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Effect Of Secondary Metabolites Products from Marine *Streptomyces* Against Bacteria Causing Otitis Media

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Abstract: The most prevalent and serious illness in the world, otitis media, is typified by fluid accumulation in the middle ear along with acute infection signs and symptoms, which are brought on by bacterial infections. Due to increasing of multi drug resistance bacteria we are in this study use marine *Streptomyces* specially its secondary metabolites against these multi drug resistance bacteria after isolation and prove that they affected these bacteria. Forty-four are actinomycetes isolates were taken from marine habitats including Hurgada marine sea, Ras Sedr sediment, Ain Sokhna sediment marine sea water, while thirty-six bacterial isolates were obtained from Kafr El-Sheikh General Hospital, Benha University Hospital and Mabaret El-Asafra hospital. The antimicrobial activities of ethyl acetate extracts for isolated *Streptomyces* spp. Tested using the agar disc diffusion method. 50 µl of each extract culture were soaked on filter paper discs and placed on neutral agar media seeded with isolated bacteria. Antimicrobial activity for *Streptomyces* extracts isolated from three regions is observed against isolated bacteria**.**

Keywords: Otitis media**,** *Streptomyces,* secondary metabolites.

1. Introduction

Over 360 million people worldwide suffer from a debilitating hearing loss.

20Up to 40% of this avoidable hearing loss may be attributable to infection, and over 60% of this hearing loss may be avoidable [1-6]. The three regions of the ear that might get infected are the outer (Otitis Externa, OE), middle (Otitis Media, OM), and inner (Otitis Interna, OI) [7–9]. The most prevalent and serious illness in the world is otitis media, also known as middle ear inflammation; it can manifest as suppurative, acute (AOM), or chronic (COM) OM [10-12].

Middle ear effusion (MEE), or the accumulation of fluid in the middle ear, along with acute infection-related signs and symptoms, are the hallmarks of AOM.5. Many kids experience AOM just sometimes, whereas some kids experience episodes frequently of AOM [13].

Ear infections can be caused by bacteria such as *Streptococcus pneumoniae* (*S. pneumoniae*), *Haemophilus influenzae* (*H. influenzae*), *Proteus* species, *Pseudomonas aeruginosa* (*P. aeruginosa*), *Staphylococcus aureus* (*S. aureus*), and *Streptococcus pyogenes* (*S. pyogenes*) [8-14-15].

The main source of antibiotics is *Streptomyces* bacteria. They are also some of the most intricate bacteria, developing into a web of filaments that give rise to aerial branches that carry spore chains. Beginning in the 1950s, early genetic research created a map of the *Streptomyces* coelicolor chromosome that includes genes involved in the development of morphology and antibiotic synthesis [16].

The genus *Streptomyces*, belonging to actinobacteria, is a natural source of diverse metabolites having numerous clinical, agricultural and biotechnological applications. These metabolites of *Streptomyces* are known for their biological roles such as cell-cell communication, morphogenesis, pathogen suppression, pest management, nutrient acquisitions, and several therapeutic applications. So far, chemical structures of less than 30 % of these compounds have been elucidated. In addition, the basic scaffolds of different secondary metabolites obtained from microorganisms are a source of inspiration for chemists [17].

So, in this study we use the secondary metabolites *Streptomyces* as an antibiotic against bacteria and show that there are affecting on these pathogenic bacteria.

2. Material and methods

2.1. Sampling

Samples were taken from marine habitats including Hurgada marine sea, Ras Sedr sediment, Ain Sokhna sediment marine sea water, while bacterial isolates were obtained from Kafr El-Sheikh General Hospital, Benha University Hospital and Mabaret El-Asafra hospital.

2.2. Isolation of marine Streptomyces

The serial dilution method of Hayakawa **and Nonomura (1987)** [18]. was used to isolate marine *Streptomycetes* from marine and soil samples. To minimize moisture films on the agar surface, petri dishes were prepared one day ahead of time and incubated at room temperature overnight [19].

Briefly, 0.1 ml inocula of the dilution were poured on each plate and dispersed with a sterile glass rod using starch nitrate agar medium [20].

