Development of a quantitative image analysis method for blackhead removing efficacy evaluation

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Introduction:

- **Background**: In the cleanser category, blackhead removing claim always catches consumers' attention. Blackhead is a type of acne, which is one of the common diseases in dermatology. Excessive sebum secretion leads to blockage of hair follicle orifice. Under the condition of long-term exposure to the air, sebum is affected by oxidation and dust in the air to form blackhead. The occurrence factors are related to a large amount of sebum secretion, pilosebaceous vasculature and follicular hyperkeratinisation, daily living habits and heredity.
- **Objective**: In order to effectively monitor and attenuate blackhead, we need an accurate and reliable method to evaluate blackhead quantitatively. Current methods for the evaluation of blackhead are mainly based on counting, and some studies also according to the Investigator's Global Assessment (IGA) for research, which is a semi-subjective evaluation method relying on doctors and experts. The methods described above are not only centralized, subjective and ineffective, but also lack of accurate and scientific evaluation system for image information. This paper attempted to design an image analysis method to explore its feasibility in blackhead assessment. VISIA-CR is a professional facial imaging and analysis instrument in combination with clinical experience and digital camera technology [2]. In this study, VISIA-CR was used to take the images of subjects before and after using the product, so as to explore the usefulness of image analysis method in blackhead assessment in combination with Image-Pro Plus7.0 (IPP), and to study its reliability.

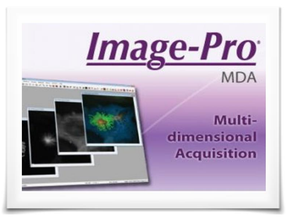
Materials & Methods:

Materials:

➢ Sample:
The test sample was a pore clear glacier mud mask formulated with lactobionic acid.

➢ Instruments:

- VISIA-CR (Canfield, USA)



- Image-Pro Plus7.0 (Media Cybernetics, USA)

Methods:

➢ Subjects:
33 subjects with oily skin and blackhead skin concern, between the ages of 20 and 45 (average age 27.3±3.9 years) were enrolled in the study.

➢ Study design:
The test sample was evenly smeared on the test area at the dosage of 2mg/cm^2, removed after 15 minutes. The test product should be used every 3 days for 2 weeks. Facial images of all subjects were collected by VISIA-CR (Canfield, USA) at baseline, instant, 1 week and 2 weeks later.

➢ Visual assessment:
Blackhead level evaluation was performed by 2 experts at baseline, instant, 1 week and 2 weeks later. Blackhead are rated and counted by whether the pores are open, whether the oil is exposed, and the depth of the color of the exposed oil.

➢ Image analysis:
The blackhead area on the nose has a noticeably different color from the surrounding skin, after using test sample, the blackhead were reduced and the blackhead area restored the original color of skin. Due to the obvious nose area color change, we chose the Image-Pro Plus7.0 (Media Cybernetics, USA) image analysis system to quantify skin color evenness.

Results & Discussion:

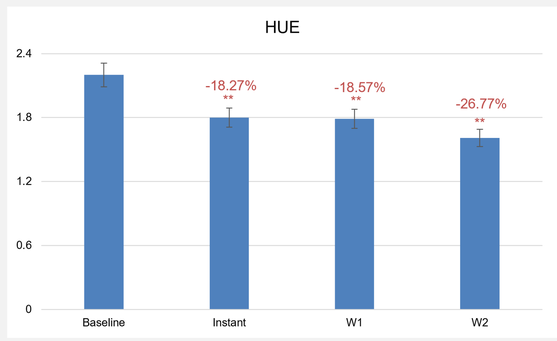


Fig.-1 IPP analysis results show that the skin color evenness HUE decreases after use, which means the skin color of test area became more evenness and the blackhead removed or the color of blackhead became lighter. Error bars indicate standard error of mean. Improvement (%) of instant, W1 and W2 from baseline are also presented (** indicate P≤0.01 vs. baseline).

Fig.-2 Example of blackhead removing effects during the 2 weeks' treatment. Subject 04#, female, 24 y.o., Chinese. The image taken by the VISIA-CR optical source standard 2.

As shown in Figure.-1 and Figure.-2, the results of IPP analysis demonstrated that versus with before, the standard deviation of HUE was significantly decreased by 18.27% immediately after using the pore clear glacier mud mask, 18.57% significantly decreased after 1 week, 26.77% significantly decreased after 2 weeks (P<0.05).

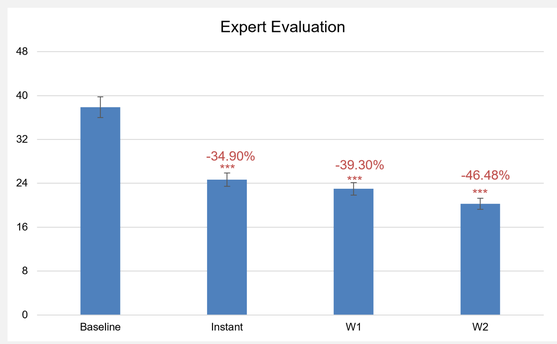


Fig.-3 After using the product, blackhead can be effectively removed and expert scores also reduced. Error bars indicate standard error of mean. Improvement (%) of instant, W1 and W2 from baseline are also presented (*** indicate P≤0.001 vs. baseline).

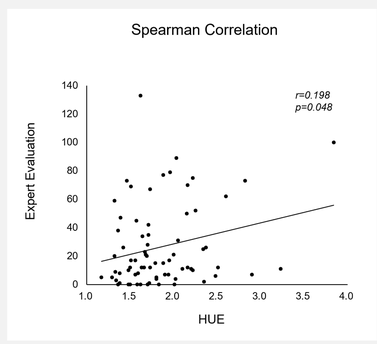


Fig. -4 Correlation between HUE and expert evaluation results was analyzed and by Spearman's correlation coefficient (r). P < 0.05 was regard as statistically significant.

Compared with baseline, the expert evaluation of blackhead level at instant, week 1 and week 2 had significant differences (P<0.05). The results show that expert score decreased by 34.90% immediately after using the sample, 39.30% decreased significantly after 1 week, 46.48% decreased significantly after 2 weeks (Figure. 3). Correlation between HUE and expert evaluation results showed that there was a significant positive correlation between HUE and expert evaluation results (P=0.048), and the correlation coefficient was 0.198 (Figure. 4).

Conclusions:

In this paper, image analysis method was used to evaluate blackhead removing efficacy. VISIA-CR facial imaging booth and Image Pro Plus (image analysis software) were used to quantitatively analyze the standard deviation of HUE at the test area in terms of reducing the number of blackhead or lightening the color of blackhead oil oxidation. The data measured by this method positive correlate significantly with the visual observations, providing a new method for assessing blackhead from cosmetics point of view. The data measured by this method positively correlates with the visual observations, providing a new method for assessing blackhead from a cosmetics point of view. The limitations of current blackhead evaluation methods have been solved. This paper develops a new method for evaluating the efficacy of cosmetic blackhead removal, enriches the application of image analysis technology in clinical research. It also provides a scientific and objective evaluation method for the long-term treatment of skin blackhead.

References:

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