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Comparative Analysis of Skin Condition after Using Cleansing Oil and Cleansing Water for Removing Facial Makeup

Ji-Yeon Yu[1], A-Young Jang[2], Byung-Soo Chang[3]

[1]Master, [2]Ph.D., [3]Professor, Department of Cosmetology, Hanseo University, Seosan, Chungnam 31962, Republic of Korea

ABSTRACT

Background/Objectives: The purpose of facial makeup is to make skin look beautiful and appealing without giving any physiochemical stimulation to the skin. To do this, it is important to clear the skin by removing the cosmetics after applying makeup.

Method: After removing facial makeup using cleansing oil and cleansing water available in the Korean market, skin oil content, water content, and pH were measured with a skin analyzer and ingredients of cosmetic film were determined with a dermascope and scanning electron microscope.

Findings: Shortly after applying daily makeup, the cosmetic film was evenly applied to the face skin. As time passes, the cosmetic film formed a thick cosmetic film with the sebum and sweat components secreted from the skin as well as inorganic components of cosmetics. Scanning electron microscope observation showed that most cosmetic membranes consisted of spherical silica, nanometer sized iron oxide and titanium dioxide, and micrometer sized talc and ultramarine. Vellus hairs distributed on the skin were covered with cosmetic ingredients. Thus, cuticle layer was not observed. Face skin washed with cleansing water and cleansing oil was clean without observation of cosmetic ingredients.

Improvements/Applications: Cleansing oil is more effective than cleansing water in maintaining skin oil content and acidity while cleansing water is more effective than cleansing oil in moisturizing the skin

Keywords: *cleansing oil, cleansing water, dermascope, make up, skin condition, scanning electron microscope*

Introduction

In modern society, people consider that both internal images and external images are important. Makeup has been used as a means to present social image[1]. Women may apply makeup to look beautiful and express their personality. Maintain the health of skin is a fundamental part to look beautiful. The skin has various metabolites released from the human body. Sebum is a light yellow, oily substance that is secreted by sebaceous glands to keep the skin and hair moisturized. When it is exposed to air for a long time, it can be oxidized. Its oxidation is influenced by oxygen and microorganisms such as bacteria. The cleansing process to remove such waste on the surface of skin is called cleansing[2].

Cleansing is a fundamental act to remove sweat, sebum, dead cells, and dust from the skin using cleansers such as soaps, forming cleansers, gels, and scrubs[3,4]. To maintain a healthy skin, mild cleansing and moisturizing with protection from ultraviolet rays are required. Cleansing is also the first step in skin care. It is essential for maintaining healthy skin. Cleansing is very important because if impurities remain on the skin, hair pores of skin can get clogged which can affect metabolism and cause skin aging.

There is a growing interest in protecting and managing skin from various air pollutants such as fine dust since air pollution is now becoming a serious

Corresponding Author:
Byung-Soo Chang
Professor, Department of Cosmetology,
Hanseo University, Seosan,
Chungnam 31962, Republic of Korea
Email: bschang@hanseo.ac.kr

social problem globally. It is important to select and use a cleanser that is specific to one's skin type based on precise knowledge to properly protect the skin.

There are diverse types of cleansing cosmetics. They are classified based on the skin type. The quality of the product is also being upgraded and specialized. With development of manufacturing technology and cosmetic technology of cleansing cosmetics, the range of cleansing cosmetics is getting wider. Cleansing products are largely divided into cleansing lotion, cleansing oil, cleansing water, cleansing gel, and cleansing foam. Cleansing lotion contains a lot of surfactant, alcohol, and moisturizer. Thus, it is suitable for dry skin, aging skin, and sensitive skin. Cleansing oil contains very small amount of surfactant and ethanol. Thus, it is less irritating than cleansing lotion. It is suitable for aging skin, moisture-lacking skin, and dry skin. Cleansing water is a liquid detergent that is not tacky. It is formulated with a small amount of lotion, surfactant, and ethanol to make it suitable for sensitive skin and allergic skin. Cleansing gel is completely oil-free. It is suitable for sensitive skin, allergic skin, and acne skin. Cleansing foam contains surfactant with glycerine, sorbitol, and oily ingredients. It is less irritating than soap, suitable for sensitive skin and aging skin.

