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Microalgae richness and assemblage of man-made solar saltpans of Thoothukudi, TamilNadu

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Solar saltpans are ponds of brine sun evaporated to crystallize salt (Halite). Once provide ambient ecology for several halophilic microalgae. Enumeration of microorganisms in Thoothukudi solar saltpans revealed the presence of 30 genera of microalgae belonging to the divisions of *Cyanophyta, Bacillariophyta* and *Chlorophyta. Chlorophyta* species is the dominant group of solar salterns of Thoothukudi.

Key words: Solar saltpans, halophilic microalgae, diversity, salt production and Thoothukudi.

INTRODUCTION

Solar saltpans are man-made system of interconnected ponds (Reservoir, Condenser and Crystallizer) for the production of salt from seawater and/or underground brine by means of evaporation. Luxuriant growth of certain microalgae is noticed in this saltern (Korovessis and Lekkas, 2000). Microalgae are practical grouping of photosynthetic organisms of simple construction, it includes a diverse array of morphologies from single cell to multicellular (Ashok Kumar et al., 2011). The organisms living in every solar salt pans constitute a biological system, which are able to aid to harm salt production. Systems aiding salt production maintain stable species composition and concentrations, they produce and accumulate sufficient organic matter to power the biota, prevent leakages and also increase the solar energy absorption (Reginald and Diana, 2008; Lakshmanan, 2008). The microalgae also colour the brine by producing floating coloured cells in high concentrations (Oren et al., 1992); besides enhancing, the rate of evaporation in saltern. These microorganisms play a very important role in the recycling of materials (nutrients and other substances) in saltpan ecosystem and occupy important membership in of biogeochemical cycles (Kabilan et al., 2012). Therefore the purpose of this study was to investigate the species richness and biodiversity of microalgae occurring in a man–made solar saltern in Thoothukudi.

MATERIALS AND METHODS

Water and algal mat samples were collected in four different solar saltpans interdistance of these salt pans maybe around 5 kms (8°46'46"N and 78°9'3"E) of Thoothukudi using 2 lit polythene containers. In each salt pan, five samples are collected from different ponds of reservoir, condenser and crystallizer. The collected samples were preserved using 2% formaldehyde for the laboratory analysis. Microalgae specimens were observed under optical microscopy (Olympus BX51) with different magnifications (up to 100x). Genus and species level identification of *Cyanophyta,*

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Table 1. Microbial communities in Thoothukudi solar salt pans.

Microorganisms	Thoothukudi solar salt pans			
	Salt pan 1	Salt pan 2	Salt pan 3	Salt pan 4
		Cyanophyta		
Anabaena sp	+	+	+	*
Aphanocapsa sp	*	+	+	+
Chroococcus sp	*	+	+	+
Gleocapsa sp	+	+	*	+
Gleothece sp	+	*	*	+
Lyngbya sp	+	+	*	+
Oscillatoria sp	+	+	+	+
Phormidium sp	+	+	+	*
Spirulina sp	+	+	+	+
Synechococcus sp	+	+	*	+
Synechocystis sp	+	+	+	+
		Bacillariophyta		
Amphora sp	+	+	+	+
Caloneis sp	+	+	+	*
Coscinodiscus sp	+	+	+	+
Cyclotella sp	+	+	+	+
Cymbella sp	+	+	+	+
Diatoma sp	+	+	+	*
Fragillaria sp	+	+	+	+
Gyrosigma sp	+	+	*	+
Mastogloia sp	+	*	*	+
Navicula sp	+	+	*	+
Nitzschia sp	+	+	+	+
Pinnularia sp	*	*	+	+
Pleurosigma sp	+	+	+	+
Synedra sp	+	+	+	+
		Chlorophyta		
Chlorella sp	+	+	+	+
Chlorococcum sp	*	+	+	+
Closterium sp	+	+	+	+
Cosmarium sp	+	+	+	*
Dunaliella sp	+	+	+	+

Bacillariophyta and *Chlorophyta* were examined according to Prescott (1951), Hendey (1964), Sarma and Khan (1980), Komarek and Anagnostidis (2005) and Thajuddin and Subramanian (2005).

RESULTS

30 genus level species of microalgae were identified in the four solar saltern system of Thoothukudi (Table 1), species were found to be of three divisions viz, *Cyanophyta* (11 genes), *Bacillariophyta* (16 genes) and *Chlorophyta* (5 genes). *Bacillariophyta* showed the maximum number of species in Thoothukudi salt pans. Some of these species viz, *Caloneis* sp., *Diatoma* sp., *Anabaen* sp., *Gyrosigma* sp., *Lyngbya* sp., *Gleothece* sp. and *Pinnularia* sp. are not present in commonly all saltpans.

