

Screening for Antimicrobial Activities and Enzymatic Activities Production of Some Actinomycetes spp. Isolated from Different Soil Samples from Hilla Province

 Yazi Abdullah Jassim* & Eman Mohamed Jarallah

Department of Biology, College of Science, University of Babylon, Hilla, Iraq

*Corresponding author: Yazi Abdullah Jassim | e-mail: yaziabdalla2014@gmail.com

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ABSTRACT

One hundred and fifty soil samples were collected from different cities in Babylon, Iraq. Thirty-three Actinomycetes isolates were obtained, purified and identified according to morphological properties and biochemical tests. All isolates were tested for their antimicrobial activities and screened for production of some important enzymes such as amylase, catalase, protease, cellulase and lipase. The results obtained that 13 isolates have such potential, and all 13 isolates have amylase activity. The most active isolates in the production of study enzymes were KO-AG18, HI-SA24 and KO-RS27. Most 13 Actinomycetes isolates showed antimicrobial activity against some Gram-positive bacteria (*Staphylococcus albus*, *Staphylococcus aureus* and *Streptococcus pyogenes*) and Gram-negative (*Klebsella pneumoniae*, *Escherichia coli*, *Serratia marcescens*, *Pseudomonas aeruginosa* and *Aeromonas hydrophila* due to inhibition zone diameter (mm) ranging from 4-37 against Gram-negative and from 6- 37 against Gram-positive bacteria.

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INTRODUCTION

Actinomycetes are gram -positive bacteria, and it is a diverse group of heterotrophic prokaryotes forming hyphae at some stage of their growth and widely founds in both terrestrial and aquatic environments. Actinomycetes are the major type of soil bacteria that produce huge natural metabolites. The antibiotics and enzymes are the most and important metabolites (Chiani et al., 2010). They produce some enzymes which Crashing of complex organic materials in sediments or soil as cellulases, protease, gelatinase, ureases, lectinases and amylase (Gulve & Deshmukh, 2012). Amylase is the most used enzyme in the starch in- dusty. It has huge Applications in industry such as in the syrup production which made from oligo-saccharide and monosaccharide. Also, in industries of textile, amylase is used for resizing of clothing materials

(Tonkova, 2006). Actinomycetes are good decomposers of organism materials and production amylases was cleared by several strains of Actinomycetes (Kar & Ray, 2008).

Cellulases produced by Actinomycete are degrade extracellular enzymes and inducible (Ibrahim & El-diwany, 2007). Actinomycete can produce cellulase through their growth on Actinomycete materials of cellulose. Thus, introduction of cellulolytic enzymes by microbiology is degraded as beneficial- microbiological tool for recovery of bioenergy from degraded cellulose and have gained significant attention due to their wide applicability in various industrial processes including pulp and paper, textile, laundry, biofuel production, food and feed industry, brewing and agriculture (Balamurugan et al., 2011; Kuhad et al., 2011). Cellulase is involved in hydrolysis of cellulose,

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one of abundant organic compound which can be easily converted to new products that have significant commercial- interest. Bioconversion of cellulose to mono- sugars has been studied as re-searchers seek to produce bioethanol and bio-based products, food and animal feeds, and many valuable chemicals (Barros et al., 2010).

One of the most important groups of enzymes that produced commercially and for industrial purposes are Proteases (Deng et al., 2010). They have important applications in a many of industrial applications and some processes such as food, detergents, leather and pharmaceuticals (Ribitsch et al., 2010). Despite considering Actinomycetes to be among the important- producers of enzymes and antibiotics (Rai et al., 2018). However, the present studies concerning that proteases produced by actinomycetes to be most important of secondary products or metabolites that are exploited (Simkhada et al., 2010). This study aimed to isolate various Actinomycetes species from different soils in Hillah city and screening it for their potential to produce some hydro- lytic enzymes (cellulase, amylase, Catalase, protease and Lipase).

MATERIALS & METHODS

Collection of Samples

The different soils were collected randomly from different city in Babylon /Iraq. These samples were kept in sterile and dried polyethylene sac and kept until used at room temperature.

Isolation of Actinomycetes

Soil samples were treated with calcium carbonate for 24h, then subjected to serial dilution till 10⁻⁶. One milliliter of each dilution cultured on ISP2 media by pour plate method. The plates of bacteria were put in incubator for seven days at 28°C. The colonies were sub cultured several times on the same media to get pure isolated colonies.

ISP-2 (International Streptomyces Project-2 agar medium) (Malt Extract -Yeast Extract Agar)

This media was used for growing Actinomycetes isolates. It prepared from the following chemicals; Bacto-Yeast Extract 4.0g, Bac- to-Malt Extract 10.0 g, Bacto-Dextrose 4.0 g, Distilled water 1.0 Liter, then add agar- agar 20.0 g. Adjust pH to 7.3. Liquefy agar by steaming at 100°C for 15-20 minutes. Then sterilize by autoclaving at 121°C, for 15 minutes (Pridham, 1974).