Its Components are {Starch 20 (g/l), KNO_3 2 (g/l), K_2HPO_4 2 (g/l), $MgSO_4.7H_2O$ 1 (g/l), NaCl 0.5 (g/l), $FeSO_4.7H_2O$ 0.5 (g/l), Fe 0.01 (g/l) and Agar 20 (g/l)}.

2.3. Small-scale fermentation and extraction of the crude secondary metabolite from actinomycetes

Small-scale fermentation was carried out for all isolated *Streptomyces* isolates by cultivating them on rice media for 15 days and extracting the crude extract using ethyl acetate. The obtained extract solutions were concentrated under a rotating vacuum to obtain the *Streptomyces* crude extracts.

2.4. Isolation of group of some pathogenic bacteria from middle ear.

Twenty-six bacterial isolates were obtained from Kafr El-Sheikh General Hospital (KFS) (13 isolates), Benha University Hospital (BU) (7 isolates), and Mabaret El-Asafra Hospital (MA) (6 isolates). The samples are taken from ears that have been discharged due to the possibility of infection. The bacteria are then cultured on blood agar and MacConkey and left for 24 hours.

January through April of 2022 was covered by this investigation. Age-based classification was used for the patients, who ranged in age from 10 to 50. Using a sterile cotton swab, a sample was taken from a region that was inflamed. Patients

who had not taken antibiotics for at least a week before the swab collection process had their samples taken.

2.5. Gathering and Cultivating Ear Discharge

First, normal saline was used to clean the outer ear. After that, a discharge sample was gathered. Following inoculation, swabs were placed on blood agar and MacConkey plates, which were then incubated aerobically for 24 to 48 hours at 37°C.

2.6. Determination of antimicrobial activity

The extract obtained was diluted to a concentration of 1 mg/ml in CH_2Cl_2: MeOH (9: 1), and 50 µL aliquots were soaked on 5 mm Whattman No. 1 filter paper discs. The discs were then dried at room temperature under sterile conditions [21]. On agar plates seeded with test microorganisms, the paper discs were incubated for 24 hours at the appropriate temperature for each test organism. Microorganisms, both yeast and bacterial, were grown on nutritional agar.

Results

2.7. Isolation of actinomycetes from different marine sample

44 isolates of actinomycetes were obtained from various maritime environments, such as the Hurgada marine sea, the Ras Sedr sediment, and the Ain Sokhna sediment. The morphological traits of the colonies which are typically spherical, convex, shaped colonies are used to isolate Streptomyces. In contrast, 26 bacterial isolates were obtained from Mabaret El-Asafra Hospital (MA) (6 isolates), Benha University Hospital (BU) (7 isolates), and Kafr El-Sheikh General Hospital (KFS) (13 isolates).

Table (3.1). Different sample collected isolated from different marine and terrestrial localities

Code	Location
HG	Sea water Hurgada
RS	Ras Sedr sediments
AS	Ain Sokhna sediment

Table (3.2). Distribution and percent of *Streptomyces* spp. isolated from different marine localities

No. of sample	Location	Isolates account	Percentage Incidence (%)
1	Sea water Hurgada	13	29.5
2	Ras Sedr sediments	17	38.6
3	Ain Sokhna sediment	14	31.8
Total isolate		**44**	**100**

2.8. Fermentation and extraction

To extract the bioactive components, the isolated *Streptomycetes* isolates were grown on rice medium and subjected to small-scale fermentation. After inoculating 250 ml Erlenmeyer flasks with 25 g of solid rice media with a Streptomyces spore suspension, the flasks were incubated for 15 days. Ethyl acetate was used to remove the cultures (Table 4.3: 4.7). For use in additional research, the ethyl acetate phase was evaporated until it was completely dry.

Table (3.3). Crude secondary metabolite extraction from actinomycetes in the sea water of Hurghada

Serial No.	Isolate code	Weight of extract(mg)
1	HG1	1.6
2	HG2	2.5
3	HG3	3.4
4	HG4	3.8
5	HG5	4.7
6	HG6	4.1
7	HG7	3.7
8	HG8	3.5
9	HG9	4.0
10	HG10	2.5
11	HG11	3.1
12	HG12	4.3
13	HG13	2.9

Table (3.4). Crude secondary metabolite extraction from actinomycetes in the from Ras Sedr sediment

