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Detection of Bacterial Contaminants on Gate Passes Issued to Motorists in Federal University Dutse, Northwest Nigeria

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Abstract

The study was conducted to isolate and identify possible bacterial contaminants on the gate passes issued to motorists in the three (3) major gates leading to Federal University Dutse. Swab stick method was employed to sample possible bacterial contaminants from seventy (70) gate passes. Sampling was done at the end of the daily activities to maximize the chances of isolating bacteria that might be present thereon. The swab sticks labelled S1 to S70, were instantaneously taken to the Microbiology laboratory with a view to conducting bacteriological analysis by means of customary microbiological methods. Plate colony count method was adopted to compute the number of bacteria present on the sampled gate passes. 'Results generated on the total viable count show that S31 sampled from gate two had the highest load (1.68×10^{-2} CFU/mL) while S43 sampled from the same gate recorded the lowest load (0.34×10^{-3} CFU/mL). Four (4) bacteria; Escherichia coli, Staphylococcus aureus, Klebsiella sp. and Salmonella sp. were detected on the sampled gate passes. All the gate passes issued to motorists coming in and out of the Federal University Dutse were contaminated with different bacteria most of which are known to be pathogenic. Due to the results derived from this study, it is therefore suggested that the University authority should make available hand antiseptics for motorists and security staff handling the gate passes in order to minimize and prevent the spread of pathogenic bacteria.

1. Introduction

A gate pass is an essential card that is issued with a view to monitoring vehicular movement in and out of an organization. The issuance of gate passes is done to ensure that the information regarding incoming and outgoing cars on campus is duly documented. In Federal University Dutse, a typical gate pass is usually a 4 × 4 inches' plastic card with unique number engraved thereon. It is issued at the gate by security men once cars drive into the University and also collected back on exit. According to Aliyu et al. (2018), the gate pass card is essential in preventing car theft and other materials belonging to an organization and as such important document for car owners working in the organization. The health-risks linked with toilet conveniences, office equipment and other fomites have been documented in the literature nonetheless less devotion has been focused on the lock handles of toilets and offices coupled with gate passes as lifeless items which could harbour and spread communicable agents (Amala et al., 2015). Innumerable bacteria have been isolated from municipal façades thus providing data on the comparative cleanliness of public surfaces that are frequently interacted with as well as recognizing the environments with pollutants and risk of contacts (Reynolds et al., 2005). According to Australian Academy of Science (2022), numerous possible communicable bacteria, yeasts, viruses and moulds have the adaptive capability of surviving over a long period of time on surfaces and can potentially transmit diseases in the process.

Students' and lecturers' hands seem to be the most common vector of bacterial infections, although food served within lecture rooms, as well as educational equipment and table surfaces have also been implicated (Roberts et al., 2011). Bacterial contaminants can be found on the surfaces of items that are being touched by humans or transferred between many people. The blend of continuous usage coupled with the heat manufactured by gate passes produces a key reservoir for many microorganisms that are customarily present on the skin of humans (Al-Adalal, 2010). Owing to available literature that has established the dangers associated with disease transmission through fomites, this study was conducted to isolate and identify bacterial contaminants present on the gate passes that are being circulated to motorists, most especially staff members of Federal University Dutse with a view to confirming its safety status on the general public that always comes in contact with it.

2. Materials and Methods

2.1 Sampling Area

A bacteriological survey was piloted at the three (3) main gates on the campus of Federal University Dutse. According to Falnyi *et al.* (2022), Dutse which is the headquarter of Jigawa State lies on latitude of 11042'8.46" N and longitude of 9020'2.46" E.

2.2 Sample Size

The sampled gate passes were derived from the method reported by Yamane (1976)

$N/1+N(e)^2$

Where N=80, e=0.05

$80/1+80(0.05)^2$

$80/1+80(0.0025)$

$80/1+0.2$

$80/1.2=66.6$

Therefore, seventy (70) gate passes were selected for bacteriological examination.

