

PERSONAL CARE INDUSTRY COLOR CONTROL SKIN WHITENING MEASUREMENT AND ANALYSIS



Skin whitening or lightening has long been a trend in Asia and is set to boost the global market. The global market for skin lighteners is estimated to be around US\$19.8

billion, driven by the growing desire for light-colored skin both for men and women primarily from the Asian, African, Japan, China, India and the Middle East region. Skin whitening in general, refers to the practice of using chemical substances to lighten the skin tone or to provide an even skin complexion by lessening the concentration of melanin. Skin whitening products represent one of the fastest growing segments in the global beauty industry.

Many cosmetic or personal care manufacturers are capitalizing on the consumers' desire for fair skin and had extended their product range from facial care to overall skin care which changes the trend in how whitening products are being used. In order for them to develop a product that not only is safe but also gives the results that their customers are looking for, these companies conduct research and development to produce a good quality and performance product to compete in the market.

In the process of developing these products, numerous studies have to be made prior to putting these products on the shelves. Besides testing the products for performance and safety, one of the simple but critical test is to find out the effect of the products on the subject's skin color.

Colorimeters has been recognised and has also been tested and proven to be suitable for such skin color evaluation with relation to the effectiveness of the skin whitening products. This is because the color data provided by such instruments particularly the CIE L*a*b* and L*C*h color spaces, has long been internationally accepted and validated. They are routinely used to analyse colors in a way that is strictly correlated with the human vision on color judgement.

The Konica Minolta Chroma Meter CR-400 or the Spectrophotometer CM-600d are two of the instrument models that exhibits such capability and flexibility in gathering these critical information during the studies on skin color differentiation or changes. These models

are widely and commonly used for such application due to its light weight and ergonomic design that allows the skin care technologist to handle it with ease during the many measurements required during such testing.

In order to ensure that test procedures and measurements are standardized, correct settings of the measurement conditions are important. Below are just some of the common settings in the color instrument and recommended procedures in order to obtain representable results.

Instrument Settings

1. Illuminant - D65 illuminant is selected in the instrument. This is representation of daylight and which most studies are based on.
2. Color Space - The CIE L*a*b* (CIE-1976) is selected as the standard color system.
3. Light Source - Xenon-arc lamp with UV filtered.
4. Standard Observer - 2 or 10°.
5. Data - Absolute L*a*b*, not differential.
6. Aperture - Diameter 8mm (with illumination area of 11mm).



Measurement Procedures

For reliable color measurements on skin, it is best to allow the subject to rest in a prone position for ten minutes with the skin area uncovered, this is to eliminate contact or stress related redness and marks. During measurements, care should be taken when applying the cone shape aperture of the Chroma Meter CR-400 or the Spectrophotometer CM-600d sensing probe so that it just makes contact with the skin, without any pressure.



CM-600d



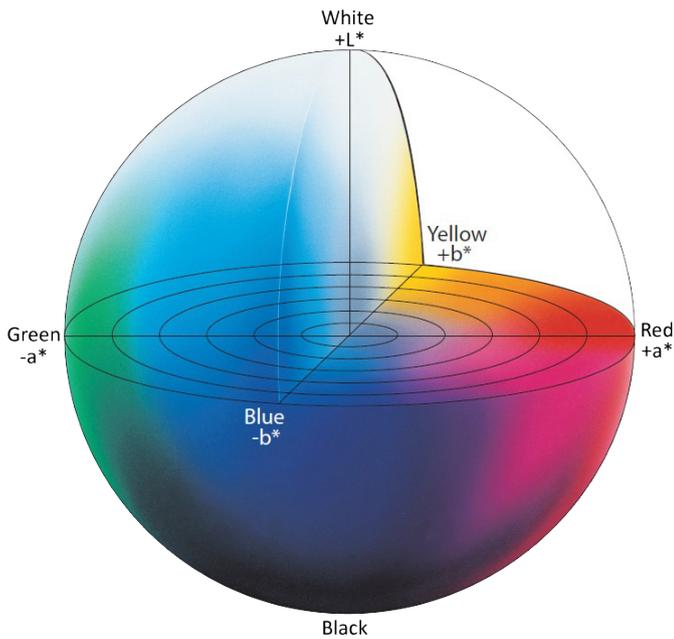
CR-400

This is very important as undue pressure may cause a "blanching effect on the skin and could lead to inaccurate measurement results. An ergonomic position should

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be adopted to ensure comfort and ease of movement during measurement and preliminary training may be necessary for the user, until a standard deviation smaller than 0.2 on the L*, a* or b* co-ordinate can be obtained by repeated measurements on the same skin area. Do note that the instrument aperture should not be altered by means of a diaphragm to cater for different spot size as this will adversely affect the results.

