Turbidity, Tea, And UV-VIS

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ABSTRACT

This report focuses on how turbidity affects the UV-VIS measurements of tea and how to correct for the turbidity and obtain valid color readings from the UV-VIS alone. A method is proposed to obtain turbidity corrected color and Hue measurements of tea and coffee products. Cornstarch is used to introduce cloud into a tea sample to validate the method.

INTRODUCTION

Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally individually invisible to the naked eye. When measuring absorbance in a UV-VIS spectrometer, the suspended particles block the photons and appear as absorbance. Any color measurement of tea must take turbidity into account. One way to do this is to centrifuge or filter the same and then measure the color. Another is to provide a turbidity correction factor to the UV-VIS absorbances. This report uses the second method.

MATERIALS AND METHODS

The absorbance spectra measured from 400 to 800nm using a ThermoElectron Genesys 6 UV-VIS Spectrophotometer (Minneapolis, MN) and individual absorbances at 460, 560, 510, 610, and 750 were determined. Various samples of cornstarch and tea concentrate were analyzed.

RESULTS AND DISCUSSION

In general, suspended particles block light and have an almost flat spectra as they block photons equally at all wavelengths. Figure 1 shows the spectra of 0.1% cornstarch, tea concentrate at ~0.7°B, and tea concentrate with 0.1% cornstarch.

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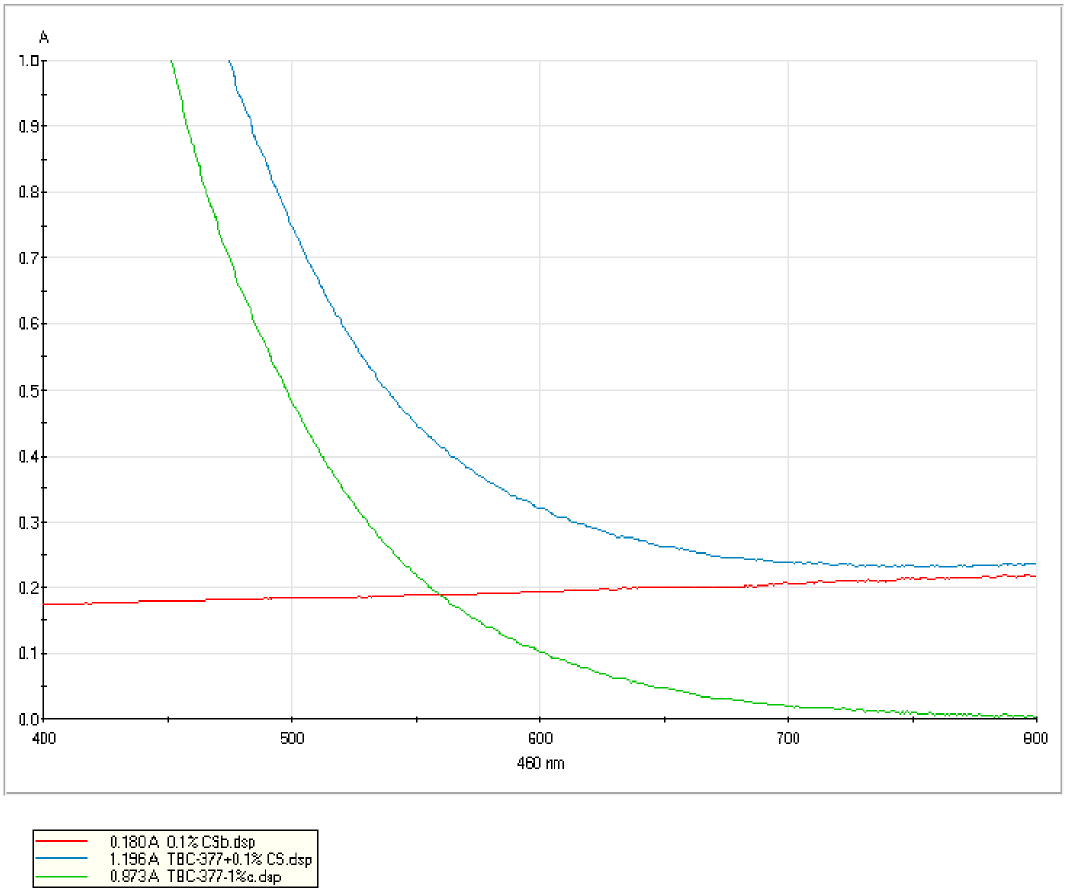

While there is a slight upward trend in absorbance with increasing wavelength, the amount is relatively small. If it is assumed to be unchanging, then by simply choosing a reference wavelength where tea does not absorb significantly and the turbid particles block the light, then a simple correction factor can be implemented. As can be seen, the tea concentrate with cornstarch is almost an exact addition of the individual spectra. Furthermore, it can be observed that the spectra for tea decreases dramatically at the higher wavelengths. Therefore, it is proposed that the absorbance at 750nm be used as a reference absorbance for future measurements in order to correct for turbidity. Additionally, it is further proposed that the corrected absorbance at 560nm be used as the color intensity and correct Hue be used for the redness level. Hue is

$$Hue = 10 * \log\left(\frac{A_{510} - A_{750}}{A_{610} - A_{750}}\right)$$

Where A_x is the absorbance at wavelength x nm.

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If we apply this method to a model solution we see

Sample	A560	A510	A610	A750	Hue
CS	0.189	0.184	0.195	0.213	-0.25
Tea concentrate + CS	0.414	0.670	0.305	0.235	3.42
Tea concentrate	0.187	0.413	0.087	0.01	6.76
Corr. Tea concentrate + CS	0.179	0.435	0.070	0	7.93

Table 1 is the absorbances of 0.1% cornstarch, ~0.7°B tea concentrate + 0.1% CS, ~0.7°B tea concentrate, and corrected ~0.7°B tea concentrate + 0.1% CS. If one compares the tea concentrate by itself to the tea concentrate with cornstarch, using normal absorbances for color and hue would result in vastly different results (e.g A560 of 0.414 vs 0.187, Hue of 3.42 vs 6.76). However, if the corrected absorbances are used, one can see that the color is similar (0.179 vs 0.187) and the hue is gone from a 3.34 difference to a 1.17 difference.

Clearly using the correction factor of 750nm is a vast improvement over non-corrected absorption data.

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