Affect Of Turbidity On Color Measurements

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Kevin L. Goodner, Ph.D.

ABSTRACT

One of the problems measuring tea color is the interference of turbidity on absorbance readings. In order to try and determine the best method for measuring color, corn starch was used to add turbidity to solutions to observe the affect on color. As expected with increasing turbidity, larger absorbances are seen. Centrifuging the sample and analyzing the supernatant solved the problem, but could be problematic if the solid is colored as well as a turbidity inducing agent.

INTRODUCTION

Two key quality factors in tea are color and clarity. The measurement of these characteristics in an objective way is a priority for Sensus. A study was conducted to determine the affect of turbidity on color measurements along with a methodology to eliminate the interference. A collection of samples were analyzed at varying levels of turbidity and conditions.

MATERIALS AND METHODS

Solutions were made with 0.00%, 0.01%, 0.10%, and 1.00% corn starch in water and with 0.3°B TBC-377 solution. The tea/corn starch samples were divided into two groups, control and centrifuged at 3.7k rpm for 3 min.
The absorbances of these solutions were measured from 400 to 800nm using a ThermoElectron Genesys 6 UV-VIS Spectrophotometer (Minneapolis, MN) and individual absorbances at 460, 560, 510, and 610 were determined.
Hue was calculated as 10 x log (A510/A610)
Turbidity of samples was measured using a Hach 2100P Turbidimeter (Lovland, CO) and reported in NTU (Nephelometric Turbidity Units).

RESULTS AND DISCUSSION

Figure 1 is a photo of water with varying levels of corn starch in order to vary the turbidity level. The turbidity goes from clear to extremely cloudy. The addition of tea base concentrate adds color which can be seen in Figure 2. The bottom row shows how turbidity will affect appearance of a finished product. The top row is the supernatant from the samples after centrifugation. The picture isn't perfectly clear, but the back row appearances were almost identical.
Table 1 is a collection of the data for the turbidity and spectral absorbances of the various solutions. It is clear that turbidity has a large affect on absorbance, which would affect a color

2991 Hamilton-Mason Rd
Hamilton, OH 45011
Tel: 513-892-7100
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reading if using absorbance only. For example, the absorbance at 560nm goes from 0.048 to 1.354 as the corn starch concentration in plan water increases from 0.01% to 1.00%. The same trend is seen when tea is added to the water, the absorbance goes from 0.063 to 1.712 as the corn starch concentration increases from 0.00% to 1.00%. However, if the supernatant after centrifugation is used, the absorbances for the various corn starch levels are 0.065, 0.075, 0.063, and 0.066 which are all similar to the 0.063 absorbance observed in the un-centrifuged, 0.00% corn starch sample. Similar results are observed for the other wavelengths measured, along with the hue. This gives an indication that measuring color is best performed with samples after they have been centrifuged.
And important note is that corn starch is white and doesn't add any color itself. This might not be the case for suspended solids in tea samples. This point needs to be further investigated.

Figure 1. Corn starch in water. From left: 0.00%, 0.01%, 0.10%, 1.00%

Figure 2. Corn in 0.3°B tea concentrate. From left: : 0.00%, 0.01%, 0.10%, 1.00%. Back row centrifuged at 3.7k rpm for 3min, supernatant.

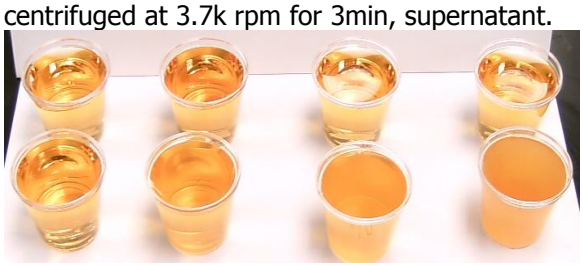

Table 1. Samples analyzed and their absorbances and turbidity.

				Absorbance				
Corn Starch %	Tea (°Brix)	Centrifuged	Turbidity	460	560	510	610	Hue
0	0	No	0.36	0	0	0	0	------
0.01	0	No	49.5	0.46	0.048	0.047	0.05	-0.27
0.1	0	No	353	0.161	0.171	0.166	0.178	-0.30
1	0	No	Error	1.305	1.354	1.327	1.384	-0.18
0	0.03	No	0.42	0.321	0.063	0.146	0.029	7.02
0.01	0.03	No	32	0.39	0.092	0.186	0.054	5.37
0.1	0.03	No	248	0.41	0.207	0.283	0.18	1.97
1	0.03	No	Error	1.948	1.712	1.78	1.698	0.20
0	0.03	Yes	0.46	0.324	0.065	0.148	0.031	6.79
0.01	0.03	Yes	0.43	0.378	0.075	0.173	0.036	6.82
0.1	0.03	Yes	0.48	0.319	0.063	0.145	0.03	6.84
1	0.03	Yes	1.00	0.329	0.066	0.151	0.032	6.74

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