

## **Antimicrobial Activity of Extracts from Aquatic Algae Isolated From Salt Soil and Fresh Water in Thailand**

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**Abstract:** *Introduction: In this study antimicrobial activity of extracts from four species of algae (Chara sp., Oscillatoria sp., chlorella sp., and Dulenilla salina.) was evaluated against different human pathogens; i.e. Escherichia coli, Staphylococcus aureus, Psuedomonas sp. Bacillus sp. and Candida albicans.*

*Methods: The extracts of selected algae were tested for their activity against some bacteria and fungi.*

*Results: The extracts of the selected algae exhibited a potential activity against bacterial and fungal growth.*

*Conclusion: The algal extracts are potentially prolific sources of highly bioactive secondary metabolites that might lead in the development of new pharmaceutical agents.*

**Keywords:** *antimicrobial activity, algae, algal extract*

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### **1. INTRODUCTION**

In the recent years, the interest in the study of algae as sources of bioactive compounds has increased.

Recent studies indicate the presence of some bioactive compounds in the blue green algae, these organisms are a rich source of structurally novel and biologically active metabolites (Ely et al., 2004) such as antimicrobial (Bouhlal et al., 2010), antiviral (Bouhlal et al., 2011, Kim and Karadeniz, 2011), antifungal (de Felício et al., 2010), anti-allergic (Na et al., 2005), anticoagulant (Dayong et al., 2008), anticancer (Kim et al., 2011), antifouling (Bhadury and Wright, 2004) and antioxidant activities (Devi et al., 2011).

Extracts of marine algae were reported to exhibit antibacterial activity. In general, isolation of bioactive compounds from cyanobacteria is done to discover new compounds for pharmaceutical, agricultural or bio control application.

Many marine natural products possess novel functional groups and molecular structures compared to those from terrestrial sources. To date, 21,800 natural products have been described from marine organisms (Marin Lit, 2011; Blunt et al., 2011).

Secondary metabolites from marine organisms are an important source of biomolecules for drug discovery and development (Cragg et al., 2004). Since its inception in the 1950's, a myriad of novel marine derived compounds with unique carbon skeleton never been reported from terrestrial source, have been identified. A number of these natural products possess potent biological properties and currently are either in preclinical or clinical testing for the treatment of various human ailments (Cragg et al., 2004). The important compounds identified as antimicrobial are fatty acids, acrylic acid, halogenated aliphatic compounds, terpenes, sulphur containing heterocyclic compounds, carbohydrates and phenols (Kannan et al., 2010).

Therefore the present study was aimed to test the antimicrobial activity of some green algal extracts against some human pathogens.

## 2. MATERIAL AND METHODS

### 2.1. Culturing and Growth Conditions

Algae specimens obtained from Botany Department, Faculty of Science, Kasetsart University were cultured on BG11 nutrition medium for 16 h under illumination and 8 h under darkness. Algae were harvested approximately after a 15 day production period. The algal strains are *Chara* sp., *Oscillatoria* sp., *Chlorella* sp. and *Dunaliella salina*.

### 2.2. Preparation of Extracts

#### 2.2.1. Chemical Extraction of Algae

For extraction, 30 g of the dried algae was extracted using cold methanol, chloroform, diethyl ether for 48 h, then the extracts were concentrated to dryness in a rotary evaporator. The extracts were diluted using dimethyl sulfoxide DMSO (2mg/ml) and then filtered for sterilization.

### 2.3. Antimicrobial Activity

The antimicrobial agar diffusion assay was performed according to modified Kirby-Bauer disc diffusion method NCCLS (2001) against four bacterial strains; i.e. *Pseudomonas* sp., *Escherichia coli*, *Staphylococcus aureus* and *Bacillus* sp. 25 µl of each extract was loaded on sterile filter paper discs with 5 mm in diameter and air dried and then deposited on the surface of agar medium (Mueller-Hinton Agar, pH 7.4 ± 0.2 at 25 °C). The plates containing Muller-Hinton Agar were inoculated by immersing a swab in the inoculums and spreaded it onto the entire surface of the media and then incubated at 37 °C for 24 h (Ballantine et al., 1987).

