

INTRODUCTION

- Ultraviolet (UV) radiation is classified into UVA, UVB, and UVC based on wavelengths ranging from 100 to 400 nm.
- UVA (315-400 nm) accounts for 95% of UV radiation that is found in natural sunlight (1) and is subdivided into UVA2 (315-340 nm) and UVA1 (340-400 nm) (2).
- UVA irradiation leads to formation of reactive oxygen species (ROS) (e.g. singlet oxygen), which results in oxidative stress (3).
- In contrast to UVB, UVA is not completely filtered by clothing and penetrates into deep dermis, causing dermal damage (4-6).
- Rodent studies have demonstrated that UVA is carcinogenic (7).
- Sun protection factor (SPF) represents sunscreen efficacy to protect from erythema, which is mainly caused by UVB and UVA2, not UVA1.

Light	UVC	UVB	UVA	
			UVA2	UVA1
Wavelength (nm)	100-280	280-315	315-340	340-400
Reaches Earth's surface	0 %	5 %	95 % (Majority UVA1)	
Effects on skin		DNA damage "Sunburn UV"	Reactive oxygen species formation → oxidative stress	
Carcinogenic		Yes	Yes	
Filtered by clothing		Yes	No	
SPF (Sun Protection Factor)		X	X	

OBJECTIVES

- The primary aim of this study is to use a novel UVA1 emitting device to measure singlet oxygen production in real time.
- The secondary aim is to measure singlet oxygen production after avobenzone and zinc oxide application and subsequent exposure to UVA1.

RESULTS (ex-vivo human skin)

