Application Note

P-0002

Optical rotation measurement of sucrose and l-menthol

Introduction

Optical rotation is the property of substances, rotating the plane of polarization when linearly-polarized light passes through such substances. This is the property which occurs specifically to optical active substances in which the refractive indices of right and left circularly-polarized light are different. Optical rotation that rotate light in a clockwise direction as viewed towards the light source is defined as *dextrorotation* (+) and the opposite, *levorotation* (-).

The angle of rotated plane of polarization is called as optical rotation and polarimeter is the instrument to measure such optical rotation. Optical rotation is proportional to cell pathlength and is related to sample concentration, measurement wavelength and temperature. The specific optical rotation $[\alpha]^t_x$ is calculated from the following formula using temperature t (ºC), wavelength x (nm), cell pathlength l (dm), sample concentration c (g/100 ml) and measured optical rotation α.

$$[\alpha]^t_x = 100\,\alpha/cl$$

JP, USP and EP suggest to measure optical rotation using D-line of Na lamp.

Polarimeter is used for several purposes such as purity certification of sugar, verification of pharmaceuticals and optical purity determination of optical active substances obtained from asymmetric synthesis in organic chemistry field.

Keywords: Optical rotation measurement, sucrose, menthol, ORD

Optical rotation measurement of sucrose

5 g/100ml of sucrose (Wako Pure Chemical Industries, Ltd., JIS special grade) was prepared and measured using P-2000 with 100mm cell, Na lamp D-line under 20ºC.

Figure 1 shows the printout view of measurement result. The average of optical rotation in 5 times measurement was +3.3264 deg. and its specific optical rotation calculated was +66.5280 which is in good agreement with the specific optical rotation of 5g/100ml sucrose solution described in JIS K0063 1) , +66.500.

5%Sucrose_20℃.p1d

[Data Information]
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[Measurement Information]
Instrument Name P-2000
Model Name P-2000
Serial No. A071661232

Light Source Na
Monitor wavelength 589 nm
D.I.T. 5 sec
No. of cycle 5
Cycle interval 0 sec
Temp. Monitor Holder
Temp. Corr. Factor None
Aperture(S) 8.0nm
Aperture(L) 2.0nm
Mode Optical Rotation
Factor 1

[Comment]
Sample name 5% Sucrose
Comment
User
Division
Company JASCO

		No.	Sample No.	Mode	Calc. Data	Meas. Data	PMT Voltage[V]	Temperature(C)
1	*	1	1-1	Specific O.R.	+66.5348	+3.3267	243	19.99
2	*	2	1-2	Specific O.R.	+66.5388	+3.3269	243	19.99
3	*	3	1-3	Specific O.R.	+66.5368	+3.3268	243	19.99
4	*	4	1-4	Specific O.R.	+66.5428	+3.3271	243	19.99
5	*	5	1-5	Specific O.R.	+66.5388	+3.3269	243	19.99
6	*	6	Avg.		+66.5384			
7		7	S.D		0.0030			
8		8	C.V		0.0045			

Figure 1 Printout view of optical rotation measurement of 5g/100ml sucrose solution.

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Optical rotation measurement of 1-menthol

l-menthol (Wako Pure Chemical Industries, Ltd.) was prepared under the condition suggested in JP (2.5g ethanol (95), 25ml, 100mm) and its optical rotation was measured. Its specific optical rotation was calculated to be $[\alpha]^{20}_{D}$ = -50.01 which is well within the JP criteria: -45.0 ~ -51.0.

Generally, optical rotation is increased in shorter wavelength region. For optical rotation measurement, Na lamp D-line is usually applied, while when the optical rotation of the sample is very small using D-line, by irradiating shorter wavelength light, optical rotation can be measured in easier way. In this application data, optical rotation measured using P-2000 with both Na lamp D-line and Hg lamp emission line wavelength (546, 436, 405, 365 nm) and ORD spectrum (showing wavelength dispersion of optical rotation) measured using J-820 + ORDM-401 were compared. As shown in Figure 2, both measured values by P-2000 and ORDM-401 are very consistent. Like this, by employing shorter wavelength light for samples with small optical rotation, the measurement can be implemented easily.

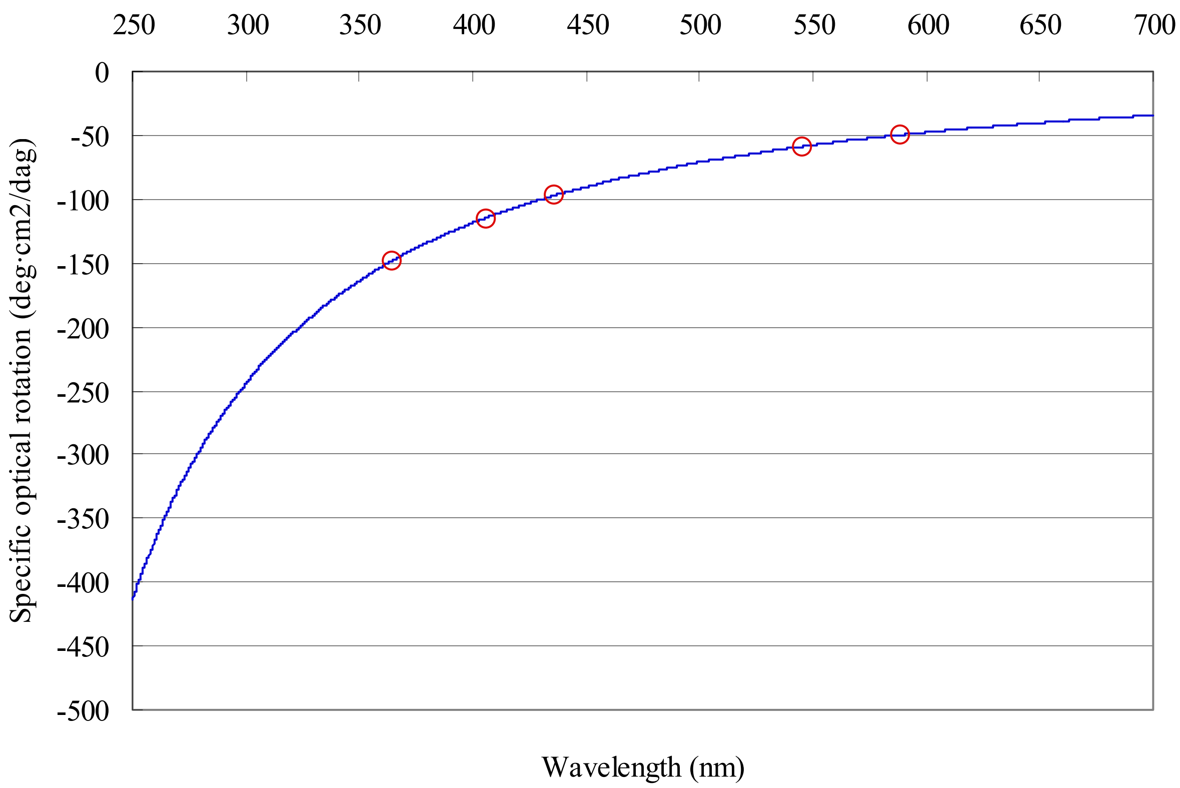

Figure 2 Optical rotation of 1-menthol and comparison with ORD spectrum

: P-2000 measured value : ORD spectrum

Reference

(1) Optical rotation of sucrose solution described in JIS K0063 is referred to Handbook of Chemistry and Physics, 42nd Edition (1960-1961), P1784, The Chemical Rubber Co., Ohio, U.S.A..

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