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Isolation and Identification of Bacteria from Some Used Makeup Tools in Sana'a City

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Abstract:

Makeup has become a significant aspect of women's daily lives, and makeup brushes are considered the magic wand for applying makeup to the face. Frequent use and sharing of makeup brushes by different customers may become a potential pathway for bacterial pathogens to spread. The present study aimed to isolate and identify bacterial contaminants in utilized makeup brushes. Twenty makeup tools (brushes and sponges) were collected from different personal houses, student bags, and a beauty salon in Sana'a city, Yemen, and inoculated into two culture media (nutrient agar and blood agar). The identification of isolated bacteria was confirmed by morphology and biochemical characters. The percentage of isolated bacteria in the beauty blender sponges and foundation sponges was higher than in blusher brushes and blending brushes. The bacterial isolates were more prevalent in the shared salon's cosmetic materials than in student bags and personal house cosmetic materials. A total of 50 bacterial isolates were identified as follows: *Staphylococcus aureus* (42%), *Bacillus* spp. (24%), *Staphylococcus epidermidis* (20%), and *Bacillus cereus* (14%), respectively in utilized makeup brushes. The study has concluded that makeup brushes may act as a source of infection and increase the risk of infection.

INTRODUCTION

Women now consider makeup to be an essential part of their everyday lives, using it for sun protection, beauty purposes, and clearing extraneous matter (Onurdağ *et al*., 2010). Makeup tools, such as brushes and sponges, are specialized items used to apply makeup. The most popular tools for applying and removing makeup are brushes and sponges (Mwambete and Simon, 2010). Many women are more likely to cross-contaminate when they share makeup and makeup products with friends and family. Others do not replace makeup tools, despite how long ago they were purchased (Hugbo *et al*., 2005; Udayanga *et al*., 2024). Certain makeup products have a rich texture, mostly because of their high moisture content and the presence of essential minerals that contain a wide spectrum of organic and inorganic compounds, which provide a suitable environment for the growth and reproduction of microorganisms (Ghalleb *et al*., 2015). Makeup brushes may serve as ideal habitats for a variety of bacteria, which can cause infections of varying degrees of severity (Alshehrei, 2023; Stanley *et al*., 2019).

Bacteria, mold, and yeasts are the real microbes causing the contaminated makeup tools (Jairoun *et al*., 2020). Everybody has unique skin microflora, which may be spread to others by using common tools such as makeup sponges and brushes. This poses a risk to women's health (Noah, 1995; Dadashi and Dehghanzadeh, 2016; Osilo *et al.,* 2023).

Makeup tools can be contaminated with bacteria by using the same brushes repeatedly for an extended amount of time when applying makeup to the face (Enemuor *et al*., 2013), sharing several women’s makeup brushes with friends and relatives (Ragheb *et al*., 2012), repetitive usage of salon tools by all customers without considering the hygienic conditions (Naz *et al*., 2012), and exposing makeup brushes to elevated levels of moisture (Lundov *et al*., 2009).

Unfortunately, the majority of makeup brushes and other makeup tools, even after being thoroughly disinfected, still constitute a risk of bacterial transmission and infection whenever they come into contact with skin cracks. The makeup brushes, contaminated with microorganisms, can clog pores and follicles in the skin (Enemuor *et al.*, 2013; Bouslimani *et al*., 2019; Ekakitie, 2024).

The most frequent bacteria on contaminated makeup tools are: *Staphylococcus aureus*, *S. epidermidis*, *S. warneri*, *Streptococcus* sp., *Bacillus cereus*, *B. circulans*, *Pseudomonas aeruginosa*, *Enterobacter* sp., *Klebsiella* sp., and *Escherichia coli* (Enemuor *et al*., 2013; Bashir and Lambert, 2019; Jairoun *et al*., 2020; Alshehrei *et al*., 2023). This study aimed to isolate and identify bacterial contaminants in used makeup brushes in Sana’a City, Yemen.

MATERIALS AND METHODS

Study Area

We conducted this study by collecting used makeup tools (brushes and sponges) from houses, students’ bags, and beauty salons in Sana’a City, Yemen, as shown in Table 1.