Serial No.	Isolate code	Weight of extract(mg)
14	RS1	2.8
15	RS2	3.5
16	RS3	4.2
17	RS4	3.6
18	RS5	5.1
19	RS6	4.8
20	RS7	3.9
21	RS8	0.8
22	RS9	3.2
23	RS10	3.1
24	RS11	2.4
25	RS12	3.5
26	RS13	4.4
27	RS14	3.6
28	RS15	4.2
29	RS16	2.6
30	RS17	4.1

Table (3.5). Crude secondary metabolite extraction from actinomycetes in the Ain Sokhna sediment

Serial No.	Isolate code	Weight of extract(mg)
31	AS1	0.5
32	AS2	4.3
33	AS3	2.6
34	AS4	3.0
35	AS5	3.2
36	AS6	2.1
37	AS7	2.7
38	AS8	3.5
39	AS9	2.3
40	AS10	4.8
41	AS11	5.1
42	AS12	3.6
43	AS13	2.9
44	AS14	3.3

2.9. Biological screening

2.9.1. Antimicrobial screening activity

The antimicrobial activity of ethyl acetate extracts for isolated *Streptomyces* spp. were tested using the agar disc diffusion method. 50 µl of each extract culture were soaked on filter paper discs and placed on neutral agar media seeded with isolated bacteria. The plates were incubated at 28^{o}C and observed for a clear zone activity after 2-3 days **(Table 3.6- 3.14).** Ciprofloxacin was used as a control.

Table (3.6). *Streptomyces* extracts obtained from Hurgada seawater exhibit antimicrobial action against KFS bacteria

	(Antimicrobial activity (mm												
.Extracta no	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13
HG1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG2	10.0	8.0	0.0	12.0	0.0	10.0	12.0	10.0	0.0	0.0	8.0	8.0	10.0
HG3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG4	12.0	13.0	0.0	0.0	0.0	12.0	8.0	10.0	14.0	16.0	10.0	0.0	14.0
HG5	12.0	14.0	14.0	16.0	12.0	14.0	12.0	16.0	12.0	13.0	18.0	18.0	20.0
HG6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG9	10.0	14.0	13.0	12.0	10.0	8.0	0.0	0.0	14.0	10.0	8.0	10.0	0.0
HG10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG12	0.0	12.0	10.0	14.0	12.0	10.0	8.0	0.0	10.0	0.0	0.0	12.0	0.0

The table (3.6) show the antimicrobial activity for *Streptomyces* extracts isolated from sea water Hurgada and show that HG2, HG4, HG5, HG9 and HG12 have an effect on bacteria but HG5 the most influential on all bacteria collected from KFS (K1: K13)

Table (3.7). *Streptomyces* extracts obtained from Hurgada sea water exhibit antimicrobial action against BU bacteria

	(Antimicrobial activity (mm						
Extract .no	B1	B2	B3	B4	B5	B6	B7
HG1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG2	12.0	16.0	0.0	12.0	10.0	8.0	10.0
HG3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG4	0.0	12.0	10.0	12.0	14.0	0.0	0.0
HG5	14.0	16.0	14.0	18.0	20.0	14.0	16.0
HG6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG9	10.0	0.0	8.0	12.0	10.0	0.0	12.0
HG10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HG12	14.0	10.0	12.0	0.0	12.0	0.0	10.0
HG13	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The table (3.7): Show the Antimicrobial activity for *Streptomyces* extracts isolated from sea water Hurgada and show that HG2, HG4, HG5, HG9 and HG12 have an effect on bacteria but HG5 the most influential on all bacteria collected from BU (B1: B7)

Table (3.8). *Streptomyces* extracts obtained from Hurgada sea water exhibit antimicrobial action against MA bacteria

	(Antimicrobial activity (mm					
.Extract no	MA 1	MA 2	MA 3	MA 4	MA 5	MA 6
HG1	0.0	0.0	0.0	0.0	0.0	0.0
HG2	12.0	10.0	8.0	12.0	0.0	12.0
HG3	0.0	0.0	0.0	0.0	0.0	0.0
HG4	0.0	12.0	10.0	8.0	10.0	12.0
HG5	16.0	18.0	22.0	18.0	16.0	14.0
HG6	0.0	0.0	0.0	0.0	0.0	0.0
HG7	0.0	0.0	0.0	0.0	0.0	0.0
HG8	0.0	0.0	0.0	0.0	0.0	0.0
HG9	0.0	12.0	14.0	8.0	12.0	10.0
HG10	0.0	0.0	0.0	0.0	0.0	0.0
HG11	0.0	0.0	0.0	0.0	0.0	0.0
HG12	12.0	10.0	14.0	0.0	12.0	10.0
HG13	0.0	0.0	0.0	0.0	0.0	0.0

