Egyptian Journal of Biology, 2003, Vol. 5, pp 62-69
 Egyptian British Biological Society (EBB Soc)

Biological activities and phytochemical constituents of the gray mangrove *Avicennia marina* (Forssk.) Vierh.

Ishrak Khafagi[1*] , Ali Gab-Alla[2] , Waleed Salama[3] and Moustafa Fouda[3]

1. Botany Department, Faculty of Science, Suez Canal University, Ismailia,
2. Marine Sciences Department, Faculty of Science, Suez Canal University, Ismailia,
3. Nature Conservation Sector, Egyptian Environmental Affairs Agency (EEAA), Cairo.

ABSTRACT

In vitro assessment of the antibacteriophage, antibacterial and anticandidal activities as well as cytotoxicity were evaluated for both aqueous and ethanol extracts prepared from roots, cotyledons, leaves and stems of *Avicennia marina*. Aqueous extracts of both shoots and roots of the seedlings demonstrated antibacteriophage activity using coliphage against *Escherichia coli* NRRL B-3704, which indicates antiviral activity. Aqueous extracts also exhibited moderate cytotoxicity against the larvae of the brine shrimp *Artemia salina,* which demonstrates antiplasmodial and antimalarial activities. However, both aqueous and ethanol extracts of various parts of the seedlings lacked antimicrobial activities against eight microbial test strains. On the other hand, irradiation of either seedling parts or plant extracts with long-wave UV radiation elicits immediate phototoxic activity. Investigating the production of growth-regulating substances in crude extracts reveals the presence of auxin- and cytokinin-like activities. Phytochemical analysis of ethanol extract of the shoot system indicates the presence of some biologically active metabolites including tannins, flavonoids, sterols, iridoid glycosides and organic acids. Alkaloids and saponins were not present in the extracts, which means no toxicity. The potential medicinal value and phytochemical prospects of the gray mangrove grown on the Red Sea coastline of Egypt are discussed.

KEYWORDS: antibacteriophage activity, phototoxic antimicrobials, cytotoxicity, growth regulators, Gulf of Aqaba, Red Sea.

INTRODUCTION

Mangrove forests have been utilized for many functions including wood production, firewood and charcoal (Tomlinson 1994). However, wood-related activities or industries based on lingo-cellulose as a manufacturing substrate are very destructive and the rates of mangrove renewal do not match this at all (Kairo *et al*. 2001). Recently, it has been strongly recommended that mangroves should be considered as a valuable source for chemical constituents with potential medicinal and agricultural values (Miles *et al*. 1998). Although the chemical constituents of most mangrove plants still have not been studied extensively, investigations have led so far to the discovery of several novel compounds with prospective medicinal value for the discovery of new chemotherapeutic agents.

Avicennia marina (Forssk.) Vierh. (Avicenniaceae) has received some attention in determining its important chemical constituents. A napthoforan compound with phytoalexin activity has been isolated (Sutton *et al*. 1985; Miles *et al*. 1998) and fatty acids, sterols and hydrocarbons studied in relation to their chemotaxonomic significance in eleven mangrove species including *A. marina* (Hogg & Gillan 1984). The presence or absence of an iridoid glucoside 2′-cinnamoyl mussaenosidic acid from *A. marina* extracts can be used in subspecific chemotaxonomy (Bousquet-Mélou & Fauvel 1998).

In vitro antimalarial activity and cytotoxicity of *A. marina* have also been reported and flavonoid glycosides having preliminary anticancer activity isolated (Sharaf *et al*. 2000). Recently, chemo-preventive activity (anti-tumor promoters) of some naphthoquinones and their analogs isolated from *Avicennia* plants was noted (Itoigawa *et al*. 2001). The bark and roots of *A. marina* are known to contain the tannin lapachol

* Address for Correspondence

(Tomlinson 1994). The bark, leaves and fruits of *A. marina* are used in folk medicine to treat skin diseases.

The current study was planned to have more insight into the active metabolites of the gray mangrove *A. marina.* Application of a range of bioassays was intended to capture unexplored medicinal uses. The study aims to: a) assess antibiotic action and growth-regulating potential of both aqueous and ethanol extracts prepared from roots, cotyledons, leaves and stems; b) analyze its phytochemical constituents; and c) highlight potential uses and valuable chemical constituents of such endangered marine plant.

