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Application News

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Spectrophotometric Analysis

Color Measurement of Solutions with the UV-1900 Spectrophotometer: Differentiating the Colors of Japanese White Dashi Soup Bases

Food comes in a variety of colors. The color of food is one of the important elements in its taste and presentation.

Although there is a sensory aspect to color, it can be expressed objectively as numerical values by measuring its transmission spectrum with an ultraviolet-visible spectrophotometer and calculating the color values. This makes it possible to compare colors between samples.

In this study we measured various kinds of white dashi soup bases (Japanese white soy sauce-based soup stock) from different manufacturers and determined their color values, as described below.

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Measurement of the Visible Spectrum of Japanese White Dashi Soup Bases

We prepared six kinds of Japanese white dashi soup bases from different manufacturers. Fig. 1 distinguishes them with the notation A through E. In the photograph it can be seen that C and E are dark brown compared to the other samples.

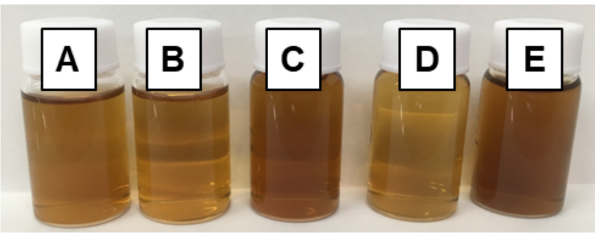

Fig. 1 Appearance of the Samples for Measurement

Each sample was measured using a quartz cell with an optical path length of 10 mm under the conditions in Table 1 (the equipment used was the UV-1900 shown in Fig. 2). The results of transmittance measurement of each sample are shown in Fig. 3. With all the samples, it can be seen that the transmittance decreases as the wavelength becomes shorter. In addition, differences in transmittance were observed among the samples. The relatively dark-colored C and E were found to have a low transmittance compared to the other samples.

Fig. 2 Appearance of the UV-1900

Table 1 Measurement Conditions

Instrument used	: UV-1900
Measuring wavelength range	: 380 to 780 nm
Scan speed	: High speed
Sampling interval	: 1.0 nm
Light source switching wavelength	: 323 nm

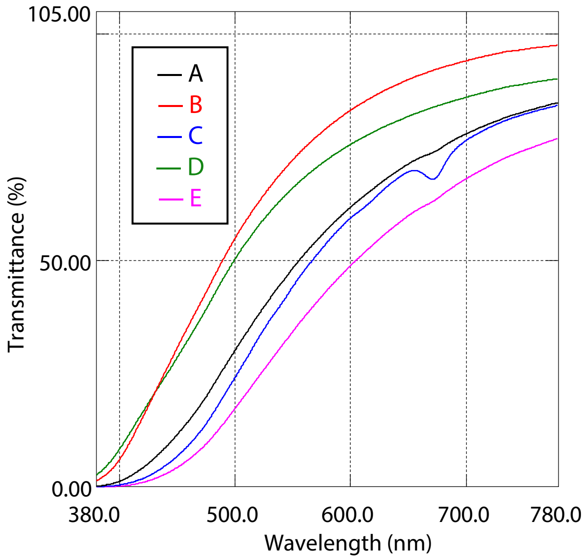

Fig. 3 Transmission Spectrum of Japanese White Dashi Soup Bases
Black: A, Red: B, Blue: C, Green: D, Pink: E

Color Measurement of Japanese White Dashi Soup Bases

For the measurement results in Fig. 3, color values in the L*a*b* colorimetric system were calculated using the optional LabSolutions™ UV-Vis color measurement software. The results are shown in Table 2. D65 lighting and a two-degree field of view were used for the calculation.

Fig. 4 shows a chart that plots the values in Table 2 on an L*a*b* chromaticity diagram, and Fig. 5 shows an enlarged view of the a*b* graph on the right side of Fig. 4. The L* graph on the left side of Fig. 4 shows that the higher the value, the brighter the color. From Table 2 and Fig. 4, it is apparent that, relatively speaking, B shows the highest value and C and E show relatively low values in the L* graph, and this result matches the visual results well.

In addition, the a*b* graph on the right side of Fig. 4 shows the chromaticity that indicates the hue and saturation. a*b* shows the directions for each color. Specifically, the right side of the figure shows the red system, the left the green system, the top the yellow system, and the bottom the blue system. It can be seen from Fig. 4 that all the samples are in the yellow system. In addition, Fig. 5 shows that the yellow is stronger in C and E than in the other samples.

