

Investigation of the Effect of Cosmetics on Skin Staphylococci: A Study Case in Surabaya

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Abstract: The human skin serves as a protective barrier against various microorganisms. The skin microbiome is a complex community of microorganisms that plays a crucial role in maintaining skin health. The composition of the microbiome includes commensal bacteria that can prevent the colonization of pathogenic bacteria. *S. aureus* (*S. aureus*) is a pathogenic bacterium commonly found on the skin and can cause various skin infections. Cosmetics, such as toner, moisturizer, serum, sunscreen, and powder, are commonly used for skincare and can impact the skin microbiome. This study aimed to investigate the effect of cosmetics on the growth of *Staphylococcus*. Samples were collected from healthy individuals who regularly used facial care products. Bacterial colonies were enumerated and analyzed. Statistical analysis was performed to determine the significance of the effect of cosmetics on *Staphylococcus* growth. The results showed that the density of *Staphylococcus* species other than *S. aureus* was higher, indicating lower levels of *S. aureus* on the cheek of normal human skin. There was no significant difference in the growth of *S. aureus* and *Staphylococcus* spp. species when exposed to cosmetics. However, the density of *Staphylococcus* species was higher in individuals using serum and moisturizer products. The discussion explored the impact of various cosmetic products on *Staphylococcus* growth. Toners have some effect on the skin based on the formula, But the effect on *Staphylococcus* growth is not completely clear. Moisturizers contribute to overall skin health and hydration, which indirectly affects the presence of bacteria. Sunscreens may contain ingredients with antimicrobial properties, but their effect on *Staphylococcus* growth is still unclear. Serums contain active ingredients that can have inhibitory effects on bacterial growth. The use of powder products may not significantly affect *Staphylococcus* growth unless they contain specific antimicrobial ingredients. In conclusion, the use of cosmetics did not have a significant impact on the growth of *S. aureus* and *Staphylococcus* spp. species. The composition and concentration of active ingredients in cosmetics, as well as individual factors and skin conditions, may influence their effects on the skin microbiome. Maintaining a balanced and healthy skin microbiome is important for skin health and reducing the risk of infections.

Keywords: Cosmetics, Moisturizer, Face powder, Serum, Skin microbiome, *Staphylococcus aureus*, Sunscreen toner.

1. Introduction

Human skin is the first line of defense against environmental exposure to a variety of microorganisms, including bacteria, fungi, yeast, and viruses. Human skin is a complex ecosystem with various microenvironmental conditions, so the skin

microbial community is very diverse and complex [1]. The composition of the healthy human microbiome usually consists of commensal bacteria such as *Staphylococcus*, *Streptococcus*, *Propionibacterium*, *Micrococcus*, *Corynebacterium*, *Propionibacterium*, *Dermabacter*, *Brevibacterium* [2]. Skin structures such as hair follicles, sebaceous glands, eccrine and apocrine sweat glands as well as the subepidermal skin compartment, provide biological niches for the microbiome [3]. Balanced interactions between microbiomes can be both synergistic and competitive then can prevent colonization of pathogenic bacteria. For example, the interaction of *Staphylococcus epidermidis* (*S. epidermidis*) can inhibit the growth of *Staphylococcus aureus* (*S. aureus*) by inhibiting biofilm formation [2]. *S. aureus* is known as a pathogenic bacterium which is mostly identified as the cause of many skin infections such as impetigo, rosacea, and atopic dermatitis [4]. *S. aureus* is a frequent colonizer of the human population and one of the leading opportunistic bacterial pathogens of humans, causing major morbidity and mortality globally [5].

Cosmetics are products used for skin and body care and appearance, including products such as skincare, make-up, perfume, and others. The use of cosmetic facial products aims to protect and maintain the health of facial skin so that it remains good. Cosmetics can be used as a face cover that can change appearance [6]. In addition, cosmetics aim to improve skin quality and slow down the aging process [7]. Skin care products can affect the composition of the facial skin microbiome [8]. Based on previous research, cosmetics can contribute to the skin microbiome diversity, in particular, when used regularly or in the long term [7], [9]. The active ingredients contained in cosmetics can support or inhibit the growth of certain microorganisms. Among the compounds that stimulate the skin's microbiome is N-acetylglucosamine, a precursor of hyaluronic acid, commonly found in skin care cosmetics [10]. The use of cosmetics can affect the skin microbiome and interactions with bacteria, including *Staphylococcus*. Investigation of the effect of cosmetics on the growth of *Staphylococcus* aims to understand how the use of cosmetics can affect the growth, abundance, or activity of *Staphylococcus* on the skin. This is important because changes in the skin microbiome and *Staphylococcus* growth can impact the skin health and the risk of infection.

