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Isolation of Nitrosoguanidine Induced NaCl Tolerant Mutant of Spirulina platensis with Improved Growth and Phycocyanin Production

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Abstract : Spirulina spp., as a promising source of many commercially valuable products, is grown photo autotrophically in open ponds and raceways on a large scale. However, the economic exploitation in an open system seems to have been limited because of lack of multiple stress-tolerant strains. The present study aims to isolate a stable stress tolerant mutant of Spirulina platensis with improved growth rate and enhanced potential to produce its commercially valuable bioactive compounds. N-methyl-n'-nitro-n-nitrosoguanidine (NTG) at 250 µg/mL (concentration permitted 1% survival) was employed for chemical mutagenesis to generate random mutants and screened against NaCl. In a preliminary experiment, wild type S. platensis was treated with NaCl concentrations from 0.5-1.5 M to calculate its LC_{50}. Mutagenized colonies were then screened for tolerance at 0.8 M NaCl (LC_{50}), and the surviving colonies were designated as NaCl tolerant mutants of S. platensis. The mutant cells exhibited 1.5 times improved growth against NaCl stress as compared to the wild type strain in control conditions. This might be due to the ability of the mutant cells to protect its metabolic machinery against inhibitory effects of salt stress. Salt stress is known to adversely affect the rate of photosynthesis in cyanobacteria by causing degradation of the pigments. Interestingly, the mutant cells were able to protect its photosynthetic machinery and exhibited 4.23 and 1.72 times enhanced accumulation of Chl a and phycobiliproteins, respectively, which resulted in enhanced rate of photosynthesis (2.43 times) and respiration (1.38 times) against salt stress. Phycocyanin production in mutant cells was observed to enhance by 1.63 fold. Nitrogen metabolism plays a vital role in conferring halotolerance to cyanobacterial cells by influx of nitrate and efflux of Na+ ions from the cell. The NaCl tolerant mutant cells took up 2.29 times more nitrate as compared to the wild type and efficiently reduce it. Nitrate reductase and nitrite reductase activity in the mutant cells also improved by 2.45 and 2.31 times, respectively against salt stress. From these preliminary results, it could be deduced that enhanced nitrogen uptake and its efficient reduction might be a reason for adaptive and halotolerant behavior of the S. platensis mutant cells. Also, the NaCl tolerant mutant of S. platensis with significant improved growth and phycocyanin accumulation compared to the wild type can be commercially promising.

Keywords : chemical mutagenesis, NaCl tolerant mutant, nitrogen metabolism, photosynthetic machinery, phycocyanin
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