



EFFECT OF NaCl ON MORPHOLOGICAL CHARACTERISTICS OF *CHLORELLA VULGARIS*

Shaila Hiremath^{1*} and Pratima Mathad²

¹Department of Botany, Sharnbasveshwar College of Science, Kalaburagi, Karnataka, India

²Department of P. G. Studies and Research in Botany, Gulbarga University, Kalaburagi

ARTICLE INFO

Article History:

Received 10th July, 2018

Received in revised form 2nd August, 2018

Accepted 26th September, 2018

Published online 28th October, 2018

Key words:

Chlorella, NaCl, morphological characteristics

ABSTRACT

In the present study the effect of NaCl on morphological characteristics of *Chlorella vulgaris* Beijerinck was investigated. In order to evaluate the effect of NaCl, *Chlorella* was treated with different concentrations (0.1-0.4M) of NaCl, besides control. The study revealed that *Chlorella vulgaris* exposed over 30 days to different concentrations of NaCl exhibited marked morphological variations. At lower concentrations morphological variations were not pronounced but at higher concentrations distinct abnormalities such as enlarged cells with autospores, decolorized cells, inhibition of cell division, prominent increase in the diameter of the cells with shrunken chloroplast, cells with granular chloroplast and enlarged cells with disrupted chloroplast were noticed.

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INTRODUCTION

Saline stress is a major environmental factor that limits growth and productivity. Salinity problems are highly increasing due to indiscriminate use of chemical fertilizers, improper drainage and faulty agronomic practices. It is an ever present threat to crop yield especially in the countries where irrigation is an essential aid to agriculture. Hence, crop production has been seriously hampered by the soil salinity and this problem is becoming more serious every year.

Therefore, there is a pressing need to bring back such areas under cultivation and check their further spread and also to improve the fertility of saline soil which is utmost necessary from the agricultural point of view. Amelioration of saline soil has gained lots of importance. Many attempts have been undertaken to counteract the adverse effects of saline stress by using chemical amendments. However, reclamation through biological means is another approach. Algae including Cyanobacteria have attracted considerable attention in this respect because the algae have tremendous capacity to increase the fertility of soil and they offer an economically attractive and ecologically sound alternative to chemical fertilizers for realizing the ultimate goal of increased productivity, especially in rice cultivation. Hence, deeper understanding of the ecology and physiology of algae including cyanobacteria becomes

essential for the successful development of algalization technology especially under salt affected soils. Though algae flourish well in the saline soil but when salinity increases it has adverse effects on the algae. Therefore, the present study has been undertaken to observe the effect of NaCl on the morphological characteristics of *Chlorella vulgaris*.

MATERIALS AND METHODS

The organism used in the present study i.e., *Chlorella vulgaris* Beijerinck was isolated from the garden soil of Gulbarga University Gulbarga, Karnataka. De's modified Beneck's medium was found best suited for the growth of the alga in the laboratory. The cultures were maintained in the culture room at temperature of $26 \pm 2^\circ\text{C}$.

Further to study the impact of NaCl, the experiments were carried out in 250ml conical flasks, contained 100ml of De's modified Beneck's basal medium. The exponentially growing algal suspension was centrifuged and inoculated in the flasks containing different concentrations of NaCl such as 0.1, 0.2, 0.3 and 0.4 M besides control and kept for observation to 30 days. The samples were drawn periodically during growth (10th, 20th and 30th day) from control and different concentrations of NaCl and were subjected for the analysis of morphological characteristics of *Chlorella vulgaris*.

RESULTS AND DISCUSSION

Microphotographic observations of the green alga *Chlorella vulgaris* exposed over 30 days to different concentrations of

*Corresponding author: Shaila Hiremath

Department of Botany, Sharnbasveshwar College of Science, Kalaburagi, Karnataka, India

NaCl exhibited marked morphological variations. At lower concentrations morphological variations were not pronounced but at higher concentrations distinct abnormalities such as enlarged cells with autospores, decolorized cells, inhibition of cell division, prominent increase in the diameter of the cells with shrunken chloroplast, cells with granular chloroplast and enlarged cells with disrupted chloroplast. It was speculated that morphological variations probably due to the reduction in the metabolic activities of the cells due to NaCl stress. Chlorosis and shrinkage of chloroplast may indicate partial desiccation and loss of turgor. Abnormalities, deformation, enlargement, granulation etc. may be due to unfavorable growth conditions created by salinity.

