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ANTIMICROBIAL ACTIVITIES OF SOME YEAST STRAINS AND GC/MS ANALYSIS OF *Rhodotorula mucilaginosa* AUMC13565 BIOACTIVE METABOLITES

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Primary screening of the antibacterial activity of yeast methanolic extracts against six pathogenic bacterial strains were examined by disc diffusion methods. Antimicrobial activities of the highest 10 molecular identified yeast strains methanolic extracts were confirmed against pathogenic (bacteria, yeast, dermatophyte and filamentous fungi) by using disc diffusion method and wells diffusion method were tested. The major metabolites in methanolic extract of the highest antimicrobial active *Rhodotorula mucilaginosa* AUMC13565 strain were determined by GC/MS analysis. The GC/MS analysis showed 41 active metabolites are classified based on their structure into 13 alcohols, 7 aldehyds, 6 fatty acids, 5 azoles derivatives and 10 other metabolites. All the available information about the detected metabolites were reported and included GC/MS %, Retention Time, CID number, molecular formula, molecular weight g/mol, uses and bioactivity. The most detected metabolites had many bioactivities included seven metabolites had anticancer activity followed by 5 from "anti-bacteria, antifungal and flavoring agents", 3 anti-inflammatory, 2 antioxidant, one metabolite from each "antidiuretic, estrogen receptor, insecticide, herbicide, plant growth regulator, antineoplastic diseases, antischizophrenia, immune system disorders nematotoxic, antimalaria, anti-leukemia and immunosuppressant agents according to the references in Pub Chem. citation.

Keywords: Yeast antimicrobial bioactivity; *Rhodotorula mucilaginosa*, GC/MS analysis.

1.INTRODUCTION

Since antibiotics discovered numerous peoples suffering from the inflammation. So, the worldneeds a new natural and safe antimicrobial agent's source without side effect on the human health. Bacterial resistance to antimicrobial agents is the most problems facing the treatments of the bacterial diseases [1].

Consequently, the discovery of new antibacterial agents is important for human. Various investigations reported that numerous yeast genera have the ability to produce natural antimicrobial agents and act as food

preservatives for prolonging the shelf life of food with improve the safety of food efficacy [2-8].

Saccharomyces cerevisiae strains are able to produce impart desirable flavor, aroma and antimicrobial activity metabolites includes different levels of isobutanol, isoamyl alcohol, acetaldehyde and acetic acid [9]. Alcohols act as flavoring agents, antifreeze, antiseptics, fuels, preservative, solvents, antioxidant and antimicrobial [10].

Fungal alcohols, aldehyds, phenols & flavonoids and organic acids have been reported as antibacterial activity [11].

Hydroxyl groups in alcohols or phenols is quit reactive and easily forms hydrogen bonds with active sites of target enzymes. Alcohols and aldehyds are very effective metabolites against bacteria and fungi [12-13]. Azoles are largest and most antifungal metabolites isolated from yeast. They inhibit the fungal cell membrane synthesis by inhibiting 14-α-emethylation of lanosterol in ergosterol biosynthetic pathway. Azoles are classified into many derivatives such as fluconazole active against pathogenic yeast *Candida* and *Cryptococcus*, azoles derivatives "itraconazole, posaconazole and voriconazole" are active against filamentous fungi [9].

This article has been designed for screening the antibacterial activities of yeast methanolic extracts isolated from different sources against six bacterial strains. The highest antibacterial extract(s) were confirmed against pathogenic bacteria, yeast and fungi. The major metabolites of the highest antimicrobial active strain (*R. mucilaginosa* AUMC13565) were also determined by GC/MS analysis.

2. MATERIALS AND METHODS

2.1 Source of yeast strains:

Yeast strains (Table 1) were isolated from different sources and identified by molecular technique in Korean lap and deposited in Assiut University Mycological Center (AUMC) [1].

2.2 Preparation of yeast inoculums and cultivation the yeast samples:

The medium contains yeast extract, maltextract, peptone, and glucose (YMEPG) was prepared and used for preparation of yeast inoculum. Medium was adjusted to pH 3.7 and autoclaved at 121°C for 20 min. A loop full of yeast inoculum was taken from a pure culture of the yeast isolate and inoculated into 50 ml of sterilized medium then incubated for 72 hours at 28^{o}C on a shaker at 100 rpm [14].

Each broth culture was centrifuged for 15 min at 5000rpm.The cell biomass was dried and weighted and homogenized with 40 ml methanol in a high-speed blender at 16.000 rpm. The homogenized mixture was kept in a shakerovernight. Then the mixture was filtered through Whitman filter paper No.1, and the residue of the extract was dried and stored in a dark glass vial for further work [15].

