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Evaluation of Microbial Contamination of Combs and Brushes in Beauty Salons within the University of Port Harcourt, Rivers State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author HOS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors TTO and CJU managed the analyses of the study. Author TTO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Beauty salons may provide a suitable medium for the growth and transfer of pathogenic microorganisms which may be of public health significance. This study was aimed at investigating the microbial contamination of beauty salon tools within the University of Port Harcourt, Rivers State, Nigeria. Nutrient agar was used for the determination of total culturable heterotrophic bacterial counts and Potato dextrose agar was used for the determination of total spore counts. Bacterial isolates were subjected to different biochemical tests while the fungal cultures were identified by macroscopy and microscopy. Results revealed bacterial load obtained from combs and brushes across the three campuses studied ranged from 6.3x105 to 2.8x106 CFU/swab area and 5.8x105 to 1.8x106 CFU/swab area respectively. Total spore counts obtained from combs and brushes across the three campuses ranged from1.8x105 to 1.0x106 CFU/swab area and 4.2x105 to 9.3x105CFU/swab area respectively. The bacterial isolates obtained from the salon tools include *Staphylococcus aureus*, *Bacillus* spp., *Micrococcus* spp.,*Serratia* spp.,*Citrobacter* spp., *Proteus* spp. and *Shigella* spp., while the fungal isolates include *Aspergillus flavus*, *Penicillium* spp.,

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Tricophyton spp. and *Microsporium* spp. *Staphylococcus aureus* (27.7%) and Bacillus spp.(22.2%) were the predominant bacterial isolates in the study while *Aspergillus flavus* (36.3%) and *Penicillium* spp.(27.3%) were the most occurring fungi. The study showed that fomites used in beauty salons harbour significantly high microbial load including microorganisms of possible public health significance.

Keywords: Beauty salons; pathogenic microorganisms.

1. INTRODUCTION

Besides the day to day interactions of people which constitute one way of spreading disease, the major source and spread of infections in communities are fomites [1]. The environment plays an important role in transmission of microbial agents to humans, with many environmental materials serving as vehicles [2]. Tools used in Beauty salons can become contaminated with pathogenic microorganisms and can be potential reservoirs of such pathogenic microorganisms. Any service with the potential to break the skin's surface can be associated with infections, and these infections can be transmitted to and between clients if proper infection control procedures are not implemented.

Beauty salon services may pose potential health concerns to their clients, including risk of infection and injury. These health risks will vary depending on the nature of the service, the tools used, the health status of the clients and service providers, as well as the infection control procedures implemented. While invasive procedures, such as piercing and tattooing, are clearly associated with bacterial and viral infection risks, even non-invasive procedures, such as hair dressing, pedicure and manicure can result in infections [3].

Beauty salons play an important role in possible transfer of skin and eye infections due to the use and reuse of beauty salon tools and equipment [4]. Items such as razors, scissors, combs, clippers and hairpins can accidentally pierce the skin. Nail and cuticle clippers, nail files, and callus removers used in beauty salons have also been implicated in disease establishment among beauty salon users [5].

Beauty salons are considered high-exposure environments for transmission of human pathogens [6]. Ruddy et al. [7] reported a case of Methicillin-resistant *Staphylococcus aureus* (MRSA) infection in patient previously tested negative for MRSA, after a visit to the hospital hairdresser. Improperly sanitized cuticle cutters had been attributed to cause varying serious complications, ranging from an inflamed cuticle to hepatitis [5]. Pelenita [8] stated that dirty instruments also contribute to infection by blood borne diseases such as HIV or hepatitis. Other infections that can be spread in hairdressing premises include skin infections on the scalp, face and neck such as impetigo and fungal infections such as *Tinea capitis* and *Tinea barbae* [9-11].

Commonly isolated bacteria from hair dressing and beauty salons include *Staphylococcus aureus, Staphylococcus epidermis*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa, Bacillus* spp*. Micrrococcus* spp. *Enterococus* spp. and *Enterobacter* spp. while fungal isolates include *Aspergillus flavus, Aspergillus fumigates, Alternaria* spp., *Cladosporium* spp*., Geotrichum candidum, Rhizopus nigricans., Cladosporium, Trichophyton* spp*., Mucor* spp*., Rhizopus arrhizus*, *Candida albicans, Penicillium* spp. [4,5,12,13].

Beauty salons around the University environment have been observed to receive a lot of patronage, and a better percentage of this population is made up of students who make direct or indirect contact with each other. The study therefore sets out to determine the microbial population and diversity in selected beauty salon tools across the different campuses of the University of Port Harcourt.