For skin color typing, it is recommended to use only absolute L*a*b* values and colorimetric measurements should be conducted on the area where products will be applied and exposed later in the test. At least four measurements should be taken and the mean L*, a*, b* values calculated.



The Individual Typology Angle (ITA°) on the mean L*, a*, b* can be calculated using the formula below upon obtaining the measurement results.

$$ITA^\circ = [\tan^{-1} ((L^*-50) / b^*)] 180/3.14159$$

Where Arc Tangent is expressed as radians.

The ITA° can easily be computed and displayed for easy analysis using the Konica Minolta Data Management software, Spectramagic NX Pro, which also allows the screen display to be customized to users' requirement.

Below is an example of the software template.

SpectraMagic NX Pro Software - Skin Color Analysis

| Instrument Model : CR-400/410 Serial No. : 8201010 | | Std Observer : 2 degree Illuminant : D65 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|---------|-----------|----------|----------|----------|------------|----------|----------------|-------------------|-----|----------------|-------------------|--------|----------------|-------|------|-------|-----|-----|-----|-----|-------|-----|-----|---|------------------|-------|-------|-------|-------|------|-------|------|-------|---------|---------|---|-----------------|-------|------|-------|------|-------|-------|------|-------|---------|---------|---|----------------|-------|------|-------|------|-------|-------|-------|-------|---------|---------|---|-------------------|-------|------|-------|------|-------|-------|------|-------|---------|---------|---|--------------------|-------|------|-------|------|------|------|------|-------|---------|---------|---|-------------------|-------|------|-------|------|-------|-------|------|-------|---------|---------|
| Skin Color Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Subject Group : Asian Subject Age : 33 yrs old Test Duration : 28 days | No. of Application Daily : Twice Formulated Extract : 4 % Measure Temp : 22 deg C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Before | | After | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Subject Info : Left Arm (tan) 6/2/2014 3:48:17 PM | Left Arm 3 (fair) 6/2/2014 5:58:32 PM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C'ment : This is to test the effect of whitening product on the arm skin color. | | Data taken after 28 days usage of whitening product on the arm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Skin Color : Before | | After | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measure Spot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L* | 57.97 | 64.61 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| a* | 9.12 | 6.89 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| b* | 18.88 | 17.26 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| dL* | 6.65 | dEab | 7.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| da* | -2.23 | Visual Judge | PASS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| db* | -1.62 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Skin Melanin Assessment | | Skin Lightness Assessment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| less yellow | | lighter | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Degree of Skin Pigmentation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 - 28 = Tan | ITA = 40.26 | Above 55 = V. Light | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28 - 41 = Inter | | 41 - 55 = Light | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th></th> <th>Data Name</th> <th>L*(D65)</th> <th>a*(D65)</th> <th>b*(D65)</th> <th>dL*(D65)</th> <th>da*(D65)</th> <th>db*(D65)</th> <th>dE*ab(D65)</th> <th>ITA</th> <th>Lightness(D65)</th> <th>Pseudo Color(D65)</th> </tr> </thead> <tbody> <tr> <td>Target</td> <td>Left Arm (tan)</td> <td>57.97</td> <td>9.12</td> <td>18.88</td> <td>---</td> <td>---</td> <td>---</td> <td>---</td> <td>22.88</td> <td>---</td> <td>---</td> </tr> <tr> <td>1</td> <td>Left Arm 2 (tan)</td> <td>57.50</td> <td>10.18</td> <td>18.29</td> <td>-0.47</td> <td>1.06</td> <td>-0.59</td> <td>1.30</td> <td>22.29</td> <td>lighter</td> <td>lighter</td> </tr> <tr> <td>2</td> <td>Left Arm (fair)</td> <td>62.98</td> <td>8.96</td> <td>15.17</td> <td>5.01</td> <td>-1.16</td> <td>-3.71</td> <td>6.24</td> <td>40.55</td> <td>lighter</td> <td>lighter</td> </tr> <tr> <td>3</td> <td>Left Hand Palm</td> <td>66.97</td> <td>8.48</td> <td>11.96</td> <td>9.01</td> <td>-0.84</td> <td>-6.92</td> <td>11.37</td> <td>54.82</td> <td>lighter</td> <td>lighter</td> </tr> <tr> <td>4</td> <td>Left Arm 2 (fair)</td> <td>63.34</td> <td>8.13</td> <td>15.78</td> <td>5.37</td> <td>-0.99</td> <td>-3.10</td> <td>6.28</td> <td>40.21</td> <td>lighter</td> <td>lighter</td> </tr> <tr> <td>5</td> <td>Right Facial Cheek</td> <td>61.23</td> <td>9.38</td> <td>19.08</td> <td>3.27</td> <td>0.26</td> <td>0.20</td> <td>3.28</td> <td>30.49</td> <td>lighter</td> <td>lighter</td> </tr> <tr> <td>6</td> <td>Left Facial Cheek</td> <td>63.07</td> <td>9.01</td> <td>18.73</td> <td>5.11</td> <td>-0.11</td> <td>-0.15</td> <td>5.11</td> <td>34.91</td> <td>lighter</td> <td>lighter</td> </tr> </tbody> </table> | | | | Data Name | L*(D65) | a*(D65) | b*(D65) | dL*(D65) | da*(D65) | db*(D65) | dE*ab(D65) | ITA | Lightness(D65) | Pseudo Color(D65) | Target | Left Arm (tan) | 57.97 | 9.12 | 18.88 | --- | --- | --- | --- | 22.88 | --- | --- | 1 | Left Arm 2 (tan) | 57.50 | 10.18 | 18.29 | -0.47 | 1.06 | -0.59 | 1.30 | 22.29 | lighter | lighter | 2 | Left Arm (fair) | 62.98 | 8.96 | 15.17 | 5.01 | -1.16 | -3.71 | 6.24 | 40.55 | lighter | lighter | 3 | Left Hand Palm | 66.97 | 8.48 | 11.96 | 9.01 | -0.84 | -6.92 | 11.37 | 54.82 | lighter | lighter | 4 | Left Arm 2 (fair) | 63.34 | 8.13 | 15.78 | 5.37 | -0.99 | -3.10 | 6.28 | 40.21 | lighter | lighter | 5 | Right Facial Cheek | 61.23 | 9.38 | 19.08 | 3.27 | 0.26 | 0.20 | 3.28 | 30.49 | lighter | lighter | 6 | Left Facial Cheek | 63.07 | 9.01 | 18.73 | 5.11 | -0.11 | -0.15 | 5.11 | 34.91 | lighter | lighter |
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| 3 | Left Hand Palm | 66.97 | 8.48 | 11.96 | 9.01 | -0.84 | -6.92 | 11.37 | 54.82 | lighter | lighter | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5 | Right Facial Cheek | 61.23 | 9.38 | 19.08 | 3.27 | 0.26 | 0.20 | 3.28 | 30.49 | lighter | lighter | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Powered by SMNX Designed by AC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Below is a guide in classifying the subject's skin color into the different skin color category of "Tan", "Intermediate", "Light" and "Very Light".

