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Bacteriological and Mycological survey of domiciliary cockroach in Owo, Metropolitan

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Abstract

The presence of cockroaches in the home can raise safety concerns. Dirty behavior and presence, especially where food is stored or processed, can cause it to emerge as a mechanical vector of various food-derived pathogenic microorganisms. Cockroaches can carry pathogenic microorganisms on their surface, ingest pathogens through contaminated food, and infect humans by mechanical means. The purpose of this study was to determine the frequency of pathogenic and fungal infections transmitted by cockroaches and whether these bacteria were susceptible or resistant to commonly selected antibiotics. A total of 105 cockroach samples were collected from different households in Owo, 35 each from toilets, kitchens and shops. Bacteria and fungi were separated from the outer and inner surfaces of the cockroach by internal and external cleaning. The coliform enumeration was performed according to the Miles and Misra method. Antimicrobial susceptibility testing was also performed using the disc diffusion method. Escherichia coli was mainly found on the outer surface of cockroaches collected in toilets and kitchens, and Pseudomonas erginosa, which was most frequently seen 14 times, was mainly found on the outer surface of cockroaches collected in stores. E. coli is mainly isolated from the inside of cockroaches collected in toilets, stores and kitchens. *Proteus vulgaris, Kleb. Pneumonia* was the second most common bacterium isolated from the inside of cockroaches collected in the kitchen. *Candida albicans* had the highest amount of fungi isolated from the outer surface of cockroaches collected from toilets, stores, and kitchens at 24, 19, and 21. *Proteus vulgaris,* isolated from both the inner and outer surfaces of the collected cockroach, was completely resistant to all commonly used antibiotics. Domestic cockroaches frequently carry pathogens on the outside and inside and some of these bacteria are resistant to common antibiotics and can be very difficult to treat.

Keywords: Domiciliary Cockroach; Bacteriological; Mycological

Introduction

Cockroaches are one of the most common pests in most homes, especially in hot and humid environments such as kitchens, toilets, sewers and even septic tanks.

Their presence has always raised safety concerns as a mechanical carrier of various food-borne pathogenic microorganisms, especially due to their dirty behavior and their presence in the place where food is stored or handled. (Sisai et al., 2010; Adeleke et al., 2012). Cockroaches can carry pathogenic microorganisms from the outside to the cuticle while actively crawling in a dirty environment at night. They may also ingest pathogens from contaminated food and later excrete or vomit from food or crawling surfaces. Thus, cockroaches can easily contaminate food when in contact with food (Donkor, 2020).

Cockroaches carry a variety of diseases, but are not direct carriers of diseases such as mosquitoes. The process of transmission of these diseases is due to mechanical transmission and serves as a reservoir for some pathogenic organisms (Lake Norman pest Control, 2019). Experimental evidence indicates the possible role of cockroaches in the transmission of pathogenic organisms such as bacteria, parasites, fungi, and even some viruses that are extremely dangerous to human health (Yusof, 2018). Bacteriological study by Sisai et al. (2010), for cockroaches caught in the kitchen and toilet, cockroaches caught in the toilet show more sporulation, Bacillus cereus, coliforms, and E. coli than those in the kitchen. According to Pai et al. (2005), it was discovered that cockroaches collected in hospitals and homes carry some multidrug-resistant (MDR) bacteria, and that most hospital cockroaches carry drug-resistant Klebsiella spp. This should play a role in the epidemiology of nosocomial infections.

Of the 55 American cockroaches collected from the sewers of a hospital in Isfahan, Iran, 31 were infected with the fungus. We found that 40.00% were infected with Aspergillus niger, 3.64% with Rhizopus, 7.27% with Penicillium, and 5.45% with Mucor. 17 (30.91%) cockroaches were contaminated with Candida glabrata and 23 (41.82%) cockroaches were contaminated with Candida krusei (Tatang and Tsila, 2017). Cockroaches not only contaminate food, but can also cause allergies to cockroach droppings and cause asthma-related health problems (Tatang and Tsila, 2017). This study was conducted to determine the frequency of pathogenic bacteria and fungi transmitted by cockroaches and to assess the resistance of these bacteria to common antibiotics.

Methodology

Study Area

The study was conducted in Owo. Owo is a city in Ondo State in the south-western part of Nigeria.

Sample Population

Sample populations of this study were cockroaches that were found in some selected residential houses in Owo, Ondo state, Nigeria. The targeted cockroach populations were those that were found in the kitchen, toilet and store as these places tends to harbor cockroaches, and are crucial part of the house where diseases are easily spread. The population was grouped into three thus; the first group was cockroaches found in the kitchen, the second groups were those found in the toilet, while the third groups were cockroaches found in the store.

Sampling Method and Sample Size

Stratified sampling method was used to select the study population, as they were stratified into three; cockroaches found in the kitchen, toilet and store of residential houses in Owo. At least thirty five cockroaches from kitchen, toilet and store were collected as samples to their respective group. Therefore a total of 105 cockroach samples were used for the analysis.

Instrument

One of the instruments that were used is the result sheet for documentation of observation and result. Laboratory materials and equipment that were

used include; Centrifuge machine, 70% alcohol, physiological normal saline, glass slide, cover slips, universal bottle, microscope, wire loop, straight wire, peptone water, commercially prepared agar plate, incubator, gram staining reagent kit, gram positive and gram negative discs.

