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Bacterial and fungal contamination of some cosmetics used by female students in Saladin Governorate, Iraq

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Abstract

Cosmetics with a rich texture can provide the perfect conditions for dangerous microorganisms to grow. Furthermore, each person's skin microbiota is different and could be dangerous to another. Sharing cosmetics could spread the pathogenicity of the skin and eyes in saloons for beauty. Determining the level of contaminants brought about by bacteria was the primary goal of this study in used skin and eye cosmetics that are sold to women in beauty shops as public makeup kits.

Contaminated cosmetics were found among the 50 types examined in this investigation. Items including eye pencil, lip pencil, and mascara were examined. The pollutants ranged in concentration from 102 to 104 C.F.U./ml and included Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Klebsiella pneumonia, and fungi with the value Penicillium spp., Aspergillus fumigatus, and Candida albicans. Cosmetics are susceptible to microbiological proliferation since they contain water and additional nutrients. According to a recent study, certain microorganisms are dangerous to people.

The research area's face products and other communal health and cosmetic items are highly polluted. Thus, it is crucial to create stringent inspection guidelines for cosmetic items both before and after they are put on the market, store used cosmetics in cool, dry locations, and raise awareness among staff of beauty salons. About the proper use, hygienic handling, and upkeep of medical supplies and cosmetics. The pollutants ranged from 102 to 104 C.F.U./ml and included bacteria such as Aspergillus fumigatus, Candida albicans, Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Escherichia coli, and Klebsiella pneumonia, as well as fungus like Penicillium spp.

Keywords: Bacteria; Fungi; Cosmetics; Microbiological Contamination; Beauty Salons

1. Introduction

Cosmetics have become widely used for aesthetic objectives in recent years. In the meantime, beauty salons are crucial in the potential spread of eye and skin infections because the women's use of makeup kits in public [1]. Despite strict laws gradually raising the microbiological standards of cosmetics, reports of contamination have been common and in certain instances have caused consumers to face severe issues.2 Cosmetics frequently lack labels indicating their manufacture and expiration dates, and the preservative's efficacy diminishes over time. Additionally, the essential mineral factors that promote growth, organic and inorganic materials, and humidity present in cosmetic provide the perfect conditions for the development of microorganisms [2]. Each person's skin microbiota is different and can be spread to others via commonplace items like brushes and pads, endangering the women's health. As a result, the density and diversity of microorganisms in typical cosmetics used in beauty salons are probably higher [3]. Poorly preserved water-based products are often found to contain microorganisms *such Candida albicans, Pseudomonas aeruginosa,*

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Bacillus species, Staphylococcus, Enterobacter, Klebsiella, and *Penicillium* [4]. According to Dawson and Reinhard's survey, at least one microorganism from Sixty-seven percent of the fifteen eye shadow brands included bacteria from the species Staphylococcus, Micrococcus, Corynebacterium, Acinetobacter, Bacillus, as well as Moraxella. Many of the potentially hazardous bacteria found in cosmetics are found in ordinary human flora [5]. The United States Pharmacopeia (USP) has identified four bacterial markers for cosmetic contamination: Staphylococcus aureus, Salmonella species, Escherichia coli, and Pseudomonas aeruginosa. All four of these bacterial markers are also included in the European Pharmacopeia (EP), along with additional criteria for differentiating the different Enterobacteriaceae levels [6]. In a variety of poorly preserved medical solutions, the presence of organic material significantly raises the danger for development and accumulation or turbidity caused by bacteria, yeast, mold, or algae. When the oil phase hydrolyzes or the aqueous phase's pH changes, emulsions can become noticeably thinner and more heterogeneous, separate, break down, or transform color [7].

The research aims to know the extent of bacterial and microbial contamination in beauty salons, the types of bacteria in each product from the samples taken from the beauty salon this contamination some cosmetics used by female students in Saladin Governorate, Iraq.

