DUNALIELLA SALINA AN ENERGY CONVERSION MICRO ALGA IN SOLAR SALTPANS

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ABSTRACT

Microbenthic algal consortia are organized in multi layered structures that cover the surface of illuminated submerged substrates with a so-called biofilm. The ability of algae to produce oxygen in photosynthesis as well as their uptake rates of N and P make them effective components of any biological system. The organisms living in solar salt works constitute a biological system, which are able to aid or harm salt production. Systems aiding salt production maintain stable species composition and concentrations. They produce and accumulate sufficient organic matter to enrich the biota, prevent leakage and also increase the solar energy absorption. The natural conditions do not support more salt production and there is a requirement for the biological management. The naturally available organic and inorganic nutrients support the development of *Dunaliella salina* algal blooms that are benefit for solar salt heat absorption resulting in faster evaporation and an increase in the salt quality.

Keywords: *Dunaliella salina,* Salt pans

Introduction

Solar salt works are man-made systems of interconnected ponds for the extraction of salt from seawater, by means of solar and wind evaporation (Korovessis and Lekkas, 2000). The phytoplankton production and distribution vary considerably in the ecosystem (Paul and Selvaraj, 1993). Phytoplankton production contributes about 95% of total productivity in the marine environment (Steema Nielsen, 1975). The production of common salt (sodium chloride) is one of the most ancient and widely distributed industries in the world. The physical and chemical compositions of salt production from various sources are varied widely depending upon the manufacturing techniques, climatic conditions and process adopted. The technique of solar salt production involves fractional crystallization of the salts in different ponds to obtain sodium chloride in the purest form (Sorgeloos and Tackaert, 1991). The present study is aimed at the influence of *Dunaliella salina* in solar salt works in the production of maximum pure salt. Algal culture is introduced in the experimental and control condenser and crystallizer ponds. Samples were collected from experimental and condenser ponds for quality analysis.

Materials and Methods

The micro algae developed in the laboratory were brought to the field for inoculation. The inoculation was carried out at 6° clock in the morning. During inoculation the inoculums was introduced randomly in different places of the condenser experimental ponds. Soon after inoculation water samples were collected in different places of the experimental and control ponds to estimate the micro algal biomass from the day of inoculation onwards. This process was continued till the condenser water reached 100 ppt salinity. This was reached on the 7th day after inoculation. The algal count observed in the control and experimental inoculums is presented in Table-1.

When the water reached 100 to 320 ppt, the crystallization process takes place. After the crystallization process was over, salt crystals were carefully collected in separate polythene bags and brought to the laboratory for its quality analysis. For quality analysis the parameters studied were moisture, insoluble matter, sulphate, calcium, magnesium and NaCl (Table-2) using standard procedures.

Result

The first reading was taken on the day of inoculation (0 day). On this day *Dunaliella salina* algal count was $0.05 \pm 0.004 \times 10^4$ cells/ml. The other estimations for the subsequent seven days were 0.35 ± 0.012, 0.96±0.035, 1.28±0.028, 2.28 ± 0.012, 3.10±0.013, 4.38 ± 0.04 and $4.82 \pm 0.037 \times 10^4$ cells/ml. But the *Dunaliella salina* count resulted in uninoculated pond waters were 0, 0, 0, 0.80±0.066, 1.11±0.071, 1.57±0.071, $0.91 \pm 0.154 \times 10^4$ cells/ml from 0 to 7th day respectively.

The moisture, insoluble matter, sulphate, calcium, Mg and NaCl contents in the salt during the study showed decreased level from the control towards the experimental ponds. Moisture content in the control pond salt was 2.38±0.259 % and the salt forms the experimental pond it was 2.45±0.187 %. Insoluble matter % was in control 0.02±0.006 and experimental pond 0.04±0.009. Sulphate % was 0.50±0.006 in control and 0.59±0.033 in experimental pond. Calcium content % was 0.03±0.003 in control and 0.04±0.004 in experimental. Magnesium content % was 0.18±0.007 in control and 0.19±0.007 % in experimental pond. NaCl content in the control pond salt was 96.78±0.05% and the experimental pond was 96.80±0.04. Except moisture all the other parameters like insoluble matter, sulphate, calcium, magnesium and sodium chloride were higher in the experimental ponds than the control ponds.

Table 1: *Dunaliella salina* count observed in the control and experimental inoculum (condenser pond)

Inoculation Days	Condenser Pond (Cell Count $\times 10^4$ cells/ml)	
	Control	Experimental
0	0	0.05±0.004
1	0	0.35±0.012
2	0	0.96±0.035
3	0	1.28±0.028
4	0.80±0.066	2.28±0.012
5	1.11±0.071	3.10±0.012
6	1.57±0.071	4.38±0.041
7	0.91±0.154	4.82±0.037

Table 2: Salt quality parameters observed in the control and experimental crystallizer pond

Content (%)	Control	Experimental Pond
Moisture	2.38±0.254	2.45±0.187
Insoluble Matter	0.02±0.006	0.04±0.009
Sulphate	0.50±0.006	0.59±0.033
Calcium	0.03±0.003	0.04±0.004
Magnesium	0.18±0.007	0.19±0.007
NaCl	96.78±0.05	96.80±0.04

Discussion

Water in the ponds is hypersaline and a steep salinity gradient is maintained for the production of salt. Sodium chloride production from solar salt works depends upon location, favorable climate and the living microorganisms growing in the concentrating ponds and crystallizers. These essential microorganisms constitute a biological system, which serves two important functions in salt production. The microorganisms produce a thick, many-layered mat on the bottom of the pods, which prevents leakage of the brine. The microorganisms also colour the brine by producing floating coloured cells in high concentrations. The coloured cells increase the absorption of solar energy, which raises brine temperature, and thus improve evaporations (Oren et al., 1992). Temporal patterns of interaction between salinity and water depth can be important determinants of the biological community of the saline system (Campbell, 1995) and the hydro biological activity determines the quality and quantity of salt production in the solar salt operation (Sorgeloos, 1983).

The naturally available organic and inorganic nutrients support the development of algal blooms and these blooms are beneficial as they ensure increase of solar heat absorption which in turn results in faster evaporation and thus increases the salt quality (Sorgeloos, 1983).

Dunaliella salina, whose cells accumulate carotenoids when grown in high salt concentrations and therefore appear red. The red color of the concentrated saltern ponds is often regarded as a significant contribution to the solar salt production process. Light energy absorbed is converted into heat, thus increasing the heat accumulation of the water and so improving the salt crop in salterns (Sorgeloos, 1983). The coloured microorganisms present increase the absorption of solar energy, which raises brine temperature, and thus enhance evaporation. In the present study, the role of *Dunaliella salina* in the salts of experimental ponds, showed considerable reduction of moisture content and also light variation of sulphate, calcium and magnesium content enhanced the quality of salt.

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