application note

The Determination of Food Colours in Mixtures

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Introduction

The use of food colours for aesthetic reasons is widespread and almost traditional in many countries.[1,2] Manufacturers often mix dyes to obtain an acceptable colouring in foodstuffs. Unfortunately, overlapping absorbance peaks can cause difficulties in determining the concentrations of individual component colours. In this Application a method is presented for automatically determining the concentrations of two dyes in food products.

Because multiple "common" names exist for each food colour, the abbreviated colour index generic names are used in this text. Table 1 lists alternative naming schemes for the colours studied.

Experimental

Instrumental

A GBC 911 UV-Visible spectrometer was used for the analysis. The instrument can readily perform multiple wavelength analyses and concentration calibrations, and permanently store all relevant equations and operator programs. This allowed the development of an automated method capable of being recalled and run with a minimal amount of complexity.

Plastic semi-micro cuvettes were used due to their low cost and robust nature.

Scans of all foods and dyes used, and all calibration graphs, were plotted on a COMX 4-pen colour plotter.

Deionised water was obtained from a reverse osmosis, mixed-bed deionising unit that supplies Type 1 ultrapure water (Modulab™, Reagent Grade Model Water Systems, LiquiPure, Australia). All dilutions used 5% citric acid, a commonly used food acid.

As all dyes used were commercial preparations, GBC cannot guarantee their stated "percent dyestuff'.

Procedure

Preliminary investigations revealed that the green colouring of many foodstuffs comprised food colours Yellow 23 and Blue 9.

Blue 9 was expected to interfere with the analysis of Yellow 23 in a mixture as it has a secondary absorbance peak near that of the major absorbance peak of Yellow 23.[3] These dyes were therefore individually diluted or mixed, as required, to produce standards of each component and the mixture.

Scans were performed of a 34 ppm solution of Yellow 23 and a 10 ppm solution of Blue 9. Fig. 1 shows both scans plotted on a common set of axes. Using the instrument's "Peak Seek" function, their absorbance maxima (A_{max}) were located at 427 nm and 629 nm respectively.

Table 1. Colour index (CI) codes and names for "Yellow 23" and "Blue 9"

	Yellow 23	Blue 9
CI generic name	Acid yellow 23	Acid blue 9
CI No.	19140	42090
ECAdditive No.	E102	E133
Prototype or old CI No.	CI640	CI1180
Common Names	Tartrazine D&C yellow no. 5 FD&C yellow no. 5	FD&C blue no. 1 Alphazurine FG Erioglaucine Azure blue AEG

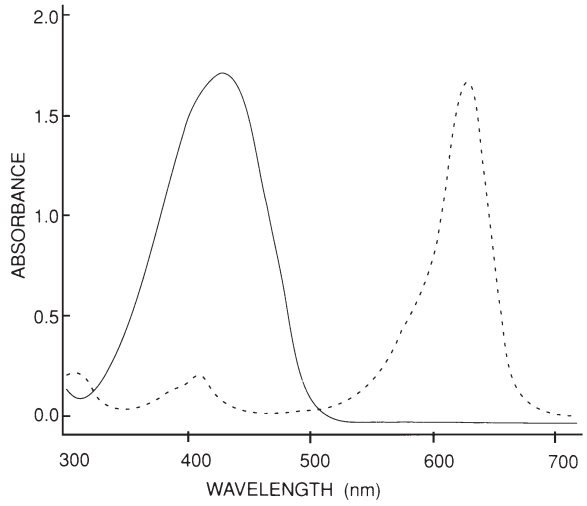

Fig. 1. Scans of Yellow 23 (——) and Blue 9 (– – –) dyes

The instrument's "Absorbance Maths" function was used to determine the absorbance ratio of the 10 ppm Blue 9 standard, given by

A_{427} / A_{629} (1)

The calculated ratio of 0.046 indicates that, in a mixture of the two dyes, the absorbance at 427 nm (Yellow 23's A_{max}) due to Blue 9 is 0.046 times the absorbance at 629 nm (Blue 9's A_{max}). Thus the corrected absorbance of Yellow 23 is given by

$A_{427} - (0.046 \times A_{629})$ (2)

Expression (2) was entered into the instrument's Absorbance Maths function for later storage and use as the method for determining Yellow 23 concentrations in a mixture.

Calibration

A linear calibration of concentration versus absorbance at 629 nm was performed using four Blue 9 standards in the range 1 to 15 ppm. The resultant calibration factor was found to be 7.2 (that is, Blue 9 concentration = 7.2 x A_{629}). This calibration was stored as program 1 in the permanent memory of the 911 UV-Vis.

Similarly, a calibration at 427 nm, using four Yellow 23 standards in the range 8.5 to 34 ppm, gave a calibration factor of 19.22 (that, is, Yellow 23 concentration = 19.22 x A_{427}). This calibration and expression (2) were stored as program 2.

Analysis

The following solutions, known to contain the colours of interest, were chosen for analysis:

- An ice confection (defrosted).
- Jelly crystals (these were initially diluted according to the manufacturer's instructions and dissolved by heating prior to analysis).
- Standard Blue 9/Yellow 23 mixtures.

The jelly crystals and ice confection were analysed neat, and at 1:2 and 1:3 dilutions, with results factored back to the neat concentration.

All solutions and their dilutions were measured using the following procedure:

1. Zero the instrument at 629 nm and 427 nm.

2. Recall program 1.

3. Measure the Blue 9 concentration.

4. Recall program 2.

5. Measure the Yellow 23 concentration (using the Absorbance Maths function).

Results

Table 2 summarises the food sample results, while standard mixture results appear in Table 3. All were within 3% of their mean values.

Table 2. Mean dye concentrations (ppm) measured in food samples.

Food sample	**Yellow 23**	**Blue 9**
Jelly Crystals	15.5 ± 0.3	3.08 ± 0.03
Ice confection	30.7 ± 0.3	13.4 ± 0.2

Table 3. Actual and measured dye concentrations (ppm) for standard mixtures.

Standard mixture	Yellow 23		Blue 9	
	Actual	Meas'd	Actual	Meas'd
1	34	33.8	15	14.4
2	25.5	25.7	10	9.9
3	17	17.2	5	5.1
4	8.5	8.6	2.5	2.5

Conclusion

Use of built-in absorbance maths and concentration functions, combined with the storage ability of the GBC 911 UV-VIS spectrometer, enabled the simple development of routine methods for analysing mixtures of food colourings.

References

1. Maurice Hanssen and Jill Marsden, "Additive Code Breaker," Lothian Publishing Co., Melbourne, Australia, 1984.

2. "Webster's Third New International Dictionary," G&C Merriam Co., Springfield, Massachusetts, USA, 1969.

3. "Catalog Handbook of Fine Chemicals," Aldrich Chemical Co., Milwaukee, Wisconsin, USA, 1988.