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Microbial Assessment of Bed Linens in Ekiti State University Students' Hostels

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Authors' contributions

This work was carried out in collaboration among all authors. Authors TOO and JOO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AOO and DTM managed the analyses of the study. Author AOO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Bed linen is clearly recognized as a potential reservoir for microorganisms and could be a vector of disease transmission. The present study was aimed at isolating and characterizing bacteria and fungi from different kinds of bed linen of student in Ekiti State University hostels. Pour plate method was used for the enumeration of total bacteria count from the posterior and anterior end of the bed linen. The average bacteria count for the anterior and posterior end was 7.46 and 7.16 Log_{10} CFU/ml respectively. The most dominant microbial species were bacteria and these were mostly found in the environment and on human skin. The bacteria isolated were *Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis, Enterobacter aerogenes, Bacillus cereus, Escherichia coli and Klebsiella aerogenes. Bacillus cereus* had the highest frequency of occurrence (25%), followed by *Staphylococcus aureus* (15%), *Escherichia coli* (15%), *Klebsiella aerogenes* (15%), *Staphylococcus epidermis* (15%), *Enterobacter aerogenes* (10%) and *Proteus mirabilis* (5%). The fungi isolates were *Aspergillus sulphureus, Aspergillus fumigatus, Aspergillus niger, Aspergillus flavus* and *Fusarium* spp. Antibiotics susceptibility test was carried out on the bacteria isolates with gram negative bacteria showing resistance to Cotrimoxazole and gram positive bacteria showing resistance to Amplicillin. Most of the bacteria isolates have multiple antibiotics

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resistance. The bacterial isolates were susceptible to Ciprofloxacin. Plasmid profiling was also done with *Escherichia coli* having three high molecular weight plasmids, *Bacillus cereus* and *Enterobacter aerogenes* do not possess plasmid. The identified species are suspected to be opportunistic pathogens for human, representing a risk for people with weakened immune system, especially in cases of super-infection.

Keywords: Bed linens; antibiotic resistance; microbial load; plasmid profile.

1. INTRODUCTION

Majority of University students engage in their busy academic schedules during the day and usually find comfort in their beds in the evening time till day break. Due to stress encountered during the school hours, most of them just jump on their beds to relax. In the process, microorganisms encountered from different contacts are being transferred to their beds. These microbes can as well find their way during the production of the beddings through airborne contamination. The potential for spread from linens was demonstrated by Shiomori et al. [1] who determined numbers of surface and airborne MRSA before, during and after bed making for 13 in patients with MRSA (Methillin resistance *Staphylococcus aureus*) infection or colonization in a Japanese hospital. Fungal spores released by soil fungi into the wind can be a natural mechanism of transportation. When clothing come in contact with these spores, it can serve as source of fungal infections [2]. Some individuals love pets so much that they allow them on their beddings not minding the microbial load on the animals. This can pose a serious public health risk because they may contain microorganisms that are both pathogenic to humans and resistant to several classes of antibiotics [3].

Skin is a home to diverse microorganisms normally associated with skin cells, sweat, sputum, and vaginal and anal excretions [4], some of which promote immunity or fight invaders. Most of these microbes are there to help to protect humans from pathogenic invaders and help the immune system to maintain delicate balance between protection and damaging inflammation. As we have microbes that are beneficial to our health, there are also pathogenic organisms which are disease causing organisms and can also cause death due to their accumulation on the body.

However, in instances where an individual is immune-compromised, has an underlying infection, or has other predisposing factors such as asthma that makes them susceptible to infectious diseases, the environment in which a person finds themselves may have a strong effect on their health [5].

Regular washing of bed linens with detergents and spreading in the sun are means of eliminating these microbes. Unfortunately, many of these students don't practice such hence, exposed to the risks posed by these microbes and also the possibility of transfer of different infections among the students.

The huge impact of the student's health on their academic performances prompted this study, to assess the microbial load of bed linens in students' hostels and determine the antibiotic resistance and plasmid profile of these organisms.

2. MATERIALS AND METHODS

2.1 Collection of Samples

Ten rooms selected randomly in different hostels were taken into consideration, two samples were taken from each room (one from the upper part of the linen and the other from the lower part of the linen). Sterile swab sticks moistened in normal saline were used to pick samples from the bed lines. The swab sticks were immediately transported to the laboratory for microbial analyses.

