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Detection *Staphylococcus Aureus* Contaminated Some Door Handles and Table Surfaces and Their Sensitive to Antibiotics

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Abstract

The current study's objective was to identify and isolate *Staphylococcus* spp. germs from a few of Omar Al-Mukhtar University's faculty laboratories. It is regarded as the first investigation carried out at Omar Al-Mukhtar University to assess the level of Staphylococcal bacterial contamination of door handles and table surfaces inside the laboratories. 33 isolates from the College of Science's Botany Department were used in the study, which took place in the department's laboratories during the fall semester of the academic year (2022). After evaluating the expanding colonies and using morphological inspections and biochemical tests to diagnose the isolates, it was showen that 90.9% of the samples from the Botany Department were *Staphylococcus* and that the percentage of *S. aureus* reached 36.7% of isolates of *Staphylococcus*. A biofilm-forming capacity was demonstrated by 80% of the isolated bacteria, of which 29% were *S. aureus*. In order to ascertain the effectiveness of the antibiotics and which ones the bacteria are resistant to, the sensitivity of thirty *S. aureus* isolates to hospital-grade antibiotics against infection was tested. The findings revealed a high level of resistance to the majority of antibiotics and a definite resistance to gentamicin. Methicillin-resistant MRSA isolates made up 73.3% of the isolates, whereas vancomycin-resistant VRSA isolates made up 70%.

Keywords: Contamination ; table's surfaces ; door handles ; laboratories; *S.aureus*

INTRODUCTION

Every ecosystem is largely composed of microorganisms (Morris & Blackwood, 2024). [h1] In an academic setting, service desks are frequently accessible to visitors, staff, and students for a variety of reasons. Door handles have a very high risk of cross-contamination with bacteria since they are not regularly cleaned. Many people use the doors frequently, which lead to the collection of viruses, which, while entering and leaving, they pick up from somewhere else and put on the handles (Aiello et al., 2004). According to a study conducted in (Ayuba et al., 2019). to isolate and identify bacteria from staff office door handles in a few departments of the College of Science at Gombe State University, the traffic, exposure, and environment play important roles in changing the levels of contamination. The departments with the highest bacterial counts were those that contained These offices are used by a sizable number of department employees and students. According to (Otto, 2014), staphylococcus has been discovered on human body surfaces as part of the regular microflora and on environmental surfaces such as classroom door handles, toilets, tissues, the

bloodstream, and the noses of pets like cats and dogs. It has been documented that nearly every staphylococcal species can lead to opportunistic infections (Otto, 2009). Hazardous and potentially fatal infections such as severe sepsis, pneumonia, toxic shock syndrome, and endocarditis can be brought on by Staphylococcus aureus (Lowy, 1998). Staphylococci are harmful because they can enter the body and release a variety of endotoxins and blood enzymes (Todar, 2004). Biofilms developed which aid in the bacterial adhesion and colonization process (Forrest & Tamura, 2010). Furthermore, it was thought to be one of the most significant disease-causing variables that promote Staphylococcus attachment and colonization of tissues, which results in persistent infections since pathogens are difficult to eradicate (Darwish & Asfour, 2013). Every surface has microorganisms on it, and there are numerous direct and indirect ways for them to get there. According to the findings of the study carried out by (Umeanaeto et al., 2021), there was bacterial growth in 60.9% of the samples, with Staphylococcus spp. accounting for the largest number of isolated bacteria (20.5%).

The aim of research

To isolate and diagnose *Staphylococcus aureus* which contaminates door handles and table surfaces from some labs in the botany department at the Faculty of Science, And Screening of bacteria resistance to antibiotic and their capacity to form biofilm.

MATERIALS AND METHODS

Collecting of Samples and Bacterial Isolate Diagnosis

Samples were collected in 2022/2023 during the autumn season by swabs from the surfaces and placed on a selective media of mannitol salt agar (MSA) and were incubated at 37C° for 24-48 hours. The bacteria were purified for Identification. And then the bacteria suspicious grown colonies were based on Gram staining and standard biochemical reactions; including catalase, coagulase, and antibiotic susceptibility test (Habib et al., 2015; JF & Williams, 2000).

Detection of biofilm formation

To detect biofilm formation at a wavelength of 492 nm using a plate reader in accordance with (Shukla & Rao, 2017), measurements of the bacterial biofilm composition of some isolates are made using a microtitre plate; readings are obtained via a dish reader device (Erba Lisa Scan), and the OD is measured.