Sample collection

Twenty used makeup tools (brushes and sponges) were collected with the approval of the makeup brush owners. The surface of each makeup tool was swabbed completely by sterilized swabs moistened in a sterile solution and transferred to the microbiology laboratory for analysis (Mbah *et al.*, 2023).

Isolation and purification of bacteria

In sterile conditions, each sterile swab was inoculated on two different solidified media (nutrient agar and blood agar). The isolates were incubated for 24 h at 37 ºC. All plates were observed for the growth of bacterial colonies after incubation (Saleem *et al.,* 2018; Agi *et al*., 2023; Ebah *et al*., 2024). All isolates were streaked onto nutrient agar for purification. The purified colonies in nutrient agar slants were

kept at in refrigerator for future use (Monica, 2006).

Identification of bacteria

Identification of isolated bacteria was confirmed by morphology and biochemical characters using standard biochemical tests as reported in previous studies (Bergey and Holt, 2000; Saleem *et al.,* 2020; Urooj *et al.,* 2022; Aernan *et al*., 2023).

Table 1. Location and number of collected makeup tools.

No.	Makeup tools	Sample collection place	Type of use
1	Beauty blender 1	Beauty salon	Shared use
2	Beauty blender 2	Student bags	Individual use
3	Beauty blender 3	House	Shared use
4	Beauty blender 4	Student bags	Individual use
5	Beauty blender 5	House	Individual use
6	Foundation sponge 1	House	Shared use
7	Foundation sponge 2	House	Individual use
8	Foundation sponge 3	Student bags	Individual use
9	Foundation sponge 4	Beauty salon	Shared use
10	Foundation sponge 5	House	Shared use
11	Blusher brush 1	Beauty salon	Shared use
12	Blusher brush 2	House	Individual use
13	Blusher brush 3	House	Shared use
14	Blusher brush 4	Beauty salon	Shared use
15	Blusher brush 5	Student bags	Individual use
16	Blending brush 1	Student bags	Individual use
17	Blending brush 2	House	Shared use
18	Blending brush 3	Beauty salon	Shared use
19	Blending brush 4	House	Individual use
20	Blending brush 5	House	Individual use

RESULTS AND DISCUSSION

Isolated bacteria from makeup brushes

Based on colony morphology, a total of 50 bacterial strains were isolated from 20 makeup tools. The analysis of the makeup brushes showed that all the samples examined were contaminated with bacteria. The percentage of isolated bacteria in the beauty blender sponges and foundation sponges (15 each) was higher than in blusher brushes and blending brushes (10 each) (Table 2).

In this study, the percentage of isolated bacteria from makeup sponges (60%) was higher than that of isolated bacteria from makeup brushes (40%). This result agrees with Seaver (2019), who showed the makeup sponges were contaminated with 85.7% bacterial growth while the makeup brushes had 66.2%. Makeup sponges' higher percentage is due to the fact that they are usually used wet, and wet environments foster the growth of bacteria. Cohut (2019) also observed that makeup tools harbor harmful bacteria because they are not regularly cleaned, and that beauty blenders had

the worst bacterial growth. In contrast, Al-Rawi et al. (2018) found that the brushes harbored more bacterial contamination than sponges. This could be due to the larger surface area of the brush.

Table 2. The number of isolated bacteria from makeup tools.

Makeup brushes	Beauty blender sponge	Foundation sponge	Blusher brush	Blending brush
Number of examined samples	5	5	5	5
No. of isolated bacteria (%)	15 (30%)	15 (30%)	10 (20%)	10 (20%)

The percentage of isolated bacteria was higher in the shared used salon's cosmetic materials (35%) than in student bags and personal houses cosmetic materials (Table 3). These findings are similar to those of Dadashi and Dehghanzadeh (2016), who reported that makeup tools from hostels, markets, and makeup studios were the most contaminated compared to makeup tools obtained from houses. This may be because of how often they are used and shared among people. Beauty salons and markets are exposed to many irritants and allergens that may cause occupational disease and it has been estimated that (10-20%) of beauty salon customers are affected by skin disorders. Likewise, other researchers showed that the microbial contamination rate in cosmetics that are shared in beauty salons is higher than the rates reported for personal cosmetics, and cosmetician's repeated use of sponges and other tools leads to the growth of these pathogens (Mbah *et al.,* 2023; Ghias and Fozouni, 2024).

