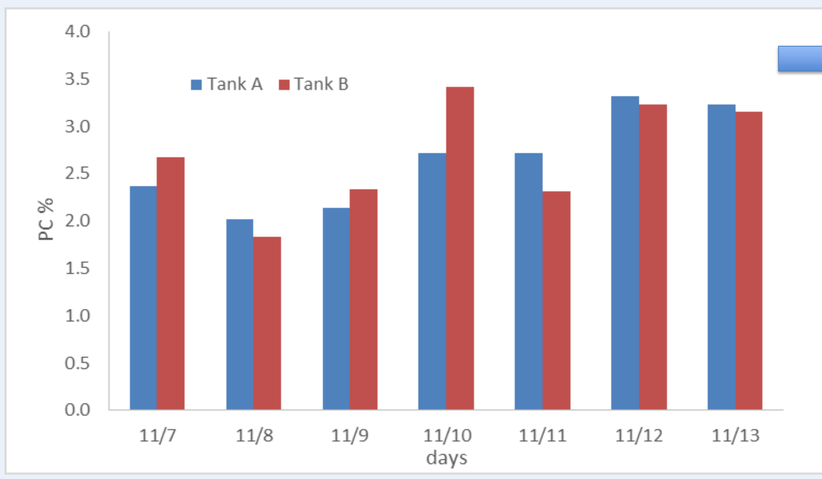


Final biomass density of *Geitlerinema* sp. reached 0.54 g/L (during month of NOV)

Figure 3: outdoor growth curve of *Geitlerinema* sp. microalgae



Maximum average Phycocyanin concentration within Biomass reached up to 6.1 % in MAY



Maximum average Phycocyanin concentration within Biomass reached up to 3.5 % in MAY

Figure 4: Phycocyanin concentration in *Geitlerinema* sp.

Conclusion

- Maximum Cell Phycocyanin concentration was obtain during the month of May.
- Overall areal productivity was also observed higher during May, were average ambient temperature ranged from 28 to 39 °C.

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