ORIGINAL ARTICLE

Extracellular polymeric substances from marine actinobacterium of *Micromonospora* sp. and their antioxidant activity

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ABSTRACT

Actinobacteria, Gram-positive bacteria are the largest phyla among the major species in the bacteria domain. *Micromonospora* sp. is one of the secondary metabolite-producing *Actinobacteria*, and it has a comprehensive spectrum of antibacterial, antifungal, antitumor, antiviral, antiparasitic, diabetogenic anti-inflammatory, insecticidal, inhibitory of enzyme, antioxidant, and other biological activities. The objective of the study is to assess the antioxidant activity of the *Actinobacterium Micromonospora* sp. producing extracellular polymeric substances (EPSs). Enumeration and isolation of *Actinobacteria* from sediment samples are done. The marine *Actinobacteria*, *Micromonospora* sp. are identified by melanoid pigments and other chemotaxonomical characteristics. EPS is produced from the potential marine *Actinobacteria* and their components are estimated. The total antioxidant value is found for the EPS. The antioxidant activity of the ascorbic acid equivalent which was 142.65 μg/ml was equivalent to 150 μg/ml of the total antioxidant activity of the EPS produced. The role of different antioxidants and the action in different diseases were challenged since they could act as many mechanisms such as reducing power, providing hydrogen to radicals, and scavenging activity (free radical). To conclude, the potent antioxidant activity was obtained from *Actinobacteria Micromonospora* sp. producing extracellular substances. These extracts might bear anticancer metabolites and are considered a potent anticancer drug.

Key words: Antioxidant, innovative products, marine *Actinobacteria*, novel extracellular polymeric substances

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INTRODUCTION

Actinobacteria are the high phyla among the major species currently documented within the domain of bacteria.[1] They are Gram-positive bacteria with tremendously great content of cytosine of the genome and guanine.[2] It exists in the form of filamentous bacteria, resulting in the formation of branched hyphae. As a result, they are documented as an in-between group between fungi and bacteria which

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could be compared with other forms of studies performed using seedlings.[3] They are well-known biological active compound producers and the most beneficial species for products in agricultural, biotechnology, food industries, and pharmaceutical. These are also exploited for secondary metabolite production.[4] One such secondary metabolite is the *Micromonospora*, which has bioactive natural products with potential applications.[5]

Micromonospora is a genus of bacteria belonging to the family of *Micromonosporaceae* in the phylum *Actinobacteria*. These bacteria take part in the production of biofuels by cellulase enzyme through the hydrolysis of plant cells. Further, different species of *Micromonospora* were known for the production of antimicrobial and antifungal compounds that can inhibit the plants from pathogens. For example, the rice plant pathogen *Rhizoctonia solani* was inhibited using the antibiotic compound dapiramicin extracted from *Micromonospora*.[6] Our researchers have huge research experiences and knowledge; in this regard, many great-quality publications are done recent years.[7] Our institution possesses high excellence indication-based research and has shined in many fields.[8-13] In the present study, extracellular polymeric substances (EPS)-producing marine *actinobacterium* of *Micromonospora* sp. was isolated from the sediment sample and their antioxidant properties were done. These extracts bear anticancer metabolites and are considered potent anticancer drugs.

MATERIALS AND METHODS

The marine sediment collection was done around the Tuticorin coast, Tamil Nadu. The collected sediments were carefully transferred into a sterile container and reached to laboratory (lab). After reaching the lab, the sample was air-dried for 48 h and then sundried for 12 h. The air-dried samples are macerated through mortar and pestle.

The isolation of marine *Actinobacteria* was done using Kuster's agar (KUA) medium supplemented with 10 µg/ml of cycloheximide and nalidixic acid as an antibacterial and antifungal agent, respectively. The macerated sediment sample was serially diluted, and the samples were spread and incubated at ambient temperature for a week in KUA medium. The population density of *Actinobacteria* from sediment samples was expressed as colony-forming units per gram. The distinct morphology of *Actinobacteria* was picked for pure culture and further analysis. Morphologically distinct colonies were selected and pure cultures were obtained. Confirmation of the marine *Actinobacteria* is done by observing the characteristic features.

Total antioxidant activity of the actinobacterial EPS was done by Kamala *et al.*, 2015. The reducing capacity of EPS obtained from the *Micromonospora* sp. was done (Sivaperumal *et al*., 2018).

RESULTS

The present study results confirmed that *Micromonospora* species were isolated from the *Actinobacteria* [Table 1]. *Micromonospora* sp. was verified by the white color of the aerial mycelium; in addition to that, there were positive readings for reverse side pigments, arabinose, xylose, mannitol, sucrose, and raffinose, and there were negative readings for melanoid pigment, soluble pigment, inositol, fructose, and raffinose which could be compared to other compounds obtained from the root extracts.[14] The amino acids of glycine+, Meso DAP+ present in the cell wall and cell wall sugar of arabinose, and the cell wall type index (I/D) are play a vital role in the identification of Micromonospora species. Further, commonly biosynthesized compounds from the marine actinobacterium showed potential antioxidant properties.[15] From Table 2, it was noted that the EPS obtained from the *Micromonospora* sp. was composed of carbohydrates (62%), protein (28%), nucleic acids (7%), and unidentified (3%) Table 2. Compared to previous studies, the compositions are more or less in carbohydrates, protein, and other components.[12] The antioxidant activities of the EPS were compared to that of the standard ascorbic acid equivalents (AAE), and it is noted that the antioxidant activity of the AAE which was 142.65 ± 1.286 mg/ml was equivalent to 150 mg/ml of the total antioxidant activity of the EPS produced [Table 3].

Table 1: Characteristic features of the Micromonospora spp. were obtained from the sediment samples

Color of aerial mycelium	**White**
Melanoid pigment	-
Reverse side pigment	+
Soluble pigment	-
Spore chain	**Rods/cocci**
Assimilation of carbon source	
Arabinose	+
Xylose	+
Inositol	-
Mannitol	+
Fructose	-
Rhamnose	-
Sucrose	+
Raffinose	+

Table 2: The total composition of extracellular polymeric substances obtained from Micromonospora spp.

EPS components	**%**
Carbohydrates	62
protein	28
Nucleic acid	7
Unidentified	3

DISCUSSION

Marine actinobacterial *Micromonospora* sp. showed possible antioxidant potential against all other antioxidant studies when compared to other studied organisms.[16] Very limited studies about marine actinobacterial derivatives for antioxidant activities were available. The marine *Streptomyces* sp. revealed the inhibition of 59.32% for DPPH scavenging and exhibited cytotoxicity to cells (cancer) as seen on cytochrome P450.[17] The role of antioxidants for various diseases is challenging as it involves many mechanisms such as free radical scavenging activity, donating hydrogen to radicals, inhibition of beta-carotene bleaching, metal-chelating ability, and quenching singlet oxygen, which was particularly seen in tamarind extract.[18]

It can be comprehended from various studies that there is still a very basic consideration of metabolic assortment in the particular genus and how it relates to the perception of species *Micromonospora* causing a decrease in the nitric oxide production in the cell line.[19] These days, *Micromonospora* sp. consists of an assortment of species. The *Micromonospora* sp. of marine actinobacteria are typically identify by spore color, spore chain morphology and other chemotaxonomical characteristics. Further, the site of sample collection from environment or plant for isolating bio-active compounds from marine actinobacterium.[20] The modern explosion in the field of prokaryotic genome sequences especially, studies on COX2 involvement and inhibitory activity which offers us numerous tools to define the taxonomy and appreciate patchiness among genus level identification.[21] Considerate this unpredictability is most significant for selecting the *Micromonospora* that not only impacts human health such as human colon cancer etc., but also biofuel production and crop fitness.[22]

CONCLUSION

The present study concluded that EPS obtained from marine actinobacterium of *Micronospora* sp. showed potent antioxidant potential activities. These marine microbial substances will be possible to use as natural products for therapeutic studies in the future.

Table 3: The following consists of the values of the total antioxidant activity and the total reducing power of the Micromonospora produced when compared to the ascorbic acid (standard)

TAA	AAE	TRP	AAE
25μg/ml	38.58±1.217	25μg/ml	9.28±1.6
50 μg/ml	54.39±1.302	50 μg/ml	20.79±2.1
75μg/ml	76.54±0.812	75μg/ml	31.95±2.4
100μg/ml	98.37±1.225	100μg/ml	42.68±1.9
125μg/ml	118.35±1.314	125μg/ml	59.14±2.1
150μg/ml	142.65±1.286	150μg/ml	72.38±2.4

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Conflicts of interest

There are no conflicts of interest.

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