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Epidemiology and Control of Nosocomial Pathogens Recovered from Some Governmental Hospitals, Cairo, Egypt

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> TOTAL of 350 samples were collected from different sites located in three governmental Ahospitals in Cairo, Handwashing sink was the most contaminated site followed by Computer keyboards and ultrasonic machines. According to viteck, bacterial isolates were identified as Staphylococcus aureus, S.saprophyticus, Bacillus cereus, B.subtilis, Klebsiella pneumonia, Acnietobacter baumanii, Pseudomonas auerignosa and Escherichia coli. Fungal isolates such as Aspergillus niger, Aspergillus fumigatus, Rhizopus stolonifer, Fusarium oxysporum, Cladosporium herbarum, Penicillium melanoconidium, and etc., were identified by macro and micro morphological characteristics. S. aureus and K. pneumonia were the most common isolated bacteria with percentage (44.2&24.7%) respectively, while A.niger was the most common isolated fungus with percentage (13%). Synthetic antimicrobial agents are widely used to fight microbial infections with some limitations and toxicity, consequently, many researches focused on new antimicrobial substances from natural plants. Antimicrobial activity of both natural (Eucalyptus leaves and Garlic extracts) and synthetic antimicrobials (Chloramphenicol, Amoxicillin, fluconazole and Amphotericin B) were tested against isolated microbial species using agar disk diffusion method. B. cereus was the most sensitive bacterial species to garlic extract with 45mm inhibition zone diameter while S.aureus and B.cereus were the most sensitive species to Eucalyptus extract with 35&30mm, respecively. On the contrary both of natural extracts possess very weak activity against isolated fungal pathogen.

> Keywords: Antimicrobial agents, Bacterial and fungal contamination, Nosocomial infections.

Introduction

The term of nosocomial is used for any disease acquired by patient under medical care during hospital stay (Khan et al., 2015). Nosocomial infections can spread through direct contact individual-to individual that occur from commonly by the hands or by indirect contact through some objects such as common vehicle, liquid and food (Osman et al., 2018). Bacteria, viruses and fungal pathogens are responsible for nosocomial infections depending on based on different populations of patient, medical facilities and differences in the environment underlying which the care is considered (Khan et al., 2017). Commonly, bacteria are responsible for ninety percent of nosocomial

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infections occurrence, while mycobacterial, viral, fungal or protozoal agents represent the less common microorganisms. Bacteria that frequently cause nosocomial infections Staphylococcus include aureus, **Bacillus** cereus, Streptococcus spp. Acinetobacter spp., coagulase negative Staphylococci, enterococci, Pseudomonas aeruginosa, Legionella and members of the Enterobacteriaceae family such as Escherichia coli, Salmonella spp. Proteus mirabilis, Serratia marcescens and Klebsiella pneumoniae. However, E. coli, S. aureus, enterococci and P. aeruginosa are considered the most frequent nosocomial pathogens among bacterial organisms (Bereket et al., 2012). In addition to that, fungal pathogens also cause nosocomial infections but they are considered



less common than bacteria, From these fungal pathogens; Asperigillus species, Fusarium species, Rhizopus species, Cladosporium species and Penicillium species (Khan et al., 2017). It was found that plant sources with antimicrobial effect, are considered environmentally friendly to control some of the fungal contamination but these plant sources may not have effect on some of fungal pathogens such as species which produce myctoxins, responsible for fungal contamination (Tiwari et al., 2017). Synthetic antimicrobial agents are widely used to fight microbial infections such as Chloramphenicol which is considered commonly used in the past because of its broad spectrum of activity against many Gram-positive and Gramnegative bacteria (Eliakim-Raz et al., 2015). Also Amoxicillin is considered more effective against gram positive than gram negative microorganisms and it exhibits greater efficiency when compared to other antibiotics, e.g. ampicillin, azithromycin, clarithromycin, cefuroxime and doxycycline in treatment of different infections(Kaur et al., 2011). Amphotricin-B is considered the most active drug used against fungal pathogens (Noor & Pellegrini, 2018). Also fluconazole is considered one of the antifungal drugs which was considered the first azole systematically used for chemoprophylaxis of invasive infections because of its high level of activity and low toxicity, so fluconazole enabled an earlier and prophylactic use of systemic antifungals (Vazquez et al., 2016). It was found that the continuous use of antimicrobial drugs over the years is the main factor responsible for the appearance of bacterial resistance that threat public health (Pesarico AP et al., 2013). In recent years, due to this bacterial resistance to synthetic

