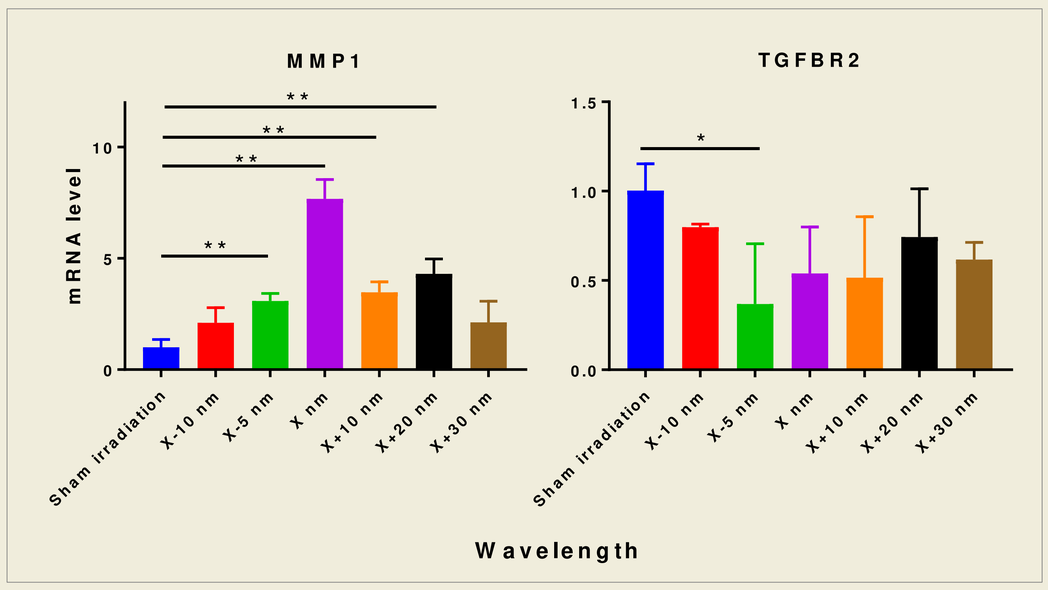
Wavelength characteristics for UVA1 phototherapy with suppressed immediate pigment darkening

Hideyuki Masuda[1,2] and Akimichi Morita[1]

1.Department of Geriatric and Environmental Dermatology,
Nagoya City University Graduate School of Medical Sciences, Nagoya, Japan
2.USHIO INC., Tokyo, Japan.

Introduction

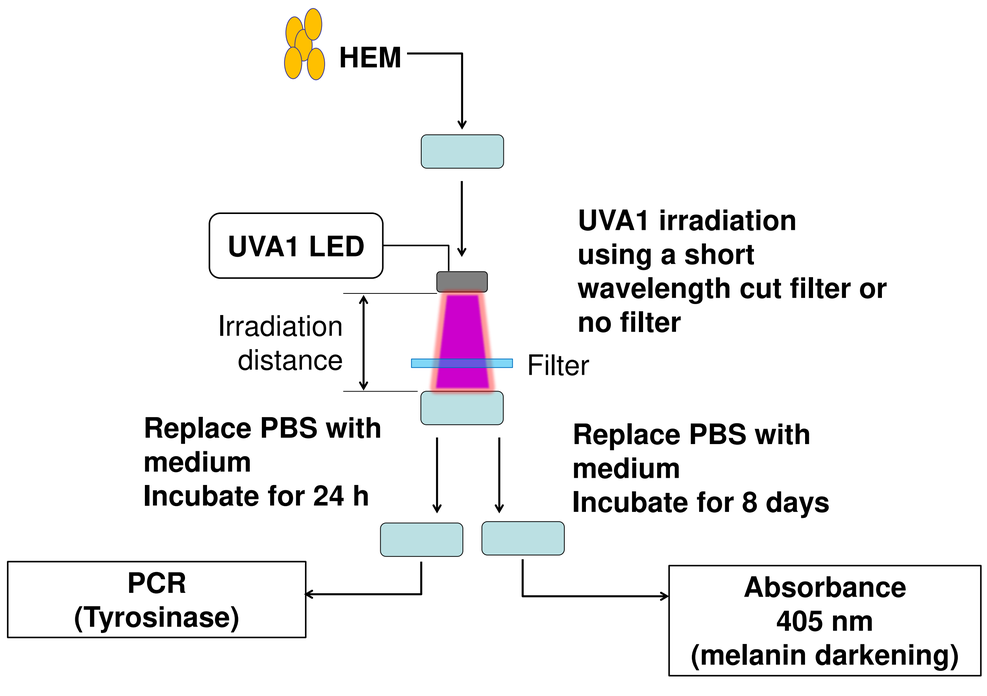
UVA1 phototherapy selectively uses the longer UVA1 wavelengths (340-400 nm), and does not include the shorter UVA2 wavelengths (320-340 nm) or UVB wavelengths (290-320 nm) that cause an erythema reaction. Several studies report the effectiveness of UVA1 phototherapy for various diseases such as atopic dermatitis, T-cell lymphoma, and systemic sclerosis. Previously we reported wavelength characteristics of UVA1 phototherapy (see below).