2.2 Media for Isolation and Enumeration

The following media were used for the isolation and enumeration of microorganisms: Nutrient agar, Plate Count Agar, Nutrient broth, Potato Dextrose agar, Malt Extract agar and Mac-Conkey agar. Each of the media used was prepared and sterilized according to manufacturer's specifications.

2.3 Isolation and Enumeration of Bacteria and Fungi from Bed Linens

The swap sticks were dipped into nutrient broth for 15 minutes at room temperature. The swab

sticks were removed and the broth served as the stock sample. Ten-fold serial dilution was carried out on the samples. Dilutions 10^{-5} and 10^{-6} were plated in duplicates using pour-plate method. Nutrient agar and Mac-Conkey agar plates were incubated at 37°C for 24 h while Malt Extract agar plate were incubated at 25°C for 3-5 days [6]. After incubation, developed colonies on the plates were counted and recorded. Colonies on nutrient agar were recorded as total bacteria count (CFU/ml) while that of Malt Extract agar was recorded as total Fungal count.

Colonies from culture plates were sub-cultured on a fresh plate by streaking sequentially until pure culture was obtained. The pure cultures were stored on slants and stored at 4°C till further analysis.

2.4 Morphological and Biochemical Characterization of Bacteria Isolates from Bed Linen

The tests carried out on the isolates includes: Catalase test, coagulase test, motility test, indole production, citrate production, oxidase test, MR, VP, urease test, glucose utilization, hydrogen sulphide production [7,8]. The fungi isolates were identified by using their morphological characteristics as compared with literatures.

2.5 Antimicrobial Susceptibility Test

The bacteria isolates were tested against a panel of 10 antibiotics using disk diffusion method. The multi-disk contained antibiotics that are specific for gram positive bacteria as well as the one specific for gram negative bacteria. Gram positive antibiotics contains Streptomycin (30 µg), Ciprofloxacin (10 µg), Ceftriaxone (25 µg), Amoxacillin (30 µg), Cefuroxime (20 µg), Ampicillin (30 µg), Gentamycin (10 µg), Pefloxacin (10 µg), Erythromycin (10 µg) and Cotrimoxazole (30 µg). Gram negative antibiotic disk contains Sparfloxacin (10 µg), Ciprofloxacin (30 µg), Amoxacillin (30 µg), Amoxicillin (10 µg), Gentamycin (30 µg), Pefloxacin (30 µg), Ofloxacin, (10 µg), Cotrimoxazole (30 µg) and Chloramphenicol (30 µg).

The zones of inhibition were measured to the nearest millimeter using a transparent ruler. The bacteria isolates were identified as susceptible, intermediate or resistant according to the National Committee for Clinical Laboratory Standards Guidelines (CLSI) [9]. All the isolates that showed intermediate reaction to antimicrobial agents were considered as resistant. Based on the clinical breakpoints, a set which uses minimum inhibitory concentration (MIC) measurements defined as the lowest concentration of an antimicrobial that will inhibit the visible growth of a microorganism after overnight incubation [10].

2.6 Plasmid Isolation

Plasmids were isolated using the QIAGEN Plasmid Purification mini kit. The analysis was carried out described by the manufacturer of the kits.

2.7 Gel Integrity

The integrity of the extracted plasmid was checked on a 1% Agarose gel ran to confirm amplification. The buffer (1XTAE buffer) was prepared and subsequently used to prepare 1% agarose gel. The suspension was boiled in a microwave for 5 minutes. The molten agarose was allowed to cool to 60°C and stained with 3 µl of 0.5 g/ml ethidium bromide (which absorbs invisible UV light and transmits the energy as visible orange light). A comb was inserted into the slots of the casting tray and the molten agarose was poured into the tray. The gel was allowed to solidify for 20 minutes to form the wells. The 1XTAE buffer was poured into the gel tank to barely submerge the gel. Two microliter (2 l) of 10X blue gel loading dye (which gives colour and density to the samples to make it easy to load into the wells and monitor the progress of the gel) was added to 10 µl of each PCR product and loaded into the wells after the 100-3000 bp DNA ladder was loaded into well 1. The gel was electrophoresed at 120V for 45 minutes visualized by ultraviolet trans-illumination and photographed. The sizes of the PCR products were estimated by comparison with the mobility of the molecular weight ladder that was run alongside experimental samples in the gel.