antimicrobial agents and emerging of multi resistance strains, many researches focused on new antimicrobial substances from natural sources such as plants. Among these plants, Garlic extract (Allicin) (Easa et al., 2001, 2002; Rad et al., 2017), in addition to that Eucalyptus is an aromatic medicinal plant which considered one of the proper choices as antimicrobial agent. The leaf extracts of this plant have many effects as anti-inflammatory, anticancer, antifungal, antiviral and antioxidant (Easa & El-Beih, 2002; Seyyednejad et al., 2014; Saadia et al., 2018; Elsonbaty et al., 2020). The present study aimed to study the characteristics of the most predominant and pathogenic different organisms microbial causing nosocomial infections and how to control of these infections and reduce them using natural antimicrobials.

Materials and Methods

Sampling procedure

Three hundred and fifty samples were collected from three governmental hospitals in Cairo from January 2016 until Autumn 2016 as shown in (Table 1). Sterile test tubes each containing prepared nutrient broth were labeled appropriately and were taken to the hospital. Swabbing of the surface of each item was made using sterile cotton wool soaked with nutrient broth. In addition to that, samples for isolation of fungi were collected by swabbing the surface of the same sites in the three hospitals using sterile disinfected swab with 70% alcohol solution (Viegas et al., 2016). All the samples were transported back to the laboratory immediately for isolation of pathogenic microorganisms (Muhammad et al., 2017).

TABLE 1.	Samples	collected	from	different	sites in	selected	hospitals

Sites of compline		No. of samples		Tatal
Sites of sampling	Hospital (A)	Hospital (B)	Hospital (C)	Total
Hand washing sink	11	11	11	33
Computer keyboards	11	10	12	33
Telephone/cell phones	10	10	11	31
Portable radiograph equipment	10	10	11	31
Ultrasound machine	11	11	10	32
Stethoscopes	10	11	11	32
Blood pressure cuffs	11	10	10	31
Suction system switches	11	10	11	32
Ventilator (e.g., buttons, circuits)	10	11	11	32
Bed rails	10	10	11	31
White coats/scrubs	10	11	11	32
Total	115	115	120	350

Isolation and identification of nosocomial pathogens

The streak-plate procedure is used to isolate bacteria on different specific media (Sanders et al., 2012), isolated bacteria were identified by recognizing their culture characteristics on different selective and specific media: MacConkey agar, Cystine Lactose Electrolyte Deficient agar (CLED) agar, Blood agar while Nutrient agar, Mannitol salt agar agar (MYP) agar, Deoxyribonucleic acid agar (DNA agar)according to Bergy's Manual of Systematic Bacteriology (Scardovi et al., 1986; Holt et al., 1984). Microscopic characteristics such as cell morphology, arrangement and gram reaction of bacterial isolates were determined using Gram stain technique (Cruickshank et al., 1975). Biochemical reactions were carried out by Vitek2compact system according to the manufacture's instruction, Vitek 2 Compact is considered an automated microbial identification system that was developed as a result of bioMerieux's long-standing experience with microbial identification (Pincus, 2006). Fungal isolates were identified macromorphologically using different media as: Sabroud's dextrose agar, Potato dextrose agar, Czapek's yeast agar, and yeast extract sucrose agar and micromorphologically by slide culture technique (Gaddeyya et al., 2012).

Antimicrobial assay

Preparation of Eucalyptus leaves extract

Fresh leaves of Eucalyptus were collected from public park. The leaves were thoroughly washed under running tap water and allowed to dry at room temperature for 2 days. The dried material was crushed into fine powder in an electric grinder and stored in airtight bottles (Ammer et al., 2016). 50g of dried leaves powder was thoroughly mixed with 200mL methanol in triplicate conical flasks. The flasks containing extract were heated on boiling water bath for 1hr, wrapped with aluminum foil and kept at room temperature for5 days with occasional shaking. After stipulated time, the liquid extract of flasks was transferred to falcon tubes and subjected to centrifugation at 5000rpm for 10min. The clear supernatants from the falcon tubes were shifted to pre-weighed beakers, and allowed to evaporate the solvent in hot water bath to get dried methanol free extract of Eucalyptus (Ammer et al., 2016).