2. MATERIALS AND METHODS

2.1 Collection of Samples

Twelve composite samples were collected from the combs and brushes in the selected public salons within the three university campuses (Choba, Abuja and Delta Park), within the study period (May-June, 2018) using sterile swab sticks. The sterile swab sticks were moistened in normal saline first before they were used to swab the combs and brushes. They were replaced into the container, labeled appropriately and were

immediately transported to the laboratory for microbiological analysis.

2.2 Isolation and Enumeration of Bacterial and Fungal Isolates

This was done to estimate the number of organisms in different samples. Swab samples were diluted in 10 ml sterile normal saline to make a stock solution and shaken mechanically for 10 minutes. Exactly 1ml from the sample stock solution was pipette aseptically into a test tube containing 9ml of normal saline to make 10^{-1} dilution and from this dilution, 10^{-2}, 10^{-3}, 10^{-4}, and 10^{-5} dilutions were made.

Nutrient agar and potato dextrose agar were prepared for plating out the diluted samples. Duplicate plates were set for the plating of the dilution of the different samples, 0.1ml of 10^{-3} dilution was collected and dropped on the surface of the agar using a sterile pipette and spreading was done using a sterilized hockey stick. Bacterial plates were incubator at 37^0C for 24 hours while fungal plates were incubated at 27°C for 48-72 hours. The number of colonies that developed from each plate ranging between 30 and 300 after incubation was counted and recorded.

The bacterial isolates were identified based on their cultural and biochemical characteristics with reference to Holt et al. [14]. Morphological characteristics such as shape, colour, arrangement of spores, structure of the mycelium, and structure of hyphae and arrangement of sporangiophores were used in identifying the fungal isolates as described in Ellis et al. [15].

2.3 Ethical Consideration

Ethical approval was sought from the department in the University of Port Harcourt. A letter of consent was presented to the salon owners before the commencement of the study.

3. RESULTS

The results of bacterial load obtained from combs and brushes from salons across the three campuses was shown in Table 1, which ranged from 1.8×10^6 to 3.7×10^6 CFU/swab area and 1.6×10^6 to 3.4×10^6 CFU/swab area respectively. In Table 2, the total spore counts obtained from combs and brushes from salons across the three campuses were recorded and it ranged from 6.9×10^5 to 1.9×10^6 CFU/swab area and 1.2×10^6 to 1.6×10^6 CFU/swab area respectively.

The bacterial isolates obtained from combs and brushes are *Staphylococcus aureus, Bacillus* spp*., Micrococcus spp., Serratia* spp*., Citrobacter* spp*., Proteus* spp*. and Shigella* spp. while the fungal isolates include *Aspergillus flavus, Penicillium* spp*., Tricophyton* spp. and *Microsporium* spp. (Table 3).

The percentage occurrence of bacterial isolates was shown in Fig. 1. The organisms and their level of occurrence include *Staphylococcus aureus* (27.7%), *Bacillus* spp. (22.2%), *Micrococcus* spp. (11.1%), *Serratia* spp (16.7%), *Citrobacter* spp. (5.6%) *Proteus* spp. (11.1%) and *Shigella* spp. (5.6%).

Table 1. Total bacterial counts obtained from Salon tools

Salon location	Bacterial counts (CFU/swab area)	
	Comb	Brush
Abuja campus	2.5×10^6	3.2×10^6
Delta campus	1.8×10^6	3.4×10^6
Choba campus	3.7×10^6	1.6×10^6

Table 2. Total fungal counts obtained from Salon tools

Salon location	Spore counts (CFU/swab area)	
	Comb	Brush
Abuja campus	1.9×10^6	1.3×10^6
Delta campus	9.9×10^5	1.6×10^6
Choba campus	6.9×10^5	1.2×10^6

Table 3. Microbial isolates obtained from combs and brushes

Microbial isolate	Salon tool	
	Comb	**Brush**
Bacteria	*Staphylococcus aureus*, *Bacillus* spp., *Micrococcus* spp., *Serratia* spp., *Citrobacter* spp., *Proteus* spp. and *Shigella* spp	*Staphylococcus aureus*, *Bacillus* spp., *Micrococcus* spp., *Citrobacter* spp. and *Proteus* spp.
Fungi	*Aspergillus flavus*, *Penicillium* spp., *Tricophyton* spp. and *Microsporium* spp.	*Aspergillus flavus*, *Penicillium* spp., *Tricophyton* spp. and *Microsporium* spp.

