



Fine Particulate Matter-Induced Oxidative Stress Mediated by UVA-Visible Light Leads to Keratinocyte Damage

Krystian Mokrzyński ^{1,†}, Olga Krzysztynska-Kuleta ^{1,†}, Marcin Zawrotniak ², Michał Sarna ¹ and Tadeusz Sarna ^{1,*}

¹ Department of Biophysics, Faculty of Biochemistry, Biophysics and Biotechnology, Jagiellonian University, 30-387 Cracow, Poland; mokrzynski.krystian@gmail.com (K.M.); olga.krzysztyńska@doctoral.uj.edu.pl (O.K.-K.); michal.sarna@uj.edu.pl (M.S.)

² Department of Comparative Biochemistry and Bioanalytics, Faculty of Biochemistry, Biophysics and Biotechnology, Jagiellonian University, 30-387 Cracow, Poland; marcin.zawrotniak@uj.edu.pl

* Correspondence: tadeusz.sarna@uj.edu.pl

† Contributed equally

Supplementary materials

Table S1. Identification of free radicals trapped using DMPO in 70%/30% DMSO/H₂O.

Season	Excitation Wave-length [nm]	A _N [mT]	A _{Hα} [mT]	A _{Hβ} [mT]	Radical	Reference	R ² of the Fit
Winter	365	1.332	1.062	0.133	Superoxide anion	[31–33]	0.96
		1.435	1.247	-	Nitrogen-centered radical		
		1.705	1.313	-	Unidentified 1		
	400	1.326	1.056	0.137	Superoxide anion		0.97
		1.426	1.256	-	Nitrogen-centered radical		
		1.716	1.295	-	Unidentified 1		
	440	1.341	1.070	0.133	Superoxide anion		0.92
		1.439	1.278	-	Nitrogen-centered radical		
		1.722	1.323	-	Unidentified 1		
	540	1.330	1.058	0.127	Superoxide anion		0.60
Spring	365	1.338	1.060	0.140	Superoxide anion	[31,32,34]	0.95
		1.514	1.699	-	Sulfur-centered radical		
		1.328	1.516	-	Unidentified 2		
	400	1.333	1.065	0.140	Superoxide anion		0.95
		1.509	1.703	-	Sulfur-centered radical		
		1.330	1.498	-	Unidentified 2		
	440	1.329	1.067	0.135	Superoxide anion		0.80
		1.516	1.700	-	Sulfur-centered radical		
		1.301	1.490	-	Unidentified 2		
	540	1.322	1.072	0.132	Superoxide anion		0.50
Summer	365	1.338	1.059	0.141	Superoxide anion	[31,32,34]	0.97
		1.508	1.701	-	Sulfur-centered radical		
		1.335	1.065	0.140	Superoxide anion		0.96
	400	1.516	1.707	-	Sulfur-centered radical		
		1.338	1.068	0.135	Superoxide anion		0.75
		1.517	1.694	-	Sulfur-centered radical		
	540	1.336	1.066	0.133	Superoxide anion		0.55
Autumn	365	1.326	1.060	0.128	Superoxide anion	[31–33]	0.96
		1.426	1.242	-	Nitrogen-centered radical		
		1.700	1.346	-	Unidentified 1		
	400	1.327	1.056	0.133	Superoxide anion		0.97
		1.421	1.248	-	Nitrogen-centered radical		
		1.699	1.341	-	Unidentified 1		
	440	1.323	1.052	0.132	Superoxide anion		0.95
		1.423	1.265	-	Nitrogen-centered radical		
		1.311	1.049	0.125	Superoxide anion		0.50