2. Materials and Methods

2.1. Samples

The cosmetics used in the present research were three brands of eye pencil, lip pencil, and mascara; they were all bought from various factories in Iraqi supermarkets. The sampling period was three months, from April to July 2025. First, obvious alterations such as pigmentation, turbidity, and sedimentation were seen. Following that, a pH meter was used to determine each brand's pH value.

2.2. Microbial survey

To counteract the growth inhibitors in the components, Almost 1 gram of the makeup was added to nine milliliters of liquid Eugon LT100 broth medium while the makeup was being kept sterile. Initially, the tubes were cultured for 48–72 hours at 37°C. After that, 1 mL of each culture was taken out and put into the Levine eosin methylene and Cetrimide Agar medium. MacConkey agar and Sabouraud Dextrose Chloramphenicol Agar were incubated at 37°C for 24 to 48 hours. The colonies that developed on the medium were measured in order to determine the overall count of colony forming units per gram or milliliter of material (CFU g-1) after the plates containing growing colonies were isolated. Based on their morphology and biochemical testing, the isolated bacteria were further identified using recognized bacteriological procedures. The look of fungi was used to differentiate them. Furthermore, the relevant test for recognizing Candida yeast was performed, which entailed growing the yeast in human serum and incubating it for three hours at 37°C.

2.3. Statistics

The data was analyzed using Minitab software in compliance with the ANOVA test. Nevertheless, the mean beneath the P. value of 0.05 when compromised by the ducun multiple range test.

3. Results

Table 1 showed the variety and prevalence of the isolated fungus and bacteria in various amounts in mascara, Cosmetics that were bought included lip and eye pencils. from beauty salons. The percentages of bacteria, fungi, and no microbes were 23 (46%) and 22 (44%), respectively, and 5 (10%).

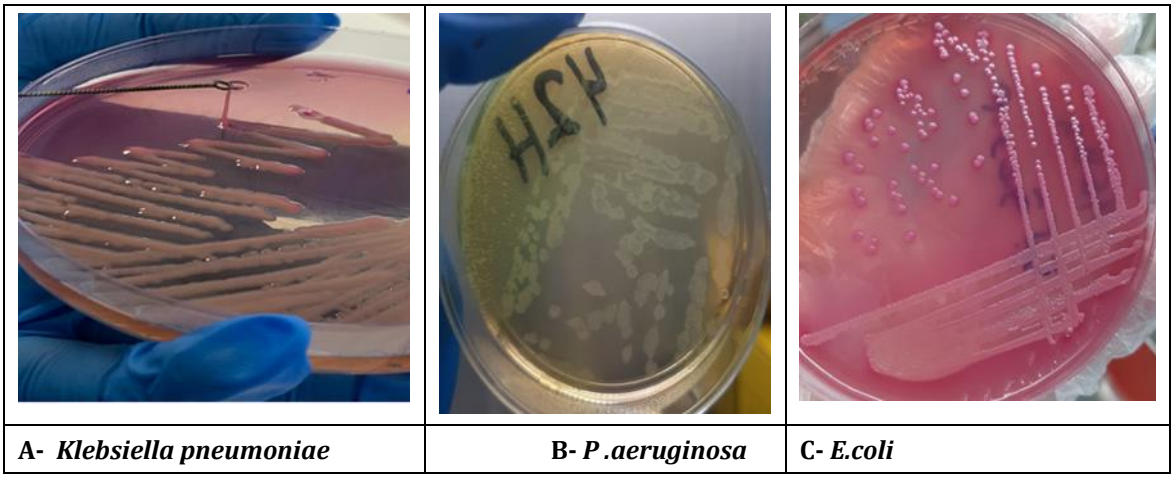
Table 1 Frequency of microbiological contamination in samples of cosmetics collected from salons serving women

Cosmetic type	**No. of samples**	**Frequency**			
		Bacteria	Fungi	**No microbial**	P value
eye pencil	15(30%)	8 (53%)	6 (40%)	1(7%)	0.001
lip pencil	15(30%)	7(46%)	5(34%)	3(20%)	
mascara	20(40%)	8(40%)	11(55%)	1(5%)	
Total	50(100%)	23(46%)	22(44%)	5(10%)	
P value	0.001				

Table 2. Demonstrated *that Pseudomonas aeruginosa* was among the most common bacteria found in the eye pencil cosmetics that were in use. Taking into account that the fungus Penicillium spp. that was isolated from lip pencil was most prevalent Fungi Hazardous contaminants that were isolated from cosmetic preparations.