Screening of *Staphylococcus* species resistance to antibiotic

Nine antibiotics—Clindamycin, Oxacillin, Ampicillin, Tetracycline, Gentamicin, Trimethoprim, Doxycycline, Vancomycin, and Amoxicillin—were used in a sensitivity test on thirty isolates. According to the Clinical Laboratory Standards Institute (Wayne, 2011), the antibiotics were obtained from the Turkish business Bioanalyse in order to assess the susceptibility of *Staphylococci* Kirby-Bauer, 2016 and to explain the inhibition of diameter area using the disk diffusion method.

RESULTS

Identification of *S. aureus* isolates from research laboratories' door handles and table surfaces based on their morphological, biochemical, and biofilm-forming properties

In order to collect and identify bacteria found on table surfaces and handles in the labs of the Botany Department, College of Science, Omar Al-Mukhtar University, this study was carried out in the autumn semester of the academic year 2022. Following their isolation from laboratory table surfaces and handles, 33 isolates were identified based on their morphological and biochemical features, as listed in Table (1).

According to the findings, the majority of the isolates (30) were *Staphylococcus* bacteria, with 11 out of 30 being *S. aureus*. These findings were based on the morphological features of the colony on mannitol salt agar medium and Gram stain, as well as the catalase test and plasma coagulase enzyme test. Of these, 36.7% of the isolates were *S. aureus* coagulase in plasma and 63.3% were *Staphylococcus* negative.

Table (1) *Staphylococcus* and *S. aureus* isolates isolated from table surfaces and door handles in study laboratories according to morphological and biochemical characteristics and biofilm formation

Isolates	Colony color	Mannitol use	Gram stain	Cell shape	Catalase test	Coagulase test	Definition	biofilm formation
1	white	-	-	Spherical in chains	-	-	It is not *Staphylococcus*	+
2	white	-	-	Spherical in chains	-	-	It is not *Staphylococcus*	+
3	yellow	+	+	Spherical	+	+	S.aureus	+
4	Creamy	+	-	Spherical	-	+	Staph.	+
5	yellow	+	+	Spherical	+	+	S.aureus	+
6	white	+	-	Spherical	-	+	Staph.	+
7	white	+	-	Spherical	-	+	Staph.	+
8	yellow	+	+	Spherical	+	+	S.aureus	+
9	yellow	+	+	Spherical	+	+	S.aureus	+
10	white	+	-	Spherical	-	+	Staph.	+
11	yellow	+	+	Spherical	+	+	S.aureus	++
12	white	+	-	Spherical	-	+	Staph.	+
13	white	+	-	Spherical	-	+	Staph.	+
14	Creamy	+	-	Spherical	-	+	Staph.	+
15	Creamy	+	-	Spherical	-	+	Staph.	+
16	yellow	+	+	Spherical	+	+	S.aureus	-
17	Creamy	+	-	Spherical	-	+	Staph.	-
18	Creamy	+	-	Spherical	-	+	Staph.	-
19	Creamy	+	-	Spherical	-	+	Staph.	+
20	white	+	-	Spherical	-	+	Staph.	++
21	white	+	-	Spherical	-	+	Staph.	++
22	white	-	-	Spherical in chains	-	-	It is not defined	+
23	white	+	-	Spherical	-	+	Staph.	+
24	white	+	-	Spherical	-	+	Staph.	+
25	yellow	+	+	Spherical	+	+	S.aureus	+
26	white	+	-	Spherical	-	+	Staph.	++
27	yellow	+	+	Spherical	+	+	S.aureus	++
28	white	+	-	Spherical	-	+	Staph.	+
29	white	+	-	Spherical	-	+	Staph.	+
30	white	+	-	Spherical	-	+	Staph.	+
31	yellow	+	+	Spherical	+	+	S.aureus	-
32	yellow	+	+	Spherical	+	+	S.aureus	-
33	yellow	+	+	Spherical	+	+	S. aureus	-

+ Poor biofilm formation ++ Moderate biofilm formation -- No biofilm formation

Staphylococcus spp. screening for antibiotic resistance

Assessing the antibiotic sensitivity of *S.* aureus (Clindamycin, Oxacillin, Ampicillin, Tetracycline, Gentamicin, Trimethoprim, Doxycycline, Vancomycin, Amoxicillin) are the nine antibiotics that were used. In hospitals and clinics, these antibiotics are thought to be the most frequently utilized for treating bacterial infections. The results of the antibiotic sensitivity tests and the percentage of antibiotic resistance of the bacterial isolates are displayed in Table (2). The percentage of antibiotic

resistance varies from 0% to 100% for each isolate. The findings show that isolates No. 5,6,10,12,13, and 15 were sensitive to all tested antibiotics, while isolates No. 9,19,21, and 22 showed strong resistance at a rate of 88.9% and were susceptible to all tested antibiotics. Isolates No. 3,8,16,17,18,23, and 30 exhibited complete resistance to the antibiotics at a rate of 100%. Each of the isolates No. 2, 24, and 27 has a resistance rate of 77.8%, while the resistance rates of the remaining isolates range from 55.6% to 66.7%. The percentage of resistance and sensitivity of the *S. aureus* isolates tested to each antibiotic is displayed in Table (3). The results show that the antibiotic with the highest resistance percentage was Gentamicin, and the antibiotics with the lowest resistance percentage were Tetracyclin, Doxycycline, and Amoxicillin. The antibiotics with the highest resistance rates were Trimethoprim (76.7%) and Oxacillin (73.33%), where the resistance to Oxacillin is used as an indicator of MRSA bacteria.

Table (2). Susceptibility of *Staphylococcus sp.* and *Staphylococcus aureus* isolates and their resistance to antibiotics

Isolates	OX-10	AX-10	TE-10	VA-10	DO-30	CN-10	AM-10	SXT-25	CLN-30	Percentage of resistance of a single isolate to antibiotics
1	R	S	R	S	R	S	R	R	S	55.6%
2	S	R	R	S	R	R	R	R	R	77.8%
3	R	R	R	R	R	R	R	R	R	100%
4	S	S	S	S	R	R	R	R	R	55.6%
5	R	S	S	S	S	S	S	S	S	11.11%
6	R	S	S	S	S	S	S	S	R	22.2%
7	R	R	R	R	R	S	S	S	R	66.7%
8	R	R	R	R	R	R	R	R	R	100%
9	R	R	R	R	R	R	R	R	S	88.9%
10	R	S	S	S	R	R	S	S	S	33.3%
11	S	R	R	R	R	S	R	S	R	66.7%
12	S	R	S	S	R	S	R	S	S	33.3%
13	R	S	S	R	S	S	S	R	R	44.4%
14	S	R	R	R	R	S	R	S	S	55.6%
15	S	S	S	S	S	S	S	S	S	0
16	R	R	R	R	R	R	R	R	R	100%
17	R	R	R	R	R	R	R	R	R	100%
18	R	R	R	R	R	R	R	R	R	100%
19	R	R	R	R	R	R	S	R	R	88.9%
20	S	S	R	S	R	R	R	R	S	55.6%
21	R	R	R	R	R	S	R	R	R	88.9%
22	R	R	R	R	R	R	S	R	R	88.9%
23	R	R	R	R	R	R	R	R	R	100%
24	R	R	R	R	R	R	R	S	S	77.8%
25	R	S	R	R	R	R	R	S	S	66.7%
26	R	S	R	R	R	S	S	S	R	55.6%
27	R	R	R	R	R	S	R	S	R	77.8%
28	S	R	R	S	R	R	R	R	S	66.7%
29	R	R	R	R	R	R	R	R	S	88.9%
30	R	R	R	R	R	R	R	R	R	100%

S is sensitive to antibiotics **R** is resistant to antibiotics

Table (3). Percentage of sensitivity and resistance of *Staphylococcus aureus* isolates to antibiotics

Antibiotic	Sensitivity	resistance%
Clindamycin	33.33%	66.67%
Oxacillin	26.67%	MRSA 73.33%
Ampicillin	33.33%	66.67%
Tetracyclin	40%	60%
Gentamicin	13.33%	86.67%
Trimethoprim	23.33%	76.67%
Doxycycline	40%	60%
Vancomycin	30%	70%
Amoxicillin	40%	60%

