A Relevant Study Correlating the Actual Observed Physiological Properties and a Cosmetic-User’s Subjective Evaluations of Skin†

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The purpose of the present study is to get an accurate grasp of female’s self assessments, examine which skin problems have good/bad correlations with objective evaluations and analyze the reasons for the ones that do not match.

In this study, we collected 174 healthy Japanese female’s evaluations on their own facial skin through the face to face interviews and questionnaires. Then the results were compared with physiological evaluations, which include clinical observations and measurements for the water content, skin surface lipids, skin elasticity, skin microstructure, etc.

Oiliness and age related condition (pigmentation, wrinkles, sagging) show relatively good correlation while dryness does not. This incongruity between the subjective evaluation and the actual skin condition often leads to an inadequate selection of cosmetics and improper skin care which may induce skin troubles.

Introduction

The selection of the most appropriate products, pertaining to the effectiveness of skin care afforded by commercial cosmetics, is an extremely important function for recommending specific products to satisfied customers. Thus far, most selection processes have primarily relied upon the user’s subjective evaluation, which may result in an inadequate recommendation of products that are subsequently ineffective.

Female’s subjective evaluations of their own skin, however, were respectively realized by multiform ways under the influence of their bred environment, their age, a standard of living and many other various factors. In the case of a mismatch between the subjective evaluation and the actual skin condition, an inadequate selection often occurs which may lead to some skin troubles.

Taking into consideration a customer’s needs for commercial cosmetics, a useful method to evaluate the physical properties of the skin with an individual’s subjective assessment, not only in laboratory use but even at the store, is wanting. The purpose of the present work was to develop methods of analyses that can relate the actual observed physical properties of skin and a subjects evaluation, various methods and instruments were also de-
developed. On the basis of our developed analytical methods for the assessment of the actual skin condition, we can therefore make proper recommendations of cosmetic usage to our consumers.

**Experimental Methods**

Healthy Japanese female volunteers whose ages ranging from 17 to 77 years were selected for physical tests. The 174 subjects were asked to face to face interviews and questionnaires in order to obtain their subjective assessment of their skin pertaining to each season. There were a total of 49 questions for the determination of the subjective evaluation with regards to their skin condition. All questions were scaled into three categories or ranks: 1) yes, 2) average, and 3) no. Typically, the subjective assessment was related to questions regarding the moisture content of their skin (e.g. moist, powdery, likely to roughen, etc.), greasy feelings (e.g. pimples, oiliness, accumulation of foundation, etc.), aging feeling (e.g. wrinkling, pigmentation, sagging, etc.).

The subjects skin condition was next evaluated by trained personnel. The subjects skin condition regarding dryness, scaling, redness, acne, pigmentation, pore, firmness and wrinkling were evaluated by a practiced observer using a scale of 1–4 (3 or 5) for each category. All evaluations by trained personnel as well as objective measurements (see below) were performed 20 min. after the subjects face had been washed and under fixed room conditions, 20°C, 40%R.H.

Objective assessment of the volunteers skin conditions were made by instruments specifically utilized within Kao Corporation to provide consumers with appropriate recommendations for cosmetic usage. The objective determinations that we made were:

1) Skin conductance (µmho) which is considered to reflect the skin surface water content was determined using the Skin Surface Hygrometer SKICON-200(IBS) and our Sofina Beauty Computer (Kao)\(^1\).

2) Micro-topography of the skin surface was performed by the Direct Skin Analyzer (DSA) developed within Kao which is based on CCD imaging technology, shown in Fig.-1. It basically consists of a CCD camera attached to a fiber optic light unit that can magnify the skin surface 200 times (Fig.-2). We evaluated the skin scaling score, texture and pore size of hair follicle using photographic images recorded by this unit \(2,3\).

3) The skin, pigmentation were determined by the Skin Tone Analyzer (STA) also devel-
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oped within Kao\(^4\). The system is similar in technology with DSA, however, the optical fiber unit contains two polarized filters to limit diffuse reflections emanating from the stratum corneum which is magnified by 20 times (Fig.-3). We scaled the micro-pigmentation score according to photographs shown in Fig. 4 that were recorded by this unit.

