립스틱의 광택 및 광택 지속성에 대한 객관적인 측정법에 관한 연구

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(2005년 2월 28일 접수, 2005년 3월 11일 채택)

A Study on the Sensory Tests Correlated Objective Measurements for the Gloss and Gloss-lasting Capability of Lipstick

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(Received February 28, 2005; Accepted March 11, 2005)

요 약: 립스틱의 경우 광택과 광택 지속성은 일반적으로 관찰자의 주관적인 판단에 의해서 측정되곤 하였다. Glossmeter는 네일 에나멜과 같은 메이크업 화장품의 광택을 측정하는데 적용되었다. 그러나 립스틱의 경우에는 항상 일정하게 샘플링하기가 어려워 적용하는데 문제점이 있었다. 또한 광택 지속성은 측정할 수가 없었다. 본 연구에서는 기존의 주관적인 감각테스트에 크게 의존하던 립스틱의 광택 및 광택 지속성의 측정방법을 최적화하여 설정하였다. 도포물질, 크기, 도포회수 등의 변수들을 변화시켜 광택 측정법을 표준화하였다. 그리고 온도와 진동회수를 조절하여 광택 지속성을 측정할 수 있는 최적의 측정방법을 도입하였다. 이러한 방법을 적용하여 측정한 광택값은 주관적인 감각 테스트의 결과와 유사한 값을 나타내었다. 이 방법은 통계적 도구인 6 시그마에 의해 재현성과 반복성이 유효하다는 것을 증명하였다.

Abstract: In case of lipsticks, observer's subjective sensitivity has been the main index to estimate gloss and gloss-lasting capability. The glossmeter has been applied to measure the gloss of make-up cosmetics like nail enamel, however is not effective for lipstick because of uneven sampling. Also gloss-lasting capability couldn't have been measured. In this study, we optimized measurement methods of gloss and gloss-lasting capability of lipsticks, which are highly correlated to subjective sensory tests. We set up the standard methods of gloss measurement by changing application conditions, for example, materials, sizes and application number of times and so on. And we introduced optimizing measurement system, in which shaking speed and temperature were controlled to measure gloss-lasting capability. Applying our methods, the gloss values were very close to the results of sensory tests, and we could express the gloss and gloss-lasting capability of lipsticks numerically. Repeatability and reproducibility of our methods were certified by six-sigma statistical tool.

Keywords: gloss, gloss-lasting, lipstick, make-up, six-sigma

1. Introduction

Recently customers want natural make-up and glamorous and shiny lips with natural color, so enhanced glossy lip products like lipgloss and glossy lipsticks are esteemed as trends.

Glossy properties have risen from designing products qualities by developers to buying products by customers but we were used to estimate them by observer's sensibility subjectively. And the glossmeter that has been applied to measure the gloss of make-up cosmetics like nail enamel is not enough for lipstick because of it's uneven sampling. And gloss-lasting capability couldn't have been measured.

We had to standardize the measurement methods in order to compare gloss and gloss-lasting capability in lipsticks or lipgloss relatively, and for standardization introduced the specific and optimizing system, in which shaking speed and temperature were controlled.

Six-sigma is an integrated, disciplined proven approach

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Table 1. The AHP Analysis of Glossmeter

	Time	Reliability	Hardness	Cost	Importance	Impact Factor
Time	1	0.25	0.5	3	0.782542	0.1629629
Reliability	4	1	2	4	2.378414	0.4953000
Hardness	2	0.5	1	2	1.189207	0.2476501
Cost	0.3333	0.25	0.5	1	0.451801	0.0940867
Total					4.801965	

	Time	Reliability	Hardness	Cost	Results
Impact factor	0.162963	0.495300	0.247650	0.094087	
Panel test	0.104729	0.088746	0.097169	0.636986	0.1450189
Glossmeter	0.636986	0.352189	0.700711	0.258285	0.4760767
Goniometer	0.258285	0.559065	0.202120	0.104729	0.3789044

for improving business performance. Six-sigma focuses on projects that will produce measurable business results for management methodology driven data and especially it is based upon improving processes by understanding and controlling variation, thus improving predictability of business processes. In the filed of cosmetics R&D, it can be applied in order to transform qualitative levels into measurable quantitative variables throughout statistically analysis.