DISCUSSION

According to a study, the microscopic diagnosis of Gram-stained slides revealed that the cells were spherical, clustered, and positive for Gram stain. In (Chakraborty et al., 2011) All isolates had the capacity to withstand a high concentration of mannitol salt, according to the results of biochemical tests, which is in line with a study's findings (Ahmed et al., 2010) and that the mannitol sugar can be fermented by *S. aureus*. The discoloration of the medium to a yellow hue distinguishes the strain in question from certain staphylococci strains that lack the capacity to metabolize mannitol, thus preserving the medium's original coloration. Furthermore, empirical evidence from biochemical analyses has confirmed that each staphylococcal isolate exhibits catalase enzyme activity, a trait corroborated by the results of the plasma coagulation enzyme test, which relies on this enzymatic activity. Specifically, Staphylococcus aureus, as the producer of coagulase enzyme, contrasts with other Staphylococci species that do not produce the enzyme essential for plasma coagulation. These discernible distinctions align with the conventional characterization of staphylococcal bacteria. (Baron et al., 1994; JF & Williams, 2000). 80% of the *Staphylococcus* isolates, according to the results of the biofilm formation test, were able to form biofilm. Of these, 29% were isolated from the *S. aureus* species, of which 20.8% had a high ability to form biofilm and 79.1% had a moderate ability. The outcomes supported the researcher's conclusions (Erfani et al., 2015): Our study's findings were consistent with the researcher's, since 80% of *staphylococcal* isolates develop biofilm (Tsopmene et al., 2023) All isolates of *Staphylococcus* spp. produced biofilms; 12.69% produced strong biofilms, 77.77% produced moderate biofilms, 9.52% produced weak biofilms, and so on.

The percentage of resistance for Vancomycin was 70% and the lowest percentage was 66.7% for both Clindamycin and Ampicillin. The results of our research agreed with the researcher's findings (Yeh et al., 2011). The majority of *Staphylococcus* spp. isolates are resistant to Ampicillin, which contradicts the findings of the researcher (Noel et al., 2017) who found that Gentamicin is the antibiotic with the lowest resistance rate, 15.3%, for the majority of *Staphylococcus* spp. isolates. Additionally, the results of the researcher (Domínguez et al., 2002) showed that the isolates of *Staphylococcus* had low resistance to Clindamycin, Gentamicin, Tetracycline, and Oxacillin, with resistance rates of 2.6%, 13%, 20.5%, and 25.6%, respectively, and high sensitivity against Vancomycin. Furthermore, the results of our study converged with the researcher (Vaez et al., 2011), as the isolates demonstrated high resistance to Ampicillin, and our findings where the *Staphylococcus* isolates did not accord with the researcher's findings about the isolates' susceptibility to vancomycin and gentamicin at 100% and 76%, respectively, and demonstrated resistance to amoxicillin, oxyacillin, telacyclin, and clindamycin. The results obtained by the researcher mentioned did not align with our findings (Nazarchuk et al., 2020). Sensitivity to gentamicin in S. aureus was noted at 42.86%, whereas sensitivity to doxycycline stood at 65.38%. Our study's results were consistent with those reported in Shaker's investigation from 2018, revealing that Staphylococcus isolates showcased resistance to a spectrum of antibiotics, including Amoxicillin, Gentamicin, Vancomycin, Ampicillin, Oxacillin, and Trimethoprim.

CONCLUSION

The study's findings indicate that *Staphylococcus* species, including *S. aureus*, were widely distributed on laboratory door and table handles. It demonstrated that *Staphylococci* were treated with antibiotics in hospitals and clinics despite their various resistance. The implementation of treatment recommendations and the establishment of a robust national action plan to address antibiotic resistance are crucial for countries, as contaminated hands can spread bacteria to handles and table surfaces within university buildings. Numerous isolates that are resistant to various antibiotics oc-

cur as a result of the use of multiple antibiotic kinds. Because overusing antibiotics can lead to a number of issues, including the emergence of new strains of antibiotic-resistant bacteria and the development of antibacterial resistance, we advise only using antibiotics when absolutely necessary and in the appropriate manner. Be cautious to prevent infection by often washing your hands and avoiding close contact with ill persons. Door handles play a significant part in the transfer and spread of bacteria and should therefore be given special attention during sterilization since the transmission of bacteria from stainless steel surfaces to the hands is increased.

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REFERENCES

Ahmed, M. O., Abuzweda, A. R., Alghazali, M. H., Elramalli, A. K., Amri, S. G., Aghila, E. S., & Abouzeed, Y. M. J. L. J. o. M. (2010). Misidentification of methicillinresistant Staphylococcus aureus (MRSA) in hospitals in Tripoli, Libya. *5*(1).

Aiello, A. E., Marshall, B., Levy, S. B., Della-Latta, P., Larson, E. J. A. a., & chemotherapy. (2004). Relationship between triclosan and susceptibilities of bacteria isolated from hands in the community. *48*(8), 2973-2979.

Ayuba, L., Suwange, M., Enefiok, U. J. I. J. o. M. S., & Technology. (2019). Bacterial contamination of door handles/knobs in gombe state university, Nigeria. *4*(8), 204-211.