Method of Bacteria and Fungi Isolation

The following methods were used to isolate bacteria and fungi on the external and internal surface of cockroaches;

Isolation of Bacteria from cockroaches (Bacteriological Examination)

External Washing:

The cockroaches were put into sterile universal bottle, 2 mls of physiological normal saline was added and then thoroughly shaken for two minutes to dislodge the pathogens into the normal saline. The cockroaches were removed and the remaining liquid was poured into a clean centrifuge tube and then spinned for 5 minutes at 2000rpm. The supernatant was discarded and the sediment was used for culture. A loopful of the sediment was then cultured on MacConkey agar, Chocolate agar and Blood agar. The MacConkey agar plate and Blood agar plate that has been cultured was incubated aerobically at 37^{o}Cover night for bacteriological investigation and the Chocolate agar plate that has been cultured was incubated anaerobically at 37^{o}Cover night for bacteriological investigation

Internal Washing

The External surface of the cockroaches were washed with 70% alcohol and then allowed to dry under antiseptic condition under sterile condition. The decontaminated cockroach was washed with physiological normal saline for 2 minutes inside a sterile universal bottle to remove traces of alcohol. The gut of the cockroach was dissected out and macerated aseptically with a sterile pestle and mortar in 2 mls of normal saline. The resulting macerated particle was cultured on MacConkey agar, Chocolate agar, and Blood agar. The MacConkey agar plate and Blood agar plate that has been cultured was incubated aerobically at 37^{o}Cover night for bacteriological investigation and the Chocolate agar plate that has been cultured were incubated anaerobically at 37^{o}Cover night for bacteriological investigation**.**

- Isolation of Fungi from cockroaches (Mycological Examination)

External Washing:

The cockroaches were put into sterile universal bottle, 2 mls of physiological normal saline was added and then thoroughly shaken for two minutes to dislodge the pathogens into the normal saline. The cockroacheswere removed and the remaining liquid was poured into a clean centrifuge tube and spinned for 5 minutes at 2000rpm. The supernatant was discarded and the sediment was used for culture. A loopful of the sediment was cultured on Sabouraud's dextrose agar with 0.5% Chloramphenicol and 0.05% Cyclohexamide (to inhibit the growth of bacteria and saprophytic fungi respectively). The cultured plate was incubated at 37^{o}C for 2 weeks, and thenexamined for fungal growth

Internal Washing

The Internal surface of the cockroaches were washed with 70% alcohol and then allowed to dry under antiseptic condition under sterile condition. The decontaminated cockroach was washed with physiological normal saline for 2 minutes inside a sterile universal bottle to remove traces of alcohol. The gut of the cockroach was dissected out and macerated aseptically with a sterile pestle and mortar in 2 mls of normal saline. The resulting macerated particle was cultured on Sabouraud dextrose agar with 0.05% chloramphenicol and 0.05% Cyclohexamide (to inhibit the growth of bacteria and saprophytic fungi respectively). The cultured plate was incubated at 37^{o}C for 2 weeks, and was examined for fungal growth.

Procedure for Quantitative Estimation of Bacteria isolated from Internal and External Surface of Cockroaches

Quantitative analysis of bacteria isolated from internal and external surface of cockroaches was calculated using the Miles and Misra's Method since this method has been shown to be precise.

Materials

- A calibrated automatic pipette, delivering drops of 20µl, 900µl and 100µl.
- Petri dishescontaining MacConkey agar.
- Peptone water (as diluent)
- Bacterial suspension.
- Sterile universal bottle

Method

- In a Pre-labeled container, the solution was serially diluted (1 in 10 dilution) by adding 900µl of peptone water and 100µl of undiluted of washings (external and internal) into a sterile container. (**Note**: Dilutions was made to at least 10^{-8} into a sterile container).
- The surface of the plates was sufficiently dry to allow a 20µl drop to be absorbed in 15–20 minutes.
- Plates were divided into equal sectors and the sectors were labeled with the dilutions.
- In each sector, 20 µl of the serial diluted solution was dropped onto the surface of MacConkey agar plates in duplicate and the drop was allowed to spread naturally.
- The plates were left upright on the bench to dry before inversion and incubated at 37^0C for 18 – 24 hours.
- Each sectors were observed for growth and the colonies were counted in the sector where the highest number of full-size discrete colonies can be seen (usually sectors containing between 2-20 colonies was counted).

Equation to calculate the number of colony forming units (CFU) per ml from the original aliquot is as follows:

- ✓ CFU per ml = Average number of colonies for a dilution x 50 x dilution factor.

Note: Colony-forming units were counted after overnight incubation at 37^oC and mean count of plates was taken. The overall load of bacteria carried by each insect was counted by taking into consideration both external and internal colony-forming units together.

Identification of Bacteria

The colonies were identified by standard bacteriological procedures; Microscopic morphology by gram staining, Biochemical tests.

Gram staining

Gram's stain was performed on the isolate to determine if the organism is gram negative or gram positive.

Method

- A drop of normal saline was placed on a clean grease free glass.
- A loopful of the organism was emulsified into the normal saline to make a smear, and the smear was allowed to air dry.
- The smear was heat fixed by passing it (cell side up) through a flame
- Crystal violet was then added by covering the heat-fixed cells with a prepared solution, and was allowed to stain for approximately 1 minute.
- The slide was rinsed with water.
- Lugol's iodine solution was added for 1 minute. This acts as a mordant and fixes the dye, making it more difficult to decolorize and reducing some of the variability of the test.
- The slide was briefly rinsed with water.
- The smear was decolorized briefly by applying acetone.
- The slide was rinsed with water to stop decolourization.
- The smear was stained with a counterstain (safranin) which stains all cells red.
- The slide was blotted gently and the slide was allowed to dry.
- The slide was observed under Microscope using x100 objective lens.

Biochemical Test

Several biochemical tests were performed on the isolates for identification purposes. Some of the biochemical tests to be done include: Citrate utilization test, Urease test, Indole test, Oxidase test, Urease test.

- Catalase Test

Procedure:

Two drops of 3% hydrogen peroxide (H_2O_2) was dropped on a clean glass slide using a sterile dropper. An isolated bacterial colony from the MacConkey agar will be placed in the drop of hydrogen peroxide by using a sterile applicator stick, and observed for any effervescence.

- Oxidase Test

Procedure

A piece of filter paper was placed in a clean sterile petri dish, and 2 or 3 drops of freshly prepared oxidase reagent was added to it. Using a piece of stick, a colony of the test organism was smeared on the filter paper. A blue-purple colour within 10 seconds shows an oxidasepositive test.

