Diversity of Marine Actinomycetes - A Review

Dr. Baskar.V[1] Dr. Subha.K.[2] Dr. Panneerselvam. A.[3]
[1,3]Department of Botany and Microbiology [2]Department of Microbiology
[1,3]A.V.V.M Sri Pushpam College (Autonomous), Poondi- 613 503, Thanjavur, Tamil Nadu, India.
[2]Idhaya college for women,Sakkottai, Kumbakonam - 612 001

Abstract— Marine Actinomycetes is one of the major emerging areas of research in tropics. Marine actinomycetes occur on the sediments and in water and also other biomass (mangrove) and substrates (animal). These organisms are gaining importance not only for their taxonomic and eco-logical perspectives, but also for their unique metabolites and enzymes. Actinomycetes have been looked upon as potential sources of bioactive compounds, and the work done earlier has shown that these microbes are the richest sources of secondary metabolites. They hold a prominent position as targets in screening programs due to their diversity and their proven ability to produce novel metabolites and other molecules of pharmaceutical importance. This great diversity of marine actinomycetes has offered greater chemical diversity. The diverse chemical compounds of marine actinomycetes have been found to have various biological activities such as antimicrobial, anti-tumor, anti-malarial, anti-algal, antioxidant, anti-inflammatory etc. These various bioactive metabolites of marine actinomycetes are having scope for developing as potent therapeutic agents. The potential of marine actinomycetes is rightly realized though the current biological wealth of these organisms is relatively unexplored.

Key words: Marine Actinomycetes, diversity, sediments, bioactive metabolites, biological activities

I. Introduction

Actinomycetes, the filamentous, high G+C rich gram positive bacteria, are the most economically and biotechnologically valuable prokaryotic microorganisms. They were found to produce nearly half of the discovered bioactive secondary metabolites. These secondary metabolites include antibiotics, antitumor agents, immunosuppressive agents and enzymes (Berdy, 2005; Lam, 2006).

Actinomycetes are proven resources for the search of novel bioactive metabolites. Hence, focus on the successful isolation of novel actinomycetes from terrestrial sources for drug screening programs in the past fifty years was given. However, the number of discovery of new metabolites from terrestrial actinomycetes has decreased, whereas the rate of re-isolation of known compounds has increased. Thus, it is crucial that new groups of actinomycetes from unexplored or underexploited habitats be pursued as sources of novel bioactive secondary metabolites (Fenical *et al.,* 2009). A large number of actinomycetes have been isolated and screened from soil in the past several decades, accounting for relevant secondary metabolites available commercially.

Recent studies have concluded that selected groups of marine actinomycetes are found to offer a reliable source of new natural products (Fenical and Jensen, 2006). Hence, this paper would review the recent scenario about diverse marine actinomycetes.

II. Diversity Of Marine Actinomycetes

Lakshmanaperumalsamy (1978) isolated 518 *Streptomyces* strains from the sediments of estuarine, backwater, marine, freshwater and mangrove environment of Porto Novo using Grein and Meyer's agar, Kuster's agar and Glucose asparagines agar.

Actinomycetes were isolated from near shore marine sediments collected at 15 island locations throughout the Bahamas. A total of 289 actinomycete colonies were observed, and all but 6 could be assigned to the suprageneric group's actinoplanetes and *Streptomycetes*. A bimodal distribution in the actinomycete population in relation to depth was recorded, with the maximum numbers occurring in the shallow and deep sampling sites (Jensen *et al.*, 1991). Kala and Chandrika (1995) used different media for isolating and maintaining actinobacteria collected from mangrove sediments.

About 100 strains were isolated from a mangrove stand of Morib, Selangor, Malaysia in an earlier study Vikineswary *et al.* (1997). Patil *et al.* (2001) reported 133 strains of actinobacteria from 129 marine samples collected from various stations along the Tuticorin coast. Mathew and Philip (2003) isolated six strains of actinobacteria from the sediments of the Arabian Sea.

The actinomycetes diversity marine sediments were collected from located in Hainan Island, South China, in April 2004. Ninety four marine actinomycete strains were isolated. About 87.5% of the isolates were *Streptomyces* sp., and 12.5% *Micromonospora* sp. The *Streptomyces* isolates were classified into 13 groups, and the *Cinerogriseus* group was the dominant among the *Streptomycete* isolates (You *et al*., 2005).