Previous studies have reported the importance of cleansing in skin care due to skin diseases such as atopic dermatitis, acne, and cleansing effects[5,6]. However, studies about the effect of cosmetic ingredients in cleansing product that modern women use daily on physiological changes of the skin surface and the removal of air pollutants are insufficient.

In this study, changes of oil, moisture, and pH of facial skin cleansed with cleansing water or cleansing oil compared to those of facial skin before facial cleansing were determined. Cosmetic membrane before and after cleansing was observed with a scanning electron microscope over time.

Results of this study will provide research data on the selection of cleansing products that can completely remove cosmetic ingredients after applying makeup on the face

Method

Materials: As test materials, cleansing water (Bioderma sensibio H20, Korea) and cleansing oil (Mefacttory super light cleansing oil, Korea) were used. This study was approved by the Bioethics Committee of the Public Institutions designated by the Ministry of Health and Welfare of the Republic of Korea.(Approval number POI-201808-13-002).

Experimental Method

Skin Analysis: Ten women in their 20s were selected as subjects. Their skin conditions before and after applying makeup were analyzed with a dermascope (CC-205, Sometech Inc, Korea). After applying makeup, subjects cleansed the makeup with cleansing water on the right cheek, cleansed the makeup with cleansing oil on the left cheek, and then washed their faces with water. Right and left cheeks of subjects at 2 hours after cleansing were measured and analyzed for oil content, water content, and pH with noninvasive skin integration analyzer (MPA580, Courage + Khazaka electronic GmbH, Germany).

Oil Content Measurement: A sebumeter was used to measure facial skin moisture contents of subjects whose faces were cleansed with cleansing oil and cleansing water. A sebumeter cassette was placed on the skin area for measurement. It was pressed for 20 to 30 seconds with an appropriate pressure. The amount of oil per 1cm^2 was measured. Measurement was repeated three times and mean value was calculated.

Water Content Measurement: A corneometer was used to measure skin moisture content of the same subject. A probe attached to the corneometer was applied vertically to the surface of the skin. After lightly pressing the skin, it measured moisture content of the stratum corneum. The measurement was repeated three times. Mean value was then calculated.

pH Measurement: Skin pH meter was used to measure the pH of skin surface of the same subject. After repeating the measurement three times for each subject, the mean value was used.

Dermascope Observation: Skin condition of subject with makeup and that of the same subject after facial cleansing with cleansing water or cleansing oil were observed using a dermascope to check skin conditions

Scanning Electron Microscope Observation: To analyze cosmetic ingredients coated on the face after applying makeup, the skin of the cheek was scraped with a sharp double sided razor and used as experimental material. The collected sample of cosmetic component was adhered onto a stub with a copper tape and dried in a vacuum dryer (HMDS-6210 Hasuc, China) for 24 hours. Dried samples were platinum-coated to a thickness of 20 nm using an ion-deposition machine (IB-5 ion

coater, Eiko, Japan) and placed on a scanning electron microscope (S-4700, Hitachi, Japan) to be observed at high voltage of 15kV.

Result and Discussion

This study observed facial skins immediately, at 4 hours, and at 8 hours after applying makeup with a dermascope to check makeup conditions of female subjects. On the skin immediately after applying the make-up, the cosmetic membrane was evenly applied [Figure 1a].

The facial makeup of career women is mixed with sebum and sweat secreted from the skin over time. In this study, facial skin at 4 hours after applying makeup was found to be irregular because inorganic components of cosmetics were clumped to cover the curved fine wrinkle surface between keratinocytes [Figure 1b].

