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Supplementary material

Appendix 1.

Table A1. Relationships between multiple eggshell coloration metrics and biliverdin concentration within that same eggshell. SE: standard error, d.f.: degrees of freedom, BGC: blue-green chroma. See below and (Montgomerie 2008) for calculations used to generate color metrics. Some metrics were not normally distributed (i.e., $P < 0.05$).

Metric	Parameter	SE	R^2	F	d.f.	*P*	Normality *P*
Hue (photo)	0.0056	0.00076557	0.476	53.48	1,59	<0.0001	0.038
Saturation (photo)	0.03514	0.00751	0.271	21.92	1,59	<0.0001	0.032
Brightness (photo)	-0.00631	0.00384	0.044	2.69	1,59	0.1062	0.18
B1	-0.00202	0.00044566	0.246	20.57	1,63	<0.0001	0.98
B2	-0.80842	0.17826	0.246	20.57	1,63	<0.0001	0.98
B3	-0.41144	0.20236	0.062	4.13	1,63	0.0463	0.30
S1R	-6.40491	1.12881	0.338	32.19	1,63	<0.0001	0.0002
S1G	4.49384	0.71733	0.384	39.25	1,63	<0.0001	0.45
S1B	5.35164	0.73854	0.455	52.51	1,63	<0.0001	0.096
S1U	-2.94172	0.50976	0.346	33.3	1,63	<0.0001	0.59
S1Y	6.63471	2.04428	0.143	10.53	1,63	0.0019	0.027
S1V	-2.755	0.46863	0.354	34.56	1,63	<0.0001	0.73
S2	0.05541	0.01486	0.181	13.91	1,63	0.0004	<0.0001
S3	3.2625	0.44231	0.463	54.41	1,63	<0.0001	0.12
S5a	0.02412	0.00362	0.414	44.43	1,63	<0.0001	0.14
S5b	0.01342	0.00264	0.291	25.87	1,63	<0.0001	0.33
S5c	0.01197	0.00265	0.245	20.38	1,63	<0.0001	0.24
S6	0.53085	0.31153	0.044	2.9	1,63	0.0933	0.050
S7	0.11024	0.01565	0.441	49.64	1,63	<0.0001	<0.0001
S8	0.31082	0.06302	0.279	24.33	1,63	<0.0001	0.012
S9	0.57941	0.09516	0.371	37.07	1,63	<0.0001	0.0014
H1	0.00172	0.00124	0.030	1.94	1,63	0.1687	<0.0001
H3	0.00062927	0.00008701	0.454	52.3	1,63	<0.0001	<0.0001
H4a	0.09972	0.07509	0.027	1.76	1,63	0.1890	<0.0001
H4b	0.25568	0.086	0.123	8.84	1,63	0.0042	<0.0001
H4c	0.01747	0.028	0.006	0.39	1,63	0.5349	<0.0001
BGC	2.75955	0.38099	0.454	52.46	1,63	<0.0001	0.13
Red Chroma	-11.53451	2.48277	0.255	21.58	1,63	<0.0001	<0.0001

Functions to calculate color metrics shown above, adapted from Montgomerie 2008.

$$B_1 = \sum_{\lambda min}^{\lambda max} R_i$$

Where: $R_{\lambda i}$ = Proportional reflectance at the *i*th wavelength

$$B_2 = B_1 / n_w$$

Where: n_w = number of wavelength intervals used to calculate B_1

$$B_3 = R_{max}$$

Where R_{max} and R_{min} = Maximum and minimum proportional reflectances, respectively

$$S_1 = \sum_{\lambda a}^{\lambda b} R_1 / B_1$$

Where: S1 is calculated for different intervals (a-b) of interest in the numerator, as follows: S1R, λ605-λmax; S1G, λ510-605; S1B, 400-510; S1U, λmin-λ400; S1v, λmin-λ415; S1Y, λ550-λ625. All of these are a bit arbitrary, and S1U is the only one in common use.

$$S_2 = R_{max} / R_{min}$$

$$S_3 = \sum_{\lambda Rmax-50}^{\lambda Rmax+50} R_i \Big/ B_1$$

$$S_5 = \sqrt{\left(B_r - B_g\right)^2 + \left(B_y - B_b\right)^2}$$

Where: Subscripts refer to the red (r), yellow (y), green (g), and blue (b) segments of the spectrum. Three different values are calculated for S5, as follows: S5a with r = 625–700, y = 550–625, g = 475–550, and b = 400–475; S5b with r = 605– 700, y = 510–605, g = 415–510, and b = 320–415; and S5c with r = 600– 700, y = 500–600, g = 400–500, and b = 300–400.

$$S_6 = R_{max} - R_{min}$$

$$S_7 = \left(\sum_{\lambda Rmin}^{\lambda Rmid} R_i - \sum_{\lambda Rmid}^{\lambda Rmax} R_i \right) \Big/ B_1$$

Where: λ_{Rmax}, λ_{Rmin} = wavelength at maximum and minimum reflectance, respectively and λ_{Rmid} = wavelength at the reflectance midpoint between R_{max} and R_{min}.

$$S_8 = (R_{max} - R_{min})/B_2$$

$$S_9 = (R_{\lambda 450} - R_{\lambda 700})/R_{\lambda 700}$$

$$BGC = \sum_{400}^{575} R_1 \Big/ B_1$$

$$Red\ Chroma = \sum_{595}^{655} R_1 \Big/ B_1$$

$$H_1 = \lambda_{Rmax}$$

$$H_3 = \lambda_{Rmid}$$

$$H_4 = arctan\{[(B_y - B_b)/B_1]/[(B_r - B_g)/B_1]\}$$

Where: Subscripts refer to the red (r), yellow (y), green (g), and blue (b) segments of the spectrum. Three different values are calculated for H4, as follows: H4a with r = 625–700, y = 550–625, g = 475–550, and b = 400–475; H4b with r = 605– 700, y = 510–605, g = 415–510, and b = 320–415; and H4c with r = 600– 700, y = 500–600, g = 400–500, and b = 300–400.

Reference:

Montgomerie R (2008) CLR, version 1.05. Queen's University, Kingston, Canada. URL

http://post.queensu.ca/~mont/color/analyze.html [accessed 18 September 2009].