Isolation of *Staphylococcus aureus* from Some Cosmetics Products and their Relationship to Acne in Women Visiting Beauty Salons in Mukalla City

Wedad M. Alhaik[1]*, Ahmed M. Al-Haddad[2] Fatima S. Masiaan[1], Funoon A. Bamjhafi[1], Manar Z. Bamseika[1], Hiba A. Bawazir[1]

[1]Department of Biology, College of Science, Hadhramout University, Mukalla City, Yemen
[2]Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Hadhramout University, Mukalla City, Yemen.

Abstract:

Background: While cosmetics are widely used for enhancing appearance, improper handling and storage can make them sources of microbial contamination and skin issues.

Objective: This study aimed to isolate and identify *Staphylococcus aureus* from cosmetic products in Mukalla, Yemen, and investigate its association with acne in female users. Forty product samples were collected from four beauty salons in the period from December 2024 to February 2025.

Methods: Samples were collected with sterile swabs, cultured on blood agar, and identified via morphological, microscopic, and biochemical tests. Questionnaires administered to salon staff and clients assessed potential risk factors. Data were analyzed statistically.

Results: Overall, 37.5% of cosmetic samples were contaminated with S. aureus, with blush showing the highest rate (12.5%). Women aged 15–25 years were most affected and most prone to acne. Statistical analysis ($p < 0.05$) indicated a significant link between clients' hygiene practices and reported skin problems, such as facial irritation and redness.

Conclusion: Contaminated cosmetics, particularly blush, can transmit *S. aureus* to the skin. Microbial colonization and toxin production may lead to inflammation, resulting in acne and other skin infections.

Keywords: Cosmetic products, contamination, *Staphylococcus aureus*, salons, clients, acne, Mukalla city, Yemen.

Corresponding author:
***Wedad M. Alhaik: Address: Department of Biology, College of Science, Hadhramout University, Mukalla, Yemen.**
Email: wedadalhaik2024@gmail.com
Mobile: +967-773239584

عزل المكورات العنقودية الذهبية من بعض أدوات مستحضرات التجميل وعلاقتها بحب الشباب عند النساء المرتادات لصالونات التجميل في مدينة المكلا

وداد محمد الحيك[1]*، أحمد محمد الحداد [2]،
فاطمة صبري مسيعان[1]، فنون علي بامجحفي[1]،
منار زكي بامسيكة[1]، هبة امين باوزير[1]

الملخص:

الخلفية: بينما تُستخدم مستحضرات التجميل على نطاق واسع لتعزيز المظهر، فإن سوء التعامل والتخزين يمكن أن يحولها إلى مصادر للتلوث الميكروبي ومشاكل الجلد.

الهدف: هدفت هذه الدراسة إلى عزل وتحديد بكتيريا المكورة العنقودية الذهبية (*Staphylococcus aureus*) من مستحضرات التجميل في مدينة المكلا، اليمن، والتحقيق في علاقتها بحب الشباب لدى المستخدمات. تم جمع أربعين عينة من المنتجات من أربعة صالونات تجميل في الفترة من ديسمبر 2024م إلى فبراير 2025م.

الطريقة: تم جمع العينات بواسطة مسحات معقمة، وتمت زراعتها على أجار الدم، وتحديدها عبر الاختبارات الشكلية والمجهرية والكيميائية الحيوية. تم استخدام استبيانات مع طاقم الصالونات والعملات لتقييم عوامل الخطر المحتملة. وتم تحليل البيانات إحصائياً.

النتائج: إجمالاً، كان 37.5% من عينات المستحضرات ملوثة ببكتيريا المكورة العنقودية الذهبية، حيث أظهر أحمر الخدود (البلاشر) أعلى معدل تلوث (12.5%). كانت الفتيات والنساء في الفئة العمرية من 15 إلى 25 سنة الأكثر تأثراً والأكثر عرضة للإصابة بحب الشباب. أشار التحليل الإحصائي ($p < 0.05$) إلى وجود علاقة ذات دلالة إحصائية بين ممارسات النظافة الشخصية للعميلات ومشاكل الجلد المبلغ عنها، مثل تهيج الجلد والاحمرار في الوجه.

