Qatar Univ. Sci. J. (1991), 11: 155 - 160

THE ANTIBIOTIC ACTIVITY OF SOME AQUATIC PLANTS AND ALGAL EXTRACTS FROM JORDAN

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Key Words: Antibiotic, aquatic plants, algal, extracts, Jordan.

ABSTRACT

The antimicrobial activity of the extracts of three fresh water green algae, four marine green algae, two brown marine algae and five red marine algae from the Jordanian part of the Aqaba Gulf, together with four aquatic higher plants were screened against *E. coli* and *Staphylococcus aureus*. The inhibition zones were observed and measured from the margin of the well containing the plant extract to the beginning of the bacterial growth on nutrient agar plates.

The fresh water algae extracts showed the highest antimicrobial activity against both indicator bacteria, while the marine algae were active against *Staph. aureus* only.

The green algae were the most effective followed by the brown and red marine algae.

The extracts of *Lemna minor*, *Potamogeton sp.*, *Nastorium officinale* and *Apium nodiflorum* were also active against *Staph. aureus* only.

INTRODUCTION

The antimicrobial activity of some marine as well as fresh water thalli and algal extracts has been partly studied by Hornsey and Hide (1974) and by Glombitza (1979). Hornsey and Hide (1985) have also shown that the production of the active compounds varies with the season of the year. In any event extrametabolites are of at least great biochemical interest and are of high significance in explaining a number of algal behaviors such as periodicity and the response of one species to another when growing in close proximity, or in mixed cultures. A substance from one species may be inhibiting the growth of another algal species or bacteria living in the same habitat. In their behaviour antibiotics may induce specific reactions or

modify specific physiological activities of another species negatively (Prescott 1968). Examples of such antibiotics are Chlorellin from *Chlorella,* Pendorine from *Pandorina* and Phormidine from *Phormidium sp.* Since there is a lack of information in Jordan about the antibacterial activity of the local plants, we found it of interest to carry out this study.

MATERIALS AND METHODS

Collection of specimens:

The marine algae used in this study were collected from the Gulf of Aqaba opposite the marine scientific station (Fig. 1). They are:

Enteromorpha linza , *Ulva lactuca*
Cladophora coelothrix , *Padina pavonica*
Colpomenia sinuosa , *Hypnea musciformis*
Gelidium sp. , *Codium tomentosum*
Laurencia obtusa , *Galaxuara rugosa*
Polysiphonia sp.

The above mentioned species were identified according to Natour *et al.* (1979). Also the following fresh water algae were collected from the Zarqa river in Jordan: *Spirogyra, Chara, Cladophora.*

Some aquatic higher plants were also used in this study and collected from the old Romanian Jerash pools; *Lemna minor, Potamogeton sp., Apium nodiflorum* and *Nasturium officinale.*

Preparation of extracts:

One gram of fresh plant material was taken in triplicate, washed with distilled water and sterilized with 10 sodium hypochlorite for 20 sec., then washed again three times with sterile distilled water. The plant material was extracted in 8 ml phosphate buffer of pH 7.2 using a pestle and mortar. The mixture was centrifuged at 3000 gravity for 5 minutes. The supernatant was decanted; and the pellet was resuspended in 2 ml phosphate buffer and centrifuged again as above. Both supernatants were combined.

Antibiotic activity:

Nutrient agar plates were seeded with 0.1 ml of an overnight culture of *Staphylococcus aureus* or *Escherichia coli.* Wells were cut from plates with a cork border 9 mm in diamter (3 wells in each plate). 0.1 ml of the plant extract was introduced into each well and the plates were incubated at 37°C for 24-48 hours. Inhibition zones were observed and measured from the margin of the well to the

beginning of the bacterial growth. As control phosphate buffer was used instead of plant extract.