2.3 Collection and Swabbing of Gate Passes

The gate passes were collected for swabbing from the three (3) main gates in the University at the end of the daily activities to maximize the chances of isolation of bacteria that might be present thereon. The swab sticks employed were dampened with five (5) mL of saline water that was poured into the swab stick case and excess were taken out as reported by Cheesebrough (2000). Individual dampened sterile cotton swab was employed to swab the gate passes. This was done via a tri-directional approach; up/down, left/right and obliquely. The swab sticks were successively plugged and appropriately labelled. The swabbed samples were instantaneously conveyed to the laboratory in a cooler stocked with ice cubes for onward bacteriological analysis.

2.4 Inoculation and Incubation of Samples

Each sample was inoculated on basal media; Nutrient Agar (NA) and MacConkey agar (MA) plates. The media were prepared following the instructions of the manufacturer (Himedia Limited). A preliminary streak was made by using the labelled swab sticks, before a flame-sterilized wire loop was employed to make the secondary and tertiary streaks in parallel pattern, with the wire loop sterilized before carrying out each succeeding step so as to attain a four-way streak plate-technique aseptically. The plates were subsequently placed in the incubator at 37 $^{\circ}$C in an inverted position for a day.

2.5 Plate Count

The procedure reported by Bichanan *et al*. (1994) was employed to count the bacterial colonies that grew on the plates. Using sterile water, the samples were serially diluted by adopting different dilution ratios; 1:10, 1:100, 1:1000 and so on. It was later cultivated on NA plates that were sealed, labeled and incubated appropriately. For the purpose of counting the bacterial isolates present on the sampled gate passes, plate count agar was employed for a general count while MA was employed for counting *E. coli.* Characteristically, one set of plates was incubated at 22 °C while the second set was incubated at 37 °C for a day. Having incubated the plates, the colonies that developed were counted accordingly.2.6 Determination of Bacterial Counts

2.6 Determination of Bacterial Counts

Having incubated the plates, bacterial colonies that developed were mathematically expressed as colony forming unit per milliliter of the sample (CFU/mL);

CFU/mL= Number of colonies × Dilution factor/Amount plated

2.7 Sub-culturing and Purification of Colonies

After overnight incubation, each plate of NA and MA was removed from the incubator and presumptively identified. Colonies obtained were further sub-cultured on NA, Eosin Methylene Blue (EMB) agar and Salmonella-Shigella-Agar (SSA).

2.8 Gram Staining of Bacterial Isolates and Biochemical Characterization Tests

Gram staining of bacterial isolates was conducted by adopting the procedure reported by Olutiola *et al.* (2000). Indole, Voges–Proskauer (VP) and catalase tests were conducted as reported by Aryal (2019). Coagulase, citrate and methyl red (MR) tests were done following the procedures reported by Aryal (2018).

3. Results and Discussion

The results of the bacterial load detected on the gate passes assayed in this study are depicted in Tables 1, 2 and 3. It can be deduced that S31 from gate two had the highest bacterial load (1.68×10^{-2} CFU/mL) while S43 from the same gate recorded the lowest bacterial load (0.34×10^{-3} CFU/mL) (Table 2).

Table 1: Bacterial Loads in Gate Passes Sampled from Gate One

Samples	Number of Colonies	CFU/mL
S1	162	1.30×10^{-2}
S2	158	1.26×10^{-2}
S3	146	1.17×10^{-2}
S4	154	1.23×10^{-2}
S5	182	1.46×10^{-2}
S6	136	1.09×10^{-2}
S7	152	1.22×10^{-2}
S8	132	1.06×10^{-2}
S9	102	0.82×10^{-2}
S10	101	0.08×10^{-2}
S11	92	0.74×10^{-3}
S12	82	0.66×10^{-3}
S13	112	0.90×10^{-3}
S14	106	0.85×10^{-3}
S15	122	0.98×10^{-3}
S16	116	0.93×10^{-3}
S17	103	0.82×10^{-3}
S18	98	0.78×10^{-3}
S19	108	0.86×10^{-3}
S20	68	0.54×10^{-3}

