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Effect of Salinity on Catalase and Peroxidase Activity of *Chlorella vulgaris* Beijerink

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ABSTRACT

In the present work, the effect of NaCl on catalase and peroxidase activity of Chlorella vulgaris Beijerink was investigated The C. vulgaris was treated with different concentrations of NaCl viz., 0.1, 0.2, 0.3 and 0.4M besides control over 10, 20 and 30 days. The results exhibited increase in the catalase and peroxidase activity up to 0.3 M, whereas it was decreased at 0.4M for all the cultures over all the durations. The study revealed that, increased activity of catalase and peroxidase was an adaptive mechanism to reduce the $H2O_2$ and offer protection against oxidative damage and tolerance against salt.

Keywords : Chlorella, Catalase, Peroxidase, NaCl

I. INTRODUCTION

Among various types of stress, saline stress is a major environmental factor that limits plant growth and productivity in many areas of the world (Allakhverdiev et al., 2000 ; Ashraf, 2009). Living organisms, especially microorganisms, are exposed to various types of natural stress, such as nutrient limitation, temperature, pH, salinity, drought, pollution etc. The adaptability of microalgae differs to salinity and other stress conditions. The ability of cells to survive and flourish in saline environment under the influence of osmotic stress has received considerable attention.

In this respect, algae including Cyanobacteria have attracted considerably, since they are inhabitants of biotopes characterized by changing salinities and can serve as model organisms for a better understanding of salt acclimation in the more complex physiological processes of higher plants (Bohnert and Jensen 1996 ; Bohnert and Sheveleva 1998; Fogg 2001). In response, they have developed series of enzymatic and non enzymatic detoxification systems to counteract ROS and protect cells from oxidative damage (Sairam and Tyagi 2004)

Various antioxidant enzymes like superoxide dismutase (SOD), polyphenol oxidase (PPO), peroxidase (POD), and catalase (CAT) are involved in the detoxification of the reactive oxygen species (ROS) in order to avoid algal cell damage induced by salt stress (Cavalcanti et al., 2007). Higher plants also produce compatible solutes like proline or glycine

betaine to adjust the osmotic potential within their cell and to serve as osmo-protectants for stabilizing the antioxidative enzymatic activities during osmotic stress (Hasegawa et al., 2000; Hoque et al., 2007). These osmotic adjustments protect sub-cellular structures and reduce oxidative damage caused by free radicals produced due to high salinity.

In algae enhanced activity of catalase and peroxidase suggest an effective scavenging of H2O2 and tolerance against salt. However, catalase activity was found to be bearing upon most significant positive correlation with salinity in Gelidia and Ulva (Agarwal et al., 2004). Chakraborthy et al. 2010 suggested that, increased activity of peroxidase was an adaptive mechanism to reduce the $H2O_2$ and offer protection against oxidative damage. Therefore in the present study, an attempt has been made to investigate the effect of NaCl on catalase and peroxidase activity of Chlorella vulgaris Beijerink.

II. METHODS AND MATERIAL

The organism used in the present study i.e., Chlorella vulgaris Beijerinck was isolated from the garden soil of Gulbarga University, Gulbarga. De's modified Beneck's medium was best suited for the growth of C. vulgaris in the laboratory. Axenic cultures were maintained at temperature of 26 ± 2oC. Further to investigate the effect of NaCl, the experiments were carried out in 250 ml conical flasks, contained 100 ml 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 peroxidase and catalase contents of Chlorella vulgaris Beijerink. Catalase activity was assayed estimating residual hydrogen peroxide by forming titanium-hydroperoxide complex (Teranishi et al., 1974). The Peroxidase activity was assayed as increase in optical density due to the formation of tetra guaiacol (Castillo et al., 1984).

