RED-LIGHT REFLECTION OF ULTRAMARINE BLUE: IMPACT ON SKIN-ENHANCING EFFECT WHEN USED IN COSMETICS

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Abstract (Maximum of 200 words)

This study explores the use of ultramarine blue (UB) as an alternative colorant to black iron oxide in foundation products for lighter skin tones in North Asia. Traditionally, foundation uses a mixture of white, red, yellow, and black pigments for shade creation, but this study shows that UB can replace black iron oxide without compromising color accuracy. Furthermore, spectroscopic analysis revealed that foundation using UB provide cosmetic benefits, such as reducing the appearance of wrinkles and improving overall skin uniformity compared to conventional formulation, due to the contribution of UB's ability to increase the red-light reflection. It is important to note that the color difference of the two foundations is so small that it cannot be distinguished with naked eyes ($\Delta E00 \simeq 0.6$), and the difference in the reflectance spectrum can be confirmed only in this red-light reflectance region. Despite its small magnitude, this red-light reflection produces a significant skin-enhancing effect. This finding confirms the existing understanding that red-light improves skin appearance. The optical effects were verified in-vitro by applying foundation to artificial skins that mimic human skin, and the specificity of UB was

further discussed. This opens new possibilities for cosmetic formulations, especially for people with lighter skin tones.

Keywords: (4-6 keywords separated by a semicolon).

ultramarine blue; red-light; reflectance spectrum; liquid foundation; skin-enhancing effect; pigment

Introduction.

The color blue holds a special allure for humanity. Perhaps this is because our very existence is based on the blue planet Earth. The azure sky overhead, the vast blue ocean surrounding us, these are elements of our environment that evoke a sense of wonder and joy. It is a color that brightens our hearts just by imagining it. Interestingly, there is even a theory that blue light has a calming effect on the human mind [1]. Thus, blue, which has a profound impact on our psyche, is unquestionably an essential color for humanity. However, historically it was not straightforward to obtain blue as an object, in contrast to the blue appearance of light. Blue pigment, which can produce a beautiful azure color, was considered extremely valuable, and numerous artists and creators are said to have dedicated themselves to obtaining this "blue." Consequently, a plethora of alluring blue pigments have been utilized in a multitude of artistic creations, continuing to captivate the public imagination to this day [2-5]. The color ultramarine blue (UB) is frequently observed in the works of Johannes Vermeer [6], while cobalt blue was a favored color of Vincent van Gogh [7]. Additionally, cobalt blue was utilized to adorn Chinese porcelain [2]. In Japan, Prussian blue is depicted in ukiyo-e prints [8], and indigo dyeing is renowned for its ability to produce the distinctive, refined blue characteristic of Japanese art [2].

Blue pigments are also frequently used with other pigments, rather than being used in isolation. It is well documented that when combined with other pigments (e.g., a tricolor mixture of red, yellow, and UB), it can result in a black appearance that is utilized as a substitute for, for instance, black iron oxide [9]. By blending these pigments, novel colors can be created. In light of the current emphasis on diversity, we are actively developing formulations that incorporate blue pigments to create cosmetics that match individual skin tones. For instance, in the United States, the development of a foundation for individuals with deeper skin tones involved the addition of UB to conventional white, yellow, red, and black inorganic pigments, resulting in new innovation pathways for formulation [10]. This addition effectively prevented the foundation from exhibiting a grayish appearance in individuals with deeper tones. It is crucial to highlight that blue pigments are not employed in the creation of blue foundations. The objective is to create a more skin-tone adapted color as a foundation. While blue pigments are employed, the foundation itself is not blue in color.

The research project described in this paper commenced as an extension of the development of formulations for deeper skin tones, with a particular focus on the potential effects of using blue pigments on lighter skin tones, such as those found in North Asia. As previously outlined in the initial paper [11], the present study primarily investigated the potential of substituting traditional black pigments (black iron oxide) with blue pigments (in this case, UB) in foundation. The results demonstrated that such a substitution is indeed beneficial. This outcome was not initially anticipated, but it was discovered that foundations containing blue pigments reflect light with a wavelength of 650nm or more (red-light) more strongly than those containing black pigments. When applied to human skin and observed, these characteristics were found to be highly effective in enhancing the ability to hide wrinkles, coverage, and the ability to even out skin tone.

The objective of this paper is to examine in detail the optical effects observed when a blue pigment foundation is applied to an artificial skin that simulates human skin tone, in comparison to a black pigment foundation. Additionally, the investigation seeks to elucidate the specific properties of UB as a blue pigment for shade matching. It is necessary to ascertain whether UB specifically is a prerequisite for the achievement of these skin-enhancing effects, or whether any blue pigment can achieve comparable results. The objective of this study is to identify the optimal blue pigment for cosmetic foundation applications. Our findings will inform future formulation development.

Materials and Methods.

Color representation

The CIELAB color space [12] is employed to describe colors and color changes. In this color space, L*, a*, b*, C*, and h represent lightness, reddishness-greenness, yellowness-blueness, saturation, and hue angle, respectively. Furthermore, to discuss the color difference between two points in the color space, ΔE00 is employed, which considers human visual perception and offers enhanced precision, particularly in the blue-green region [13, 14].

Sample

Ultramarine blue

The ultramarine blue (UB) utilized in this series of foundation studies is Unipure Blue LC686 (Sensient), a commercially available high-purity pigment that has undergone surface treatment with amino acids in order to enhance its dispersion in the oil phase.

Various blue pigments

To investigate the properties of blue pigments, we procured UB, cobalt blue, Prussian blue, and indigo blue, which are pure paint pigments with no surface modification, from an art supply store. It should be noted that these were used for experimental purposes only and not used in in-vivo evaluation on human skin from safety reason.

Liquid foundation

Samples were prepared via a general emulsification method, and the following three types were prepared on a laboratory scale.

(1) FDT_B: A silicone oil-based (W/S) liquid FDT containing conventional white, yellow, red, and black pigments, created with reference to the shades already available in our brand liquid foundations on the market.

(2) FDT_U: In the liquid foundation of (1), the black pigment (black iron oxide) was replaced in its entirety by a blue pigment in the W/S type liquid FDT.

(3) FDT_BbyU: A W/S-type liquid FDT containing white, yellow, red, and blue pigments as in (2) was further toned by a colorist under a D65 light source to achieve a color identical to that of (1). In this instance, the compositions of all pigments (white, yellow, red, and blue) differ from those in (1).