MATERIALS AND METHODS

Seeds of *A. marina* were collected from El-Nabq Gulf of Aqaba, Red Sea in November 2002. Voucher specimens of the mature plant were deposited in the Botany Department Herbarium, Suez Canal University, Ismailia, Egypt. Seeds were transferred in moist plastic bags to the laboratory in Ismailia. One-year-old plants growing in the laboratory in plastic pots watered with 21 ‰ saline water were used as the experimental plant materials for the study. Plants of *A. marina* were maintained in a 16 h photoperiod at light radiation 100 - 150 μmol $m^{-2}s^{-1}$ and temperature 30 ± 5°C during the day and 20 ± 5°C at night.

Various parts of *A. marina* seedlings were extracted by maceration with ethanol (10 ml/g fresh weight) for 5 min in a homogenizer, left to stand overnight in the dark, then filtered (Harborne 1984). The filtrates were evaporated in a rotary evaporator under reduced pressure at 40ºC. The residue was dissolved in 3 ml ethanol yielding the crude ethanol extract for further assays. Aqueous extracts of both shoot and root systems were also prepared. Both aqueous and ethanol crude extracts were tested immediately for various biological activities. Ethanol extracts of the shoot system (Figure 1 A) was used for the phytochemical analysis.

Table 1 lists the details of test organisms and specific bioassay methods performed in order to evaluate the biologically active metabolites that may be present in the tissues of *A. marina*.

The antibacteriophage bioassay was performed using coliphage against *Escherichia coli* NRRL B-3704 in the direct plaque assay (Ackermann & DuBow 1987), which indicates the antiviral activity of the mangrove extracts. The antibacteriophage assay may suggest possible models for anti-tumour action (Robertson *et al*. 1982). A combination of 0.5 ml of the host bacterial culture in the exponential growth phase and 0.1 ml of the phage in addition to 0.1 aqueous test extract were mixed thoroughly in a tube of 5 ml Lauria soft Agar (0.7 %). Then, the soft-agar medium was poured on a Lauria agar plate and left to solidify. The plates were incubated inverted at 37.5 ºC for 12-16 h. Clear areas of lytic plaques (pfu/ml) were counted in comparison with the control, which had 0.1 ml distilled water instead of the plant extract.

Cytotoxicity was assessed using the multi-well cytotoxic assay (Solis *et al*. 1993) carried out against the larvae of the brine shrimp *Artemia salina* (obtained from Interpet Ltd. Dorking, England). The bioassay demonstrates antimalarial activity and predicts antitumor and pesticidal potential. Brine shrimp eggs were hatched in seawater supplemented with 6 mg/l dried yeast, oxygenated with an aquarium pump and incubated in a warm room at 22-29 °C for 48 hr. Serial dilutions in 100 μl seawater were made into the 96 wells of microplates. Control wells with either seawater or Tween 80 were included in each experiment. About 100 μl of the nauplii (containing 10-15 organisms) was added to each well and the multi-well plate incubated at 22-29 °C for 24 hr. Plates were then examined under a binocular microscope and the numbers of dead (non-motile) nauplii in each well counted. Finally, all shrimps were scarified by adding 100 μl methanol to each

well. After 15 min, the total numbers of shrimps/well were counted. Probit analysis (Finney 1971) was used for calculating the LC_{50} values.

Antimicrobial activities of both aqueous and ethanol extracts of various parts of *Avicennia marina* plant were tested by the disc-diffusion method (Ericsson & Sherris 1971) against eight test strains. The antibacterial activity was assessed against five bacteria capable of human pathogenicity and one airborne bacterium, *Bacillus subtilis* (Table 3). Two yeasts were used for investigating the anti-candidal activity of the crude extracts. The microorganisms were obtained from the culture collection of the United States Department of Agriculture, Northern Regional Research laboratory (Peoria, Illinois, USA).