In facial skin at more than 8 hours after applying makeup, cosmetic ingredients, the sebum, and sweat secreted from the skin are gathered with each other to form a thick film [Figure 1c]. This skin stratum covering cosmetic ingredients coated on the skin was not exposed and attachment of foreign objects contaminated by the external environment during daytime activities was observed. In addition, sebaceous lumps secreted from the sebaceous gland were observed. Vellus hairs on the surface of skin were found to be transparent and white [Figure 1c]. Vellus hairs present in the facial skin are white fine hairs without medulla or melanin granules[7].

Figure 1: Dermascope images of facial skin. a: immediately after daily makeup. b: 4 hours after applying daily makeup. c: 8 hours after daily makeup. white arrows: sebum, black arrows: vellus hairs. 20x.

The facial skin of female subject after applying makeup was gently scratched with a sharp razor and cosmetic ingredients collected therefrom were observed with a scanning electron microscope. These scraped cosmetic ingredients were clumped together to form lumps. Among cosmetic ingredients, spherical silica having various sizes were most frequently observed. Plate-shaped talc and ultramarine pigment were also observed [Figure 2a].

Talc is so smooth that it is scratched with nails. It provides excellent spread and lubrication. Thus, it is used as a conditioning agent in cosmetics[8]. Raw materials of talc are added to most cosmetics, especially powder, makeup base, BB cream, twin cake, foundation, and so on. Silica having spherical form is widely used as an additive to improve the spreadability and application of cosmetics on the skin[9]. Nanomaterials such as titanium dioxide and iron oxide were observed with the scanning electron microscope at high magnification [Figure 2b]. These fine materials filled the space between large cosmetic ingredients such as silica and formed a homogeneous thickness of cosmetic membrane when makeup was applied. Iron oxide is a mineral pigment most commonly used in cosmetics. It is harmless to the human body with excellent stability.

In the present study, the thickness of vellus hairs collected together with cosmetic ingredients in the facial skin was measured to be 11 μm. Their surface was covered with fine pigment ingredients of cosmetics [Figure 3a]. In a previous study on morphological features of vellus hairs, Chang[7] has reported that the length of vellus hair distributed in the facial skin is about 1 mm and the thickness is about 16 μm at the vicinity of the hair root. It became thinner toward the end. The thickness at its apiculus was measured to be 0.5 μm.

In this study, the materials surrounding these vellus hairs were inorganic pigments including titanium dioxide, iron oxide, and sweat, and sebum secreted from the skin mixed with each other [Figure 3b]. When observing with a scanning electron microscope, no cuticle layer was observed on the surface because vellus hairs were covered by fine cosmetic inorganic substances.

After facial skin was cleansed with cleansing oil or cleansing water to erase the cosmetic membrane, it was observed with a dermascope [Figure 4]. For the surface of skin cleansed with cleansing oil, cosmetic ingredients were removed that the surface of fine wrinkles between keratinocytes was shiny [Figure 4a]. For the skin cleansed with cleansing water, cosmetic ingredients were also removed. The stratum corneum on the surface of the skin was found and vellus hairs were clearly visible [Figure 4b].

In order to check change of skin moisture after cleansing, the right side of the face was cleansed with cleansing water while the left side was cleansed with cleansing oil to measure skin portions of both cheekbones [Figure 5a]. As a result of measuring the moisture content of the skin surface using an integrated analyzer, the average water content was 81.02% when the face was cleansed using cleansing water. It was 76.05% when the

face was cleansed with cleansing oil. Thus, both cheeks had sufficient water content. The measurement result revealed that skin surface moisture was higher when it was cleansed with cleansing water than that when it was cleansed with cleansing oil. The way to wipe off water is also important in order to protect the skin barrier and increase moisturizing after cleansing. Tapping the skin slightly with a towel to dry the skin can reduce the risk of skin damage due to friction and maintain skin moisture[10].

Excessive sebum production and secretion can result in a shiny and greasy face. Oily skin causes skin disorders such as acne that can lead to aesthetic problems and ultimately decrease quality of life[11]. Therefore, the use of cosmetics is recommended to reduce the shine of skin which is not an easy task.