الاستنتاج: يمكن لمستحضرات التجميل الملوثة، وخاصة أحمر الخدود، أن تنقل بكتيريا المكورة العنقودية الذهبية إلى الجلد. قد يؤدي استيطان الميكروبات وإفرازها للسموم إلى حدوث التهاب، مما يؤدي إلى حب الشباب وغيرها من التهابات الجلد.

الكلمات المفتاحية: أدوات مستحضرات التجميل، التلوث، بكتيريا المكورات العنقودية الذهبية، الصالونات، الزبونات، حب الشباب، مدينة المكلا، اليمن.

Introduction:

Beauty salons, where women seek beauty and a distinctive appearance, often turn into fertile ground for the transmission of various infections, skin diseases, and eye diseases. This is due to the lack of hygiene and preventative measures, and the absence of oversight and accountability. This leaves some people with psychological and financial burdens to treat these diseases and infections, due to the lack of sterilization and cleaning equipment, as well as the improper use of chemicals. This is due to the proliferation of counterfeit products and fake brands, which are manufactured under unsuitable conditions. Cosmetics have become important in daily life due to the many areas of their uses and thus the increasing rates of consumption every year (1). In order to avoid bacterial contamination in cosmetics, preservatives are added to the ingredients (2). These additives have problems that arise from the quantities of additives. A deficiency in the preservative may cause microbial growth in the product later and thus spoil the products before their expiration date. An increase in these materials may cause damage to the user's skin or change the effect of the product from unforeseen damage (3). Therefore, a balance is needed in adding preservatives to kill microorganisms and not harm the consumer who uses them.

Cosmetics could be potentially contaminated with organisms, causing infections such as eye infections or even death from direct or indirect exposure to microbial contaminated cosmetics, including mouthwash, hand cream, and mascara (4).

The fact that these products are good environments for microbial growth is attributed to the fact that some of these products, such as creams, contain high levels of moisture, minerals, and other organic and inorganic materials, which are suitable environments for the growth of microorganisms. A number of beauty salon supplies, such as tweezers, sponges, brushes, and grooming products, can transmit these diseases (5). Therefore, this study focuses on taking samples of some cosmetic tools used in beauty salons in Mukalla city to detect microbial infection with *Staphylococcus aureus*, which is the potential cause of many skin diseases such as acne (6), in order to investigate the ways of growth and transmission of infectious agents in salons and cosmetics to reach correct treatments that prevent diseases.

Materials and Methods:

Study Design:

The research methodology was based on a cross-sectional analytical and laboratory study. Samples of various cosmetic tools were collected from four beauty salons in the city of Mukalla, and then sent to Al-Salam Laboratory in the city of Mukalla for laboratory examination.

Period and area of study:

This study was conducted between December 2024 and February 2025 in the city of Mukalla and its suburbs.

Sample size:

Forty samples of cosmetic products from four beauty salons in the city of Mukalla and its suburbs.

Collection and Preparation of Specimens:

The samples were collected from various beauty salons in Mukalla and its suburbs after obtaining permission from the salon owners. The samples were selected from various cosmetic products, such as mascara, lipstick, creams, eyeliner, and blusher, which are frequently used. It was ensured that the samples represented a variety of cosmetic products used in salons. Also, a questionnaire was completed for some female customers present to obtain information related to the study, as well as another questionnaire for the salon owner.

Samples were taken using sterile cotton swabs and then transferred to Al-Salam Medical Laboratory for culture and diagnosis. They were cultured in Petri dishes containing blood agar and solid MacConkey agar using the slicing method. The dishes were incubated at 37°C for 24 hours to identify bacteria growing on the diagnostic media (7).