Monochrome sample for each color

In order to evaluate the color characteristics of each color, a monochromatic sample of each color was also prepared. In other words, the same components as in the FDT above were used, with the exception that the pigment composition is 100% monochromatic pigment. Samples were prepared for the following pigments: white, yellow, red, black, and blue.

Sample application

On Artificial skin: In order to reproduce the application of foundation under conditions similar to real human skin (color, texture, etc.), we utilized the "No. 10C" Bioskin model from Beaulax Co. Ltd. The bioskin is a circular structure with a diameter of 5 cm and a thickness of 5 mm. It is based on a polyurethane resin and has a color with L* =ca. 69.4, a* = ca. 11.0, and b* = ca. 19.3. Sample foundation was applied evenly using a finger at an amount of 1 mg/cm². After application, the sample was left to dry at room temperature overnight.

On Contrast card: To investigate the hiding power of the foundation, we used the black-and-white contrast cards manufactured by ERICHSEN GmbH & Co. KG. The foundation was applied using an Elcometer® film applicator to a thickness of 50 μm and allowed to dry at room temperature overnight.

Instrumental measurements/observations

CM-700d & CM-3610d

Konica Minolta spectrophotometer CM-700d & CM-3610d (SEC mode, light source D65, measuring diameter 8 mmφ) were employed to quantify the color at each of three points on the bioskin. The colorimetric wavelength range was 400–700 nm for CM-700d and 360-740 nm for CM-3610d.

Light box

To investigate the impact of different light sources on the appearance of objects, an LED view lightbox from THOUSLITE was employed. The light box is capable of emitting light of various colors within a narrow wavelength range of 350-700 nm. The apparatus can be configured to simulate ambient light, such as the D65 standard.

Hyperspectral imager

In hyperspectral imaging, data collected is no longer an RGB image like a color camera; rather, it is a three-dimensional hyperspectral data cube that records the reflectance at each wavelength at each spatial location within the field of view of the instrument. The hyperspectral imager (HSI) utilized in this study is a singularly designed spectral scanning instrument constructed around a liquid crystal tunable filter (LCTF) [15, 16]. For in vivo measurements, the model's face is illuminated by diffuse illumination from an integrating sphere with an 80-cm diameter. The fiber-coupled illumination source is a broad-spectrum xenon lamp that provides a continuous spectrum. In contrast to colorimetry, which describes the appearance of an object under a specific set of lighting conditions, reflectance spectra provide a more comprehensive characterization and can predict the color a sample will exhibit under any lighting. Furthermore, the instrument is able to detect differences in reflectance of a few percent that are not evident in L*a*b* values. In this study, in vivo HSI measurements of human facial skin were conducted for FDT_B and FDT_BbyU. For the two models, images were taken before (T0) and after (T1) the application of each FDT. For the subsequent analysis, working regions of interest (ROI) comprising 1.1 cm × 1.1 cm rectangle (74 × 74 pixels) on the left and right cheeks was selected relative to a defined set of facial feature landmarks determined by an automated algorithm. Subsequently, average reflectance spectra were extracted from each ROI to analyze the product's impact on the skin.

Tinting strength

In this study, two types of mixtures were employed: one with a pigment-mineral oil ratio of 2:10 and the other with a pigment-mineral oil-TiO_2 ratio of 2:10:4. Each mixture was prepared in the laboratory using a triple cylinder. Subsequently, the mixed bulk was positioned within a plastic pan (e.g., a 2 cm x 2.5 cm eyeshadow pan). The bulk was prepared with a thickness that ensured the bottom would not be visible. Subsequently, a glass slide was positioned on the surface of the bulk, and the color parameters L*, a*, and b* were quantified in the SCE mode of the CM-700d. Finally, the tinting strength measure ΔEab is calculated using the formula $\Delta Eab = ((\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2)^{1/2}$. A smaller ΔEab indicates a higher tinting strength.

Results.

(1) Ultramarine blue

UB is a type of inorganic pigment, in the same class as titanium dioxide (commonly used for white) and iron oxide (commonly used for yellow, red, and black), which is used in normal foundation toning. Figure 1 depicts drawdown films of monochromes containing each inorganic pigment at a thickness of 50 μm on a black and white contrast card. It is evident that the degree of coverage varies according to the type of pigment employed. A comparison of the tinting strength of white titanium dioxide against inorganic pigment dispersions other than white is presented in Figure 2. It is evident that the tinting strength of blue is considerably inferior to that of yellow, red, and black.

It is therefore necessary to ascertain how the various color parameters change when those pigments are mixed together. Figure 3 illustrates the color change when the ratio of pigments is altered from the values obtained by applying monochromatic pigments (black, yellow, red, and blue) to a skin-colored bioskin (No. 10C), from black to yellow, black to red, blue to yellow, and blue to red. Figure 3(a) and (b) depict the relationship between the a* and b* values and one between the h and C* values, respectively. The position of the large marker in the figure indicates the applied color of each monochrome, while the position of the small marker on the curve connecting the monochrome markers indicates the applied color when each color is mixed together. For example, on the line connecting B and Y, the applied color when the colors are mixed in each ratio can be determined by examining the markers on the curve from the side closer to B. These markers indicate the applied color when the colors are mixed in the following ratios: 25%/75%, 50/50, 75/25, 90/10, and 95/5. In Figure 3(b), two markers indicate the applied color of blue. These are the same points with different h notations, which indicate the direction of change. The first marker indicates a change from h=0 to the positive side, while the second indicates a change from h=0 to the negative side. In this notation, the change in h from yellow to blue is represented by the transition from h = 90 to 270 in the green region, while the change in h from red to blue is represented by the transition from h=0 to -90.

In the range of skin tones that make up the majority of skin tones globally [17], a* and b* ≥ 0 ($0 \leq h < 90$), the direction of color change is consistent when black is mixed with yellow or red, and when blue is mixed with yellow or red. This indicates that the direction of color change is consistent when yellow or red monochrome is mixed with black and when blue is mixed. That is, in the region where a* and b*≥ 0 in Figure 3(a) (shown in darker color in the figure), both a* and b* decrease as black or blue increases. Additionally, in Figure 3(b), h remains relatively unchanged, yet there is a notable decline in C*. The preceding analysis demonstrates that black and blue are essentially interchangeable for use in foundation makeup, although there are slight differences in tinting strength, as illustrated in Figure 2.

