Supplementary Materials

Harnessing Light Wavelengths to Enrich Health-Promoting Molecules in Tomato Fruits

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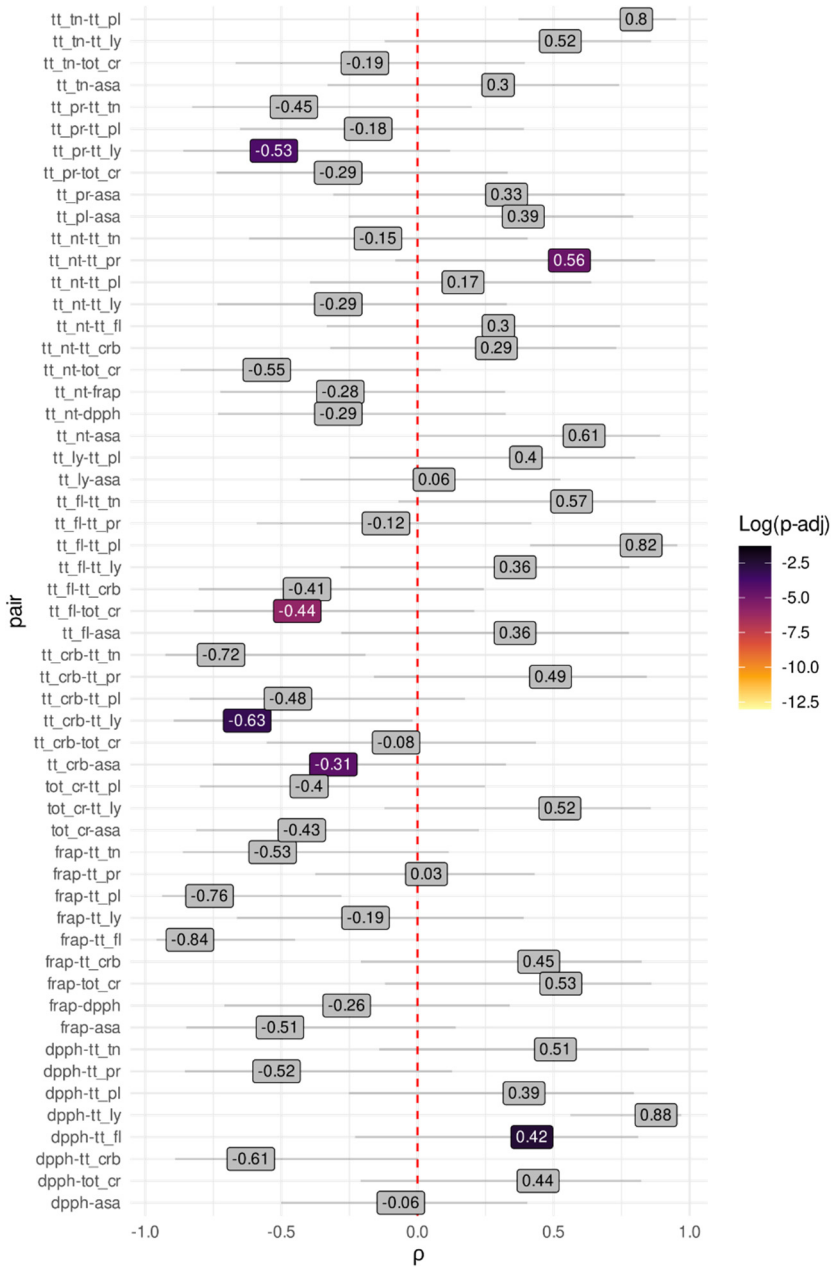
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frap-dpph
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dpph-tt_pr
dpph-tt_pl
dpph-tt_ly
dpph-tt_fl
dpph-tt_crb
dpph-tot_cr
dpph-asa
0.8
0.52
-0.19
0.3
-0.45
-0.18
-0.53
-0.29
0.33
0.39
-0.15
0.56
0.17
-0.29
0.3
0.29
-0.55
-0.28
-0.29
0.61
0.4
0.06
0.57
-0.12
0.82
0.36
-0.41
-0.44
0.36
-0.72
0.49
-0.48
-0.63
-0.08
-0.31
-0.4
0.52
-0.43
-0.53
0.03
-0.76
-0.19
-0.84
0.45
0.53
-0.26
-0.51
0.51
-0.52
0.39
0.88
0.42
-0.61
0.44
-0.06
pair
-1.0
-0.5
0.0
0.5
1.0
ρ
Log(p-adj)
-2.5
-5.0
-7.5
-10.0
-12.5

Figure S1. Correlation analysis for all pairwise comparisons among dose levels and response markers. Spearman rank correlations (psych::corr.test) with bias-corrected 95 % CIs and Holm-adjusted p-values were calculated for all variable pairs and plotted as point-ranges colored by the log10-transformed adjusted p-value. tot_cr: Total carotenoids; tt_ly: Total lycopene; tt_nt: Total anthocyanins; tt_pl: Total polyphenols; tt_fl: Total flavonoids; tt_tn: Total condensed tannins; asa: Total Ascorbic acid; frap: Total antioxidant capacity; dpph: DPPH radical scavenging activity; tt_pr: Total soluble proteins; tt_crb: Total carbohydrates.

