Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Spl Issue [3] 2022: 431-435

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

REVIEW ARTICLE **OPEN ACCESS**

Morphology and Role of Actinomycetes: A Review

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ABSTRACT
The search for ecologically responsible, premium, and healthy alternatives to agrochemicals has piqued our interest in evaluating the potential of currently available actinomycetes to improve properties of soil, plant growth and photosynthesis, grain yield, and chemical characteristics of economically important cereals. Natural bioactive composites are abundant in Actinomycetes. On the basis of pH and temperature, they were also classified. Actinomycetes have long been recognised as prolific creators of enzymes, antibiotics, and anti-cancer medicines, as well as important players in the organic matter recycling process. Intensive initiatives in isolating and screening rare genera of microorganisms aid in the discovery of a replacement substance with a completely distinct chemical structure. Actinomycetes produced a variety of industrially important bioactive chemicals with great economic value, and they were always a fascinating organism to study for secondary metabolite production. Actinomycetes produce enzymes such as cellulases, proteases, amylases, lipases, chitinases, and pectinases, which are used in a multitude of sectors. . The taxonomic and ecological positions of antibiotics that give rise to actinomycetes are well known for metabolic flexibility, which occurs frequently during the assembly of economically important primary and secondary metabolites. The metabolic reputation of reference of actinomycetes not only offers a motivating topic for research, but it also provides the opportunity to commercialise the metabolites produced during the method. Actinomycetes produce enzymes like amylase, lipase, and cellulases, which are used in the food, fermentation, textile, and paper industries the never-ending search for new microbial enzymes improved outcomes in industrial processes, which are the key to profit growth.
Keywords : *Actinomycetes, filamentious bacteria, antibiotics*

Received 11.08.2022 Revised 25.09.2022 Accepted 27.10.2022

INTRODUCTION:

Soil microorganisms called as the actinomycetes. They are bacteria, yet they have some fungi-like traits that are likely the product of genetic drift due to a common habitat and lifestyle (1). Actinomycetes are a diverse collection of microorganisms that live in soil and have threadlike filaments. After mycelium establishment and hyphal tip extend growth, the name actinomycete is regarded as a traditional Greek (akts, 'ray') and (mks,'mushroom or fungus'). They're widely spread in nature and involved in a variety of biological and metabolic activities, including as the manufacturing of extracellular enzymes. Actinomycetes are ubiquitous in soil and make up a large percentage of the soil microflora (2). Actinomycetes are gram-positive bacteria with a high guanine + cytosine concentration of about 55 percent in their DNA, and they're known to be providers of a variety of secondary metabolites, antibiotics, and bioactive chemicals that have an effect on microbial growth. Actinomycetes resemble mushrooms in their filamentous structure, branching appearance, and conidia generation. As a result, they're also regarded as ray fungi. These microbes have shown to be a rich supply of bioactive compounds, accounting for two-thirds of clinically useful antibiotics as well as a diverse spectrum of industrially relevant enzymes. Actinomycetes generates two forms of branching mycelium: substrate mycelium and as well as aerial hyphae. Streptomyces is the most usual actinomycete. Streptomyces and Micromonospora are the two primary categories of soil actinomycetes that serve as essential sources of antibiotics. Streptomyces is said to account for roughly 80% of antibiotic compounds, whereas Micromonospora is close behind, accounting for only one tenth of Streptomyces' total. The diversity and morphology of actinomycetes found in a given soil are impacted by a variety of factors, including soil type, geographical area, cultivation, as well as organic compounds (3). Amongst other things many scientists are conducting research to identify actinomycetes as antibiotic sources. Because of the growth of multi - drug resistance in pathogenic strains, the quick introduction of new illnesses, and hence the use of multi - drug - resistant pathogenic organisms in bioterrorism, the demand for new antimicrobial drugs is greater than ever. They form symbiotic nitrogen-fixing relationships with over 200 plant genus, and they may also act as growth promoters or biocontrol agents, as well as cause disease in some plant species. Well within type of Helicobacter, Actinomycetes are frequently found in the human upper genital tract as well as the gastrointestinal system, including the mouth, esophagus, and alimentary canal, (4) Because of the emergence of drug/multi-drug tolerance in most pathogenic bacteria, the search for bioactive metabolites, including new antibiotic compounds, from microbial origin for possible use in agricultural, medicinal, and commercial applications has become much more relevant. Researchers all across the world are working hard to find novel, strong, long-lasting, and broad-spectrum antimicrobial chemicals from a variety of sources, including bacteria (5). The use of natural products like soils in research is based on the assumption that samples of widely disparate regions are much more likely to generate novel microorganisms, and hence, novel metabolites, as a result of the geographical contrast. Actinomycetes are mostly found in soil, but they are also found in abundance throughout natural settings, allowing for the isolation of a wide range of actinomycetes in discovery of better metabolites. Streptomyces comprise a large fraction of the overall actinomycetes population in natural soil habitats and are known to be prolific makers of valuable bioactive chemicals (6). Streptomyces species had isolated from ocean, marine sediments, including mangroves, marine mollusks, and detritus, to name a few. Findings was that about 70% of Streptomyces species obtained from marine mollusks were hostile to the test microorganism, but only 20-25 percent of cultures obtained from sediments were antagonistic. This shown to be superior to commercial formulations in the therapy of malignancies at the time (7).

