New methods in photometry: Testing a new spectrophotometer

Photometry is an important part of modern laboratory activity within a beverage company. The determination of bitterness units, colour and photometric iodine samples are just some examples of the routine analysis that takes place in a brewery laboratory. These methods involve various enzymatic detections, such as the determination of alcohol or sugars (sucrose, fructose and glucose).

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Introduction

For any large or small beverage facility, quick and easy operation of analysis equipment is important for every lab in order to guarantee efficient and high performance of the equipment. The DR6000 spectrophotometer offers the possibility to process daily samples quickly and more efficiently.

Lab photometry

The DR6000 is a single beam spectrophotometer with reference beam technology. The device has two cell compartments. One of these compartments is designed for the automated analysis of 13 mm round cells on the basis of an additional integrated barcode detection function. The second compartment acts as a universal adapter to hold various rectangular cells.

With a variety of options for use, over 200 analysis programmes are stored in the photometer. This reflects the wide number of applications that can be significantly expanded through the option to implement proprietary methods.

It is not only the barcode detection of round cells that enables faster sample processing, but also the RFID module. This technology not only makes it possible to identify the user using a RFID user transponder on the device; RFID transponders can also be used to identify the samples. This firstly rules out sample mix-ups and secondly facilitates or ensures tracebility. The table on page 2 shows the technical data for the photometer.

Touch screen with clearly structured user interface

Functions/operation

The DR6000 has the standard functions of a spectrophotometer and can be used in many laboratories for routine analysis, as well as for special tests. With the touch screen and the simple menu navigation, the spectrophotometer offers a very user-friendly interface. (Figure 1)

Table 1: Technical data of the photometer
Source: Hach® GmbH

Technical performance data	
Display mode	Interfaces
Light source	Deuterium lamp (UV) and halogen lamp (visual range)
Wavelength range	190–1,100 nm
Wavelength accuracy	±1 nm (wavelength range 200–900 nm)
Wavelength reproducibility	<0.1 nm
Wavelength resolution	0.1 nm
Wavelength calibration	Automatic
Wavelength selection	Automatic, depending on process selected
Scan speed	900 nm/min (in 1-nm increments)
Spectral bandwidth	2 nm (1.5–2.9 nm at 656 nm, 1 nm at the D2 line)
Photometric measurement range	±3 abs (wavelength range 200–900 nm)
Photometric accuracy	5 m abs 0.0–0.5 abs, <1 % at 0.5–2.0 abs at 546 nm
Photometric linearity	<0.5 % to 2 abs
Scattered light	KI solution at 220 nm <3.3 abs/<0.05 %
Long-term stability	10 hours at 546 nm ≤0.0034 abs
Data storage	5,000 measurement values
User programmes	200
Dimensions	Width 50 cm/height 21.5 cm/depth 46 cm
Weight	11 kg
Interfaces	2x USB type A 1x USB type B 1x Ethernet

The start menu provides quick access to the following areas:

- Stored programmes
- User programmes
- Barcode programmes
- Favourite programmes
- Single wavelength
- Multi-wavelength
- Wavelength scan
- Time course

Hach offers a variety of pre-installed analysis programmes. The Hach tests and processes using Hach chemicals can be found under the menu items “Stored Programmes” and “Barcode Programmes”. Custom processes can be stored in the menu under “User Programmes”. Single wavelength measurements can be shown as absorbance, transmission or concentration.

The multi-wavelength programme allows up to four wavelengths to be measured and calculations for absorbance differences and absorbance relationships to be shown. The time course provides the option of recording a wavelength over a specific time period.

The “wavelength scan” function can be used to record spectra in a specific wavelength range, which renders the results more informative when performing several analyses. An enhanced photometric iodine sample can provide better and more specific information about a higher iodine value with one spectrum.

Options for use

One current problem is the determination of the colour of drinks, for example mixed drinks made from beer and coloured soft drinks, which clearly deviate from the colour of the beer. With the usual wavelength of 430 nm, it is not guaranteed that this value is reliable and meaningful.

A new method offers colorimetric recording using L*a*b*.

L*a*b*

The three letters represent the axes in a three dimensional colour system for the evaluation of brightness, the red–green proportion and the yellow–blue proportion: This system offers another type of colour evaluation:

L* = 0% black
100% white
a* = -a* = green
+a* = red
b* = -b* = blue
+b* = yellow

This allows the colour to be recorded more clearly and represented as a diagram. All measurement data can be stored in an internal memory. This can record up to 5000 items of measurement data.Additionally, the integrated analytical quality assurance can be used to perform a proprietary check of the working method, the photometer or the accessories.