Baron, E. J., Peterson, L., & Fenigold, S. (1994). Diagnostic Micobiology.(9th edn.) Mosby Publication. In: USA.

Chakraborty, S. P., KarMahapatra, S., Bal, M., & Roy, S. J. A. A. J. M. S. (2011). Isolation and identification of vancomycin resistant Staphylococcus aureus from post operative pus sample. *4*(2), 152-168.

Darwish, S. F., & Asfour, H. A. J. T. S. W. J. (2013). Investigation of biofilm forming ability in Staphylococci causing bovine mastitis using phenotypic and genotypic assays. *2013*(1), 378492.

Domínguez, E., Zarazaga, M., & Torres, C. J. J. o. c. m. (2002). Antibiotic resistance in Staphylococcus isolates obtained from fecal samples of healthy children. *40*(7), 2638-2641.

Erfani, M., Ghasemi, D., Mirnejad, R., & Piranfar, V. (2015). Incidence and antibiotic susceptibility pattern of Staphylococcus spp. in urinary tract infections (UTI), Iran, 2013-2014.

Forrest, G. N., & Tamura, K. J. C. m. r. (2010). Rifampin combination therapy for nonmycobacterial infections. *23*(1), 14-34.

Habib, F., Rind, R., Durani, N., Bhutto, A. L., Buriro, R. S., Tunio, A.,…Sciences, B. (2015). Morphological and cultural characterization of Staphylococcus aureus isolated from different animal species. *5*(2), 15-26.

JF, M. J. L., Williams, & Williams, B. (2000). Biochemical tests for identification of medical bacteria.

Lowy, F. D. J. N. E. j. o. m. (1998). Staphylococcus aureus infections. *339*(8), 520-532.

Morris, S. J., & Blackwood, C. B. (2024). The ecology of soil biota and their function. In *Soil microbiology, ecology and biochemistry* (pp. 275-302). Elsevier.

Nazarchuk, O. A., Nahaichuk, V. I., Osadchuk, N. I., Dmytriiev, D. V., Dmytriiev, K. D., & Turzhanska, O. S. J. W. L. (2020). Prognostic parameters of the susceptibility of Staphylococcus spp. to aminoglycosides and doxycycline. *73*(8), 1615-1619.

Noel, C. d. C., Silvério, F. M., Francisco, N. L. d. S. G., Almeida, N. R. d., & Soares, L. d. C. J. R. b. c. s. (2017). Suscetibilidade antimicrobiana e fatores de virulência de Staphylococcus em fômites do hospital universitário sul fluminense. 245-254.

Otto, M. J. C. o. i. m. (2014). Staphylococcus aureus toxins. *17*, 32-37.

Otto, M. J. N. r. m. (2009). Staphylococcus epidermidis—the'accidental'pathogen. *7*(8), 555-567.

Shukla, S. K., & Rao, T. S. J. B. (2017). An improved crystal violet assay for biofilm quantification in 96-well microtitre plate. 100214.

Todar, K. G. (2004). *Todar's online textbook of bacteriology*. Kenneth Todar University of Wisconsin-Madison Department of Bacteriology.

Tsopmene, U. J., Iwewe, Y. S., Eyong, I. M., Bisso, B. N., & Dzoyem, J. P. J. C. (2023). Antibiotic Resistance Profile, Biofilm Formation Ability, and Virulence Factors Analysis of Three Staphylococcus spp. Isolates From Urine. *15*(4).

Umeanaeto, P. U., Okafor, U. C., Unam, M. C., Ilo, C. C., Okoli, C. C., Afulukwe, S. C.,…Sciences, L. (2021). Assessment of parasites and bacterial contamination of office door handles in nnamdi azikiwe university, Awka, Anambra State. *9*(2), 120-127.

Vaez, H., Tabaraei, A., Moradi, A., & Ghaemi, E. A. J. A. J. M. R. (2011). Evaluation of methicillin resistance Staphylococcus aureus isolated from patients in Golestan province-north of Iran. *5*(4), 432-436.

Wayne, P. (2011). Clinical and laboratory standards institute. Performance standards for antimicrobial susceptibility testing.

Yeh, P. J., Simon, D. M., Millar, J. A., Alexander, H. F., Franklin, D. J. O. p. h., & perspectives, r. (2011). A diversity of Antibiotic-resistant Staphylococcus spp. in a Public Transportation System. *2*(3), 202-209.