And we first introduced six-sigma statistical tool in order to analyze proving the processes and numerical data per each process objectively. This trial to combine sensory estimation in cosmetics with statistics is very powerful for us to experiment systematically and analyze the data logically.
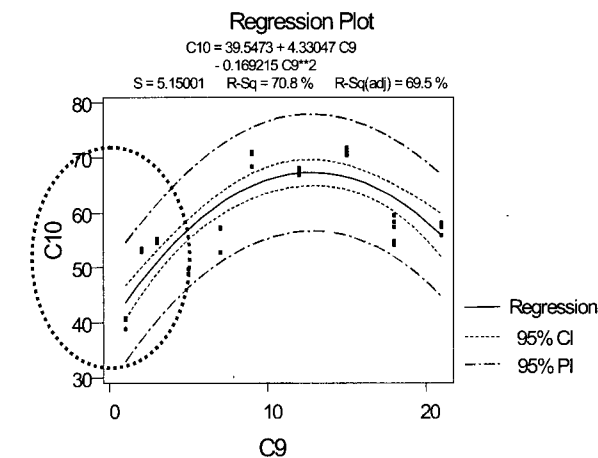
2. Experiments

2.1. Methods

We set up the methods of gloss and gloss-lasting capability measurements of lipsticks. The gloss of lipsticks was measured by glossmeter (Micro-Tri-Gloss, BYK Gardner). We standardized the methods of gloss measurement as changing application conditions, for example, materials, sizes and application number of times and so on. And gloss-lasting capability of lipsticks was measured by optimizing system using both water bath (Model: J-SWB1, Jisco Corp.) and glossmeter. Shaking speed and temperature were controlled in this system and we experimented under constant environments.

2.2. The Standardization of Measurement Methods in Lipstick's Gloss

We examined some methods like glossmeter, gonio-

Figure 1. The regression analysis data.

meter, panel test as comparing suitability of them one another in the effectiveness on time, reliability, facility and cost. The Table 1 is the results of AHP (analytic hierarchy process), so we choose the glossmeter as the method.

According to AHP, a glossmeter was suitable to measure gloss properties of lipsticks. We defined gloss ratio as % ratio of reflected light/incident light. The higher % ratio is, the better gloss of lipstick is.

We examined the methods of gloss measurement as changing application conditions, for examples, kinds of application materials, the number of times for applications and measuring tester and so on. After preceding several experiments we set up the SOP (standard operating procedure), showed in Figure 1, regression analysis data fixed application times and Figure 2 summarized all results. In last step, we have to prove the methods we set up by gage R&R, which stands
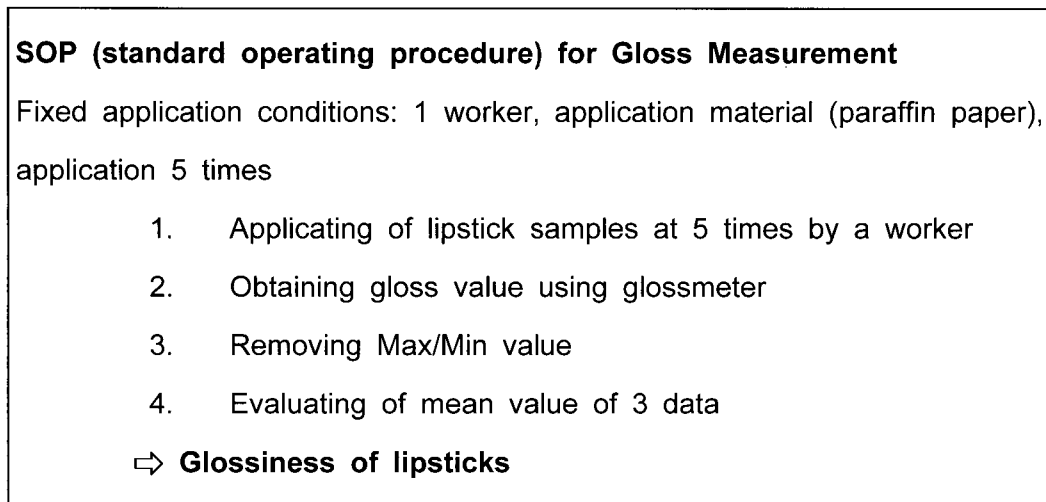

SOP (standard operating procedure) for Gloss Measurement

Fixed application conditions: 1 worker, application material (paraffin paper), application 5 times

    1.　　Applicating of lipstick samples at 5 times by a worker

    2.　　Obtaining gloss value using glossmeter

    3.　　Removing Max/Min value

    4.　　Evaluating of mean value of 3 data

  ⇨ **Glossiness of lipsticks**

Figure 2. SOP for gloss measurements.