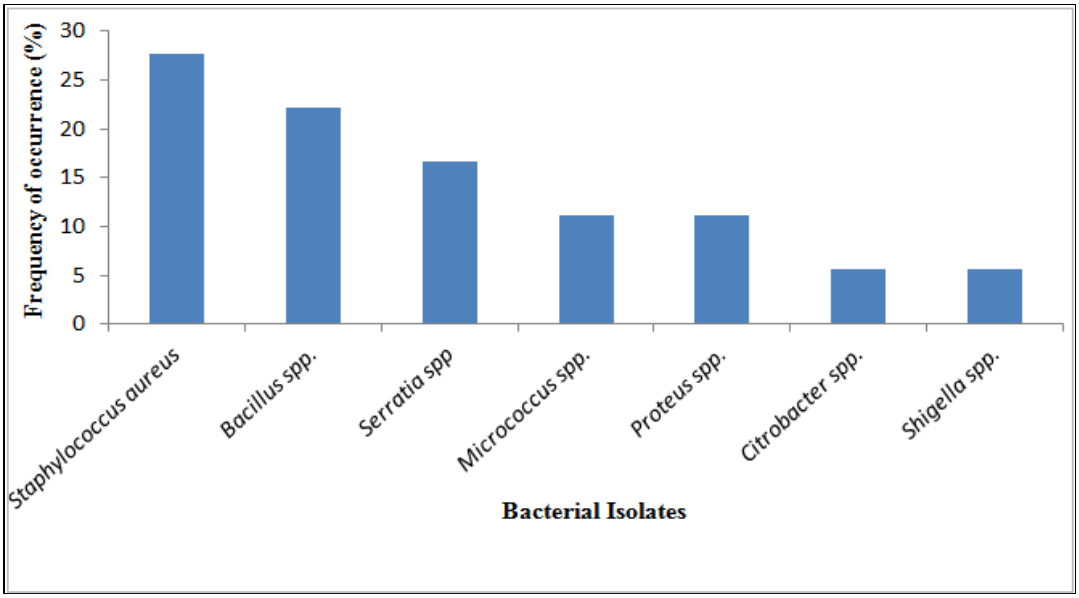

Fig. 1. Percentage occurrence of bacterial isolates

The percentage occurrence of fungal isolates is shown in Fig. 2. The organisms and their level of occurrence include Aspergillus flavus (36.3%), *Penicillium* spp. (27.3%), *Tricophyton* spp. (18.2%) and *Microsporium* spp. (18.2%).

4. DISCUSSION

The microbial population and diversity of combs and brushes used in public salons were determined. Results revealed that bacterial load obtained from combs and brushes from salons across the three campuses studied to range from 1.8 x 10^6 to3.7 x 10^6 CFU/swab area and 1.6 x 10^6 to 3.4 x 10^6 CFU/swab area respectively. This is similar to the study carried out by Mbajiuka et al. [16] who reported total bacterial counts obtained from brushes, combs and dryer in beauty salons to be between 1.4 x 10^6 to 1.6 x 10^6 cfu/swab area.The total spore count ranged from 6.9 x 10^5 to 1.9 x 10^6 CFU/swab area and 1.2 x 10^6 to 1.6 x 10^6 CFU/swab area.

The high microbial load obtained from the beauty salon tools can be attributed to the public services these tools are subjected to. A survey carried out in the course of this study revealed that no form of cleaning or sterilization was carried out for these tools and this will definitely lead to a build-up of microorganisms, hence putting customers of these salons at risk of infections should these organisms be pathogenic. Inevitably, salon workers handle these tools with their hands and this can contribute to the spread of infections if these hands are not thoroughly washed. Many studies have demonstrated the beneficial impact of hand washing and/or use of alcohol-based hand rubs for reducing pathogenic bacteria on hands and/or reducing infection rates in various institutional settings [17,18]. Since hands are important for intrapersonal and interpersonal transfer of microorganisms, as well as environmental transfer, the dynamics of hand microbial communities and factors impacting them are of considerable importance [19].

