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Plant Pigments Lab Report

I. PURPOSE/OBJECTIVE:

The color of briefly cooked vegetables in neutral, basic, and acidic aqueous environments was determined using Munsel's book of colors and Hunts. Using a spectrophotometer the absorbency of food dyes was measured at different wavelengths.

II. DATA

Table 1: Munsell and LAB readings from the four vegetable each cooked at three pH conditions

Group	Vegetables	Munsell Values			LAB		
		Acid	Neutral	Base	Acid	Neutral	Base
A	Carrots	2.5YR 6/16	2.5YR 5/14	2.5YR 6/16	57.74, 14.48, 13.53	71.42, 3.81, 3.95	60.92, 3.87, 12.07
	Broccoli	7.5Y 3/6	5GY 3/6	5GY 10/5	55.21,-0.31, 4.26	62.58,-3.32, 4.97	73.85, -1.55, 2.31
B	Carrots	2.5YR 6/16	2.5YR 5/14	2.5YR 6/16	58.11, 22.71, 18.51	53.27, 14.31, 15.25	58.19, 21.03,16.47
	Broccoli	7.5Y 3/6	5GY 3/6	7.5GY 4/8	57.16, -2.78, 12.63	55.59, -6.50, 7.91	49.40, -9.62,10.72
C	Carrots	2.5YR 6/16	2.5YR 6/12	2.5YR 5/14	58.11, 22.71, 18.51	53.27, 14.31, 15.25	58.19, 21.03, 16.47
	Broccoli	7.5 6/8	5GY 4/8	7.5GY 4/8	57.10, -2.70, 18.51	55.59, -6.50, 67.91	49.40, -9.62, 10.17
D	Red Cabbage	5RP 4/12	2.5P 4/10	2.5G 3/8	65.05, 4.74, -0.73	63.59, 1.52, -1.82	45.26, 0.11, -0.73
	Cauliflower	5Y 9/2	7.5Y 8.5/4	5Y 9/6	10.36, -0.11, 2.05	67.19, -0.26, 2.39	69.69, -0.25, 1.81
E	Red Cabbage	5RP 5/12	7.5P 4/8	10G 2/6	49.80, 13.68, -1.36	56.08, 5.92, -7.32	47.05, -0.44, 1.16
	Cauliflower	5Y 9/2	5Y 9/2	5Y 7/12	72.72, -1.21, 8.57	73.63, -1.00, 6.83	66.73, -2.30,10.01
F	Red Cabbage	2.5RP 4/12	10P 4/12	5RP 2/8	46.16, 19.53, -2.84	45.85, 11.60, -5.39	44.93, 8.40, -4.43
	Cauliflower	5Y 8.5/2	10Y 9/12	5Y 8/4	76.23, -1.24, 12.27	71.36, -2.39, 9.34	73.22, -3.11,17.65

Table 2 pH class data

	pH before cooking	pH after cooking

AM Station	Vegetables	Acid	Neutral	Base	Acid	Neutral	Base
A	Carrots	3.20	7.45	8.02	3.52	5.88	9.23
	Broccoli	2.82	7.77	8.03	4.27	6.17	9.04
B	Carrots	2.84	6.98	8.04	5.36	6.59	9.20
	Broccoli	2.85	7.02	8.07	3.57	6.61	8.52
C	Carrots	3.08	6.62	8.52	3.34	5.93	9.30
	Broccoli	2.93	6.89	8.12	4.32	6.12	8.72
D	Red Cabbage	3.04	9.04	9.11	3.27	5.95	9.55
	Cauliflower	3.94	8.00	9.11	3.54	6.76	9.18
E	Red Cabbage	2.87	6.00	8.13	3.22	6.21	9.63
	Cauliflower	3.04	6.50	8.24	6.82	3.34	9.34
F	Red Cabbage	2.95	6.52	8.09	1.70	4.45	8.25
	Cauliflower	3.10	7.00	6.24	1.52	4.50	7.34