Citrate Utilization Test

Procedure

Slopes of the medium were prepared in bijou bottles as recommended by the manufacturer. Using a sterile straight wire, the slope was streaked with the test organism and then the butt was stabbed. The Simmons citrate agar was incubated at 37^0C for 48 hours. The medium wasthen observed for any colour change.

Indole Test

Procedure:

Bijou bottles with peptone water was labeled with the test organism name and sample code. Gram negative lactose fermenting colonies was picked from the MacConkey agar plates using a sterilized inoculating loop and a suspension was made into the peptone water. It wasthen incubated at 37^0C for 24 hours. Two drops of Kovacs reagent was added into each bottle of overnight broth culture and then observed for the presence of a red ring.

Coagulase Test

Procedure

A clean grease free glass slides was labeled with the test organism and sample code. One drop of physiological normal saline was placed onto the glass slides using a sterile pipette. A colony of the test organism was emulsified into the normal saline on the clean grease free glass slides and a loopful of plasma was added to the suspensions and mixed gently. Clumping of the organisms was observed within 10 seconds.

- Urease test

Urease test was done to differentiate enterobacteria, e.g *Proteus spp*.

Procedure

The test organism is inoculated in a bijou bottle containing 3ml sterile Cristensen's modified urea broth and incubated at 35-37^{o}C for 3-12hours.

Fungi identification

The fungi isolates were identified by microscopic examination of the actively growing mold using morphological characters such as: the absence or presence rhizoid, colour, and micro-morphology of their sporulating structures and conidia.

Procedure for Quantitative Estimation of fungi isolated from Internal and External Surface of Cockroaches.

A ten-fold dilution was carried out on each suspension to determine the total viable count of each cockroach using the pour plate method counts were made on plates showing discrete colonies. A quantitative analysis of fungi was calculated by taking into consideration both external and internal colony-forming units together.

Procedure for Antibiotic Sensitivity Testing

Antimicrobial susceptibility testing was done for bacterial isolates by using disc diffusion method on Mueller-Hinton Agar (MHA). Bacterial inoculum was prepared by suspending the freshly grown bacteria in 4-5 mL peptone water and the turbidity was adjusted to that of a 0.5 McFarland standard. It waspoured on the plate, and the antibiotic disc was placed on it. After overnight incubation, the result was interpreted as susceptible and resistant according to National Committee for Clinical Laboratory Standards and the isolates showing resistance to two or more different classes of antibiotics are considered as multidrug resistant (MDR) strains.

Data Analysis

Data was analyzed using SPSS version 20 statistical software. Descriptive statistics was also used to present the result in tables and in chart.

Ethical Clearance

An ethical approval was obtained from ethical clearance committee at FMC Owo, Ondo State and all information's obtained at each course of the study waskept confidential

Informed Consent

An informed consent was obtained from the participants and all information's obtained at each course of the study was kept confidential.

Results

Rate of Bacteria Isolated in the Internal part and on External Body Surface of Cockroaches

A total of 105 cockroach samples were collected from toilet, store and kitchen from different household in Owo, in which 35 cockroaches per each group. Bacteria were successfully isolated from a total of 89(84.8%) of cockroach samples collected, in which 32(91.4%) of cockroaches from toilet, 29(82.9%), of cockroaches from store, 28(80%) of cockroaches from kitchen.

Major bacteria isolated on the external surfaces of cockroaches include, *Kleb. pneumoniae*, *E. coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, and *Kleb. oxytoca*.

Figure 1 below is the chart that shows the rate of bacteria isolated on the external surface of cockroaches.

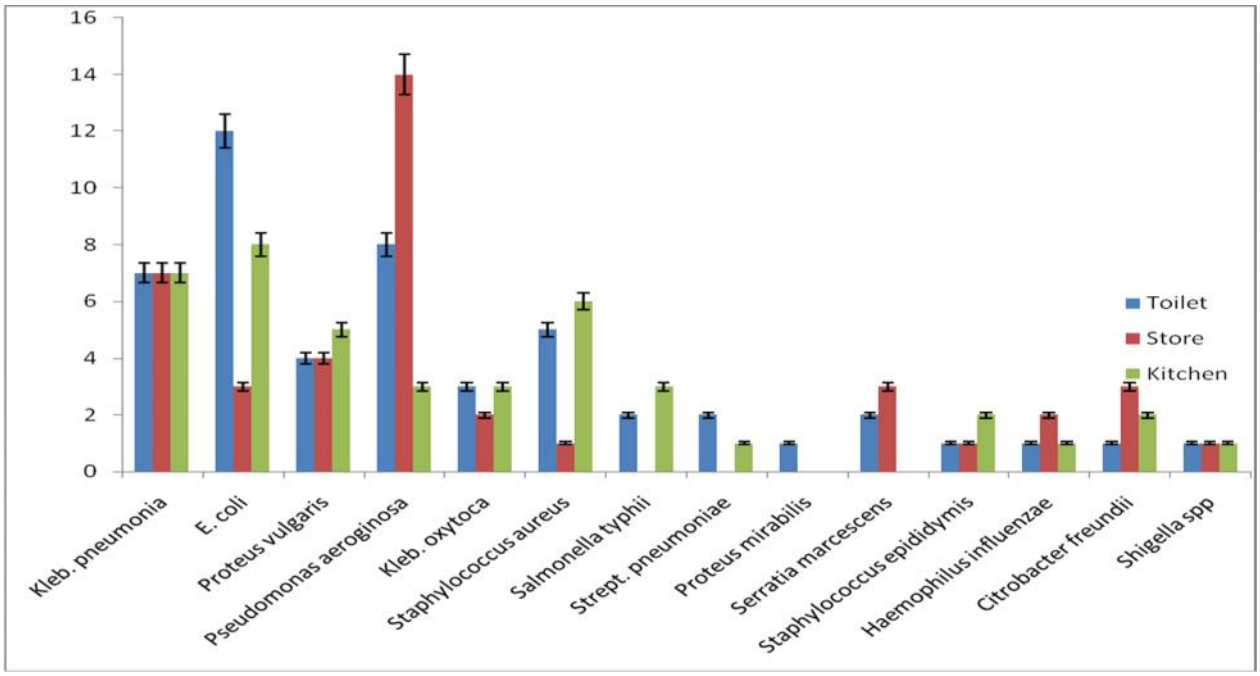

Figure 1: Rate of Bacteria Seen on the External Body Surface of Cockroaches Found in Toilet, Store and Kitchen.

