

# Research on dose effect of toner application to achieve good skin condition

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## Introduction:

The appearance of skin condition has very important aesthetic value. The skin condition of the whole face brings various of interests for dermatologists and cosmetologists, but skin condition indicator, visual topography always changes with age, sun exposure, endocrine factor and so on [1][4]. In order to maintain skin in "good condition", skin care products are anxiously pursued. When we use cosmetic, we are always told to apply the right amount of cosmetic, but how much is the right amount? However, it is difficult to define the parameters of good skin condition, and very few articles have studied the relationship between the amount of cosmetic used and skin characteristics. The aim of the study was to develop the good skin condition index (GSC) that could reflect the skin condition comprehensively. In addition, an example study was conducted, to verify GSC by dose effect, and further to define the right amount of cosmetic application to achieve good skin condition.

## Materials & Methods:

### Noninvasive instrumental measurements

Front facial photos of volunteers' faces were captured with a VISIA-CR Imaging System (for grading, Canfield Scientific, America). Skin properties parameters were measured by the following noninvasive instruments(Table 1):

Table 1: Noninvasive instruments and skin parameters

Noninvasive instruments	Skin parameters	Interpretation
Corneometer CM825	moisture	The hydration of skin
Vapometer	TEWL	Transepidermal water loss of skin
SkinColorCatch	L, a, b,	L: skin's brightness a: The value in the color space from green (-A *) to red (+ A *) chromaticity. For skin tone measurements, the higher the A * value, the redder the skin. b: The value in the color space from blue (-b*) to yellow (+b*). For skin tone measurements, the higher the B * value, the yellower the skin.
	MI, EI, ITA	MI: skin's melanin EI: skin's erythema ITA: skin's color individual type, the higher the ITA value, the whiter the skin
Glossmeter	Gloss	Skin's glossiness
Sebumeter	Grease	The content of skin's grease
pH meter	pH	Skin's pH
Cutometer	R2, R5, R7	The index of skin elasticity, the closer the data is to 1, the better the skin's elasticity
Primos	Ra, Rz, Rq	The parameter of skin texture and roughness, the smaller the value is, the smoother the skin is

### Experimental procedures

(1) The volunteers cleaned their facial skin and rested in the laboratory (21 ± 1 ° C, 50 ± 10 % relative humidity) for 30 minutes. Then facial photos were taken under standard light. Investigators/experts graded the whole front face photos. The skin condition scale only had two grades (Table 2). All photos were assessed by three trained investigators with an identical set of randomized photos.

Table 2: The skin condition scale

Grade	Description
1	Good skin condition
0	Not good skin condition

(2) The second experiment was designed to research the relationship between the skin parameters and the dose of toner application.

- 20 healthy volunteers were chosen for the test.
- Skin parameters (skin hydration, TEWL, skin gloss, the skin color (L, a, b, ITA), and skin erythema/melanin (E/M)) before and after toner application were measured using noninvasive instruments mentioned above.
- The essence toner was sprayed on the half of volunteers' face through oxygenator on the same area of their faces for 5 seconds each time, by which the dosage of essence tone was about 0.3-0.4g for every 5 seconds.
- The relevant skin indexes were tested after the skin was massaged to thoroughly absorbed. Then the toner was again sprayed on the same part of facial skin for another 5 seconds and massaged until absorption, and so on, until they were continuously sprayed for 10 times (50 seconds in total).

### Statistical analysis

Measures of reproducibility could be used to assess the agreement between different individuals or the consistency of response by the same individual [5]. The reproducibility and consistency of the rating scale were characterized by kappa statistics. Kappa values fall between 0 and 1. According to Altman a value of <0.20 shows poor agreement, 0.21 to 0.40 fair, 0.41 to 0.60 moderate, 0.61 to 0.80 good, and 0.81 to 1.00 very good agreement [6].

The principle of factor analysis in principal component analysis was used to indicate the Good skin condition index (GSC), which is to synthesize several variables with a certain correlation into a small number of factors, and to study how a group of measured indicators with a complex relationship is dominated by a few internal independent factors [7]. Logical regression analysis method is to study the quantitative relationship between a dependent variable (subject to normal distribution) and multiple independent variables. According to the classification of dependent variables, it can be divided into binary logistic regression and multiple logistic regression. In this paper, binomial logistic regression analysis is used.

## Results & Discussion:

### Consistency of the grades

The skin condition of 300 volunteers were rated by 3 trained professional investigators. The overall consistency between three different investigators was good, kappa was 0.623.

### Skin condition and the other data from instrument test

Specific data of skin parameters of volunteers with different skin conditions are shown in the below table 3.

Table 3: Data of instruments parameters with different skin conditions (mean)

Skin parameters	Age	Moisture	Melanin	Erythema	Gloss	Grease	PH	TEWL	L	a	b	ITA	R2	R5	R7	Ra	Rq	Rz
Grade 0	34.90	59.30	155.55	350.76	5.97	53.42	5.83	18.72	59.80	16.78	11.94	39.16	0.53	0.56	0.36	22.01	27.48	120.43
Grade 1	29.13	61.36	130.53	303.43	5.69	51.46	5.83	15.59	62.30	16.10	11.10	47.76	0.55	0.57	0.38	19.51	24.41	108.31

### Select parameters

All parameters were analyzed through KMO and Bartlett tests. The KMO test is to see whether the data is suitable for factor analysis, and the Bartlett test is to see whether the data comes from the volunteers to multivariate normal distribution. In this experiment, the value of KMO test is 0.624, which is indicating that factor analysis can be carried out. The significance of Bartlett test is 0.000, which is indicating that the data comes from normal distribution and is suitable for further analysis.

