Development of a Chlorophyll sensor

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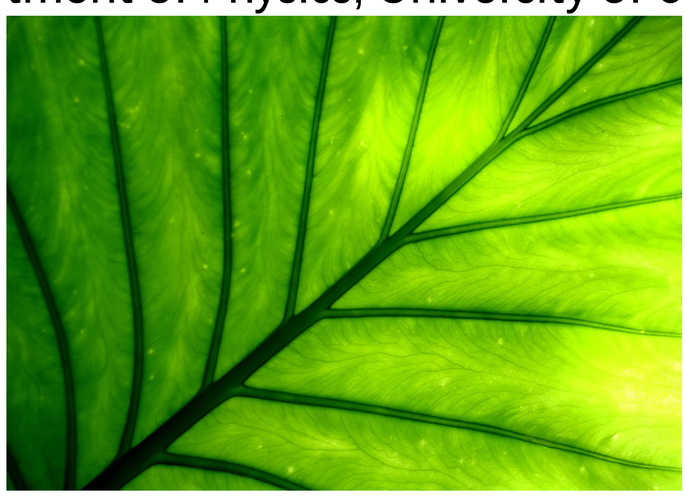
1. Introduction

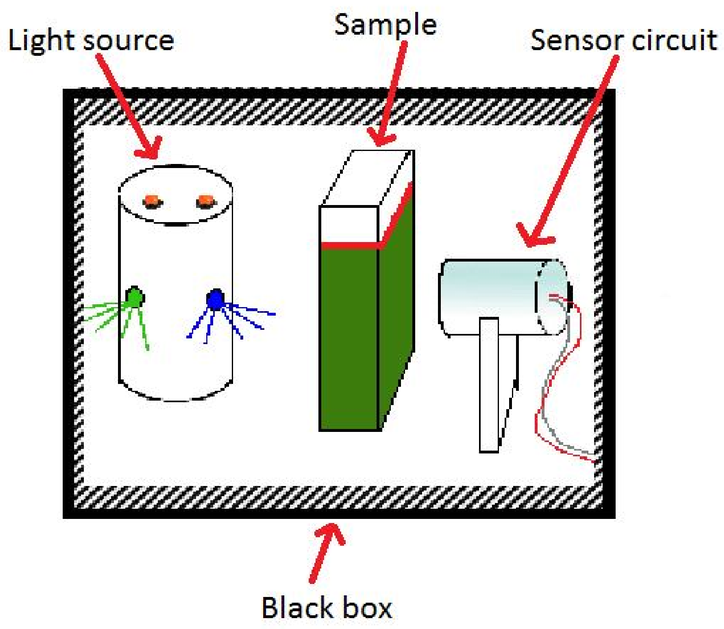


Since water is the basis of life, water pollution has become one of the major global crisis in today's world. Higher level of nutrients is one of the indicators, that claims a water sample is polluted. The population of phytoplankton (a green color algae), is higher in such water samples. Chlorophyll is universally used as an indicator of phytoplankton biomass. Therefore by measuring the level of chlorophyll, it is possible to make conclusions about the level of pollution in a water sample .

2. Objective

Measure the chlorophyll level in a water sample (without mixing the sample in acetone) using an optical method (by measuring absorbance).

3. Methodology



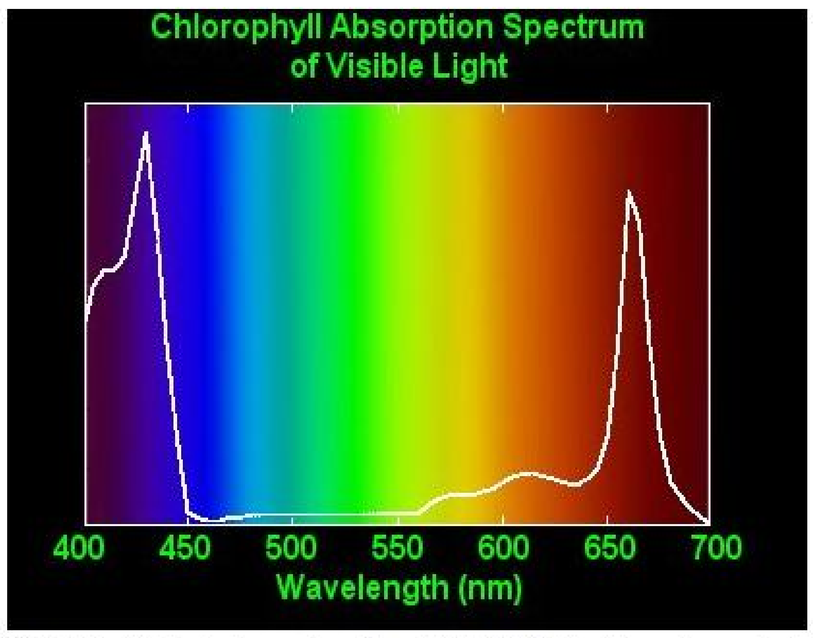
•A UV LED and a green LED were used as the light source