Screening of the Antimicrobial Agent

Each of the Actinomycetes spp isolates were inoculated in a 500 ml flask containing 250 ml of ISP-2 broth of pH 7.2 and incubated at 28°C for 10 days. After incubation period, the fermented broth is filtered through a What man No.1 filter to separate the cellular components from the culture filtrate, then the broths were centrifuged at 6000 rpm for 15 minutes and the cell free supernatant was taken. Culture supernatants were extracted with an equal volume (1:1 v/v) of appropriate of ethyl acetate before shaking vigorously for one dryness and the residue obtained was weighted (Ahmed, 2007). The residue that obtained from evaporated flask in water bath is weighed and used for antibacterial analyses as secondary screening test. This performed by the agar well diffusion method against standard pathogenic organisms' organic layer added to the above organic layer (Atta, 2010). Hour to complete the extraction and formation of two layers (organic layer and aqueous layer). The ethyl acetate phase that contains the antibiotics was separated from the aqueous layer phase, then the ethyl acetate was evaporated in water bath at 80 °C to 90 °C.

Enzyme Screening

Production of Amylase: Actinomycetes isolates were screened for amylolytic properties by starch hydrolysis test on starch agar plate. The streaked Actinomycetes isolates were incubated at 28±2°C for 7 days. After the incubation 1% iodine solution (freshly prepared) was flooded on the starch agar plates and a clear zone of hydrolysis were considered as amylase producers.

Cellulase Activity

By using CMC agar medium. The bacterial isolates from soils were cultured on CMC agar plates. The plates were incubated at 28±2°C for 7 days. After the incubation apply a clear decomposition zone on the CMC medium after immersing the dish with 1% Congo Red dye were indication for producing cellulase enzymes (Immanuel et al., 2006).

Catalase Activity

Place a small amount of the colony on the surface of a clean glass slide and add 3 drops of 3% hydrogen peroxide H₂O₂ and mix well. The positive result is the speed of oxygen evolution and bubbles on the slide (within 5-10 sec.) The negative result is that no bubbles or bubbles are small or unclear.

Activity of Lipase

Peptone tween agar plates (PTA) were prepared according to isolates of Actinomycetes were streaked

in Pep- tone-tween agar and plates were cultured for seven days at 28±2°C. appearance of Opalescent structures around the colonies is evidence of the lipase activity (Gopinath et al., 2005).

Activity of Protease

Isolates of Actinomycetes were cultured on Skim-milk agar (SMA) and they were incubated for 7 days at 28±2°C. Appearance of a clear zone on plates of SMA is evidence of the of protease activity (Berdy, 2005).

RESULTS & DISCUSSION

Actinomycetes a diverse group of heterotrophic procaryotes forming hyphae at some stage of their growth and producing different types of antibiotics of medical and agriculture applications. Actinomycetes spp. responsible of 80%of total common antibiotics

(Pandey et al., 2004). At the present study all 13 isolates were identified according to their morpho- logical features and biochemical tests. The results showed that all these isolates return to Streptomyces species, they were giving the characteristic symbols as showed in Figure 1 and table 1, the antimicrobial activity of differ- ent Actinomycetes isolates were tested. The 13 Actinomy- cetes isolates were showed antimicrobial ability against some bacteria Gram- positive bacteria (Streptococcus pyo- genes, Staphylococcus albus, and Staphylococcus aureus) and some Gram- negative (Klebsella pneumoniae, Esche- richia coli, Serratia marcescens, Pseudomonas aeruginosa and Aeromonas hydrophila (Remya & Vijayakumar, 2008) as showed in table 2 and figure 2. Study at the same field, isolated tow antibacteri- al active Actinomycetes from different soil samples of Hillah.

Table 1
Sampling sites

Site	Sample no.	Abbreviated
Al-Mahaweel	16	MA-AG16
Al-Kothar	18	KO-AG18
Al-Hilla	24	HI-SA24
Al-Kothar	27	KO-RS27
Al-Amam	34	AM-AG34
Al-Hamza	28	HA-RS28
Al-Hamza	37	HA-CL37
Al-Kasim	41	KA-SA41
Al-Mashrwia	42	MA-CL42
Al-Mashrwia	43	MA-CL43
Al-Mussiab	46	MU-AG46
Al-Amam	52	AM-AG52
Al-Hamza	55	HA-RA55