Cultural characteristics and microscopical examination:

The initial diagnosis of bacterial isolates was made based on the morphological characteristics of the colonies growing on blood agar and MacConkey agar, which included the shape, color, and texture of the colonies (8), Gram stain was carried out according to (9) method.

Biochemical Tests:

Diagnostic tests were performed to confirm the presence of Staphylococcus aureus isolated by the following biochemical tests: Catalase test, Coagulase test, DNase test (7).

Ethical approval:

Official permission and approval were obtained verbally from the owners of beauty salons to conduct the study, and from the Deanship of the College of Science, Hadhramout University.

Statistical Analysis:

The data of the study sample were collected and statistically analyzed using the software (Software Sciences For Package Statistical) (SPSS, Verion 24), where analysis of variance was used followed by the (t-test) test to balance between groups and calculate frequencies, percentages, standard deviation, calculate the Chi-square value, and the significant value (*P-Value*). The results are presented in the form of tables charts.

Results:

The percentage of contamination of cosmetic tools with *Staphylococcus aureus*:

The total contamination rate of the studied cosmetic tools with *S. aureus* was 37.5%, where the highest contamination rate was (12.5%) in the blushes samples, and the lowest contamination was (2.5%) in mascara and eyeliner, respectively, with a statistically significant relationship between the contamination of different cosmetic tools with *S. aureus* at *P-value* = 0.01, which indicates the possibility of increased sensitivity of the facial skin due to the frequent use of blushes, which increases the chance of acne appearing (Table 1).

Identification and diagnosis of isolated bacteria:

Isolates bacteria are identification by macroscopic and microscopic examination (10, 11, 12), and biochemical test (13)

The study of the impact of some risk factors causing contamination of cosmetic tools:

a- Risk factors associated with hygiene and sterilization practices in salons:

This result showed that the majority of salons (75%) rarely sterilize makeup tools after each use, and about (25%) were sterilize only with soap and water. There is a significant relationship between beauty salons on the sterilization of cosmetic tools, and the use of the same tools for more than one customer without cleaning at *P-value* < 0.05, while there is no statistically relationship between the number of times tools are replaced, and there is no relationship between workers' prior training and contamination of tools at *P-value* > 0.05 (Table 2).

b- Risk factors associated with product quality and customer opinion:

This result in Table (3) showed that the most women affected by contamination are those between the ages of 15-25 years, and they are the most likely group to develop acne. Young people of this age, the women of this study feel reassured about the cleanliness of tools (85%) and they prefer to use their own cosmetic tools inside the salon. They also like to ask the staff in salon to clean or change tools before use.

c- Risk factors associated with clients' daily habits and practices:

Table 4 showed that 17.5% of women do not care about sterilizing their skin after applying makeup, and there were 40% of women apply cosmetics directly to their faces .the majority of them (92.5%) do not use chemical bleaching agents, but rather use natural products for the same purpose (72.5%), this indicates that the appearance or worsening of acne has nothing to do with the bleaching materials used by women, About (27.5%) of women who frequent salons suffer from facial allergies, scarring, and pimples, or health problems such as eye irritation and redness immediately after visit the salon directly (37.5%).

Table (1): Distribution rate of *Staphylococcus aureus* isolated from cosmetic tools

Cosmetic	Samples no.	Isolated Bacteria (%)	*P-value*	$\chi 2$
Lipsticks	8	4 10	0.01	2.03
Cecestores (beauty blender)	8	4 10		
Mascara	8	1 2.5		
Blushes	8	5 12.5		
Eyeliner	8	1 2.5		
Total	**40**	**15 37.5**	-	-

P-value ≤ 0.05, Chi-square (χ^2) = 0.2172

Table (2): Risk factors associated with salon hygiene and sterilization practices

