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Effect of NaCl on Secondary Metabolites of *Oscillatoria willei*

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ABSTRACT

The present investigation was carried out to assess the effect of NaCl on Secondary Metabolites of *Oscillatoria willei*. In order to determine the effect of NaCl the O.*willei* was treated with different concentrations of NaCl viz., 0.2, 0.4, 0.6 and 0.8M besides control over 10, 20 and 30 days. The results exhibited maximum increase in the Phenol, Flavonoid and Alkaloid up to 0.6 M for all the cultures over all the durations. The results exhibited that, increased activity of secondary metabolites may enhance the salt tolerance and protect the alga against oxidative damage caused by salt stress.

Keywords: *Oscillatoria,* Phenol, Flavonoid, Alkaloid, NaCl

I. INTRODUCTION

Saline stress is a major environmental factor that limits the plant growth and productivity in many areas of the world (Allakhverdiev et al., 2000; Ashraf, 2009). Abrol et al. (1988) estimated that, the world as a whole is loosing at least 3 hectares of fertile land every minute due to salinization/sodification. It is increasing gradually in many parts of the world, particularly in arid and semiarid areas. Presently, out of 1.5 billion hectares of cultivated land around the world, about 77 million hectares is affected by excess salt content (Evelin et al., 2009). According to Jadhav et al. (2010) nearly 40% of world's surface has salinity problem.

The importance of soil salinity for agricultural yield is enormous as it affects the establishment, growth and development of plants leading to huge loss in the productivity (Mathur et al., 2007). Salinity stress leads to series of changes in basic biosynthetic functions, including photosynthesis, photorespiration and amino acid synthesis in plants (Kawasaki et al., 2001; Ozturk et al., 2002; Seki et al., 2002). It is an important deterrent to agriculture in many areas of the world. However, salts not only affect the growth of plants but also inhibit the proliferation and activity of native or introduced microorganisms.

For most organisms enhanced salt concentrations were not favorable for the growth. But, algae are grouped into halophytic and halo tolerant based on tolerance extent, because they differ in their adaptability to salinity. According to Richmand (1986), algae produce some metabolites to protect from salt injury and also to balance as per the surrounding osmotica . Emad et al , 2010 stated that salt stress leads to an imbalance of the cellular ions resulting in ion toxicity and osmotic stress; leading to retardation of growth either directly by salt or indirectly by oxidative stress induced by ROS. The antioxidant defense machinery protects algae against oxidative stress damages. Algae similar to plants, possess very efficient enzymatic antioxidant defense systems that protects cells from oxidative damage by scavenging ROS.

Microalgae are considered as promising alternative source for antioxidants such as carotenoids, flavonoids and phenols in addition to being rich sources of proteins, carbohydrates and fatty acids (Li et al. 2007; Natrah et al.,2007; Hajimahmoodi et al., 2010; Rodriguez-Garcia and Guil-guerrero 2008; Chacón-Lee and González-Mariño 2010; Lee et al., 2010).
Secondary or primary metabolites produced by algae may be potential bioactive compounds of interests in the pharmaceutical industry (Ely et.al, 2004; Febles et.al, 1995 and Tuney et.al., 2006). It has been reported that number of secondary metabolites are produced by algae as a chemical defense against predation, herbivory and competition for space (DeLara-Isassi et.al., 2000; De Nys et. al., 1998).
Therefore in the present investigation an attempt has been made to understand the effect of NaCl on Secondary Metabolites of Oscillatoria willei.