2.3 Antibacterial activity:

The antibacterial spectrum of the methanolic extracts of tested yeast was examined against six AUMC B bacterial strains included 3 from Gram –ve (*Escherichia coli* 53, *Pseudomonas aeruginosa* 73, and *Serratia marcescens* 55) and Gram +ve (*Bacillus cereus*52, *Staphylococcus aurous* 54 and *Micrococcus luteus* 112). Nutrient Agar (NA) medium was prepared and sterilized at 121ºC for 20min,then pour into sterilized Petri dishes. Using micropipette 200µm from bacterial spore suspension were spread on the surface of the medium. Each extract was dissolved into 500µm methanol and then the disc of filter paper was impregnated in methanolic extract and completely air dried. Each filter paper disc was saturated with methanolic extract and applied on the surface of the bacterial culture. The inhibition zone was recorded after 24 hours [12,16].

2.4 Antimicrobial activities by wells diffusion methods with DMSO as a solvent:

The antimicrobial activity of the selected methanolic extracts of the highest antibacterial active yeast strains were applied against pathogenic bacteria, yeast, dermatophytic and filamentous fungal strains were provided from AUMC using methanol & disc diffusion method and DMSO &Welles cavity method for determined their microbial activity against pathogenic bacteria and fungi.

The antifungal activity of the methanolic extract of the highest bioactive yeast strains were applied against six pathogenic fungal strains which provided by the AUMC No. included four filamentous fungi (*Aspergillus flavus* 1276, *Fusarium oxysporium* 215, *Geotrichum candidum* 226 and *Scopulariopsis brevicaulis* 16), one dermatophytic strain (*Trichophyton rubrum* 1804) and one yeast strain (*Candida albicans*1299). Each fungal strain was grown for 4 days in Universal tubes containing 20 ml of Sabouraud's dextrose broth [17]. The bioassay was done in 10 cm sterile Petri plates in which microbial suspension (1ml/plate) and 15 ml appropriate agar medium were poured. Nutrient agar and Sabouraud's dextrose agar was respectively used for bacteria

and fungi [14]. Yeast extract were dissolved in dimethyl sulfoxide (DMSO) at 2%w/v (=1 mg/ml) were pipetted in the 3 cavities per dish (50 µl/cavity), the incubated the bacterial cultures for 48 hours and four days for fungal cultures at 28°C. Results were recorded as the diameter (in mm) of the inhibition zone around cavities [18].

2.5 GC/MS analysis:

GC/MS analysis of the *R. mucilaginosa* AUMC13565 which has the most highest antimicrobial activity for determining its active antimicrobial metaboles profile [10]. The analysis was performed using Apparatus: GC-MS (7890A-5975B) by injecting into a DB-Column. The GC/MS conditions included, oven program: 40°C for 2 min; then 10 °C/min to 150 °C for 3 min; then 10 °C/min to 220°C for 6 min; then 15 °C/min to 280 °C for 28 min; run time 61 min and 2 min (Post Run) 260 °C.Flow program: 0.5 mL/min for 10.9 min and 1 mL/min per min to 1 mL/min for 30 min. Analysis of the extraction was performed using Agilent GC/MS, (Agilent Technologies, Palo Alto, CA, USA) at the analytical Chemistry Unit, ACAL, Chemistry Department, Faculty of Science, Assiut University, Assiut, Egypt.

3. RESULTS&DISCUSSION

3.1 Screening of the yeast antibacterial activity:

Table 1 clearing the antibacterial activity of yeast strains methanolic extract were tested using disc diffusion method. The activity of each extract was determined by measuring the inhibition zone.Based on the diameter of the inhibition zone the antibacterial activity of the tested methanolic extracts was classified into high, moderate and low. All the tested yeast strains have antibacterial bioactivity against Gram-negative bacterial strains strongly compared to its effect on Gram-+ve bacterial strains. The high antibacterial activates (showed inhibition zone ≥20 mm). *Pseudomonas aeruginosa B73*has highly sensitive effect against tested yeast extracts with inhibition zone diameter range between 21-46 mm. The most resistance bacterial strain against yeast extract was *M. luteu* B112 not affected by yeast extracts with undetected inhibition zone.

A total tested molecular identified yeast strains were selected for confermation their highest antibacterial activity, these yeast strains are related to five genera included *R. mucilaginosa, D. rugosa, S. cerevisiae, D. hansenii* and *P. laurentii* were 5, 3, 2,1 and 1 strains, respectively (Table 1).

