Enhance Growth and Biochemical Composition of *Nannochloropsis oceanica*, Cultured under Nutrient Limitation, Using Commercial Agricultural Fertilizersm

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Abstract

Microalgae culture media should be economic, allow for high growth, satisfy the needs of microalgal cells and easy to prepare. In this study, we evaluate the effect of different media formula prepared from commercial agricultural fertilizers (CAGF), comparing to F/2 Guillard standard medium as a control medium, on growth (cell density, CD; dry weight, DW and speciýc growth rate, Õ) and biochemical composition (lipid, protein, and carbohydrate) of *Nannochloropsis oceanica*. Comparing to N/P ratio (9.6) and actually quantity (12.36 g/l and 1.29 g/l, respectively) of F/2 standard medium, six N/P ratios (19.2, 9.6, 9.6, 4.8, 3.2 and 1.6) were prepared from Nitric Acid (N-Nt) or Ammonium Sulphate (N-Am), as a nitrogen source, with phosphoric acid (P), as a phosphorus source, for culturing media of *N. oceanica*. The results investigated that some CAGF media achieved signiýcant (P Ò 0.05) growth and biochemical composition higher than F/2. Comparing to lipid percentage (30.70 %) of F/2, the lipid percentage of *N. oceanica* cultured on different CAGF media were ranging from 18.40% to 46.12%, depending on nutrient limitation, nitrogen source, N/P ratios and actually atom concentrations. Finally, the use of CAGF constitutes a viable alternative of F/2 medium to reduce the production costs *N. oceanica*

of tested parameter, T: mean value of recorded treatment prepared from CAGF, and F: mean value of recorded F/2 Guillard medium.

Statistical analysis

Statistical analysis was performed using analysis of variance (ANOVA). Di erences among means were considered signi cant at $p<0.05$ multiple range of post hoc comparisons were performed using the least signi cant di erence (LSD) to resolve the di erences among the means of replication according to of Duncan, (1955) [15] using SPSS (2007) [16].

Results

e e ect of di erent nutrient medium prepared from CAGF, comparing to F/2 medium, on the growth and biochemical composition of were shown in Table 2. e results investigated that some CAGF media achieved signi cant ($P \leq 0.05$) growth and biochemical composition higher than F/2 while other CAGF media achieved signi cant ($P \leq 0.05$) growth and biochemical composition lower than

division/day, M% -61), N-Am50+P100 (0.234 division/day, M% -65)**,** N-Nt100+P300 (0.228 division/day, M% -66) and N-Am100+P300 (0.201 division/day, M% -70)**,** as shown in Table 2.

Biochemical composition

Total lipid observed in cultured on F/2 medium was 30.70%. Treatment N-Am100+P300 (which achieved the lowest signi cant μ) achieved the highest signi cant ($P \leq 0.05$) total lipid (46.12%, M% 59), followed by N-Nt50+P100 (42.84%, M% 40), N-Am50+P100 (39.21%, M% 28), N-Am100+P50 (37.21%, M% 21), N-Nt100+P300 (36.00%, M% 17) and N-Am50+P50 (32.01%, M% 4), while the lowest signi cant total lipid was observed by N-Nt50+P300 (18.4%, M% -40), followed by N-Nt100+P100 (19.72%, M% -36, which achieved the highest signi cant μ), as shown in Table 2.

Total protein observed in cultured on F/2 medium was 14.46 . Only three treatment media, based on ammonium sulphate, through all experimented media were achieved total protein signi cantly ($P \leq 0.05$) lower than F/2 control, these three media were N-Am100+P100 (10.64%, M% -26), N-Am50+P50 (10.27%, M% -29) and N-Am50+P100 (12.93%, M% -11). On the other hand, the highest signi cant ($P \leq 0.05$) protein was achieved by N-Nt100+P300 (28.46%, M% 97) and N-Am100+P50 (28.4%, M% 96).

Carbohydrates observed in

biochemical composition lower than F/2. ese signi cant di erences may be due to N/P ratios, concentrations and sources. However, to optimize the production of for aquaculture purposes in marine hatcheries, CAGF should be used with advantages of reduced cost media, high productivity and easy to prepare of culture medium. Our suggestions were in agreement with Guzman-Murillo et al. who suggested that, CAGF media may be used to improve the biochemical composition of microalgae for the purposes of aquaculture, production of bioactive materials and biotechnology. Bae and Hur, (2011) found that the growth of cultured on fertilizer medium was similar to that of . cultured in F/2 medium. On the other hand, our results disagree with Simental and Sanchez-Saavedra (2003) [22] who pointed that, comparing to F/2 medium, the using of liquid CAGF did not achieve any signi cant di erences in cell concentration and growth rate of and . is disagree may be due to the experiment conditions, N/P ratios, concentrations and sources

In F/2 medium, the nitrogen (in form of sodium nitrate) and phosphorus (in form of sodium hydrogen orthophosphate.) concentrations in medium stock solution were 12.36 g/l and 1.29 g/l, respectively, and 0.0124 g/l and 0.0013 g/l in microalgae culture solution, respectively, with ratio N/P (9.6). Hsieh and Wu [23] reported that nitrogen sources were strongly a ecting microalgae quality and quantity**.**

Our study investigated that in the case of nitric acid, the treatment medium N-Nt100+P100, which has the same N/P ratio and concentrations of F/2 medium, achieved growth (cell density, dry weight and speci c growth rate) higher than F/2 and/or ammonium sulphate-nitrogen based media**.** Until now, there is no recorded data available about using of nitric acid as nitrogen source in medium composition of marine microalga . To date, nitrate is a commonly studied as a nitrogen source used to understand nutrient limitation to induce lipid accumulation w49 Tm[(a)1taen soEMC 219 (t)-5 (i)-5 (l n)4 ETEMC /n374 (d pan <<[(ni)12 (t)-5 (s)5 (t)53)12 (t u)3 (sin)8 (g o)12 (f)]T2g (l)-2.9

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