E.coli with the highest frequency of 12 and 8 were mostly isolated from external surface of cockroaches collected in the toilets and kitchens respectively and *Pseudomonas aeruginosa* with the highest frequency of 14 were mostly isolated from external surface of cockroaches collected in the store. *Proteus mirabilis, Staphylococcus epididymis, Haemophilus influenza, Citrobacter freundii,Shigella spp.* were less isolated from external surfaces of cockroaches collected in the toilet. *Salmonella typhii, Strept. pneumoniae, Proteus mirabi*lis were not isolated from cockroaches collected from store while, *Staphylococcus aureus, Staphylococcus epididymis, Shigella spp.* were less isolated. *Proteus mirabilis, Serratia marcescens* were not isolated from cockroaches collected from kitchen while, *Strept. pneumoniae, Haemophilus influenza,* and *Shigella spp.* were less isolated.

Major bacteria isolated on the internal surfaces of cockroaches include, *Kleb. pneumoniae, E.coli,Proteus vulgaris, Pseudomonas aeruginosa, Kleb. oxytoca*, this is almost the same with the bacteria isolated from external surfaces.

Figure 8below is chart that shows the rate of bacteria isolated in the internal part of cockroaches.

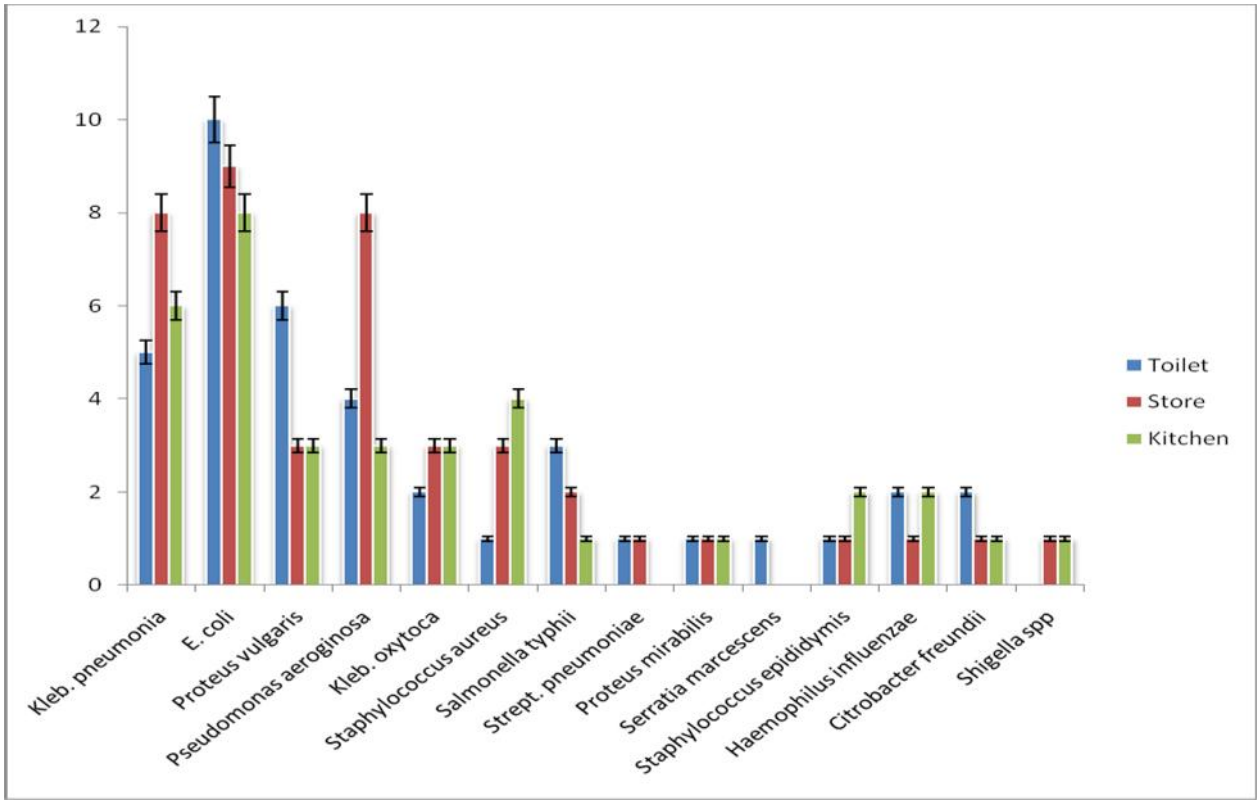

Figure 2: Rate of Bacteria seen in the internal Part of cockroaches found in Toilet, Store and Kitchen

E.coli with the highest frequency of 10 and 9, 8 were mostly isolated from internal surface of cockroaches collected in the toilets, store and kitchen respectively. *Proteus vulgaris, Kleb. pneumoniae* were the second most isolated bacteria from the internal surface of cockroaches collected in the kitchen. While *Kleb. pneumoniae* and *Pseudomonas aeruginosa* were also second most isolated bacteria from internal surface of cockroaches collected from the store. Also *Kleb. pneumoniae* and *Staphylococcus aureus* were second most isolated bacteria from internal surface of cockroaches collected from the kitchen. *Strept. pneumoniae, Proteus mirabilis, Serratia marcescens, Staphylococcus epididymis* and *Staphylococcus aureus* were least isolated from internal surface of cockroaches collected from the toilet. *Staphylococcus epididymis, Haemophilus influenza, Citrobacter freundii, Shigella spp., Streptococcus pneumoniae*, and *Proteus*

mirabilis were least isolated from internal surface of cockroaches collected from the store. *Citrobacter freundii*, *Shigella spp*, *Proteus mirabilis*, *Salmonella typhii* were least isolated from internal surface of cockroaches collected from the kitchen.