The highest antibacterial effect against *P. aeruginosa* B73 was recorded by *R. mucilaginosa* MH298828 (AUMC13564) with 46 mm inhibition zone. The extract of *D. rugosa* MH333102 (AUMC13568) was the highest antibacterial against *S. marcesens* B55 record 47mm inhibition zone. The highest antibacterial effect against *E. coli* B53 was recorded by an *D. rugosa* MH341116 (AUMC13567) racheaed to 28mm inhibition zone. The extract of *R. mucilaginosa* MH298828 (AUMC13564) recored as highest antibacterial yeast against *B. cereus* B52 (30mm inhibition zone).

Rhodotorula mucilaginosa MH298828 (13565) and *D. rugosa* MH341116 (13566) were the most active yeasts against all the tested bacteria, followed by *D. rugosa* MH333102 (13568), *R. mucilaginosa* MH298827 (13567) and *D. rugosa* MH333095 (13571) as recorded in Table (1).

Pseudomonas aeruginosa B73 was the most affected and sensitive bacterium by all the tested yeast methanolic extracts, followed by *S. marcesens* 55, *B. cereus* 52, *M. luteus* 112, *St. aureus* 54 and *E. coli* 53 (Table 1).

The extract of *D. rugosa* MH333102 (AUMC13568) had a highest activity against *M. luteus* B112as well as *R. mucilaginosa* MH298828 (AUMC13564). The extract of *R. mucilaginosa* MH298828 (AUMC13564) recored as highest antibacterial yeast against *S. aureus* B54 (27mm inhibition zone) (Table 1).

The results of used wells methods cleared that the *R. mucilaginosa* MH298828 (13565) was the most active yeast strain against all tested bacteria.

The *D. rugosa* MH333102 (13568) strain was active against *Trichophyton rubrum* 1804 dermatophytic tested fungus.

The *R. mucilaginosa* MH298828 (13565) strain methanolic extract was used for GC/MS to make the chemical profile of the antibacterial metabolites.

Table 1. Antibacterial activities of 12 selected yeast strains methanolic extracts against six pathogenic bacterial strains by using disc diffusion method determined by mm diameter of the inhibition zoneand flavonoids contents

No. of the tested yeast strains in GBAN (AUMC)	**Source of isolation**	**Tested pathogenic Gram +ve & Gram –ve bacterial strains AUMC No.**						
		G-ve				**G+ve**		
		E. coli B53	***P. aeruginosa B73***	***S. marcesens B55***	***B.cereus B52***	***M. luteus*B112**	***St. aureus B54***	**Categories**
1. ***Rhodotorula*** *mucilaginosa* MH298828 (13565)	Molasses	**22 H**	**46 H**	**32 H**	**30 H**	**30 H**	**27 H**	**6H**
2. ***Diutina*** *rugosa* MH341116 (13566)	Orange juice	**28 H**	**35 H**	**32 H**	**26 H**	**23 H**	**25 H**	**6H**
3. *D. rugosa* MH333102 (13568)	Dough	**15 M**	**20 H**	**47 H**	**20 H**	**30 H**	**15 M**	**4H+2M**
4. *R. mucilaginosa* MH298827 (13567)	Molasses	**23 H**	**15 M**	**29 H**	**23 H**	**20 H**	**17 M**	**4H+2M**
5. *D. rugosa* MH333095 (13571)	Guava	**22 H**	**27 H**	**23 H**	**19 M**	**17 M**	**19 M**	**3H+3M**
6. ***Debaryomyces*** *hansenii* KR264905	Tomato	**19 M**	**21 H**	**16 M**	**21 H**	**17 M**	**24 H**	**3H+3M**
7. ***Saccharomyces****cerevisiae* KM504287	Cane juice	**18 M**	**27 H**	**22 H**	**19 M**	**19 M**	**23 H**	**3H+3M**
8. ***Papiliotrema*** *laurentii* MH333092 (13569)	Carrot pickled	**18 M**	**22 H**	**26 H**	**16 M**	**15 M**	**20 H**	**3H+2M+L**
9. *R. mucilaginosa* MH333091	Molasses	**12 L**	**12 L**	**15 M**	**18 M**	**21 H**	**9 L**	**H+2M+3L**
10. *S. cerevisiae* GHM	Germany	**12 L**	**21 H**	**11 L**	**13 L**	**16 M**	**8 L**	**H+M+4L**
11. *R. mucilaginosa* MH341115 (13570)	Carrot pickled	**10 L**	**22 H**	**12 L**	**17 M**	**8 L**	**15 M**	**H+2M+3L**
12. R. mucilaginosa MH333100 (13564)	Molasses	**8 L**	**25 H**	**12 L**	**7 L**	**8 L**	**9 L**	**H+5L**
Total recorded results		**4H+4M+4L**	**10H+M+L**	**7H+2M+3L**	**5H+5M+2L**	**5H+5M+2L**	**5H+4M+3L**	**36H+20M+16L**

Antibacterial categories abbreviations according to the inhibition zone diameter determined by mm.