Table 3. Percentage of isolated bacteria based on location and type of usage.

Location	Type of usage	Incidence of bacteria (%)
Beauty salon	Shared use	35%
Student's bags	Individual use	27%
Personal homes	Shared use	24%
Personal homes	Individual use	14%

Identification of isolated bacteria

According to the results of the biochemical tests, *Staphylococcus aureus* accounted for 42% of the isolated bacteria in the samples. This species was followed by *Bacillus* spp. (24%) and *Staphylococcus epidermidis* (20%). With 14% of all isolates, *Bacillus cereus* was the least common (Table 4). This is in agreement with Mbah *et al*. (2023), who collected 100 samples from the makeup tools. The isolated bacteria were identified as: *S. aureus* (51.5%), Coagulase-negative *Staphylococcus* (25.8%), *Pseudomonas aeruginosa* (16.5%), and *Klebsiella pneumoniae* (6.2%). In contrast, Agi et al. (2023) collected 80 samples of makeup brushes. The microorganisms isolated and identified were *S. epidermidis* (55%), *S. aureus* (22.5%), and *Candida albicans* (22.5%). Ogbonna et al. (2024) isolated bacteria from different makeup kits (brushes, razor blades, and mascara) and identified bacteria isolates belonging to the five genera. The percentage of these isolates was as follows: *Staphylococcus* sp. (33.3%), *Streptococcus* sp. (16.6%), *Micrococcus* sp. (16.6%), *Bacillus* sp. (16.6%), and *E. coli* (16.6%).

Table 4. The distribution of bacterial isolates based on the type of makeup brushes.

Isolated bacteria / Makeup brushes	*Staphylococcus aureus*	*Staphylococcus epidermidis*	*Bacillus* spp.	*Bacillus cereus*
Beauty blender	9	5	1	—
Circular sponge	5	—	9	1
Blusher brush	5	5	—	—
Blending brush	2	—	2	6
Total (%)	21 (42%)	10 (20%)	12 (24%)	7 (14%)

In this respect, *S. aureus* was the most predominant isolate on the makeup brushes (Table 4). Al-Musawi (2016), Amin and Qadir (2020), Mohammed et al. (2020), and Alshehrei (2023) also found that *S. aureus* accounted for the majority of the bacterial growth on cosmetic items. *S. aureus* is among the most significant bacteria that cause disease in people, such as skin infections and abscesses. These symptoms could occur due to the impairment of the human immune system, skin structure, and wounded epithelium. This may be because this bacterium is prevalent in nature and part of the skin's normal flora (Al Kindi *et al*., 2019).

This finding disagrees with the results of Agi et al. (2023) and Noor et al. (2020), who found *S. epidermidis* to be the most prevalent species. The reason for this high prevalence of *S. epidermis* is that it is considered to be a normal flora of the skin. Furthermore, *S. aureus* was also isolated from the makeup brushes. Because of the regional differences, the result can also vary. Another hazardous bacterium was isolated during this investigation, *Bacillus* sp., which causes localized necrotizing cellulitis in the skin (Dadashi and Dehghanzadeh, 2016).

CONCLUSION

This study showed that makeup brushes can shelter bacteria with a high microbial load. Although most bacteria isolated from these makeup brushes were skin-normal flora, they have the potential to cause skin infections in consumers if the skin is compromised. Makeup brushes can also serve as stores and carriers of bacteria, which are transmissible from person to person. It is also noteworthy that the rate of microbial contamination in makeup tools used in beauty salons is higher than the rate reported in personal tools. Therefore, we must avoid sharing makeup tools in public and avoid using a makeup brush for a long time. Also, it is important to maintain a high level of personal hygiene and environmental sanitation among individuals and beauty salons to prevent the spread of infections.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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