After incubation for 24 h, whether a clear zone around a disc appears or not was observed in each Petri plate. The presence of clear zone around a disc was evidence of antibacterial activity. Diameters of the zones of inhibition were measured in millimetres. Each test was prepared in triplicate. Discs loaded with each extracting solvent were considered as control.

## 3. RESULTS AND DISCUSSION

Four algal species were tested for antibacterial activity against five bacterial and fungal strains (Table 1), the degree of activity was varied with reference to algal species, type of the solvent used and the tested bacterial and fungal organisms.

**Table1.** Antibacterial and antifungal activities of different cyanobacteria extracts

Algal species	Organic solvent	Diameter of inhibition zone (mm)				
		<i>E.coli</i>	<i>S. aureus</i>	<i>B. subtilis</i>	<i>Pseudomonas sp.</i>	<i>C. albicans</i>
<i>Chara</i> sp.	Methanol	6	13	8	7	-
	Diethyl ether	-	6	-	-	-
	Chloroform	7	7	10	6	-
<i>Oscillatoria</i> sp.	Methanol	5	12	7	5	6
	Diethyl ether	-	-	8	-	-
	Chloroform	6	10	-	7	-
<i>Chlorella</i> sp.	Methanol	6	9	-	11	5
	Diethyl ether	-	-	-	-	-
	Chloroform	3	7	6	-	8
<i>Dunaliella salina</i>	Methanol	8	9	8	10	6
	Diethyl ether	11	-	5	9	-
	Chloroform	-	8	-	5	4
Control		-	-	-	-	-

In order of solvent type, high antimicrobial activity was observed to the extracts of methanol. The highest activity was recorded for the methanolic extract of *Chara* sp. (13 mm) against *Staphylococcus aureus*, followed by chloroform extract of *Oscillatoria* sp. (12 mm) against *Staphylococcus aureus*, followed by methanolic extract of *Dunaliella salina* (11 mm) against *E.coli* and methanolic extract of *Chlorella* sp. against *Pseudomonas* sp..

Less antifungal activity was reported in this study. Moderate activity against all selected pathogenic microorganisms was reported for methanolic extract of *Oscillatoria* sp. High activity

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was recorded for methanolic extract of *Dunaliella salina*. *Oscillatoria* sp. and *Dunaliella salina*. Showed potential activity against all tested pathogens.

No activity reported for the diethyl ether extract of *Clorella* sp.

Similar activities were carried out by Goud et al. (2007) and Prashant et al. (2006) who investigated that methanolic extract of blue green alga and green algae have shown good antimicrobial activity.

The results reported in this study are in accordance with a number of reports by many authors on antibiotic and other pharmacological effects from cyanobacteria. The genus from cyanobacteria, generally studied on an antimicrobial activity are *Nostoc* sp. (Knübel et al., 1990; Bloor and Englan, 1991; de Mule et al., 1991), *Scytonema* sp. (Chetsumon et al., 1993; 1994; 1995; Stewart et al., 1988; Ishida et al., 1997), *Microcystis* sp. (Carmichael et al., 1988), *Oscillatoria* sp. (Bagchi et al., 1990; Barchi et al., 1984) and *Phormidium* sp. (Fish and Codd, 1994). De Mule et al. (1991) determined that the methanol extracts of *Nostoc muscorum* revealed antibacterial activity. Priyadharshini et al., 2013) found that *Oscillatoria* sp. extracts had an excellent activity against some bacterial pathogens.

The results shown in this study give an indication of the presence of promising antimicrobial compounds in the algae under the study. Further phytochemical studied are needed to elucidate the components responsible for antimicrobial activity of these extracts against human pathogens.

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