Table S1. Effect of melanin molecular vibration on pigmentation phenotype. The results of four PLSR models for feather color intensity (brightness) are shown. Vibrational characteristics refer to the spectral position (X), intensity (Y), width at half maximum (W) and area (A) of diagnostic Raman bands 1, 2 and 3 for pheomelanin and eumelanin. Predictors whose regression coefficients are significant are marked in bold (*: $P < 0.05$, **: $P < 0.01$). Different PLSR models are made for feathers used to analyse DHR fluorescence and for feathers used to analyse Mitosox fluorescence, as well as considering the light brown color patch of feathers belonging to the Red Villafranquina breed (VF) and considering the black color patch of the same feathers.

Predictor	DHR feather brightness (brown VF)		Mitosox feather brightness (brown VF)		DHR feather brightness (black VF)		Mitosox feather brightness (black VF)	
	Predictor weight	Regression coefficient	Predictor weight	Regression coefficient	Predictor weight	Regression coefficient	Predictor weight	Regression coefficient
Pheo X1	**-0.18 ****	**-5.80 x 10^{-5}**	**-0.17 ****	**-7.70 x 10^{-5}**	**-0.20 ****	**-8.70 x 10^{-5}**	**-0.20 ****	**-1.12 x 10^{-4}**
Pheo Y1	**-0.24 ****	**-6.42 x 10^{-4}**	**-0.17 ***	**-6.95 x 10^{-4}**	**-0.24 ****	**-8.80 x 10^{-4}**	**-0.19 ****	**-1.01 x 10^{-3}**
Pheo W1	**-0.12 ****	**-9.13 x 10^{-4}**	-0.09	-1.02 x 10^{-3}	**-0.17 ****	**-1.74 x 10^{-3}**	**-0.09 ***	**-1.40 x 10^{-3}**
Pheo A1	**-0.15 ****	**-5.00 x 10^{-6}**	-0.07	-3.00 x 10^{-6}	**-0.15 ****	**-7.00 x 10^{-6}**	-0.06	-4.00 x 10^{-6}
Pheo X2	**-0.17 ****	**-2.10 x 10^{-5}**	**-0.17 ****	**-2.80 x 10^{-5}**	**-0.20 ****	**-3.20 x 10^{-5}**	**-0.20 ****	**-4.10 x 10^{-5}**
Pheo Y2	**-0.27 ****	**-2.56 x 10^{-4}**	**-0.20 ****	**-2.72 x 10^{-4}**	**-0.28 ****	**-3.57 x 10^{-4}**	**-0.24 ****	**-3.93 x 10^{-4}**
Pheo W2	**-0.14 ****	**-4.07 x 10^{-4}**	**-0.12 ***	**-4.89 x 10^{-4}**	**-0.16 ****	**-6.25 x 10^{-4}**	**-0.17 ***	**-8.48 x 10^{-4}**
Pheo A2	**-0.27 ****	**-2.00 x 10^{-6}**	**-0.21 ****	**-2.00 x 10^{-6}**	**-0.28 ****	**-2.00 x 10^{-6}**	**-0.24 ****	**-3.00 x 10^{-6}**
Pheo X3	**-0.18 ****	**-1.60 x 10^{-5}**	**-0.17 ****	**-2.10 x 10^{-5}**	**-0.21 ****	**-2.40 x 10^{-5}**	**-0.20 ****	**-3.10 x 10^{-5}**
Pheo Y3	**-0.24 ****	**-1.32 x 10^{-3}**	**-0.14 ***	**-1.06 x 10^{-3}**	**-0.24 ****	**-1.74 x 10^{-3}**	**-0.16 ****	**-1.45 x 10^{-3}**
Pheo W3	**-0.11 ****	**-1.15 x 10^{-3}**	-0.07	-1.22 x 10^{-3}	**-0.18 ***	**-2.35 x 10^{-3}**	-0.09	-1.78 x 10^{-3}
Pheo A3	**-0.18 ****	**-2.10 x 10^{-5}**	-0.03	-5.00 x 10^{-6}	**-0.18 ****	**-2.80 x 10^{-5}**	-0.03	-6.00 x 10^{-6}
Eu X1	0.00	2.00 x 10^{-6}	-0.03	-2.00 x 10^{-5}	-0.03	-1.60 x 10^{-5}	-0.07	-5.40 x 10^{-5}
Eu Y1	-0.11	-1.16 x 10^{-3}	**-0.15 ****	**-2.10 x 10^{-3}**	**-0.11 ****	**-1.52 x 10^{-3}**	**-0.15 ****	**-2.60 x 10^{-3}**
Eu W1	0.05	3.58 x 10^{-4}	-0.05	-4.78 x 10^{-4}	0.02	1.69 x 10^{-4}	-0.08	-8.33 x 10^{-4}
Eu A1	-0.10	-1.90 x 10^{-5}	**-0.15 ****	**-3.30 x 10^{-5}**	**-0.10 ****	**-2.50 x 10^{-5}**	**-0.16 ****	**-4.30 x 10^{-5}**
Eu X2	0.00	0.00	-0.03	-7.00 x 10^{-6}	-0.03	-6.00 x 10^{-6}	-0.07	-1.80 x 10^{-5}
Eu Y2	-0.12	-4.18 x 10^{-4}	**-0.15 ****	**-7.33 x 10^{-4}**	**-0.11 ****	**-5.03 x 10^{-4}**	**-0.16 ****	**-9.28 x 10^{-4}**
Eu W2	-0.03	-8.80 x 10^{-5}	-0.04	-1.81 x 10^{-4}	-0.06	-2.50 x 10^{-4}	-0.08	-4.42 x 10^{-4}
Eu A2	**-0.12 ***	**-3.00 x 10^{-6}**	**-0.15 ****	**-5.00 x 10^{-6}**	**-0.12 ****	**-4.00 x 10^{-6}**	**-0.16 ****	**-6.00 x 10^{-6}**
Eu X3	0.00	0.00	-0.03	-6.00 x 10^{-6}	-0.03	-5.00 x 10^{-6}	-0.07	-1.60 x 10^{-5}
Eu Y3	-0.10	-3.09 x 10^{-4}	**-0.14 ****	**-5.48 x 10^{-4}**	**-0.10 ****	**-3.98 x 10^{-4}**	**-0.15 ****	**-7.21 x 10^{-4}**
Eu W3	-0.01	-3.70 x 10^{-5}	0.00	9.00 x 10^{-6}	-0.05	-1.85 x 10^{-4}	-0.05	-2.64 x 10^{-4}
Eu A3	-0.10	-2.00 x 10^{-6}	-0.13	-3.00 x 10^{-6}	**-0.10 ***	**-2.00 x 10^{-6}**	**-0.14 ****	**-4.00 x 10^{-6}**
Slope	**0.25 ****	**2.11**	**0.30 ****	**3.36**	**0.21 ****	**2.33**	**0.25 ****	**3.44**
Breed	**- ****	**-3.19 x 10^{-3}**	**- ****	**-4.38 x 10^{-2}**	**- ****	**-4.02 x 10^{-2}**	**-**	**-5.70 x 10^{-2}**
Sex	**- ****	**3.57 x 10^{-2}**	-	3.89 x 10^{-2}	**- ****	**4.91 x 10^{-2}**	**-**	**5.57 x 10^{-2}**