II. MATERIALS AND METHODS

The blue green alga Oscillatoria willei BDU 141621 was obtained from National Facility for Marine Cyanobacteria (NFMC) Tiruchirapalli. The ASN III medium (Rippka et al., 1979) at pH 7.5 was best suited for the growth of the alga O. willei.
The present work was planned in such a way that, in one set, the cultures of Oscillatoria willei was treated with different concentrations of NaCl such as 0.2, 0.4, 0.6, 0.8 M besides control. In another set, alga was treated with different concentrations of NaCl in combination with gypsum (10mM) along with control. The experiments were carried out in 500 ml sterile Erlenmeyer flasks containing 300 ml of nutrient media. To this, 30 ml of exponentially growing O. willei was harvested, washed, centrifuged and inoculated separately into each of these flasks containing the media 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 Phenol, Flavonoid and Alkaloid. The phenols were estimated by Folin-Ciocalteaus method (Bray and Thorpe, 1954). The flavonoids from algae quantitatively estimated by Swain and Hills method (1959). The total alkaloid contents of algae were estimated by Ikans method (1981).

III.RESULTS

O.willei treated with different concentrations of NaCl viz., 0.2, 0.4, 0.6 and 0.8 M over 10, 20 and 30th days showed increase in phenol content with maximum of 0.453, 0.467 and 0.479 mg/g at 0.6 M and with minimum of 0.323, 0.336 and 0.349 mg/g at 0.8 M for all the cultures. (Table and Fig 1). Whereas flavonoid content increased with maximum of 0.731, 0.840 and 0.951 mg/g at 0.6M and with minimum of 0.357, 0.543 and 0.557 mg/g at 0.8 M for all the cultures. (Table and Fig 2)
Similarly maximum increase in the alkaloid content was found at 0.6M with 0.933, 0.972 and 1.063 mg/g and minimum with 0.534, 0.633 and 0.727mg/g at 0.8 M for all the cultures. (Table and Fig 3)

IV. DISCUSSION

Our results on phenol, flavonoid and alkaloid contents of O.willei exposed to different concentrations of NaCl indicated gradual increase up to 0.6 M thereafter showed decrease in all the cultures over all the durations.

Similar results were noticed by Rezazadeh et al. (2012) in Cynara scolymus L. under saline stress. It has been indicated that, antioxidant activity of phenolic compounds is mainly attributed for their redox actions, neutralizing free radicals, quenching singlet and triplet oxygen, or decomposing peroxides (Osawa, 1994). The phenol content is known to be influenced by environmental conditions such as salinity, nutrient level and irradiance, as well as occurrence of grazer or pathogen attack (Solene et al., 2008). However, the occurrence of phenolic compounds in blue green algae is less documented than that in higher plants (Santoyo et al., 2006; Colla et al., 2007).

Ali et al. (2003) observed increased flavonoid content in Barley seedlings. It has been speculated that abiotic stress frequently induces Flavonoids and protect plants (Dixon and Paiva, 1995; Grace and Logan, 2000). These compounds accumulated in plant tissue could help to protect themselves from damaging effects and act as a free radical scavenger because the hydroxyl groups present in their structure (Caturla et al., 2003; Potapovich and Kostyuk, 2003).

Rocha et al. (2005) reported enhanced alkaloid with increased NaCl level in Cereus peruvianus. It has been indicated that application of NaCl enhances alkaloid production (Anitha and Kumari, 2006).

V. CONCLUSION

The present study exhibited increase in the Phenol, Flavonoid and Alkaloid contents of O.willei when exposed to different concentrations of NaCl except at 0.8 M. The results indicated that, increased content of these metabolites may play an important role in the stress tolerance mechanism and protect the algae from oxidative damage caused by salt stress.

VI. REFERENCES

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Table–1: Effect of different concentrations of NaCl on Phenol content of *Oscillatoria willei*

NaCl con. (M)	Phenols (mg/g)		
	10 days	20 days	30 days
Control	**0.375 ± 0.08**	**0.394 ± 0.02**	**0.405 ± 0.02**
0.2	**0.413 ± 0.24**	**0.424 ± 0.06**	**0.414 ± 0.04**
0.4	**0.423 ± 0.16**	**0.439± 0.03**	**0.444± 0.05**
0.6	**0.453 ± 0.17**	**0.467 ± 0.05**	**0.479 ± 0.08**
0.8	**0.323 ± 0.07**	**0.336 ± 0.06**	**0.349 ± 0.02**

