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Ashort Review On Streptomyces Species

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Abstract

The genus Streptomyces is the largest and one of the most diverse group of actinobacteria, which are economically important as soil inhabitants. Streptomyces spp. are G+ filamentous bacteria known for their complex life cycle and the production of a large part of the secondary metabolites, including more than two-thirds of clinically used antibiotics. These organisms are also important in soil ecology, by actively degrading a wide range of organic matter and impacting the cycling of carbon and nitrogen. Recent developments in genome sequencing and synthetic biology have provided new possibilities for the activation of silent biosynthetic gene clusters (BGCs) in strains of Streptomyces with the aim of discovering novel bioactive compounds. In this review, we will describe the taxonomy and morphology/ecology of streptomyces and their ecophysiologcal functions, biotechnological significance and recent trends in research efforts f or isolation of novel strains.

Introduction

Streptomyces is a bacterial genus of the phylum Actinobacteria and the family Streptomycetaceae. They are filamentous, aerobic, Gram-positive bacteria that have a high guanine-cytosine (G+C) content (68–78%) in DNA and complex multicellular morphology (Kämpfer, 2012). The number of validly published species of Aurantimonas to date is >600 (Parte et al., 2020).

They are mainly soil inhabitants and are important for the decomposition of organic matter with geosmin production being responsible for typical smell in soil (Seipke et al., 2012). Yet Streptomyces is more than just ecology. They are most important producers of secondary metabolites in the bacterial kingdom and to a large extent underlie the discovery of antibiotics, anticancer drugs, antifungals, immunosuppressants, and enzyme inhibitors (Berdy, 2012)

Review of literature

The genus Streptomyces belongs to the order Streptomycetales and family Streptomycetaceae (Kämpfer, 2012). Modally, organisms of the genus Streptomyces exhibit a filamentous growth in which substrate mycelium forages the solid medium and aerial mycelium that differentiates to form chains of spores (Kieser et al.., 2000). Unlike mycetes they lack chitin in the cell walls but feature peptidoglycan with LL-diaminopimelic acid.

Ecological Role and Habitat

Members of the genus Streptomyces are saprophytic and can be found everywhere in terrestrial and aquatic environments. They participate in the degradation of recalcitrant organic matter including cellulose, lignin and chitin, contributing to soil fertility (van der Meij et al., 2017). Furthermore, some strains have been isolated as free from the rhizosphere (Amer and Abd-Alla, 2001).Some species also form beneficial for plants by stimulating growth and protecting the root against pathogens through antibiotic and plant hormone production.

Antibiotic and Secondary Metabolite Production

One of the striking features of these Streptomyces.Some and related speCies is their potential to produce great diversity .The ability to have made Known only a few secondary metabolites. These are clinically significant antibiotics, such as:

S. griseus Streptomycin (Schatz et al., 1944)

Tetracycline from S. aureofaciens

Erythromycin from S. erythraea

Chloramphenicol from S. venezuelae

Neomycin from S. fradiae

Avermectin from S. avermitilis

Genomics and Secondary Metabolism Regulation

Sequencing M145 revealed the first complete genome of a Streptomyces and over 20 BGCs (Bentley et al., 2002). Approaches in modern bioinformatics such as antiSMASH have meanwhile revealed hundreds of silent, newly so-called cryptic BGCs scattered across the various Streptomyces genomes (Medema et al., 2011).

Control of secondary metabolism is a complex process and overall is mediated by a network of global and pathway-specific regulators that integrate antibiotic formation together with morphological development.

Biotechnological and Industrial Applications

In addition to the above antibiotic production, Streptomyces produce many other enzymes or drug candidates like cellulases, proteases and xylanases used in pharmaceuticals, agriculture and food industries (Kieser et al., 2000). Compounds like rapamycin (S. hygroscopicus), tacrolimus (S. tsukubaensis), and clavulanic acid (S. clavuligerus) have changed the face of medicine with their immunosuppressive and b-lactamase inhibitor activities

Emerging Research and Genetic Engineering

Genome editing methods, such as CRISPR-Cas9, now allow researchers to wake up silent gene clusters and engineer Streptomyces strains to further produce metabolites (Huang et al., 2015). The development of synthetic biology tools has made it possible to reconstitute intricate biosynthetic pathways in heterologous hosts for the purpose of discovering novel antibiotics to address antimicrobial resistance (Rutledge & Challis, 2015).

Discussion

The Streptomyces will contribute to the ecological equilibrium and the biotechnological progress. Their distinct developmental biology and high biosynthetic capacities, make them excellent microbial factories for bioactive compound discovery. Nevertheless, many problems remain such as the difficulty in growing numerous strains in the laboratory, low yields of metabolites and complexity of the regulation of secondary metabolism (Chater, 2016).

More recently, the role of Streptomyces in sustainable agriculture as biofertilizers and biocontrol agents has been increasingly recognized (Viaene et al., 2016). Moreover, investigation of extremophilic Streptomyces sp. From the sea and desert have revealed new anticancer compounds with good biological activity (Subramani & Aalbersberg, 2012).

This potential will be realized through the use of integrated “omics” technologies (genomics, transcriptomics, proteomics, metabolomics). These tools enable a systems-level perspective of cellular function driven by systems metabolic engineering toferrooxidans and beyond.

Conclusion

Streptomyces species are like a treasure trove of powerful compounds that have really made a big impact on medicine and biotechnology these days. They are super versatile and can adapt to different environments, which is probably why they’ve been so successful throughout evolution. Thanks to all the cool stuff happening in genomics and synthetic biology, we’re now in a great position to find even more antibiotics and treatments.

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