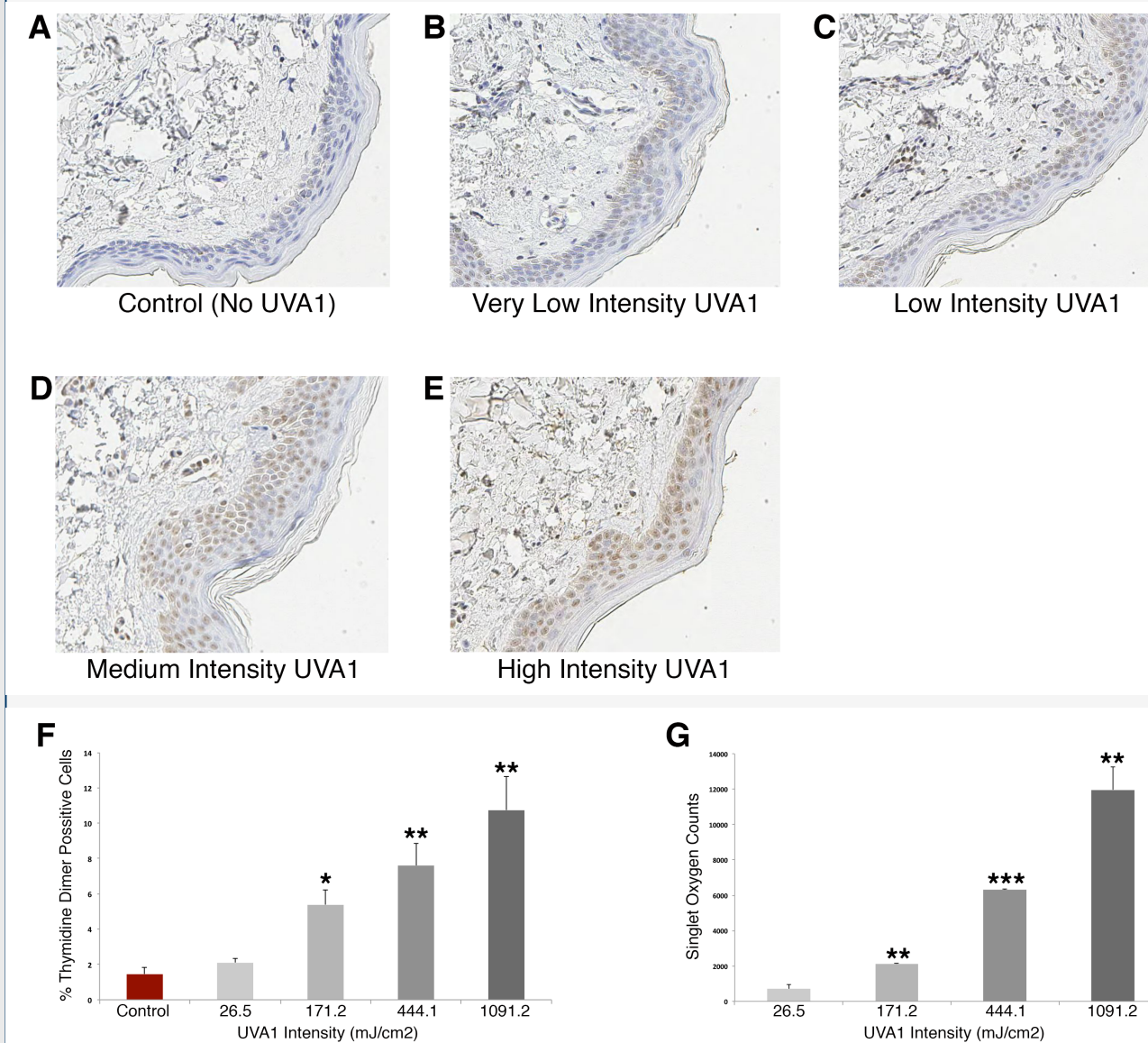


Figure 1. UVA1 effect on thymidine dimer (A-F) and singlet oxygen production (G).

(n = 3 per group, *p < 0.05, **p < 0.01, ***p < 0.001)

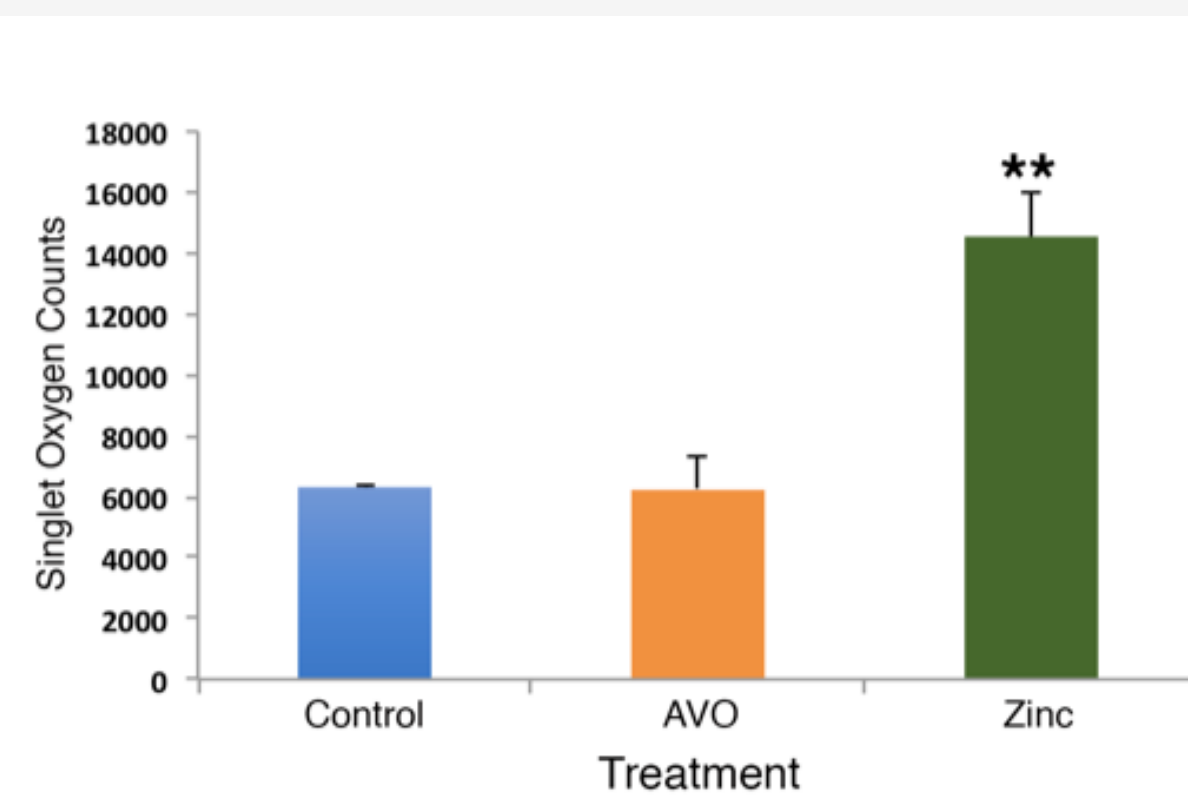


Figure 2. Singlet oxygen production after sunscreen application and exposure to UVA1 (444.1mJ/cm²).

