International Journal in Management and Social Science
Volume 09 Issue 11, November 2021 ISSN: 2321-1784 Impact Factor: 7.088
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

STUDYING ABOUT SIGNIFICANCE, CLASSICAL APPROACH AND DIVERSITY OF ACTINOMYCETES

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ABSTRACT

Many bioactive secondary metabolites have been successfully identified and developed into therapeutic medicines and other organic molecules, and this article provides a concise overview of the actinomycetes and their potential to create these metabolites. Microorganisms are becoming more resistant to current treatments, thus the discovery of new antibiotics is crucial. The incidence of bacterial strains resistant to antibiotics is increasing, calling for the discovery of new microbial agents to combat them. Therefore, actinomycetes hold a prominent position, primarily used in antibiotic production, because of their diversity and demonstrated ability to produce new bioactive compounds. In order to generate drugs from microbial extracts, it is necessary to identify and isolate hitherto undiscovered bacterial families that are also excellent producers of secondary metabolites. In order to illustrate the versatility of this formidable bacterium, this summary describes the effects of only a few of the antibiotics produced by actinomycetes. Exploring previously unexplored ecological niches is crucial for advancing our knowledge of novel actinomycetes. In general, each actinomycetes strain will develop its own set of peculiar chemicals. This allows for the possibility of devoting greater resources to the search for new strains from which valuable compounds may be extracted.

Keywords: - Actinomycetes, Metabolites, bacteria, Compounds, Isolation

I. INTRODUCTION

The order Actinomycetes is comprised of aerobic, spore-forming, gram-positive bacteria that can grow on a wide range of substrates and produce aerial mycelium. Genetic evidence reveals it is related to other species with a high (G+C) ratio in their DNA (>55mol%), as shown by 16S ribosomal cataloging and DNA:rRNA matching studies. It's one of the largest known taxonomic groups, and one of the 18 main bacterial lineages. Because of their unusual combination of bacterial and fungal characteristics, the Actinomycetes were given the name "Actinomycetes," which derives from the Greek words "atkis" (a ray) and "mykes" (fungus). It is possible that the actinomycetes generate antibiotics and other compounds with medicinal use. Actinomycetes produce a wide variety of bioactive secondary metabolites, including antibiotics, anticancer medicines, immunosuppressive compounds, and enzymes.

II. SIGNIFICANCE OF ACTINOMYCETES

Actinomycetes are a valuable biotechnology resource because to the widespread application of their secondary metabolites. Many research facilities around the world have spent considerable time and energy screening, isolating, and characterizing actinomycete strains with the potential to produce secondary metabolites. Some of the most important Actinomycetes genera for creating biomolecules with commercial value include Streptomyces, Saccharopolyspora, Amycolatopsis, Micromonospora, and Actinoplanes. Bioactive natural products such as antibiotics, anti-parasitic and antifungal agents, herbicides, pesticides, anticancer or immunosuppressive agents, and industrially important enzymes have helped establish the genus Actinomycetes, and specifically the genus Streptomyces, as an industrially important microorganism. Seventy-five percent of medications used in medicine and sixty percent used in agriculture are derived from Actinomycetes bacteria. Secondary metabolites have economic significance because, unlike primary metabolites, they tend to accumulate in large amounts. Actinomycetes are of enormous economic value due to the abundance of secondary metabolites they produce, including antibiotics, other medications, toxins, pesticides, and hormones for the development of animals and plants. The secondary metabolites produced by Actinomycetes are perhaps most well-known as antibiotics.

Some people refer to antibiotics as "wonder drugs" because to how well they eliminate dangerous microorganisms. These chemicals are noteworthy because they include a large variety of structurally and functionally distinct physiologically active components. Numerous microbial processes, such as DNA, RNA, and protein synthesis, membrane function, electron transport, sporulation, and germination, are attacked. So, they are effective drugs for treating bacterial illnesses. Infections and wounds that were previously incurable might now be treated thanks to antibiotics.

The first antibiotic, discovered by Sir Alexander Fleming in 1928 (Fleming, 1980), cleared the path for the discovery of numerous secondary metabolites with analogous actions. The secondary metabolites produced by actinomycetes are essential to sustaining life. Many antibiotics, including streptomycin, tetracycline, chloramphenicol, nystatin, tunicamycin, avermectin, rapamycin, clavulanic acid, and antitumor drugs like actinomycin, mitomycinC, anthracyclines, doxorubicins, daunorubicin, mitomycin, and bleomycin, as well as drugs like cyclosporine that

Anthracyclines (Aclarubicin, Daunomycin, and Doxorubicin), peptides (Bleomycin, Actinomycin D), aurelic acids (Mithramycin), enediynes (Neocarzinstatin), antimetabolites (Pentostatin), carzinophilin, and mitomycins are only some of the anticancer medications produced by the Actinomycetes. In addition to potent therapeutic effects, medications developed from actinomycetes often display the desirable pharmacokinetic properties required for clinical development.