(2) Blue and black substitution

The substitution of blue and black for one another was not initially perceived as a remarkable phenomenon. Indeed, it is probable that most individuals have recollections of substituting blue when black was not accessible, such as during the period of artistic expression in elementary school. However, was this a perfect substitute? Alternatively, was there a perceptible difference in appearance when the substitutions were made? Consequently, two types of foundation were created and the impact of substituting blue for black on the applied color was evaluated. One foundation was toned with white, yellow, red, and black, in accordance with the conventional foundations (FDT_B series), while the other was created by replacing all black with blue (FDT_U series). The shade ranges of the commercial foundations were utilized as a reference to create a foundation that encompasses a broad spectrum of shades. The formulations were applied to the bioskin, allowed to dry overnight, and then calorimetrically measured with a CM-700d spectrophotometer.

Figures 4(a), 4(b), and 4(c) illustrate the colorimetric outcomes of L*, C*, and h, respectively. The horizontal axis represents the value for FDT_B, while the vertical axis depicts the value for FDT_U. The dashed lines in the graphs indicate the 1:1 contour line for the values of each parameter. The farther the data points are from these lines, the greater the change in parameter values due to substitution from black to blue. These results are noteworthy. First, Figure 4(a) shows that L* increases across the board by replacing black with blue. As illustrated in Figure 2, the tinting strength of blue is considerably inferior to that of black. Consequently, it can be postulated that L*, which had been suppressed by the presence of black pigment, is increased by replacing it with blue pigment. This phenomenon is particularly evident in the low L* region, indicating that black pigment was used in large quantities. Figure 4(b) reveals that C* has increased due to the replacement of black pigment with blue pigment, particularly in the high C* region. This indicates that C* was suppressed by the presence of black pigment. Figure 4(c) illustrates an intriguing phenomenon. In nearly all color tones, substituting 100% black pigment with 100% blue pigment results in a redder shade of foundation. This observation will be a crucial consideration in future discussions.

Next, the foundations were toned to the same color to account for the parameter changes caused by replacing the blue color with black above. In other words, a sample (FDT_B) toned with white, yellow, red, and black (0.053 wt% as black iron oxide) and a sample (FDT_BbyU) toned with white, yellow, red, and blue (0.43 wt% as UB) using blue instead of black, were applied to bioskins and the color difference dE00 was successfully reduced to 0.64. The measured values were L*/a*/b* = 65.2/14.3/25.2 for FDT_B and L*/a*/b* = 65.9/13.9/25.1 for FDT_BbyU. A color difference of 0.64 is a level at which the difference in color is almost unrecognizable to naked eyes [18]. In other words, it indicates that black and blue alternatives can be toned to similar colors to the extent that the difference in applied color is not visually recognizable.

Figure 5 depicts two drawdowns for FDT_B and FDT_BbyU under D65 light at λ = 405-670 nm (a) and under red-light at λ = 670 nm (b) on a white paper card. The opacity of each drawdown film was approximately 90% (FDT_B) and 87% (FDT_BbyU), with only slight differences due to the minimal amount of black and blue content originally included. The coverage was calculated using the formula $(16+L^*_{black})^3/(16+L^*_{white})^3 \times 100$ (%), based on the L* values obtained from measurements using the CM-700d on the black and white contrast cards [11]. As can be seen in Figure 5(a), FDT_B and FDT_BbyU exhibit virtually indistinguishable coloration under D65 light. Consequently, the color difference between the drawdown films is barely discernible. However, as previously reported [11], in a comparison test in which FDT_B and FDT_BbyU were applied to a human face by an expert, the foundation of FDT_BbyU demonstrated superior performance in terms of "hiding skin wrinkles," "eliminating unevenness of color," and "improving skin homogeneity." It is perplexing that there is a discrepancy in effectiveness despite the identical color. The underlying cause is believed to originate from the phenomenon observed in Figure 5(b). In other words, under red-light in (b), the boundary of drawdown is clearly visible, indicating that FDT_BbyU is brighter and reflects more light. This phenomenon is not observed when light of other wavelengths is irradiated. It is only observed in the red-light region of 650 nm or more, which is the effect of UB, a blue pigment. Under D65 light, the slight difference in red-light reflection, which is almost imperceptible to naked eyes, creates a significant difference in makeup effect. This evidence demonstrates how the human eye perceives subtle differences and the significance of these differences in the context of makeup.

Figure 6 shows the reflectance spectrum of the bioskin when FDT_B and FDT_BbyU are applied and dried, as measured using the Konica Minolta CM-3610d desktop colorimeter. As already mentioned, the difference in color between FDT_B and FDT_BbyU is 0.64 as ΔE00, which is so slight that it cannot be distinguished by the naked eye. This device makes it possible to measure the reflectance of longer wavelengths. As can be seen in Figure 6, the reflectance increase above 650nm continues on to longer wavelengths up to 740nm.

Figure 7 shows the results of an investigation into the effects of black and blue pigments on the reflectance spectrum. Figure 7 shows the changes in reflectance spectrum %R when two monochromatic colors are mixed in different ratios: (a-1) red and black, (a-2) red and blue, (b-1) yellow and black, and (b-2) yellow and blue. The figure only displays the colors that exist within the region of a* and b* ≥ 0, which was also discussed in Figure 3. For comparison, the blue spectrum is also shown. The measurements were conducted using a CM-700d. Figure 7 (b) presents the outcomes of the experiment with a yellow monochrome. In Figure 7(a), both the increase in the proportion of black and blue exhibit a similar trend, whereby they both reduce the reflectance spectrum in the 600-650 nm range, which is attributed to red. However, the reflectance spectrum above 650 nm exhibits a markedly different pattern. In other words, in contrast to the case of black, the increase in the proportion of blue is maintained without a reduction in the reflection in the region above 650 nm. This phenomenon is also observed in the yellow monochrome in Figure 7 (b). This is the characteristic spectrum of UB, which is believed to be the source of the skin-enhancing effect that is observed when blue pigments are used.

The aforementioned results were obtained through the fabrication of a drawdown and through the application on an artificial bioskin. However, it remains unclear whether this phenomenon can be observed in the actual state of application on a human face with a thinner spread. Figure 8 illustrates the outcomes of applying the identical quantity of FDT_B and FDT_BbyU to a human face and measuring the color alteration before and after application in a specified and fixed ROI through the utilization of the Hyper Spectral Imaging method. Each graph depicts the ratio of the reflectance spectra of the unexposed skin prior to application (T0) and following application (T1). The value of the vertical axis (T1/T0) is constrained between 1 and infinity, with larger values indicating increased reflection and smaller values indicating decreased reflection. Figure 8(a) and (b) illustrate the FDT_B and FDT_BbyU, respectively. From these graphs, it is evident that there is a significant difference in the wavelength region above 620 nm. FDT_B indicates a slight attenuation of the red reflected light due to the application, whereas FDT_BbyU demonstrates a slight increase, but no decrease, of the reflected light in these red regions.

