

## Supplementary Materials

# Synthesis, Characterization, and Anti-algal Activity of Molybdenum-Doped Metal Oxides

Sondavid Nandanwar <sup>1,†</sup>, Myung Won Lee <sup>2,†</sup>, Shweta Borkar <sup>2</sup>, Jeong Hyung Cho <sup>1</sup>, Naresh H. Tarte <sup>3</sup> and Hak Jun Kim<sup>2,\*</sup>

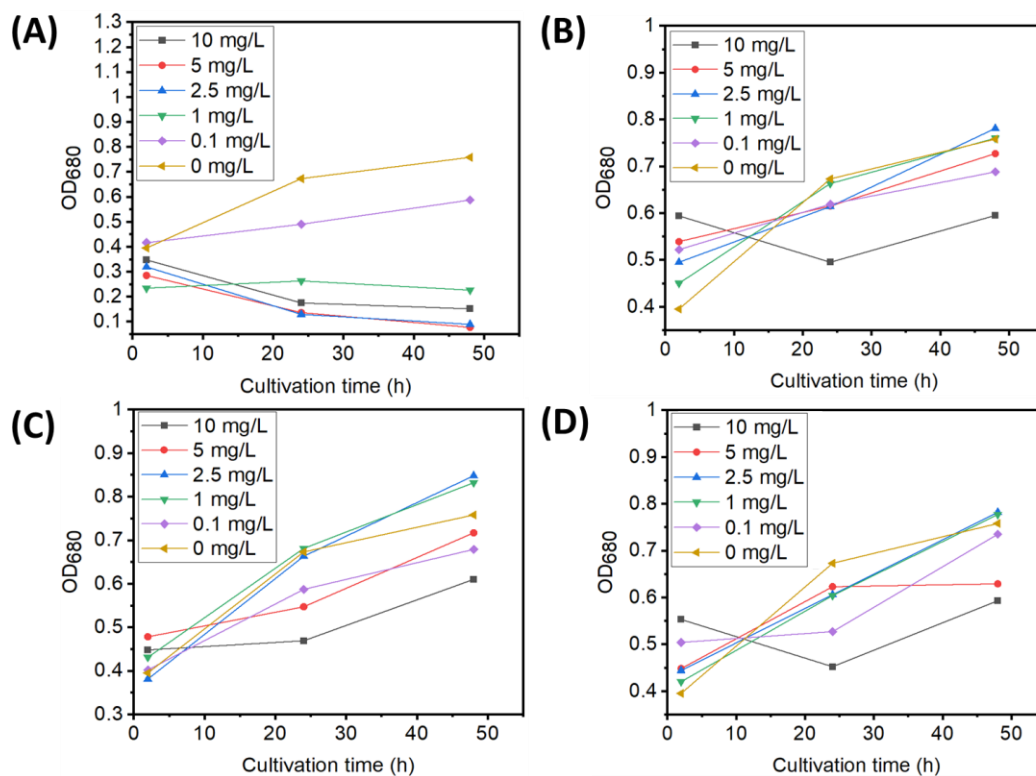
<sup>1</sup> Department of Marine Convergence Design, Pukyong National University, Busan 48513, Korea; sondavid30@pukyong.ac.kr (S.N.); jhcho7@pknu.ac.kr (J.H.C.)

<sup>2</sup> Department of Chemistry, Pukyong National University, Busan 48513, Korea; mwlee@pknu.ac.kr (M.W.L.); shwetaborkar@pukyong.ac.kr (S.B.)

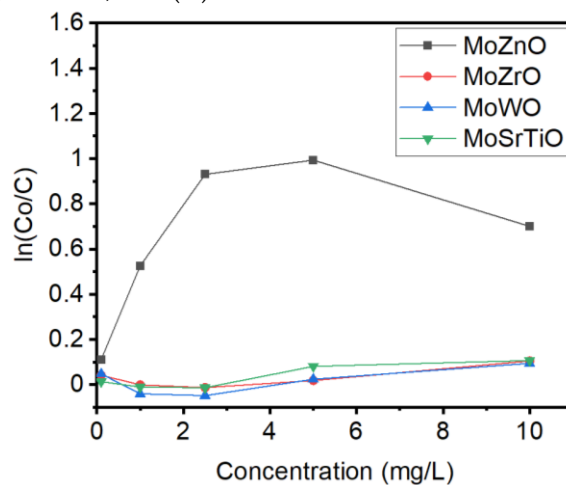
<sup>3</sup> Department of Chemistry and Biology, KSA of KAIST, Busan 47162, Korea; naresh@kaist.edu