The table (3.8): Show the Antimicrobial activity for Streptomyces extracts isolated from sea water Hurgada and show that HG2, HG4, HG5, HG9 and HG12 have an effect on bacteria but HG5 the most influential on all bacteria collected from MA (MA 1: MA 6)

Table (3.9). *Streptomyces* extracts obtained from Ras Sedr sea water exhibit antimicrobial action against KFS bacteria

	(Antimicrobial activity (mm												
.Extract no	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13
RS1	10.0	8.0	0.0	12.0	10.0	10.0	11.0	9.0	0.0	0.0	0.0	0.0	10.0
RS2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS7	10.0	8.0	12.0	0.0	12.0	8.0	10.0	12.0	0.0	10.0	12.0	0.0	0.0
RS8	12.0	12.0	8.0	0.0	10.0	12.0	0.0	0.0	10.0	10.0	12.0	8.0	0.0
RS9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS12	0.0	10.0	8.0	12.0	14.0	8.0	12.0	10.0	14.0	0.0	8.0	0.0	8.0
RS13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS14	0.0	8.0	8.0	12.0	8.0	12.0	10.0	10.0	12.0	0.0	12.0	8.0	8.0
RS15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The table (3.9) show the antimicrobial activity for *Streptomyces* extracts isolated from sea water Ras Sedr and show that RS1, RS7, RS8, RS12and RS14 have an effect on bacteria collected from KFS

Table (3.10). *Streptomyces* extracts obtained from Ras Sedr Sea water exhibit antimicrobial action against BU bacteria

	(Antimicrobial activity (mm						
.Extract no	B1	B2	B3	B4	B5	B6	B7
RS1	12.0	12.0	10.0	14.0	0.0	14.0	12.0
RS2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS3	8.0	9.0	14.0	12.0	10.0	0.0	0.0
RS4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS7	8.0	12.0	10.0	8.0	12.0	14.0	0.0
RS8	12.0	14.0	10.0	12.0	10.0	8.0	0.0
RS9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS12	16.0	14.0	14.0	18.0	14.0	12.0	10.0
RS13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS14	10.0	8.0	14.0	10.0	8.0	14.0	0.0
RS15	10.0	12.0	8.0	14.0	12.0	10.0	0.0
RS16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RS17	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The table (3.10) show the antimicrobial activity for *Streptomyces* extracts isolated from sea water Ras Sedr and show that RS1, RS3, RS7, RS8, RS12, RS14 and RS15 have an effect on bacteria collected from BU

Table (3.11). *Streptomyces* extracts obtained from Ras Sedr Sea water exhibit antimicrobial action against MA bacteria

	(Antimicrobial activity (mm					
.Extract no	MA 1	MA 2	MA 3	MA 4	MA 5	MA 6
RS1	12.0	12.0	14.0	10.0	14.0	13.0
RS2	0.0	0.0	0.0	0.0	0.0	0.0
RS3	0.0	0.0	0.0	0.0	0.0	0.0
RS4	0.0	0.0	0.0	0.0	0.0	0.0
RS5	0.0	0.0	0.0	0.0	0.0	0.0
RS6	0.0	0.0	0.0	0.0	0.0	0.0
RS7	8.0	0.0	10.0	12.0	12.0	0.0
RS8	12.0	14.0	12.0	16.0	8.0	10.0
RS9	0.0	0.0	0.0	0.0	0.0	0.0
RS10	0.0	0.0	0.0	0.0	0.0	0.0
RS11	0.0	10.0	8.0	0.0	10.0	12.0
RS12	14.0	12.0	0.0	12.0	10.0	0.0
RS13	0.0	0.0	0.0	0.0	0.0	0.0
RS14	10.0	12.0	8.0	12.0	14.0	8.0
RS15	0.0	12.0	14.0	10.0	0.0	10.0
RS16	0.0	10.0	12.0	14.0	10.0	8.0
RS17	0.0	0.0	0.0	0.0	0.0	0.0