H: High activity ≥20mm M: Moderate activity=19.9 to16mm L: Low activity=15.9 to 0.1mm

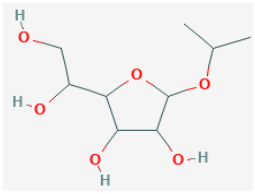
Table 2. Metabolites recorded by GC/MS in methanolic extract of *Rhodotorula mucilaginosa* MH298828strain.

IUPAC of the recorded by GC/MS library	%	RT	CID	MF	MW	Uses and bioactivity
1. α-d-Mannofuranoside-isopropyl **alcohol**	11.7	10.6	537903	$C_9H_{18}O_6$	222.237	
2. α.-Furfuryl alcohol or 2-Furanmethanol **alcohol**	6.9	7.0	3761	$C_5H_6O_2$	98.101	Irritate skin, eyes and mucous membranes
3. D(-)Mannitol; hexane-1,2,3,4,5,6-hexol; sorbitol, (D)-gulitol **alcohol**	5.4	13.3	453	$C_6H_{14}O_6$	182.172	**Anti-dental bacteria,** anti-inflammation, antidiuretic
4. (4-Ethenyloxy)-1-butanol **alcohol**	4.1	12.5				
5. 1,2,3,4-butanetetrol or erythritol **alcohol**	3.3	11.6	8998	$C_4H_{10}O_4$	122.12	**Anti-dental bacteria,**
6. 1-S-Nonyl-1-thio-d-mannitol **alcohol**	1.9	17.1	537510	$C_{15}H_{32}O_5$ S	324.476	
7. 2-Ethoxyethanol; cellosolve **alcohol**	0.7	13.2	8076	$C_4H_{10}O_4$	90.122	Anti-leukemia & solvent has many other uses
8. 1,3-Diamino-2-propanol **alcohol**	0.3	10.8	17882627	$C_3H_{10}N_2O$	90.126	Antioxidants, cytoprotective, protease inhibitors
9. l-Threitol **alcohol**	3.3	11.9				
10. 2- Methyl-1-propanol **alcohol**	0.3	6.4				
11. 1-Tetracosanol **alcohol**	0.1	23.8	10472	$C_{24}H_{50}O$	354.663	Anti-inflammatory, vitamin formulation
12. Nonadecanol **alcohol**	0.06	19.8	80281	$C_{19}H_{40}O$	284.528	**Antibacterial**, immunosuppressant
13. 10,6,2,14-tetramethyl-15-hexadecen-1-ol **alcohol**	0.04	25.1				
1. 5-Hydroxymethylfurfural **aldehyd**	23.6	13.0	237332	$C_6H_6O_3$	126.111	Flavoring agents**, antibacterial**
2. 5-Hydroxymethyl)-2-furane- carboxaldehyd **aldehyd**	23.5	13.0				
3. D3,2-Dihydroxypropanal **aldehyd**	2.2	13.2	751	C3H6O_3	90.078	Anticancer
4. 1-Methylpentyl hydrosulfide **aldehyd**	1.8	13.1	519310	C_6H1_4S	118.243	
5. 2- Furaldehyde **aldehyd**	1.3	6.6	7362	$C_5H_4O_2$	96.085	Antimalarial parasite
6. Methyl- (2-propenyl)-hydrazine-formaldehyde **aldehyd**	1.2	14.0				
7. 5-Methyl-2-furfural **aldehyd**	0.3	8.7	12097	$C_6H_6O_2$	110.112	Nematotoxi,c flavoring Agents
1. Heptadecanoic acid or margaric acid **Fatty acid**	5.4	13.3	10465	$C_{17}H_{34}O_2$	270.457	Antineoplastic, anti-inflammatory, anticancer, antischizophrenia, immuneenhancer
2. Hexadecanoic acid or palmitic acid **Fatty acid**	0.8	23.4	175			Anti-cancer
3. 9-Octadecenoic acid or oleic acid **Fatty acid**	0.6	25.9	445639	$C_{18}H_{34}O_2$	282.46	Anticancer, plant growth regulator, flavoring agent
4. Heneicosanoic acid **Fatty acid**	0.2	8.6	16898	$C_{21}H_{42}O_2$	326.565	Antioxidant
5. 12.9-Octadecadienoic acid **Fatty acid**	0.2	25.8	5282457	$C_{18}H_{32}O_2$	280.452	
6. Octadecanoic acid or stearic acid **Fatty acid**	0.1	26.3	5281	$C_{18}H_{36}O_2$	284.484	Flavoring agents and estrogen receptor
1. 3-[3,5-bis(trifluoromethyl)phenyl]-5-(4-methyl-1piperidylmeth-1,2,4-oxadiazole **Azole**	2.4	6.5				Antifungal