Totally 17 actinomycete isolates were screened from the saltpan regions of Cuddalore and Parangipettai (Dhanasekaran *et al.*, 2005b). Kathiresan *et al.* (2005) isolated 160 strains from the sediments of mangrove, estuary, sand dune and industrially polluted marine environment of Cuddalore. Of these, mangrove sediments were the rich sources for actinobacteria. Sivakumar *et al.* (2005) isolated actinobacteria from different stations of the Pitchavaram mangrove ecosystem using three different media. Dhanasekaran *et al.* (2009) isolated actinobacteria from Annagkoil estuarine soils of Tamilnadu. Krishnaraj and Mathivanan (2009) reported 137 different isolates of marine actinomycetes from deep sea sediment collected from the Bay of Bengal.

Remya and Vijayakumar (2008) reported 173 actinomycetes from near shore marine environment at 8 different locations of Kerala, West Coast of India. Among them, 64 isolates were morphologically distinct on the basis of spore mass colour, reverse side colour, aerial and substrate mycelia formation and production of diffusible pigment. The majority (47%; n=30) of these isolates were assigned to the genus *Streptomyces*.

A total of 288 marine samples were collected from different locations of the Bay of Bengal starting from Pulicat Lake to Kanyakumari, and 208 isolates of marine actinomycetes were isolated using starch casein agar medium. The growth pattern, mycelial coloration, production of exopolysaccharides and diffusible pigment and abundance of *Streptomyces* sp. were documented. Among marine actinomycetes, *Streptomyces* sp. was present in (88%) large proportion (Ramesh and Mathivanan, 2009).

Totally 189 *Streptomyces* isolates were obtained from eight different soils of Cuddalore, Tamil Nadu, India. Among them, only 78 isolates were morphologically distinct. The highest diversity in the *Streptomyces* populations was observed (Dhanasekaran *et al.,* 2009). Vijayakumar *et al.* (2010) studied the marine soil and sediment samples were collected from different locations of Muthupet mangrove, Tamilnadu. A total of thirty different marine actinomycete isolates were isolated on starch casein agar medium.

A total of 20 different actinomycetes were recovered from salt pan region of Kodiakarai, Nagapattinam District using starch casein agar medium. From 20 isolated actinomycetes 10 were dominant in their growth. Among the 10 actinomycetes *Streptoverticillium album* was highly dominant from their isolates (Gayathri *et al.,* 2011).

Kaviyarasi *et al.* (2011) studied the isolation of actinomycetes from the marine soil sample was collected from Manora at Thanjavur Dt., Tamil Nadu, India. Ten actinomycetes species including *Actinobispora yunnanensis, Streptomyces albus, Micromonospora echinospora, Saccharopolyspora hirsute, Streptomycetes cyaneus, Actinomadura citrea, Saccharomonospora viridis, Thermomonospora mesophila, Streptoverticillium album Microtetrospora fastidiosa* were isolated.

Totally 107 actinomycetes isolates were screened from 36 sediment samples collected from two different stations such as Thondi and Karankadu of Palk Strait region situated along the South East coast of India. The number of isolates were found maximum in Karankadu mangrove region (62) followed by Thondi (45) sediment samples particularly in monsoon season (Ravikumar and Suganthi, 2011).

Sathiyaseelan and Stella (2011a) collected the sediment samples from different stations of the Muthupet mangrove ecosystem (10°15'-10°35'N and 79°20'–79°55'E), situated along the Southeast coast of India for the isolation of actinomycetes using Kuster agar medium. The following seven isolates were characterized and identified as *Streptomyces neyagawaensis, A. aureocirculatus, A. aureocirculatus, S. spheroides, S. albulus, S. antibioticus, S. mirabilis* and *S. umbrosus.*

Rajesh *et al.* (2011) reported seven actinomycete isolates from the sediments collected from the mangrove. Among the 7 isolates, 3 isolates belong to *Streptomyces* sp. Sathiyaseelan and Stella (2011b) screened five actinomycetes from soil collected in two different regions of Parangipattai. Morphological studies indicated that the strains belonged to the genera *Streptomyces spectabilis, Actinomadura roseale, Streptomyces platensis, Streptomyces kavamyceticus* and *Streptomyces citricolor.*

A total of 42 actinomycetes were isolated from mangrove sediments of Andaman and Nicobar Islands, India (Baskaran *et al.,* 2011). Naikpatil and Rathod (2011) isolated 54 actinomycetes from marine environment of Karrwar, west coast of India. Among them 10 actinomycetes were dominant in their growth. *Streptomyces* sp. was most highly dominant from their isolates.