Rate of Fungi isolated in the internal part and on the External Body Surface of Cockroaches

Fungi were successfully isolated from a total of 66(62.9%) of cockroach samples collected, in which 22(62.9%) of cockroaches from toilet, 22(62.9%) of cockroaches from store, 22(62.9%) of cockroaches from kitchen.

Fungi isolated from both internal and external surface of cockroaches include *Candida albicans*, *Fusarium spp.*, *Aspergillus spp.*, and *Penicillum spp*.

Figure 9 below is the chart that shows the rate of fungi seen on the external surface of cockroaches found in Toilet, store and kitchen

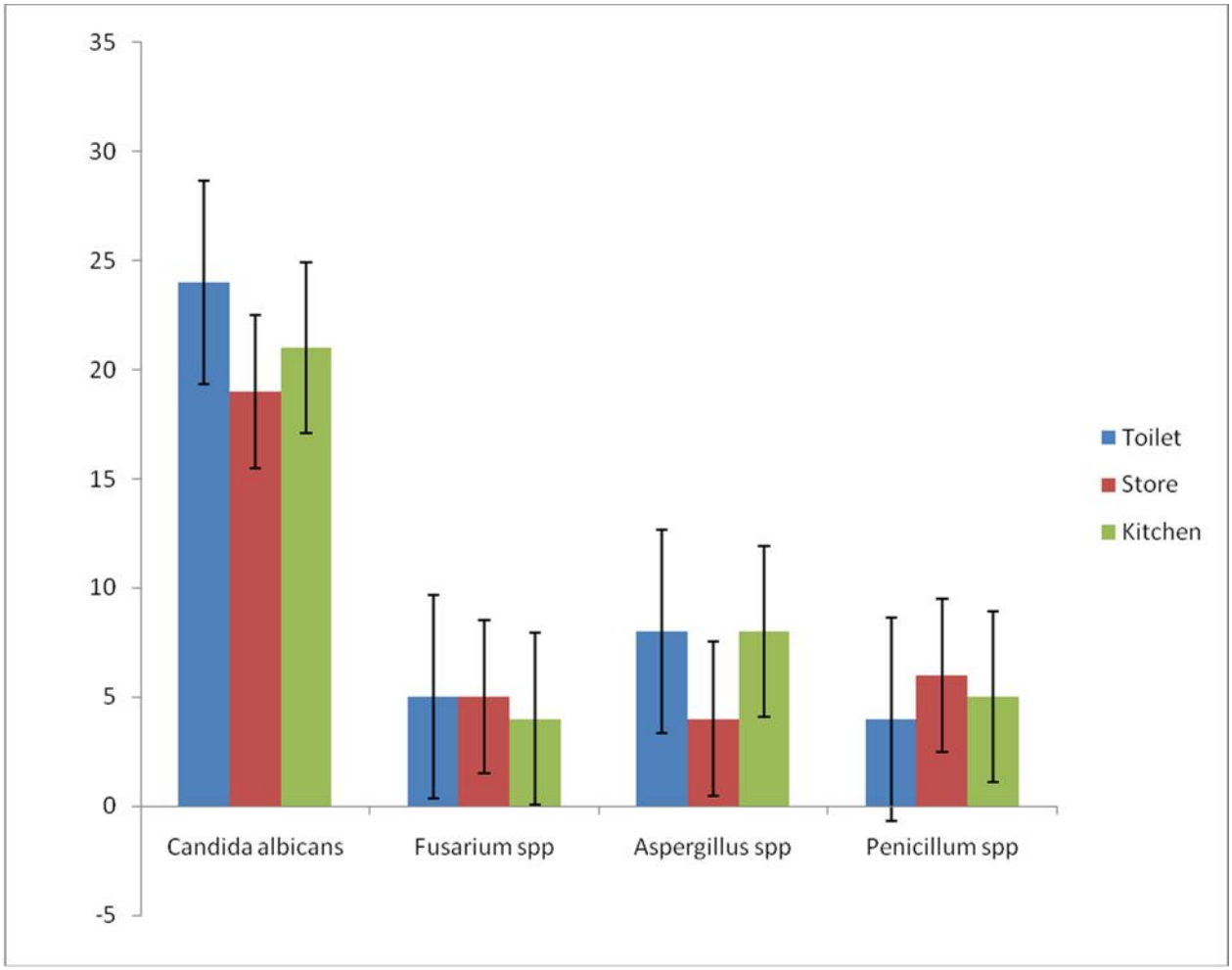

Figure 3: Rate of Fungi Seen On the External Surface of Cockroaches Found in Toilet, Store and Kitchen

Candida albicans has the highest frequency of 24, 19 and 21 of fungi isolated from external surface of cockroach collected from toilet, store and kitchen respectively. *Penicillum spp.*, *Fusarium spp.*, and *Aspergillus spp*. were the least fungi isolated from external surface of cockroach collected from toilet, store and kitchen respectively as their frequency is 4 each.

Figure 10 below is the chart that shows the rate of fungi seen in the internal part of cockroaches found in Toilet, store and kitchen.