Discussion.

(1) Skin-enhancing effect of red-light

The series of in vitro and in vivo experiments described above clearly demonstrate that there is, in fact, a skin-enhancing effect of red-light reflection using UB. This finding is consistent with reports by cosmetics companies since the 1990s that red-light improves the appearance of the skin [19-21]. One hypothesis is that the increased reflection of red-light makes the skin look more beautiful [19], which is consistent with our findings. As a result, they have succeeded in developing a new material that more efficiently reflects only red-light under various light conditions. Another hypothesis is that red-light can penetrate the dermal layer of the skin without being absorbed, thereby hiding conditions such as open pores, uneven skin tone, and blemishes [20, 21]. Consequently, a new powder has been developed that efficiently transmits red-light. In contrast, the noteworthy aspect of this study is that it has confirmed the red-light reflection effect of UB, a blue pigment that is already commonly used as a cosmetic pigment.

(2) Uniqueness of ultramarine blue

Up to this point, we have been discussing the topic under the assumption that "blue pigment = ultramarine blue", but as a matter of principle, we should finally discuss whether the above equivalence formula is valid or not. This is a verification of whether the beautiful skin effect we have discussed so far is due to the blue color itself or to the chemical composition of Ultramarine Blue. To do this, it is necessary to clarify the characteristics of different blue pigments and compare their optical properties.

Figure 9 shows a photographic image of various blue pigments dispersed in either an aqueous or W/O solvent and applied to a black and white contrast card at a thickness of 50 μm. The figure also shows the reflectance spectrum of the applied area on the black card. Since the pigments themselves were not surface treated, it was necessary to use different dispersing solvents for each pigment. As all samples are dispersions of blue pigments, they show a blue light reflectance with a peak around 450 nm. On the other hand, an increase in red-light reflectance in the wavelength region above 650 nm was observed only for Cobalt Blue and UB, but not for Prussian Blue or Indigo Blue. In other words, the red-light reflection discussed in this paper is not a general property of blue pigments. Rather, it is the effect of unique blue pigments such as ultramarine. It is worth noting that cobalt blue, which was found to have a similar red-light reflection, is not currently approved for use in cosmetics. To our knowledge, UB is the only blue pigment that has been shown to reflect red-light and can be used in cosmetics. In the future, it is hoped that formulations will be developed that utilize the benefits of UB as an alternative to black pigments.

Conclusion.

This study sought to investigate the potential benefits of utilizing UB as an alternative to black iron oxide in cosmetics, particularly in the context of foundations, for individuals with lighter skin tones in North Asia. It was discovered that although UB exhibits a lower tinting strength when compared to black iron oxide, an increase in its concentration in foundations resulted in a similar change in h to that observed with black iron oxide and UB in the shade range used on North Asian consumers' skin. This evidence suggests that foundations for North Asian consumers, traditionally formulated with mixtures of white, red, yellow, and black pigments, can also be produced with white, red, yellow, and blue. Moreover, it was demonstrated that when a shade that is nearly identical to that produced with black pigment is toned with blue pigment, the slight red-light reflecting ability of UB can provide a novel skin-enhancing effect despite the fact that they are the same color foundation. To further substantiate the significance of UB as a blue pigment, a spectroscopic analysis was conducted on pigments that emit blue light (e.g., Prussian blue, cobalt blue, indigo blue, etc.) as well as UB. To the best of our knowledge, UB is the only inorganic pigment that can be used in cosmetics and that exhibits red-light reflection. These findings reinforce the existing understanding that red-light improves the appearance of skin and suggest new avenues for cosmetic formulations, particularly for individuals with lighter skin tones in North Asia.

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Figure 1 Drawdown films of monochromes containing each inorganic pigment at a thickness of 50 um on a black and white contrast card

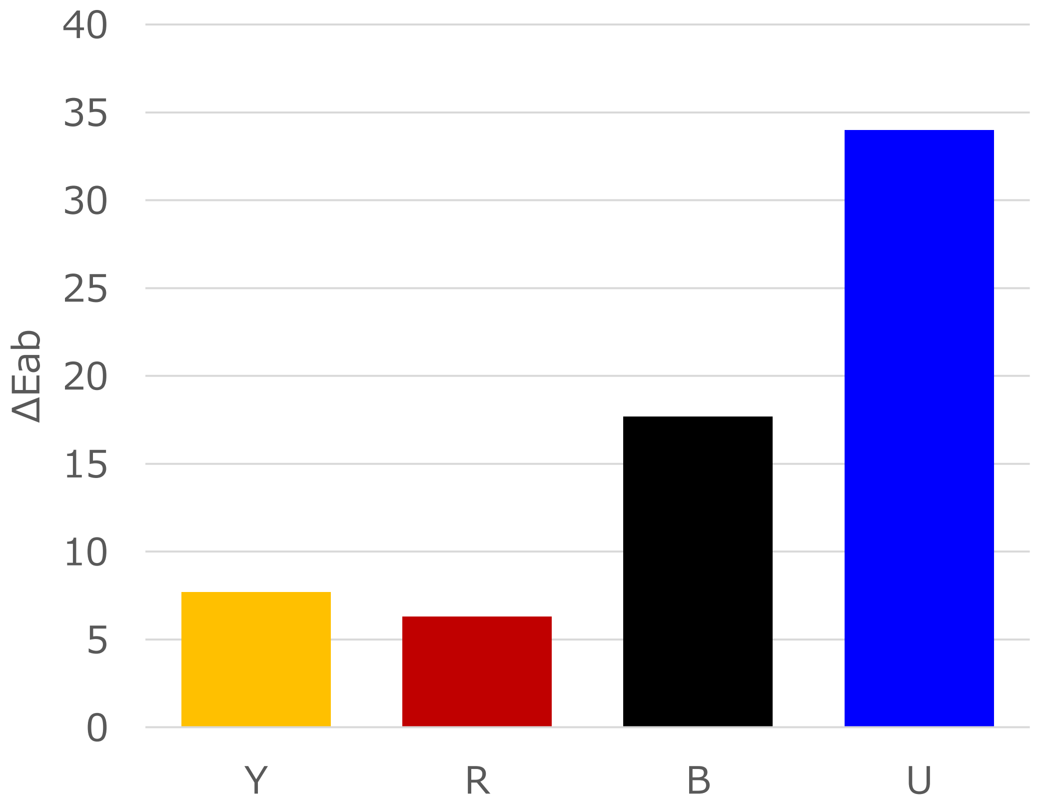


Figure 2 Color difference ΔEab when mixing white titanium dioxide against inorganic pigment dispersions in oil. Smaller ΔEab means better tinting strength.