Fig.1: Effect of different concentrations of NaCl on Phenol content of *Oscillatoria willei*

Oscillatoria willei

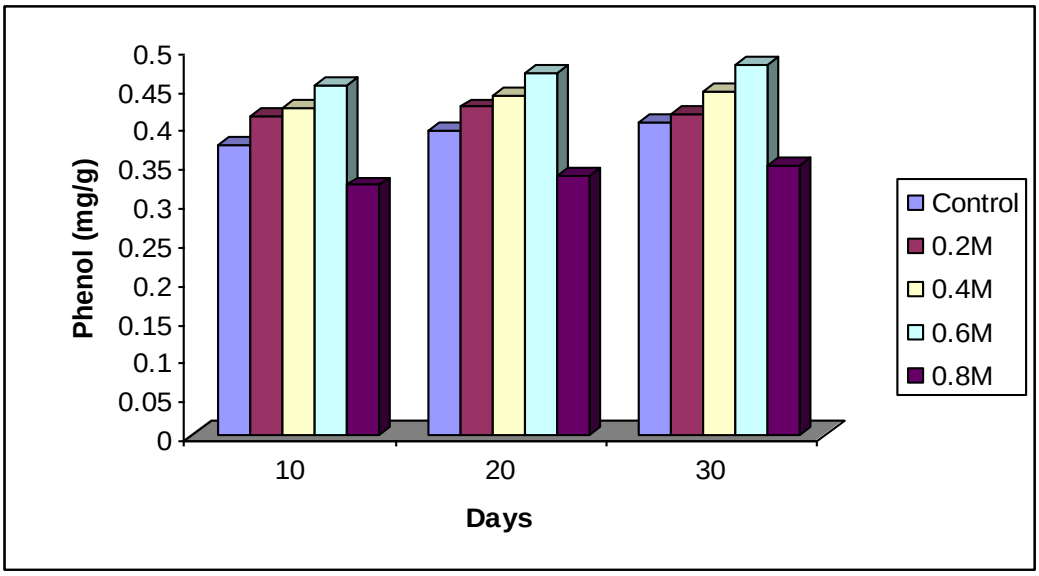
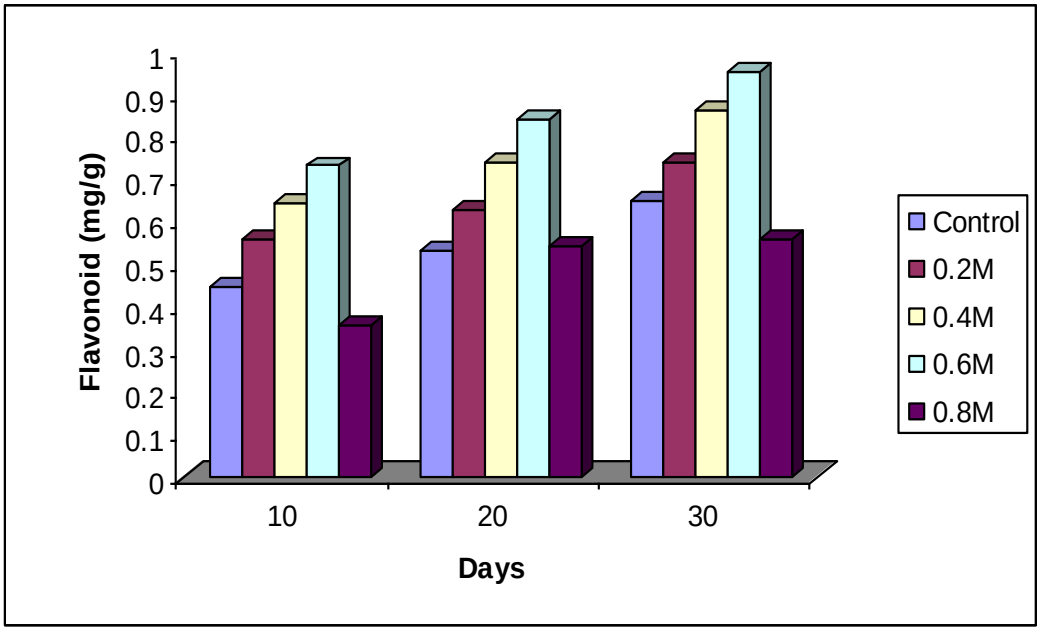


