CD spectra of pharmaceutical substances - