



E-ISSN: 2278-4136

P-ISSN: 2349-8234

JPP 2019; 8(4): 3146-3148

Received: 01-05-2019

Accepted: 03-06-2019

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Natural product repertoire of the marine actinomycetes *Nocardia* sp.

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Abstract

Actinomycetes are a very attractive and promising source in the production of novel bioactive compounds. They exhibit a wide range of pharmacological activities. The genus *Nocardia* consists of various species, such as *Nocardia brasiliensis*, *Nocardia fukuyae*, *Nocardia interforma*, *Nocardia gloverula* and *Nocardia* sp. *Nocardia* sp is a rich source of metabolites containing diverse chemical classes, including benzoquinones and different classes of peptides as thiazolyl peptide and lipopeptides with various valuable biological activities. The review provides a survey for all the compounds isolated from *Nocardia* sp, along with their corresponding biological activities, whenever applicable.

Keywords: *Nocardia* sp, actinomycetes, peptides, antibiotic, anticancer

1. Introduction

Actinomycetes derived from marine source considered one of the richest source of secondary metabolites with therapeutic effect ^[1]. 13,700 bioactive compounds were identified from actinomycetes up to 2010 ^[2]. Sixty percent of the applied antibiotics between 1950 and 1970 were isolated from actinomycetes ^[3]. *Nocardia* sp (Kingdom: Bacteria: phylum: Actinobacteria; class: Actinobacteria; order: Actinomycetales; Suborder: Corynebacterineae; family: Nocardiaceae, Genus: Nocardia) is reported to be a very rich source of bioactive metabolites. *Nocardia* species, reported as an important producer of antibiotics ^[4]. Many chemical and biological examinations carried especially for *Nocardia* sp, found in the previous literature. These investigations confirmed that *Nocardia* sp is rich with different classes of natural products as peptides with various subclasses as thiazolyl peptides ^[5] and Lipopeptides ^[6], benzoquinones ^{[7],[8]} and picolinic acid ^[9]. *Nocardia* sp collected from different regions including Florida ^[6], Egypt ^[7], Japan ^[10]. Biological examination of *Nocardia* species provides that the most important activity is its antibacterial activity as it considered an antibiotic reservoir, moreover, it have antitumor ^[7, 11] and cytotoxic activities ^[12]. Our aim in this review is to present the chemical structures of the natural products isolated from *Nocardia* sp, their places of collection and their biological activities whenever applicable.

2. Peptides

Peptides are one of the most abundant metabolites from the marine actinomycete *Nocardia* sp. With different sub classes for example, lipopeptides as peptidolipins B-E (1-4), isolated from a marine *Nocardia* sp. (strain WMMB215), cultivated from the ascidian *Trididemnum orbiculatum* ^[1]. They possess antibacterial activities as; they examined against methicillin-resistant *Staphylococcus aureus* (MRSA), methicillin-sensitive *Staphylococcus aureus* (MSSA) and showed that Peptidolipins B (1) and E (4) have antibacterial activity with MIC 64 µg/mL against MRSA and MSSA. While, Peptidolipins C (2), D (3) have an activity of more than 64 µg/mL with MIC against MSSA and MRSA ^[1]. Moreover, another subclass of peptides is thiazolyl peptide as nocaithiacin I-III (5-7) ^[5] they were considered as an antibiotic complex. Previously reported from *Nocardia* sp. isolated from *Amycolatopsis* sp ^[5].

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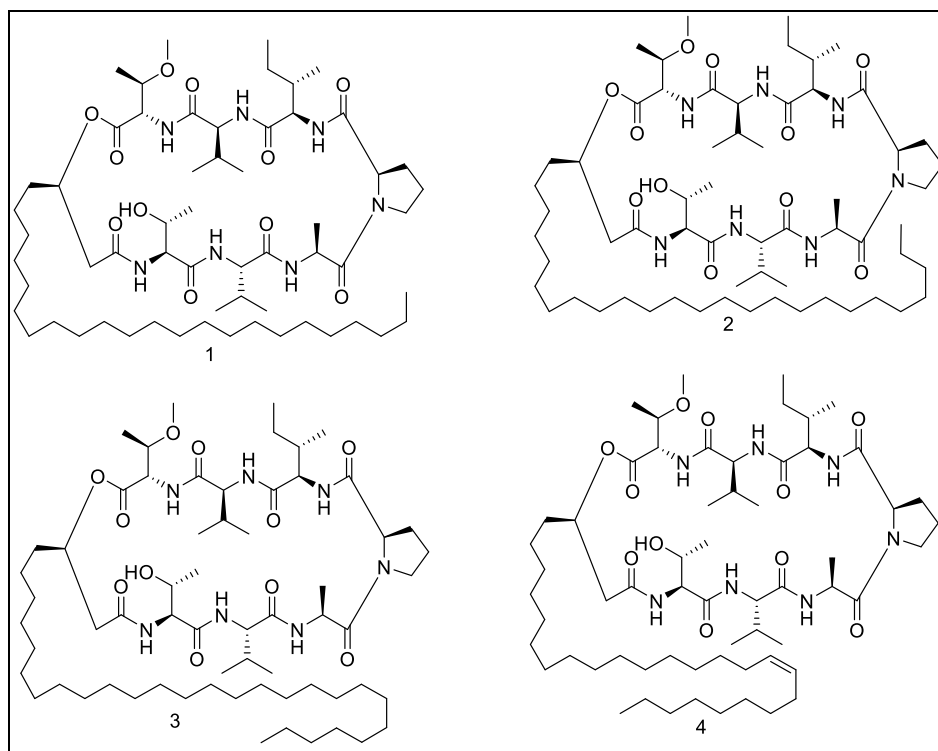


Fig 1: The chemical structure of compound (1-4)