Table 2. The Results about Temperature of System

	Temperature						
						Constants : working time, shaking speed	
	Sample						
Temperature of system	Water				Oil		
	1		2		1		2	
	Before	After	Before	After	Before	After	Before	After
45℃	60.3	20.2	61.5	13.4	60.0	4.6	52.1	8.6
	59.2	20.4	61.5	13.4	59.8	4.5	52.4	8.5
	59.1	19.9	61.4	13.4	59.9	4.6	52.3	8.6
	58.8	19.8	61.5	13.4	59.8	4.6	52.2	8.6
40℃	52.8	22.1	55.5	26.7	61.4	20.2	57.0	25.2
	53.4	22.3	55.5	26.7	61.5	20.4	57.2	25.3
	53.4	22.3	55.4	26.8	61.5	20.4	57.2	25.3
	53.4	22.4	55.3	26.7	61.4	20.4	57.3	25.3
36.5℃	56.8	19.2	53.9	30.6	61.1	27.0	55.5	25.9
	56.8	19.4	53.8	60.7	61.2	26.9	55.5	26.2
	56.9	19.3	53.8	30.4	61.1	27.0	55.6	26.4
	56.8	19.5	53.8	30.4	60.9	26.9	55.7	26.4

for gage repeatability and reproducibility. So we obtained the regression data for gage R&R and we could conform the measurement system is effective because of % tolerance value, 16.16 no less than 20.

2.3. The Standardization of Measurement Methods in Lipstick's Gloss-Lasting Capability

Up to the present gloss-lasting capability couldn't have been measured objectively. So we introduced to optimizing system, which provided unique and ideal conditions controlled shaking speed, temperature, for measuring gloss-lasting capability.

First of all we had to define the gloss-lasting capability as clearly and accurately as possible. So we introduced the new concepts, gloss decreasing degree and gloss ratio. We defined gloss decreasing degree as difference between before and after gloss values (before-after) under physical shaking conditions in the opti-

SOP (standard operating procedure) for gloss-lasting capability measurements

1.   Obtaining (before) gloss value by SOP step of gloss measurement

2.   Shaking in optimizing system

3.   Tissue-off

4.   Obtaining (after) gloss value

5.   Repeating 5 times

6.   Removing Max/Min data

7.   Estimating mean value of other 3 data

⇨ (transform) **Gloss-lasting Capability**

⇨ **Gloss Decreasing degree △=before after**

⇨ **Gloss Ratio(%) = after/before *100**

Figure 3. SOP for gloss-lasting capability measurements.

mizing system, and gloss ratio as % relative gloss ratio (after/before). Therefore the less gloss decreasing degree is and the larger gloss ratio is, the better the gloss-lasting capability is.

In set-up experiments, we changed the application variables, for examples, shaking speed and bath temperature and working time and so on. Above all we checked the change for temperature and shaker working time respectively, and other variables was fixed. As changing the temperature of system from 36.5 to 45℃ with putting other conditions constant, we could set the temperature 40℃ in order to discriminate between before and after gloss value in both water and oil bath. Table 2 shows that it is suitable to set the temperature of system as 40℃.

Afterwards as like the standardization procedure of gloss measurement methods, we set up the SOP (standard operating procedure) in gloss-lasting capability to Figure 3.

3. Results and Discussion

3.1. Correlation Numerical Data to Observer's Sensibility in Gloss Properties

We made a correlation analysis between gloss values measured by glossmeter and subjective sensory test results. The experimental method is as follows. Four
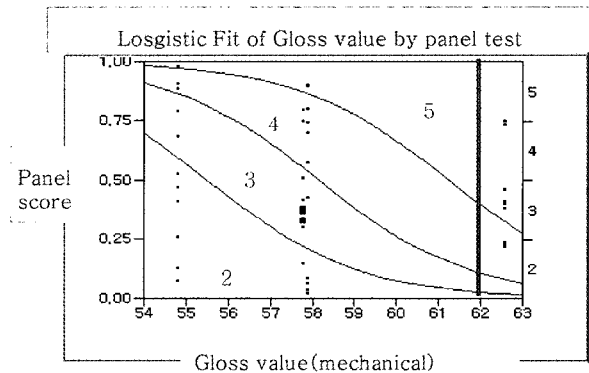

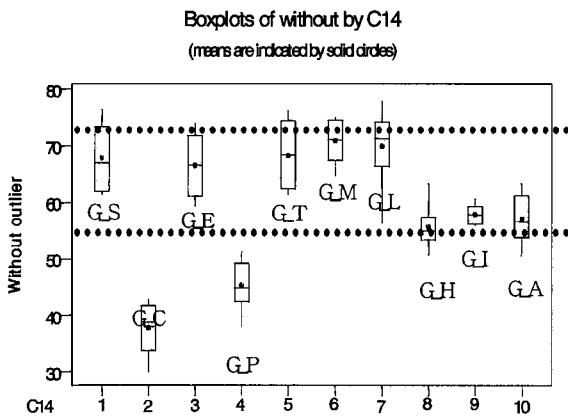**Figure 4.** The logistic fitting of gloss value by panel test.

lipsticks were used for the test samples, which had measurement values from 54.8 to 62.6. 11 panels tested relative gloss degree for four samples and voted from 1 to 5 points for 5 points matrix. Table 3 is the results of panel test.