\* Correspondence: kimhj@pknu.ac.kr; Tel.: +82-51-629-5587

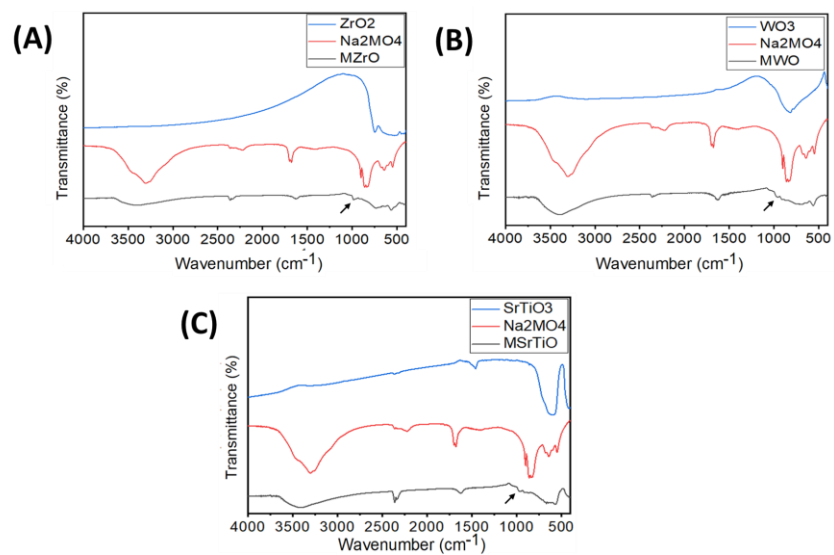
† The authors contribute equally in this work.



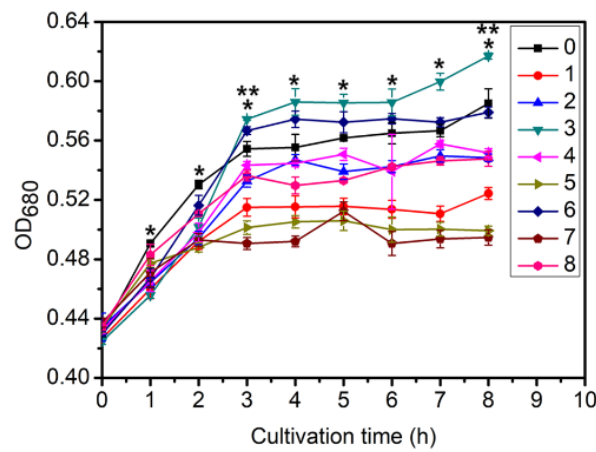
**Figure S1.** Preliminary anti-algal activity of molybdenum-doped metal oxides at 2 h, 24 h, and 48 h (A) MoZnO, (B) MoZrO<sub>2</sub>, (C) MoWO<sub>3</sub>, and (D) MoSrTiO<sub>3</sub>.



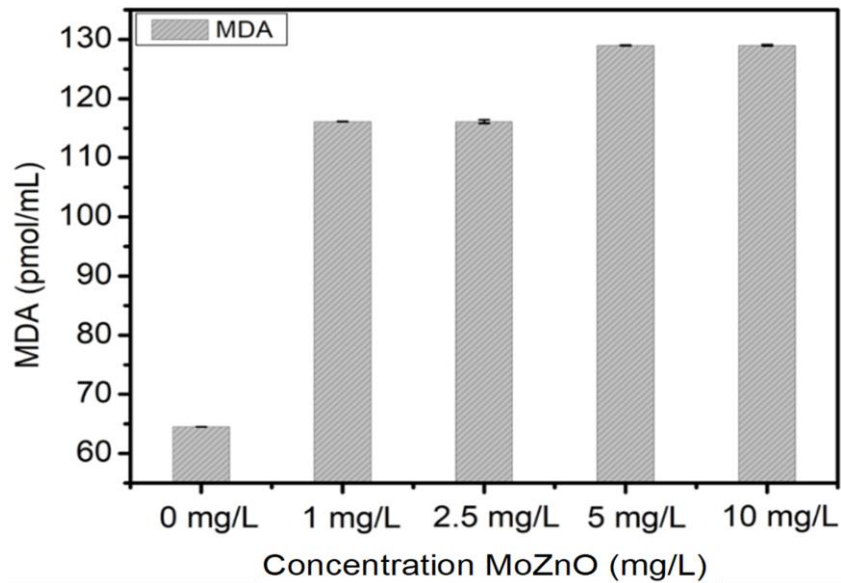
**Figure S2.** Plot of pseudo first order rate versus concentration of molybdenum-doped metal oxides (obtained from preliminary anti-algal activity).