Table 1: Bioassays and test organisms used for *in vitro* assessment of various biological activities of *Avicennia marina* plant extracts

Biological activity	**Bioassay**	**Test organism**	**Plant extract**	**Biological Indication**
Antibacterial	Disc Diffusion/ Hole-plate/ (MIC)	Gram-positive & Gram-negative test bacterial strains	Aqueous/ Ethanol	Bacteriostatic & Bactericidal (i.e. activity against prokaryotic cells)
Anticandidal	Disc diffusion/ Hole-plate	*Candida albicans* & *Candida tropicals*	Aqueous/ Ethanol	Anticandidal (i.e. activity against unicelluar eukaryotic cells)
Anti-bacteriophage	Plaque assay	Coliphage against *E. coli*	Aqueous	Activity against coliphages (i.e. antiviral activity)
Cytotoxicity	Multi-well cytotoxicity assay	nauplii of *Artemia salina*	Aqueous	Antiplasmodial, antifilarial & antimalarial activity
In vitro Phototoxicity	Elicitation with long wavelength UV	*Candida albicans* & Gram-positive & Gram-negative bacteria	Ethanol	Immediate induction of defence compounds (phytoalexins) by abiotic elicitor
Plant growth regulators	*In vitro* bioassay for induction of callus, roots & shoots.	Carrot hypocotyls	Aqueous	1. Induction of roots (i.e. presence of auxin), 2. induction of shoots (i.e. presence of cytokinin), 3. growth inhibition (i.e. presence of inhibitors).

An *in vitro* phototoxicity bioassay was applied in order to assess the influence of abiotic factors such as long-wave UV radiation on the induction of immediate antimicrobials. The *Candida* phototoxic assay adjusted by Knudsen (1985) was applied. The method depends mainly on measuring the area of the yeast/bacterial free zone. Crude ethanol extracts prepared from *A. marina* shoots were used to test phototoxicity. Filter paper discs loaded with 95 % ethanol were used as control. Six experimental replicate plates and six control plates were used for each treatment. Plates were irradiated for 1 min with UV radiation emitted from either a UV lamp (long wave source) or a solar simulator source. Cultures were incubated at 30°C for 18-48 hr in the dark. The area (cm^2) of clear zone of inhibition surrounding the test material was determined for each treatment. The irradiated intensity was determined as energy fluency rate (i.e. energy density per unit time) with an international light model IL 1400A radiometer. It was 1.25 $mW/min/cm^2$ as determined from the UV lamp and 50 $mW/min/cm^2$ produced from the solar simulator. A detailed experimental study was undertaken recently in order to calibrate the minimal time of exposure and the optimal irradiating energy required for inducing the maximum inhibition of microbial growth (Khafagi *et al*. 2001).

Investigating the growth regulating potential of ethanol extracts of *A. marina* was done using *in vitro* growth assay of carrot explants in a growth regulator-free medium

containing the mangrove extract (Brain *et al*. 1973; Khafagi *et al*. 1999). Carrot hyopocotyls were grown aseptically on tissue-culture media (Murashige & Skoog 1962) supplemented with 0.75 % agar and 3 % sucrose at pH 5.8. Extracts of various *A. marina* organs were tested for having growth-regulating substances. Induction of callus, roots, shoots or growth inhibition were tested in plates inoculated with 1-cm-long hypocotyls and supplemented with 1 ml aqueous mangrove extracts.

Phytochemical tests for alkaloids, flavonoids, saponins, tannins, sterols & terpens and glycosides were carried out as described by Trease & Evans (1987) and Evans (1996). Each test was qualitatively expressed as negative (-) or positive (+). Subsequent thin-layer chromatographic (TLC) analysis was performed on silica-gel G pre-coated plates using the recommended TLC systems for major classes of plant chemicals described by Harborne (1984).

RESULTS

The aqueous extracts of both shoots and roots have moderate antibacteriophage and cytotoxic activities. Aqueous extracts of shoots displayed more activity than that of the roots. *A. marina* shoots decreased the infectivity of phages (pfu/ ml) against their host bacteria more than root extracts (Table 2). The LC_{50} of shoot extracts was more active than that of the roots (Table 2).

Table 2: Antibacteriophage and cytotoxic activity of *Avicennia marina* plant extracts

	Antibacteriophage activity Coliphage against *Escherichia coli* NRRL B-3704		Cytotoxicity *Artemia salina* nauplii
Plant extract	Mean value for Control (pfu/ml)	Mean value for 0.1 µl Plant extract (pfu/ml)	LC_{50} (µl/ml)
Shoot system	850 ± 0.33	120 ± 0.27	12.50 ± 0.24
Root system	850 ± 0.33	147 ± 0.16	25.25 ± 0.49

LC_{50} is estimated from the brine shrimp micro-well assay by calculations using probit test.

Both aqueous and ethanol extracts of various plant parts lack antimicrobial activities against seven microbial test strains (Table 3). Alternatively, treatments of shoot and root extracts with long-wavelength UV radiation induced phototoxic activity, which may reflect immediate production of phytoalexin defence compounds (Table 3 & Figure 1).

