The Absorption of Light by Chlorophyll
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Introduction

Chlorophyll is the major photon absorbing pigment in terrestrial plants. The complex structure of the chlorophyll molecule allows for the absorption of photons, generating an electric current. Even though chlorophyll can absorb a wide range of photons, each wavelength is absorbed with a different efficiency. In this lab the efficiency of absorption for a range of visible light wavelengths was tested relative to a baseline value. Given that terrestrial plants are green it is hypothesized that the lowest efficiency of absorption will be in those wavelengths that represent green light and the highest wavelength will be in those wavelengths that represent blue light.

Procedure

Spinach leaves were ground in a mortar and pestle with a small quantity of acetone (less than 5 ml) to produce a slurry containing chlorophyll. The slurry was filtered through a 0.2 micrometer syringe filter and diluted 1:10 with ethanol. The prepared filtrate was analyzed at the prescribed wavelengths (see Trial 1 of Table I) by spectrophotometer, after the machine had been zeroed with an ethanol control. The absorption of the sample at each wavelength was recorded and a percent difference from the control wavelength in the infrared spectrum (720 nm). The experiment was repeated with fresh slurry and the new results were recorded under Trial 2 of Table I.

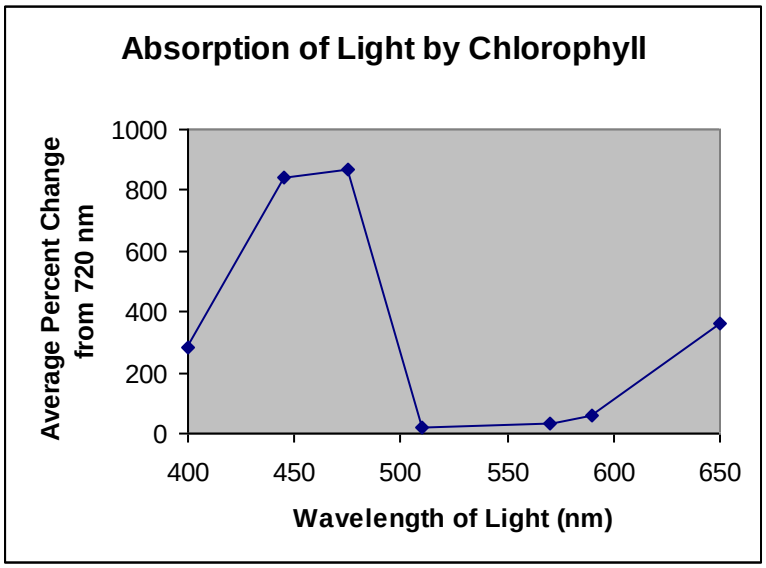
Results

TABLE I

Wavelength (nm)	Color	Absorption		Percent Change		Average % Change
		Trial 1	Trial 2	Trial 1	Trial 2	
720	Infrared	0.015	0.110	NA	NA	NA
650	Red	0.057	0.600	280	445	360
590	Orange	0.020	0.210	33	90	62
570	Yellow	0.024	0.112	60	2	31
510	Green	0.021	0.109	40	-1	18
475	Blue	0.156	0.995	940	805	870
445	Indigo	0.148	0.986	886	796	840
400	Violet	0.052	0.450	247	310	280

Consecutive data sets were collected and analyzed for the percent difference in absorption between the prescribed wavelength and a control infrared wavelength (720 nm). To compensate for differences in chlorophyll concentrations an average between two runs was calculated. The data shows noticeable peaks in absorption around 475 nm (blue light) and a second peak at 720 nm (red light).

Graph



Discussion

The original hypothesis was supported in that the lowest change in absorbance was noted in the green spectrum and the highest level of absorbance was noted in the blue spectrum. Of note, there was an additional peak of absorbance in the red spectrum, and significant absorbance in the indigo and violet spectrum. The hypothesis should be adjusted to account for the lack of absorbance in the yellow and orange spectrum, even though the plants are neither yellow nor orange. This problem could be explained by secondary color pigments in the leaf that can not be visualized in the background of the chlorophyll, though further testing would be needed to confirm this.

Numerous errors could have affected our results. First, we used two separate slurries to determine absorbance, meaning that we could have had varying amounts of chlorophyll present in each sample. Second, the amount of extraction could have varied between samples, affecting the properties of the dissolved standards. Finally, the two samples were run on separate machines to save time, meaning that the calibration between machines could have introduced an error.

Reference

Darwin, E. (2003). *Chlorophyll: How I learned to love the color green*. Liverpool: Scopes Publishing.