

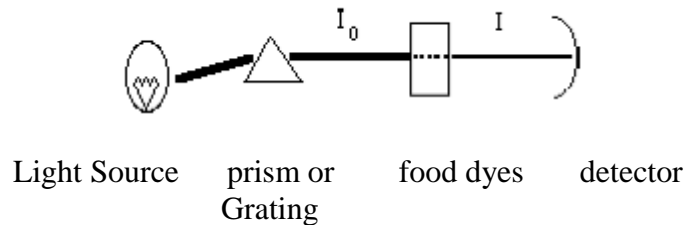
#7 Visible Spectrum of Food Colors

Purpose:

Compare the visible spectra of different brands of food dyes.

Introduction:

A spectrum is a recording of the wavelengths absorbed by a sample. Colored compounds, such as the food colors used in this experiment absorb in the visible.



The transmittance, %T, is the ratio of the intensity of the incident light (I_0) and the intensity of the emerging light (I), or $\%T = I / I_0$

Absorbance, A , is the logarithm of 100 divided by %T:

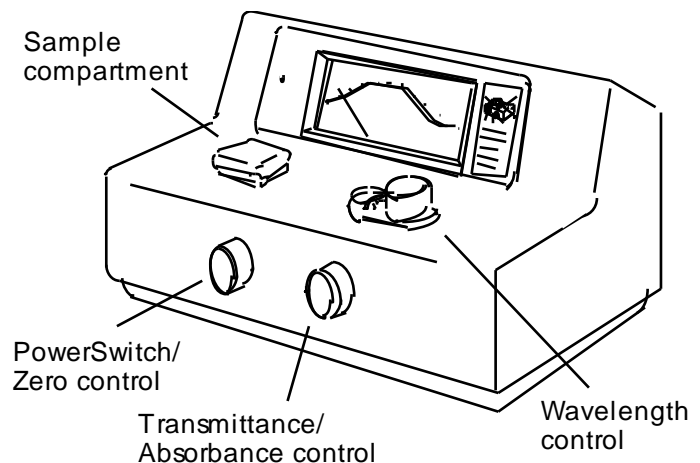
$$A = \log (100 / \%T)$$

If $\%T = 50$, then $A = \log 100/50 = \log 2 = 0.30$

Find 50% T on the meter scale and notice that it corresponds to 0.30 on the Absorbance scale. The % transmittance scale is linear and increases from left to right. The Absorbance scale is Logarithmic and increases from right to left. It is more accurate to read % transmittance rather than absorbance, so record the %T values and convert them to A .

Apparatus

You will be taking a spectrum of food dyes using a Spectronic-20. To use this instrument refer to the operating instructions attached.



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Procedure

Choose one color and take samples of different brands for that color.

Taking the Spectrum of Food Dye

1. The samples you are provided have been prepared by adding one drop of food coloring to a volumetric flask then diluting with water to 100 mL. Pour each of the samples into its own cuvette to a level of approximately 2 cm. Be careful to identify which brand is which and record the brand names in the data table. Also, prepare a blank cuvette using distilled water. (The blank is used to adjust for a full scale indication at each wavelength.) Find the %T measurement at 400 nm for each sample.

2. Measure the % transmittance every 10 nm between 400 nm and 700 nm (remembering to adjust the transmittance control for a full scale indication using a blank at each new wavelength). Record %T.

Note: At 600 nm the filter selection lever must be switched.

After determining the approximate wavelengths of the maximum absorbance (minimum transmittance) of the solution you may want to “redo” the region around the peak wavelengths proceeding with smaller steps in order to make the peak wavelength determinations more accurate. Some dyes, such as green, have more than one peak. When you are through taking the spectrum, keep the solutions. When you find a difference among spectra of different brands, you can also try to see the difference by eye.

3. Convert % transmittance to absorbance. Make a plot of absorbance vs. wavelength for each of the solutions, by drawing a smooth line through the points. This is the visible spectrum of the stock solutions of food dye.

4. Record the wavelength(s) at which the maximum absorbance is observed and the peak height(s). Include the major peaks. Compare for each brand. The larger the peak height the greater the concentration. Estimate the concentrations of different brands of the same color.

Note: The drops are similar in size. One drop of McCormick’s weighs about 3 g and 1 drop of a generic brand (such as Tone’s) weighs closer to 4 g.

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Data and Results (Spectra of Food Colors)

Name(s) _____

Color _____

Brand: McCormick's			Brand:		
λ nm	%T	A	λ nm	%T	A
400			400		
410			410		
420			420		
430			430		
440			440		
450			450		
460			460		
470			470		
480			480		
490			490		
500			500		
510			510		
520			520		
530			530		
540			540		
550			550		
560			560		
570			570		
580			580		
590			590		

switch filter

600			600		
610			610		
620			620		
630			630		
640			640		
650			650		
660			660		
670			670		
680			680		
690			690		
700			700		

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Data and Results 2 (Spectra of Food Colors)