Fig.-3 Camera device of Skin Tone Analyzer (KAO) is constructed by two polarized filters and an imaging device (CCD) and connecting to the same system as Direct Skin Analyzer.

4) The skin surface lipid content was determined as a SEBUM value using our Sofina Beauty Computer (Kao)\(^5\). From a slightly different location on the volunteers face, the surface lipids were subsequently extracted by an organic solvent mixture of acetone and diethyl ether (1:1). The extracted lipid was then analyzed by gas chromatography techniques which had quantitated both the squalene and cholesterol amounts (\(\alpha g/cm^2\))\(^5\).

5) The number of exfoliative cells removed from the skin surface by a new type of adhesive tape developed specifically for Kao were directly counted using Image Analysis System (PIAS), or by light transmittance intensity measurements via Kao’s Sofina Beauty Computer (SBC) shown in Fig.-5\(^6\)\(^7\).

6) Of the many types of inter-cellular lipids (ICL), ceramides were specifically analyzed to estimated the total ICL content within.

Fig.-4 Typical photographs of micro pigmentation Scales 1-5 which was recorded by STA.

1. no pigmentation 2. slightly pigmentation 3. scattering pigmentation

4. scattering pimentation and moderate wide-spread pigmentation 5. strong wide-spread pigmentation

7) Skin elasticity was measured using a Cutometer (Courage and Khazaka) which measures the ability of the skin to regain its initial position after deformation in the form of the ratio known as U/u.

All data that were obtained from both objective and subjective measurements were inputted into Statistical Analyses System (SAS Institute Inc.) to perform all reported calculations for proper evaluation.

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Fig.-5  The cornocyte stripping tape getting exfoliative cells of stratum corneum is inserted into SBC unit and measured its transmittance as the number of exfoliative cells by computer.

Fig.-6  This figure shows the flow of Ceramide Analysis System (Kao) using HPLC. This system can analyze one sample within approximately 10 min.
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Results and Discussion

Fig. 7 exhibits the most common facial regions and the degree of concern about the region's skin condition expressed by four specific age groups during subjective analyses. Based on the age of each group, different locations assumed varying degrees of concern. For example, in the young years (ages 17-24 yr) the area in the proximity of the nose was of typical concern regarding primarily oiliness and sweaty condition expressed by four specific age groups.

Fig. -7 The most common facial regions and the degree of concern about the region's skin condition expressed by four specific age group. All data show % of persons for each concern within each age group and facial region.
pores. In the elderly groups (ages 35 yr and over), the areas surrounding the eyes was of primary concern regarding fine line and dark circles. In the overall subjective categories of the young age groups, the most important concern is pores situated around the nose and pimples. For the 35 yrs and over age groups, fine lines and pigmentation are of significant concern. Thus far, there is a good correlation in the subjective data between age groups and the typical facial areas that are important in daily facial care.

In Fig.-8, we show the results of one of our factor analyses for both subjective and objective data in four main categories (oily factor, subjective dryness factor, objective dryness factor and age factor). For the case of the oily factor, both the subjective and objective results are included because there is a good correlation between these data. For example, Fig.-9 shows the results of our subjective and objective assessment of the presence of pores. As evidenced, there is a remarkable degree of agreement between the volunteers knowledge of an abundance of pores and the objective data, shown in the photographs in Fig.-10 obtained via our STA system. Using this system, it is also easy to recognize that the pores contain micro-comedo. In

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* () = subjective
  others = objective

*mention only above 0.3 of factor score.

**Fig.-8** Factor loadings of factor analysis of 9 objective parameters, 7 subjective parameters and age using varimax rotation after standardizing all parameters. This table shows factor loadings over 0.3 only. These factor loadings were categorized by each factor and named by their characteristics.
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Fig.-9 The volunteers knowledge of an abundance of pores was shown as % of answer 1 (yes) in each age group. Pore score of the nose were evaluated by a practiced observer.

Fig.-10 Photograph of 20x of the nose recorded by our STA which shows micro-comedo.

Fig.-11 This figure shows the average of conductance value in each level of scaling score.