Table 3: Antimicrobial activity and UV-dependent phototoxicity of *Avicennia marina* plant extracts. - = inactive. Numbers are the calculated area (cm^2) of growth inhibition induced on irradiation of plant extracts in the presence of microorganisms.

Test organism	Source	Antimicrobial Activity		UV-dependent activity of shoot extracts (cm^2)	
		Shoot extract	Root Extract	UVA lamp (1.25 mW/ min/ cm^2)	Solar simulator (50 mW/ min/ cm^2)
Staphylococcus aureus	NRRL B-767	-	-	2.55	25.35
Bacillus subtilis	NRS- 744	-	-	2.48	24.11
Escherichia coli	NRRL B-3704	-	-	1.99	12.88
Klebsiella pneumonia	NRRL B-3521	-	-	2.1	14.66
Proteus vulgaris	NRRL B-123	-	-	1.89	10.23
Candida albicans	NRRL Y-477	-	-	3.12	26.78

The carrot-hypocotyl bioassay shows that ethanol extracts of seeds and cotyledons have auxin-like and cytokinin-like activities and only scarce amounts of growth inhibitors. *In vitro* assays inoculated with 1-cm carrot hypocotyls and assayed for the growth-regulating activity of *A. marina* cotyledon extracts showed the production of some short

roots and many long and hairy roots (Figure 1 B1), comparable with exogenous application of 1 mg/l IAA or NAA. Induction of well-developed shoots (two-shoots/explant) was noticed from mixing *A. marina* extracts of both shoots and roots, and those producing shoots also induced some root formation too (Figure 1 B2). Root extracts alone induced dark callus formation in carrot hypocotyls (Figure 1 B3).

Phytochemical analysis of *A. marina* plant extracts reveals the presence of tannins, sterols, flavones, iridoid glycosides and organic acids, but volatile oils, alkaloids and saponins were not detected in ethanol extracts (Table 4). Phytochemical analysis using standard chemical reactions followed by subsequent separation on TLC silica-gel G plates supplemented with suitable detection methods revealed the production of more than four major spots of flavonoids, two spots of iridoid glycosides and two sterols. Alkaloids and saponins were not detected even though more than one investigation method was used.

Table 4: Phytochemical analysis of the *Avicennia marina* shoot system.

Metabolite	Occurrence	Subsequent TLC analysis	Significance
Volatile oils	-	-	Absence from green parts
Tannins	+	Hydrolyzable tannins	Phenolic compound (i.e. may bind to proteins & carbohydrates)
Unsaturated sterols & Terpenes	+	Sterols & terpenes	Physiologically active growth factors
Alkaloids	-	-	Absence means low toxicity
Flavonoids	+	Flavone	May have biological activity
Glycosides carbohydrates	+	Iridoid & flavonoids glycosides	Biologically active glycosides
Saponins	-	-	Absence denotes lack of toxicity
Organic acids	+	Oxalic & citric	Antioxidants

