

Acne treatment using selective amplification of sunlight spectrum with fluorescent therapeutic material (FTM)

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Abstract

Background and Objectives: The therapeutic effect of blue light in the spectral range of 400-500 nm for acne treatment was investigated. This clinical study determines the efficiency of blue - fluorescent therapeutic material (FTM) to convert the broad spectrum of light generated by the sun into to a narrow band having maximal efficacy for acne treatment. The broad spectrum of light was generated by a sun simulator and passed through the fabric (FTM) having fluorescent properties. Patients were exposed to the selected light spectrum for a period of 40min per session during 8 treatments over 4 weeks.

Independent observation demonstrated increase in number of patients with nearly clear face from 4% to 7.7%.

After the treatments, the amount of patients with severe and moderate body acne decreased from 30% to 22%. No adverse effects were observed or reported by the patients. Correlation between exposure time and treatment efficacy was noted.

The fluorescent therapeutic material (FTM) offers a promising solution for improvement of skin conditions during normal outdoor daily activity.

Introduction

Acne is a dermatological problem effecting 70% of adolescents and a significant part of the adult population. This problem is especially true for the population of south Asia due to a hot climate and high humidity which often worsens skin conditions. The therapeutic effect of blue light on acne is well-known in medicine, and actively used by dermatologists in professional treatments. Studies [1,2] report significant improvement of acne vulgaris after skin irradiation with filtered light from a broad spectrum light source. Blue light in the range of 405nm-420nm was shown as an effective and safe solution for mild and moderate acne.

Another study, [3] demonstrated significant acne improvement after treatment with blue light and superior results with a combination of blue and red light.

Significant advancement to acne treatment was achieved with the development of Light Emitting Diode (LED) technology producing monochromatic light with a predetermined spectrum. Studies report improvement of acne appearance for a majority of patients after 8 treatments with a blue LED device.

The positive effect of blue light for acne reduction is based on the process - photodynamic therapy (PDT) - which produces singlet oxygen, proving fatal for skin bacteria. This process is the result of a photo-chemical reaction between blue light and porphyrins generated by bacteria.

The therapeutic effect of sunlight on skin affected with acne has been known for some time, but harmful ultra-violet (UV) radiation produced by the sun makes this treatment risky. For that reason, dermatologists refrain from recommending this treatment. The positive effect of sunlight became clear after analysis of the sun spectrum having a significant part of radiation in the blue range of spectrum (400nm-500nm). Figure 1 shows sun spectrum in the wavelength range of 250nm to 2500nm.

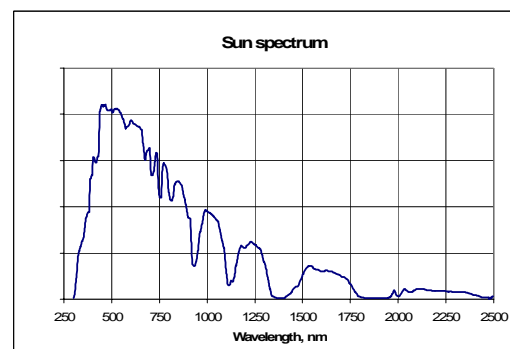


Figure 1. Typical sun spectrum

With the typical sun radiation at summer time being $40\text{mW}/\text{cm}^2$, the intensity of light in the

blue range will be about $6\text{mW}/\text{cm}^2$. This intensity of blue light is comparable with the output energy of LED devices.

Methods and materials

In the current study, we used fluorescent therapeutic material (FTM), developed by SunSoul Inc., Canada. The material was developed to convert the sun's broad spectrum to the specific spectrum which provides maximum benefits for acne treatment. The unique matrix of the fabric is treated with a fluorescent blue pigment which amplifies transmission of light in the spectral range of 400-500nm and in the near infrared spectrum.

The specific transmission spectrum of the fluorescent therapeutic material (FTM) is shown in figure 2.

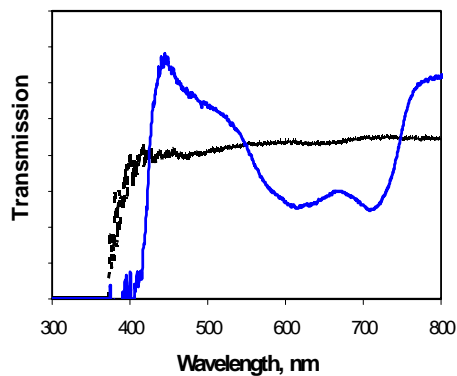


Figure 2. Black curve - light transmission by non-treated material, Blue curve is light transmission by blue FTM

The FTM almost doubles the delivery of light in the range 400-450nm. Fluorescent pigment applied to the polymer matrix absorbs the UV radiation and converts it to blue light - thereby amplifying its intensity on the skin's surface. The specific pigment process and composition also increases light transmission in the near infrared spectrum above 700nm which has skin healing properties.