Garlic extract (Allicin)

Garlic extract powder was purchased from SCIENCEMED for Veterinary Drugs. It was dissolved in methanol solution as a solvent, with the concentration of 1mg Allicin/1mL methanol. Methanol was used alone as a negative control throughout this experiment.

Synthetic antibacterial and antifungal drugs

Chloramphenicol was purchased from Sedico Pharmaceutical company. Amoxicillin purchased from GlaxoSmithKline was Pharmaceutical Company. Fluconazole was purchased from Amoun Pharmaceutical Manufacture. Amphotricin-B was purchased from Abbott Pharmaceutical Manufacture.

Bacterial inoculum preparation

A sufficient number of bacterial colonies obtained from well-isolated, morphologically similar colonies were suspended in 4 to 5mL of sterile distilled water to equal a 0.5 McFarland standard (Disha et al., 2018).

Fungal inoculum preparation

The tested fungal species cultured on Sabroud dextrose agar (SDA) in 9cm plate and incubated at 28°C for 7 days. The fungus was harvested aseptically using 5mL of sterile water. The spore suspensions were adjusted to a concentration of 1-2 x 10^6 spores/mL in sterile distilled water (Yazdani et al., 2009).

Antimicrobial activity using well diffusion method

According to, Clinical & Laboratory Standards Institute (CLSI) guidelines (Cui et al., 2021) muller Hinton agar plates were inoculated with the tested organisms using a sterile cotton swab rolled in the suspension of bacterial and/or fungal cultures. A sterile cork borer of 5mm diameter was used to make wells on inoculated medium. Then 100µL of each of the plant extracts (natural antimicrobial agents) at concentration 1mg/mL, and synthetic antimicrobial agents were dropped into each appropriate labeled well (Atata et al., 2003; ShahidiBonjar et al., 2004). The inoculated plates were kept in the refrigerator for 1 hour to allow the antimicrobial agents to diffuse on to the agar (Atata et al., 2003). The Mueller Hinton Agar plates were incubated at 37°C for 24h for bacteria and at 28°C for 5-7days for fungi. Antimicrobial activity was determined by measuring the mean value diameter of inhibition zones at mm formed after incubation (Akinsulire et al., 2007).

Statistical analysis

Statistical analysis was carried out depending upon on the method (one sample t-test) which is calculated in order to determine if each bacterial species has effect on the different sites in the hospital. The mean for each sample is calculated first then standard deviation will be calculated to get (t-test value) which we can calculate p-value from it, according to Krzywinski & Altman (2013) and Lakens (2017). The calculated P-values determine the significance which if it's less than (0.05) P< 0.05, that means bacterial species are statistically significant.

Results

A total of 292 bacterial isolates were obtained from 350 samples collected from 11 places in 3 different governmental hospitals in Cairo, 131 of them were gram negative isolates and 161 were gram positiveas shown in Table 2. The bacterial isolates were identified using Vitek 2 compact system as shown in Fig.1.

Among	g gra	im po	sitive a	and no	egative
TABLE 2.		count of ent sites	bacterial	isolates	among

Sites	Total bacterial isolates count				
	Gram negative	Gram positive			
Pressure cuffs	8	18			
Ventilator (buttons and circuits)	11	10			
Suction system switches	5	9			
Portable radiograph equipment	10	7			
Ultrasound machine	15	16			
Bed rails	7	8			
Stethoscopes	12	18			
White coats/scrubs	5	5			
Telephone/cell phones	13	22			
Computer keyboards	18	22			
Handwashing sink	36	26			
Total	131	161			

bacterial isolates, it was found that the most common bacterial species cause the infection in hospital sites were *Klebsiella pneumonia*

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& Staphylococcus aureus with (30& 20 isolates) respectively in hand washing sink hand (18,14 isolates) of Staphylococcus aureus in (stethoscopes) & (pressure cuffs, ultrasound machine & computer keyboards) respectively followed by Klebsiella pneumonia with (12 isolates) in computer key boards, This result clarifies that Staphylococcus aureus pneumonia were the most & Klebsiella predominant nosocomial bacterial pathogens isolated from different sites in selected hospitals. On the other hand, Bacillus subtilis & Bacillus cereus were the least isolated nosocomial bacterial pathogens as shown in Table 3. The previous distribution of bacterial species was clarified using statistical analysis based on (one sample t-test for a mean calculation), this study stated that there is a significant effect for (Staphylococcus aureus, Staphylococcus saprophyticus, E. coli, Bacillus cereus & Bacillus subtilis) which cause contamination of different sites in hospitals, in which this is determined by calculating the p-value of each bacterial species in different sites, where (P-value) less than 0.05 that means that bacterial species are statistically significant.