Role of Actinomycetes

A source of industrially important Enzymes: Actinomycetes

Actinomycetes produce a huge variety of chemical composites for an example: the enzymes, an antibiotics, the antitumor causative agents, plant growth regulators and the vitamins. Actinomycetes are one of the different groups of microorganisms that are well chacterized and honoured for their metabolic versatility. They play a vital part in decomposition of organic matter, e.g. cellulose, chitin and pectin, thus, they play an important part in carbon cycle and help to maintain the soil structure (8).

Enzymes present in Actinomycetes:

Lipase enzyme: Lipase enzyme are present in Actinomycetes. Lipases are part of the family of hydrolases which act on carboxylic ester bonds. The natural function of lipases is to hydrolyze triglycerides into diglycerides, monoglycerides, adipose acids, and glycerol (9). Lipases have the potential to be used in processing of oils and fat, cosmetics, diagnosis and detergents or cleaners.

Chitinases: Chitinases are another group of industrially important enzymes which have capability to hydrolyse chitin. Chitinases produced by some Actinomycetes are thermostable and active at wide range of pH which make them suitable for artificially industrial application (10). Chitinase from these Actinomycetes strains was used to recover chitibiose, a potential antioxidant which generally have applications in biomedical and food industry.

Alkalophilic enzymes: The significance of thermostable lipases for different applications has been growing snapply. Biocatalyst thermostability allows a violent heat operation temperature, which is clearly profitable because of an advanced reactivity (higher reaction rate, lower diffusional restrictions), advanced stability, advanced process yield (increased solubility of substrates and products and favourable equilibrium displacement in endothermic reactions), lower density and fewer contamination problems. Thermostable enzymes can be obtained from mesophilic and thermophilic organisms; even psycrophiles have some thermostable enzymes (11).

Amylase enzyme: α-Amylases enzyme are starch demeaning enzymes that catalyse the hydrolysis of internal a-1, 4-O-glycosidic bonds in polysaccharides. α-Amylases are one of the most important artificial enzymes that have a huge variety of operations ranging from conversion of starch to sugar syrups, to the product of cyclodextrins for the pharmaceutical industry (12). The world product of α- amylases from B. Licheniformis and Aspergillus species Of about 300 tons of pure enzyme protein annually.

Keratinases: keratinase are artificial industrially important enzymes produced by a number of Actinomycetes strains like Streptomyces's spp. and Actinomadura. Actinomycetes also produce a number of other important enzymes which are dextranase, peroxidases nitrile hydratase, laccases, alginate lyase and cutinase. Dextranase from Streptomyces spp. is sitable to degrade dextran and are useful in the processing of sugar product from sugarcane juice at alkaline pH and high temperature. (13).

Actinomycetes as an Antibiotic producers:

Actinomycetes have been known as the topmost source of antibiotics. Two third of moment antibiotics are produced from actinomycetes. The important antibiotics produced by the actinomycetes include anthracyclines, aminoglycosides, lactams, chloramphenicol, macrolides, tetracyclines, nucleosides, peptides and polyethers. Molecular biological techniques have helped on large scale in finding new antibiotics formed by the actinomycetes. The significance of actinomycetes in industrial biosynthesis has stimulated many aspects of basic research on these microorganisms (14). Efforts encouraged to harness the chemical diversity from actinomycetes. The antibiotics produced by actinomycetes (and other microbes) have been continuously evolving for over one billion years (15). It was first discovered in the 1940s that about 1% of total actinomycetes isolated from any soil sample produce streptomycin whereas daptomycin producers were discovered only after screening nearly 107actinomycetes(16). An average actinomycete strain has the genetic potential to produce 10~20 secondary metabolites. The important antibiotics formed by the actinomycetes include anthracyclines, aminoglycosides, lactams, chloramphenicol, macrolides, tetracyclines, nucleosides, peptides, species ME 98-M-3, phenicine from Streptomyces lavendulae enhanced immune responses in mice. Immunosuppressive agents like FR-900506 reported by Fujisawa pharmaceutical company, produced by Streptomyces tsukubaensis sp. Nov. shows stronger inhibition against interleukin-2 production, mixed lymphocyte reaction, interferon, cytotoxic-T cells and platelet activating factor-C induction(17). Antibiotics also include amphotericin, nystatin, chloramphenicol, gentamycin, erythromycin, vancomycin, tetracycline, novobiocin, neomycin, etc. In these antibiotics some are targeted bacterial ribosome‟s and which are used in treating respiratory infections, for example in treating the Legionnaires‟ disease used tetracycline and erythromycin.