Note: CFU/mL= Number of colonies × dilution factor /volume of agar

Table 2: Bacterial Loads in Gate Passes Sampled from Gate Two

Samples	Number of Colonies	CFU/mL
S21	72	0.58×10^{-3}
S22	86	0.69×10^{-3}
S23	99	0.79×10^{-3}
S24	94	0.75×10^{-3}
S25	78	0.62×10^{-3}
S26	172	1.38×10^{-2}
S27	101	0.08×10^{-2}
S28	166	1.33×10^{-2}
S29	204	1.63×10^{-2}
S30	84	0.67×10^{-3}
S31	210	1.68×10^{-2}
S32	203	1.62×10^{-2}
S33	162	1.30×10^{-2}
S34	58	0.46×10^{-3}
S35	53	0.42×10^{-3}
S36	72	0.58×10^{-3}

S37	98	0.78×10^{-3}
S38	88	0.70×10^{-3}
S39	138	1.10×10^{-2}
S40	96	0.77×10^{-3}
S41	146	1.17×10^{-2}
S42	86	0.69×10^{-3}
S43	43	0.34×10^{-3}
S44	91	0.73×10^{-3}
S45	52	0.42×10^{-3}
S46	130	1.04×10^{-2}
S47	121	0.97×10^{-3}
S48	132	1.06×10^{-2}
S49	76	0.61×10^{-3}
S50	69	0.55×10^{-3}

Note: CFU/mL= Number of colonies × dilution factor /volume of agar

Table 3: Bacterial Loads in Gate Passes Sampled from Gate Three

Samples	Number of Colonies	CFU/mL
S51	172	1.38×10^{-2}
S52	192	1.54×10^{-2}
S53, S67	162	1.30×10^{-2}
S54	158	1.26×10^{-2}
S55	106	0.85×10^{-3}
S56	184	1.47×10^{-2}
S57	102	0.82×10^{-3}
S58	77	0.62×10^{-3}
S59	180	1.44×10^{-2}
S60	78	0.62×10^{-3}
S61	196	1.57×10^{-2}
S62, S66	103	0.82×10^{-3}
S63	201	1.61×10^{-2}
S64	182	1.46×10^{-2}
S65	175	1.40×10^{-2}
S68	140	1.12×10^{-2}
S69	112	0.90×10^{-3}
S70	84	0.67×10^{-3}

Note: CFU/mL= Number of colonies × dilution factor /volume of agar

The results of the colonial attributes of the isolated bacteria are presented in Table 4. It can be seen that S2, S3, S4, S5, S6, S10, S11, S12, S17, S19, S20, S30, 31, S32, S33, S34, S35, S40, S41, S48, S49, S50, S51, S57, S59, S60. S62, S63, S65, S66, S67 and S68 appeared color less on SSA while the colonies appeared showed no growth on EMB (Table 4).

Table 4: Colonial Attributes of the Bacterial Isolates on Agar Media

Samples	SSA	EMB
S2, S3, S4, S5, S6, S10, S11, S12, S17, S19, S20, S30, 31, S32, S33, S34, S35, S40, S41, S48, S49, S50, S51, S57, S59, S60. S62, S63, S65, S66,S67, S68	Colourless colonies	No growth
S7, S21, S22, S23, S24, S42, S43, S44, S45, S46, S47, S70.	Pale cream colonies	Pink to Purple colonies
S8, S9, S36, S37, S52, S53, S54, S51, S61, S69	Colourless colonies	Grey colonies
S1, S13, S14, S15, S16 S18, S25, S26, S27, S28, S29, S38, S39, S56, S58, S64	Pink to red colonies	Metallic green sheen colonies

However, S7, S21, S22, S23, S24, S42, S43, S44, S45, S46, S47 and S70 appeared in pale cream colour on SSA and in pink purple colour on EMB (Table 4). Also, S8, S9, S36, S37, S52, S53, S54, S51, S61 and S69 appeared

colourless on SSA and grey colour on EMB (Table 4). S1, S13, S14, S15, S16 S18, S25, S26, S27, S28, S29, S38, S39, S56, S58 and S64 appeared pink to red colonies on SSA and in metallic green sheen on EMB (Table 4). It can be observed in Table 5 that two (2) distinct morphological characteristics; gram positive cocci in cluster and gram negative (rod shape) were seen microscopically (Table 5). The various biochemical tests done on the bacterial isolates leading the identification of *Escherichia coli, Staphylococcus aureus, Salmonella* sp. and *Klebsiella* sp. as being the bacteria that were inherently present on the gate passes during sampling (Table 6). It can be specifically observed that *Staphylococcus aureus* tested positive to only catalase and coagulase test (Table 6).

