DISCUSSION

CHAPTER 5

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Actinomycetes are prominent Gram-positive bacteria that establish a filamentous structure distinguished by vertical filamentous hyphae, and they contain DNA that has a high G C content (>55%). They belong to the phylum Actinobacteria, considered one of the fundamental taxonomic categories within the current classification of bacteria, comprising 18 major lineages. These lineages have many different variations in the sequence of the soil [141-142]. According to Bergey's Manual of Brackets and their principle, actinomycetes are divided into eight distinct genera and comprise 63 sections. Actinomycetes are free-living, spore-forming, saprophytic microorganisms in soil, stocks, and water. All of them share these characteristics. In the first place, actinomycetes were regarded primarily as per their morphological measures because their scientific classification of actinomycetes was additionally consolidated in examinations with their morphology, which is insufficient to recognise various genera and many segments. Further, applying phylogenetic and molecular approaches has significantly impacted the facilitation of these bracketed styles [143-145]. However, the development of molecular methods has allowed for the correct classification of many organisms previously placed in rejected groups [146]. However, since 16S rRNA and PCR were used to sequence and identify it, the number of species and phylogenies has steadily increased [147-149].

Research on rRNA pairing suggests that Actinomycetes share a phylogenetic connection. This understanding is derived from a research approach that utilised 16S ribosomal profiling and DNA investigation, which are critical and reveal a high ratio of guanine (G) to cytosine (C) in their DNA, exceeding 55 mol%. The terminology "Actinomycetes" traces its roots back to Greek words "atkis" (meaning beam) and "mykes" (meaning organism) and encompasses both microorganisms and parasites [151]. Actinomycetes inhabit soil and exhibit traits identical to bacteria and fungi but have enough distinguishing characteristics to separate them. According to Kumar et al., Actinomycetes are limited to the Actinomycetales order but are classified alongside bacteria that fall under the Schizomycetes class. Actinomycetes are a bacterial group that possesses numerous interesting and critical features. Actinomycetes are highly valued for their ability to synthesise antibiotics and other bioactive molecules with medicinal properties. They influence the organic matter cycle within the soil ecosystem and display a diverse array of distinct life cycles compared to other prokaryotic organisms. Actinomycetes are categorised as essential due to their genus's vast diversity and demonstrated capability to generate novel compounds. The phenomenon above can be attributed to the increasing importance of screening secondary microbial metabolites to identify new lead molecules, both antibiotic and non-antibiotic. Actinomycetes are among the most critical soil organism groups. However, later, they were separated from many marine samples, including those taken from sediments from the deep sea—[152-159] and close vents for hydrothermal energy [160]. There is a unanimous agreement in the scientific community that actinomycetes can be indigenous to the marine ecosystem. This particular environment may yield a substantial quantity of

atypical actinomycetes. Antibiotics and other substances can be made from various organisms, and this field is rapidly expanding. Like their decomposing terrestrial counterparts, marine actinomycetes play an important ecological role and can significantly influence the recycling of complex carbon-based compounds in aquatic ecosystems [161]. However, to comprehend actinomycetes from the marine environment, the necessity of conducting a taxonomic study and establishing a well-defined biodiversity is evident [162].

Actinomycetes and actual bacteria can be easily distinguished on four agar plates. Dissimilar to disgusting, unmistakable states of genuine microorganisms which develop rapidly, they exhibit a leisurely and fragile consistency, adhering firmly to the surface of the agar. Due to their potential to produce antibiotics, actinomycetes have received much attention [163]. Some of the antibiotics that are currently in use include rifamycin, gentamicin, and streptomycin. Actinomycetes produce erythromycin. Actinomycetes are essential in agriculture as well as the pharmaceutical industry. Actinomycetes isolated from soil have been shown to inhibit the development of several plant pathogens in a previous study. Studies also reported that actinomycetes isolated from agricultural soil in Turkey could inhibit Erwinia amylovora, which causes apple fire blight, and Agrobacterium tumefaciens, which causes Crown Gall disease, are both bacteria [164].

About the findings, it was discovered that a sum of 280 microbes had been separated, from which 24 strains of actinobacteria were singled out and identified across 120 soil samples from the Uttarakhand region (inclusive of Tehri-Garhwal, Chamoli, Srinagar, Uttarkashi, and Haridwar), where monocrotophos pesticides were predominantly used. These separated strains of actinobacteria were subsequently

subject to further identification through molecular screening. The outcomes showed the strains belonged to the genera Micromonospora (constituting 65%), Actinomycetes (representing 25%), and Streptomyces (comprising 10%) (Specific data not presented). The research findings are consistent with prior studies [165-175]. It was further observed that the HPLC technique was used to detect pesticide derivatives [176, 177]. The investigation into the use of actinobacterial formulations on maize growth over 20 days demonstrates significant growth enhancements. The study highlights the potential of actinobacteria as biofertilizers, with some formulations like CC-CMC powder showing up to 41.67% growth increase. These findings suggest a promising avenue for sustainable agriculture, emphasizing the importance of selecting specific actinobacterial strains for targeted crop growth improvement.