MICROORGANISMS IN SALT PANS: AN OVERVIEW

1.1 SALT PANS AS A UNIQUE ECOSYSTEM

The biological process that develops along with the increasing salinity in the evaporating ponds of saltern forms a unique saline ecosystem which is yet to be better understood. The author’s personal empirical knowledge coupled with a review of literature emphasized the need for a study of this sort, i.e., salt tolerant micro algae and microbes as influencing agents in salt production. In this chapter, to begin with, is given a general description of salt production.

In parallel with the physicochemical process, a chain of micro algae and microbes are developed in the evaporating ponds system, constituting the biological process of the salt production. Such a chain is similar to those of naturally saline or hypersaline coastal ecosystems.

The biological process of saltern is a sensitive process and depends on temperature, depth and turbidity of brine, physicochemical process during salt production and, the overall design of the saltern. Organisms developing in saltern that operate efficiently constitute a biological system or ecosystem, which interacts with the physicochemical process and is vital to the production of salt.
The biological system is in admirable harmony with the production process of the saltern, in three ways, viz.,

First, it produces the appropriate quantity of organic matter, which is a source of energy for the various organisms, and reduces the permeability of the bottom of the ponds, thus minimizing brine losses, particularly at low concentrations.

Second, it renders red hue to the brines in the salt pans, facilitating enhanced absorption of solar radiation and shielding solar radiation reflection from the white salt bed. The red colour of the brines in the pans is attributable to *Halobacterium*, *Aphanothece* and the unicellular alga - *Dunaliella salina*. They act as catalysts in the crystallization of better quality salt rich in β-carotenoids adding nutritional values to the salt.

Finally, it creates and maintains the appropriate conditions in the salt pans, for the continuous and maximal production of high quality salt (Korovessis and Lekkas, 1994).

### 1.2 THE STUDY AREA

The study area is located in Thoothukudi [Formerly Tuticorin also called Pearl City (due to pearl production)], capital city of Thoothukudi District of Tamil Nadu State, a coastal city adjoining Gulf of Mannar. In order to study such an ecosystem of hyper saline nature, the solar salt farm of M/s Palanithai Salt Works (PSW), Thoothukudi located at Lat. 8°45’ N and Long. 78°13’ E
opposite to Tuticorin Alkalies and Chemicals industries Thoothukudi, Tamil Nadu, South India (Fig. 1.1) was chosen as the study pan due to easy access to the author. Frequent field visits and several measurements were inevitable in this study which envisaged a highly cooperative farm owner. In this respect PSW extended all possible help to the author. However, care was taken not to disturb the routine works and business of the PSW while making field observations. The following were the objectives set forth in the present study.

1.3 OBJECTIVES

The prime objective of the study is to bring out if there are relations, if any, between salt production and hyper saline micro algae. And thus it required the following to accomplish the objective and also to validate the micro organic role in the salt pans:

1. To study the role of biological factors in salt production.
2. To range the effective meteorological parameters in salt production
3. To culture test micro algae for the use in the tray-pan experiment.
4. To conduct simulation studies using trays (for salt pans)
5. To study the interaction between the extrinsic and intrinsic factors in salt production.
Fig 1.1  Location of study area: index and map
The role of hyper saline micro algae and microbes in salt producing pans has been put forth, both in favour and against, by different authorities. Details are available elsewhere in the following chapters. Microorganisms influence salt production through its mat forming habit and colour acquiring property. Literature survey coupled with field observations reveal and strengthen the effectiveness of microorganisms in salt production. So, biological factors need to be identified and assessed for validation of the role of microorganisms in salt pans.

The second objective is of paramount importance in salt production as meteorological variables contribute much to the evaporation of sea water or brine impounded in salt pans. As heat energy is reinforced by the colouration of micro algae and microbial mats, it emphasizes the study of microorganisms in the salt pans as a critical component in the salt production.

The third objective met the requirement of micro algae to be introduced into the trays containing brine for the accomplishment of the next objective. Isolation and mass culture developed served the purpose.

The fourth objective had been necessitated a laboratory scale or bench scale simulation of salt pan works. For that purpose a few number of trays were used simulating pans. Experiments were held for different volumes and chlorophyll concentration of live algae, especially *Dunaliella viridis* (cultured), in trays kept on the field within the study area, so that evaporation will be similar both in real pans and in trays.
The fifth objective attempted to explore the factors influencing salt production in an overall perspective.

1.4 SCOPE

On many counts, the present study was limited by the constraints of real salt pan activities which could not be overcome as it could have affected the salt production. However, the study, experiments and the results conveyed the desired and/or searched outcome. Field testing also proved that there exists an indispensable relation between salt and salt tolerant organisms.

1.5 SALT PAN GEOLOGY

Tuticorin coast rests on recent marine sediments especially rich in clay which only makes salt pan operation the best suitable field business along this coast. Beneath the black clay is a shell bed which lies on calcareous sediments. Such geological environment favours brine (saline groundwater) conditions, a huge resource base for salt industries based on evaporation process.

1.6 SALT PAN CLIMATE

Thoothukudi lies in a semi arid climatic zone with an average rainfall of 800mm and an average temperature of 30°C. The area experiences wind from both the monsoons of NE and SW directions. While SW monsoonal wind is dry, northeasterly winds bring moisture to the area.
1.7 ORGANIZATION OF CHAPTERS

Chapter 1 introduces the role of microorganisms in the salt pan. This overviews the objectives of the study, scope, geology and climate.

Chapter 2 gives a general description of salt and salt production process. This will enable the reader to follow the subsequent chapters.

Chapter 3 deals with the materials and methods that were adopted in the course of study. It also portrays the salt pan architecture.

Chapter 4 is devoted to account on field experiments conducted. In field experiments, assessment of evaporation rate with reference to the reduction in brine volume can be related to the quantum of salt that can be expected.

Chapter 5 details *Dunaliella*. Its taxonomy, morphology, locomotion, vegetative, sexual reproduction and role in thermal regime of the salt pans are also described. Distribution of *D. viridis*, isolation and culture are detailed. Further, in this chapter, the effect of introduced *D. viridis* in salt production (tray simulation studies) is described.

Chapter 6 illustrates results and analysis. The link among the brine chemistry, *Dunaliella viridis*, and salt production is visualized through statistical analyses and effective salt pan lay out through computer modeling for which computer software called *PHRQPITZ* was used.

Chapter 7 concludes the study with a summary. Also suggested in that chapter is a biological recommendation for a better salt yield.
1.8 SUMMARY

In this chapter is given an overview of microorganisms in the salt pan, salt pan as a unique ecosystem, objectives, scope, geology, climate and the plan of the study. To give the reader clarity on the subject the next chapter details salt and salt production, in general.