(n = 3 per group, **p < 0.01)

RESULTS (in-vivo human skin)

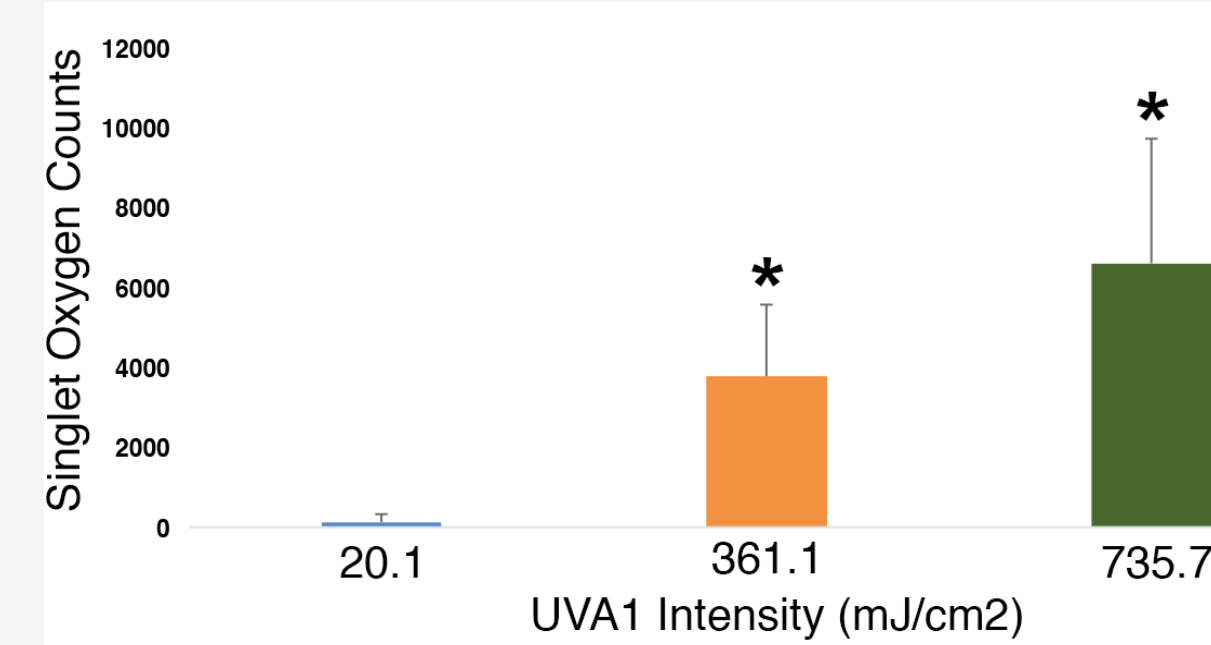


Figure 3. UVA1 exposure and singlet oxygen production on volar forearm.

(n = 6, *p < 0.05)

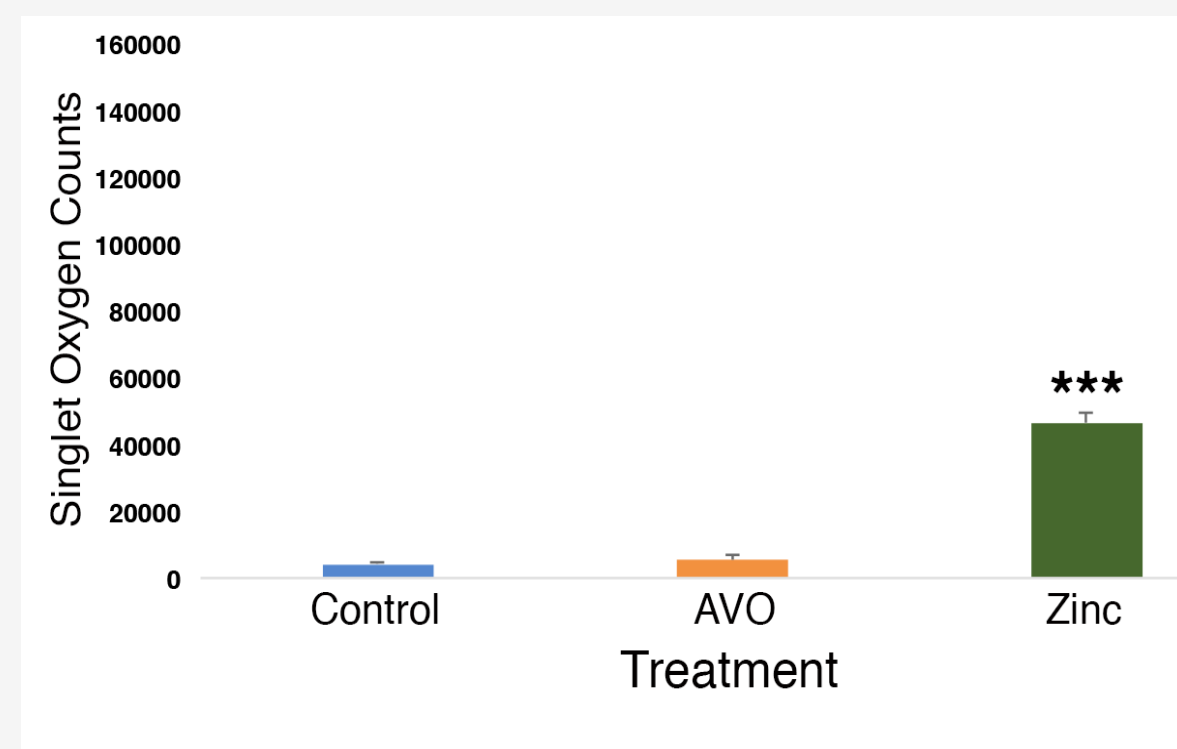


Figure 4. Singlet oxygen production after sunscreen application to volar forearm and exposure to UVA1 (753.7 mJ/cm²).