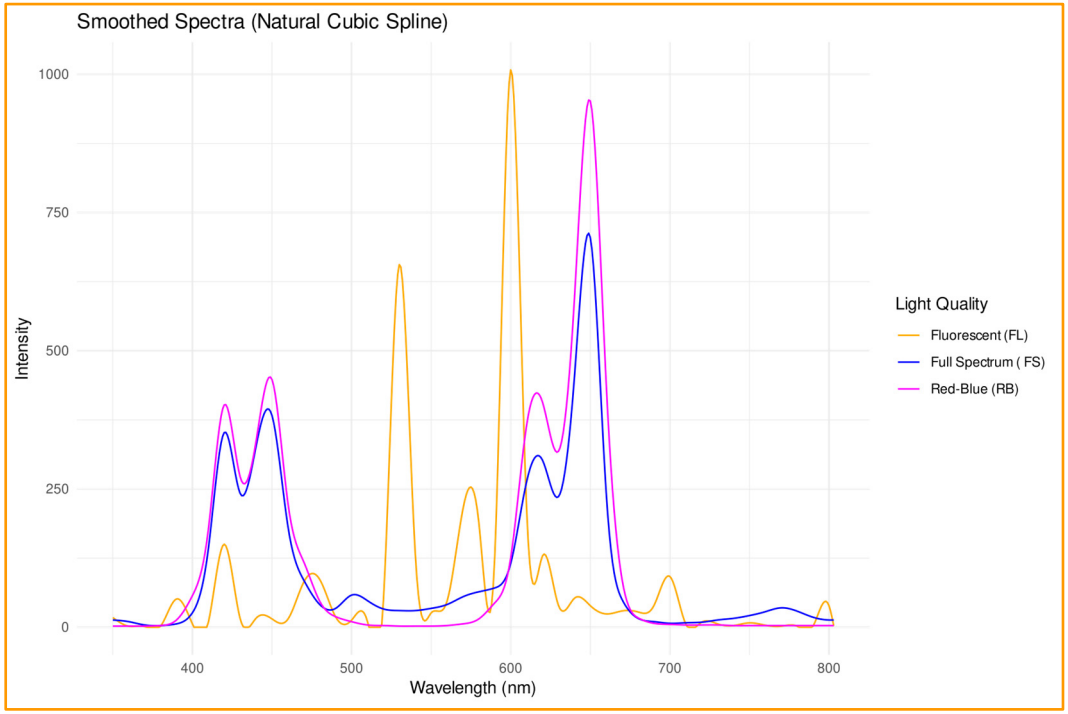

Figure S2. Smoothed spectra of three light qualities (Fluorescent, Full Spectrum, and Red-Blue) using natural cubic spline interpolation. Irradiance Range: 350–800 nm. UV, ultra-violet (350–390 nm); B, Blue (390–500 nm); G, Green (500–560 nm); Y, Yellow (560–600 nm); R, Red (600–700 nm); IR, Far-Red (700–800 nm).

Table S1. Classes of polyphenol compounds as associated to human health benefits

Class	Compound(s)	Health Associations	References
Antioxidant & Anti-inflammatory Effects	3-p-Coumaroylquinic Acid	Potential anti-inflammatory activity via Akt and EGFR inhibition	39220934
	Apigenin	Antioxidant, anti-inflammatory properties.	PMC6472148
Neuroprotective & Cognitive Health	Apigenin	Antioxidant, anti-inflammatory, neuroprotective, cognition-enhancing; potential in Alzheimer's disease treatment/prevention.	PMC6472148
Anti-cancer Properties	Apigenin-8-C-Glucoside	Anti-cancer effects.	27693342
	Apigenin-8-C-Glucoside	Antioxidant, anti-inflammatory effects.	27693342
	Apigenin-8-C-Glucoside	Antioxidant, anti-cancer, anti-inflammatory, neuroprotective effects.	27693342
	Astragalin	Antidiabetic properties; beneficial in diabetes management.	PMC5954929
	Astragalin	Anticancer properties.	PMC5954929
	Astragalin	Antioxidant, anti-inflammatory properties.	PMC5954929
	Astragalin	Neuroprotective, anti-inflammatory, antioxidant properties.	PMC5954929
	Caffeoylquinic Acid Derivative	Antioxidant properties; beneficial effects on human health	28911486
	Catechin	Potential in cancer prevention.	PMC7084675
	Catechin	Antioxidant; modulates gut microbiota and reduces harmful bacteria.	34206736
Cardiovascular Health	Catechin	Antioxidant; supports cardiovascular health by reducing oxidative stress.	34206736
	Chlorogenic Acid	Regulates glucose metabolism; improves insulin resistance; reduces risk of type 2 diabetes.	36576278
	Chlorogenic Acid	Antioxidant, anti-inflammatory activities.	36576278
	Chlorogenic Acid	Regulates glucose and lipid metabolism; reduces risk of type 2 diabetes and cardiovascular diseases.	36576278
	Cis-Resveratrol-3-O-Glucoside	Protective against ethanol-induced brain injury via inhibition of oxidative stress	29708326
	Coumaric Acid	Chemopreventive effects against colon cancer.	PMC6720745
	Coumaric Acid	Antioxidant, anti-inflammatory effects.	16449979
	EC-3-O-Gallate	Inhibits HGF/Met signaling in breast cancer cells	
	EGC Gallate Glucoside	Promotes hair growth and dermal papilla cell proliferation	17092697

