UV-Vis Characterization of Aromatic Content in Bio-oil

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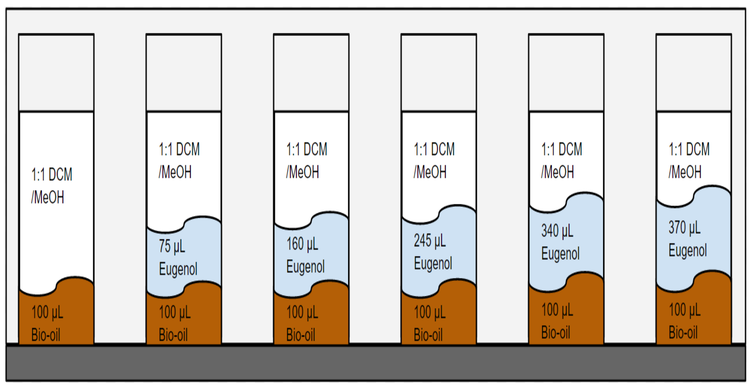
Background:

- Bio-oil is an alternative source currently being studied for its use as an alternative and renewable transportation fuel.
- Lignin present in the biomass feedstock is converted to aromatics during the oil production.
- Absorbance of these functionalities can be used to quantify the aromatic content in bio-oils.
- UV-Vis is an inexpensive method by which specific target compounds can be quantified within a mixture.
- Beer-Lambert law can be used to quantify the amount of specific molecules within a sample based on absorption.
- The relationship between concentration of bio-oil mixture and the absorption of UV light is shown in Figure 1.
  - Linear response indicates that the unknown will obey the Beer-Lambert law.
  - Different oil types have different slops.



Sample Preparation:

- Unknown oils were prepared using fast pyrolysis (A), catalytic fast pyrolysis (B and C). For the samples B and C were prepared using different catalysts.
- Solutions were created by using a fixed amount of bio-oil and an increasing amount of Eugenol Standard. All samples were prepared by weight.

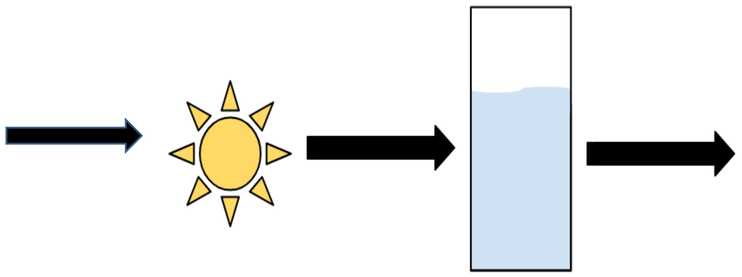
Results and Future Work:

- The calculated amount of aromatic groups in each bio-oil sample is summarized in the Table.
- It is possible with this method to quantify certain compounds within bio-oil by using the Beer-Lambert law.
- Further testing and repeated trials with each type of bio-oil is of importance for verifying the reproducibility of these results.
- As this method was tested with one standard, testing different compounds would be of interest. Bio-oil contains a vast number of compounds hence creating a need for development of a method to streamline the sample preparation and data collection.

- This plot illustrates why we can use colorimetric techniques to analyze bio-oil.
- We used the Standard Addition method for the analyses, which adds a known amount of a standard to a unknown mixture. The mixture contains the standard, so when plotted, the amount of target compound within the sample can be extrapolated.