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2. Material and Methods

A. Sample Collection

Participants were selected from 15 people with the criteria of being healthy, not taking antibiotics, and using daily facial care products. A sterile cotton bud was applied to the participants' cheek with an area of 3 cm x 3 cm and then inserted into a microtube containing 1 ml of NaCl sterile and homogenized. 100 µl of sample liquid is poured on Media Salt Agar (MSA) for bacterial culture on the swab results.

B. Enumeration

Bacterial colonies growing on MSA media were counted in units of CFU/cm². Yellow colonies were counted as colonies of *S. aureus* and white colonies were counted as *Staphylococcus* spp. [11].

C. Statistical Analysis

The effect of facial cosmetic products on *Staphylococcus* was tested using the 2 Sample T Test using the Minitab 16 software. The P-Value result <0.05 showed that there was a significant difference in effect.

3. Results

A. The Results of *Staphylococcus* Density

Based on the results of *Staphylococcus* density (figure 1a), the dominant yield was higher in *Staphylococcus* species other than *S. aureus*, around 14 – 533 CFU/cm². This shows that cheek of normal human skin has lower *S. aureus* which was even absent in two participants. *S. aureus* (figure 1b) is known as an

opportunistic pathogen that has interactions with other microbiomes so that it can maintain human skin health. Some of *Staphylococcus* are normal flora of the skin and mucous membranes of humans, but others can cause suppuration and even fatal septicemia [12]. *S. aureus* is the most invasive species and the most different from other species because it has coagulase enzymes. This organism is found in 40% of healthy people, in the nose, skin, armpits or perineum [13].

B. The Effect of Using Cosmetics on Skin *Staphylococci* Density

Based on the results of the diagram (figure 2), it shows that there is no clear relationship between the two variables and the results of the t test are not significant. It can be explained that there is no significant difference between the two groups or variables being compared. This shows that the effect of using cosmetics in the form of facial wash, toner, moisturizer, serum, sunscreen, and powder is not significant for the growth of *S. aureus* and *Staphylococcus* spp. However, based on the results of the density of *S. aureus* and *Staphylococcus* spp. species, the dominant results were higher for the growth of *Staphylococcus* sp. The highest density of bacteria was found in *Staphylococcus* spp. reaching 533.3 CFU/cm² was found to be highest in the use of serum and moisturizer products. Moisturizer and serum products play a role in maintaining healthy skin [14].

4. Discussion

Toner is a skin care product that is generally used after cleaning the face. Toner is usually used to clean and hydrate the