Table 1: Antibiotics and Bioactive secondary metabolites from actinomycetes.

Source	Antibiotics	Bioactive metabolites			
	Total	With other activity	No antibiotic activity	Antibiotics Plus other Active compounds	Total bioactive metabolites
Bacteria	2900	780	900	1680	3800
Actino mycetes	8700	2400	1400	3800	10100
Fungi	4900	2300	3700	6000	8600
Total	16500	5500	6000	11500	22500

Adapted from Berdy, 2005 and reproduced from Kurtböke, 2010.

III. Classical Approach

Physiological, morphological, and biochemical features are the backbone of traditional categorization schemes. Streptomyces may be identified using the conventional approach laid forth in the identification key provided by Nonomura and Bergey's Manual of Determinative Bacteriology (Buchanan and Gibbons 1974). These features have been widely used for Streptomyces taxonomy for a great deal of time. They are quite helpful in routine identification. These are discussed below:

1. Aerial Mass Color

An extremely simple system is used to record the mature sporulating aerial mycelium's color (white, grey, red, green, blue, and violet). The two colors are captured simultaneously once the color of the air mass is between two color sets. Both color series are recorded if the strain being studied has intermediate tints in its aerial mass color.

2. Melanoid Pigments

Based on their prevalence throughout the medium, melanoid pigments (such as browns with varying degrees of green, black, or other secondary colors) are categorized into several sets. The strains are classified based on whether or not they produce melanin (+) or do not ().

3. Reverse Side Pigments

The strains were categorized as distinctive (+) or not discernible or none () based on their ability to give differentiating colors on the opposite side of the colony. Colors like yellow, olive, and yellowish brown fall into the later group ().

4. Soluble Pigments

Based on whether or not they synthesize melanin, the strains are classified as either producers (+) or non-producers (-). Orange, red, green, violet, blue, and yellow are the colors kept in the ledger.

5. Spore Chain Morphology

The strains have been divided into "sections" based on the possible effects they may have on spore chains. Streptomyces species may be divided into the rectiflexibiles (RF), retinaculiaperti (RA), and Spirales (S) groups. We record both spore chains (e.g., SRA) when a strain generates them.

6. Reproductive Structure Surface

The best instrument for identifying spore form and surface preferences is the scanning electron microscope. Therefore, the use of the cross-hatched cultures prepared for microscopic inspection is acceptable.

The electron grid must be cleaned, and tape must be applied on its surface. Placing mature spores of the strain on the adhesive tape, then covering it with gold for half an hour, yields a specimen that can be analyzed under an electron microscope at varying magnifications. The reproductive structure silhouettes are characterized as spiny, smooth, warty and hairy.

IV. ISOLATION AND DIVERSITY OF MARINE ACTINOMYCETES IN INDIA

India is surrounded by water on three sides, therefore nine of its states and four of its union territories have coastlines. These include a wide variety of extreme environments, such as backwater lakes, lagoons, estuaries, and mangroves. Despite difficulties with sample collection, sample transfer, isolation, and maintaining the isolates, researchers in India have uncovered a number of previously unknown strains. Numerous marine vertebrates and invertebrates have been examined to better pinpoint the symbiotic actinomycetes.

Diverse actinomycetes taxa have been found in sediment samples collected from a variety of coastal, beach, mangrove, estuary, lagoon, and lake environments (Fig. 1). Not only that, but offbeat environments, such hot springs and salt pans, have yielded offbeat breeds. Recent research has led to the isolation of novel actinomycetes from marine organisms. The genus Streptomyces is the most often reported one, followed by Micromonospora and Rhodococcus. Antibiotics and many other types of secondary metabolites are mostly derived from these microorganisms. All sorts of infections, even those that have developed resistance to multiple drugs, are no match for these chemicals. When compared to their land-dwelling counterparts, marine actinomycetes produced significantly higher levels of bioactive chemicals. Six samples were collected from the Palk Strait of the Bay of Bengal (Point Calimere, Athirampattinam, Mallipattinam, Manora seashores, Vedharanyam saltpan, and Muthupet mangroves), and 55 morphologically distinct strains were identified.