In this sensory test 8 panels among 11 were aware of the best glossy lipstick and they could rank four samples by the order of numerical gloss degree. In the case that the gloss degree was less than 3, panels were a little confused. But when the difference of the gloss value was more than 5, almost panels could recognize relative gloss between samples.

According to these data, we could know that it was very closed to results of sensory tests in lipstick' gloss.

Table 3. The Data of Lipstick of Lipstick'gloss by Sensory Test

|	Sample 1	Sample 2	Sample 3	Sample 4
Gloss value	62.6	57.9	57.8	54.8
Panel 1	4	5	3	2
Panel 2	5	2	3	4
Panel 3	5	4	2	3
Panel 4	4	2	3	5
Panel 5	5	3	4	2
Panel 6	5	4	3	2
Panel 7	5	4	3	2
Panel 8	5	2	3	4
Panel 9	4	5	3	2
Panel 10	5	4	3	2
Panel 11	5	2	4	3
Mean	4.73	3.36	3.09	2.82

Figure 5. The comparison chart-gloss.

Therefore we were able to conclude that our gloss measurement methods are effective to discriminate lipsticks' gloss. Figure 4 is the logistic fitting of gloss value by panel test.
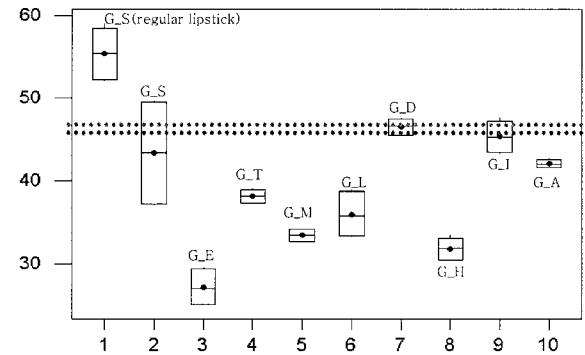
3.2. The Comparison the Gloss Value in Lipsticks

As SOP of gloss measurement methods, we estimated several gloss values of global brands'lipsticks including ours and compared them. The comparison charts are as follows (Figure 5).

The gloss value ranged from 30 to 75. And the best glossy products have scores near 70. It was verified that people was aware that products over gloss value 60 were shiny and glossy throughout panel test. Thus we could analogize that in the aspect of gloss cus-
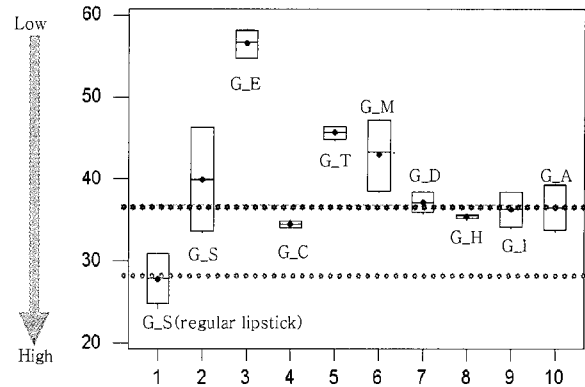
Figure 6. The comparison chart-gloss decreasing degree.

Figure 7. The comparison chart-gloss ratio(%).

tomers satisfied with products that have gloss values over 60.

3.3. The Comparison the Gloss-Lasting Capability in Lipsticks

As SOP of gloss-lasting capability measurement methods, we estimated several values of global brands'lipsticks including ours and compared with them. Figure 6 shows the comparison data of gloss-lasting properties on the basis of the gloss decreasing degree (before-after).

By the gloss decreasing degree, the scores are distributed from 35 to 60. The smaller value is, the better gloss-lasting property is, because this value means the difference between before and after gloss degrees after physical shaking in the optimizing system. Therefore the superior groups have value near 35. Our product noted by G_I belongs to this superior groups by marking the value 36.

On the basis of the other, gloss ratio (after/before % ratio), the calculated values range from 25 to 50. (Figure 7), which means relative after gloss degree

compared with before gloss degree. Figure 7 indicates that the gloss ratio of best product is over 46, and that of pacific product is 43 to match the upper results about the gloss decreasing degree to belong to superior groups in the aspect of gloss-lasting capability. Also It was verified that panels were aware that products over gloss ratio 40 were lasting glossy properties throughout panel test.

4. Conclusions

In our study, we have set up the standard methods of gloss and gloss-lasting capability measurements in lipsticks. And we tested the effectiveness of those methods by six-sigma analytical tool. And according to SOPs per each property, we could obtain numerical data about gloss and gloss-lasting capability of representative glossy lipsticks made by global brands. Analytical results about glossy properties throughout our procedure, SOPs were matched by observers' sensory tests results.

Furthermore the standard methods would get us to design prescriptions for gloss-enhanced products like glossy lipsticks and verified by their glossy data.

These methods will be also convenient and effective to estimate glossy properties of other lip products like lipgloss as well as lipstick.

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