(IJUSE) 2026, Vol. No. 13, Issue 1, Jan-Dec **e-ISSN: 2454-759X, p-ISSN: 2454-7581**

Prevalence and Characterization of *Pantoea agglomerans* Isolated from the Cardiac Surgery Unit of Al-Sader Teaching Hospital, Basrah, Iraq

Mohaned A.Kadhim Al-Atbee
Department of Biology, College of Science, University of Basrah, Iraq

[1]*Date of Receiving: 09 April 2026; Date of Acceptance: 12 June 2026; Date of Publication: 07 October 2026*

Abstract

Background: Nosocomial infections caused by *Pantoea agglomerans* have become an important potential environmental reservoir in humans. **Objective:** The present study aimed to isolate, identify, and determine the prevalence of *P. agglomerans* in the cardiac surgery unit of Al-Sader Teaching Hospital, Basrah Province, Iraq. **Methodology:** 300 environmental swabs from cardiac surgery were biochemically identified and underwent susceptibility testing to determine bacterial antimicrobial susceptibility. Findings were statistically analyzed using SPSS to assess prevalence and identify antimicrobial susceptibility patterns for hospital-acquired infections. **Results:** A total of 96 *P. agglomerans* isolates were recovered from 300 environmental swab samples. The distribution of isolates was as follows: 29/60 (48.3%) from suction systems, 19/60 (31.6%) from floors, 17/60 (28.3%) from beds, 16/60 (26.6%) from doors, and 15/60 (25%) from nurses' hands. Identification was performed using morphological, cultural, microscopic, and biochemical characteristics and was confirmed using API 20E biochemical identification strips (bioMérieux SA, Marcy-l'Étoile, France). Statistical analysis demonstrated a significant difference in the isolation frequency among sampling locations (χ^2= 9.87, df= 4, p=0.043). The recovered isolates exhibited considerable resistance to several commonly used antibiotics, whereas colistin and imipenem showed the highest susceptibility rates. **Conclusion:** The *P. agglomerans* was detected in several sampling locations, although the highest level of contamination was observed in suction systems, suggesting that moist medical equipment may contribute to its persistence within the hospital environment. Strengthening environmental surveillance programs may help limit bacterial persistence and reduce the risk of healthcare-associated infections.

Keywords: *Pantoea agglomerans; Gram-negative bacterium; nosocomial infections.*

Introduction

Pantoea agglomerans is classified as a Gram-negative, facultatively anaerobic bacterium in the family Erwiniaceae. This organism has been considered under numerous taxonomic names, involving Erwinia herbicola and Enterobacter *agglomerans*. It is commonly dominant in plants, food, dust, soil, water, and other environmental reservoirs. Also, healthcare environments can be reservoirs for this bacterium [1,2]. Therefore, its capability to occupy such a wide spectrum of ecological niches has elevated interest in both its environmental allocation and its clinical significance [3]. *P. agglomerans* has also been related to plant disease and other ecological interactions, even though several strains are correlated to plants and have been investigated for biologically useful applications [4]. In surrounding healthcare settings, it is increasingly identified as an opportunistic pathogen, especially in patients vulnerable to infection [5].

[1] *How to cite the article:* Al-Athee M.A.K; (May 2026); Prevalence and Characterization of *Pantoea agglomerans* Isolated from the Cardiac Surgery Unit of Al-Sader Teaching Hospital, Basrah, Iraq; *International Journal of Universal Science and Engineering;* Vol 13, 76-82

The organism has been implicated in relation to medical materials and contaminated fluids that remain in healthcare environments under suitable circumstances. It deserves attention in infection-prevention programs because hospital surfaces, equipment, and other environmental locations could serve as opportunistic reservoirs for it.

[6]. The broad ecological distribution of *P. agglomerans* may further support its persistence in different settings [7]. This issue is of particular concern in cardiac surgery units, where invasive procedures, intensive patient care, and frequent use of medical devices may provide opportunities for environmental organisms to reach susceptible patients.

Antimicrobial resistance makes the control of environmental bacterial contamination more difficult. Resistant *P. agglomerans* has been reported in both clinical and environmental isolates, with reduced susceptibility associated with acquired resistance determinants and other changes affecting antimicrobial response. Environmental isolates are consequently relevant to antimicrobial-resistance surveillance because they may persist and contribute to the circulation of resistant organisms. In Iraq, however, information on *P. agglomerans* in hospital environments is still limited, and reports from specialized surgical units are particularly uncommon.