Fig.-12 This figure shows the average of conductance value in each level of scaling score by DSA.

addition to objective DSA results, sebum level data obtained by SBC also correlated well with the volunteers assessment of the oiliness of their skin, particularly in the vicinity of the nose. Moreover, counting acne by direct observation was in good correlation with the volunteers impressions and objective determinations of oiliness, as expected. It is
rather evident from these results that individuals are well aware of the degree of oiliness of their skin, and they are particularly concerned about controlling or correcting their oily condition. Hence care should be taken upon recommending effective products that best suit the individuals needs, because they know well if the product had performed according to their wishes. It may also be necessary to provide informational assistance to the consumer regarding the proper usage of the product if best results are to be achieved.

The subjective dryness factor convey by the volunteers had not correlated well with the objective data determined via conductance and exfoliative measurements. The conductance data had, however, correlated well with scaling score determined by our trained personnel and DSA scaling measurements, as shown in Fig.-11 ~ Fig.-13. It appears that our volunteers were unable to distinguish the scaling condition of their skin, independent of the degree of moistness or dryness condition of their skin (see Fig.-14). There is a discrepancy between the subjective and objective assessment of scaling in skin. Hence we believe that the objective methods of evaluation by DSA scaling score, and transmitted intensity measurements and conductance via SBC are important in making the proper determinations of consumers skin scaling conditions. The data obtained the above methods were well supported by independent deter-

![Fig.-13](image-url) Photograph 200x on cheek recorded by DSA which shows severe scaling condition of the skin.

![Fig.-14](image-url) The relation between dryness feelings (moist, emollient, dry, peeling) and scaling score (cheek). Scores were, sc1=no scaling, sc2=slightly scaling, sc3=severe scaling, sc4=very severe scaling, and showed as frequency in each category of feeling (answer).
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Deminizations of total ceramide content per cell, which had decreased as the scaling score increased. Our results indicate that we would best be able to make recommendations to our consumers as to the most effective product for their daily cosmetic uses, relying on data obtained from our Direct Skin Analyzer and Sofina Beauty Computer. Furthermore, the objective data are also extremely useful for the development of better products containing ceramides that enhance the skin's functions as good water barrier, as well as improve its overall appearance.

In the age related concerns, the subjective and objective data correlated well in regards to skin sagging, wrinkling and pigmentation. That is, our subjective data obtained by the Cutometer Ur/Ut correlated well with the individuals and professionals' impressions of the skin's firmness (see Fig.-15). The Ur/Ut data indicating the firmness of skin decreased with increasing age of the individual. At present, we believe that the reduction in the firmness of the skin is caused by structural alterations in the dermis. The mechanisms responsible for these changes are not well-understood, however, we should develop new technologies to evaluate as well as possibly correct for the loss in the firmness of skin. The visible pigmentation of skin determined by a trained professional and individual volunteers also correlated well with data obtained.

![Fig.-15](image)

**Fig.-15** The average of Ur/Ut in each firmness score. Score 4=soft, 3=moderate soft, 2=moderate hard, 1=hard.

![Fig.-16](image)

**Fig.-16** Aging change of micro pigmentation determined by the criteria in Fig. 4. This shows the frequency of scores in 7 age groups.
by the Skin Tone Analyzer (STA). The micro-
pigmentation that is not observable by the in-
dividuals but which can be measured by the STA is
categorized into five types (see Fig.-4). With in-
creasing age, it was found that type V pigmen-
tation had markedly increased whereas type I non-
pigmented skin had decreased (see Fig.-16). In
order to respond to the consumers needs to remove
unwanted pigmentation, we should consider de-
pigmenting agents not only for the visible
pigments, but also for the micro-pigments that can
only be observed under magnification yet account
for the consumers concerns.

Conclusions

We had established the consumers are well aware
of their needs in regards to oily and pigmented
skin, as well as other age related changes. The sub-
jective data are well correlated with methods used
to determine the skins physical condition objective-
ly. For example, we can base our recommendations
to the consumer relying solely on data obtained ob-
jectively and the recommendation would suit well
the consumers wishes. In some instances, the con-
sumer is unaware as to the true condition of the
skin, such as scaling and micro-pigmentation. In
these cases, it is best to rely on proven technology,
such as Kao’s Sofina Beauty Computer, DSA and
STA to provide data that enables us to not only
make good skin care products, but make the best
recommendations to our consumers needs.

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