While UVA1 phototherapy has a high therapeutic effect, it also causes immediate pigment darkening (IPD) as a deleterious effect. IPD is a dull grayish-brown pigment enhancement observed during or immediately after UVA irradiation. IPD begins to disappear 5 to 10 min after irradiation and generally disappears within several hours. Irradiation with UVA at levels several times the threshold level at which IPD develops leads to a persistent pigment darkening that does not disappear even after 24 h and may continue for several weeks. Therefore, IPD may interfere with treatment completion. The peak wavelength of the IPD action spectrum is around 340 nm[1)]. In an effort to decrease IPD, we investigated the wavelength characteristics of UVA1 phototherapy.

Materials&Methods

Normal human epidermal melanocytes (HEM) were irradiated with UVA1 using a short wavelength cut filter or no filter. After irradiation, the cells were incubated for 24 h and tyrosinase mRNA expression was measured by real-time polymerase chain reaction. In addition, the cells were incubated for 8 days and melanin darkening was evaluated by measuring the absorbance of 405 nm using a plate reader.



Irradiation condition

Table Intensity and irradiation time

	Dose [J/cm²]	Irradiation distance [mm]	Intensity [mW/cm²]	Irradiation time [mm:ss]
Sham irradiation	0	-	-	00:00
Filter (-)	15	30	111.4	02:15
A filter (+)	15	30	85.8	02:55
B filter (+)	15	30	97.2	02:34

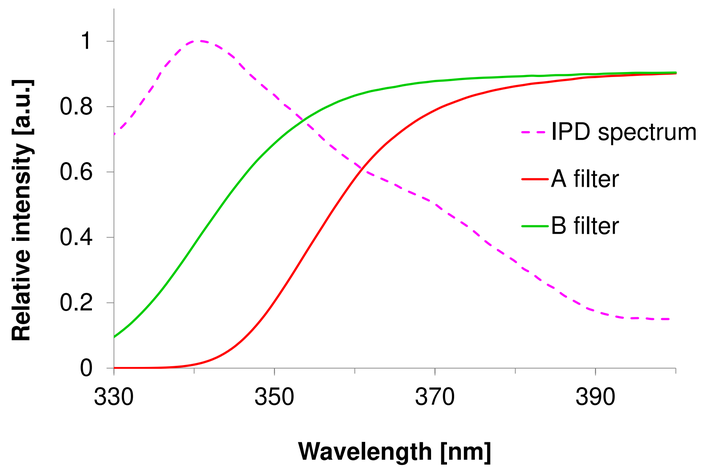


Fig.1 Relative IPD spectral distribution and transmittance of the filter.

Result

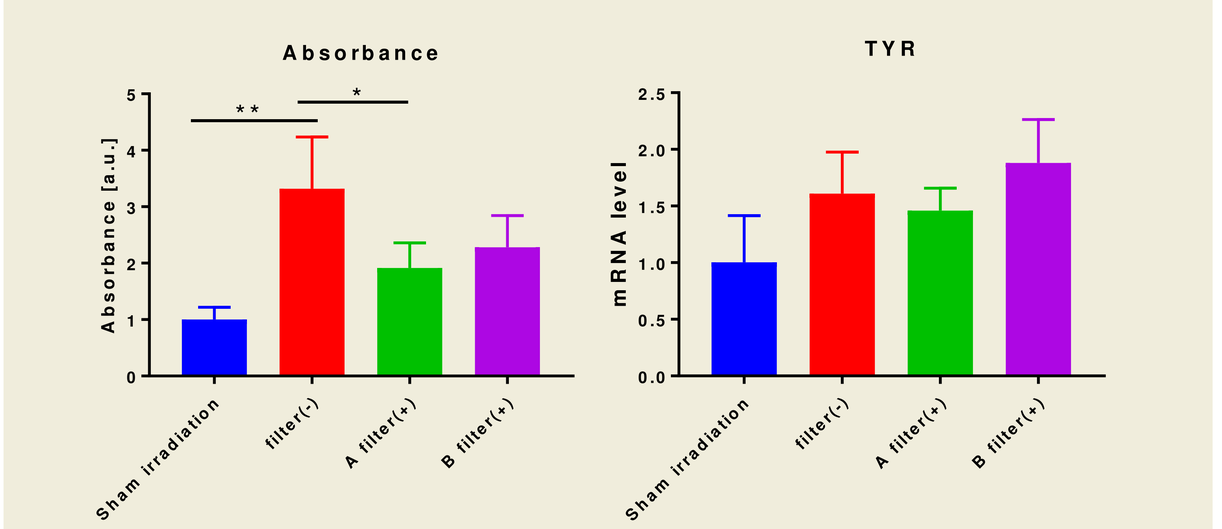


Fig.2 Absorbance of 405 nm (melanin darkening) and tyrosinase mRNA expression.

Summary

UVA1 irradiation increased the tyrosinase mRNA levels and absorbance – that is, promoted both melanin production and darkening, which was suppressed by use of the filter.

Conclusion

These results suggest that the use of a cut filter may suppress IPD during UVA1 phototherapy.

Reference

1) Irwin C, et al., An ultraviolet radiation action spectrum for immediate pigment darkening, Photochem Photobiol. 1993 Mar;57(3):504-7.