Characterizing environmental bacteria in high-risk hospital areas can provide useful information for infection-prevention planning. Therefore, this study was undertaken to isolate and identify *P. agglomerans* from selected environmental sites in the cardiac surgery unit of Al-Sader Teaching Hospital, Basrah, Iraq. The study also determined the isolation frequency at the different sampling sites and examined the antimicrobial susceptibility of the recovered isolates. The results provide baseline data on environmental contamination and antimicrobial susceptibility in the investigated unit.

Materials and Methods

Collection of Samples

A total of 300 environmental swab samples were collected from the cardiac surgery unit of Al-Sader Teaching Hospital, Basrah Province, between April and September 2024. Samples were obtained from five sites: suction systems, beds, doors, floors, and nurses' hands. With 2 mL of sterile normal saline, each swab was pre-moistened before collection. Then, the swabs were soaked in Brain Heart Infusion Broth (BHI)-containing sterile tubes. For processing, the swabs were transported in an ice box to the microbiology laboratory.

Laboratory Procedures

Utilizing standardized specimen-handling procedures, the samples were processed in the microbiology laboratory [8]. The foundations of Presumptive identification of *P. agglomerans* were colony morphology, Gram staining, and a set of biochemical reactions, involving oxidase, catalase, hydrogen sulfide production, indole production, and the Voges–Proskauer reaction [9]. In addition, as part of biochemical characterization, carbohydrate employing was evaluated. Afterward, presumptive isolates were confirmed utilizing API 20E biochemical identification strips following the manufacturer's instructions. At 35 °C, the strips were incubated, and the reactions were recorded after 20–24 h. In tryptic soy broth (TSB) containing 20% glycerol at −20 °C (Merck Co.), confirmed isolates were retained until further use.

Antimicrobial Susceptibility Testing

By the Kirby–Bauer disk diffusion method on Mueller–Hinton agar, antimicrobial susceptibility was identified [10]. The antimicrobial agents examined were ampicillin (10 µg), carbenicillin (100 µg), ceftazidime (30 µg), cefotaxime (30 µg), imipenem (10 µg), streptomycin (10 µg), amikacin (30 µg), gentamicin (10 µg), tobramycin (10 µg), piperacillin (100 µg), colistin (25 µg), and tetracycline (30 µg).

Statistical Analysis

Employing SPSS version 26, data were analyzed. To determine the isolation rate and the percentages of isolates classified as resistant, intermediate, or sensitive to the tested antimicrobials, descriptive statistics were utilized.

The Chi-square (χ^2) test was used to examine differences in the frequency of *P. agglomerans* isolation among the five sampling sites. A p-value of <0.05 was considered statistically significant.

Results

As summarized in (**Table 1**), The results of the present study demonstrated the isolation of *Pantoea agglomerans* from different environmental sites within the operation unit. A total of 96 isolates of *P. agglomerans* were recovered from 300 collected samples from the cardiac surgery unit, representing an overall prevalence rate of (32%). The highest isolation rate was observed in samples collected from suction systems, where 29 isolates were recovered from 60 samples (48.3%). Lower isolation rates were detected from floor surfaces (31.6%), beds (28.3%), doors (26.6%), and nurses' hands (25%). These findings suction systems showed the highest recovery frequency and may represent a potential environmental niche for *P. agglomerans* persistence.

Table 1. The number and percentage of *Pantoea agglomerans* isolated from different locations of Cardiac Surgery Unit of Al-Sader Teaching Hospital

Location	**No. of Samples**	**No. of *Pantoea agglomerans***	**%**
Suction system	60	29	48.3
Floor	60	19	31.6
Bed	60	17	28.3
Door	60	16	26.6
Nurse hands	60	15	25
Total	300	96	32

Statistical analysis showed a significant difference in the frequency of *P. agglomerans* isolation among the five sampling locations ($\chi^2 = 9.87$, df = 4, p = 0.043). The higher recovery rate from suction systems suggests that this site may provide conditions that favor persistence of the organism compared with the other sampled locations; however, the specific environmental factors responsible were not directly measured in this study.

All 96 isolates showed positive reactions for catalase, Simmons citrate utilization, and motility, whereas indole and hydrogen sulfide (H_2S) production were negative. Additional biochemical reactions were consistent with the identification of *P. agglomerans*. Confirmation with API 20E showed the same biochemical profile among the 96 isolates. The isolates were aerobic and utilized galactose, lactose, glucose, arabinose, mannitol, inositol, rhamnose, maltose, and melibiose. They were also positive for the Voges–Proskauer reaction and citrate utilization and negative for indole production.

Antimicrobial susceptibility evaluation displayed remarkable divergence among the tested agents. Ampicillin exhibited the highest resistance rate, with 87 of 96- isolated resistant (90.63%) and none- classified ones as sensitive. Additionally, Resistance was recurring with carbenicillin (73.96%), gentamicin (71.88%), and amikacin (68.75%). Resistance to cefotaxime and tetracycline was 50.0% for each, while the corresponding rates for streptomycin and tobramycin were 48.96% and 44.79%, respectively. Lower resistance rates were observed with ceftazidime (28.13%), piperacillin (20.84%), and imipenem (11.46%).

Colistin showed the highest proportion of susceptible isolates, with 84/96 (87.50%) classified as sensitive. Imipenem was also active against most isolates, with 72/96 (75.00%) sensitive. Sensitivity to ceftazidime and piperacillin was 60.41% and 59.37%, respectively. The remaining susceptibility rates were 47.92% for tobramycin, 42.70% for tetracycline, and 40.63% for streptomycin. Overall, the isolates showed resistance to several antimicrobial agents, particularly agents belonging to the β-lactam and aminoglycoside groups, while colistin and imipenem retained the greatest activity in this collection.

Table 2. Antibiotic susceptibility of *Pantoea agglomerans.* N= 96

Antibiotic	Resistance n (%)	Intermediate n (%)	Sensitive n (%)
Ampicillin	87 (90.63)	9(9.37)	0(0)
Carbenicillin	71 (73.96)	17 (17.7)	8(8.34)
Ceftazidime	27 (28.13)	11 (11.46)	58 (60.41)
Cefotaxime	48 (50)	19 (19.80)	29 (30.20)
Imipenem	11 (11.46)	13 (13.54)	72 (75.00)
Streptomycin	47 (48.96)	10(10.41)	39 (40.63)
Amikacin	66 (68.75)	9 (9.37)	21 (21.88)
Gentamicin	69 (71.88)	12 (12.50)	15 (15.62)
Tobramycin	43 (44.79)	7 (7.29)	46 (47.92)
Piperacillin	20 (20.84)	19 (19.79)	57 (59.37)
Colistin	3 (3.13)	9 (9.37)	84 (87.50)
Tetracycline	48 (50)	7 (7.30)	41 (42.70)

Discussion

In this study, *Pantoea agglomerans* was isolated from 96 of 300 environmental samples collected from the cardiac surgery unit, corresponding to an overall isolation rate of 32%. This rate was higher than the 12.6% reported by Al-Kidsawey and Mhdi, who recovered the organism from 19 of 150 samples obtained from an open-heart operations unit at Marjan Hospital in Iraq [11]. The difference between the two studies may be related to differences in sampling procedures, hospital conditions, environmental characteristics, and the periods during which samples were collected. The present findings nevertheless show that *P. agglomerans* was distributed across several sites within the investigated cardiac surgery unit.

The highest isolation rate was found in suction systems (48.3%). This finding is biologically plausible because equipment that remains moist may provide conditions that support bacterial survival and biofilm formation [12]. Nevertheless, moisture and biofilm formation were not measured directly in the present study, so this explanation should be regarded as a possible factor rather than a demonstrated cause. The biochemical characteristics of the recovered isolates were compatible with the phenotypic diversity previously described for *P. agglomerans* [13]. The agreement between the conventional biochemical tests and API 20E identification also supports the use of these phenotypic methods for routine identification of the organism.

Antimicrobial susceptibility testing showed high resistance to several agents. Ampicillin (90.63%) was recorded as the greatest resistance, followed by carbenicillin, gentamicin, and amikacin in (71.88%), (73.96%), and (68.75%) ratio respectively. These outcomes point to reduced susceptibility to β-lactam and aminoglycoside-containing drugs. The ampicillin resistance proportion in the recent study was higher than that reported by Masoud et al. in *P. agglomerans* bloodstream isolates from a neonatal intensive care unit [14]. Such disparity could reflect variations in isolate source, exposure to antimicrobials, practices of local prescribing, and selection pressure within the particular environments. A previous study has also characterized numerous resistance-related features in *Pantoea*, strengthening the need for susceptibility testing of locally recovered isolates rather than presuming a pattern of uniform resistance [15].

The presence of resistance to numerous antimicrobial agents is related to an infection-control perspective. Susceptible patients could be reservoirs of opportunistic organisms on hospital equipment and environmental surfaces. *P. agglomerans* has been related to opportunistic infections, involving infections recorded in vulnerable populations [16]. Consequently, even though *P. agglomerans* is less commonly deliberated than major healthcare-associated pathogens,

the recovery of isolates with decreased antimicrobial susceptibility from a cardiac surgery environment merits attention. The biochemical profile gained in this survey is also concerned with the values of classic biochemical reactions in bacterial differentiation [17]. Surveys from plant-associated settings further demonstrate the broad ecological allocation of *P. agglomerans* [18], whereas general fundamentals of infectious-disease pathogenesis point that environmental microorganisms could become clinically relevant when they face susceptible hosts [19].

At all five sampling locations, detection of *P. agglomerans* endorses the value of pursuing surveillance of specialized hospital unit environments. The important measures for limiting the persistence and spread of environmental organisms can include cleaning and disinfection, environmental monitoring, appropriate antimicrobial use, and consistent infection-control procedures [20]. Antimicrobial-resistance surveillance systems likewise reiterate the relevance of surveillance of patterns of local resistance over time [21]. The ecological diversity of *P. agglomerans* has been recorded in various environments [22], and previous surveys have underlined both its versatility and its potential to be considered as an opportunistic pathogen [23]. In healthcare facilities, healthcare-associated infection records further emphasize the significance of environmental surveillance [24]. Phenotypic characterization of bacterial isolates can be assisted by metabolic trait variation, involving carbohydrate utilization [25].

The important association between sampling location and isolation frequency ($\chi^2 = 9.87$, $p = 0.043$) points that *P. agglomerans* was recovered unevenly via the investigated sites. The notably high rate of recovery from suction systems could be connected to their biofilm formation under both most of their conditions and possible, even though these factors were indirectly assessed. Further surveys integrating environmental measurements and molecular characterization could assist in identifying the reason this site resulted in numerous isolates and whether the recovered strains are widely epidemiologically connected.

Conclusion

Pantoea agglomerans was recovered from various environmental sites of the cardiac surgery unit of Al-Sader Teaching Hospital, with 32% as an overall isolation rate. The suction systems had the highest recovery rate, followed by floors, beds, doors, and nurses' hands. The considerable variations among sampling sites demonstrate that contamination was unevenly distributed within the unit. The isolates also displayed high resistance to many commonly examined antimicrobial agents, especially ampicillin, carbenicillin, gentamicin, and amikacin, while colistin and imipenem revealed the highest percentage of susceptible isolates. These outcomes endorse the continued monitoring of environmental contamination and antimicrobial susceptibility in high–risk hospital districts, along with adequate cleaning and disinfection, infection govern practices, and antimicrobial stewardship.

Funding

This research has not received any external funding

References

1. Mardaneh J, Pouresmaeil O. Pantoea Agglomerans: An Emerging Pathogen in Hospitals and Foods, A Narrative Review. Reviews in Clinical Medicine. 2024;11(2).

2. Walterson AM, Stavrinides J. Pantoea: insights into a highly versatile and diverse genus within the Enterobacteriaceae. FEMS Microbiology Reviews. 2015;39(6):968–984.

3. Lorenzi AS, Bonatelli ML, Chia MA, Peressim L, Quecine MC. Opposite sides of Pantoea agglomerans and its associated commercial outlook. Microorganisms. 2022; 10:2072.

4. Dutkiewicz J, Mackiewicz B, Lemieszek MK, Golec M, Milanowski J. *Pantoea agglomerans*: a mysterious bacterium of evil and good. Part III. Deleterious effects: infections of humans, animals and plants. Ann Agric Environ Med. 2016;23(2):197–205.

