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Effect of Climate Changes on Surviving of *Nitzschia inconspicua* Grunow

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Abstract

The climate changes that are taking place around the world became a serious environmental problem that should be concerned. Three experiments were performed to imitate conditions of the present climate changes and its effect on *Nitzschia inconspicua* surviving. The results revealed the high tolerance of *Nitzschia inconspicua* to increased water temperature. Water acidification and high salinities affected the density of *Nitzschia inconspicua* negatively. In conclusion, the drastic changes that happen in the environment do not affect *Nitzschia inconspicua* only but also affect other trophic levels. Therefore, we recommend making many efforts to help getting rid of the global warming and prevent its dramatic effects on the environment.

Keywords: *Nitzschia inconspicua*; Aquatic ecosystem; Climate change; Salinity; Temperature; Acidification

Introduction

The climate is changing at a rate never seen before. Aquatic organisms are endangered throughout the world for various reasons, including global climate change. Changes in precipitation and temperature will dramatically affect the survival of many species [1]. Plants play a key role in moderating climate change because they take up carbon dioxide (CO_2). If plants are lost, the carbon (as CO_2) will continue accumulating in our atmosphere and causes air temperature to rise, leading to ocean acidification. With climate changes, aquatic environments face increases in oceans salinity and sea level rise due to melting of the ice in the poles [2]. These combined factors result in drastic world destruction. Organisms need specific conditions in order to survive. Scientists predict that these conditions will be altered when the global climate changes. A change in salinity and temperature could lead to death, migration, or poor health of the living organisms [3]. The loss of aquatic environments will be a major disaster that will take place because of previous changes.

Hawkins et al. [4] mentioned the importance of studying the effects of global climate change, specifically increasing temperature, hydrogen ion concentration (pH) and salinity, on aquatic ecosystem. The effect of global warming on genus *Nitzschia* when the normal ranges of salinity and temperature are exceeded will be examined during the present study. The *Nitzschia inconspicua* is important microalgae that live in brackish ponds and lagoons that can tolerate hard conditions.

Nitzschia inconspicua is of a high economic importance; it is used for biofuel production and recently used in cancer treatment [5,6]. Regular consumption of *Nitzschia inconspicua* helps in heavy metals detoxification and protects the body against ultraviolet radiation treatments [7]. The recent researches proved that *Nitzschia inconspicua* supplement supports a healthy immune system response and helps “natural killer” cell activity [8]. *Nitzschia inconspicua* intake results in noticeable reductions body fat, blood cholesterol and blood glucose in human [9]. Due to vital importance of *Nitzschia inconspicua* sp. we choose it to perform the present research to assess the effect of the undergoing climate changes on it.

Materials and Methods

Nitzschia inconspicua Grunowis considered being a widely diverse diatom species found in different types of habitats, from freshwater to brackish/marine, and often in high abundance [10].

Nitzschia inconspicua Grunowis was collected from the Wadi El-Rayan lake-Egypt. The steps of isolation and purification approved by Pringshiem [11] were followed to obtain unialgal cultures. *Nitzschia inconspicua* was isolated and maintained in a unialgal culture under optimum laboratory conditions.

Water sample was collected from Wadi El-Rayan Lake, the filtered sterilized by pasteurization through rising temperature to 60°C and cooling to 4°C and heating again to 60°C. The sample was enriched with 0.1 g/l $NaNO_3$ and 0.02 g/l K_2HPO_4.

For examining the effect of PH, salinity and temperature (global warming factors), 3 experiments were carried out.

Test I: The effect of different pH on *Nitzschia inconspicu*

A simple definition for pH is that it describes the acidity, or hydrogen ion (H^+) concentration, of a solution. Different pH was adjusted in flasks (5, 7 and 8) by using sodium carbonate and vinegar.

The bioassay experiment was performed in 500 ml, clean dry Erlenmeyer flasks containing 200 ml sterilized medium. Treatments and control flasks were inoculated with 10,000 *Nitzschia inconspicua* cells ml^{-1} in a logarithmic growth phase.

Test II: Effect of different salinities

The experiment to examine various salinity effects on the *Nitzschia inconspicua* density was performed with three different salinities (25, 35, 45 g l^{-1}). Salinities were adjusted by adding commercial NaCl.

The experimental and control flasks were maintained in a local made incubator at 25 ± 1°C and light intensity of 4000 Lux from "Cool White" overhead fluorescent tubes, at lighting cycle of 14-hour light followed by 10-hour darkness. The duration of bioassay test was 7 days. Three replicate flasks were used for control and the under tested alga.

Test III: The effects of different temperature

The flasks with *Nitzschia inconspicua* culture were placed in water

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bath with different temperatures (10, 20, 30, 40, 50 and 60°C) in order to examine the increased atmospheric temperature as a result of climate changes.

