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EVALUATION OF THE MICROBIOLOGICAL QUALITY AND PUBLIC HEALTH RISK OF COMMONLY USED COSMETICS BRANDS IN KADUNA STATE, NIGERIA

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ABSTRACT

Cosmetics are substances that are used to enhance the physical aspect of humans. Because it can result in both product and financial losses, the cosmetics industry takes microbial contamination very seriously. The objective of the present investigation was to assess the microbiological quality and risk to public health of commonly used cosmetics in Kaduna State. A sterile swab was used to collect forty (40) distinct used cosmetics. Using standard protocol, the samples were inoculated onto nutrient agar, macConkey agar, and sabourad dextrose agar for the isolation and identification of bacteria and fungi. The prevalence of the isolates revealed that Staphylococcus aureus (35.3%) and E. coli (29.4%) were present in the samples, while Bacillus and Micrococcus sp. each accounted for 4.8%. Aspergillus and Rhizopus sp. had the greatest incidence rates, at 47.6% and 23.8%, respectively, while Botriytis and Alternaria account for 4.8% each. The percentage occurrence of both bacterial and fungal isolates was statistically significant, P 0.05, among the brands of cosmetics analysed. The percentage of bacteria and fungi found in the study clearly indicates the degree to which the cosmetics were contaminated during production, packaging, or use. Numerous bacteria and fungi, including Escherichia coli, Staphylococcus aureus, Bacillus sp., Micrococcus sp., Pseudomonas aeruginosa, Rhizopus, Penicillium, Fusarium, Aspergillus, Botriytis, and Alternaria species, were found to be contaminating a variety of cosmetic products that were analysed. Microbes may contaminate personal care products during production due to the handling of raw materials, or after repeated use by consumers. The necessity of preventing microbiological contamination of products has sparked significant concern among cosmetic manufacturers. Sharing cosmetics with more than one or two other individuals should be discouraged. Frequently, quality assurance should be considered alongside primary material controls, process controls, and final product inspections.

Keywords: cosmetics brands, Fusarium, Micrococcus sp., microbial contamination, public health risk

INTRODUCTION

Cosmetics are items that are meant to be rubbed, sprinkled, sprayed, introduced into, or applied to the human body or any part for cleansing, beautifying, increasing attractiveness, or changing the appearance, according to the federal food and drug cosmetics act (Nigam, 2009).

Cosmetics are substances that are used to improve the appearance of the human body. Examples of cosmetics include skin care creams, lotions, perfumes, lipstick, fingernail and toenail polish, eye and facial makeup, permanent weaves, coloured contact lenses, hair dye, hair spray, and gels, as well as a variety of other products (www.beautyhow.co.uk/blog beauty product part retrieved on 22/9/2019).

Microbial contamination of cosmetics products is a problem that the industry takes very seriously because it can lead to both product and financial losses. Additionally, cosmetic impurities may cause them to change into harmful products for consumers (Dunnigan, 1988).

When the instructions on the label are followed and the product is used as directed, the majority of cosmetics do not provide a health risk. Some people with sensitivities may experience a variety of side effects from the production procedure. From infection to a serious allergic reaction, the symptoms range (Teran and Helin, 1994).

The creation of cosmetics is not sterile, and at least the storage temperature is almost suitable for microbial development, and the majority of cosmetics contain a lot of chemicals that are favourable for microbial growth (Siegert et al., 2009). Cosmetics items may become contaminated during production by microorganisms that are present in the environment or in the raw materials, which are typically water-based and the latter from an environment that is favourable for microbial growth (Naki et al., 2006).

According to studies, the most common bacteria, yeast, and fungi detected in cosmetics include *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*, *Aspergillus niger*, *Aspergillus fumigatus*, as well as *Penicillium* spp. Although skin and mucous membranes are protected from microorganisms, cosmetics that may increase microbial infection can cause damage and minor trauma. In addition to lowering the quality of cosmetics, they can also cause infections of the skin, mucous membranes, hair, and nails. Other people have reported severe infections, even fatal ones, from being exposed directly or indirectly to other cosmetics that were microbiologically contaminated, such as mascara, liquid cream, and mouthwash (British Pharmacopeia, 2010).

Several health risks, including eye loss or respiratory infections if inhaled, boils, conjunctivitis, and skin irritation are linked to using contaminated products. Thus, research into the microbial contamination of used cosmetics is necessary to raise public awareness.

Therefore, the study aimed at evaluating the microbiological quality and public health impact of different cosmetics brand.

MATERIALS AND METHODS

Study Design

The study was designed and carried out within Kaduna metropolis. Students of Federal Polytechnic Kaduna were

used for the different cosmetics analysed. The Institution has four different campuses within the metropolitan of Kaduna and samples of these cosmetics brands were collected amongst the students both male and female residing in the campus.

Samples Collection

Forty (40) different used cosmetics products were collected in totals, using a sterile swab sticks, these were labelled based on the type of sample and date collected. The cosmetics collected include; Foundation, powder, body lotion, lipstick, eye shadow, mascara, brushes, contour, and hair colour dye, contact lenses figure 1. All the samples were taken to the laboratory for analysis.