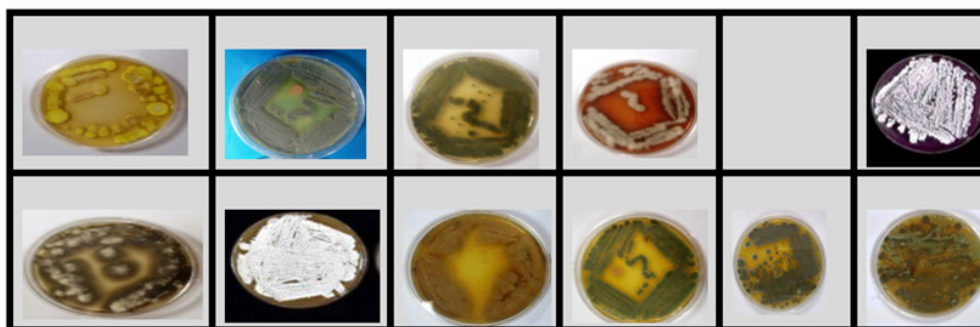


Fig. 1. Morphological and cultural characteristics of locally isolated Actinomycetes, growing on ISP2, after 7-14 days at 28±1°C

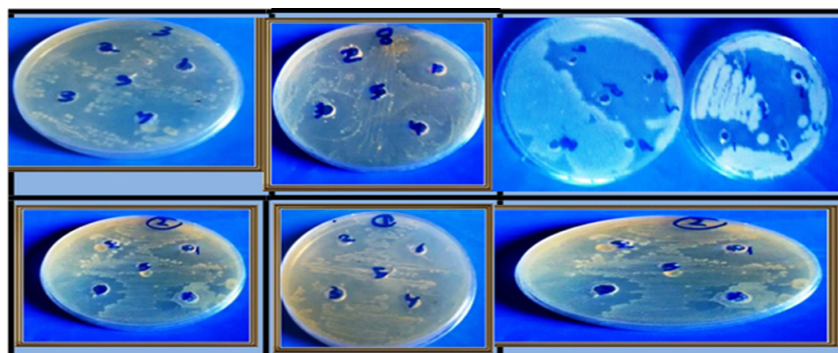


Fig. 2. Inhibition zone diameter (mm) of culture filtrate extract of the active isolates against tested organisms on Mueller Hinton agar medium

Table 2

Inhibition zone diameter (mm) of culture filtrate extract of the active isolates against tested organisms on Mueller Hinton agar medium

Actino. spp Symbol	Diameters (mm)							
	Pathogenic gram positive and negative bacteria							
	E. coli	K. pne-um.	P. aerug.	S. typhia .	A. hy-dro	S. au-reu.	S. pyog	S. al-bus
MA-Ag16	15	16.8	30.2	19.7	0	28.2	35	17.2
KO-AG18	37	32	18.5	33	33	25	37	32
HI-SA24	33	33	36	0	23	31	24.5	0
KO-RS27	8	15.3	33	12.4	19	28	8	23
HA-RS28	9	6	7	13	32	0	19	9
AM-AG34	20	0	15	33	8	12.4	28	24
HA-CL37	8	9	8	6	33	35		15.3
KA-SA41	15.3	0	8	12.4	0	9	7	23
MA-CL42	9	20	0	19	8	6	13	19
MA-CL43	0	13	7	20	28	24	33	6
MU-AG46	19	4	8	33	8	12.4	0	13
AM-AG52	7	36.3	9	19	8	13	0	0
HA-RA55	8	6	0	23	15.3	8	33	20

Actinomycetes are important group of soil bacteria that have a main role in some applications such as recycling of most organic matters by their ability to produce of some hydrolytic enzymes (Al-Saadi et al., 2013). In our study Actinomycetes were tested to produce five hydrolyzing enzymes (catalase am-ylase, cellulose, protease and lipase), in addition to their antimicrobial activity. All isolates of Actinomycetes were cultured on starch media to test their ability to analyze the starch by immersing the dish with iodine solution (1%). The appearance of clear zone around the colonies surrounded by purple color background refer to positive result. 13 isolates were positive (Figure 3 & Table 3). There are five isolates of Actinomycetes were positive for protease production which were KO-AG18, HI-SA24, KO-RS27, HA-CL37 and MA-Ag16 that grown on skim milk, while the rest isolates were negative as showed in table 3.