Table 2 Rate of Microbial species contamination that may be harmful that were separated from cosmetic preparations

Microbial species *45*	**eye pencil**	**lip pencil**	**Mascara**	**P value**
Bacteria 23				
Staphylococcus aureus 5 (22%)	2(40%)	1(20%)	2(40%)	*0.07*
Staphylococcus epidermidis 3 (13%)	2(67%)	0(0%)	1(33%)	
Pseudomonas aeruginosa 8 (35%)	5(%)	2(%)	1(%)	
Escherichia coli 5 (22%)	1(%)	4(%)	0(0%)	
Klebsiella pneumonia 2 (8%)	1(%)	0(0%)	1(%)	
Fungi 22				
Penicillium spp 8(%)	2(25%)	4(50%)	2(25%)	*0.08*
Aspergillus fumigatus 7 (%)	2(29%)	3(42%)	2(29%)	
Candida albicans 7 (%)	3(43%)	3(43%)	1(14%)	



A- *Klebsiella pneumoniae* **B- *P .aeruginosa*** **C- *E.coli***

Figure 1 A-Klebsiella pneumoniae B- *P .aeruginosa C- E.coli* on MacConkey agar

4. Discussion

One of the biggest issues facing the cosmetics business is microbial contamination, which can lead to significant damages for both product and profit [8]. According to the information in Table 2, every item had varying levels of bacterial contamination. This was including both Gram positive and Gram negative bacteria, including Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia, Staphylococcus aureus, and Staphylococcus epidermidis. The colony counts of every bacterium found ranged from 103 to 104 C.F.U./ml. Each item including Aspergillus fumigatus, Candida albicans, and Penicillium species, included fungus, as indicated in Table 2, with fungal colony counts ranging from 102 to 104 C.F.U/ml. All examined products had pH values between 6.2 and 8.1, and some contaminated products showed observable changes such color changes, pigments, and sediments [9].

Sugar, starch, protein, amino acids, organic acids, alcohols, lipids, and other nutrients are abundant in cosmetic products and offer organic substrates for microbial growth [10]. Furthermore, untreated or non-sterile water can encourage microbial growth and lead to the contamination of cosmetic items because it is a basic requirement for any bacteria that are prone to contaminate them. Almost any material in nature can support the growth of microorganisms, which can often assault or even break down these materials [11], microbial species that are important for creating ingredients or cosmetic items often flourish at neutral pH 7.0, and a variety of mould and fungal species can tolerate acidic pH levels [12]. The majority of cosmetic goods need a preservative to prevent rancidity and microbiological contamination, and they should be produced in an entirely hygienic environment. For this reason, it's critical to keep every instrument, containerized containers, and apparatus extremely clean. Contamination can occur when multiple people use the same product, and since every person has different skin microorganisms, it might become dangerous for someone else [13]. For eye and other cosmetic products, Aerobic mesophilic bacteria have a maximum of 102 and 103 colony forming units (CFU) g-1, respectively. The amount of microbiological counts in every cosmetic that was analyzed and made accessible for public use in women's beauty salons exceeded the upper limit of what was considered safe [14].

5. Conclusion

Microbiological safety is one of the most significant and evolving aspects of cosmetic quality. Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus epidermidis, Penicillium spp., Aspergillus fumigatus, and Candida albicans were among the microorganisms that contaminated mascara, lip pencil, and eye pencil to varying degrees. The cosmetics industry has compelling reasons to protect the microbiological qualities of its products.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have disclosed no financial or non-financial conflicts of interest.

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