Results and Discussion

The results of the three present experiments are given in Figures 1-3. The *Nitzschia inconspicua* under different pH (Figure 1) revealed that pH 7.2 was optimum for growth of *Nitzschia inconspicua* with average values of 4800, 4650 and 5700 cell/L after 24, 48 and 72 h consequently. At pH 8.3, the cells were affected after 48 hours with average number of 3500 cells/L. While at the acidic water (pH of 2.2) the *Nitzschia inconspicua* density was decreased to small number after both 48 and 72 hours (About 200 and 100 cells/L consequently) and the algae died shortly after that. Therefore, the present experiment confirmed the inhibition effect of increased acidity on *Nitzschia inconspicua*. The increased acidity is a process that results from the global warming, which accompanies with ocean acidification as, reported in several studies [12,13]. The ocean acidification under the effect of the global climate changes is due to dissolving of carbon dioxide from the air into the seawater resulting in forming carbonic acid, which leads to increasing of seawater acidity. In the present study, the acidic cultures have several free hydrogen ion (H^+) than the other two cultures (7.2 and 8.3 pH). The presence of the hydrogen ion disrupts the growth as reported in the acidic culture during the present study can be attributed to internal acidosis and dormancy resulted from permeability of H^+ to the cells as mentioned by Wang et al. [14].

Another symptom of global climate change is increasing salinity of water bodies, which took place due to elevated air temperature and increased evaporation rates. During the present study, the effects of different salinities on *Nitzschia inconspicua* are presented in Figure 2. The results revealed that the optimum salinity for *Nitzschia inconspicua* was 25 ppt since it showed the highest density during the experiment with about 4600 cells/L. While at salinity, value of 35 ppt the algae decreased in number after 72 h but still high in number with 4550 cells/L. unfortunately, no *Nitzschia inconspicua* cells survived at salinity of 45 ppt during the whole experiment. The present results coincide with Wang et al. [14] who reported that the highest growth rate of *Nitzschia inconspicua* was recorded at salinity of 28 ppt. On the other hand, the intolerance of *Nitzschia inconspicua* to higher salinities in laboratory may be lower than values that it can tolerate in field perhaps due to other laboratory conditions.

The increased salinity in general increases permeability to sodium ions and possibly other ions and water. The process of uncontrolled permeability no doubt can affect many vital mechanisms in the *Nitzschia inconspicua*. Therefore; increased salinities can interfere with many vital process in algae and in other aquatic animals from other trophic levels [15].

One of the most important features in climate changes is the global increase in air temperature, which affects living organisms of different trophic levels in many ways [16]. Elevated temperature will lead to distinction of many living organisms around the world [17]. Data of experiment three (Figure 3) showed the effect of increased temperature on *Nitzschia inconspicua*. The density was high at the first 2 stages of water temperatures (10 and 20°C consequently) with maximum number recorded at 20°C (about 51660 cells/L). A gradual decrease in number of *Nitzschia inconspicua* took place from 30°C to 60°C. After increasing temperature above 60°C, no algae were observed. The warm temperature activates the growth. At higher temperature, the oxygen concentration decreases due to inverse relationship with temperature, which consequently affect the *Nitzschia inconspicua* density negatively.

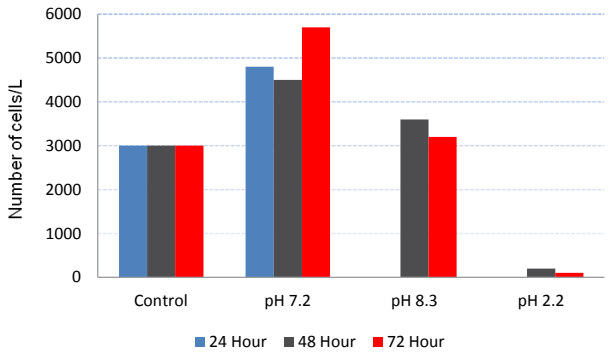

Figure 1: Effect of different PH on *Nitzschia inconspicua* density.

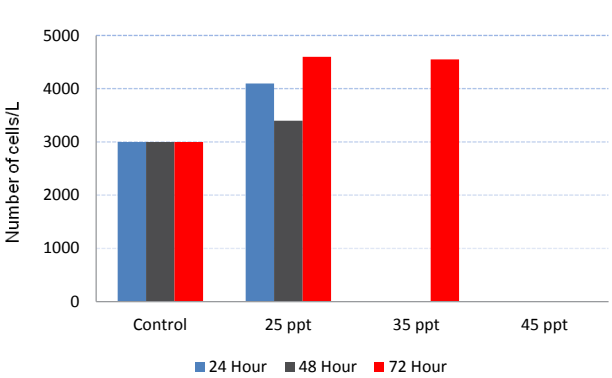

Figure 2: Effect of different salinities on *Nitzschia inconspicua* density.

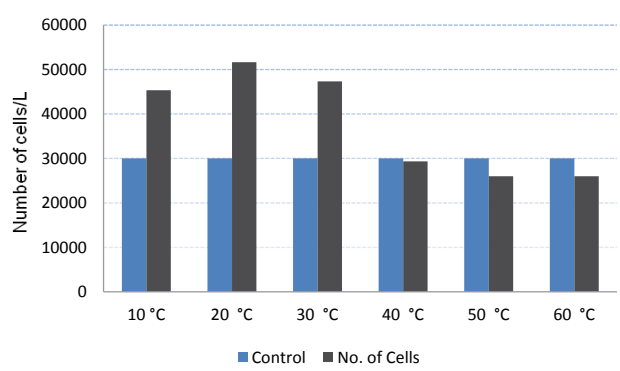

Figure 3: Effect of different water temperatures on *Nitzschia inconspicua* density.