III. RESULTS AND DISCUSSION

RESULTS

C. vulgaris when treated with different concentrations of NaCl viz., 0.1, 0.2, 0.3 and 0.4M over 10, 20 and 30 days revealed increase in the catalase activity with maximum of 0.233, 0.247 and 0.283 µg/g at 0.3M, thereafter it was decreased with minimum of 0.191, 0.212 and 0.231 µg/g at 0.4M for all the cultures. (Table- 1& Fig.1)

C. vulgaris when treated with different concentrations of NaCl viz., 0.1, 0.2, 0.3 and 0.4M over 10, 20 and 30 days also showed increase in the peroxidase activity with maximum of 0.851, 0.943 and 1.047 µg/g at 0.3 M, whereas it was decreased at 0.4M with minimum of 0.443, 0.549 and 0.630 µg/g for all the cultures. (Table -2 & Fig 2)

DISCUSSION

Our results on catalase and peroxidase activity of C. vulgaris exposed to different concentrations of NaCl indicated gradual increase at all the concentrations except 0.4 M for all the cultures over all the durations.

Similarly, Jaleel et al. (2008) reported that, plants treated with NaCl alone showed increased activity of peroxidase versus the control. It has been reported that catalase (CAT) is an important antioxidant enzyme that converts H2O2 to water in the peroxysomes (Fridovich, 1989; McCord and Fridovich, 1969). Yamazaki et al. (2003) made an observation that, higher activity of catalase (CAT) and ascorbic peroxidase (APX) decrease H2O2 level in cell and increase the stability of membranes and CO2 fixation

because several enzymes of the Calvin cycle within chloroplasts are extremely sensitive to H2O2. It has been suggested that increase in the activities of these enzymes not only promotes ROS removal, but also may increase ATP synthesis via the Mehler peroxidase reaction which is the source of additional ATP for Na+ expulsion at high salinities (Jahnke et al., 2003). Similarly, Chakraborthy et al. (2010) also observed elevated level of catalase and peroxidase activity under salt stress. It has been indicated that cytoplasmic catalase plays a role in maintenance of intracellular redox balance during dehydration and therefore tolerance against water stress. Catalase also known to prevent dehydration related oxidative damage to membranes and also helps in complete recovery of cells (Wai et al., 2000).

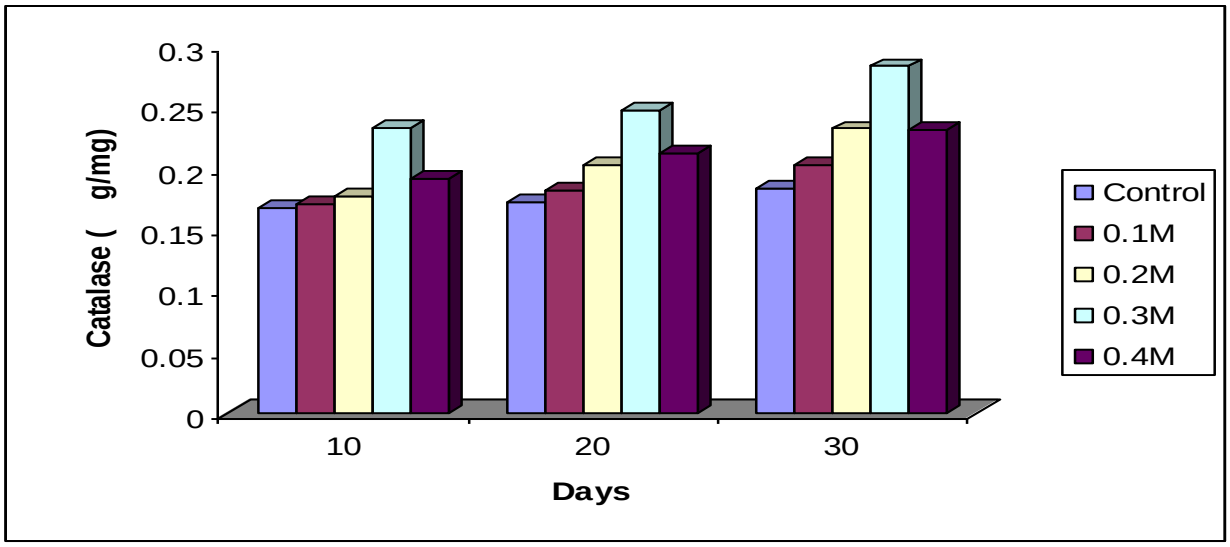
IV. CONCLUSION

Our results indicated increase in the catalase and peroxidase activity of C. vulgaris when exposed to different concentrations of NaCl except at 0.4 M. These beneficial properties revealed that increased activity of catalase and peroxidase was an adaptive mechanism to reduce the $H2O_2$ and offer protection against oxidative damage and tolerance against salt. It was speculated that, adaptation of the alga to salinity was characterized by the antioxidative enzymes like catalase and peroxidase which are involved in the detoxification of ROS and to elude resulting damage under salt stress.