Media Preparation

Three different media were used for bacteriological and mycological analysis that is nutrient agar (NA), macConkey agar (MA) and sabourad dextrose agar (SDA) all were prepared according to manufacturer's instructions.

Isolation and Identification of Bacteria

The sampled swab stick of each sample was inoculated onto nutrient agar and macConkey agar plates accordingly. The NA and MA plates were incubated for 24 h at 37°C. The plates were examined and distinct colonies were sub cultured onto freshly prepared NA and MA plates and incubated to obtain pure isolates.

On a clean, grease-free slide, a smear of the pure bacterial isolates was made, allowed to air dry, and then heat fixed. The slide was stained for one minute with 0.5% crystal violet. It was then rinsed with water, stripped off, and dyed for two minutes with mild iodine. Inside the bacterial cell, a purple/dark combination is formed by the crystal violet and iodine. It was counter stained for 2 minutes with 1% safranin, rinsed, and allowed to dry on the slide before being given a drop of oil immersion and examined with an x 100 objective under the microscope (Ochei and Kolhlkar 2008). Gram positive bacteria were identified as having recolored cells that were purple or dark, whereas gram negative bacteria were identified as having recolored cells that were pale pink.

Biochemical Tests

Catalase

A drop of hydrogen peroxide (H_2O_2) was placed on a glass slide and a bit of isolate from the agar plate was mixed with H_2O_2. It was then observed for the presence or absence of bubbling and frothing. A positive test is one which there is bubbling and frothing (Cheesbrough, 2002).

Coagulase test

Two drops of saline were placed on a clean slide and an isolate was emulsified in the saline after which a loopful of human plasma was added on the glass slide and mixed. The slide was rocked for one or two minutes, clumping of cells indicates a positive coagulase test while it absence indicate negative results (Cheesbrough, 2002).

Indole test

The bacterial isolate was cultivated for 24 hours in 4 ml of peptone water. A positive test was shown by the growth of a red colony in the layer surrounding the broth within one minute after the kovas indole reagent was added and gently agitated after the 24-hour incubation period. A negative reaction, however, preserved its yellow colour (Cheesbrough, 2002).

Oxidase test

A (1% of solution of tertramethylp-phenylene diamond dihydrocholride) was used to dampen the filter paper. A platinum loop was used to select the test colony and smear it on the filter paper. Check for a color change on the paper that has been inoculated (Cheesbrough, 2002).

Isolation and Identification of Fungi

The swap sticks were inoculated directly onto the sabourad dextrose agar (SDA) plate according to (Pitt and Hocking 1997). The plates were incubated at room temperature (28-30ºC) for 3 – 5 days. The representative of fungal colonies from inoculated plates were picked in an aseptic manner using wire loop and transferred onto freshly prepared sabourad dextrose agar (SDA) and incubated at room temperature (28-30ºC) for 3 - 5 days. The incubated plates were directly observed and distinct pure colonies were subjected for microscopy with the use of lacto phenol cotton blue as stain and viewed under the x40 objective lens, for morphology using an Atlas (Pitt and Hocking 1997).

Statistical Analysis

Statistical Package (SPSS) for Windows 07's One-way ANOVA test was used to calculate means for each parameter studied and determine whether any differences in the parameters were statistically significant.

RESULTS

From the results of the study, it was revealed that different bacterial isolates were identified using biochemical tests based on the gram reaction observed. The various test performed coupled with the morphological appearance confirmed each of the isolate. *S. aureus*, *Bacillus* sp. *E. coli*, *Micrococcus* sp. and *Pseudomonas aeruginosa* were the isolates identified as shown in Table 1.

The occurrence of the isolates revealed that *Staphylococcus aureus* (35.3%) and *E. coli* (29.4%) were the dominant and had the highest occurrence. Similarly, *Bacillus* and *Micrococcus* sp. recorded the lowest percentage occurrence of 11.8% each in the cosmetics products analysed Table 2.

Similarly, fungal isolates were identified in the cosmetics sample. The distribution of the isolates was presented in Table 3. *Aspergillus*, *Botriytis*, *Penicillium*, *Rhizopus*, *Fusarium* and *Alternaria* spp. were the isolates confirmed.

Aspergillus sp. account for the highest occurrence in the cosmetic samples with 47.6%, followed by *Penicillium* sp. 23.8 % and *Fusarium* sp. 9.5%. While *Rhizopus*, *Botriytis* and *Alternaria* sp. account for 4.8% each Table 4. The percentage occurrence of the both bacterial and fungal isolates were statistically significant.