If all these 18 parameters were used to predict the Good skin condition index (GSC), it would result in complex and poor performance models. Factor analysis in principal component analysis was used to further select parameters. In the interpretation of total variance, only the initial eigenvalues of the first 6 components are greater than 1, and the variances of these 6 components account for 80.234% of the variances of all principal components. Thus, the selection of the first 6 components is enough to replace the original variables, which can cover all the information of the original variables.

### Good skin condition index (GSC)

Logical regression analysis method is to study the quantitative relationship between a dependent variable (Good skin condition=1, not Good skin condition=0) and multiple independent variables (Age, Moisture, Melanin, Erythema, Gloss, Grease, PH, TEWL, L, a, b, ITA, R2, R5, R7, Ra, Rq, Rz).

The effects of the instrument parameters on skin condition grade were analyzed using factor analysis and logical regression analysis methods. Of all the parameters, there were six parameters significantly correlated with the skin condition. Based on the Table 4,  $\text{Logit(GSC)} = -35.089 - 0.077 \cdot \text{Age} - 0.01 \cdot \text{EI} - 0.123 \cdot \text{TEWL} + 1.144 \cdot \text{L} - 1.164 \cdot \text{b} - 0.307 \cdot \text{ITA}$ , which can reflect in 80.234% of the original parameters information.

Table 4: Variables in the Equation

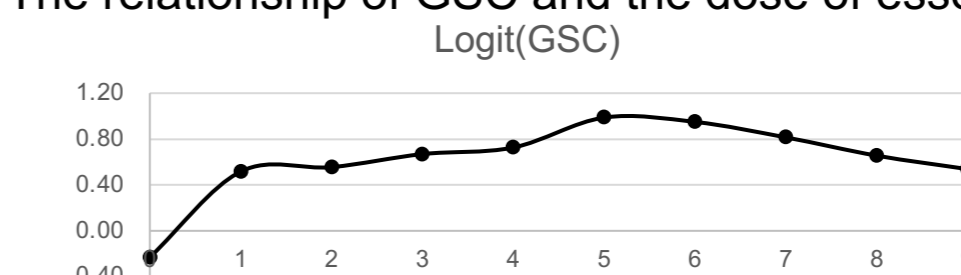
	B	S.E.	Wald	df	Sig.	Exp(B)
Age	-0.077	0.023	11.018	1	0.001	0.926
Erythema	-0.01	0.004	6.239	1	0.012	0.99
TEWL	-0.123	0.037	10.996	1	0.001	0.884
L	1.144	0.428	7.142	1	0.008	3.141
b	-1.164	0.4	8.483	1	0.004	0.312
ITA	-0.307	0.149	4.219	1	0.04	0.736
Constant	-35.089	15.774	4.948	1	0.026	0

### The dose effect of toner application

According to the Good skin condition index defined above, relevant six skin parameters were prioritized to be used to study the dose-effect of essence toner.

We found that the GSC was changed with the more times sprayed by the essence toner through the oxygenator. In particular, when the number of spray reached at 5 times, the logit (GSC) reached the relatively optimal position (Fig.1). As amount of every 5 seconds spray was about 0.3-0.4g, 5 times spray reached to 1.5-2g/half face to achieve good skin condition.

Fig.1 The relationship of GSC and the dose of essence toner



## Conclusions:

The quantitative measurement of skin condition parameter is very important in the skin science and cosmetics [8]. However, the relationship between the numerical value of skin parameters and visualized skin appearance still needs to be further studied. In our research, we established a new method to perceive what was the good skin condition through factor analysis and logical regression analysis methods.

As a result, the factors that affect the good skin condition include age, skin Erythema, TEWL, L, b, ITA, in which the cumulative variance of these 6 parameters can reach 80.234% among the numerous skin indicators. GSC by logit follows the formula below.

$\text{Logit(GSC)} = -35.089 - 0.077 \cdot \text{Age} - 0.01 \cdot \text{EI} - 0.123 \cdot \text{TEWL} + 1.144 \cdot \text{L} - 1.164 \cdot \text{b} - 0.307 \cdot \text{ITA}$

In addition, we did a quick study on dose-effect of essence toner application to achieve good skin condition based on the above model. In our study, the best amount of this essence tone was 1.5-2g/half face to achieve good skin condition. However, there was still some limitations in the second experiment, and we should expand the samples and increase the diversity of age and the types of skin care products in the subsequent study.

In summary, this study is very target-driven to achieve GSC index, to give a practical approach for volunteer to achieve good skin condition, and meanwhile it reveals the rooted parameters for dermatologists and cosmetologists to design products to achieve good skin condition as well. The GSC index achieved from huge database on 300 volunteers is reliable, and it could effectively reflect the skin visualized condition through six main parameters, such as age, skin Erythema, TEWL, L, b, ITA, follows promising formula mentioned above.

Meanwhile, a quick validation of the dose effect of essence toner was done by GSC index. Result showed that 1.5-2g/half face of tested essence toner could reach the peak of GSC, indicating the right amount application for volunteer to get best good skin condition. Further studies have to be done to really make the GSC index widely used, to further expand different types of products application.

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