Table 5: Morphological characteristics of the bacterial isolates

Colonial characteristics		Gram staining
SSA	EMB	
Pink colonies	Metallic green sheen colonies	Gram –ve rod shape
Colourless colonies	yellow colonies	Gram +ve cocci in clusters
Pale cream colonies	Purple colonies	Gram –ve rod shape
Colourless colonies	Grey colonies	Gram –ve rod shape

Note: +ve= positive; -ve= negative

Table 6: Characterization of bacterial isolates using biochemical tests

Morphology	CT	CA	ID	MeR	CR	VoP	Identity
G –ve RS	-	-	+	-	-	+	*Escherichia coli*
G +ve CC	+	+	-	-	-	-	*Staphylococcus aureus*
G –ve RS	+	-	-	-	+	+	*Klebsiella* sp.
G –ve RS	+	-	-	+	-	-	*Salmonella* sp.

Note: G –ve RS= Gram negative rod shape; G +ve CC= Gram positive cocci in clusters CT = Catalase; CA = Coagulase; ID = Indole; MeR= Methyl Red; CR= Citrate, VoP= Voges-Proskeur

With the exception of *Staphylococcus aureus*, all other three organisms tested negative to coagulase test. According to Ryan *et al*. (2004), coagulase is a protein enzyme manufactured by numerous microorganisms which facilitates fibrinogen conversion to fibrin. Coagulase test done in this study was meant to differentiate between many types of *Staphylococcus* species. As witnessed in this study, negative results other than *Escherichia coli* was significant in the identification of Enterobacteriacae due to the fact that most strains of *Escherichia coli*, *Proteus vulgaris, Providencia rettgeri*, *Morganella morganii* and *Providenicia* sp. are capable of breaking down amino acid tryptophan resulting in the onward evolution of indole (Aliyu *et al*., 2018). Twenty samples that were subjected to bacteriological analysis from gate three, were mostly detected to be contaminated with *Staphylococcus aureus* followed by *Klebsiella* sp. However, *E. coli* and *Salmonella* spp were also detected as well. Gate passes from gate two had the highest contamination. This can be attributed to the fact that it is the most used gate in terms of traffic as most of the students, staff members, and some other personalities visiting the girls' hostels go in and out of the gate. Gates one and two that lead to the senate building and other faculties recorded sizable number of bacterial loads as well respectively. This finding can again be attributed to its usage by other staff members and construction workers that access the campus through the gates as the school is still under construction. The results obtained in this study showed that the gate passes issued at the Federal University Dutse, Jigawa State were contaminated with different bacteria most of which are known to be pathogenic. These findings are in agreement with other studies conducted in Nigeria on frequently touched fomites ranging from door knobs, naira notes, mobile phones and automated teller machines (Ameh and Balogun, 1997; Ogo *et al.,* 2011; Orukotan and Yabaya, 2011; Rozario *et al.,* 2020).

4. Conclusion

It can be concluded that all the sampled gate passes recorded bacteriological contaminants in this study. *Staphylococcus aureus*, *Escherichia coli*, *Salmonella* sp. and *Klebsiella* sp. were isolated on the gate passes examined. However, gate passes sampled from gate two recorded the most and least bacterial loads. Majority of the bacteria isolated from the gate passes are known to be pathogenic thereby having the potential to cause infections in humans if inadvertently ingested. The findings recorded in this study have further established that public contact surfaces such as gate passes are habitually populated by numerous bacterial contaminants implying that pathogenic bacteria capable of initiating public health crisis can be picked up thereon. Transmission of these infections can easily occur though contact with hands.

5. Recommendations

Owning to the results obtained from this study, hand sanitizers should be provided by the University authority for the users of these gate passes in order to minimize and prevent the spread of pathogenic bacteria detected on the gate passes. It is advisable that motorists that come in contact with the gate passes issued in the three gates available on the campus of Federal University Dutse should practice effective hand washing having had contact with such.

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