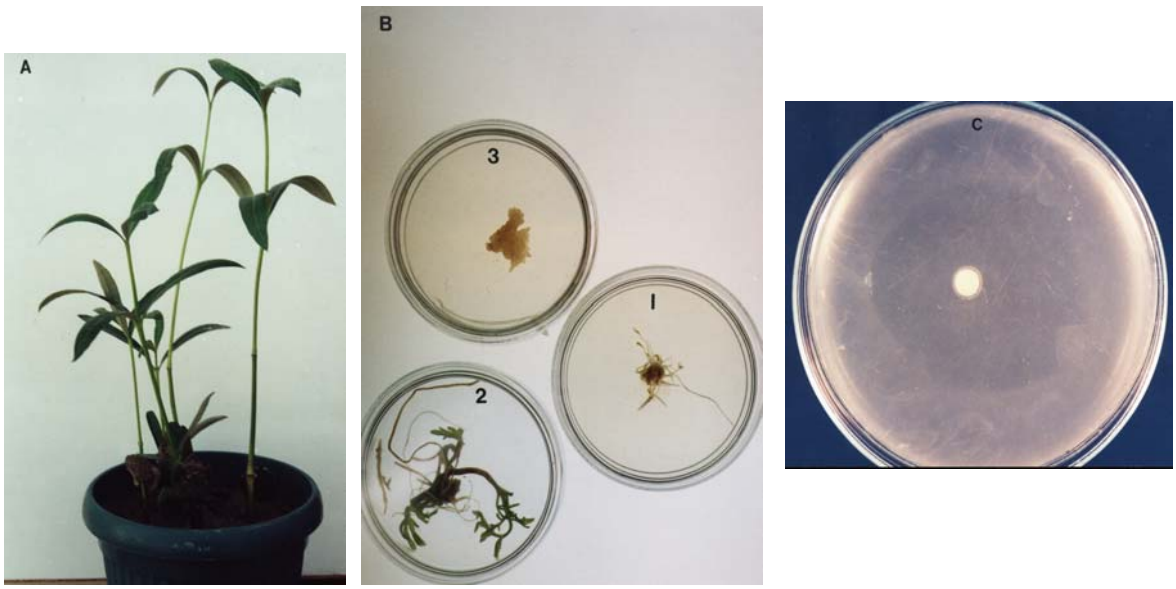

Figure 1: (A) *Avicennia marina* plant materials used for phytochemical screening and biological assays, (B) Carrot hypocotyle *in vitro* assay for growth regulating activity, (C) UV-dependent phototoxic activity of mangrove extracts.

DISCUSSION

Recent strategies for discovering novel drugs from unexplored natural resources recommended marine plants as an important source of potentially useful chemicals (Harvey 2000). Biological activities and phytochemical screening are essential steps for exploration. Employing a wide range of bioassays (Khafagi *et al*. 2003) is valuable not only for preliminary biological characterization of new compounds, but also as essential guidance of the chemical isolation procedures (Claeson & Bohlim 1997). *Avicennia marina* is used to treat skin diseases in folk medicine, suggesting that it possess some natural antimicrobials. Therefore it was intended not only to test the antimicrobial activity of its extracts (which represents the constitutive activity) but also to test inducible activity elicited by abiotic environmental stresses such as UV radiations (Ferreira & Duke 1997; Khafagi *et al*. 2001, 2003), and anti-bacteriophage and cytotoxic activities.

Our results show that aqueous extracts of both shoots and roots have moderate cytotoxic activities: *in vitro* antimalarial activity and cytotoxicity of *A. marina* have already been reported (Miles *et al.* 1998). The lack of antibacterial activity of various extracts of this plant that grows in an environment occupied by a range of microorganisms was odd as an investigational outcome. Subsequent assays investigating the role of UV radiation to induce immediate production of defence compounds (phytoalexins) verify the formation of instantaneous phytoalexins that are increased as the intensity of the radiation increased. This could be confirmed with the results reported the isolation of a napthoforan compound with phytoalexin activity (Miles *et al*. 1998). Application of a bioassay to investigate the antibacteriophage activity resulted in the knowledge that *A. marina* extracts have such activity. *Phragmites communis,* known for its value in phytoremediation of wetlands, proved to have antibacteriophage properties associated with its polyphenolic compounds (Tsitsa-Tzardi *et al*. 1990). This is may be understandable as a range of beneficial bacteria are usually found in the sediment of mangrove soils that help promote seed germination and early growth of the seedlings (Holguin *et al*. 2001). *A. marina* may also produce some substances that inhibit the natural enemies of beneficial bacteria (their phages).

Biological activities detected in the plant crude extracts are related mainly to the presence of flavonoids and flavonoid glycosides in plant tissues; the latter have already been isolated from *A.marina*, and have preliminary anticancer activity (Sharaf *et al*. 2000). The presence of compounds such as flavonoids in plant tissues (Winkel-Shirley 2002) may be characteristic features of plant stress.

The absence of toxic metabolites such as alkaloids and saponins from extracts of this plant may reflect its frequent usage as food for local people or feed for their animals. However, the presence of tannins and oxalic acid may predict the unsuitability of such plant for a daily diet.

The presence of plant growth-regulating substances including auxin- and cytokinin-like activities in *A. marina* extracts may be part of normal growth and development. Farrant *et al*. (1993) reported the presence of cytokinins, auxins and gibberellins in the whole fruits of *A. marina* during the histo-differentiation process. Gibberellins are diterpenoids present in the phytochemical content of this plant. Auxins and cytokinns are nitrogenous compounds that are normally produced from amino acids derived from primary metabolism.