Table -1: Effect of different concentrations of NaCl on Catalase activity (µg/g) of Chlorella vulgaris

NaCl/ con. M	Days		
	10	20	30
Control	0.167 ± 0.05	0.162 ± 0.07	0.172 ± 0.03
0.1M	0.170 ± 0.09	0.182 ± 0.04	0.202± 0.05
0.2M	0.177 ± 0.05	0.202± 0.09	0.232 ± 0.05
0.3M	0.233 ± 0.04	0.247 ± 0.04	0.283 ± 0.06
0.4M	0.191 ± 0.05	0.212 ± 0.01	0.231 ± 0.02

Fig. 1: Effect of different concentrations of NaCl on Catalase activity of *Chlorella vulgaris*

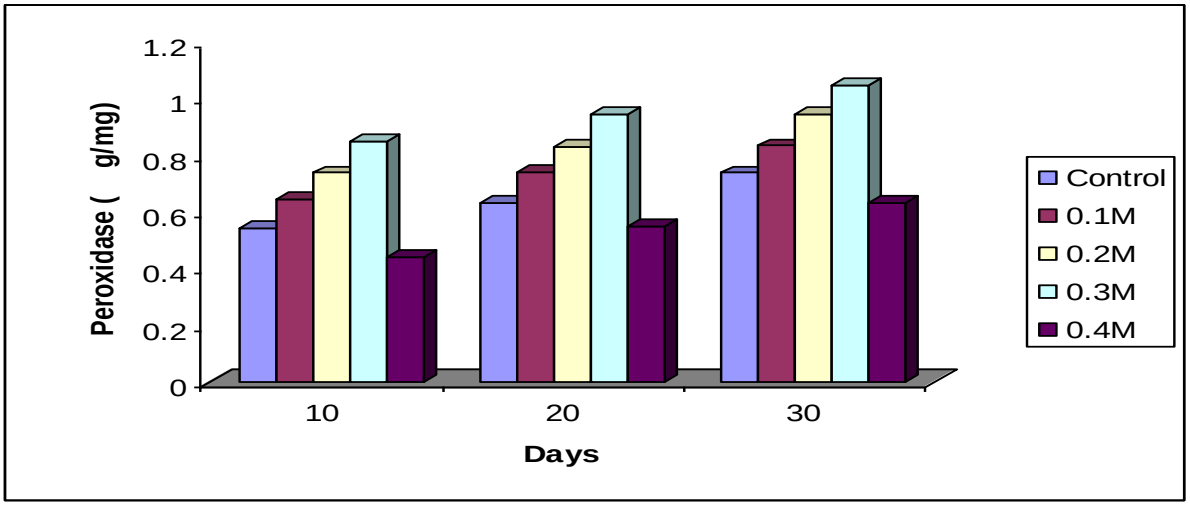


Chlorella vulgaris

Table–2 : Effect of different concentrations of NaCl on Peroxidase activity (µg/g) of *Chlorella vulgaris*

NaCl/ con. M	Days		
	10	20	30
Control	0.543 ± 0.08	0.633 ± 0.14	0.737 ± 0.08
0.1M	0.642 ± 0.14	0.740± 0.13	0.833 ± 0.08
0.2M	0.737 ± 0.14	0.830 ± 0.12	0.947 ± 0.09
0.3M	0.851 ± 0.13	0.943 ± 0.18	1.047 ± 0.17
0.4M	0.443 ± 0.07	0.549 ± 0.06	0.630 ± 0.11

Fig. 2: Effect of different concentrations of NaCl on peroxidase activity of *Chlorella vulgaris*



Chlorella vulgaris

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