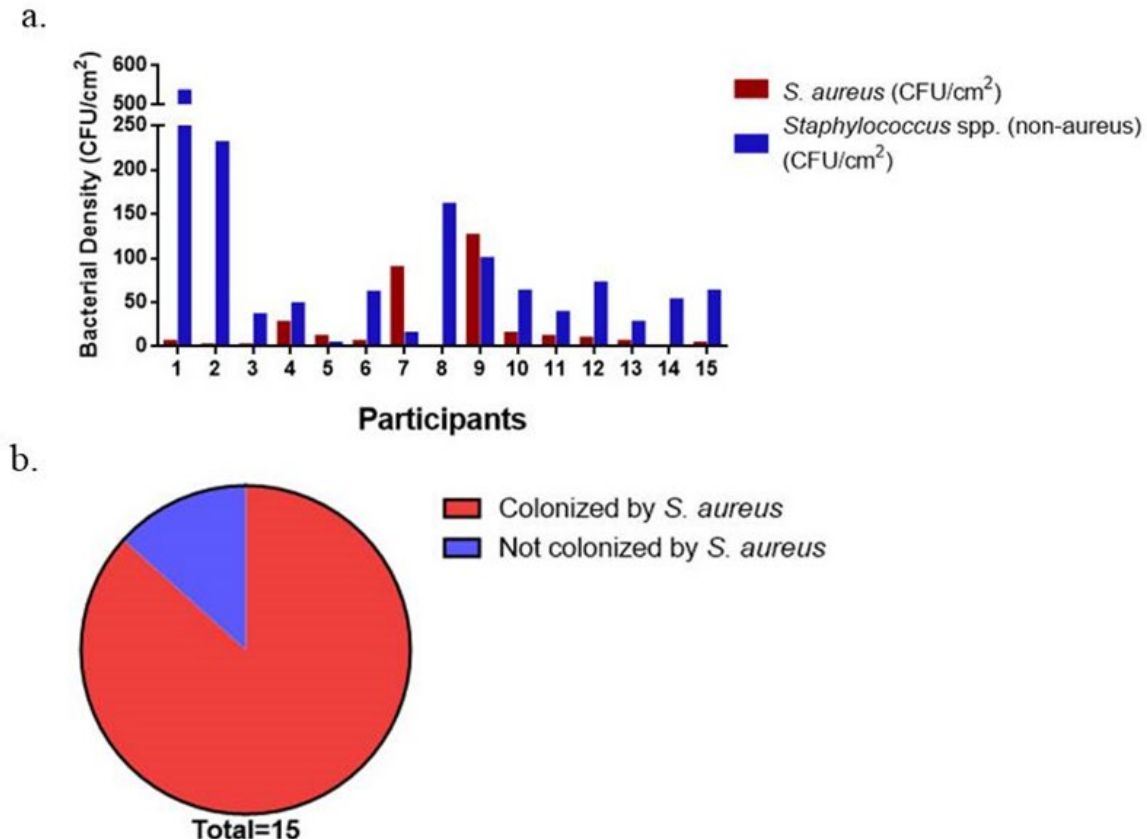


Fig. 1. *Staphylococci* on participants' skin. (a) The density of skin *staphylococci* and (b) the prevalence of *S. aureus* on skin

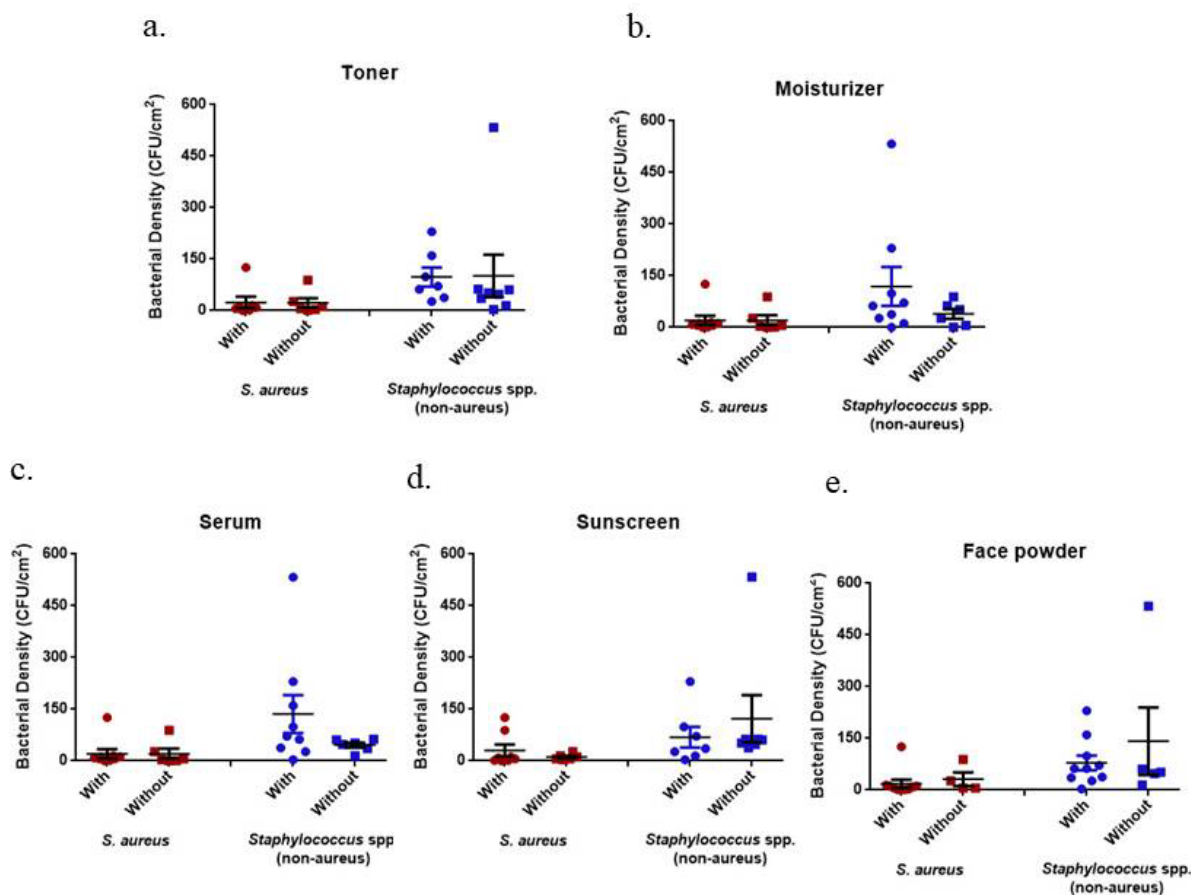


Fig. 2. The effect of various cosmetics on the density of staphylococci on participants' skin

skin [15]. Some toners contain antimicrobial ingredients, such as salicylic acid or benzoyl peroxide, which can help reduce the amount of bacteria on the skin's surface [16]. Although toners have some effect on the skin, their effect on *Staphylococcus aureus*, a bacterium that can cause skin infections, is not completely clear.