In conclusion, *Avicennia marina* plants may have potential medicinal importance. Phytochemical screening shows the presence of compounds that may have biological activity (i.e. flavonoids). The absence of alkaloids and saponins may reflect the low toxicity of this plant. Iridoid glycosides and sterol compounds could be valuable for further

chemotaxonomic studies of the genus *Avicennia*. *In vitro* bioassays using carrot hypocotyls show the presence of growth-regulating substances in the extracts of both seeds and cotyledons, which may help germination and promote plant growth. Recognition of the medicinal and phytochemical value of *A. marina* could enhance conservation plans for mangrove forests in Egypt.

REFERENCES

Ackermann HW & DuBow MS (1987) Viruses of Prokaryotes. I. General Properties of Bacteriophages. CRC Press, Boca Raton, Florida, USA. pp. 18. 29: 159.

Bousquest-Mélou A & Thrérése Fauvel M (1998). Inter-specific variation in the concentration of two iridoid glucosides in *Avicennia* L. (Avicenniaceae Endl.). *Biochemical Systematics and Ecology* 26: 935-940.

Brain KP, Challopin MC, Turner TD, Blunden G & Wildgoose PB (1973) Cytokinin activity of commercial aqueous seaweed extract. *Plant Sci. Lett*. 1: 241-245.

Claeson P & Bohlim L (1997) Some aspects of bioassay methods in natural-product research aimed at drug lead discovery. *Trends Biotechnol*. 15(7): 245-248.

Ericsson HM & Sherris JC (1971) Antibiotic sensitivity testing. Report of an international collaboration study. *Acta Pathol. Microbiol. Stand., Section B., Suppl. 217.*

Evans WC (1996) Trease and Evans' Pharmacognosy. WB. Saunders Company Limited, London, UK.

Farrant JM, Berjak P, Cutting JGM & Pammenter NW (1993) The role of plant growth regulators in the development and germination of the desiccation-sensitive (recalcitrant) seeds of *Avicennia marina. Seed Science Research* 3: 55-63.

Ferreira JFS & Duke SO (1997) Approaches for maximizing biosynthesis of medicinal plant secondary metabolites. *AgBiotech. News and Information* 9 (12): 309N-316N.

Finney DJ (1971) Probit Analysis. 3rd ed. Cambridge University Press. Cambridge.

Harborne JB (1984) Phytochemical Methods. A Guide to Modern Techniques of Plant Analysis. Chapman and Hall. London, UK. Pp. 1-34.

Harvey A (2000) Strategies for discovering drugs from previously unexplored natural products. *DDT* 5(7): 294 -300

Hogg RW & Gillan FT (1984) Fatty acids, sterols and hydrocarbons in the leaves from eleven species of mangrove. *Phytochemistry* 23: 93-97.

Holguin G, Vazquez P & Bashan Y (2001) The role of sediment microorganisms in the productivity, conservation, and rehabilitation of mangrove ecosystems: an overview. *Biol. Fertil Soils* 33: 265-278.

Itoigawa M, Ito C, Tan HT-W, Okuda M, Tokuda H, Nishino H & Furukawa H (2001) Cancer chemo-preventive activity of naphthoquinones and their analogs from *Avicennia* plants. *Cancer letters* 174: 135-139

Kairo JG, Dahdouh-Guebas F, Bosire J & Koedam N (2001) Restoration and management of mangrove systems - a lesson for and from the East African region. *South African J. Bot.* 67: 383-389.

Khafagi I, Abdel-Kareem M, Sami E & El-Gazzar H (1999) Are exogenous antibiotic safe to use in plant tissue culture media? 6th International Conference of Union Arab Biologists 8-11 Nov. 1999. *Journal of Union Arab Biologists 7(B) Botany:* 249-260.

Khafagi I, Abd El-Khader K, Kord M, Dewedar A & Abd El-Hameid M (2001) *In vitro* elicitation of plant photosensitizers in tissue culture systems irradiated with simulated solar radiation. *Egypt. J. Physiol. Sci.* 25(1): 1-14.

Khafagi I, Dewedar A & Amein M (2003) Opportunities of finding anti-infective agents from plant cell cultures. *Curr. Med. Chem. Anti. Infective Agents* 2: 191-211.

Knudsen EA (1985) The *Candida* phototoxicity test. The sensitivity of different strains and species of *Candida*, standardization attempts and analysis of the dose-response curves for 5- and 8-methoxypsoralen. *Photodermatology* 2: 80-87.