3. RESULTS

3.1 Total Bacteria Count of Bed Linens in Ekiti State University Hostels

The mean total bacteria count (Log_{10} CFU/ml) from the anterior end of the bed linens from rooms A, B, C, D, E, F, G, H, I and J were 8.06, 7.71, 8.18, 8.20, 7.86, 6.28, 7.10, 7.56, 7.29 and 6.58 respectively while that of the posterior end of the bed linens from the rooms were 7.65, 7.30,

7.48, 7.74, 7.84, 7.18, 6.50, 7.26, 6.48 and 6.20 respectively. The average bacteria count for the anterior and posterior end was 7.40 Log_{10} CFU/ml and 7.16 Log_{10} CFU/ml respectively (Fig. 1).

3.2 Frequency of Occurrence of Bacteria Isolates from Bed Linens in Ekiti State University Hostel

The research findings revealed that *Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis, Enterobacter aerogenes, Bacillus cereus, Escherichia coli, Klebsiella aerogenes* were the main bacterial isolates frequently associated with the bed linens. *Bacillus cereus* had the highest frequency of occurrence (25%), followed by *Staphylococcus aureus* (15%), *Escherichia coli* (15%), *Klebsiella aerogenes* (15%), *Staphylococcus epidermis* (15%), *Enterobacter aerogenes* (10%) and *Proteus mirabilis* (5%) (Table 1).

3.3 Distribution of Bacteria on Bed Linen from Different Rooms

Table 2 shows the distribution of bacteria isolates in rooms analyzed. The result revealed that *Staphylococcus aureus, Klebsiella aerogenes, Staphylococcus epidermis* and *Bacillus cereus* had relatively higher distribution in the rooms compared to *Enterobacter aerogenes, Escherichia coli* and *Proteus mirabilis.*

3.4 Morphological Identification of Fungi Found on Bed Linen of Different Rooms

The fungi isolates were identified by using their morphological characteristics. Findings of this study showed that *Aspergillus* sp. was found virtually on bed linens from all the rooms. *Aspergillus fumigatu* had the highest incidence followed by *Aspergillus niger, Aspergillus flavus* while *Alternaria spp and Fusarium sp.* had the lowest occurrence (Table 3).

3.5 Morphological and Biochemical Characterization of Bacteria Isolates

Identification of the isolates based on morphological and biochemical reactions to different biochemical tests is shown in Table 4.

3.6 Antibiotic Susceptibility Pattern of Gram Positive Bacteria

Table 5 shows the antibiotic resistance pattern of gram positive bacteria isolated from bed linen in different rooms of student in Ekiti State University. The isolates show the highest resistance to Ampicillin (100%), Amoxacillin (82%), Cefuroxime (55%), Erythromycin (27%), Cotrimoxazole (27%), Gentamycin (9%), Ceftriaxone (9%). The isolates were highly susceptible to Ciprofloxacin, Perfloxacin and Streptomycin.