Table -2: Effect of different concentrations of NaCl on Flavonoid content of *Oscillatoria willei*

NaCl con. (M)	Flavonoids (mg/g)		
	10 days	20 days	30 days
Control	**0.447 ± 0.03**	**0.533 ± 0.09**	**0.647 ± 0.25**
0.2	**0.557 ± 0.06**	**0.627 ± 0.08**	**0.740 ± 0.24**
0.4	**0.643 ± 0.09**	**0.737 ± 0.02**	**0.863 ± 0.24**
0.6	**0.731 ± 0.09**	**0.840 ± 0.09**	**0.951 ± 0.14**
0.8	**0.357 ± 0.10**	**0.543 ± 0.19**	**0.557 ± 0.21**

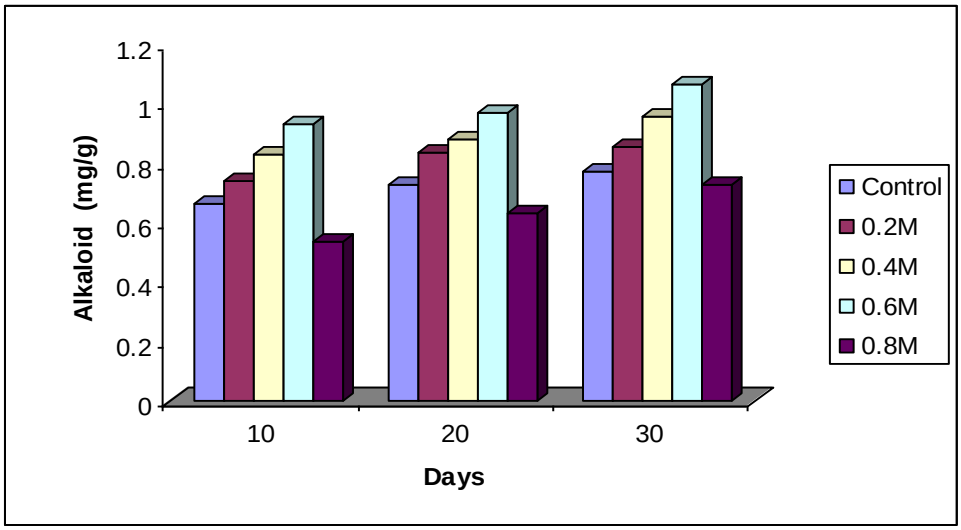
Fig. -2: Effect of different concentrations of NaCl on Flavonoid content of *Oscillatoria willei*



Table–3: Effect of different concentrations of NaCl on Alkaloid content of *Oscillatoria willei*

NaCl con. (M)	Alkaloids (mg/g)		
	10 days	20 days	30 days
Control	0.663 ± 0.05	0.727 ± 0.02	0.775 ± 0.04
0.2	0.741 ± 0.08	0.837 ± 0.09	0.853 ± 0.08
0.4	0.831 ± 0.04	0.883 ± 0.02	0.957 ± 0.08
0.6	0.933 ± 0.04	0.972 ± 0.04	1.063 ± 0.33
0.8	0.534 ± 0.02	0.633 ± 0.05	0.727 ± 0.04

Fig.–3: Effect of different concentrations of NaCl on Alkaloid content of *Oscillatoria willei*



Oscillatoria willei