A total of 181 fungal isolates were obtained from all studied sites. Computer keyboards was the most contaminated site with nosocomial pathogenic fungi (120 isolates) with percentage (66.2%) followed by both of (Hand washing sink & Suction system switches) (109 &101 isolates) with percentage (60.2% and 55.8%) respectively followed by Ventilator (92 isolates) with percentage (50.8%) while Ultrasound machine was the least contaminated site with nosocomial pathogenic fungi (20 isolates) with percentage (11%) followed Telephone/cell phones (43 isolates)with percentage (23.7%) followed by pressure cuffs (60 isolates) with percentage (33.1%) as shown in Table 4.

Based on macro and micromorphological characteristics, nosocomial fungal pathogens were identified as: Asperigillus niger, Asperigillus fumigatus, Asperigillus flavus, Asperigillus terrus, Rhizopus stolonifer, Fusarium oxysporum, Fusarium proliferatum, Fusarium nivale, Fusarium dimerum, Cladosporium herbarum, Penicillium melanoconidium, Penicillium carneum, Penicillium sclerotigenum, Penicillium viridiactum and Penicillium flavigenum.

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Fig. 1. Bacterial identification using Vitek 2 compact system: a: Escherichia coli, b: Staphylococcus aureus, c: Staphylococcus saprophyticus, d: Bacillus subtilis, e: Bacillus cereus;, f: Acnietobacter baumanii, g: Klebsiella pneumonia and h: Pseudomonas auerignosa

Sites	Pressure	Ver	Suctions	Portable equ	Ultrasound	Ве	Steth	Whi	Tel	Computer	Hand w		**Perc	P-
Bacterial species	ure cuffs	Ventilator	Suction system switches	able radiograph equipment	ınd machine	Bed rails	Stethoscopes	White coats	Telephone	er keyboards	washing sink	Total	**Percentage (%)	P-value
S.aureus	14	10	8	7	14	3	18	5	14	16	20	129	44.2	0.0003
S. saprophyticus	4	0	1	0	0	2	0	0	1	0	6	14	4.8	0.0002
P. auerignosa	1	4	4	4	5	0	1	0	0	1	0	20	6.8	0.146
A.baumanii	0	2	0	6	5	5	4	3	4	0	0	29	9.9	0.943
K. pneumoniae	6	5	0	0	6	0	7	0	6	12	30	72	24.7	0.333
B. cereus	0	0	0	0	1	2	0	0	4	2	0	9	3.1	0.005
B. subtilis	0	0	0	0	1	1	0	0	3	4	0	9	3.1	0.007
E. coli	1	0	0	0	0	5	0	2	2	0	0	10	3.4	0.002
Total	26	21	13	17	32	18	30	10	34	35	56	292	100	
***Percentage (%)	8.9	7.2	4.4	5.8	11	6	10.3	3.4	11.6	12	19.2	100		

TABLE 3. Distribution of different bacterial species for each site in hospital

#S:Staphylococcus, K: Klebsiella, A: Acnietobacter, P: Pseudomonas, E: Escherichia, B: Bacillus

** Percentage calculated in vertical column [%]= (Number of each bacterial species in all sites)/ (Total number of all bacterial species in all the sites)*100

*** Percentage calculated in horizontal column [%]= (Number of all the bacteria in each site)/ (Total number of all bacterial species in all the sites)*100

TABLE 4.	Total colony count of fungal isolate	es on
	different sites	

Sites	Total number of	*Percentage
	fungal isolates	(%)
Pressure cuffs	60	33.1%
Ventilator(buttons, circuits)	92	50.8%
Suction system switches	101	55.8%
Portable radiograph equipment	74	40.8%
Ultrasound machine	20	11%
Bed rails	80	44.1%
Stethoscopes	90	49.7%
White coats/scrubs	63	34.8%
Telephone/cell phones	43	23.7%
Computer keyboards	120	66.2%
Handwashing sink	109	60.2%