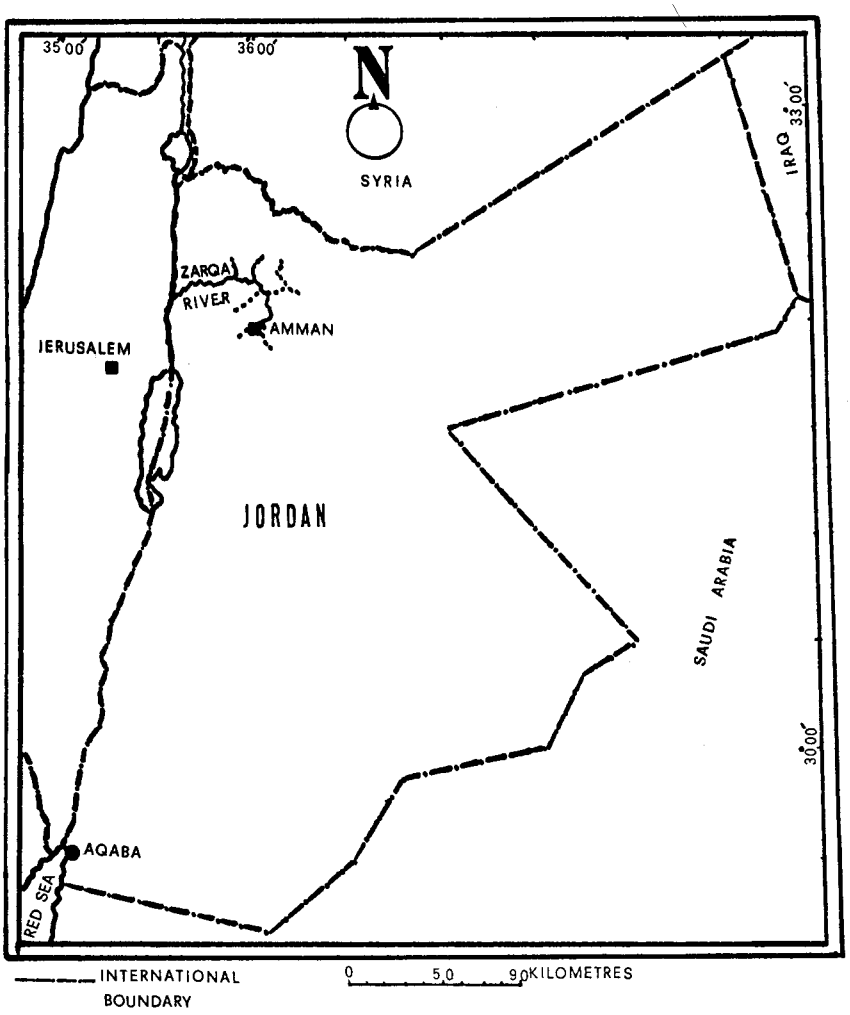

Fig. 1: Sampling stations (Aqaba, Zarqa River)

RESULTS AND DISCUSSION

Eighteen plant species have been collected from Jordan; three fresh water algae; eleven marine algae; and four aquatic angiosperms. The antimicrobial activity of these plants was different as shown in Table 1.

The fresh water algae showed the highest antimicrobial activity against both

Table 1

Antimicrobial activity of some marine and freshwater algae and higher plants from Jordan.

	Plant species	Mean inhibition zone (mm)		Locality
I.	Fresh water algae	*E. coli*	*S. aureus*	Zarqa river
	Chara sp.	13	18.5	"
	Cladophora sp.	13	17.3	"
	Spirogyra sp.	12	14	"
II.	Marine algae			Aqaba
	a. green algae			
	Enteromorpha linza	0.5	26	"
	Ulva lactuca	0.5	26	"
	Cladophora coelothrix	2	0.0	"
	Codium tomentosum	0.0	0.0	"
	b. brown algae			
	Padina pavonica	1	18	"
	Colpomenia sinuosa	0.2	17	"
	c. red algae			
	Galaxuara rugosa	0.15	13	"
	Gelidium sp.	0.15	13	"
	Hypnea musciformis	3	12	"
	Laurencia obtusa	1	11	"
	Polysiphonia sp.	0.15	11.7	"
III.	Aquatic Plants			Jerash Pools
	Lemna minor	1.7	25	
	Potamogeton sp.	1.	20	
	Nastorium officinale	0.0	14	
	Apium nodiflorum	0.0	15	

indicator bacteria. *Spirogyra* showed the least activity among the freshwater algae. While the marine algae were active against *S. aureus* but not active against *E. coli*. This might be due to the fact that *S. aureus* is not a common inhabitant in fresh water habitats and can be introduced into the marine habitat with sewage. *E. coli* might have developed resistant mechanisms against active substances produced by these marine algae. The green algae are the most effective organisms followed by the brown and red algae. All the examined green algae except *Codium* live in the intertidal zone which is the most exposed habitat to sewage pollution. The trend

that *E. coli* is more resistant than *S. aureus* has been also observed by Hornsey and Hide (1985). Also the differences in the antibiotic activity of the tested algae may be due to differences in the composition of their cell wall materials. The cell wall of the examined green algae is composed of cellulose, while that of the brown algae is composed of cellulose, alginic acid and sulfated mucopolysaccharides and that of red algae contains cellulose, xylans and pectin (Bold *et al.*, 1980).

Table (1) shows also the antibiotic activity of the aquatic plants; *Lemna minor, Potamogeton sp., Nastorium officinale* and *Apium nodiflorum. Lemna* and *Potamogeton* were active against *E. coli* and *S. aureus,* while *Nastorium* and *Apium* are active against *S. aureus* only. *Lemna* shows the highest activity among the aquatic angiosperms. This difference might be due to the habitat where *Lemna* usually grows. This minute plant lives in very shallow stagnant waters beside the river bank in small pools; where other micro-organisms such as bacteria also live and may compete with *Lemna* for nutritional resources.

ACKNOWLEDGEMENT

The authors thank the Deanship of Academic Research and Higher Studies at Yarmouk University in Jordan for funding this project.

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دراسة فاعلية المضادات الحيوية لبعض النباتات المائيـــة ومسـتخلصات الطحـــالب بالأردن

محمد نزار مسمار و م. أبو السعود

في هذا البحث أجريت دراسة لتأثير فاعلية المضادات الميكروبية المستخلصة من العينات الآتية :

ثلاثة أنواع من الطحالب الخضراء في المياه العذبة ، أربعة أنواع من الطحالب البحرية ، اثنين من الطحالب البنية البحرية ، خمسة أنواع من الطحالب الحمراء البحرية . في مياه خليج العقبة بالأردن بالاضافة إلى أربعة عينات من النباتات الراقية وذلك ضد بكتريا الأيشيريشيا كولاى ، والاستفيلوكوكس أوريس .

وقد قيست المناطق الجرداء الخالية من النمو حول حافة الحلقة المحتوية على المستخلص النباتي إلى بداية نمو البكتريا وذلك ببيئة الآجار المغذي .

وقد أثبتت التجارب أن مستخلص طحالب المياه العذبة تفرز أكثر أنواع المضادات الميكروبية تأثيراً ضد هذين النوعين من البكتريا ، وكانت مستخلصات الطحالب البحرية نشطة فقط ضد بكتريا الأستفيلوكوكس أوريس ، كما أن مستخلصات نباتات اللينا مينور والبوتا موجيتون كانت فعالة فقط ضد بكتيريا الأستفيلوكوكس أوريس .