Emulsifiers, moisturizing agents, polymers/thickeners, sensory modifiers, and preservatives are some of the ingredients used in commercially available moisturizers [17]. Humectants, occlusives and emollients are the three main types of moisturizing agents. In addition to these ingredients, advanced benefit ingredients including vitamins, antioxidants, lipids, or sunscreens are often included in moisturizing formulations [14]. Moisturizers, or moisturisers, generally have no direct effect on *S. aureus*. Moisturizers are usually designed to maintain and increase skin hydration, as well as help repair damaged skin barriers [17]. Although moisturizers are not specifically designed to kill bacteria, their proper use can contribute to overall skin health, which in turn can affect the growth and presence of bacteria, including *S. aureus* [18]. In some cases, dry or irritated skin conditions can affect the growth of *S. aureus* [19]. Using the right moisturizer according to skin type can help maintain skin hydration, reduce dryness, and repair damaged skin barriers [17]. Thus, moisturizing can help prevent skin conditions that allow *S. aureus* overgrowth.

Sunscreen has a formulation that is applied to the surface of the skin protecting it from the harmful effects of ultraviolet

(UV) rays. The mechanism of action of sunscreens is divided into chemical, organic and physical [20]. Chemical sunscreens absorb UV rays and convert them into heat energy which is then released from the skin. Examples of common chemical sunscreen ingredients include octisalate and avobenzone [21]. The most commonly used sunscreens that act as physical barriers are titanium dioxide and zinc oxide [22]. Some ingredients in sunscreens, such as zinc oxide or titanium dioxide, have antimicrobial properties that can affect bacteria on the skin [23]. However, the effect on the skin microbiome is not direct and still needs further investigation, especially the effect on the growth of *S. aureus* and *Staphylococcus spp.* species. This was also shown in the insignificant results of the effect of using sunscreen on the growth of *Staphylococcus* and *Staphylococcus spp.* species. The results of the diagram that are not significant from the effect of facial products on the growth of *S. aureus* will indicate that the use of these facial products does not have a significant impact on the growth of these bacteria.

Serums or defined as concentrates, contain about ten times more biologically active substances than creams, therefore enabling better treatment of skin problems. Combining a few drops of facial serum with your daily skin care routine will give you noticeable results in a month or less [24], [25]. Facial serum is made of very small molecules that help it penetrate deep into the skin quickly [26]. Serum is packed with many beneficial active components and nutrients [25] such as antioxidants,

ceramides, amino acids and others. The formulation of facial serum is basically an emulsion consisting of two liquids that do not mix [27]. The effect of using serum products on *S. aureus* can vary depending on the composition of the serum and individual characteristics. Some serum products may contain antimicrobial ingredients or other active ingredients that can have an inhibiting effect on the growth of *S. aureus*. For example, several ingredients such as salicylic acid, lactic acid, or tea tree oil are known to have antimicrobial properties and can reduce bacterial growth on the skin [28]. In addition, changes in pH caused by serum can also affect the growth of the microbiome [29]. The insignificant effect of serum on the growth of *S. aureus* could be due to the fact that the composition of the serum used has a low concentration as an antimicrobial for *S. aureus*. In addition, the use of cosmetic products can also maintain the stability of the microbiome so that there is no change to *S. aureus*. This is also indicated by the density of *Staphylococcus* spp. higher so that the role of *Staphylococcus* as an inhibitor of the growth of *S. aureus* is possible.

The effect of using talc products on *S. aureus* can vary depending on various factors, such as the composition of the talc products, individual hygiene, and skin conditions. The composition of the powder product can influence the interaction with *S. aureus*. Some powder products may contain antimicrobial ingredients, such as zinc oxide or sulfur, which can have a bacterial growth inhibiting effect. However, it is important to note that this antimicrobial effect may vary depending on the concentration and formulation of the substance [30]. Skin cleansing routines and the use of other care products, can also affect interactions between powder products and *S. aureus* [29]. The use of powder products on skin that is clean and kept clean can help reduce the risk of excessive growth of *S. aureus* [30]. In addition, the use of powder products in a hygienic manner also needs to be done. Choosing a powder product that suits your skin type and keeping your skin moist can help maintain healthy skin and reduce the risk of infection [31]. In this study, the use of powder has a different formula and it is possible that there is no formula such as an antimicrobial that has an impact on the growth of *Staphylococcus*. The function of the powder itself is usually to cover the face to make it look attractive [32].

5. Conclusion

The effect of using cosmetics in the form of toner, moisturizer, serum, sunscreen, and powder is not significant for the growth of *S. aureus* and *Staphylococcus* spp. The cheek of normal human skin has lower *S. aureus* which was even absent in two participants. *S. aureus*.

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