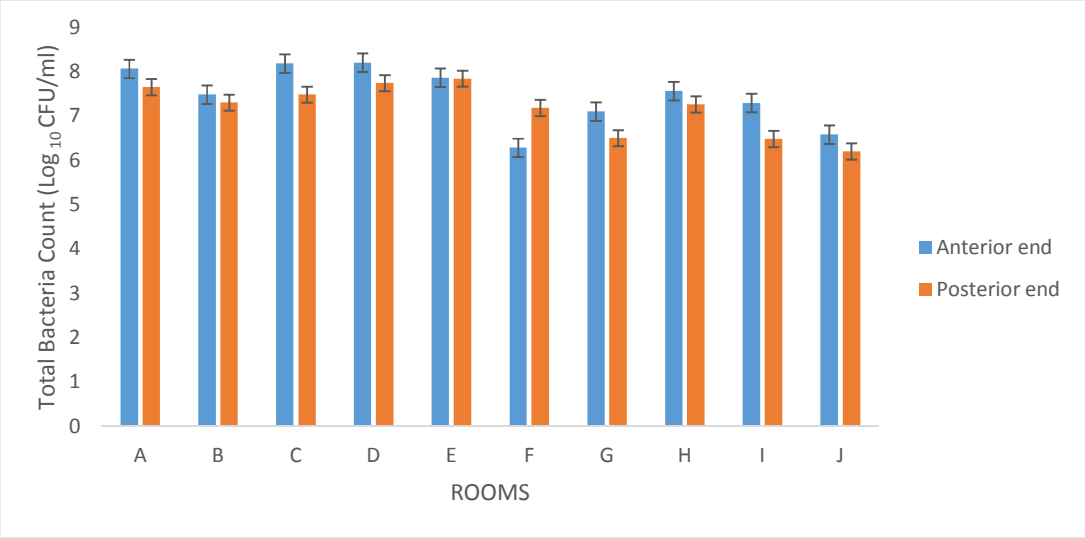

Fig. 1. Mean total bacteria count from bed linens in Ekiti State University Hostels
**Each value represents mean and standard error*

Table 1. Frequency of occurrence of bacteria isolates from bed linens in Ekiti State University Hostel

Organism	Number of isolates	Frequency of occurrence (%)
Bacillis cereus	13	25
Escherichia coli	8	15
Staphylococcus aureus	8	15
Enterobacter aerogenes	5	10
Staphylococcus epidermis	8	15
Proteus mirabilis	3	5
Klebsiella aerogenes	8	15
Total	**53**	**100**

Table 2. Distribution of bacteria on bed linens from different rooms

Isolates	Distribution of bacteria in each room										Occurrence
	A	B	C	D	E	F	G	H	I	J	
Escherichia coli	+	-	-	+	+	-	-	+	+	+	6/10
Proteus mirabilis	-	+	+	-	-		+	+	-	-	4/10
Staphylococcus aureus	+	-	-	+	+	+	+	+	+	+	8/10
Klebsiella aerogenes	+	-	+	+	-	+	+	+	+	+	8/10
Staphylococcus epidermis	-	+	+	+	-	+	+	+	+	+	9/10
Bacillus cereus	+	-	+	+	-	+	+	+	+	+	8/10
Enterobacter aerogenes	-	+	+	+	+	+	-	+	-	-	6/10

Key: + means Present, - means Absent, A, B, C, D, E, F, G, H, I & J – Room ID

Table 3. Morphological identification of fungi found on bed linen of different rooms

Isolates code	Mophological characteristics	Most probable fungi
D2a	Gray brown mycelium covering the whole plate and black color on reverse	*Alternaria spp*
B2a	Dirty white colony with yellow spores at the centre and orange on reverse	*Aspergillus sulphureus*
B2 b	Smoky gray-green with a slight yellow on reverse	*Aspergillus fumigatus*
C1a	Dark green colony	*Aspergillus niger*
B1a	A green colony with thick white margin with creamy color on reverse.	*Aspergillus flavus*
B1b	Magenta pink	*Fusarium spp*

3.7 Antibiotic Susceptibility Pattern of Gram Negative Bacteria

Table 6 shows the antibiotic resistance pattern of gram negative bacteria isolated from bed linen in different rooms of student. All organisms are highly resistance to Cotrimoxazole (100%), Gentamycin (44%), Amoxacillin (44%), Chloramphenicol (44%), Streptomycin (33%), Augmentin (33%), Pefloxacin (22%), Ofloxacin (11%). The isolates show 100% susceptibility to Sparfloxacin and Ciprofloxacin.

3.8 Plasmid Profiling

The plasmid profiling of multiple antibiotic resistant bacteria from bed linens is shown in Fig. 2. The result revealed that *Bacillus cereus* (2) and *Enterobacter aerogenes* (3) do not possess plasmid, while *Escherichia coli* (1) had three (3) high molecular weight plasmids.