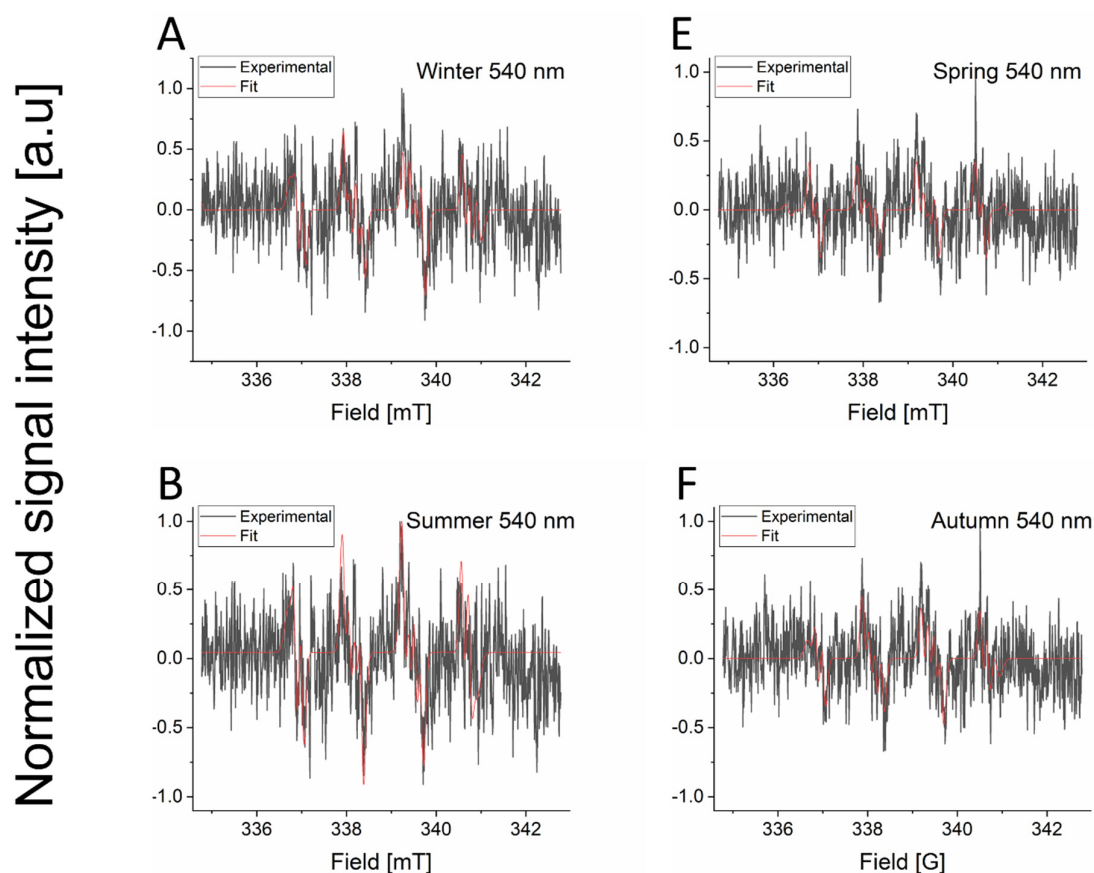


Figure S1. EPR spin-trapping of free radicals generated by PM_{2.5} samples from different seasons: Winter (**A**), Spring (**B**), Summer (**C**) and Autumn (**D**) during 540 nm irradiation. Black lines represent spectra of photogenerated free radicals trapped with DMPO, red lines represent the fit obtained for the corresponding spectra.

Table S2. Initial velocities [a.u./min] of photoproduction of free radicals adducts with DMPO spin trap.