Table 3: Munsell Values for Food Dyes

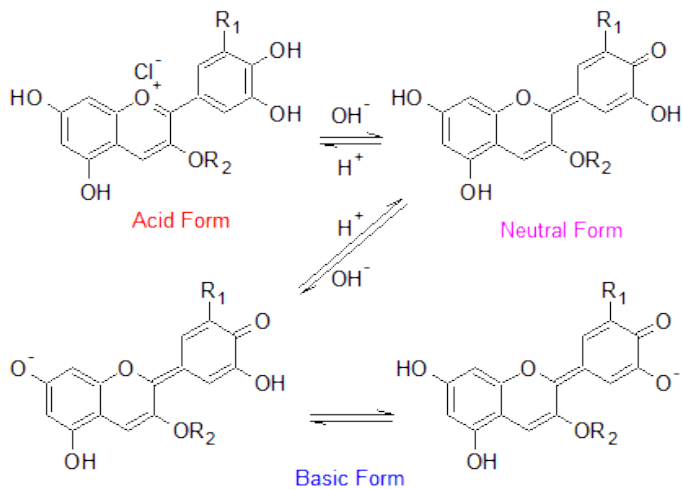|	Yellow #5	Blue #1	Red #40	Green
Munsell Value	5Y 6/12	25B 7/8	10RP 7/8	75G 6/10

2) Graph: Spectra of the four food dyes

Food Dye Wavelength vs. Absorbance
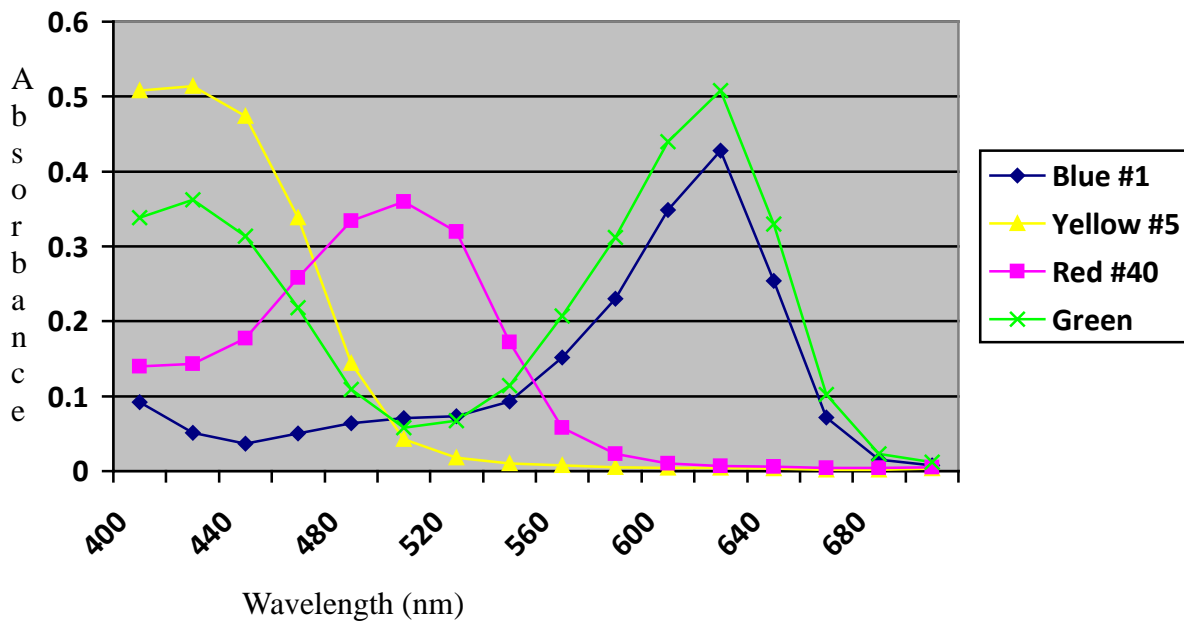
III. Questions:

1. For the anthocyannis and chlorophylls draw a chemical structure for each that relate to different colors shown after cooking at the different pH's.

2. What are the pigments in carrots and cauliflower? How were they affected by pH during cooking?

Cauliflower contains flavonoids and carrots contain beta carotene. Beta carotene is relatively heat stable in the conditions used in lab. Being in the matrix of the carrot with sugars and proteins protected the molecule from too much oxidation. However, pure beta carotene would be much more susceptible to oxidation. In the acidic and basic environments the colors appeared to be brighter. The color of the cauliflower was also not drastically affected by the acid or base environment.

3. Suggest chemical explanations for the observed changes in pigments for the pH conditions.

Beta carotene is a stable molecule and doesn't not have potential to loose or gain H+ or OH- groups. Chlorophyll has carbonyl groups which can accept hydrogen's. The magnesium at the center can also be destabilized. The anthocyanins are very indicative of surrounding pH. Many OH groups can potentially be deprotonated leading to a change in the color.

4. For the food dye spectra, discuss the relationship between the spectra and the Munsell values of the dyes. Can you infer anything about the Munsell value from its visible spectrum?

Yes the first part of the Munsell value indicates the color. R is red. Y is yellow. B is blue. Intermediate colors are indicated by YR or any other combination of the colors.