5. Cruz AT, Cazacu AC. Emerging clinical significance of Pantoea species in healthcare settings. J Clin Microbiol. 2023;61(8): e00234-23.

6. Bonadonna L, Briancesco R, Coccia AM. Analysis of microorganisms in hospital environments and potential risks. In: Indoor Air Quality in Healthcare Facilities. Cham: Springer; 2017. p. 53–62.

7. Quecine MC, Lorenzi AS, Bonatelli ML. Ecological diversity and pathogenic potential of *Pantoea agglomerans*. Microorganisms. 2022;10(10):2072.

8. Sánchez-Romero MI, Moya JMG, López JJG, Mira NO. Collection, transport and general processing of clinical specimens in microbiology laboratory. Enferm Infecc Microbiol Clin. 2019;37(2):127–134.

9. Hafezi A, Khamar Z. The method and analysis of some biochemical tests commonly used for microbial identification: a review. Comprehensive Health and Biomedical Studies. 2024;3(3).

10. Bauer AW, Kirby WMM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. American Journal of Clinical Pathology. 1966;45(4):493–496.

11. Al-Kidsawey ER, Mhdi KH. Isolation and Identification of *Pantoea agglomerans* from Open Heart Operations Unit of Marjan Hospital in Hilla City. Indian J Forensic Med Toxicol. 2020;14(1).

12. Centers for Disease Control and Prevention (CDC). Environmental Infection Control Guidelines for Healthcare Facilities. Atlanta, USA; 2023.

13. Bonaterra A, Badosa E, Rezzonico F, Duffy B, Montesinos E. Phenotypic comparison of clinical and plant-beneficial strains of Pantoea agglomerans. Int Microbiol. 2014;17(2):81–90.

14. Masoud SS, Majigo M, Gangji RR, Nyawale H, Ntukula A, Msafiri F, et al. Occurrence of *Pantoea agglomerans* bloodstream infection in neonatal intensive care unit at tertiary hospital in Tanzania: antibiotic susceptibility profile and clinical outcome. Bull Natl Res Cent. 2024;48(1):52.

15. Saticioglu IB, Duman M, Altun S. Antimicrobial resistance and molecular characterization of *Pantoea agglomerans* isolated from rainbow trout (Oncorhynchus mykiss) fry. Microb Pathog. 2018; 119:131–136.

16. Nanou C, Tzoraki M, Apostolidi DM, Metallinou D, Nanou CI. *Pantoea agglomerans* infection in neonates: A systematic review of case reports. Cureus. 2024;16(6):e62041.

17. AL-Joda BMS, Jasim AH. Biochemical testing revision for identification several kinds of bacteria. J Univ Babylon Pure Appl Sci. 2021;29(2):168–176.

18. Sherafati F, Khodaygan P, Azadvar M, Sedaghati E, Saberi-Riseh R, Baghaee-Ravari S. Association of *Pantoea agglomerans* with the citrus bacterial canker disease in Iran. J Crop Prot. 2014;3(3):345–355.

19. Nash AA, Dalziel RG, Fitzgerald JR. Mims' Pathogenesis of Infectious Disease. 6th ed. London: Academic Press; 2015.

20. World Health Organization (WHO). Global Report on Infection Prevention and Control. Geneva: WHO; 2022.

21. World Health Organization (WHO). Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report 2024. Geneva: WHO; 2024.

22. Dutkiewicz J, Mackiewicz B, Lemieszek MK, Golec M, Milanowski J. Pantoea agglomerans: a mysterious bacterium of evil and good. Part IV. Beneficial effects. Ann Agric Environ Med. 2016;23(2):206–222.

23. Mardaneh J, Dallal MMS. Isolation, identification and antimicrobial susceptibility of *Pantoea* (Enterobacter) *agglomerans* isolated from consumed powdered infant formula milk (PIF) in NICU ward: First report from Iran. Iranian Journal of Microbiology. 2013;5(3):263–267.

24. Centers for Disease Control and Prevention (CDC). Healthcare-Associated Infections Progress Report. Atlanta, USA; 2024.

25. Buron-Moles G, Chailyan A, Dolejs I, Forster J, Mikš MH. Uncovering carbohydrate metabolism through a genotype-phenotype association study of 56 lactic acid bacteria genomes. Appl Microbiol Biotechnol. 2019;103(7):3135–3152.