Table 2 L*a*b* Values for Japanese White Dashi Soup Bases from Different Manufacturers

Sample Name	L*	a*	b*
A	75.7	4.3	53.6
B	88.0	−0.9	40.7
C	72.9	6.6	62.6
D	84.9	−0.9	38.4
E	66.2	9.8	62.6

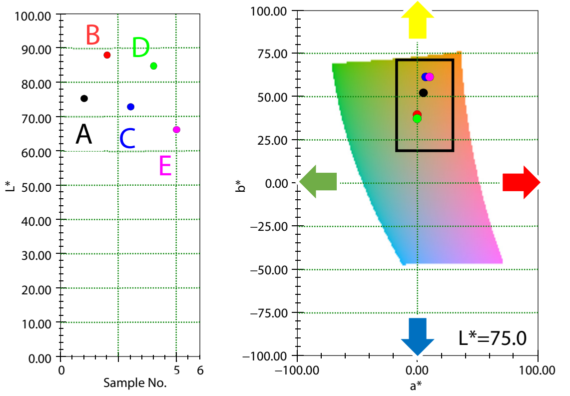

Fig. 4 L*a*b* Chromaticity Diagram for Japanese White Dashi Soup Bases from Different Manufacturers

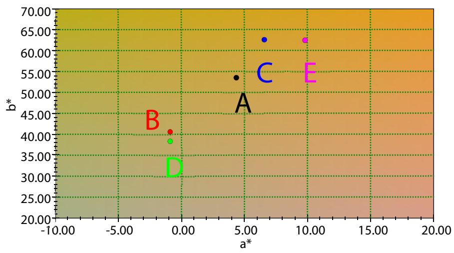

Fig. 5 Enlarged View of the Black-framed Part on the Right of Fig. 4

Measurement and Evaluation Results for Samples that are Difficult to Distinguish Visually

Even color differences that are difficult to distinguish visually can be quantitatively evaluated using color measurement. A, one of the samples measured earlier, was diluted with water and it was checked if this generated differences in the measured values. The dilution ratios are shown in Table 3, and the appearance of each sample is shown in Fig. 6. From Fig. 6, it can be seen that it is difficult to distinguish them visually.

Table 3 Dilution Ratio of Sample A

Sample Name	Dilution Factor
A	1.00 ×
A-1	1.20 ×
A-2	1.11 ×
A-3	1.04 ×

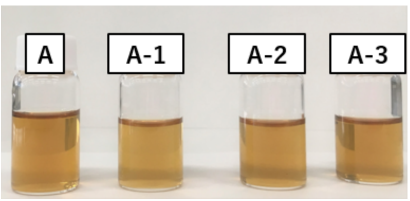

Fig. 6 Appearance of Sample A After Dilution

The transmission spectrum for each sample in Table 3 is shown in Fig. 7. It can be seen that the transmittance changes to a small extent depending on the dilution factor.

In addition, the color values in the L*a*b* colorimetric system were calculated from the spectra in Fig. 7. The results are shown in Table 4, and the L*a*b* chromaticity diagram in Fig. 8. D65 lighting and a two-degree field of view were used for the calculation. From Table 4 and Fig. 8, it can be seen that sample A-1, the one with the highest dilution ratio, was the brightest, and that the samples became darker as the dilution ratio was lowered. The value for b* also became lower as the dilution factor increased. This means that the higher the dilution ratio, the more transparent the sample becomes and the less pronounced the yellow tinge becomes.

By using the color measurement software of the spectrophotometer in this way, differences in color which are difficult to distinguish visually can be quantitatively evaluated.

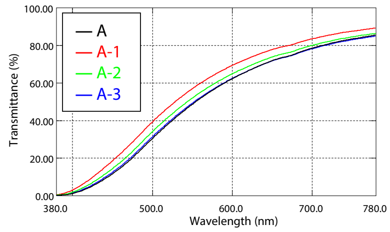

Fig. 7 Transmission Spectrum of Dilutions of Sample A

Table 4 L*a*b* Values of Dilutions of Sample A

Sample Name	L*	a*	b*
A	75.7	4.3	53.6
A-1	80.3	1.9	46.9
A-2	77.6	3.0	50.5
A-3	76.0	3.8	52.2

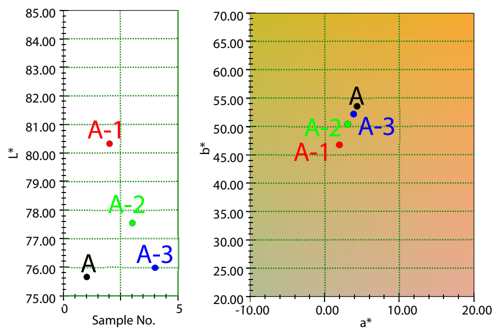

Fig. 8 L*a*b* Chromaticity Diagram for Dilutions of Sample A

Conclusion

In this study, various kinds of Japanese white dashi soup bases were measured using the UV-1900 spectrophotometer and the colors of each of these kinds were measured with color measurement software. By converting the colors to numerical values, we were able to quantitatively evaluate differences in color that are difficult to distinguish visually. These measurements can be considered useful information for comparing the colors of foods.

Combining an ultraviolet-visible spectrophotometer with color measurement software makes it possible to quantitatively evaluate the colors of various samples.

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