*Percentage calculated in vertical column [%]= (Number of colonies of fungal isolates in each site)/(Total number of fungal isolates in all the sites)*100

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From all studied sites and fungal isolates, it was found that Asperigillus niger was considered the only fungal species isolated from all the sites with the highest contamination occurrence in cell phones and ultrasound machine with 4 and 3 isolate respectively, followed by Penicillium sclerotigenum with largest number in ventilator, portable radiograph equipment and bedrails, 3 isolates, each, followed by Asperigillus fumigatus and Asperigillus flavus with largest number found in pressure cuffs & computer keyboards and stethoscopes & cell phones. On the contrary Rhizopus stolonifer was the least isolated fungal species with percentage (1.2%) followed by Fusarium dimerum with percentage (3%) and then Penicillium viridiactum with percentage (3.7%). It was found that all the Fusarium sp. and Rhizopus stolonifer species didn't cause contamination for the following sites Ventilator, Suction system switches, Portable radiograph equipment, Ultrasound machine, Bed rails, Stethoscopes and cell phones. (Table 5).

Antimicrobial activity of synthetic and natural extracts against bacterial and fungal nosocomial pathogens:

It was found that Eucalyptus extract and allicin

were very effective on controlling gram positive and gram negative pathogens. *Bacillus cereus* was the most sensitive bacterial species to garlic extract with inhibition zone diameter (45mm) followed by *Bacillus subtilis* (28mm) as shown in Table 6. While *Staphylococcus aureus* and *Bacillus cereus* were the most sensitive bacterial species to Eucalyptus extract with inhibition zone diameters 35mm and 30mm, respectively, followed by *Bacillus subtilis* (25mm). As for synthetic antibacterial agents, *Bacillus cereus* was the most sensitive bacterial species to Amoxicillin with inhibition zone diameter 54mm followed by *Staphylococcus aureus* (41mm) while from the gram negative bacterial species, *E.coli* is considered the most sensitive bacterial species to chloramphenicol with (40mm) inhibition zone diameter. Amphotricin B was considered the most active synthetic drug used against all isolated fungal species and *Penicillium carneum* was the most sensitive fungal pathogen with inhibition zone diameter 28mm followed by *Asperigillus niger* with inhibition zone diameter 25mm as shown in as shown in Tables 6, 7 and Figs. 2-6.

TABLE 5.Distribution of fungal	species among differen	t sites on selected hospitals

Sites	A.niger	A.fumigatus	A.flavus	A.terrus	R.stolonifer	F.oxisporum	F.proliferatum	F.nivale	F.dimerum	C.herbarum	P.melanoconidium	P.carneum	P.sclerotigenum	P.viridiactum	P.flavigenum	Total	**Percentage [%]
						-	n			-	um		m	n	-		[%]
Pressure cuffs	0	3	1	0	1	2	3	2	1	0	0	0	0	0	0	13	8%
Ventilator(e.g., buttons, circuits)	2	1	0	0	0	0	0	0	0	0	1	1	3	2	1	11	6.8%
Suction system switches	1	2	2	1	0	0	0	0	0	2	3	2	1	1	2	17	10.5%
Portable radiograph equipment	2	2	1	1	0	0	0	0	0	1	2	1	3	2	1	16	9.8%
Ultrasound machine	3	1	2	2	0	0	0	0	0	0	2	0	1	0	1	12	7.4%
Bed rails	2	1	1	2	0	0	0	0	0	2	1	0	3	1	0	13	8%
Stethoscopes	2	0	3	0	0	0	0	0	0	0	1	1	2	0	1	10	6.1%
White coats/ scrubs	1	0	2	1	0	3	4	2	2	0	0	0	0	0	0	15	9.2%
Telephone/cell phones	4	2	3	0	1	0	0	0	0	1	1	2	2	0	1	17	10.5%
Computer keyboards	2	3	0	0	0	2	4	5	2	1	2	1	1	0	0	23	14.1%
Handwashing sink	2	2	1	2	0	0	0	0	0	2	2	1	2	0	1	15	9.2%
Total	21	17	16	9	2	7	11	9	5	9	15	9	18	6	8	162	100%
***Percentage	13%	10.5%	9.8%	5.5%	1.2%	4.3%	6.8%	5.5%	3%	5.5%	9.2%	5.5%	11.1%	3.7%	5%	100%	