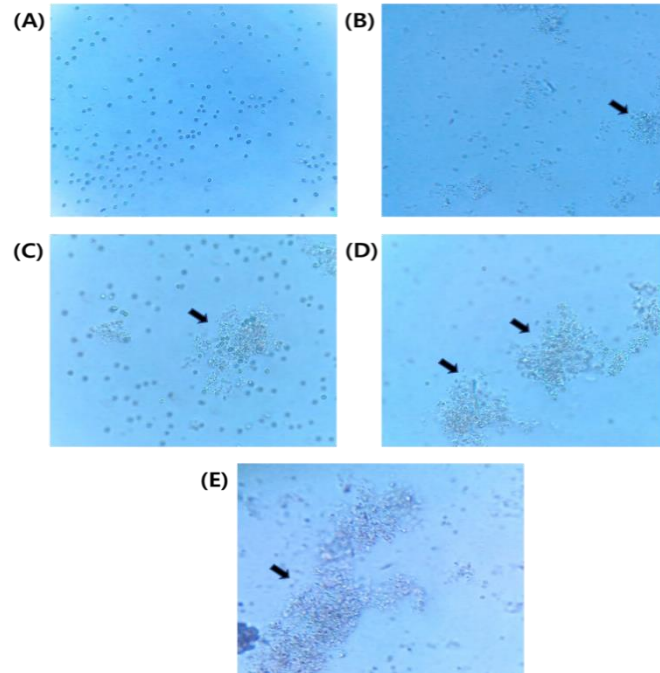
**Figure S3.** FT-IR spectra of metal oxide, sodium molybdate dihydrate, and molybdenum doped metal oxides (A)  $\text{ZrO}_2$ ,  $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ , and  $\text{MoZrO}$ , (B)  $\text{WO}_3$ ,  $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ , and  $\text{MoWO}$ , and (C)  $\text{SrTiO}_3$ ,  $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ , and  $\text{MoSrTiO}$ .



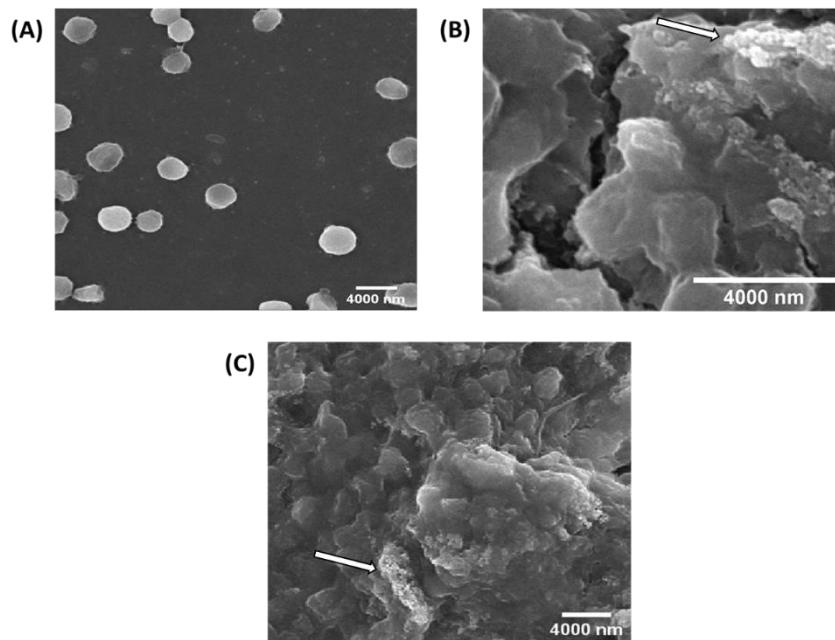
**Figure S4.** Effect of  $\text{ZnSO}_4$  (1),  $(\text{MoCl}_5)_2$  (2),  $\text{ZnO}$  (3),  $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$  (4), and their combinations  $\text{ZnSO}_4 + \text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$  (5),  $\text{ZnO} + \text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$  (6),  $\text{ZnSO}_4 + (\text{MoCl}_5)_2$  (7), and  $\text{ZnO} + (\text{MoCl}_5)_2$  (8) on the growth of *M. aeruginosa*. Statistical significance (determined by paired t-test) is shown by  $* = p < 0.05$ ,  $** = p < 0.001$ , when compared to control (0).