The table (3.11) show the antimicrobial activity for *Streptomyces* extracts isolated from sea water Ras Sedr and show that RS1, RS3, RS7, RS8, RS12, RS14 and RS16 have an effect on bacteria collected from MA

Table (3.12). *Streptomyces* extracts obtained from Ain Sokhna Sea water exhibit antimicrobial action against KFS bacteria

	(Antimicrobial activity (mm												
Extract .no	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13
AS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS3	10.0	12.0	10.0	8.0	12.0	10.0	0.0	10.0	14.0	12.0	14.0	8.0	8.0
AS4	0.0	12.0	10.0	12.0	12.0	8.0	10.0	0.0	12.0	10.0	0.0	8.0	12.0
AS5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS7	0.0	12.0	10.0	12.0	8.0	12.0	14.0	12.0	10.0	0.0	0.0	8.0	0.0
AS8	0.0	10.0	12.0	8.0	12.0	12.0	0.0	0.0	12.0	8.0	10.0	8.0	12.0
AS9	10.0	10.0	14.0	8.0	12.0	14.0	14.0	12.0	10.0	14.0	0.0	12.0	8.0
AS10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS13	12.0	14.0	12.0	12.0	10.0	8.0	14.0	12.0	14.0	12.0	0.0	12.0	12.0
AS14	12.0	8.0	0.0	8.0	10.0	12.0	14.0	0.0	12.0	10.0	10.0	12.0	8.0

The table (3.12) show the antimicrobial activity for *Streptomyces* extracts isolated from Ain Sokhna and show that AS3, AS4, AS7, AS8, AS9, AS13 and AS14 have an effect on bacteria collected from KFS

Table (3.13). *Streptomyces* extracts obtained from Ain Sokhna Sea water exhibit antimicrobial action against BU bacteria

	(Antimicrobial activity (mm						
Extract .no	B1	B2	B3	B4	B5	B6	B7
AS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS3	10.0	12.0	12.0	10.0	14.0	12.0	10.0
AS4	0.0	8.0	12.0	10.0	12.0	14.0	12.0
AS5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS8	8.0	12.0	12.0	14.0	12.0	8.0	10.0
AS9	12.0	14.0	10.0	18.0	16.0	12.0	12.0
AS10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AS13	10.0	12.0	14.0	12.0	12.0	10.0	12.0
AS14	8.0	14.0	12.0	10.0	8.0	10.0	12.0

The table (3.13) show the antimicrobial activity for *Streptomyces* extracts isolated from Ain Sokhna and show that AS3, AS4, AS7, AS8, AS9, AS13 and AS14 have an effect on bacteria collected from BU.

Table (3.14). *Streptomyces* extracts obtained from Ain Sokhna Sea water exhibit antimicrobial action against MA bacteria

	(Antimicrobial activity (mm					
.Extract no	MA 1	MA 2	MA 3	MA 4	MA 5	MA 6
AS1	0.0	0.0	0.0	0.0	0.0	0.0
AS2	0.0	0.0	0.0	0.0	0.0	0.0
AS3	14.0	12.0	18.0	16.0	12.0	10.0
AS4	0.0	8.0	12.0	10.0	12.0	10.0
AS5	0.0	0.0	0.0	0.0	0.0	0.0
AS6	0.0	0.0	0.0	0.0	0.0	0.0
AS7	10.0	12.0	10.0	12.0	12.0	14.0
AS8	8.0	12.0	12.0	10.0	14.0	10.0
AS9	14.0	14.0	12.0	12.0	14.0	10.0
AS10	0.0	0.0	0.0	0.0	0.0	0.0
AS11	0.0	0.0	0.0	0.0	0.0	0.0
AS12	0.0	0.0	0.0	0.0	0.0	0.0
AS13	0.0	8.0	12.0	8.0	12.0	10.0
AS14	0.0	12.0	10.0	10.0	14.0	14.0

The table (3.14) show the antimicrobial activity for *Streptomyces* extracts isolated from Ain Sokhna and show that AS3, AS4, AS7, AS8, AS9, AS13 and AS14 have an effect on bacteria collected from MA

3. Discussion

Lastly, according to **Chater (2013)** [16], *Streptomyces* can develop the manufacture of antibiotics and antimicrobial activity in addition to producing antimicrobial chemicals. When it comes to treating antibiotic resistance and combating bacterial infections, their secondary metabolites are essential [22-26].