*A:Asperigillus, R:Rhizopus, F:Fusarium, C:Cladosporium, P:Penicillium

**Percentage calculated in vertical column [%]= (Number of fungal species in each site)/(Total number of all fungal species in all sites)*100

***Percentage calculated in horizontal column [%]= (Number of each fungal species in all sites)/(Total number of all the fungal species in all the sites)*100

Destadation	Diameter of inhibition zone in mm for gram positive and negative bacterial species										
Bacterial species	Eucalyptus	Garlic extract	Amoxacillin	Chloramphenicol							
S. aureus	35	24	41	-							
S. saprophyticus	19	27	40	-							
B.s cereus	30	45	54	-							
B. subtilis	25	28	32	-							
P. aeurignosa	-	-	-	-							
A. baumannii	-	-	-	-							
K. pneumonia	16	24	-	34							
E. coli	23	23	-	40							

TABLE 6. Antibacterial activity of natural and synthetic antimicrobial agents against pathogenic bacterial species

[#]S: Staphylococcus, K: Klebsiella, A:Acnietobacter, P: Pseudomonas, E:Escherichia, B:Bacill

TABLE 7. Antifungal activity of synthetic and natural antimicrobial agents against pathogenic fungal species

	Diameter of inhibition zone in mm									
Fungal species	Fluconazole	Garlic extract	Eucalyptus plant extract	Amphotricin B						
Asperigillus niger	-	-	-	25						
Asperigillus fumigatus	-	-	-	20						
Asperigillus flavus	-	-	-	17						
Asperigillus terrus	-	-	-	-						
Rhizopus stolonifer	-	-	-	13						
Fusarium oxysporum	-	-	-	17						
Fusarium proliferatum	-	-	-	-						
Fusarium pnivale	-	-	-	-						
usarium pdimerum	-	-	-	-						
Cladosporium herbarum	-	-	-	21						
Penicillium melanoconidium	-	-	-	17						
Penicillium carneum	-	-	-	28						
Penicillium sclerotigenum	-	-	-	13						
Penicillium viridiactum	-	-	-	15						
Penicillium flavigenum	-	-	-	17						

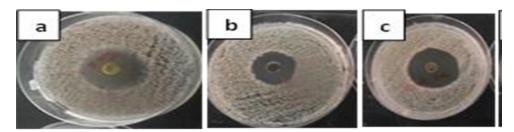


Fig. 2. Antibacterial activity of synthetic and natural antimicrobial agents against *S. aureus*; a: Eucalyptus leaf extract, b: Garlic extract and c: Amoxicillin

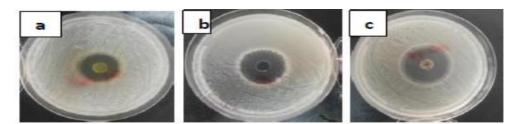


Fig. 3. Antibacterial activity of synthetic and natural antimicrobial agents against *B. subtilis*; a: Eucalyptus leaf extract, b: Garlic extract and c: Amoxicillin

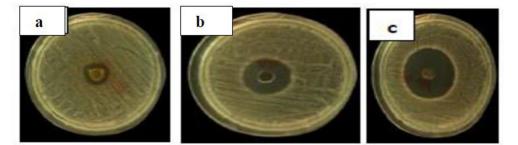


Fig. 4. Antibacterial activity of synthetic and natural antimicrobial agents against *K. pneumoniae*; a: Eucalyptus leaf extract, b: Garlic extract and c: Chloramphenic

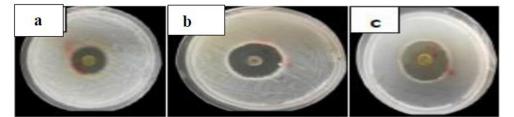


Fig. 5. Antibacterial activity of synthetic and natural antimicrobial agents against *E. coli*; a: Eucalyptus leaf extract, b: Garlic extract and c: Chloramphenicol

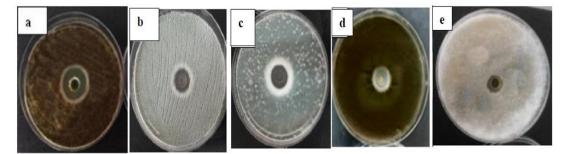


Fig. 6. Antifungal activity of synthetic antimicrobial agents (Amphotrircin. B.) against; a: Asperigillus niger, b: Asperigillus fumigatus; c: Penicillium melanoconidium; d: Cladosporium herbarum and e: Rhizopus stolonifer