Miles DH, Kokpol U, Chittawong V, Tip-Pyang S, Tunsuwan K & Nguyen C (1998) Mangrove forests-The importance of conservation as a bioresource for ecosystem diversity and utilization as a source of chemical constituents with potential medicinal and agricultural value. *1999 IUPAC* 70 (11): 1-9.

Murashige T & Skoog F (1962) Arevised medium for rapid growth and bioassays with tobacco tissue cultures. *Physiol. Plant* 15: 473-497.

Robertson IG & Baguley BC (1982) A comparison of the requirements for antitumour activity and antibacteriophage lambda activity for a series of non-intercalative DNA-binding agents. *Eur. J. Cancer Clin. Oncol.* 18(3): 271-279

Sharaf M, El-Ansari MA & Saleh NAM (2000) New flavonoids from *Avicennia marina*. *Fitoterapia* 71: 274-277

Solis PN, Wright CW, Anderson MM, Gupta MP & Phillipson D (1993) A microwell cytotoxicity assay using *Artemia salina* (Brine Shrimp). *Planta Med*. 59: 250-252.

Sutton DC, Gillan FT & Susic M (1985) Naphthofuranone phytoalexins from the grey mangrove *Avicennia marina*. *Phytochemistry* 24(12): 2877-2879.

Tomlinson PB (1994) The Botany of Mangroves. Cambridge University Press. New York, USA. 163-170.

Trease GE & Evans WC (1987) A Text Book of Pharmacognosy. ELSB/ Bailliere Tindal, Oxford P. 1055.

Tsitsa-Tzardi E, Skaltsa-Diamantidis H, Philianos S & Delitheos A (1990) Chemical and pharmacological study of *Phragmites communis* Trin. *Ann. Pharm. Fr.* 48(4): 185-191.

Winkel-Shirley B (2002) Biosynthesis of flavonoids and effects of stress. *Current Opinion in Plant Biology* 5: 218-223.

الملخص العربي

النشاط البيولوجي والمحتوى الكيميائي لنبات الشورى الرمادي (*أفسينيا مارينا*)

إشراق خفاجى[1]، على جاب الله[2]،وليد سلامة[3] ومصطفى فودة[3]

1. قسم النبات- كلية العلوم- جامعة قناة السويس- الإسماعيلية
2. قسم علوم البحار- كلية العلوم- جامعة قناة السويس- الإسماعيلية
3. قطاع حماية الطبيعة- جهاز شئون البيئة- المعادى - القاهرة

تهدف هذه الدراسة إلى التقييم المعملي للنشاط البيولوجي للمستخلصات المائية والكحولية لجذور، فلقات، أوراق وسيقان نبات الشورى ضد لاقمات بكتريا القولون والبكتريا السالبة والموجبة لجرام والخمائر ويرقات الأرتيميا. كذلك تعيين المحتوى الكيميائي من المواد الطبيعية للمستخلصات الكحولية للمجموع الخضري لهذا النبات. وقد وجد أن للمستخلصات المائية لنبات الشورى لكل من المجموعين الجذري والخضري تأثيرا مثبطا لنشاط لاقمات البكتريا والتي تتطفل إجباريا على بكتريا القولون، مما يبرهن على تأثيرها المضاد للفيروسات التي تتطفل إجباريا على الكائن الحي. وقد وجد أيضا أن لهذه المستخلصات المائية نشاط مضاد ليرقات الأرتيميا مما يعكس نشاطها البيولوجى. وقد ثبت من الدراسة عدم احتواء المستخلصات المائية أو الكحولية للمجموعين الجذري والخضري على أي نشاط مثبط لنمو البكتريا أو الخمائر. ولكن مع تعريض المستخلصات الكحولية لهذا النبات للأشعة فوق البنفسجية يمكن تحفيز قدرتها على إنتاج مضادات حيوية يتناسب تأثيرها تناسبا طرديا مع شدة الأشعة المستخدمة.

وأشار تحليل المحتوى الكيميائي للمستخلصات الكحولية لهذا النبات قلة سميتها لعدم وجود مواد قلويدية أو مواد صابونية وأن التأثير الفعال لها بيولوجيا يرجع إلى احتوائها على العديد من المواد الطبيعية مثل الفلافونيات، الستروريدات، المواد الراتينجية، الجليكوسيدات وبعض الأحماض العضوية. نوقشت الأهمية الطبية لهذا النبات المتفرد والذي ينمو على سواحل البحر الأحمر المصرية مكونا بيئة نباتية ساحلية متميزة.