**Figure S5.** Lipid peroxidation of *M. aeruginosa* cells at 4 h.

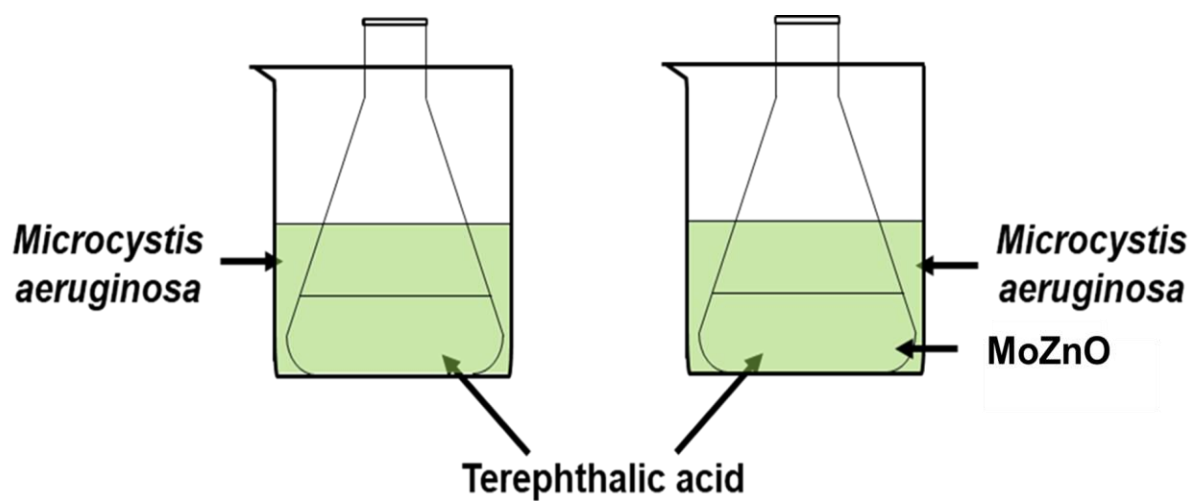


**Figure S6.** Optical microscope images of *M. aeruginosa* cells after incubation with MoZnO up to 4 h : (A) 0 mg/L; (B) 1 mg/L; (C) 2.5 mg/L; (D) 5 mg/L; (E) 10 mg/L.



**Figure S7.** SEM images of *M. aeruginosa* cells after incubation with MoZnO up to 4 h : (A) 0 mg/L; (B) 5 mg/L; (C) 10 mg/L.

TA (0.5 mM; 100 mL) was poured in two 250 mL conical flasks. After setting the conical flasks in two 500 mL beaker respectively, the beaker was filled with *M. aeruginosa* culture. One was labbled as an experimental group (SEX) and anotherone as the control group (SC).



**Figure S8.**  $\cdot\text{OH}$  assay under the shading of *M. aeruginosa*.

**Table S1.** Experimental grouping

| Group | Components                               |
|-------|--|
| EX    | BGM + 0.5 mM TA + 10 mg/L MoZnO          |
| SEX   | BGM + 0.5 mM TA + 10 mg/L MoZnO          |
| C     | BGM + 0.5 mM TA + 1mM Ip +10 mg/L MoZnO  |
| SC    | BGM + 0.5 mM TA + 1mM Ip + 10 mg/L MoZnO |