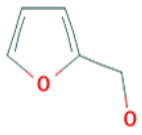
2. 2-t-butyl-4-(1-hydroxy-1-methylethyl)-3-methoxycarbonyl-5-me,2,3-dihydrooxazole **Azole**	2.8	7.1				**Antifungal**
3. 2-fluoro-5-hydroxy-1-ribofuranosyl-Imidazole **Azole**	0.2	8.6				**Antifungal**
4. 1,4,5- trimethylimidazole **Azole**	0.3	8.7				**Antifungal**
5. 4-acetylpyrazole **Azole**	0.2	7.9	565593	$C_5H_6N_2O$	110.116	**Antifungal**
1. Dl-Phenylephrine **Amino-phenols**	3.6	21.6	4782	$C_9H_{13}NO_2$	167.208	**Ant-*Staphylococcus aureus* bacteria**
2. 1,6:2,3-Dianhydro-4-O-acetyl-.β.-d-mannopyranose	2.8	7.1				
3. 6-Deoxy-3-C-methyl-2-O-methyl-L-talose	1.4	14.9				
4. 2-(Acetylamino)-2-deoxy-α-D-Galactopyranose **Amino Sugar**	0.9	10.1				
5. β-D-Glucopyranose,1-**thio**-1-[hydroxy-5-(methylthio)pentanimidat **Thio-amid-Sugar**	0.2	11.6				
6. 2-Deoxy-D-galactose **Deoxy Sugar**	0.4	12.3				
7. d-Glycero-d-**ido**-heptose **HalogenatedKetonic Sugar**	0.3	6.4				
8. Galacto-heptulose **Ketonic Sugar**	2.2	13.2	102926	$C_7H_{14}O_7$	210.182	**Anticancer**
9. D-manno-2-Heptulose **Ketonic Sugar**	2.0	10.9	12600	$C_7H_{14}O_7$	210.182	**Antibacterial**endotoxin, antitumor necrosis
10. 1-Nitro-.β-d-arabinofuranose,tetraacetate **Nitrogenous Furanose**	0.7	13.2	536786	$C_{13}H_{17}NO_{11}$	363.275	

Fourty one active recorded metabolites are classified based on their structure into 13 alcohols, 7 aldehyds, 6 fatty acids, 5 azoles derivatives and 10 other metabolites. GC/MS %, Retention Time RT, CID Number, Molecular Formula, Molecular Weight g/mol, uses and bioactivity according to Pub Chem citation [19].

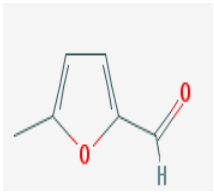
Figure1: Chemical structures of the antimicrobial metabolites recorded by GC/MS in methanolic extract of *Rhodotorula mucilaginosa* MH298828 strain according to Pub Chem citation [19].