Salon no.	Are you makeup tools sterilized after each use?			Type of sterilization			Number of times to replace makeup tools				Do you use the same makeup tools for more than one client without cleaning?		Have the workers ever been trained on the cleanliness of cosmetics and tools?	
	always	sometimes	rarely	Heat sterilizers	soap and water	No sterilize	After each customer	daily	weekly	monthly	Yes	No	Yes	No
1		√			√			√				√		√
2			√			√			√			√		√
3			√			√			√		√			√
4			√			√		√			√			√
%	**0**	**25**	**75**	**0**	**25**	**75**	0	**50**	**50**	0	**50**	**50**	0	**100**
p-value	**0.02**			**0.00**			**0.1**				**0.00**		**0.41**	

P-value ≤ 0.05

Table (3): Risk factors associated with product quality and customer opinion

Number of women (n=40)	Age group (Year)	Number of visits to salons during the year			Do you feel that the beauty tools in the salon are clean and safe?		Do you prefer to use your own beauty tools inside the salon?		I know the brands of products you use.		Do you ask the worker to clean or change the tools before use?	
		Less than 2	2-5	More than 5	Yes	No	Yes	No	Yes	No	Yes	No
21	15-25	11	6	4	21	0	18	3	16	5	17	4
16	26-35	9	4	3	11	5	14	2	9	7	15	1
3	36-45	2	1	0	2	1	2	1	2	1	2	1
Total		**22**	**11**	**7**	**34**	**6**	**34**	**6**	**27**	**13**	**34**	**6**
%		**55**	**27**	**17.5**	**85**	**15**	**85**	**15**	**67.5**	**32.5**	**85**	**15**
p-value		0.03			0.00		0.01		0.02		0.2	
χ^2		2.13			0.91		0.08		1.10		2.22	

P-value ≤ 0.05, Chi-square (χ^2 = 0.2172)

Table (4): Risk factors associated with clients' daily habits and practices

Number of women (n=40)	Age group (Years)	Sterilize skin after applying makeup		Applying cosmetics directly to the face		Use sunscreen		Use of bleaching chemicals		Use natural whitening materials		Have you ever had a facial allergy after visiting a salon?		Have you ever experienced eye irritation immediately after visiting the salon?	
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
21	15-25	21	0	7	14	12	9	2	19	17	4	5	16	6	15
16	26-35	10	6	6	10	3	13	1	15	10	6	3	13	6	10
3	36-45	2	1	3	0	0	3	0	3	2	1	3	0	3	0
Total		**33**	**7**	**16**	**24**	**15**	**25**	**3**	**37**	**29**	**1**	**11**	**29**	**15**	**25**
%		**82.5**	**17.5**	**40**	**60**	**37.5**	**62.5**	**7.5**	**92.5**	**72.5**	**27.5**	**27.5**	**72.5**	**37.5**	**62.5**
p-value		0.00		0.01		0.21		0.63		0.3		0.01		0.001	
χ^2		2.01		1.90		1.44		3.09		0.86		0.26		0.83	

P-value ≤ 0.05, Chi-squre (χ^2) = 0.2172

Discussion:

The results showed that the total contamination rate of used cosmetic tools was 37.5%. The highest rate 12.5% of *Staphylococcus aureus* (*S. aureus*) contamination was found in blush brush samples, and the lowest rate 2.5%was of mascara and eyeliner samples. This is maybe because blush (especially cream-based) contains organic compounds and fats that may provide a suitable nutrient environment for the growth of *S. aureus*, especially since the skin is its primary habitat. The bacteria can be transferred to the product through direct contact with contaminated skin or tools. Health risks may increase when boils and abscesses are present on the skin (14). In a study conducted in Saudi Arabia in 2020 to estimate the contamination of cosmetic tools with bacteria that cause acne, the highest contamination rate was found in contour brushes and blush brushes, higher than in other samples studied. The preservative components in cosmetic products may increase the contamination rate (15).