Table 4. Morphological and biochemical characterization of bacteria isolated from bed linen

S/N	Gram reaction	Catalase	Coagulase	Motility	Indole	Citrate	Oxidase	MR	VP	TSIA reaction				Urease	Organism
										Slant	Butt	Gas	H_2s		
1	GPB	+		+		+		-	-	Growth at 50°C, Growth in 7,Glucose +					*Bacillus cereus*
2	GPC	+	+	Novobiocin (sensitive)											*Staphylococcus aureus*
3	GNB	+		+	+	-	-	+	-	Y	Y	Yes	No	-	*Escherichia coli*
4	GNB	+		+	+	+	-	+	-						*Proteus mirabilis*
5	GPC	+	-	Novobiocin (resistance)											*Staphylococcus epidermidis*
6	GNB	+		+	+	-	-	+	-	Y	Y	Yes	No		*Escherichia coli*
7	GNB	+		-	-	+	-	-	+	Y	Y	Yes	No	+	*Klebsiella aerogenes*
8	GPC	+	-	Novobiocin (resistance)											*Staphylococcus epidermidis*
9	GNB	+		+	-	+	-	-	+	Y	Y	Yes	No	-	*Enterobacter aerogenes*
10	GNB	+		-	-	+	-	-	+	Y	Y	Yes	No	+	*Klebsiella aerogenes*
11	GPC	+		+		+		-	-	Growth at 50°C, Growth in 7,Glucose +					*Bacillus cereus*
12	GPC	+	+	Novobiocin (sensitive)											*Staphylococcus aureus*
13	GNB	+		+	-	+	-	-	+	Y	Y	Yes	No	-	*Enterobacter aerogenes*
14	GPC	+		+		+		-	-	Growth at 50°C, Growth in 7,Glucose +					*Bacillus cereus*
15	GNB	+		-	-	+	-	-	+	Y	Y	Yes	No	+	*Klebsiella aerogenes*
16	GPC	+		+		+		-	-	Growth at 50°C, Growth in 7,Glucose +					*Bacillus cereus*
17	GPC	+	-	Novobiocin (resistance)											*Staphylococcus epidermidis*
18	GPC	+	+	Novobiocin (sensitive)											*Staphylococcus aureus*
19	GPC	+		+		+		-	-	Growth at 50°C, Growth in 7,Glucose +					*Bacillus cereus*
20	GNB	+		+	+	-	-	+	-	Y	Y	Yes	No		*Escherichia coli*

Key: GNB- Gram negative bacilli; GPC- Gram negative cocci; GPC- Gram positive cocci; Y- Yellow; +-Positive; - Negative. VP-Voges proskauer Test; MR- Methyl red test

Table 5. Antibiotic resistance pattern of gram-positive bacteria isolates from bed linen

Test organism	Antibiotics(mm)									
	ST	CPX	CEF	AM	CXM	AMP	CN	PEF	E	COT
Gram positive bacteria										
Bacillus cereus(1)	16(S)	22(S)	17(I)	0(R)	0(R)	0(R)	15(S)	20(S)	0(R)	16(I)
Bacillus cereus(2)	18(S)	23(S)	15(I)	0(R)	0(R)	0(R)	12(I)	22(S)	12(0)	0(R)
Bacillus cereus(3)	20(S)	22(S)	18(I)	0(R)	0(R)	0(R)	12(I)	20(S)	0(R)	10(R)
Bacillus cereus(4)	16(S)	21(S)	20(S)	18(S)	20(S)	10(R)	12(I)	21(S)	18(I)	20(S)
Bacillus cereus(5)	12(I)	22(S)	17(I)	0(R)	16(I)	0(R)	20(S)	20(S)	18(I)	20(S)
Staphylococcus aureus(1)	22(S)	22(S)	20(S)	15(I)	18(I)	0(R)	20(S)	20(S)	20(S)	18(S)
Staphylococcus epidermidis(1)	12(I)	20(S)	18(I)	0(R)	0(R)	0(R)	15(S)	20(S)	18(I)	0(R)
Staphylococcus aureus(2)	20(S)	21(S)	20(S)	0(R)	12(R)	0(R)	13(I)	20(S)	20(S)	15(I)
Staphylococcus aureus(3)	21(S)	20(S)	20(S)	12(R)	15(I)	0(R)	15(S)	21(S)	21(S)	15(I)
Staphylococcus epidermidis (2)	15(S)	20(S)	15(I)	10(R)	13(R)	0(R)	18(S)	22(S)	20(S)	13(I)
Staphylococcus epidermidis (3)	18(S)	22(S)	11(R)	12(R)	15(I)	0(R)	0(R)	19(S)	17(I)	12(I)
% resistance of antibiotics	0	0	9	82	55	100	9	0	27	27