Table 1: Distribution of Bacteria Isolates from Different Cosmetics Brand

S/N	Cosmetic Brand	Bacterial Isolate
1	Foundation	*Staphylococcus aureus* *Bacillus* sp. *Pseudomonas aeruginosa*
2	Powder	*Staphylococcus aureus*

		Micrococcus sp.
3	Body lotion	*Escherichia coli* *Bacillus* sp.
4	Eye shadow	*Escherichia coli* *Micrococcus* sp.
5	Lipstick	*Escherichia coli* *Staphylococcus aureus*
6	Powder brush	*Staphylococcus aureus* *Pseudomonas aeruginosa*
7	Mascara	*Escherichia coli*
8	Contour	*Staphylococcus aureus*
9	Contact lens	*Staphylococcus aureus*
10	Hair colour dye	*Escherichia coli* *Pseudomonas aeruginosa*

Table 2: Percentage Occurrence of Bacterial Isolates in the Cosmetics Sample

Bacterial Isolate	Percentage Occurrence
Staphylococcus aureus	35.3
Bacillus sp.	11.8
Pseudomonas aeruginosa	17.6
Micrococcus sp.	11.8
Escherichia coli	29.4

Table 3: Distribution of Fungal Isolates from Different Cosmetics Brand

S/N	Cosmetic Brand	Fungal Isolate
1	Foundation	*Aspergillus* sp.
2	Powder	*Aspergillus* sp. *Rhizopus* sp.
3	Body lotion	*Botriytis* sp. *Aspergillus* sp. *Penicillium* sp.
4	Eye shadow	*Aspergillus* sp.
5	Lipstick	*Fusarium* sp. *Aspergillus* sp. *Alternaria* sp.
6	Powder brush	*Aspergillus* sp. *Penicillium* sp.
7	Mascara	*Aspergillus* sp. *Penicillium* sp.
8	Contour	*Aspergillus* sp. *Fusarium* sp.
9	Contact lens	*Aspergillus* sp. *Penicillium* sp. *Fusarium* sp.
10	Hair colour dye	*Penicillium* sp. *Aspergillus* sp.

Table 4: Percentage Occurrence of Fungal Isolates in the Cosmetics Sample

Fungal Isolate	Percentage Occurrence
Aspergillus sp.	47.6
Rhizopus sp.	4.8

Botriytis sp.	4.8
Penicillium sp.	23.8
Fusarium sp.	9.5
Alternaria sp.	4.8

DISCUSSION

The results of the study showed that all the cosmetics were heavily contaminated with both bacteria and fungi that are harmful to human body. The percentage occurrence of the bacteria and fungi observed in the study vividly signify the level in which the cosmetics brand were contaminated either during production, packaging and/ or usage. The finding is contrary with the results of the study by Samiah and Mjali 2013, which isolated *Salmonella* typhi *and Brucella* spp. in used cosmetic in Saudi Arabia.

The most frequently isolated bacteria were *Staphylococcus aureus* which is a normal body flora and opportunistic bacteria. However, it causes boils and impetigo, conjunctivitis follicutis and food poisoning. The reasons behind high percentage occurrence of bacteria in the used cosmetics might be due to personal hygiene and storage condition of the users. The result related that the bacteria present in powder, lipstick, eye shadows, content lenses, powder brushes, foundation, body lotion, eye shadows, mascara, and contours respectively obtained in this study agreed with the results of the studies of Franca (2007). According to her, micro-organism can grow on almost every substances existing in nature and often able to attack or even decompose them, cosmetic ingredients provides organic substances in form of sugar, protein and amino acid and organic acid.

Aspergillus spp., *Fusarium* species, *Penicillium* species and *Rhizopus* species observed in the study, is relatively similar to the result of Hugbo et al. (2003); Omoridian et al. (2014); Gamal et al. (2015), who isolated *Aspergillus fumigatus* and *Penicillium* species from cosmetic samples. The presence of *Aspergillus* in these cosmetics is of health concern as it produces spores responsible for *Aspergillosis*. The rest of the fungi isolated in the study are agents of spoilage in many products due to their high moisture content.

The highest bacteria were obtained from foundation and mascara products with the highest moulds from powder and hair colour dye products. This is comparable to the research carried out by Okore (1992) in his study of microbiological purity of some body lotion marketed in Nigeria. Sources of contamination could be from air, environment, and storage facilities, hand of users.

CONCLUSION

The various cosmetic products analyzed were observed to be contaminated by scores of bacteria and fungi such as *Escherichia coli, Staphylococcus aureus, Bacillus sp., Micrococcus sp., Pseudomonas aeruginosa, Rhizopus, Penicillium, Fusarium, Aspergillus, Botriytis and Alternaria* species. *Staphylococcus aureus* and *Escherichia coli* were observed in the highest percentage occurrence of 35.3% and 29.4%. The lowest percentage occurrence was in *Bacillus* and *Micrococcus* sp. with 11.8% each. On the other hand, *Aspergillus* and *Rhizopus* sp. had the highest percentage occurrence of 47.6% and 23.8%, while the lowest was observed in *Botriytis, Rhizopus and Alternaria* sp. with 4.8%. Personal care products may already be contaminated by microbes during production due to handling of raw materials, or a finished product may become contaminated after repeated consumer use. The need to prevent microbiological contamination of products has caused cosmetic manufacturers a great deal of concern. In order to achieve effectiveness against microorganisms while avoiding toxicity for consumers, microbiologists must work within a narrow range of preservatives concentration.

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