According to the data, bacteria collected from KFS (K1: K13), BU (B1: B7), and MA (MA 1: MA 6) are inhibited by the antimicrobial activity of streptomyces extracts isolated from sea water Hurghada (HG2, HG4, HG5, HG9, and HG12), Ras Sedr (RS1, RS7, RS8, RS12, and RS14), and Ain Sokhna (AS3, AS4, AS7, AS8, AS9, AS13, and AS14). The findings pave the way for novel applications of antibacterial action against microorganisms. Moreover, show a variety of inhibitory effects. Clearly found that HG5 had the greatest influence on all of the bacteria that were gathered from KFS, BU, and MA. It also shown a notable level of inhibition, indicating that HG5 has the potential to be a highly effective bacterial inhibitor.

These findings suggest a novel approach to the development of antimicrobial drugs or treatments in a variety of domains, particularly medicine and water treatment. This leads us to conduct additional research to determine the substances or circumstances that allow for the wider application of these effects.

4. References:

1. **Brown, C. S.; Emmett, S. D.; Robler, S. K. and Tucci, D. L. Global (2018):** Hearing loss prevention. Otolaryngol Clin North Am. 2018;51(3):575–592. doi: 10.1016/j.otc.2018.01.006 [PubMed] [CrossRef] [Google Scholar]
2. **Graydon, K.; Waterworth, C.; Miller, H. and Gunasekera, H. (2019):** Global burden of hearing impairment and ear disease. J Laryngol Otol. 2019;133(1):18–25. doi: 10.1017/S0022215118001275 [PubMed] [CrossRef] [Google Scholar]
3. **World Health Organization (2016):** Childhood Hearing Loss: Strategies for Prevention and Care. World Health Organization; 2016. Available from: https://apps.who.int/iris/handle/10665/204632. Accessed October 12, 2021. [Google Scholar]
4. **Aarhus, L.; Tambs, K.; Kvestad, E. and Engdahl, B. (2015):** Childhood Otitis media: a cohort study with 30-year follow-up of hearing (The HUNT study). Ear Hear. 2015;36(3):302. [PMC free article] [PubMed] [Google Scholar]
5. **Maharjan, M.; Phuyal, S.; Shrestha, M. and Bajracharya, R. (2020):** Chronic otitis media and subsequent hearing loss in children from the Himalayan region residing in Buddhist Monastic schools of Nepal. J Otol. 2020;15(4):144–148. [PMC free article] [PubMed] [Google Scholar]
6. **Jensen, R, G.; Koch, A. and Homøe, P. (2013):** The risk of hearing loss in a population with a high prevalence of chronic suppurative otitis media. Int J Pediatr Otorhinolaryngol. 2013; 77(9):1530–1535. doi: 10.1016/j.ijporl.2013.06.025 [PubMed] [CrossRef] [Google Scholar]
7. **CDC. Ear Infection** [Internet]; 2021. [cited 2021 Jun 19]. Available from: https://www.cdc.gov/antibiotic-use/ear-infection.html. Accessed October 12, 2021.
8. **Szmuilowicz, J. and Young, R. (2019):** Infections of the Ear. Emerg Med Clin North Am. 2019;37(1):1–9. doi: 10.1016/j.emc.2018.09.001 [PubMed] [CrossRef] [Google Scholar]