Key: ST- Streptomycin; CPX- Ciprofloxacin; CEF- Ceftriaxone; AM- Amoxacillin; CXM- Cefuroxime; AMP- Ampicillin; CN- Gentamycin; PEF- Pefloxacin; E- Erythromycin; COT- Cotrimoxazole; R- Resistance; I- Intermediate; S- Susceptibility

Table 6. Antibiotic resistance pattern of gram-negative bacteria isolates from bed linen

Test organism	Antibiotics(mm)									
	SP	CPX	AM	AU	CN	PEF	OFX	ST	COT	CH
Gram negative bacteria										
Escherichia coli(1)	20(S)	20(S)	15(R)	0(R)	15(S)	20(S)	18(S)	15(S)	0(R)	0(R)
Klebsiella aerogenes(1)	22(S)	22(S)	20(S)	22(S)	18(S)	20(S)	22(S)	15(S)	0(R)	0(R)
Enterobacter aerogenes(1)	15(I)	16(I)	0(R)	15(I)	0(R)	15(I)	14(R)	0(R)	0(R)	0(R)
Escherichia coli(2)	18(I)	15(I)	0(R)	0(R)	0(R)	0(R)	0(R)	0(R)	0(R)	15(I)
Klebsiella aerogenes(2)	15(I)	20(S)	18(S)	18(S)	20(S)	20(S)	20(S)	20(S)	0(R)	18(S)
Klebsiella aerogenes(3)	20(S)	20(S)	20(S)	19(S)	18(S)	22(S)	20(S)	15(S)	0(R)	18(S)
Proteus mirabilis	20(S)	19(I)	0(R)	16(I)	18(S)	18(S)	17(I)	19(S)	0(R)	14(I)
Escherichia coli (3)	15(I)	18(I)	15(I)	0(R)	12(R)	19(S)	15(I)	15(S)	0(R)	15(I)
Enterobacter aerogenes (2)	15(I)	17(I)	0(R)	16(I)	0(R)	17(I)	16(I)	0(R)	0(R)	8(R)
% resistance of antibiotics	0	0	44	33	44	22	11	33	100	44

Key: SP- Sparfloxacin; CPX- Ciprofloxacin; AM- Amoxacillin; AU- Augmentin; CN- Gentamycin; PEF- Pefloxacin; OFX- Ofloxacin; ST- Streptomycin; COT- Cotrimoxazole; CH- Chloramphenicol; R- Resistance; I- Intermediate; S- Susceptibility

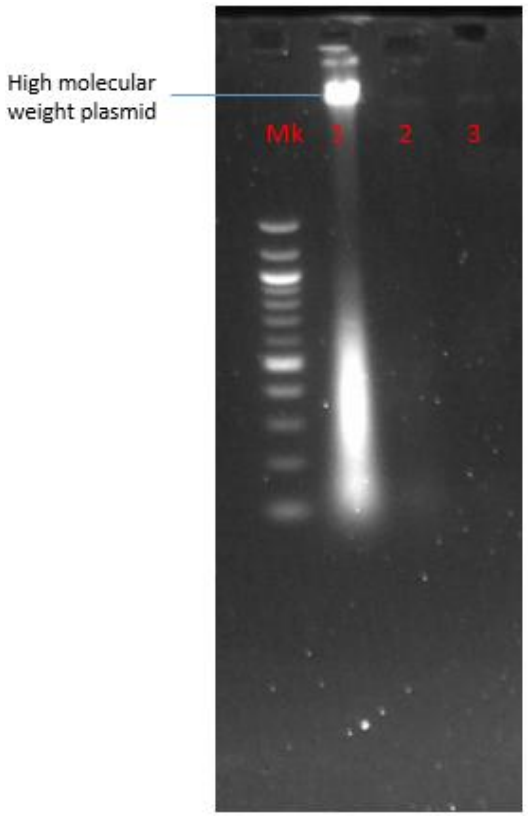

Fig. 2. Plasmid profiling of some selected isolates

Key: MK- Molecular marker, 1) Escherichia coli, 2) Bacillus cereus and 3) Enterobacter aerogenes