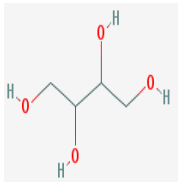
α-d-Mannofuranoside-isopropyl



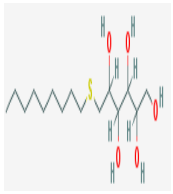
2-furanmethanol



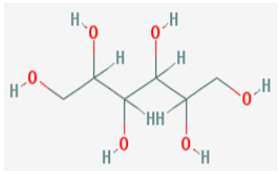
5-Methyl-2-furaldehyde



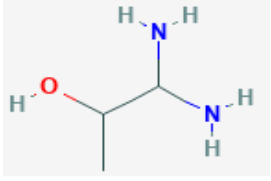
Erythritol



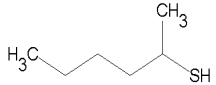
1-S-Nonyl-1-thio-d-mannitol



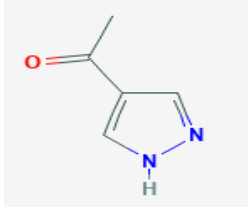
Sorbitol



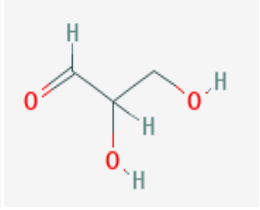
2-Ethoxyethanol; cellosolve



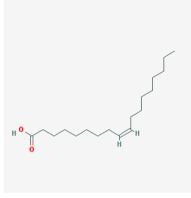
1-Methylpentylhydro sulfide



4-acetylpyrazole



2,3-Dihydroxy propanal

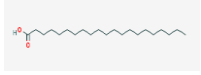


9-Octadecenoic acid or oleic acid

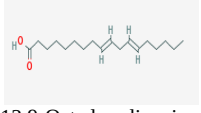
1-Tetracosanol

Nonadecanol

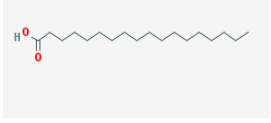
Margaric acid



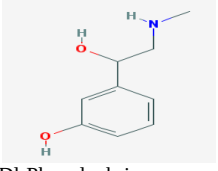
Heneicosanoic acid



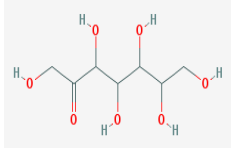
12.9-Octadecadienoic acid



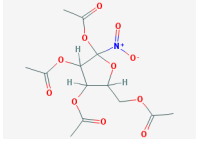
Stearic acid



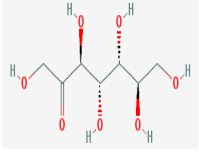
Dl-Phenylephrine



Galacto-heptulose



1-Nitro-.β-d-arabinofuranose, tetraacetate



D-manno-2-Heptulose

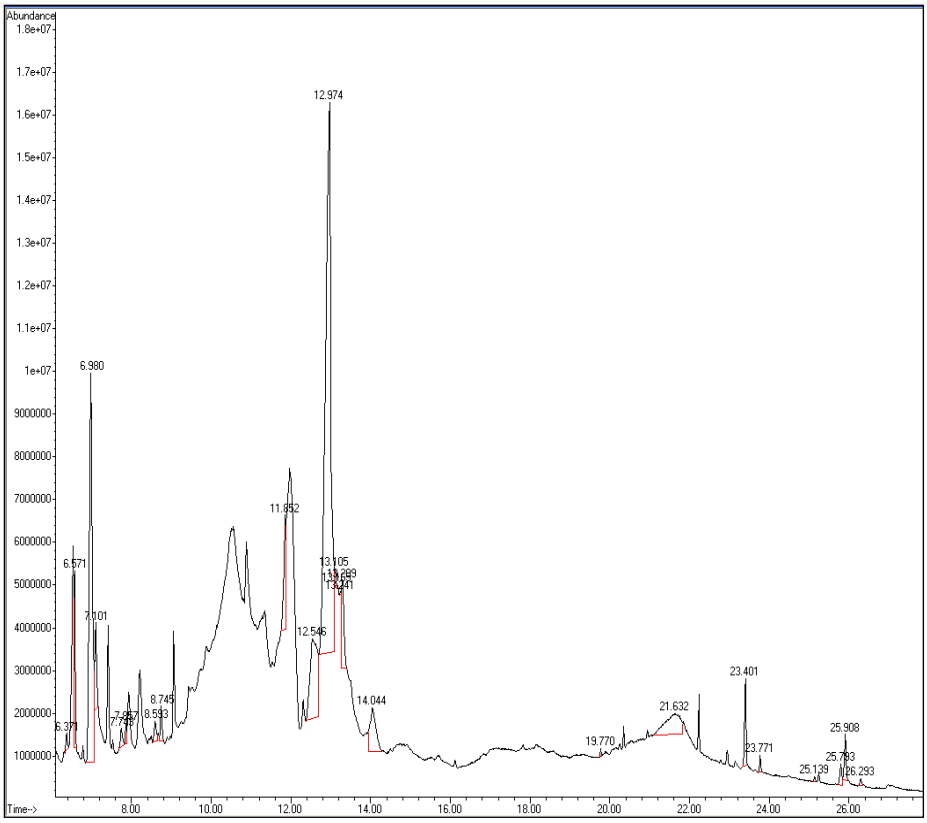


Figure 2: Antimicrobial metabolites detected by GC/MS in methanolic extracts of *Rhodotorula mucilaginosa* MH298828 strain

The chemical profile of the antimicrobial metabolites was detected by GC/MS of *R. mucilaginosa* AUMC13565 methanolic extractswas the highest antimicrobial activity analyzed and recorded 41 active metabolites are classified based on their structure into 13 alcohols, 7 aldehyds, 6 fatty acids, 5 azoles derivatives and 10 other metabolites. All the available information about the detected metabolites were reported and included GC/MS %, Retention Time, CID number, molecular formula, molecular weight g/mol, uses and bioactivity Table 2. The most detected metabolites had many bioactivities included seven metabolites had anticancer activity followed by 5 from "anti-bacteria, antifungal and flavoring agents", 3 anti-inflammatory, 2 antioxidant, one metabolite from each "antidiuretic, estrogen receptor, insecticide, herbicide, plant growth regulator, antineoplastic diseases, antischizophrenia, immune system disorders nematotoxic, antimalaria, anti-leukemia and immunosuppressant agents according to the references in Pub Chem citation [19].