Sateesh *et al*. (2011) studied the soil samples were collected from the mangroves forest of Karwar. Fifty three rare actinomycete strains were chosen using selective isolation approaches, then morphological and chemical properties of the isolates were determined. The isolates belonged to one of the following genera such as *Micromonospora, Microbispora, Actinoplanes* and *Actinomadura.*

Ullah *et al.* (2012) isolated 60 actinomycetes from the soil samples were collected from Pakistan. The isolates identification falls under three genera including *Actinomyces, Streptomyces* and *Nocardia* sp. each with the total number of 31, 17 and 12 isolates identified respectively.

Kalyani *et al.* (2012) studied the isolation of actinomycetes from marine soil samples. A total of thirty soil samples were collected from Konark and Western terrestrial sea. Totally 20 species were isolated on the basis of colony characteristics on starch casein agar. Gulve and Deshmukh (2012) isolated 107 marine actinomycetes from near sea shore sediment samples from different sites of Konkan coast of Maharashtra.

Attimarad *et al.* (2012) reported that the actinomycetes diversity in marine sediments, collected from the coastal areas of Gokharna and Muradeshwara of Karnataka state. Seventeen isolates were obtained on starch-casein agar media by soil dilution technique. Morphological, cultural and biochemical characterization indicated that the isolates belong to *Streptomyces* genus of *Actinomycetes*.

Deepa *et al*. (2012) isolated totally 16 actinobacteria strains from salt pan region of Vedharanyam, Nagapattinam District, Tamil Nadu. The isolates were identified as *Actinobispora* sp., *Actinobispora yunnanesis, Dactylosporangium* sp., *Jonesia* sp., *Micromonospora* sp., *Nocardia* sp., *Nocardioides* sp., *Saccharomonospora* sp., *Saccharopolyspora* sp., *Streptomyces albus, S. cyaneus, S. exfoliatus, S. griseoflavus, Streptoverticillium* sp., *S. baldaccii* and *Tetrrabacter* sp.

Parthasarathi *et al.* (2012) reported eight actinomycetes from sea shore marine environment locations of Bigeum Island, South West coast of South Korea. Sixty eight actinomycetes were identified at a generic level based on the colony morphology and microscopic morphology. Identification of strains by both morphological and cultural characteristics revealed that most (54%) of the isolates belonged to white and grey colour series. Out of 68 isolates, 66% of isolates were assigned to the genus *Streptomyces* sp. and the remaining was identified as *Nocardiopsis* sp. (18%), *Micromonospora* sp. (11%) and *Actinopolyspora* sp. (5%).

Chacko Vijai Sharma and David (2012) reported the actinomycetes diversity of the marine sediments from Pulicat estuary, Muttukadu, and Ennore estuaries, Tamil Nadu. Totally 227 isolate were morphologically distinct on the basis of spore mass colour, aerial and substrate mycelia formation and production of diffusible pigments. The

majority were assigned genus *Streptomyces* (60%; 162 isolates) and *Actinopolyspora* (5%; 11 isolates).

III. Conclusion

The immense scope of marine actinomycetes for the exploration of therapeutically active biomolecules has been realized recently. Marine actinomycetes produce several active chemicals such as antioxidant, antitumor, Anti-inflammatory, Therepeutic enzymes and Inhibitors and antimicrobial compounds. Many studies world over have paved the way for intensification of research on marine actinomycetes for the search of new drugs. However, the exact potential of marine actinomycetes in drug discovery is yet to be concentrated. The present study suggests that marine-derived actinomycetes are worthy of further exploration as novel drug candidates.

Acknowledgement

The authors thank Secretary & Correspondent and Principal of A.V.V.M Sripushpam college, Poondi for the Permission.

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