Discussion

Nosocomial infection is considered one of the greatest challenges to health systems in the developed world (Bouza et al., 2019). The present study revealed that Hand washing sink is considered the most colonized site with bacterial species, this may due to factors that may contribute to contamination of hand washing sink, these factors include:visible splashing out of and around the sink when the tap was turned on and the distance between the sink and the patient

ranged between 1 and 2mm. Klebsiella species and Staphylococcus species are considered the most common species on hand washing sink, this was concur with the results obtained by Roux et al. (2013). While mobile phones are considered the most site contaminated with fungal isolates, this may due to the daily contact of mobile phones with body parts such as: the face, ears and hands, these fungal isolates can survive on the surface of the cell phones causing contamination for it, other studies investigated that it's possible that air contribute to the growth of fungi on mobile phones, these fungal spores float in the air can be attached to the media on the mobile phone, this study is reported by Amanah et al. (2019). It was reported that many of medicinal plants have antibacterial activities like Eucalyptus leaf extract which has antibacterial activity against many bacterial species as: Staphylococcus aureus (Easa et al., 2019). It was found that the inhibition effect produced from Eucalyptus leaf extract differ from bacterial species to another, this depends upon difference in the cell wall of the bacterial organisms and difference in phytochemical composition of the medicinal plants (Roux et al., 2013). In addition to that Eucalyptus leaf extract has antibacterial effect against Bacillus subtilis and Bacillus cereus, this may due to leaf extract contains phytochemical compounds like (saponins, cardiac glycosides, tannins), tannins have role for its antimicrobial activity which its mechanism depends upon the ability of binding proteins then inhibiting cell protein synthesis (Alghamdi & Ababutain, 2019). On the other hand, it was found that gram negative bacteria are slightly sensitive to essential oils when compared with gram positive bacteria, this may due to the structure of their cellular walls where the cell wall of gram negative bacteria consists mainly of lipoproteins and lipopolysaccharides which form a barrier to hydrophobic compounds so they are less sensitive to antimicrobial agents, this study is reported by Bachir & Benali (2012). While it was found that E.coli and K. pneumoniae are inhibited by methanol extract of eucalyptus, this may due to eucalyptus leaf extract has high concentration of polyphenols components which include (tannins, steroid, alkaloids, flavonoids and terpenoids) (Amini et al., 2016). Many studies reported that allicin (the main active ingredient of garlic extract) has role as antimicrobial agent through inhibiting DNA and protein synthesis moderately and inhibiting RNA synthesis completely as a primary target. Additionally,

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garlic extract has many anionic components which have antimicrobial properties, from these components(nitrates, chlorides, sulfates and other water solube components), this study clarified the role of garlic extract as antmicrobial agent against many bacterial species (Staphylococcus aureus, Bacillus subtilis, Bacillus cereus, E. coli and K. pneumoniae) (Chand, 2019). Amoxicillin inhibited many of gram positive bacteria, this may due to amoxicillin is considered one of beta lactam antibiotics which act through binding to penicillin binding proteins leading to activation of autolytic enzymes in the bacterial cell wall resulting in lysis of the cell wall of bacterial species then destruction of bacterial cell (Akhavan & Vijhani, 2019). It was found that Klebsiella pneumonia and E. coli are sensitive to chloramphenicol which inhibit protein synthesis in bacterial species and acts by binding reversibly to 50S subunits of the bacterial ribosome, this study is reported by Mahato et al. (2019). Many studies reported that there are many reasons for less ability of the essential oils like (eucalyptus and garlic) to inhibit the growth of fungal species, these reasons include: volatilization overtime of the more volatile essential oils affecting the growth inhibition of fungi, in addition to that the agar itself may affect the effectivity of the essential oils in their ability to inhibit growth, similarly the effectivity of the treatments may be from the fungi becoming less sensitive to the active compounds or due to the nutrient rich agar diluting the concentration of essential oil (Padhye et al., 2013). According to the study of Shishodia et al. (2019) that reported Asperigillus species are resistant to fluconazole due to presence of certain factors including (enzyme from cell wall remodeling, oxidative stress response and energy metabolism) and also due to production of the enzymes by alterations in promoters and transcription factors in the fungal species (Macedo et al., 2018).