Eight detected metabolites were recorded as antibacterial agents citation and included mannitol; hexane-1,2,3,4,5,6-hexol; sorbitolgulitol; 1,2,3,4-

butanetetrol or erythritol; nonadecanol; phenylephrine; galacto-heptulose; manno-2-heptulose. Also 5 azoles metabolites were recorded as antifungal agents according to Pub Chem citation [19] (Table 2 and Figure 1 & 2).

The antimicrobial bioactivity was increased by increasing the number of –OH group on the alcohols [20].*Saccharomyces cerevisiae* strains producedantimicrobial metabolites includes isobutanol, isoamyl alcohol, acetaldehyde and acetic acid [21].

Also had antimicrobial activity of azoles against plant and human pathogens and dermatophytesincluded *Candida, Aspergillus flavus, A. tamarii, Cladosporium sphaerospermum, P. digitatum*and *P. italicum*were recorded [1].

Nevertheless, disc-diffusion assay offers many advantages over other methods: simplicity, low cost, the ability to test enormous numbers of microorganisms and antimicrobial agents, and the ease to interpret results provided. Moreover, several studies have demonstrated the great interest in patients who suffer from bacterial infection of an antibiotherapy based on the antibiogram of the causative agent [22,23].

About 5-20% of the yeast and filamentous fungi dry weight are sugar alcohols, polyols or polyhydric alcohol or polyalcohol [$H(HCHO)_{n+1}$ H]. Fungal polyols act as defense metabolites against the unfavorable conditions and act as antifreeze, anti-water stress for restoring the turgor pressure, act as compatible solutes (glycerol, arabitol, erythritol, and mannitol). Psychrophilic fungi produced polyols and sugar (by mg/l00mg dry wt) after 8 weeks at 15C°, *H. marvinii* psychrophilic fungus have "glycerol 0.35; erythritol 0.27; arabitol 0.21; mannitol 41.1 & trehalose 7.76". Also polyols found in fungal spores for serves and energy source [24].

Mushrooms antimicrobial active metabolites detected by GC/MS analysis included (alcohols, aldehyds, phenols & flavonoids and organic acids); anticancer (fatty acids “linoleic, linolenic, oleic, myristic, palmitic, stearic and vaccenic” and polysaccharides “glucan and PSK”); anticholesterols, anti-cardiovascular and enhancement the blood circulations (vaccenic acid and other fatty acids, pyran, glycoproteins and sterols); human health supporting (fatty acids, sterols and sugar alcohols); immune enhancer (fatty acids, glycoproteins, polysaccharides and sterols); hepato-protective (triterpenoids); and food flavoring or aroma metabolites (alcohols, aldehydes, amides, amines, carboxylic acid, esters, ketones, terponoids, thiols and mercapto) [12].

Saccharomyces cerevisiae anti-bacterial volatile active metabolites recorded by GC/MS havehighly effective to against *Proteus mirabilis.*

These antibacterial metabolite included thieno[2,3-c]furan-3-carbonitrile; 2-amino-4,6-dihydro-4,4,6,6-; Oxime; Methoxyphenyl-acetic acid-; N'-[3-(1-hydroxy-1-phenylethyl)phenyl]-hydrazide; 1-Aminononadecane; N-trifluoroacetyl; Androstane-11,17-dione,3-[(trimethylsilyl)oxy]-,17-[O-(phenylme; Benzeneacetamide,α-ethyl-; 4-Benzyloxy-6-hydroxy methyl -tetrahydropyran-2,3,5-triol; 1,2-Ethanediol; 1-(2-phenyl-1,3,2-dioxaborolan-4-yl)-; Erythritol,3,6,9,12,-Tetraoxatetradecan-1-ol,14-[4-(1,1,3,3-tetramethylbutyl; Urea,N,N'-bis(2-hydroxyethyl)-; Ergosta-5,22-dien-3-ol,acetate,(3β,22E)-; Ethyliso-allocholate; (5β)Pregnane-3,20β-diol,14α,18α-[4-methyl-3-oxo-(1-oxa-4-azal,5,5'-Dimethoxy-3,3',7,7'-tetramethyl-2,2'-binaphthalene-1,1',4,4',N-(4,6-Dimethyl-2- pyrimidinyl)-4-(4nitrobenzylideneamino)-benzene;3-[3-Bromophenyl]-7-chloro-3,4-dihydro-10-hydroxy-1,9(2H,10H); 2-Methyl-9-β-d-ribofuranosylhypoxanthine; Dodecane,1-chloro-; 2,7-Diphenyl-1,6-dioxopyridazino [4,5:2', 3'] pyrrolo-[4',5'-d]-pyridazin and 2-Bromo tetradecanoic acid [25].