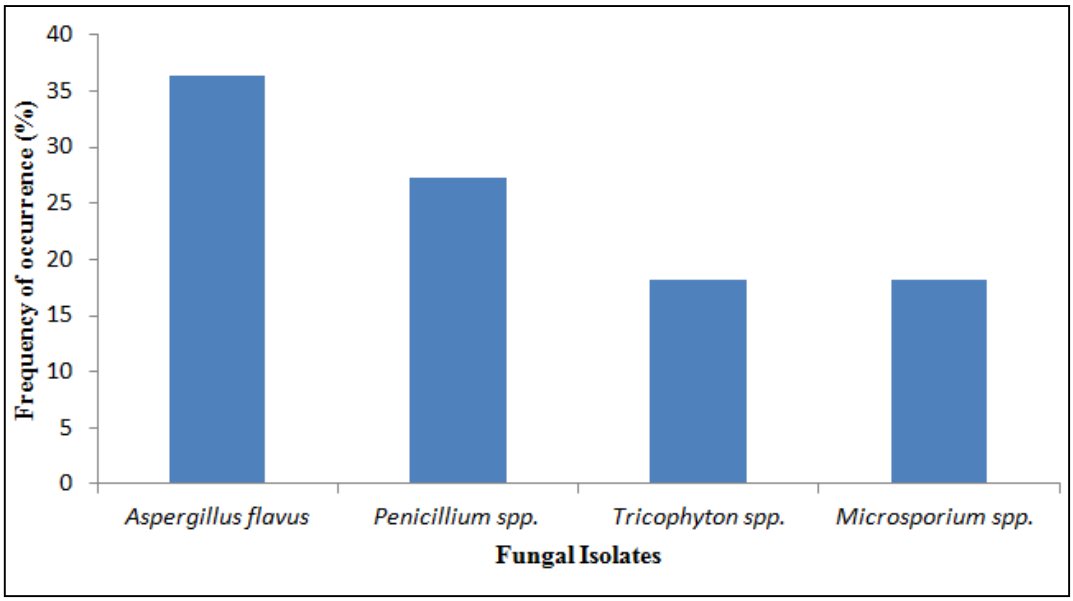

Fig. 2. Percentage occurrence of fungal isolates

The bacterial isolates obtained from the salon tools in this study were Staphylococcus *aureus*, *Bacillus* spp., *Micrococcus* spp., *Serratia* spp., *Citrobacter* spp., *Proteus* spp. and *Shigella* spp., while the fungal isolates were *Aspergillus flavus*, *Penicillium* spp., *Tricophyton* spp. and *Microsporium* spp. In a similar study by Hassan et al. [20], bacterial isolates including *Micrococcus, Bacillus* and *Staphylococcus* were obtained from salon tools, while the fungal isolates including *Cladosporium, Trichophyton, Mucor, Candida* and *Penicillium* were obtained.

Staphylococcus aureus (27.7%) and *Bacillus* spp. (22.2%) were the predominant isolates in the study. In the studies Enemuor et al. [4] and Hassan et al. [20] *Staphylococcus* spp. was also identified as the predominant isolate from all salons investigated. Similarly, Naz et al. [21] also reported the presence of *Staphylococcus* in unpreserved beauty salon tools after use. *Staphylococcus* spp. are able to cause various diseases in humans such as skin abscess, impetigo contagiosa, scaleded-skin syndrome, and it is the most commonly identified agent that is responsible for skin and soft tissue infection [4,22].

In the study carried out by Mbajiuka et al. [16] *Aspergillus* spp*, Mucor* spp and *Rhizopus* spp were isolated from beauty salon tools. Infections that can be spread in salon premises include skin infections on the scalp, face and neck such as impetigo and fungal infections such as ring worm or dematophtosis [16,23]. Contamination of hairdressing salons is used as an indicator of the burden of *Tinea capitis* in society, particularly where the fungi are prevalent and occur in epidemics [24]. Salons are exposed to many irritants and allergens that may cause occupational diseases. It has been estimated that 10–20% of beauty salon customers are affected by skin disorders [25].

It is also noteworthy that these microorganisms can be transferred from the salon tools to the hands and from one surface to another. Several factors have been identified to affect the transfer rate of bacteria from surface to another surface. These include bacteria type, source, and type of surface and moisture level [26]. Since hands are important for intrapersonal and interpersonal transfer of microorganisms, as well as environmental transfer, the dynamics of hand microbial communities and factors impacting them are of considerable importance [19]. This makes hand washing an important part of infection control from fomites such as salon tools. Several hygienic measures were reported to prevent cross-contamination from surface to another surface. Hand hygiene is one of the imperative tools to reduce and prevent surface-to-surface cross-contamination [27]. It is advisable that salons use single use products such as razor blades, disposable gloves, paper

toweling where possible and all equipment must either be discarded or cleaned in hot water and detergent and allowed to dry before re-used on another client.

5. CONCLUSION

The study showed that fomites (combs and brushes) used in beauty salons harbor significantly high microbial load, which have the potential of causing epidemic if the organisms are pathogenic. The beauty salon tools can serve as reservoirs and carriers of microorganisms which are transmissible from person to person. High level of hygiene practice should be adopted in all salons within the university campuses to prevent the spread of infections via salons.

CONSENT

A letter of consent was presented to the salon owners before the commencement of the study.

ETHICAL APPROVAL

Ethical approval was sought from the department in the University of Port Harcourt.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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