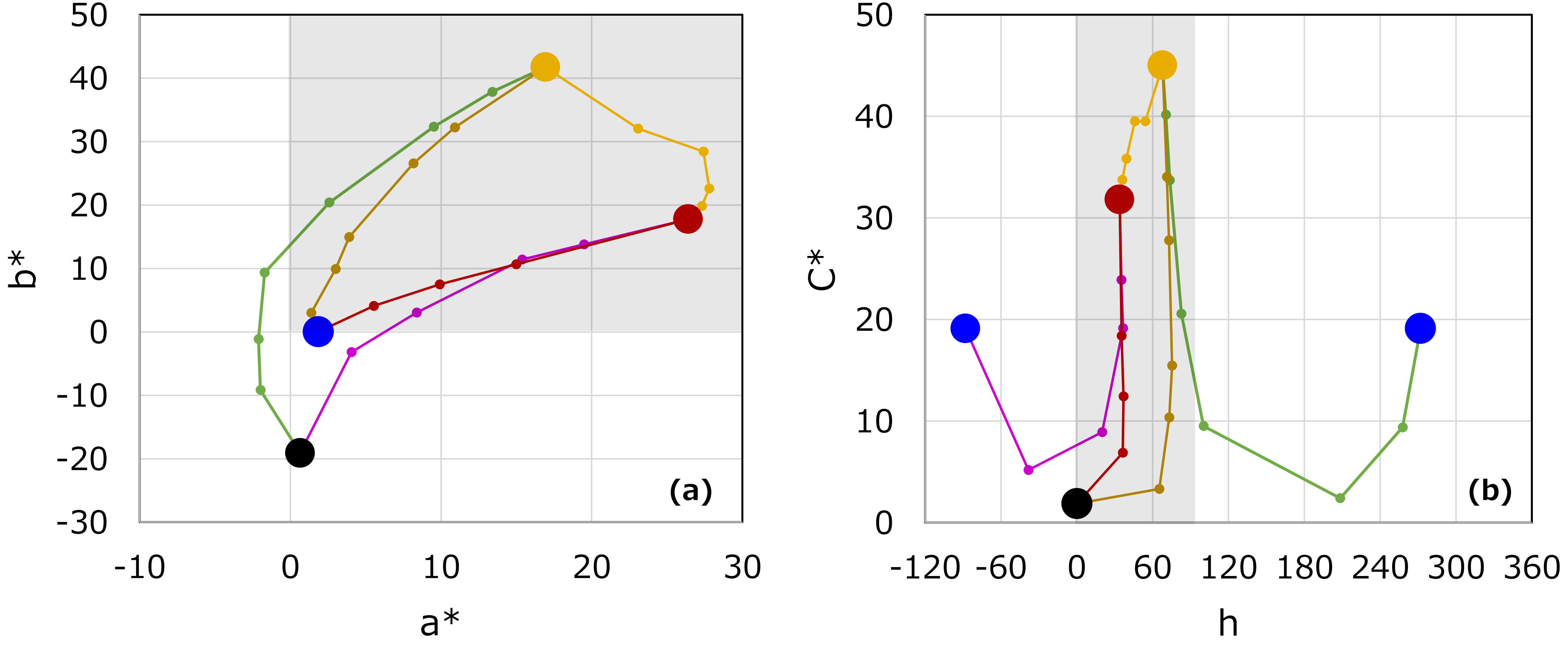


Figure 3 Color change when the ratio of pigments is changed from the values measured by applying black, yellow, red, and blue monochromatic pigments to a skin-colored bioskin, from black to yellow, black to red, blue to yellow, and blue to red.

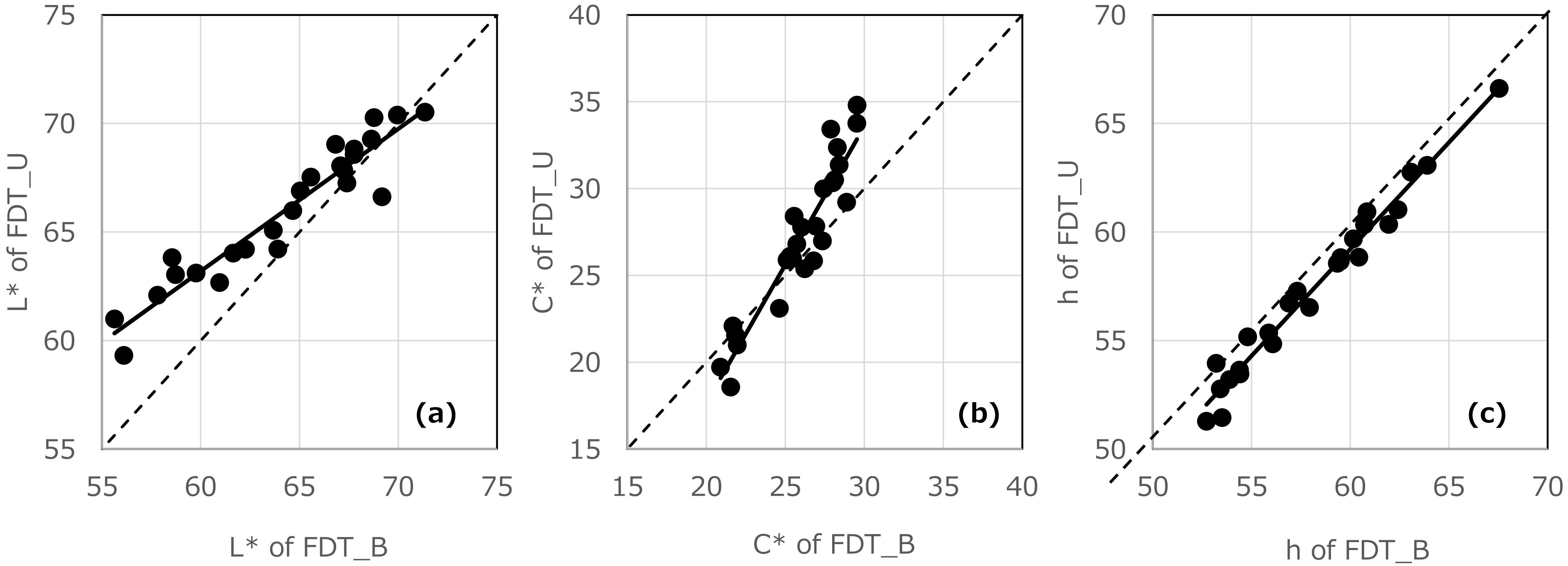


Figure 4 Colorimetric results of (a) L*, (b) C*, and (c) h, respectively. The horizontal axis shows the value for FDT_B and the vertical axis shows the value for FDT_U. The dashed lines in the graphs show 1:1 contour line for the values of each parameter. The bold lines represent the linear approximation of the data points.