	Epiafzelechin Gallate	Antioxidant; potential in cancer prevention	PMC6247744
	Epicatechin	Enhances oxidative stress status and reduces inflammation in metabolic syndrome	37732427
	Eriodictyol	Antitumor activity.	PMC7752289
	Eriodictyol	Antioxidant, anti-inflammatory properties.	PMC7752289
	Eriodictyol	Neuroprotective, antioxidant, anti-inflammatory effects.	PMC7752289
	Ferulic Acid	Antioxidant; protects against oxidative stress.	34206736
	Ferulic Acid	Antioxidant; mitigates oxidative stress, lowers blood pressure, and supports heart health.	23188120
	Genistin	Decreases risk of osteoporosis and post-menopausal symptoms; anti-cancer, antioxidant, cardioprotective, neuroprotective, hepatoprotective, and antimicrobial activities	32253713
	Hesperetin	Antioxidant; supports heart health by strengthening blood vessels and reducing inflammation.	34206736
Liver Health	Hyperoside	Hepatoprotective; mitigates liver injury and inflammation.	PMC9331122
	Isorhamnetin	Anticancer effects via cell cycle arrest and apoptosis induction	38861855
	Isorhamnetin-3-O-Neohesperidoside	Promotes osteoclast activity; potential role in bone resorption.	PMC7083939
	Isorhoifolin	Antioxidant; anti-inflammatory; potential in neuroprotection	PMC5465813
	Kaempferol	Antioxidant and anti-inflammatory properties; potential in managing various diseases	38731498
	Kaempferol-3-O-Rutinoside	Reduces body temperature by accelerating elimination of IL-6 and TNF-α in fever model	38611918
	Luteolin	Anti-inflammatory and neuroprotective effects	26361743
	Luteolin-6-C-Glucoside (Isoorientin)	Induces apoptosis and decreases invasiveness in pancreatic cancer cells	28003763
	Luteolin-7-O-Glucoside	Inhibits STAT3 pathway; antiproliferative and antioxidant properties	33525692
	Matairesinol	Anti-inflammatory and antioxidant effects; ameliorates sepsis-mediated brain injury	34705665
	Myricetin	Antioxidant, anticancer, neuroprotective, and cardioprotective effects	34646551
	Myricetin-3-O-Glucoside	Promotes osteogenic differentiation; potential in osteoporosis treatment	34646551
	Naringenin	Antioxidant, anti-inflammatory, anticancer, and cardioprotective properties	30634637
	Naringenin-7-O-Glucoside	Antidiabetic effects; improves insulin resistance and lowers blood glucose levels	30462381

	Naringenin-7-O-Neohesperidoside	Antioxidant; anti-inflammatory; potential in cardiovascular protection	PMC4085189
	Naringin	Hypolipidemic effects; regulates lipid metabolism	35189328
	Nicotiflorin	Anti-inflammatory, antioxidant, neuroprotective, and hepatoprotective effects	35379162
	Orientin	Antioxidant, anti-inflammatory, vasodilatory, and cardioprotective properties	27298620
	Quercetin	Antioxidant, anti-inflammatory, anticancer, and cardioprotective effects	37513932
	Quercetin Acetylhexoside	Antioxidant; anti-inflammatory; potential in neuroprotection	PMC5465813
	Quercetin-3-O-Galactoside	Anti-melanogenesis activity; potential in skin pigmentation disorders	36834475
	Resveratrol	Potential in preventing bowel cancer; protective against type 2 diabetes and aging	29708326
	Tetramethylpyrazine	Neuroprotective; improves cognitive function; reduces inflammation and oxidative stress	PMC8005584
	Theaflavin Digallate	Anti-inflammatory; protects cartilage; potential in osteoarthritis therapy	PMC9286955
	Theaflavin Gallate	Antioxidant; reduces cholesterol absorption; potential in cardiovascular health	PMC8601833
	Theobromine	Neuroprotective; improves cognitive performance; potential in Alzheimer's disease prevention	PMC4335269