To test the susceptibility of bacteria to the production

Table 3

Enzyme activity of Actinomycetes Isolates

Actinomy -cetes isolates	Enzymes activity				
	Amylase	Protease	Lipase	Cellulose	Catalase
MA-Ag16	+	+	-	+	+
KO-AG18	+	+	+	+	+
HI-SA24	+	+	+	+	+
KO-RS27	+	+	+	+	+
HA-RS28	+	-	+	-	+
AM-AG34	+	-	-	-	-
HA-CL37	+	+	-	-	-
KA-SA41	+	-	-	+	-
MA-CL42	+	-	+	+	+
MA-CL43	+	-	+	+	-
MU-AG46	+	-	-	+	+
AM-AG52	+	-	-	-	-
HA-RA55	+	-	-	-	-

of cellulose enzyme was developed on the center of CMC for 5 days and then colonies were flooded with the dye of Congo red means positive result ; the 8 isolates KO-AG18, HI-SA24, KO-RS27, KA-SA41, MA-CL42, MU-AG46, MA-Ag16 and MA-CL43 (Prasad et al., 2013) while the rest isolates were negative as showed in table 3 and figure 4. Vinogradova et al., (2003) cleared that the Actinomycetes degraded as one of the major bacteria communities that have ability to hydrolysis cellulose the plant cell walls. Actinomycete cellulases degraded as inducible enzymes which produce as extracellular enzyme (Ibrahim & El-diwany, 2007). The 6 positive lipase strain were confirmed by the production of clear zones (opalescent) around the Actinomycetes (Suji & Sivaraj, 2014), as results showed in table 3, some of Actinomycetes isolates have ability to produce catalase as show in figure 5 and table 3. The environmental conditions affecting the on enzyme activities such as (pH, salinity and temperature) are major factors that effect on enzymes production.

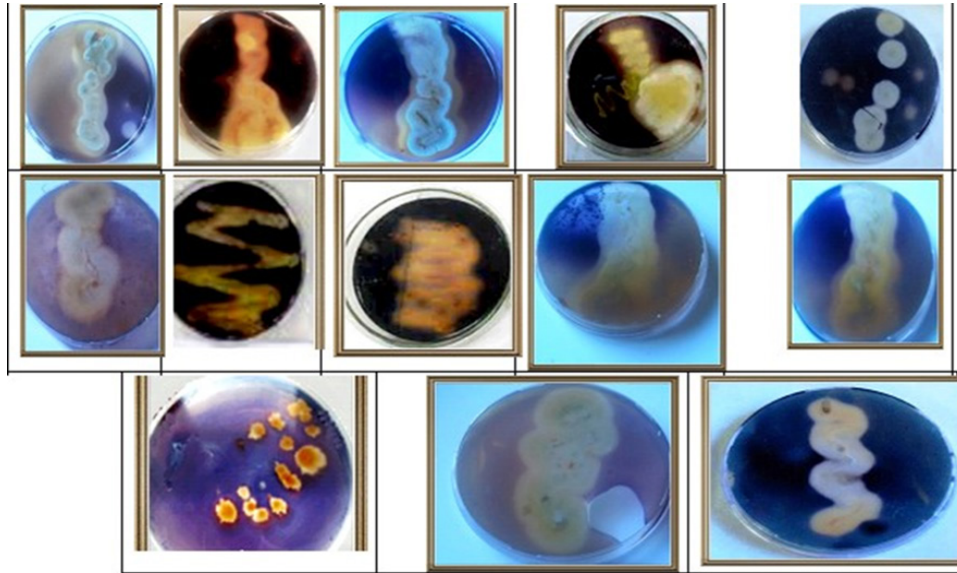


Fig. 3. positive amylase isolates

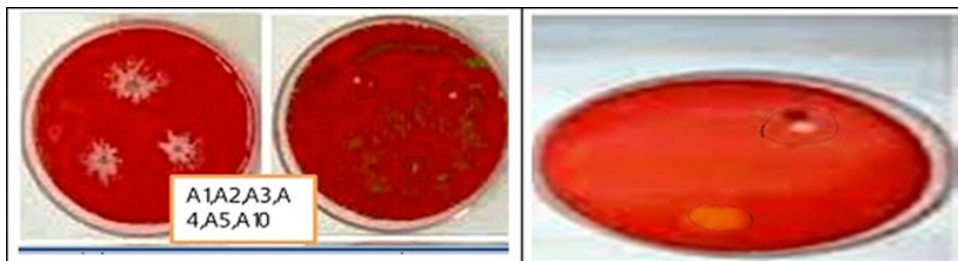


Fig. 4. positive cellulase isolates

CONCLUSION

Actinomycetes are important group of soil bacteria that have a main role in some applications such as recycling of most organic matters by their ability to produce of some hydrolytic enzymes (Al-Saadi et al., 2013). Actinomycetes are the major type of soil bacteria that produce huge natural metabolites. The antibiotics and enzymes are the most and important metabolites (Chiani et al., 2010). They produce some enzymes which Crashing of complex organic matters in sediments or soil as cellulases, protease, gelatinase, ureases, lectinases and amylase (Gulve & Deshmukh, 2012).

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Competing Interest

The authors had no competing interests.

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