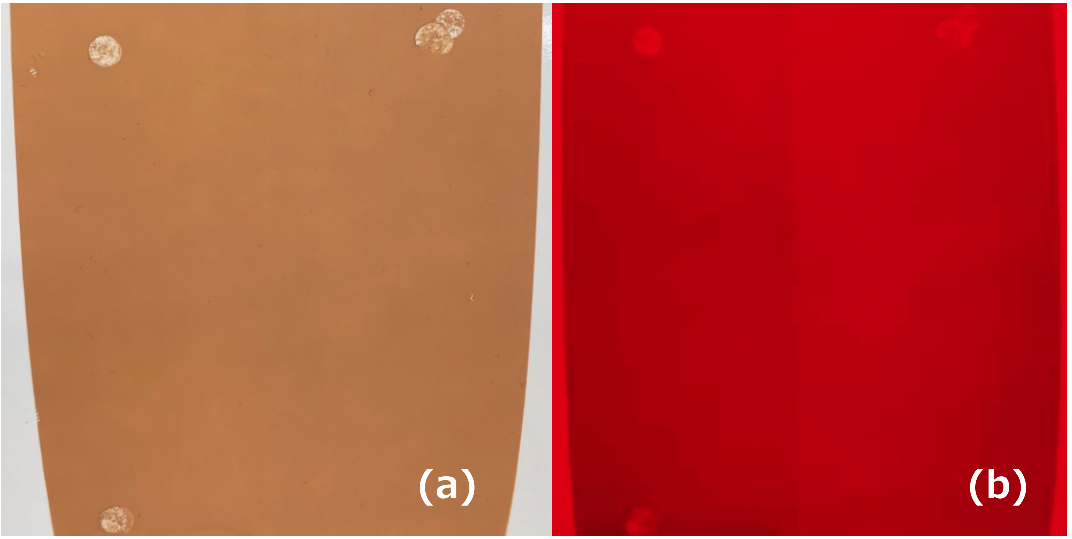
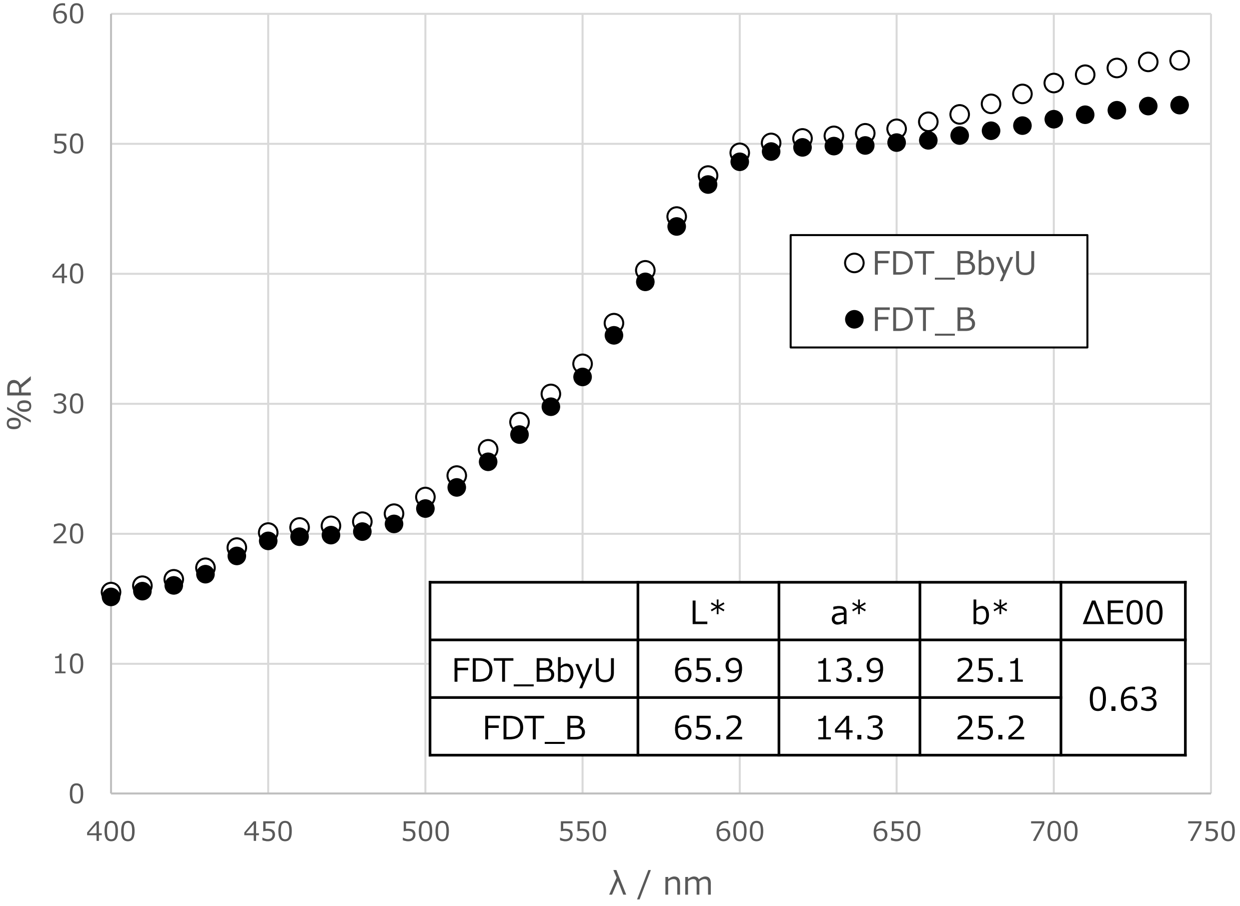


Figure 5 Two drawdowns for FDT_B and FDT_BbyU under D65 light at λ = 405-670 nm (a) and under red light at λ = 670 nm (b) on a white paper card.