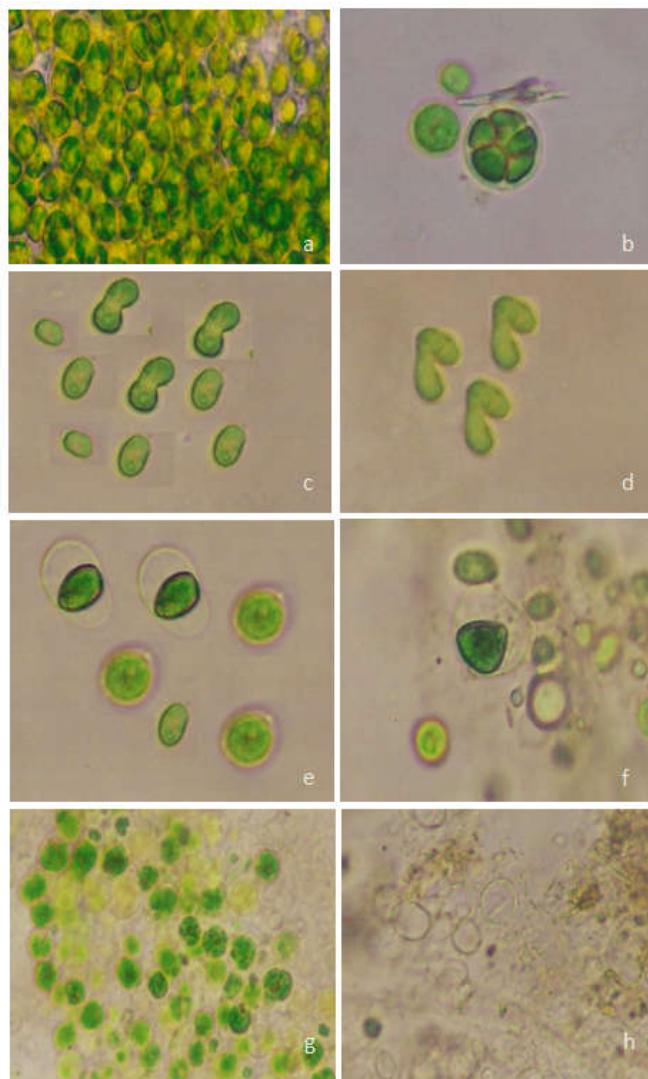


Plate 1 Results on photomicrographic observations of *Chlorella vulgaris* exposed to different concentrations of NaCl revealed distinct morphological abnormalities

- A: *Chlorella vulgaris* - Control - Healthy and normal cells
 B: *Chlorella vulgaris*- 0.1 M NaCl - Enlarged cells with auto spores.
 C & D: *Chlorella vulgaris*- 0.2M NaCl - Cells showing inhibition of cell division
 E & F: *Chlorella vulgaris*- 0.3M NaCl- Prominent increase in the diameter of the cells with shrunken chloroplast.
 G: *Chlorella vulgaris*- 0.3MNaCl - Decolorized smaller and larger cells with granular chloroplast
 H: *Chlorella vulgaris*-0.4 M NaCl- Completely decolorized enlarged and disorganized cells

Similar morphological changes in the algal cells when exposed to NaCl have been reported by several earlier investigators (Khaibullina and Gaisina, 2007; Blumwald and Elisha, 1982; Ali Laszlo and Csaba, 2004; Matthias, Anza, Ancuela, Cornelius and Ursula, 2009). According to Fodorpataki and

Bartha (2004) shrunken chloroplast is due to a partial desiccation and a loss of turgor. The morphological disturbances may be due to differences in NaCl concentrations in the cells and in the extra cellular medium. Surasak *et al.* (2009) observed significant increase in the diameter of cells under increased NaCl stress (2.0 M) in *A. halophytica*. He also reported that the shape of cells grown under stress conditions was longer than the cells grown under normal conditions. They also suggested that NaCl might arrest the formation of the shape of cells and cells under salt stress were highly heterogeneous with respect to their size and shape. Ferjani *et al.* (2003) have observed that under NaCl stress the cells were unable to complete cell division and lysed. They also indicated that the high concentrations of NaCl inhibit cell division without significantly affecting cell growth. Suggesting that NaCl might arrest the formation of the septum and the separation of daughter cells (Plate: 1).

CONCLUSION

The green alga *Chlorella vulgaris* exhibited enlarged cells with autospores, decolorized cells, inhibition of cell division, prominent increase in the diameter of the cells with shrunken chloroplast, cells with granular chloroplast and enlarged cells with disrupted chloroplast. It was speculated that morphological variations probably due to the reduction in the metabolic activities of the cells due to NaCl stress.

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