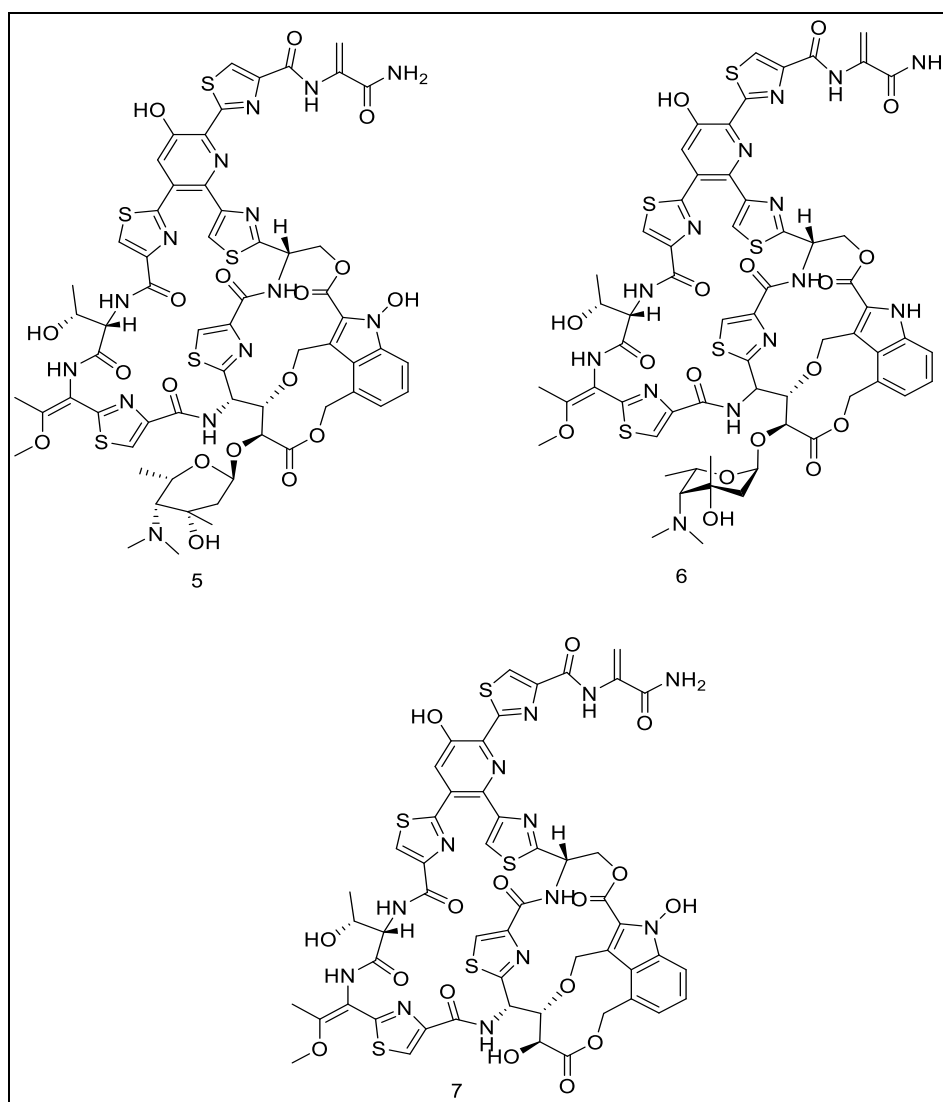


Fig 2: The chemical structures of the compounds (5-7)

3. Benzoquinones

Potent antibiotic antitumor compounds isolated from *Nocardia* sp is Macbecin I-II (8-9) considered a benzenoid ansamycins^[10]. Macbecin I-II have several biological activities as antiprotozoal, antibacterial and antifungal activities^[10]. Moreover, ubiquinone Q9 (10)^[8] isolated from *Nocardia* sp. KMM 3749 was isolated from an unidentified marine sediment at Simushir Island, Kuril Islands^[8].

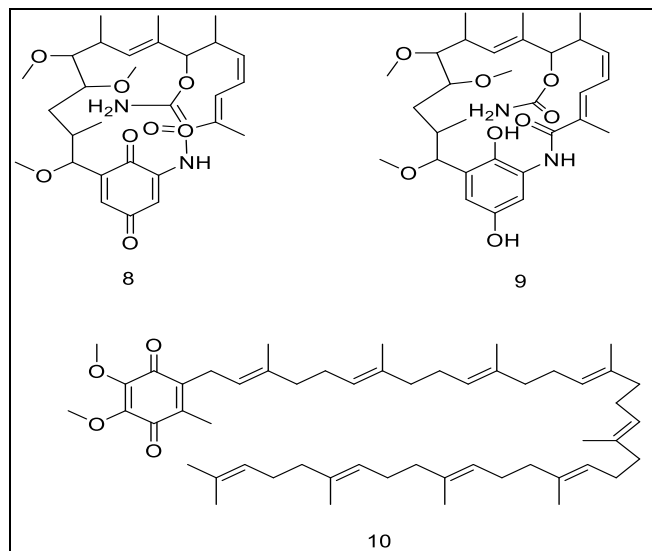


Fig 3: The chemical structures of the compounds (8-10)

4. Picolinic acid

Picolinic acid is a metabolite of tryptophan. one of its derivative is 5-Hydroxy picolinic acid (11) which is isolated from *Nocardia* sp. isolated from marine macrophytes at Japan^[9]. Exhibited a variety of biological activities as immunological, neuroprotective anti-proliferative affects within the body^[13].

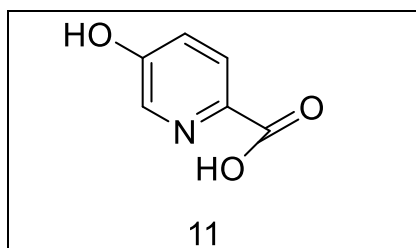


Fig 2: The chemical structures of the compounds (11)

5. Conclusions

Actinomycetes represents a huge reservoir of undiscovered natural products by having a wide range of pharmacological activities. *Nocardia* undescribed species considered an important source of secondary metabolite thus, new species discovery confirmed that there is still a chance in isolating new natural metabolites with expected strong biological activities. Peptides represents the highest distribution among the different chemical classes. Followed, by benzoquinones then acids. These chemical leads showed a huge diversity of pharmacological activities such as anticancer, antibacterial, and antiprotozoal activities. *Nocardia* sp. have a broad range of biological activities, therefore, we must held further investigations for *Nocardia* sp. as it is a promising source for discovery of new bioactive natural metabolite.

6. References

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