(n = 6, ***p < 0.001)

MATERIALS AND METHODS

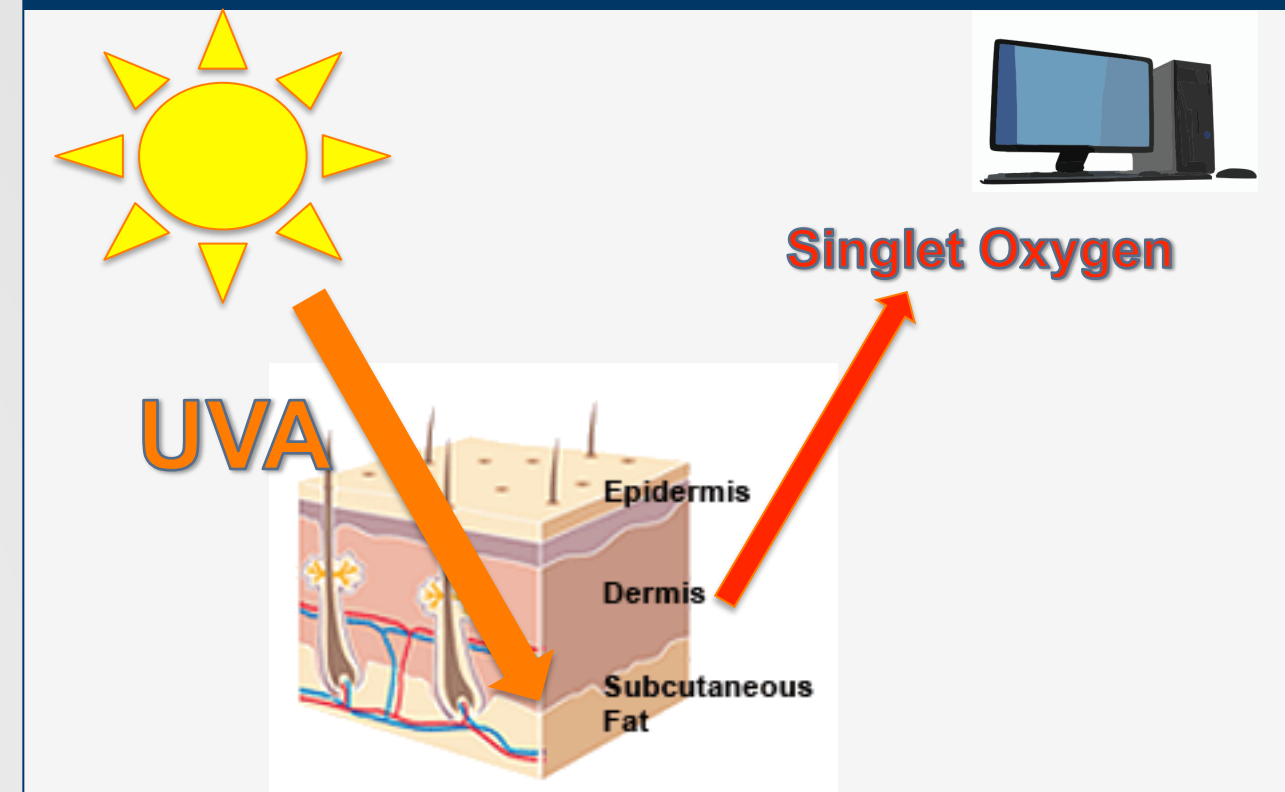
Ex-vivo human skin:

- 2cm² exposed to no UVA1 (control), 26.5mJ/cm², 171.2mJ/cm², 444.1mJ/cm² and 1091.2mJ/cm² UVA1 → singlet oxygen measured → samples stained for thymidine dimer.

In-vivo human skin:

- The UC Davis IRB approved the *in-vivo* skin study. Written informed consent was received from participants prior to inclusion in the study.
- 2cm² on volar forearms of healthy human subjects was measured and exposed to 20.1mJ/cm², 361.1mJ/cm² or 735.7mJ/cm² UVA1 → singlet oxygen production measured.

MATERIALS AND METHODS



CONCLUSIONS

- Exposure to UVA1 leads to singlet oxygen production and thymidine dimer formation.
- Application of zinc oxide containing sunscreen and subsequent exposure to UVA1 light leads to a significant increase in singlet oxygen production.
- Future directions: The role of antioxidants in protection from UVA1 induced skin damage should be investigated.

REFERENCES

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