Figure 1 shows the abundance of microalgae (%) in all salt pans of Thoothukudi. The abundance data was generated for *Chlorophyta* (53.48), *Bacillariophyta* (34.61) and *Cyanophyta* (11.91). Five genuses viz, *Chlorella* sp., *Chlorococcum* sp., *Closterium* sp., *Dunaliella* sp. and *Cosmarium* sp. of *chlorophyta* taking together occur in greater quantities compared to other division of microalgae. 34.61% of *Bacillariaphyta* species viz, *Nitzschia* sp., *Synedra* sp., *Mastogloia* sp.,*Navicula* sp., *Cymbella* sp., *Amphora* sp., *Cyclotella* sp., *Caloneis* sp., *Diatoma* sp., *Coscinodiscus* sp., *Pleurosigma* sp., *Pinnularia* sp., *Fragillaria* sp., and *Gyrosigma* sp., were recorded. *Cyanophyta* species namely *Oscillatoria* sp.,

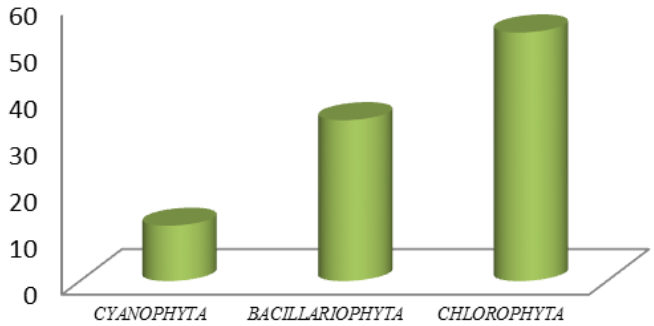

Figure 1. Abundance of microalgae in Thoothukudi saltpans.

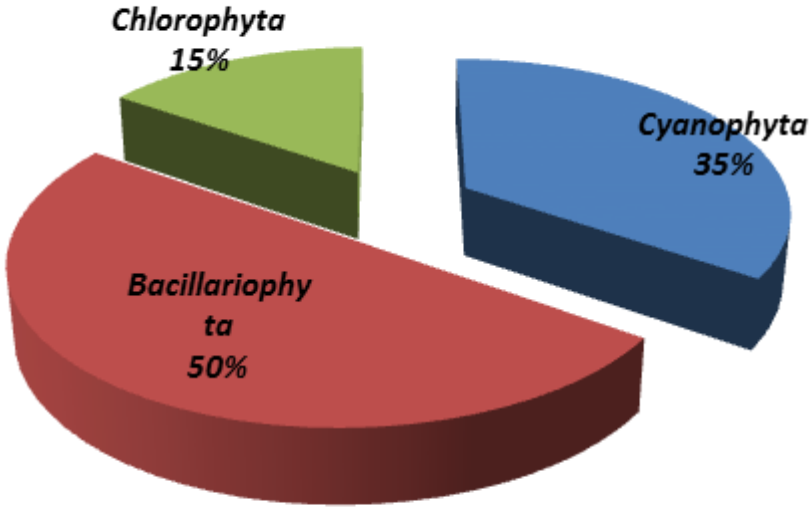

Figure 2. Species richness in salt pan 1.

Spirulina sp., *Lyngbya* sp., *Phormidium* sp., *Aphanocapsa* sp., *Gleocapsa* sp., *Synechococcus* sp., *Gleothec* sp., *Synechocystis* sp., *Anabaena* sp. and *Chroococcus* sp. were identified to 12%.

Figures 2, 3, 4 and 5 shows the species richness in all salt pans of Thoothukudi. This result indicates the *bacillariaphyta* is a dominant group of all salt pans followed by *cyanophyta* and *chlorophyta*. Nearly 15 genus of *bacillariaphyta* (47%), 11genus of *cyanophyta* (35%) and 5 genus of *chlorophyta* (18%) species were recorded in Thoothukudi salt pans. At the same time the abundance of species were observed in *chlorophyta* (53.48).

DISCUSSION

Salt pans are a unique ecosystem where series of different organisms with varying environmental conditions occurs. Organisms ranging from bacteria, archaea to fungi, microalgae etc., are known to colonies salt pans and may influence the quality of salt precipitation (Kabilan et al., 2012). The hydrology play has significant role in the development of biological community of salt pans (Davis, 2000). As recorded and pointed out by Olson (2006), Oren (2000), Golubić (1980), Borowitzka (1981), Javor (1989) and Oren and Seckbach (2001) hypersaline environment viz, solar salt pans, natural salt lake and for important microalgae groups with the dominancy of *Bacillariophyta*, *Chlorophyta* and *Cyanophyta*. As far as quantitative estimation through the microscopic examination of salt tolerant micro organisms concerned in an all the four salt pans investigated shows similar results. However, *Bacillariophyta* predominant its assemblage, the presence of microalgae assemblage provides the beneficial effect of salt production as colorization promotes solar evaporation (Lakshmanan, 2008). Overall, microalgal densities were high in salinities of 12 to 36 B^0 within saltworks waters, the salt pans salinity was recorded in various stages like reservoir