•Hamamatsu S5971 Si photodiode was used as the detector

• 10 different chlorophyll samples (obtained from leaves) with different concentrations, were used to take measurements

•Measurements were taken for both UV and green LEDs

•Data were analyzed and fit to a linear model



Source : http://studentweb.usq.edu.au/home/U1013108/biotutor/absorptionspectra.html

4. Modeling

From Beer-Lambert law $\mathrm{I}_{\mathrm{Blue}} = \mathrm{I}'_{\mathrm{Blue}} \times e^{-\alpha_B C_B L_B}$

and $\mathrm{I}_{\mathrm{Green}} = \mathrm{I}'_{\mathrm{Green}} \times e^{-\alpha_G C_G L_G}$

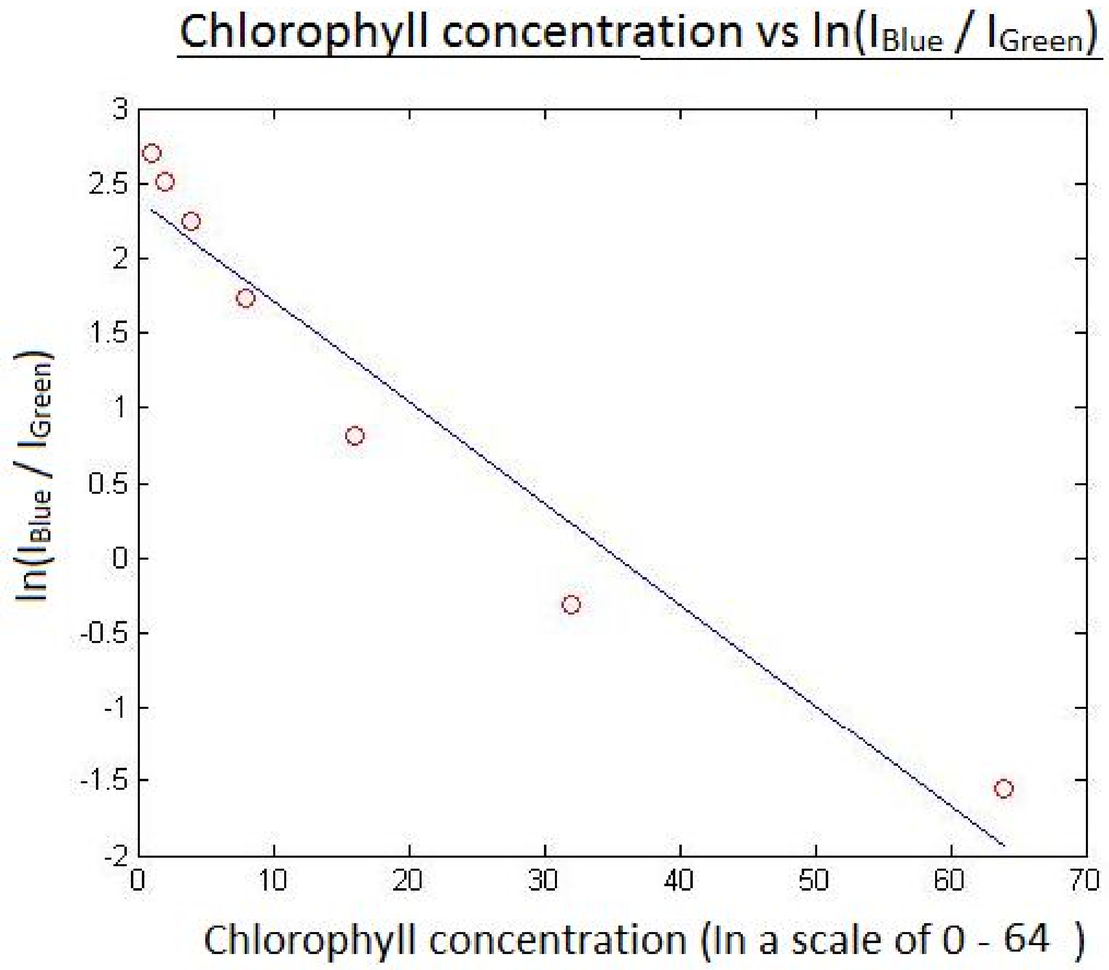
Using the above two equations data were fit to the following linear model

$$\ln\left(\frac{\mathrm{I}_{\mathrm{Blue}}}{\mathrm{I}_{\mathrm{Green}}}\right) = -\alpha_B L C_B + \alpha_G C_G L + \ln\left(\frac{I'_{Blue}}{I'_{Green}}\right)$$

$$y = -\,m\,x + c$$

Where $L_B = L_G = L$ for Mie Scattering

5. Results



6. Conclusions

•Chlorophyll level in a water sample can be measured using LEDs by measuring absorbance

•However since only the blue side of absorbance was measured, it was assumed that the samples contain only chlorophyll .

•A more improved version can be modeled to measure the chlorophyll level, using more sensitive detectors and more power full light sources (laser) by measuring fluorescence