9. **Anthony, S. F.; Dennis, L. K.; Stephen, L. H.; Dan, L. L.; Larry, J. and Joseph, J. L. (2017):** McGraw-Hill. Harrison's Manual of Medicine. 19th ed, editors. In: Harrison's Manual of Medicine. 19th ed. McGraw Hill Inc; 2017. [Google Scholar]
10. **World Health Organization (2021)**: World Report on Hearing. World Health Organization; 2021. License: CC BY-NC-SA3.0IGO. Available from: https://apps.who.int/iris/handle/10665/339913. Accessed October 12, 2021. [Google Scholar]
11. **Danisyar, A. and Ashurst, J. V. (2021):** Acute Otitis Media - StatPearls - NCBI Bookshelf. Treasure Island (FL): StatPearls Publishing; 2021. [Google Scholar]
12. **Schilder, A. G. M.; Chonmaitree, T. and Cripps, A. W. (2016):** Otitis media. Nat Rev Dis Prim. 2016;2(1):1–8. [PMC free article] [PubMed] [Google Scholar]
13. **Lieberthal, A. S. (2013)**: The diagnosis and management of acute otitis media. *Pediatrics.* 2013;131: e964–e999. doi: 10.1542/peds.2012-3488. [PubMed] [CrossRef] [Google Scholar] [Ref list]
14. **Vergison, A. (2008):** Microbiology of otitis media: a moving target. Vaccine. 2008;26: G5–G10. doi: 10.1016/j.vaccine.2008.11.006 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
15. **Tesfa, T.; Mitiku, H.; Sisay, M. (2020):** Bacterial otitis media in sub-Saharan Africa: a systematic review and meta-analysis. BMC Infect Dis. 2020;20(1). doi: 10.1186/s12879-020-4950-y. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
16. **Chater, K. F. (2013):** *Streptomyces* Brenner's Encyclopedia of Genetics, 2013, Pages 565-567
17. **Richa, S. and Vivek, S. (2020):** Bioactive compounds of *Streptomyces*: Biosynthesis to applications Studies in Natural Products Chemistry Volume 64, 2020, Pages 467-491
18. **Hayakawa, M. and Nonomura, H. (1987)**. Humic acid vitamin agar, a new medium for the selective isolation of soil actinomycetes. Journal of Fermentation and Bioengineering. 65: 501-509.
19. **Shearer, M. C. (1987)**. Methods for the isolation of non- *Streptomycetes* actinomycetes. Journal of Industrial Microbiology. 2: 91– 97.

20. **Waksman, S. A. (1961)**. The actinomycetes. Classification, identification and descriptions of genera and species. The Williams and Wilkins Co., Baltimore, 1-363.
21. **Bauer, A.W.; Kirby, W. M.; Sherris, J. C. and Turck, M. (1966).** Antibiotic susceptibility testing by a standardized single disk method. American Journal of Clinical Pathology. 45(4): 493–496
22. **Sivaranjani, M.; Srinivasan, R.; Aravindraja, C.; Karutha Pandian, S. and Veera Ravi, A. (2018):** Inhibitory effect of α-mangostin on *Acinetobacter baumannii* biofilms—An in vitro study. Biofouling 2018, 34, 579–593. [Google Scholar] [CrossRef] [PubMed]
23. **Ramanathan, S.; Arunachalam, K.; Chandran, S.; Selvaraj, R.; Shunmugiah, K. and Arumugam, V. (2018):** Biofilm inhibitory efficiency of phytol in combination with cefotaxime against nosocomial pathogen *Acinetobacter baumannii*. J. Appl. Microbiol. 2018, 125, 56–71. [Google Scholar] [CrossRef].
24. **24.Srinivasan, R.; Mohankumar, R.; Kannappan, A.; Karthick Raja,V.; Archunan, G.; Karutha Pandian, S.; Ruckmani, K. and Veera Ravi, A. (2017):**Exploring the anti-quorum sensing and antibiofilm efficacy of phytol against Serratia marcescens associated acute pyelonephritis infection in Wistar rats. Front. Cell. Infect. Microbiol. 2017, 7, 498. [Google Scholar] [CrossRef][Green Version]
25. **Srinivasan, R.; Devi, K. R.; Santhakumari, S.; Kannappan, A.; Chen, X.; Ravi, A. V. and Lin, X. (2020):** Anti-quorum sensing and protective efficacies of naringin against *Aeromonas hydrophila* infection in Danio rerio. Front. Microbiol. 2020, 11, 3087. [Google Scholar] [CrossRef]
26. **Kannappan, A.; Balasubramaniam, B.; Ranjitha, R.; Srinivasan, R.; Packiavathy, I. A. S. V.; Balamurugan, K.; Pandian, S. K. and Ravi, A.V. (2019):** In vitro and in vivo biofilm inhibitory efficacy of geraniol-cefotaxime combination against *Staphylococcus* spp. Food Chem. Toxicol. 2019, 125, 322–332. [Google Scholar] [CrossRef] [PubMed].