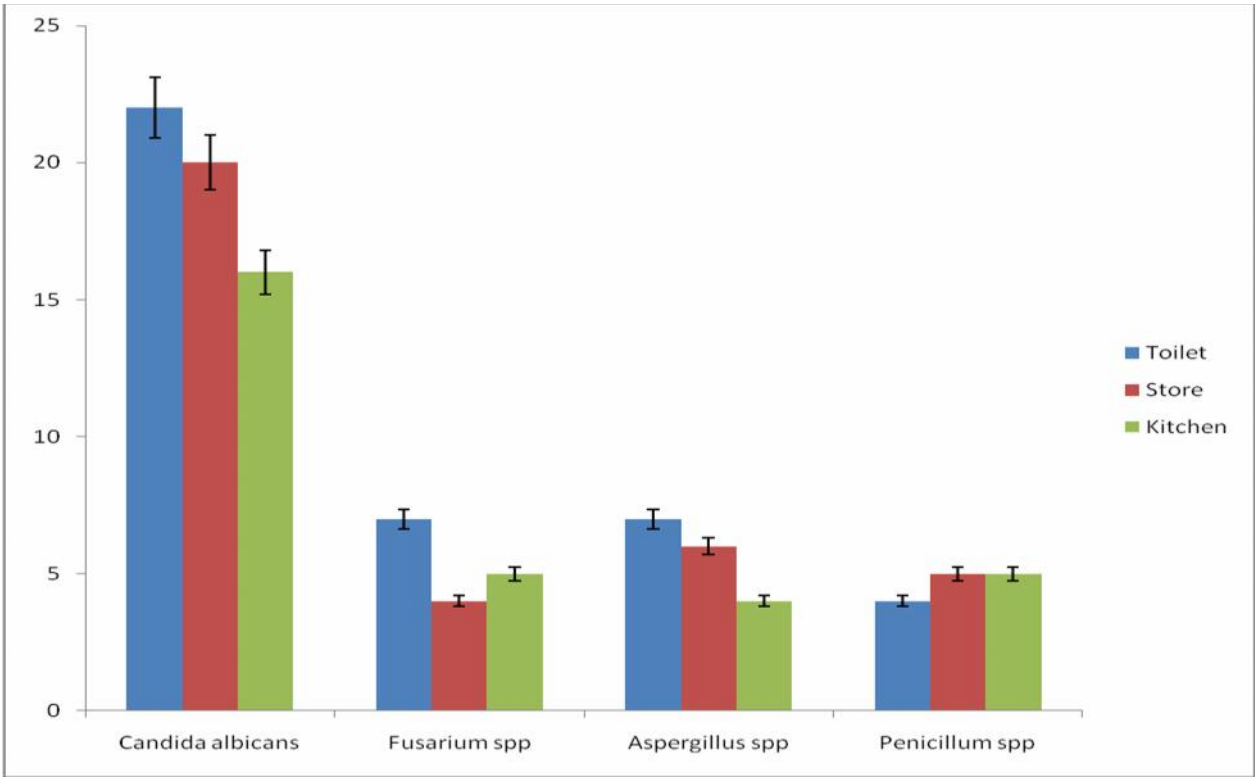

Figure 4: Rate of Fungi seen in the Internal Part of Cockroaches found in Toilet, Store and Kitchen.

Candida albicans has the highest frequency of 22, 20 and 16 of fungi isolated from external surface of cockroach collected from toilet, store and kitchen respectively. *Penicillum spp.*, *Fusarium spp.*, and *Aspergillus spp.* were the least fungi isolated from external surface of cockroach collected from toilet, store and kitchen respectively as there frequency is 4 each and this is same as internal surface.

Microbial Load of Bacteria and Fungi Seen in the Internal Part and on the External Body Surface of Cockroaches

Table 1. Microbial Load of Bacteria and Fungi seen on the External Body Surface of the Cockroaches

Organisms	Toilet Mean Load	Store Mean Load	Kitchen Mean Load
Citrobacter freundii	3.7×10^8	1.1×10^8	1.7×10^8
E. coli	6.7×10^7	1.5×10^8	2.0×10^7
Haemophilus influenzae	2.1×10^8	2.4×10^7	9.2×10^7
Kleb. oxytoca	2.4×10^6	5.0×10^7	1.0×10^8
Kleb. pneumoniae	1.2×10^8	4.4×10^8	4.5×10^7
Proteus mirabilis	1.0×10^6	Nill	Nill
Proteus vulgaris	2.3×10^6	5.4×10^7	5.0×10^8
Pseudomonas aeroginosa	1.2×10^8	4.6×10^8	8.6×10^6
Salmonella typhii	1.3×10^9	Nill	7.7×10^7
Shigella spp	1.9×10^9	3.8×10^8	1.3×10^7

Staphylococcus aureus	8.1×10^8	1.0×10^9	4.8×10^7
Staphylococcus epididymis	2.5×10^8	2.7×10^8	2.0×10^8
Strept pneumoniae	1.4×10^7	Nill	2.1×10^6
Serratia marcescens	3.1×10^8	6.4×10^6	Nill
Fungi			
Candida albicans	6.6×10^7	7.3×10^8	3.7×10^8
Fusarium spp	1.5×10^9	1.0×10^8	1.4×10^8
Aspergillus spp	5.8×10^7	2.0×10^8	7.5×10^8
Penicillum spp	1.7×10^8	6.1×10^8	5.4×10^7

Shigella spp. has the highest microbial load of bacteria isolated from external surface of cockroaches collected from toilet as the mean load value is 1.9×10^9CFU/ml, follow by *Salmonella typhii* which is 1.3×10^9CFU/ml. *Fusarium spp.* has the highest microbial load of fungi isolated from external surface of cockroaches collected from toilet as the mean load value is 1.5×10^9CFU/ml. *Staphylococcus aureus*follow by *Pseudomonas aeruginosa* has the highest microbial load of bacteria isolated from external surface of cockroaches collected from store and *Candida albicans* also have the highest microbial load of fungi isolated from external surface of cockroaches collected from store. *Proteus vulgaris*followed by *Staphylococcus epididymis*has the highest microbial load of bacteria isolated from external surface of cockroaches collected from kitchen. *Aspergillus spp.* also has the highest microbial load of fungi isolated from external surface of cockroaches collected from kitchen.

Table 2. Microbial Load of Bacteria and Fungi seen in the Internal Part of the Cockroaches.