Excitation Wavelength [nm]	Winter			Spring			Summer			Autumn		
	Superoxide anion	N-centered radical	Unidentified radical 1	Superoxide anion	N-centered radical	Unidentified radical 2	Superoxide anion	N-centered radical	Unidentified radical	Superoxide anion	N-centered radical	Unidentified radical 1
365	$9.07 \times 10^{-2} \pm 2.73 \times 10^{-2}$	$3.63 \times 10^{-2} \pm 2.73 \times 10^{-2}$	$5.00 \times 10^{-2} \pm 6.39 \times 10^{-3}$	$7.77 \times 10^{-2} \pm 4.39 \times 10^{-2}$	$4.67 \times 10^{-2} \pm 1.97 \times 10^{-2}$	$2.80 \times 10^{-3} \pm 6.35 \times 10^{-3}$	1.64×10^{-3}	2.54×10^{-3}	2.52×10^{-3}	4.50×10^{-3}	5.75×10^{-4}	7.42×10^{-3}
400	$3.03 \times 10^{-2} \pm 1.04 \times 10^{-2}$	$8.85 \times 10^{-3} \pm 2.36 \times 10^{-2}$	$3.14 \times 10^{-2} \pm 6.14 \times 10^{-4}$	$2.64 \times 10^{-2} \pm 1.58 \times 10^{-2}$	$1.91 \times 10^{-2} \pm 1.12 \times 10^{-2}$	$5.43 \times 10^{-3} \pm 1.21 \times 10^{-3}$	8.28×10^{-4}	4.42×10^{-4}	4.71×10^{-4}	6.28×10^{-4}	3.07×10^{-5}	5.28×10^{-4}
440	$1.09 \times 10^{-2} \pm 3.86 \times 10^{-3}$	$1.01 \times 10^{-3} \pm 1.88 \times 10^{-3}$	$3.32 \times 10^{-4} \pm 7.60 \times 10^{-4}$	$4.96 \times 10^{-3} \pm 2.62 \times 10^{-4}$	$7.85 \times 10^{-3} \pm 3.29 \times 10^{-3}$	9.77×10^{-4}	1.16×10^{-4}	7.06×10^{-5}	1.50×10^{-4}	1.99×10^{-5}	4.54×10^{-5}	2.97×10^{-4}

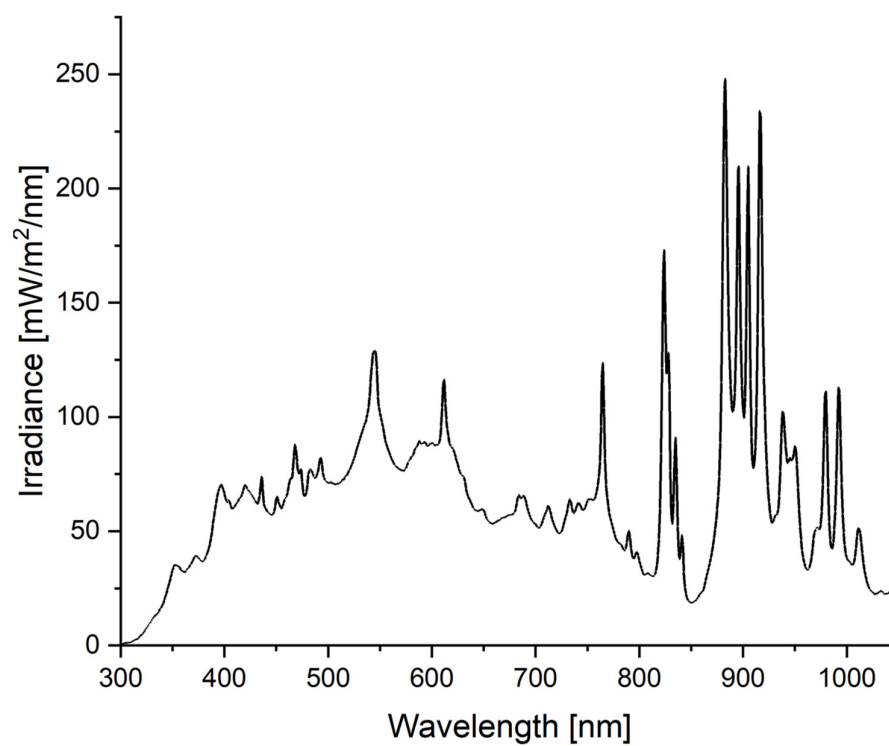


Figure S2. Irradiance of solar simulator ScienceTech SS1.6 kW equipped with AirMass 0 filter and 330 nm cut-off filter.