| ITA° | Skin Color Category |
|----------|---------------------|
| 10 - 28 | Tan |
| 28 - 41 | Intermediate |
| 41 - 55 | Light |
| Above 55 | Very Light |

Conclusion

As can be seen from the above, skin whitening evaluation can be carried out easily using the appropriate tools like

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the Chroma Meter CR-400 or Spectrophotometer CM-600d which allows the skin technologist to conduct the necessary skin assessment and product effect on the skin color in a much quicker way. The wireless Bluetooth capability of the CM-600d also helps to make the measurements much more convenient and without limitation in the measurement movement and the distance from the computer where the software is being installed.

If more detailed information of the skin analysis is required like the melanin index, total haemoglobin index (oxidised and reduced) and haemoglobin oxygen saturation index are required, the Konica Minolta Skin Analysis software can be incorporated to enhance the testing process.

For more information on the Chroma Meter CR-400, Spectrophotometer CM-600d, SpectraMagic NX Pro Software and the Skin Analysis Software, kindly visit the following web sites for more information.

Chroma Meter CR-400

<https://sensing.konicaminolta.asia/product/chroma-meter-cr-400/>

Spectrophotometer CM-600d

<https://sensing.konicaminolta.asia/product/spectrophotometer-cm-600d/>

SpectraMagic NX Pro Software

<https://sensing.konicaminolta.asia/product/spectramagic-nx/>

Skin Analysis Software

<https://sensing.konicaminolta.asia/product/cm-sa-skin-analysis-software/>

Alternatively, you can email to us at ssg@gcp.konicaminolta.com or call us at +65 6895 8685 to find out more from our color team on the product capabilities or to have a no-obligation discussion with our application advisors to help you select the appropriate models for your specific application.