Tests

With its 200 user programmes, the DR6000 offers a wide range of options for use. Not all programmes are meaningful for a brewery lab. However, as observations in previous years have shown a tendency for breweries increasingly to produce alcohol-free drinks alongside the production of beer, new methods for monitoring production and inspecting the products are required.

However, in our comparison tests with a well-known spectrophotometer, the focus was on the determination of the colour as well as the bitters. Tables 2 and 3 show the statistical analysis. With a Student(T) test, no significant difference could be determined between the control device and the DR6000.

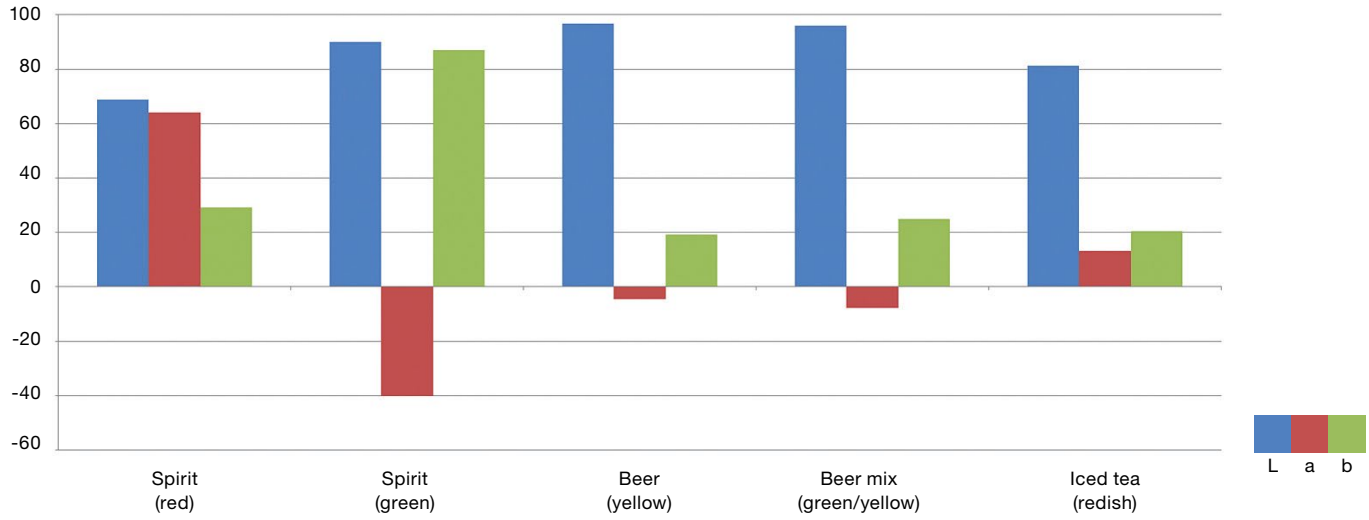

Figure 2: Colour differentiation of spirits, beer, mixed drinks containing beer and iced tea

Figure 3: Sample insertion using a cell

Table 2: Analysis of the colour n=10

	Beer 1		Beer 2	
	Control device	DR6000	Control device	DR6000
Mean	7.3	7.2	7.3	7.3
Median	7.3	7.2	7.3	7.3
Maximum	7.3	7.3	7.3	7.3
Minimum	7.2	7.2	7.3	7.3
Precision	0.018	0.013	0.029	0.021
Variance	0	0	0.001	0

Table 3: Analysis of the bitters n=10

	Beer 1		Beer 2	
	Control device	DR6000	Control device	DR6000
Mean	26.2	26.4	19	19.1
Median	26.2	26.4	19	19.1
Maximum	26.3	26.7	19.1	19.3
Minimum	26.1	26.1	18.7	18.9
Precision	0.074	0.141	0.1	0.142
Variance	0.006	0.02	0.01	0.02

Conclusion

The DR6000 spectrophotometer, with its simple menu navigation and wide range of applications, offers an easier and/or greater range of analyses for every laboratory.

Reference

Dipl.-Brm. Mirko Geier, Dr Diedrich Harms: New methods in photometry – Central Laboratory of VLB tests a new spectrophotometer, in: Brauerei-Forum (February 2012), p. 7ff.

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