Light transmission in the UV range of the spectrum is negligible through the FTM. Testing of the material by an independent lab shows a UV protection factor (UPF) of 45. In other words, FTM attenuates UV radiation by 45 times providing high protection for the skin.

Figure 3 shows a magnified image of the blue - material (FTM) and demonstrates the density of fibers at 99%, providing high protection and therapeutic efficiency.

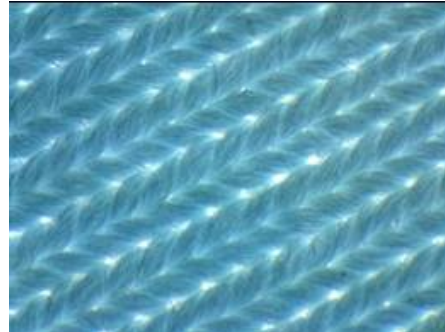


Figure 3. Magnified image of blue FTM.

The light source used was a gas discharge continuous wave (CW) lamp, providing a broad spectrum of light output for a large area with predetermined power density of about $40\text{mW}/\text{cm}^2$. The distance between sun simulator and the patient's skin was adjusted to provide uniform and controlled skin irradiation. The blue FTM was placed between the lamp and skin, optimizing the spectrum delivered to the patient's skin for acne treatment. The schematic setup of the study is shown in figure 4.

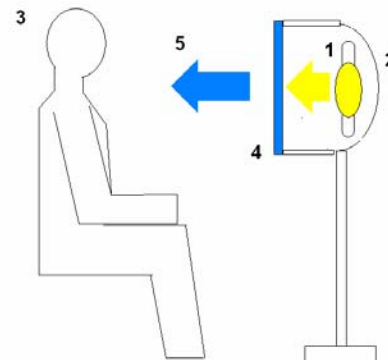


Figure 4. Schematic setup of treatment. 1-sun lamp, 2-reflector, 3-patient, 4- FTM, 5-optimized light delivered to patient.

Asian patients – both male and female - of various ages and skin types were included in the study. Each patient's body and/or face were irradiated by the light transmitted through the blue FTM. The exposure time for each site was 40 min. The total number of treatments over 4 weeks was 8, with 2 treatments per week.



Figure 5. Female patient facial results before (left) and after the treatment (right).



Figure 6. Female patient body results before (left) and after the treatment (right)

Patients were photographed both prior and post treatment. Acne counts and acne grade evaluations were performed blindly by an independent observer.

Results and discussion

There were a total number of 26 patients with 45 treatment sites including face and trunk area. Most of the patient had skin type 3 and 4 according to Fitzpatrick scale.

Patients demonstrated a slight increase of lesion inflammation during the treatment period and improvement at follow-up visits.

Acne appearance was classified according to 5 groups:

1. Nearly clear
2. Mild
3. Moderate
4. Severe
5. Maximum

Initial distribution of patient by facial acne group is shown in figure 7.

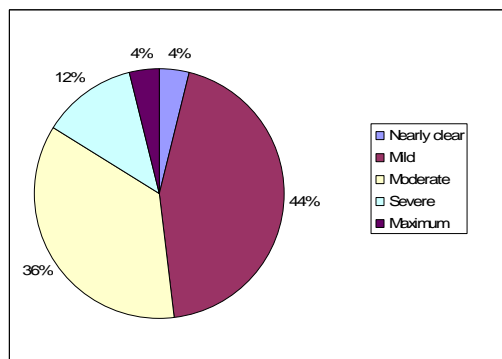


Figure 7. Initial patient distribution by facial acne group.

Independent observation of facial results demonstrated increase in number of patients with nearly clear face from 4% to 7.7%.

Initial distribution of patient by level of back acne is shown in figure 8.

After the treatments, the amount of patients with severe and moderate body acne decreased from 30% to 22%.

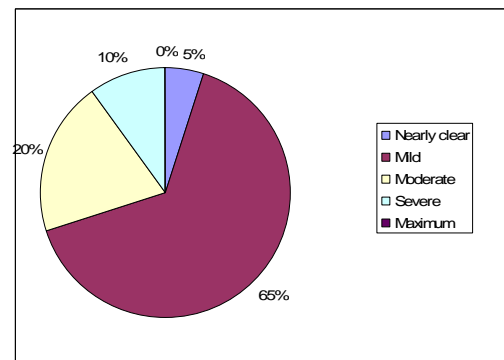


Figure 8. Initial patient distribution by body acne group.

33% of patients noted at least moderate improvement by questionnaires.

Conclusion

In spite of the statistical improvement of acne appearance at the follow-up visit, there was a strong feeling that the dose of light delivered to the patient should be higher. Due to limitations at the clinic, it was problematic to make the treatments longer. It is our belief that using blue – fluorescent therapeutic material (FTM) in the real outdoor setting will be much more effective by utilizing the significantly higher dose of actual sunlight exposure along with the FTM.

References

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4. LED science and system design matures quickly, Edition of Michael Moreti, Aesthetic Buyer Guide, Sep/Oct 2004