	L*	a*	b*	ΔE00
FDT_BbyU	65.9	13.9	25.1	0.63
FDT_B	65.2	14.3	25.2	

Figure 6 Reflectance spectrum of the skin-colored bioskin when FDT_B and FDT_BbyU are applied and allowed to dry, as measured using the Konica Minolta CM-3610d desktop colorimeter

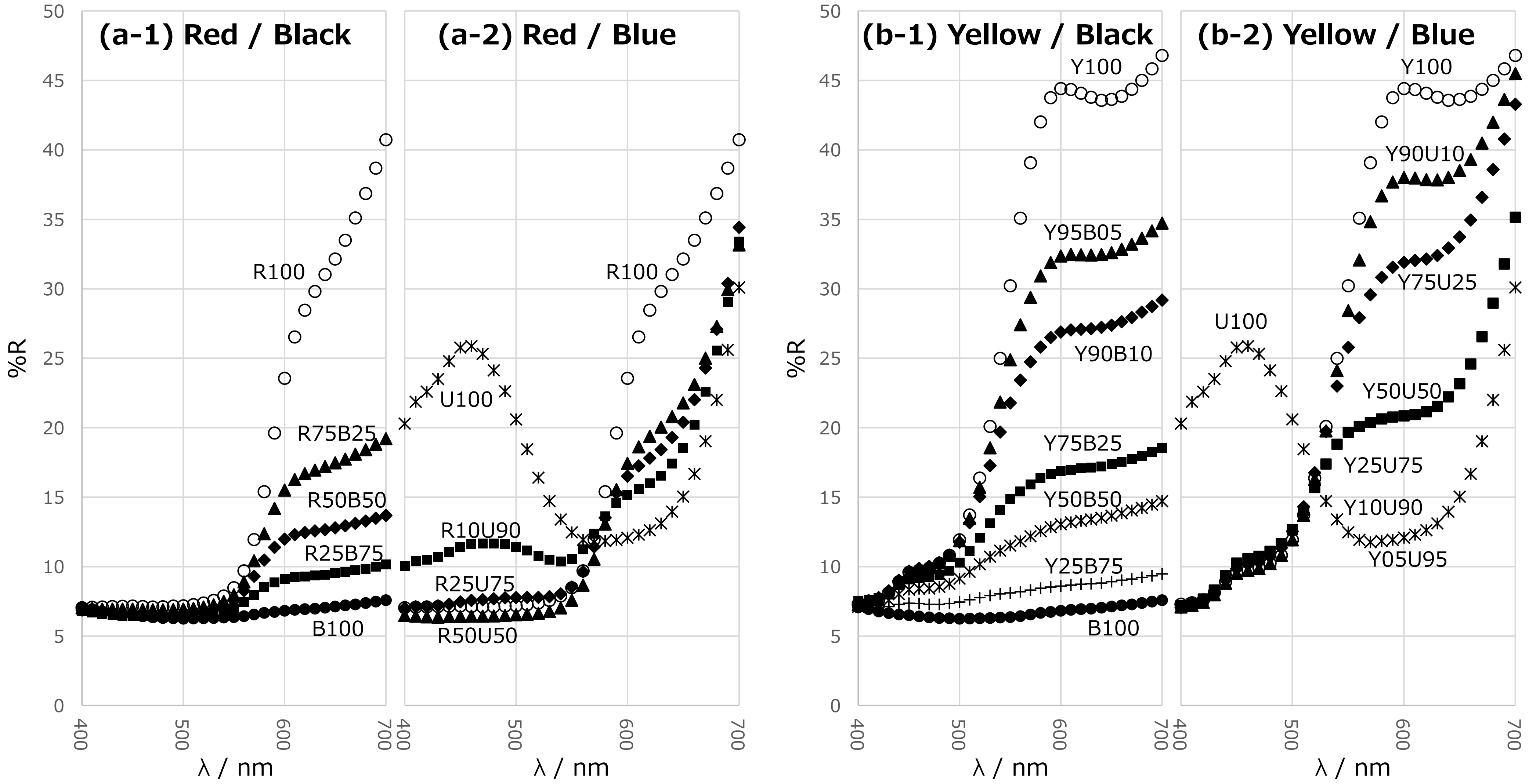


Figure 7 Changes in the reflection spectrum when two types of monochrome are mixed in different ratios: (a-1) red and black, (a-2) red and blue, (b-1) yellow and black, (b-2) yellow and blue.