Conclusion

In our study it was concluded that *Staphylococcus aureus* was the most common isolated bacteria which is susceptible to the both of natural plant extracts and synthetic antimicrobials. While it was found that from all fungal isolates *Asperigillus niger* was the most common isolated fungi followed by *Penicillium* species. Amphotricine-B is considered the only effective drug when tested against most of fungal species while both of natural extracts have no effect on the isolated fungi. Future study will

be carried out to determine MIC concentration of these natural plant extracts as antimicrobial agents and a good choice for antibiotic discovery and infection control, especially against pathogenic bacterial and fungal isolates.

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دراسة الكاننات الممرضة والمسببة للعدوى المكتسبة في بعض المستشفيات الحكومية بمصر وكيفية التحكم فيها

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تعد العدوى المكتسبة من المستشفيات أحد العدوى الهامة التي تواجه الصحة العامة، حيث إنها تسبب مشاكل مالية. وأحيانا تصل إلى أنها تسبب الوفاه في بعض المستشفيات خاصة في الدول النامية.

فى هذه الدراسة تم تجميع 350 عينة من مختلف الأماكن بالمستشفيات الحكومية الثلاثة بمحافظة القاهرة، وقد وُجِد أن الحوض الخاص بغسيل الأيدى من أكثر الأماكن تلوثاً بالبكتيريا والفطريات، ويتبعها لوحة المفاتيح الخاصة بأجهزة الحاسب الآلي والأجهزة الإشعاعية، وطبقاً لجهاز ''vitek'' تم تعريف الكائنات البكتيرية المعزولة كالتالي:

Acnietobacter baumanii, Bacillus cereus, Bacillus subtilis, Escherichia coli, Klebsiella pneumonia, Pseudomonas auerignosa, Staphylococcus aureus and Staphylococcus saprophyticus.

تم تعريف الفطريات المعزولة (عن طريق در اسة خصائصها من حيث الشكل الظاهري وخصائصها تحت الميكروسكوب) إلى:

Asperigillus niger, Asperigillus fumigatus, Asperigillus flavus, Asperigillus terrus, Rhizopus stolonifer, Fusarium oxysporum, Fusarium proliferatum, Fusarium nivale, Fusarium dimerum, Cladosporium herbarum, Penicillium melanoconidium, Penicillium carneum, Penicillium sclerotigenum, Penicillium viridiactum and flavigenum. Penicillium

يُعتبر كلاً من S.aures and Klebsiella pneumonia من أكثر البكتيريا المعزولة في هذه الدراسة، بينما يُعتبر A.niger من أكثر الفطريات التي تم عزلها من الأماكن المختلفة بالمستشفيات.

تعتبر المواد المضادة للبكتيريا والفطريات هي الأكثر شيوعاً في استخدامها لمحاربة العدوى الناتجة عن الميكروبات، ولهذا ظهرت أبحاث كثيرة تشير عن مدى أهمية استخدام المواد الطبيعية المستخلصة من النباتات كمضادات لهذه العدوى.

فى هذه الدراسة تم اختبار تأثير كلاً من المستخلصَين الطبيعيين لنبات الكافور وبودرة الثوم، كما أنه تم خلطهما ببعض، بالإضافة إلى اختبار كل من المواد المصنعة المضادة للبكتيريا (الاموكسيللين والكلور امافينيكول) وخليطهم ببعض باستخدام طريقة agar well diffusion.

يُعتبر B.cereus من أكثر الفصائل البكتيرية حساسية تجاه بودرة الثوم، بينما يُعتبر كلاً من S.aureus and B.cereus من أكثر الفصائل البكتيرية حساسية تجاه مستخلص نبات الكافور.

عند خلط كل من المواد المصنعة والطبيعية المضادة للبكتيريا، وُجد أن لها تأثير علاجي على الفصائل البكتيرية، بينما عند خلط كل من المستخلصين الطبيعيين ببعضهما كان له تأثير عكسي على الفصائل البكتيرية، وعلى الجانب الآخر وُجد أن للمواد المستخلصة الطبيعية تأثير ضعيف على الفطريات المسببة للعدوى، ووُجد أيضاً أن خلط المواد المستخلصة الطبيعية بالمواد المصنعة ضد الفطريات له تأثير عكسي على الفطريات المعزولة.