4. DISCUSSION

Textiles may act as reservoirs of microorganisms since pathogens may be able to survive on such surfaces for periods ranging from a few minutes to several hours [11,12]. The average bacteria count for the anterior and posterior end was 7.40 Log_{10} CFU/ml and 7.16 Log_{10} CFU/ml respectively. This revealed that the anterior end of the bed linen has higher microbial load compared to the posterior end and this could be as result of sweats along the upper region and nasal discharge. The bacteria identified include *Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis, Enterobacter aerogenes, Bacillus cereus, Escherichia coli, and Klebsiella aerogenes.* This coincides with other reports [13,14,15]. A number of studies specifically focused on searching Hospital Acquired Infections-relevant pathogens, mostly *Staphylococcus aureus* or *Enterococci* [16,17] but research reports on microbial load of household bed linens are scanty hence, relatedness of microbial species isolated from household to those from the hospital has not been reported. This study however report that bacteria species isolated from beds in the hostels have been reported to be isolated from hospital beds although, these bacteria were not identified with molecular procedures to ascertain their relatedness. *Bacillus cereus* with the highest frequency of occurrence and *Staphylococcus aureus* with relatively high occurrence have been reported to be associated with hospital bed linens [18]. The study of Pinon et al. [19] on Microbiological Contamination of Bed Linen and Staff Uniforms in a Hospital reported high frequency of *Staphylococcus aureus, Bacillus* and *Pseudomonas.* This also supports the findings of Boyles et al. 1997, who noted that contaminated textiles and fabrics may harbor high numbers of microorganisms as a result of contact with different body substances such as, blood, skin, stool, urine, vomits, sputum, and other body tissue and fluid. All identified gram positive bacteria were susceptible to Ciprofloxacin and Pefloxacin which makes them the most effective antibiotics for gram positive bacteria.

The identified gram negative bacteria were susceptible to Perfloxacin (56%), Gentamycin (56%), Streptomycin (55%), Ciprofloxacin (44%). The most effective antibiotics for gram negative bacteria were Perfloxacin and Gentamycin. Many isolates showed multiple antibiotic resistance to the antibiotics used. Species of *Staphylococcus, Escherichia, Bacillus* and *Pseudomonas* from hospital and environmental sources have been reported to exhibit multiple resistance to commonly used antibiotics [20].

The presence of three heavy molecular weight plasmids found in *E. coli* corroborates previous study which showed that *E. coli* isolates carry multiple plasmids which could be the reason for their resistant to antibiotics [21]. Bacteria antibiotics resistance patterns are sometimes associated with the presence of large plasmids and ability of plasmids for conjugation process [22]. However, for other isolates that had no plasmid (*Bacillus cereus* and *Enterobacter aerogenes*), they also showed multiple antibiotics resistance patterns with high number of antibiotics which indicates that resistance to most of these antibiotics is of chromosomal origin or on mobile genetic elements that may help in the dissemination of the resistance genes to other bacteria of human clinical significance [23].

5. CONCLUSION

Microbial assessment of bed linens has proved that bed linens can serve as a reservoir and route of microbial dissemination in disease outbreak. The identified species may be opportunistic pathogens for human, representing a risk for people with weakened immune system, especially in cases of super infection. These pathogens can easily acquire antibiotic resistance and therefore calls for the need to establish an effective infection control policy that incorporates the welfare of students. It also suggests the use of ciprofloxacin as it is one of the best antibiotics during infection associated with bed linen caused by gram positive bacteria and the use of Cotrimoxazole for Gram negative bacteria. The use of Ampicillin for treatments of Gram positive bacteria should be avoided as all of the isolated bacteria are highly resistant to it which makes it ineffective. This work encourages the need to promote proper hygiene practice regarding our bed linen as some individuals can use the same linen for a month and more without washing. Also, the multidrug resistant *E. coli* isolated in this study harbored high molecular weight plasmids. This can pose risk as these genetic materials can be transferred to other bacterial pathogens therefore causing them to be resistant to antibiotics.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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