The present results match with the many authors. The biochemical reactions of photosynthesis respond to temperature in the same way as normal biochemical reactions do and like all enzyme-controlled reactions, they will have an optimum temperature above which the enzymes begin to lose their structure [18].

In conclusion, the present study reported some of the side effects resulting from global climate changes. The drastic changes that happen in the environment does not affect *Nitzschia inconspicua* only, but also affect other trophic levels. Therefore, we recommend making many efforts to help getting rid of the global warming through decreasing CO_2 emission from all human activities and increasing the green cover by planting and conserving plants on our earth.

References

1. Shadrin NV, Anufriieva EV (2013) Climate change impact on the marine lakes and their Crustaceans: The case of marine hypersaline Lake Bakalskoye (Ukraine). Turk J Fish Aquat Sci 13: 603-611.
2. Abbaspour M, Javid AH, Mirbagheri SA, Givi FA, Moghimi P (2012) Investigation of lake drying attributed to climate change. Int J Environ Sci Technol 9: 257-266.
3. Shadrin NV, Mironov SS, Ferat TA (2012) Interrelations between the losses of sandy beaches and biodiversity in seas: Case of the Bakalskaya Spit (Crimea, Ukraine, Black sea). Turk J Fish Aquat Sci 12: 411-415.
4. Hawkins SJ, Sugden HE, Mieszkowska N, Moore PJ, Poloczanska E, et al. (2009) Consequences of climate-driven biodiversity changes for ecosystem functioning of North European rocky shores. Mar Ecol Prog Ser 396: 245-259.
5. Chu WL, Phang SM, Goh SH (1996) Environmental effects on growth and biochemical composition of *Nitzschia inconspicua* Grunow. J Appl Phycol 8: 389-396.
6. Jiang Y, Laverty KS, Brown J, Brown L, Chagoya J, et al. (2015) Effect of silicate limitation on growth, cell composition, and lipid production of three native diatoms to Southwest Texas desert. J Appl Phycol 27: 1433-1442.
7. Shim J, Son Y, Park JM, Kim MK (2009) Effect of Chlorella intake on Cadmium metabolism in rats. Nutr Res Practice 3: 15-22.
8. Kwak JH, Baek SH, Woo Y, Han JK, Kim BG, et al. (2012) Beneficial immunostimulatory effect of short-term Chlorella supplementation: enhancement of natural killer cell activity and early inflammatory response (randomized, double-blinded, placebo-controlled trial). Nutr J 11: 53.
9. Mizoguchi T, Takehara I, Masuzawa T, Saito T, Naoki Y (2008) Nutrigenomic studies of effects of Chlorella on subjects with high-risk factors for lifestyle-related disease. J Med Food 11: 395-404.
10. Abdulwassi NI (2016) Chlorella Grunow, a Rarely-Observed Epilithic Diatom Species in the Egyptian Inland Waters. J Biodivers Endanger Species 4: 165.
11. Pringshiem EG (1946) Pure culture of algae, preparation and maintenance. Cambridge University Press, p: 119.
12. Leung S, Cabré A, Marinov I (2015) A latitudinally banded phytoplankton response to 21st century climate change in the Southern Ocean across the CMIP5 model suite. Biogeosciences 12: 5715-5734.
13. Zheng CQ, Jeswin J, Shen KL, Lablche M, Wang KJ, et al. (2015) Detrimental effect of CO_2-driven seawater acidification on a crustacean brine shrimp, *Artemia sinica*. Fish Shellfish Immunol 43: 181-190.
14. Wang L, Min M, Li Y, Chen P, Chen Y, et al. (2010) Cultivation of green algae Chlorella sp. in different wastewaters from municipal wastewater treatment plant. Appl Biochem Biotechnol 162: 1174-1186.
15. Whitehouse MJ, Meredith MP, Rothery P, Atkinson A, Ward P, et al. (2008) Rapid warming of the ocean around South Georgia, Southern Ocean, during the 20th century: forcings, characteristics and implications for lower trophic levels. Deep Sea Res Part 1 Oceanogr Res Pap 55: 1218-1228.
16. Harter DE, Irl SD, Seo B, Steinbauer MJ, Gillespie R, et al. (2015) Impacts of global climate change on the floras of oceanic islands-Projections, implications and current knowledge. Perspect Plant Ecol Evol Syst 17: 160-183.
17. Kordas RL, Harley CD, O'Connor MI (2011) Community ecology in a warming world: The influence of temperature on interspecific interactions in marine systems. Exp Mar Biol Ecol 400: 218-226.
18. Singh SP, Singh P (2015) Effect of temperature and light on the growth of algae species: a review. Renew Sustain Energy Rev 50: 431-444.