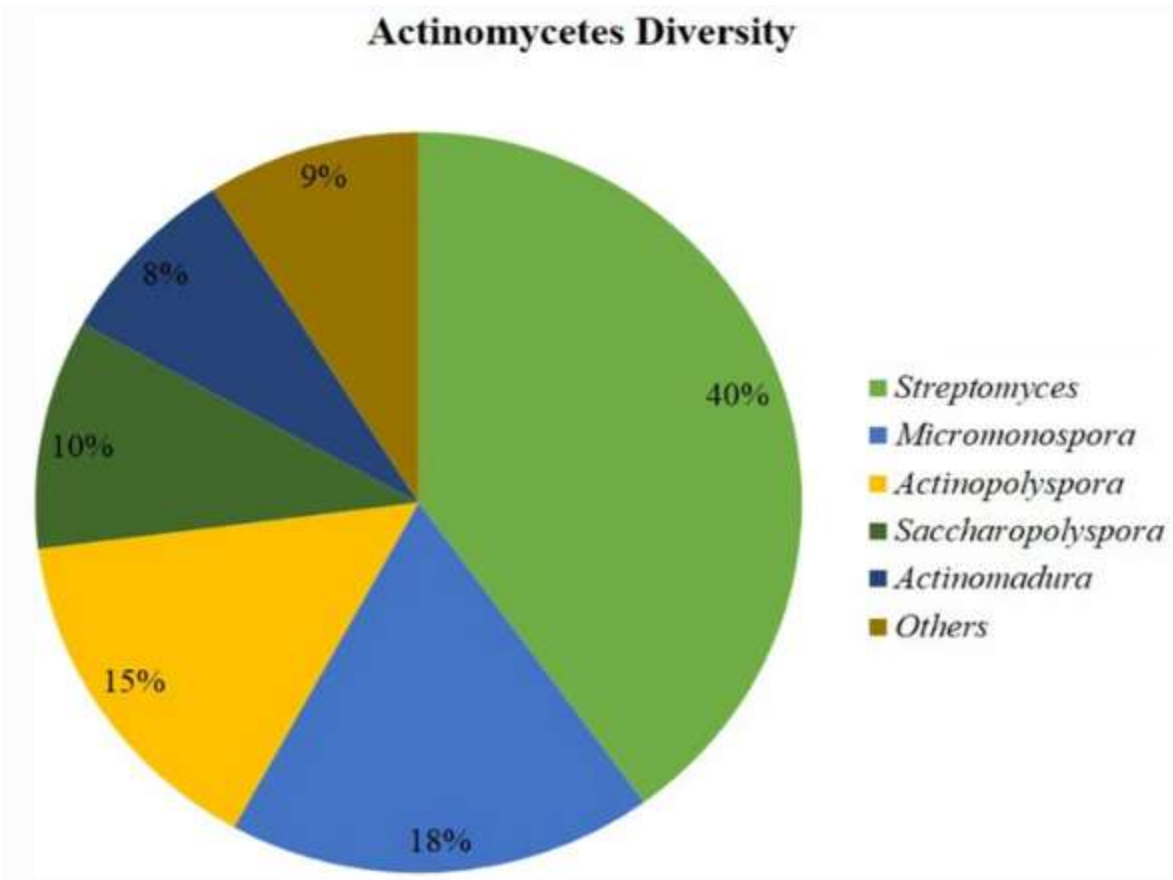

Fig.1 Percentage of the actinomycetes diversity in India

Chemicals that had been forgotten for a while were rediscovered when actinomycetes were removed from their native marine environments and put to use. Although many actinomycetes are only found in extreme environments, they may hold the key to finding new compounds with marketable activities. The physiochemical characteristics that define severe settings are drastically different from the ideal circumstances that foster the robust development of a broad array of living forms. For this reason, scientists have recently focused their isolation efforts on actinomycetes in very harsh settings that have not been explored before, such as hypersaline coastal environments, severe inland saline zones, volcanic zones, hyperarid, and glaciers. With a salinity between 35% and 50%, the sun salterns of India provide an extremely halophilic environment for marine actinomycetes. Numerous actinomycetes genera have been found along the solar salterns in Tuticorin, India. In addition to the Streptomycetes, the very rare genus Nonomuraea of actinomycetes was described.

V. CONCLUSION

New metabolites with medical and industrial applications are being produced at a rapid rate by actinomycetes. Antibiotics are made by a wide variety of actinomycetes found on Earth's surface, each of which may create its own distinct secondary metabolite. Even though antibiotics are used often, certain germs are becoming resistant to them. Therefore, it is of critical importance to public health that drugs be developed to combat these infectious microbes. Antibiotics are derived from actinomycetes, which are able to effectively digest a broad range of xenobiotic substances and perhaps convert them into organic molecules of enormous economic value. More and more evidence suggests the seas house a plethora of chemicals not found anyplace else on Earth. Some actinomycetes have evolved symbiotic relationships with other marine species like sponges, corals, fish, etc. to help them endure the harsh maritime environment.

Since marine actinomycetes have evolved with the greatest genetic and metabolic diversity, they should be prioritized for research as a source of novel secondary metabolites. New compounds, especially those made by actinomycetes, have been found to have therapeutic value. Several pharmaceutical companies looked into natural bioproducts from microorganisms as a potential source of new medicines. The maritime ecosystems of India have been the subject of several scientific studies. New actinobacterial strains are likely to be abundant in the vast majority of the world's water that has not yet been explored. The climate and ecology of the Indian Ocean vary widely from one part to another. The selection of sampling sites should be given top priority, and more research is required to establish the most efficient methods for recovering novel actinobacterial strains. Previous research on actinobacterial diversity has focused mostly on Streptomyces genera. Additional genera that have not yet had their strains described include Actinopolyspora and Micromonospora. Various novel compounds having remarkable activity towards different pathogens as well as diseases have been reported in the past decade.

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