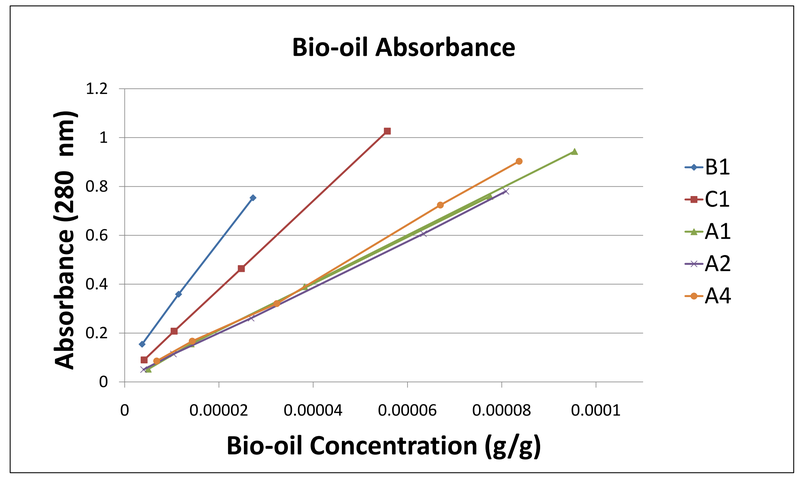
A=εbc

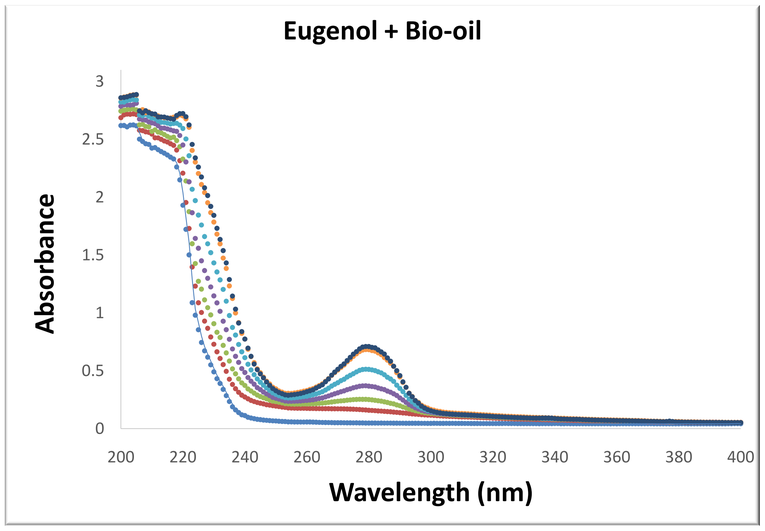
A= Absorption
ε= Molar Absorbtivity
b= Path Length (cm)
c= Concentration (mol/L)



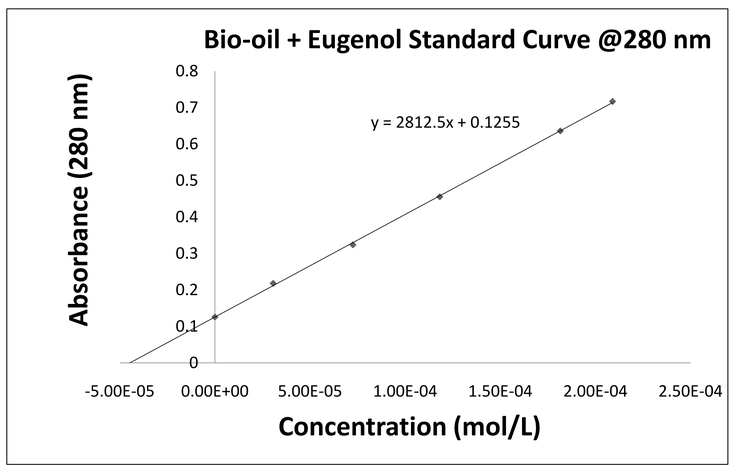
Colorimetric Analysis:

Each sample was run on a SpectraMax M5 UV-Vis by Molecular Designs. Absorbance spectra were collected between 200-400 nm.





Sample ID	Aromatic content (Eugenol (mol/L)
A1	4.32×10^{-5}
A2	4.49×10^{-5}
A3	3.93×10^{-5}
A4	4.46×10^{-5}
B1	1.17×10^{-4}
C1	6.99×10^{-5}



Data Analysis:

- Data was plotted as Absorbance vs. Concentration of Eugenol. The trend line was extrapolated to the x axis in order to calculate concentration of the standard in the bio-oil.
- The aromatic content is reported as moles/L of Eugenol.

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