Recently, many studies have been conducted to reduce sebum secretion by using a toner containing a natural substance such as green tea extract in oily skin[12]. In addition, makeup remover containing vegetable seed oil has been developed to remove inorganic substances contained in the foundation and eyeliner[13]. In this study, subjects who applied daily makeup were asked to use cleansing water on the right side of the face and cleansing oil on the left side to examine changes in skin oil after cleansing the skin. As a result of measuring oil contents in both cheekbone skin using an integrated analyzer, the average total amount of oil on the surface of the skin was 172 μg/cm^2 when cleansing water was used while it was 205.29 μg/cm^2 when cleansing oil was used [Figure 5b]. These measurement results indicated that cleansing oil gave more oil on the skin surface than cleansing water after cleansing.

It was recognized at the beginning of the 1st century that the skin surface was acidic. Since 1928, non-invasive measurement methods have been developed to measure the pH of skin surface in a variety of ways[14]. To examine changes in pH of skin surface of subjects who applied daily makeup after cleansing, cleansing water was applied to the right side of the face while cleansing oil was applied to the left side of the face. As a result of measurement using an integrated analyzer, the average pH of the skin surface was 6.3 when it was cleansed with cleansing water while it was 6.1 when cleansing oil was used for cleansing [Figure 5c]. These measurement results indicated that cleansing oil was more effective in maintaining the acidity of skin surface than cleansing water after cleansing.

The skin is affected by ultraviolet light and temperature in the daytime when people are active. The skin pH maintains slightly lower acidity in the afternoon than that in the morning[15]. This is due to the influence of sebum secreted from the skin. In this study, the skin maintained a neutral status since the sebum was removed when face was cleansed with cleansing oil.

The skin maintains acidity (pH 4-6) while the internal environment of the human body maintains a neutral state at pH of 7-9[16-18]. The pH difference between skin surface and the internal environment of the human body is caused by stratum corneum and epidermal/dermal barriers. Acidic skin surface plays an important role in preventing microbial invasion from the outside[17].

The pH of skin is slightly acidic. It changes when soap or cleansing products are used. Also, when the skin is washed with water only, the pH of the skin may increase. It may take several hours to recover to a slightly acidic state after washing the skin[18]. Even after removing the cosmetic membrane of the skin with cleansing oil and cleansing water, the use of these slightly acidic cleansing products is required for the pH of the skin to reach a physiological level of weak acidity.

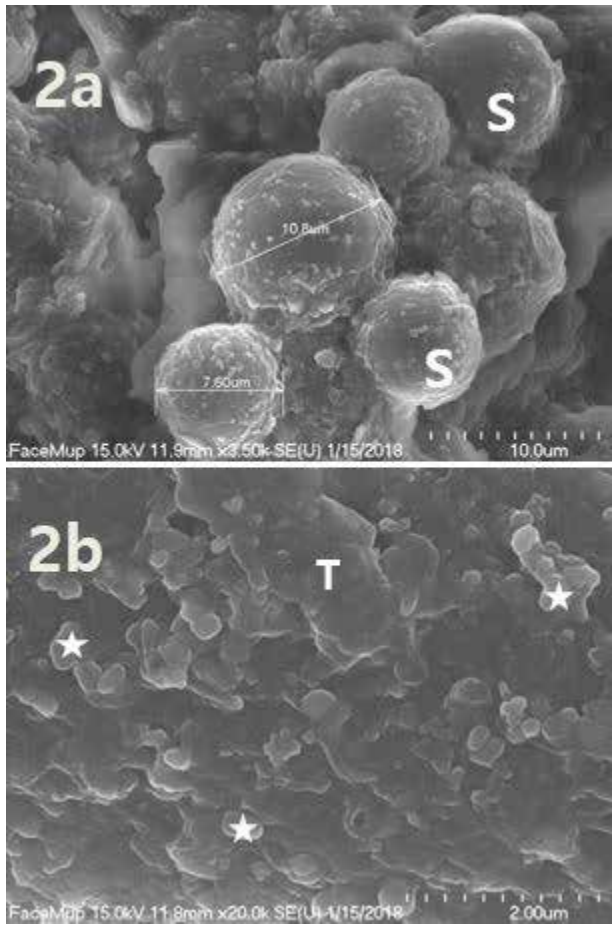

Figure 2: Scanning electron micrograph of cosmetic ingredients scraped from facial skin. a: Note that the spherical silicas(S) with various size. b: Images of cosmetic ingredients showing titanium dioxide(asterisks) and talc(T)