Actinomycetes Cell Membrane Composition

The composition of actinomycetes' cell membrane varies a lot between various groups, and this has a lot of taxonomic implications. The three properties of peptidoglycan structure and composition are used to distinguish four main cell membrane types in these filamentous bacteria. The existence of glycine in an interpeptide bridge-like connection, I diaminopimelic acid isomer on tetrapeptide side chain position 3, (ii) fructose intake of peptidoglycan, and (iii) presence of diaminopimelic acid isomer on tetrapeptide side chain position 3. Distinctive feature sugar patterns are only seen in cell membrane types II-IV of actinomycetes containing meso-diaminopimelic acid (18).

Actinomycetes as an Organic matter:

The aroma of freshly turned soil is that the results of geosmin, a volatile organic emulsion made by actinomycetes. Geosmin is also made by some cyanobacteria and produces an earthy taste in drinking water (18). Peroxidases catalyze the peroxide dependent oxidation of a range of inorganic and organic composites and are eextensively divided throughout plants, animals, and microorganisms. They are primarily intracellular enzymes with plays vital roles in cellular processes (19), but extracellular peroxidases concerned within the degradation of complex organic composites have jointly been described. Actinomycetes are known to be durable organisms and therefore appropriate for soil applications. Actinomycetes colonizes the dry soil owing to their filamentous nature and exist in soil for extended periods as resting arthrospores that germinate in the occasional presence of exogenous substrates (20). It is generally assumed that root colonization by introduced bacteria is important for the biocontrol of root pathogens which enhancing the population of such an introduced bacteria on roots should enhance disease control (21). The study of stated that actinomycetes are involved in the production of several lytic enzymes and organic acids in the rhizosphere soils that may increase the organic matter content in the soil. The secreted organic acids might be involved in natural biological buffering of soil by conquered the growth of plant pathogens in the rhizosphere (18). Several actinomycetes and other actinobacteria are famed as degraders of poisonous materials and are used in bioremediation. They are significantly well adapted to survival in harsh surroundings. Some are suitable to grow at elevated temperatures and are essential to the composting system. Actinomycetes have the highest yielding source of microorganisms for all types of bioactive metabolites, including agroactive type (22).

Morphology of Actinomycetes:

The actinomycetes are a broad category of aerobic gram-positive bacteria with a high G-C proportion that make filaments that branch.

In terms of overall shape, these bacteria resemble fungus. This likeness is most likely due to adaptation to a similar environment. The Streptomyces genera are the only ones that have studied the fine spectrum li ne of actinomycetes spores during germination (23). Endospores of the latter species act similarly to Bacil lus endospores in that a new wall layer is generated inside the cortex of something like the spore and gro ws to create the germ-tube wall.Because the spores of the Streptomyces species investigated had a two-layered wall, the inner one expanded to form the germ-tube wall. It's unclear if this layer is newly generated following germination or if it's formed by restructuring of latent spore wall material. Most fungi fall into one of two categories: I those in which the germ-tube wall is created by extending a wall layer already present in the dormant spore; and (ii) those in which the germ-tube wall is generated by extending a wall layer initially present in the dormant spore (24). There are some discrepancies in the results, as highly associated species are declared to belong to distinct groupings. This could be attributed in part to the use of different fixatives, with potassium permanganate yielding poorer results than osmium tetroxide or aldehydes (25). Hydration during specimen preparation can also cause significant alterations in spore wall layers. When grown on an agar surface, the actinomycetes branch out to form a web of hyphae that grows on both the surface and beneath the agar. Aerial hyphae are those that are on the surface of the hyphae, whereas substrate hyphae are those that are below the surface. Septa split hyphae into lengthy cells (20 mm and longer) with a large number of bacterial chromosomes (nucleoids). These are the asexually reproducing aerial upstanding hyphae that extend above the substratum. The majority of actinomycetes are not mobile.

CONCLUSION

Actinomycetes are famous for antibiotic production and continued to be explored in hope of getting novel antibiotics. The phenolic and flavonoid contents caused by applying the selected biologically active actinomycetes could increase the availability of nutrients to plant roots or protect the plants from pathogens and competing soil microflora. Actinomycetesare significance since they have ability to produce and secrete a variety of extracellular hydrolytic enzymes that are favorable for the environment. The microbial potential of extreme environments utilized to produce novel enzymes that can become future good change of green biotechnology.

ACKNOWLEDGEMENTS

This work was supported by the Department of Biotechnology, Parul Institute of Applied Sciences, Vadodara-391760, Gujarat.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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CITATION OF THIS ARTICLE

Neeti Rajput, Anjali Thakur, Dhwani Upadhyay, Prasad Andhare, Indrani Bhattacharya. Morphology and Role of Actinomycetes: A Review. Bull. Env. Pharmacol. Life Sci., Vol Spl Issue [3] 2022: 431-435