Organisms	Toilet Mean Load	Store Mean Load	Kitchen Mean Load
Citrobacter freundii	5.5×10^7	2.5×10^7	1.9×10^9
E. coli	7.7×10^7	4.8×10^8	2.9×10^8
Haemophilus influenzae	1.6×10^8	1.2×10^8	9.7×10^7
Kleb. oxytoca	4.8×10^7	6.9×10^7	5.6×10^8
Kleb. pneumoniae	1.0×10^8	1.8×10^8	7.8×10^7
Proteus mirabilis	3.8×10^5	3.0×10^6	2.0×10^7
Proteus vulgaris	4.5×10^7	1.0×10^9	5.0×10^8
Pseudomonas aeroginosa	6.3×10^7	2.5×10^8	4.7×10^8
Salmonella typhii	2.1×10^6	2.0×10^8	1.3×10^8
Shigella spp	Nill	2.7×10^8	3.0×10^6
Staphylococcus aureus	1.0×10^6	1.6×10^8	3.0×10^8
Staphylococcus epididymis	1.2×10^8	2.1×10^9	1.5×10^8
Strept pneumoniae	1.1×10^6	2.1×10^8	Nill
Serratia marcescens	2.0×10^7	Nill	Nill
Fungi			
Candida albicans	9.3×10^7	9.6×10^7	5.3×10^8
Fusarium spp	2.2×10^8	2.4×10^8	2.3×10^7
Aspergillus spp	4.5×10^7	1.8×10^7	4.9×10^8
Penicillum spp	1.4×10^8	5.0×10^8	2.0×10^8

Haemophilus influenza has the highest microbial load of bacteria isolated from internal surface of cockroaches collected from toilet as the mean load value is 1.6 x 10^8CFU/ml, follow by *Staphylococcus epididymis* which is 1.2 x 10^8 CFU/ml. *Fusarium spp*. has the highest microbial load of fungi isolated from internal surface of cockroaches collected from toilet as the mean load value is 2.2 x 10^8CFU/ml. *Staphylococcus epididymis*follow by *Proteus vulgaris* has the highest microbial load of bacteria isolated from internal surface of cockroaches collected from the store and *Penicillum spp.* also have the highest microbial load of fungi isolated from internal surface of cockroaches collected from the store *Citrobacter freundii* follow by *Pseudomonas aeroginosa* has the highest microbial load of bacteria isolated from internal surface of cockroaches collected from kitchen. *Candida albicans*also has the highest microbial load of fungi isolated from internal surface of cockroaches collected from kitchen.

Table 3: Differences in the mean bacteria load of bacteria seen on External surface of Cockroaches

	Toilet	Store	Kitchen
Toilet	0	0.939	0.065
Store	0.939	0	0.105
Kitchen	0.065	0.105	0

Comparison of mean bacteria load of bacteria seen on external surface of cockroaches within the groups using T-statistics indicated that there is no differences between the mean bacteria load of the groups (toilet, store and kitchen), as there P values is greater than 5 percent level of significance

Table 4 below is the result of differences in the mean bacteria load of bacteria seen on internal surface of Cockroaches

Table 4: Differences in the mean bacteria load of bacteria seen in the internal part of Cockroaches found in Toilet, Kitchen and Store.

	Toilet	Store	Kitchen
Toilet	0	0.007	0.018
Store	0.007	0	0.658
Kitchen	0.018	0.658	0

Comparison of mean bacteria load of bacteria seen on internal surface of cockroaches within the groups using T-statistics indicated that there are differences in the mean bacteria load of bacteria seen on internal surface of cockroaches found in the toilet & store and also kitchen & toilet as there P. values are 0.007 and 0.018 respectively, which is lower than 5 percent level of significance. There is no significant difference in the mean bacteria load of bacteria seen on internal surfaces of cockroach found in the kitchen and store, as their P. value is 0.658 which is greater than 5 percent level of significance.

Antibiogram of pathogenic bacteria isolated from internal parts and external Body surface of cockroaches

There were single to multiple resistances to antibiotics by bacteria, which were randomly selected. At least one colony was picked from each group of cockroach and was subjected to AST.

Table 5: Antibiogram of Pathogenic Bacteria Isolated from External Body Surface of Cockroach samples collected

	Gram Negative Isolates	
Bacteria Seen.	**Sensitive**	**Resistance**
Kleb. pneumonia	CPX, AM, CN, PEF, OFX, AU, S.	CH, SP, SXT, AU,
E. coli	SXT, CH, SP, CPX, AM, AU, CN, PEF, OFX, S.	AU, CH, CN, AM.
Proteus vulgaris	NILL	SXT, CH, SP, CPX, AM, AU, CN, PEF, OFX, S.
Pseudomonas aeroginosa	SXT, CH, SP, CPX, AM, AU, CN, PEF, OFX, S.	CH, SP, AU, AM.
Kleb. Oxytoca	SXT, CH, SP, CPX, AM, CN, PEF, OFX, S.	AU, AM, CN, CH.
Salmonella typhii	SXT, CH, SP, CPX, AM, AU, CN, PEF, OFX, S.	NILL
Proteus mirabilis	SXT, CH, SP, CPX, AM, AU, CN, PEF, OFX, S.	NILL
Serratia marcescens	SXT, CH, SP, CPX, AM, AU, CN, PEF, OFX, S.	NILL
Haemophilus influenzae	SXT, CH, SP, CPX, CN, PEF, OFX, S.	AM, AU.
Citrobacter freundii	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	NILL
Shigella spp	SXT, CH, SP, CPX, CN, PEF, OFX, S.	AM, AU.
	Gram Positive Isolates	
Strept. pneumoniae	PEF, CN, R, CPX, S, E.	APX, Z, AM, SXT.
Staphylococcus epididymis	PEF, CN, R, CPX, S, Z, E, SXT.	APX, AM.
Staphylococcus aureus	PEF, CN, APX, Z, AM, R, CPX, S, SXT, E	NILL

