**Supplementary Materials**

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**Figure S1. Photos of LED light source settings and experimental species**

**Table S1. Light quality effects on algal biochemical composition.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Algaa | Light | Phylum | Index | Effectsb | References |
| 1 | *Cyclotella nana* | White | Diatom | Growth | B>W>G | (Wallen & Geen, 1971a) |
|  |  | Blue |  | Photosynthesis | B>W>G |  |
|  |  | Green |  | Carbon metabolism | B>W>G |  |
| 2 | *Dunaliella tertiolecta* | White | Chlorophyta | Growth | B>W>G | (Wallen & Geen, 1971a) |
|  |  | Blue |  | Photosynthesis | B>W>G |  |
|  |  | Green |  | Carbon metabolism | B>W>G |  |
| 3 | *Cyclotella nana* | White | Diatom | Total carotene | G>W>B | (Wallen & Geen, 1971b) |
|  |  | Blue |  | Chlorophyll | B>W>G |  |
|  |  | Green |  |  |  |  |
|  |  |  |  | Protein | B>W>G |  |
|  |  |  |  | DNA | B>W>G |  |
|  |  |  |  | RNA | B>W>G |  |
| 4 | *Dunaliella tertiolecta* | White | Chlorophyta | Total carotene | G>W>B | (Wallen & Geen, 1971b) |
|  |  | Blue |  | Chlorophyll | B>W>G |  |
|  |  | Green |  | Protein | B>W>G |  |
|  |  |  |  | DNA | B>W>G |  |
|  |  |  |  | RNA | B>W>G |  |
| 5 |  *Isochrysis galbana* | White |  Haptophyta | Growth rate | B>W | (Gorai et al., 2014) |
|  | Blue |  | Chlorophyll *a*  | W>B |  |
|  |  | Carbon content | W>B |  |
| 6 | *Dunaliella salina* | White | Chlorophyta | Growth rate | B>W | (Gorai et al., 2014) |
|  | Blue |  | Chlorophyll *a*  | W>B |  |
|  |  | Carbon content | W>B |  |
| 7 | *Chaetoceros gracilis*, | White | Bacillariophyta | Growth rate | B>W | (Gorai et al., 2014) |
|  | Blue |  | Chlorophyll *a*  | B>W |  |
|  |  | Carbon content | B>W |  |
| 8 | *Heterocapsa circularisquama* | White | Myzozoa | Growth rate | B>W | (Gorai et al., 2014) |
|  | Blue |  | Chlorophyll *a*  | W>B |  |
|  | 　 | Carbon content | W>B | 　 |
| 9 | *Porphyra leucosticta* | White | Rhodophyta | PEIc | G>Y>R>W>B | (Korbee, Figueroa & Aguilera, 2005) |
|  |  | Blue |  | Optimal quantum yield | B>W>G>Y>R |  |
|  |  | Green |  | Chlorophyll *a* | G>W>Y>B>R |  |
|  |  | Yellow |  | TINCd | W>B>G>Y>R |  |
|  |  | Red |  | Soluble protein | W>B>G>Y>R |  |
| 10 | *Ulva rigida* | White | Chlorophyta | Chlorophyll *a*  | B>W>R>G | (López-Figueroa & Niell, 1990) |
|  |  | Blue |  |  |  |  |
|  |  | Green |  |  |  |  |
|  |  | Red |  |  |  |  |
| 11 | *Corallina elongata* | White | Rhodophyta | Chlorophyll *a*  | B>W>R>G | (López-Figueroa & Niell, 1990) |
|  |  | Blue |  | Phycoerythrin |  |  |
|  |  | Green |  | Phycocyanin |  |  |
|  |  | Red |  |  |  |  |
| 12 | *Plocamium cartilagineum (L.)* | White | Rhodophyta | Chlorophyll *a*  | B>W>R>G | (López-Figueroa & Niell, 1990) |
|  |  | Blue |  | Phycoerythrin | G>W>B>R |  |
|  |  | Green |  | Phycocyanin | R>W>B>G |  |
|  |  | Red |  |  |  |  |
| 13 | *Porphyra umbilicalis (L.)* | White | Rhodophyta | Chlorophyll *a*  | R>W>B>G | (López-Figueroa & Niell, 1990) |
|  |  | Blue |  | Phycoerythrin | G>W>B>R |  |
|  |  | Green |  | Phycocyanin | R>W>B>G |  |
|  |  | Red |  |  |  |  |
| 14 |  *Porphyra umbilicalis* | Blue | Rhodophyta | Growth rate | R>B | (Figueroa, Aguilera & Niell, 1995) |
|  |  | Red |  | Chlorophyll *a* | B>R |  |
|  |  |  |  | Phycoerythrin | B>R |  |
|  |  |  |  | Phycocyanin | B>R |  |
|  |  |  |  | Soluble protein | B>R |  |
|  |  |  |  | C | R>B |  |
|  |  |  |  | N | B>R |  |
| 15 | *Gracilaria birdiae* | White | Rhodophyta | Growth rate | G>W>B>R | (Bonomi Barufi, Figueroa & Plastino, 2015) |
|  |  | Blue |  | Chlorophyll *a*  | G>B>W>R |  |
|  |  | Green |  | Allphycocyanin | B>W>G>R |  |
|  |  | Red |  | Phycoerythrin | B>G>R>W |  |
|  |  |  |  | Phycocyanin | B>G>R>W |  |

a Microalgae: 1 - 8, macroalgae: 9 - 15

bExample: B>W>G means blue light is more effective than white and green light while white light is superior to green light.

c PEI: Irradiance and photosynthetic effective irradiance.

d TINC: Total intracellular nitrogen content.

Table S2. Light intensity reservation rate of of the white, red, green and blue LED tubes underneath water.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | White | Red | Green | Blue |
| Light intensity (μmol photons m-2 s-1) | Air (4 cm)a | 40 | 10 | 25 | 14 |
| Water surface (0 cm) | 26 | 6 | 16 | 9 |
| Underwater (-4 cm) | 21 | 4 | 14 | 8 |
| Residual energy ratiob | 95% | 90% | 97% | 97% |

a Distance from water surface

b Residual energy ratio (*RER*): Ratio of residual energy to initial energy for every cm of distance. *RER* was calculated as:

$RER= \sqrt[D]{\frac{E\_{B}}{E\_{A}}}$, (S1)

where EA and EB are the energy of the incident light (water surface) and the background light (underwater). D is the absolute distance from A to B.

**Refernences:**

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