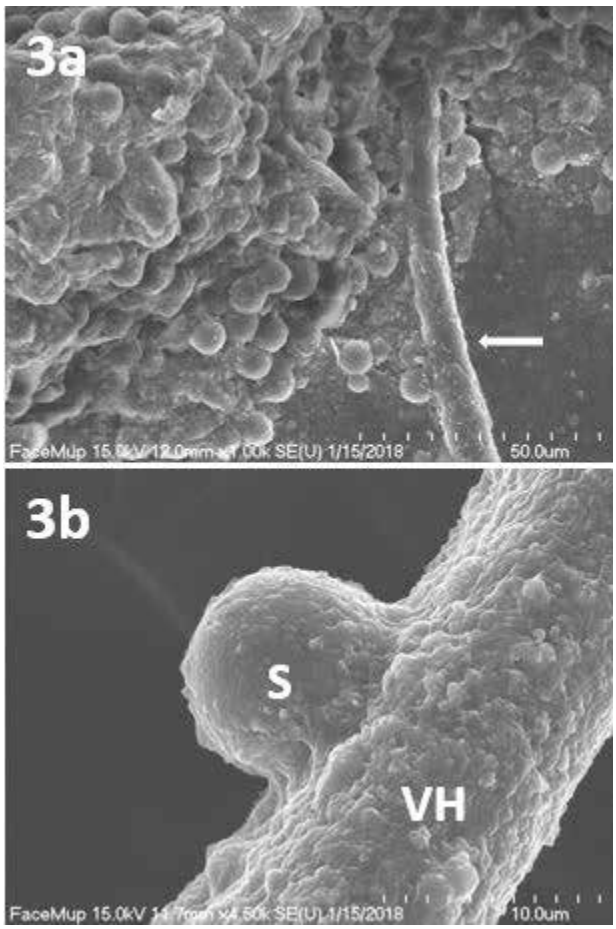

Figure 3: Scanning electron micrograph of cosmetic ingredients scraped from facial skin. a: The vellus hair (arrow) collected from the facial skin. b: The surface of vellus hair (VH) is coated with titanium dioxide and iron oxide. S: silica

Figure 4: Dermascope image of facial skin after cleansing the cosmetic membrane with cleansing oil (a) and cleansing water (b). 20x

Figure 5: Changes of face skin moisture(a), sebum(b), pH(c) indexs measured after cleansing the right cheek with cleansing water and the left cheek with cleansing oil

Conclusion

In this study, facial skin of female subjects after applying makeup and the facial skin of female subjects after cleansing with cleansing oil or cleansing water were checked with a dermascope and cosmetic ingredients in the cosmetic membrane were observed with a scanning electron microscope. Changes of oil, moisture, and pH were then checked and analyzed. Immediately after applying makeup, the cosmetic membrane was evenly applied to the facial skin while the stratum corneum was not found. During routine daily activities, sebum, sweat, and cosmetic inorganic ingredients secreted from the skin over time were mixed with each other to form a thick cosmetic film.

As a result of observing cosmetic ingredients collected from the facial skin of female subject covered by makeup with a scanning electron microscope, spherical silica with various sizes was observed the most frequently. Nanometer-sized iron oxide and titanium dioxide and micrometer-sized talc and plate ultramarine pigment were also observed.

The cleansing oil was more effective in maintaining skin oil content and acidity than cleansing water while the cleansing water was more effective in moisturizing skin than cleansing oil. In conclusion, the skin cleansed with cleansing water or cleansing oil was clean without showing any cosmetic ingredient.

Ethical Clearance: Not required

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Conflict of Interest: Nil

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