Brand	Maximum Wavelength(s)	A (or A's) at Maximum
McCormick's		

Question

1. Compare concentrations of the two brands of the same color. (See Step 4 in the Procedure).
 2. Attach the spectra. Try to put both brands on the same graph. Comment on any differences. (Some colors may show almost no difference.)
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Instructor's Guide
 (#7 Spectra of Food Colors)

Color *green*

Brand: McCormick's			Brand: Tone's		
λ nm	%T	A	λ nm	%T	A
400	42.5	0.37	400	40	0.40
410	40.5	0.39	410	37	0.43
420	41	0.39	420	38	0.42
430	42	0.38	430	41.5	0.38
440	45	0.35	440	45	0.35
450	48	0.32	450	48	0.32
460	54	0.27	460	55	0.26
470	63	0.20	470	63	0.20
480	72.5	0.14	480	72.5	0.14
490	83	0.08	490	84.5	0.07
500	91	0.04	500	89	0.05
510	95	0.02	510	90.5	0.04
520	93	0.03	520	90.5	0.04
530	92	0.04	530	88	0.06
540	89	0.05	540	82.5	0.08
550	85	0.07	550	76.5	0.12
560	79	0.10	560	68.5	0.16
570	72	0.14	570	61	0.21
580	65	0.19	580	51.5	0.29
590	58	0.24	590	42	0.38

switch filter

600	49.5	0.31	600	33.5	0.47
610	37	0.43	610	23	0.64
620	29	0.54	620	16	0.80
630	25	0.60	630	13.5	0.87
640	31	0.51	640	18	0.74
650	48	0.32	650	34	0.47
660	67	0.17	660	54	0.27
670			670		
680			680		
690			690		
700			700		

*Instructor's Guide
(Spectra of Food Color, cont'd)*

Color green

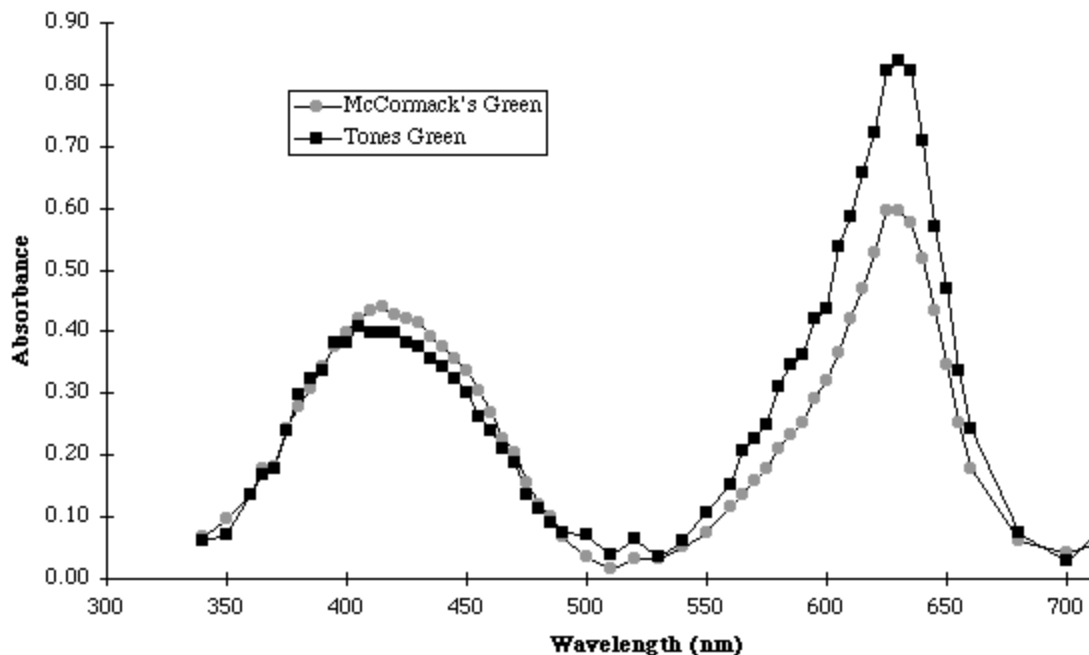
Brand	Maximum Wavelength(s)	A (or A's) at Maximum
McCormick's	630, 410	0.60, 0.39
Tone's	630, 410	0.87, 0.43

Question

1. Compare concentrations of the two brands of the same color. (See Step 4 in the Procedure).
2. Attach the spectra. Try to put both brands on the same graph. Comment on any differences. (Some colors may show almost no difference.)

1. *Green: Absorbance at 630 and 410 for Tone's is greater. Since the Tone's drop was a little larger, the concentrations are about the same. However, Tone's is cheaper.*

2. *The 630 peak for Tone's is larger and the 410 peak is a little smaller.*



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Instructor's Guide
(Spectra of Food Color, cont'd)

Time: 1 1/2

Equipment and Materials: Per group:

Items	Number	Comment
Cuvette stand	1	
Wash bottles	1	distilled water
Spectronic-20	1	
Food dye samples	2	McCormick's and Tone
Kim wipes	1	
Cuvettes	3	
Funnel	1	

Ideas/ Information

1. Different brands are very similar in concentration and color as can be seen from their spectra. However, the generic brands are cheaper.