Sxt – Sulfamethoxazole Ch - Chloramphenicol Sp - Sparfloxacin Cpx - Ciprofloxacin Am - Amoxacilin Au - Augmentin Cn- Gentamycin Pef - Pefloxacin Cn - Gentamycin Apx - Ampiclox Z - Zinnacef R - Rocephin S- Streptomycin

Klebsiella pneumoniae, *E. coli*,*Pseudomonas aeruginosa* isolated from one group of cockroaches proves to be susceptible to Au(Augmentin), while *Klebsiella pneumoniae*, *E. coli*,*Pseudomonas aeruginosa* isolated from another group of cockroach were resistance to Au(Augmentin) when tested for AST. *Proteus vulgaris* isolates that were randomly picked from all the three groups of cockroach totally resist all the common antibiotics used. *Salmonella typhii*, *Proteus mirabilis*, *Serratia marcescens*, *Citrobacter freundii*, and *Staphylococcus aureus*coloniesthat were randomly picked from all the three groups of cockroach were totally susceptible to all the common antibiotics used.

Table 6 below is the Antibiogram of Pathogenic Bacteria Isolated from Internal Body Surface of Cockroach samples collected

Table 6: Antibiogram of Pathogenic Bacteria Isolated from Internal Body Surface of Cockroach samples collected

	Gram Negative Isolates	
Bacteria Seen	**Sensitive**	**Resistance**
Pseudomonas aeroginosa	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	AM, AU, SXT, CH, CN.
Kleb. pneumoniae	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	CPX, AM, AU, SP, CPX, SXT.
Proteus vulgaris	NILL	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.
Kleb. oxytoca	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	AM, AU.
E. coli	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	AM, AU, SXT, CH
Proteus mirabilis	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	NILL
Haemophilus influenzae	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	NILL
Citrobacter freundii	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	AM, AU
Shigella spp	SXT, CH, AM, CN, PEF, S.	SP, CPX, AU, OFX
Salmonella typhii	SXT, CH, SP, CPX, AM, AU, CN, PEF,OFX, S.	AM, AU
	Gram Positive Isolates.	
Staphylococcus aureus	PEF, CN, APX, Z, AM, R, CPX, S, SXT, E.	NILL
Staphylococcus epididymis	PEF, CN, R, CPX, S, E.	APX, Z, AM, SXT.
Strept. pneumoniae	PEF, CN, R, CPX, S, E.	APX, Z, AM, SXT.

Sxt – Sulfamethoxazole Ch - Chloramphenicol Sp - Sparfloxacin Cpx - Ciprofloxacin Am - Amoxacilin Au - Augmentin Cn- Gentamycin Pef - Pefloxacin Cn - Gentamycin Apx - Ampiclox Z - Zinnacef R - Rocephin S- Streptomycin

Klebsiella pneumoniae, *E. coli*,*Pseudomonas aeruginosa* isolated from one group of cockroaches proves to be susceptible Au (Augmentin), also the same types of bacteria isolated from another group of cockroach were resistance to Au (Augmentin) when tested for AST. *Proteus vulgaris* isolates that were randomly picked from all the three groups of cockroach totally resist all the common antibiotics used. *Proteus mirabilis*, *Staphylococcus aureus* and *Haemophilus influenza* colony that were randomly picked from all the three groups of cockroach were totally susceptible to all the common antibiotics used.

Discussion

The dirty behavior of cockroaches in the house poses a great danger to human health. Current results clearly show that almost all household cockroaches carry a bacterial, fungal, or parasite pathogen. The proportion of cockroaches carrying pathogens collected in the toilet is 4,444 higher than the proportion of cockroaches carrying pathogens collected in stores and kitchens, which is inconsistent with the report (Sisai et al., 2010).

This indicates that the toilets are less clean than kitchens and shops. Gram-negative bacteria make up more than 70% of the bacteria isolated from the inner and outer surfaces of cockroaches, consistent with the report (Rivault et al., 2016). The study found that up to 88% of isolates were Gram-negative bacteria on cockroach cuticles, most of which belonged to the Enterobacteriaceae group.

Some of the bacteria isolated from the inside and outside of the cockroach are pathogenic and can cause serious illness, which can be very difficult to treat due to the response to antibiotics. Since the average loading value of Shigella is 1.9 x 109 CFU / ml, followed by Salmonella typhii of 1.3 x 109 CFU / ml, the bacteria isolated from the outer surface of the cockroach collected from the toilet have the highest microbial load. It can cause severe bowel disease. Bacteria such as; Klebsiella, Escherichia coli, Proteus Pseudomonas aeruginosa, which can cause urinary tract infections, are mainly isolated from the inner and outer surfaces of cockroaches collected in the toilet, and these bacteria Separation rate is high. Aspergillus It has also been shown to produce mycotoxins, which have the highest microbial load on fungi isolated from the outer surface of cockroaches and are the leading cause of food poisoning (Salehzadeh et al., 2007).

Multiple patterns of drug resistance were observed in all isolates obtained from both the inner and outer surfaces of cockroach.

The high prevalence of multidrug-resistant pathogens isolated from the inside and outside of cockroaches may be due to most persistent substance abuse of these antibiotics by residents of the home where the cockroach was collected. I have. Most of the antibiotics used in this study, such as Ampiclocus, Amoxacillin, and Sulfamethoxazole, have multiple resistance patterns in isolates, are inexpensive, and are common infections by people without a doctor's prescription. Widely used in the treatment of (Ehinmidu, 2003).

Conclusion

The results of this study show that there is a high rate of pathogens on the outside and inside of household cockroaches that can cause serious illness that rejects the null hypothesis. It is multidrug resistant to common antibiotics from these pathogens and can be very difficult to treat. Therefore, it is very important to maintain optimal hygiene, especially in critical areas of the home such as toilets, kitchens and warehouses, in order to prevent and control the persistent invasion of pathogen-carrying cockroaches in the home. You should be aware of the dangers of cockroach inhabiting residential areas and strive to keep your kitchens and toilets clean.

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