Yeasts have antimicrobial active metabolites against undesirable spoilage microbes during production of fermented foods and beverage, responsible for food, fruit and beverage losses, and these impacts negatively on the economy of the producing countries**.** The yeast produced extracellular metabolites which act as control agents and as preservatives. Antimicrobial active compounds produced from *Candida pyralidae* KU736785 against *Botrytiscinerea*, *Brettanomyces bruxellensis* and *C. guilliermondii* included proteins, glycoproteins and volatile organic compounds [26].

Aromatic aldehyds have antimicrobial activity against the following microbes included filamentous fungus "*Aspergillus niger"*, yeast "*C. albicans* and *S. cerevisiae"* and bacteria "*E. coli*, *B. cereus*, *P. aeruginosa* and *St. epidermidis*" were tested by Disc Diffusion Methods. Salicyl aldehydes, had highly inhibitory zones up to 49 mm in diameter [27].
Antibacterial activity of six aliphatic unsaturated aldehyds included [2-hexenal, 2-eptenal, 2-octenal, 2-nonenal, 2-decenal and 2,4-decadienal were tested and recorded except hexanal, all aldehyds caused significant changes in membrane permeability and damaged the bacterial cells [28].

4. CONCLUSION

Tested yeasts had antibacterial activities with different levels. Gram –ve *Serratia* and *P. aeruginosa* bacterial strains are more sensitive than the gram +ve bacteria. Yeast may represent novel sources of antibimicrobial metabolites and may allow the development of a pharmacologically, food preservatives in food industry for improving human health. Yeast has many advantages such as weather independent, producing simply by

fermentation with few nutritional and environmental requirements. Yeast easily grow on inexpensive substrates especially agriculture and agro-industrial residues, through few days, gives high yield with of the natural metabolites, good quality, easily extracted and easily separated from the growth media with high safety, stability, solubility in water and alcohol**.**

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النشاط الحيوى المضاد للميكروبات لبعض سلالات الخمائر وباستخدام جهاز (ت أ ل ك) تحليل الاطياف اللونية والكتلة للمركبات الايضية الموجودة فى خميرة الرودوتوريولا ميليجانس ذات الرقم ١٣٥٦٥

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المسح الشامل الأولى لقدرة الخمائرعلى أنتاج المركبات ذات النشاط الحيوى المضاد للبكتريا بأستخدام طريقة الأنتشارللمادة الفعالة خلال الأقراص الورقية تم أختبار ثمانين مستخلص الكحول الميثيلى للخمائر لمعرفة نشاطها المضاد لستة سلالات من البكتريا الممرضة.

كما تم تأكيد النشاط المضاد للميكروبات لاثنى عشر سلالة من المستخلص الكحول الميثيلى للخمائر المعرفة بواسطة البصمة الجينية لمعرفة نشاطها المضاد للميكروبات الممرضة التى شملت (ستة من سلالات البكتريا، وخميرة الكانديدا، وفطرمن فطريات اصابة الجلد والفطريات الخيطية) حيث تم اختبارها بأستخدام (الدمسوا كمادة مذيبة واستخدام طريقة الحفر فى الاجار) ثم المقارنة بين النتائج عند (أستخدام الكحول كمذيب وطريقة الانتشار عبرألاقراص الورقية). حيث سجلت طريقة أستخدام الكحول كمذيب وطريقة الانتشار عبرألاقراص الورقية ادق واكفأ نتائج.

ومن النتائج السابقة تم اختيار اعلى وأكفأ سلالات الخمائر للتعرف على المواد الفعالة والمسببة للنشاط العالى المضاد للبكتريا والفطريات بأستخدام جهاز التحليل الكروماتوجرافى والمحلل الطيفى للكتلة تم تحليل المستخلص السابق ذكرة حيث سجلت النتائج أن الرودوتوريولا ميليجانس ذات الرقم ١٣٥٦٥ تحتوى على واحد واربعون مركب نشط ومضاد للميكروبات وهذة المركبات شملت ثلاثة عشر نوعا من الكحولات وسبع الديهيدات وستة أحماض دهنية وخمس مركبات ازولية وعشر من المركبات الاخرة. وكذلك تم تجميع كل المعلومات المتاحة عن المركبات المسجلة السابقة مثل نسبة وجودها فى المستخلص، زمن الجريان داخل جهاز التحليل، التركيب الكيميائى والرمز الكيميائى ، الوزن الجزيئى ونشاطها الحيوى.