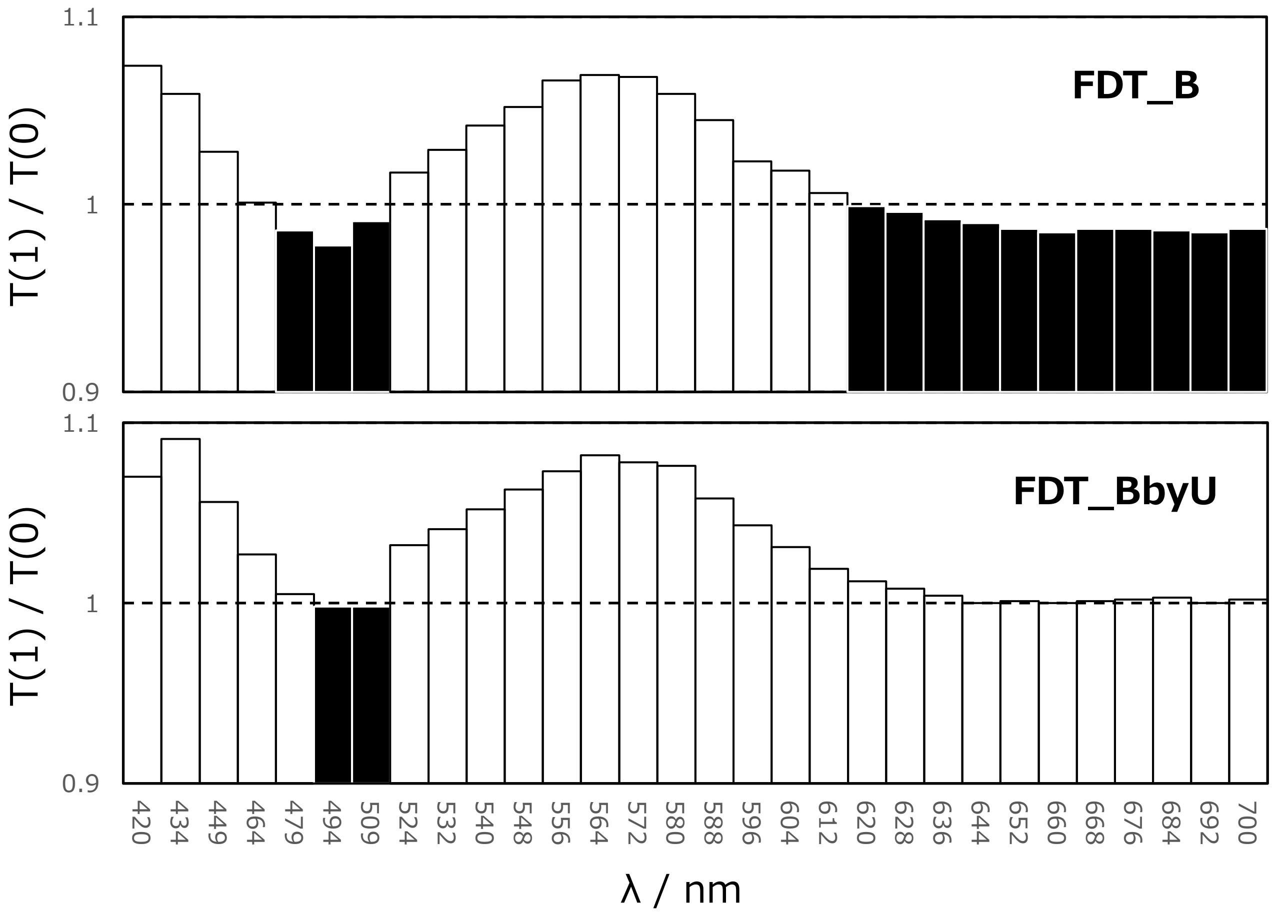


Figure 8 measuring the color change before and after application using the Hyper Spectral Imaging method. Each graph shows the ratio of the reflectance spectra of the bare skin before application (T0) and after application (T1).

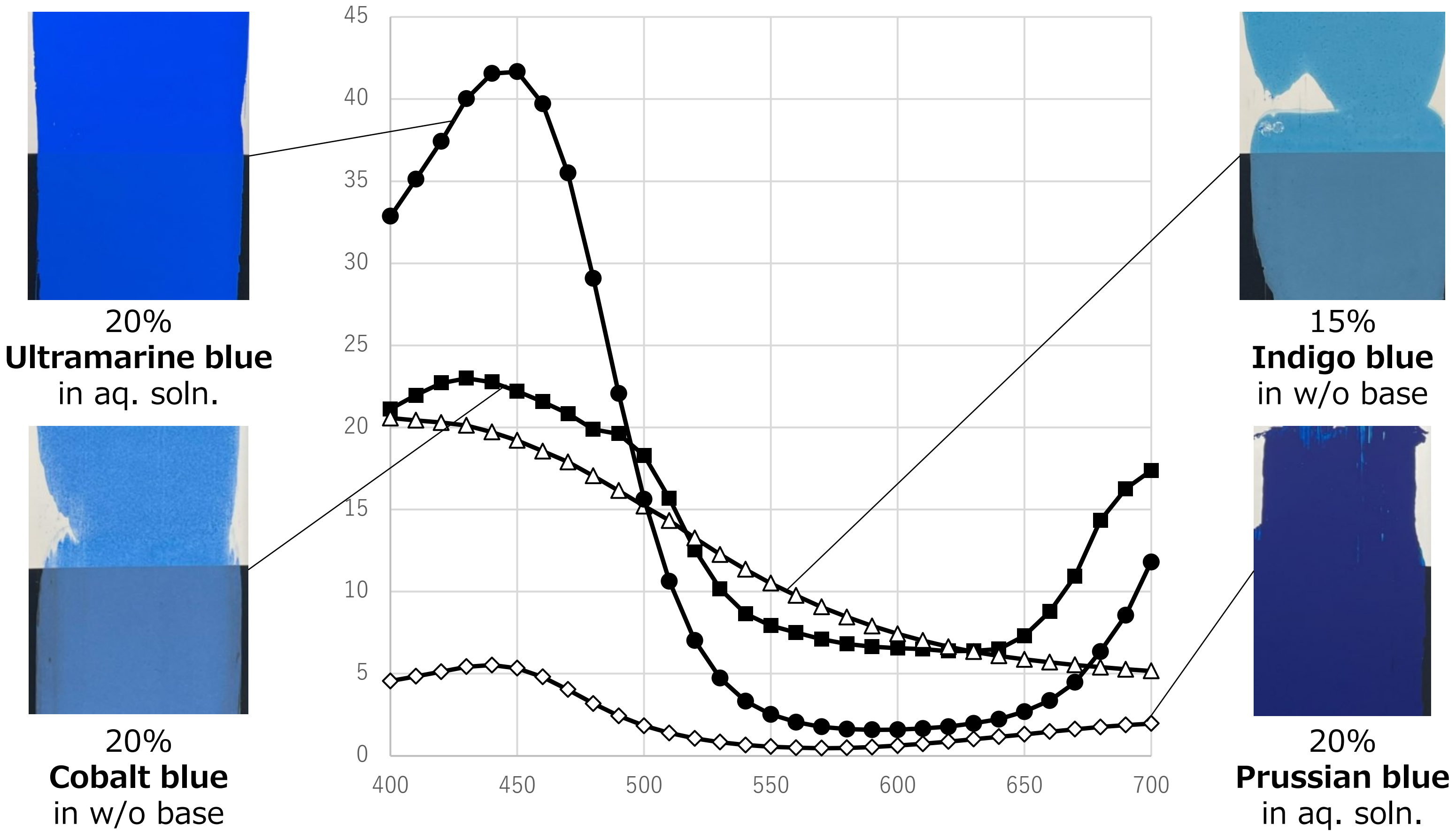


Figure 9 photographs of various blue pigments (ultramarine blue, cobalt blue, Prussian blue, and indigo blue) dispersed in either a water-based or W/O-based solvent and drawn down to a black-and-white contrast card with a thickness of 50 μm, as well as the reflectance spectra of the applied areas on the black card.