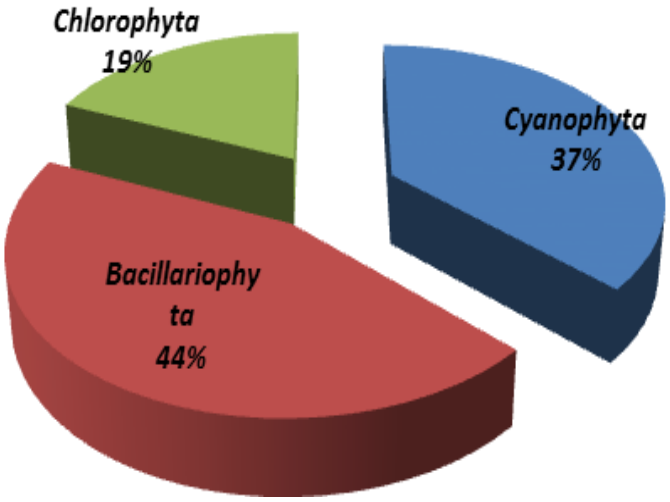

Figure 3. Species richness in salt pan 2.

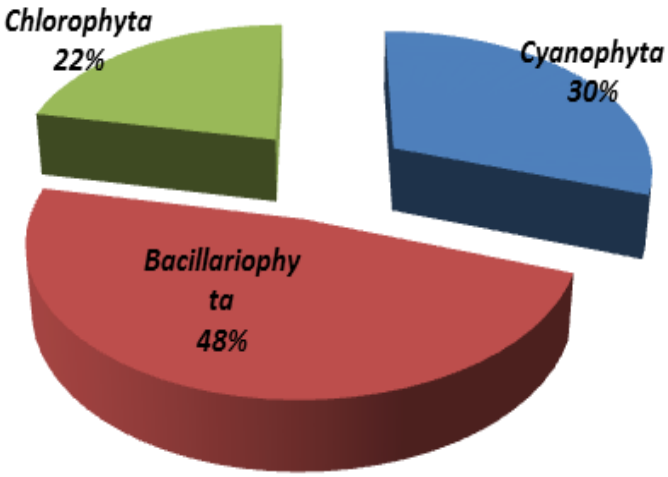

Figure 4. Species richness in salt pan 3.

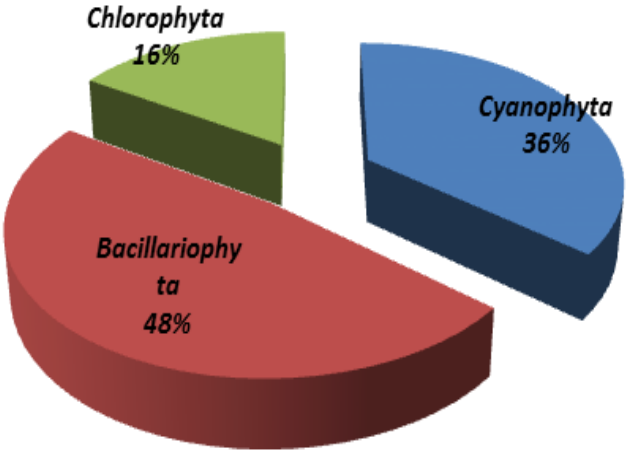

Figure 5. Species richness in salt pan 4.

condenser crystallizer and bittern in the ranges from 9 B^0 to 40 B^0. Our observations indicate that *chlorophyta* populations and the overall richness of microalgae profile in saltworks in Thoothukudi. The abundance of microalgae coloured cells increase the absorption of solar energy which raise brine temperature and thus improve evaporation (Oren et al., 1992; Michael et al., 2000). The quantity and quality of salt production in solar salt pans is determined by the hydrobiological activity (Sorgeloos, 1983). The microalgae of *chlorophyta* (*Dunaliella)*, when grown in solar saltpans in high concentration to appear red colour, it is often regarded as a significant contribution to the solar salt production process (Reginald et al., 2004). The bloom of coloured microorganisms in salt works to absorb the solar energy which increases the brine temperature and to enhance the rate of evaporation (Reginald and LailaBanu, 2009), and these organisms to release the organic carbon in solar ponds to increase the quality of precipitated salt (Giordano et al., 1994). In Our research provide the information about the appearance and assemblage of microalgae in solar saltpans from Thoothukudi in Tamil Nadu.

Conflict of Interest

The authors have not declared any conflict of interest.

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