In another study in 2024 conducted that out of 320 samples collected from cosmetics and health products, microbial contamination was detected in 180 samples (56.25%), the most common bacterial and fungal contaminants were *S. aureus* (28.5%) and *C. albicans* (11%), respectively (16). Many studies conducted in several regions showed that more than 80% of cosmetics used in salons are contaminated with various types of bacteria, especially *S. aureus*. Furthermore, cosmetic products, particularly those used collectively without regular sterilization, contain alarming levels of pathogenic microbes , that indicate the danger of staphylococci in unsterile environments and how they are easily transmitted via surfaces in contact with the skin (17, 18). A recent study conducted in Sana'a, Yemen, in 2025 addressed the isolation and identification of bacteria from makeup brushes and sponges used in various homes, female students' bags, and women's beauty salons in the city. The highest percentage of bacteria isolated was *S. aureus*. It was found to be 42% more prevalent in beauty blender and foundation samples than in blending brush samples (19).

In our result, morphological, microscopic, and biochemical tests were performed to diagnose and identify *S. aureus* isolated from various cosmetic tools according to protocol (20, 21).

Table 2 showed that the majority of the salons (75%) were rarely sterilized makeup tools after each use, and about 25% sterilized them only with soap and water. However, there was no statistically significant relationship between the numbers of times tools were replaced, and there was also no relationship between workers' prior training and tool contamination, at (*P-value* > 0.05).

In contrast, a study conducted in the United States showed that 67% of beauty salons did not use effective disinfectants or change their tools after each client, increasing the risk of skin infection transmission (22).The World Health Organization (2022) also addressed the importance of sterilizing cutting or piercing tools, even in non-medical settings such as salons, stressing that they are a potential source of infectious disease transmission (23).

Previous studies by the Centers for Disease Control and Prevention in 2023 emphasized the need to sterilize beauty tools using disinfectants registered with the Environmental Protection Agency (EPA), and to instruct salons to change or individually package tools for each client (24).

Evidence also suggests that a significant percentage of women who visit beauty salons, especially those with skin conditions such as acne, show increased awareness of the risks of bacterial infections associated with the use of shared, unsterilized tools. One of the most prominent bacteria that can grow on beauty tools is *S. aureus*, a common bacterium that causes skin infections and can exacerbate acne (25). *S. aureus* is an opportunistic microbe found on the skin and can easily multiply in unclean environments such as shared cosmetic tools. A study published in the Journal of Clinical and Aesthetic Dermatology (2023) showed that *S. aureus* represents a high percentage of microorganisms found on makeup brushes in beauty salons, and that it may contribute to skin infections and the appearance of acne-like pimples or worsen those (26). Table 3 showed that most women are between the ages of 15 and 25, maybe this age group most likely to develop acne at this age. Statistical analysis revealed a significant relationship between the number of visits to salons during the year and their use of their own cosmetic tools (*P-value* < 0.05). However, there was no statistically significant relationship between their request to change or clean their cosmetic tools (*P-value > 0.05*) (27).

S. aureus is a common pathogenic bacteria that can be transmitted to the skin via unsterilized cosmetic tools such as brushes, sponges, and other items.

Conversely, a study by Roy *et al.* (2021) conducted that there is a type of acne that occurs as a result of clogged pores due to cosmetics. The situation becomes more serious if these tools are contaminated with pathogenic bacteria, if makeup is not removed properly, or if the skin is not cleansed beforehand. The study also found that not using sunscreen exacerbates the problem because ultraviolet rays increase inflammation and skin irritation, which contributes to the appearance of acne (28).

Another study revealed that not sterilizing the skin before and after applying makeup weakens the skin's protective barrier and creates a suitable environment for bacterial growth. Using cosmetics on unclean skin can transfer contaminants directly to the pores, especially since in beauty salons, cosmetic tools such as brushes, blush, sponges, and lipstick are passed around from one woman to another without sterilization, which is the main cause of bacterial transmission, an emergence of skin problems and diseases (29).

Conclusion:

Cosmetic products and tools are frequently contaminated by *S. aureus*, and that such contamination can colonize skin and is associated with inflammatory acne. Cosmetics can carry virulence factors (enterotoxin, biofilm or antibiotics resistance) these traits increase the potential for causing skin infection or making treatment harder.

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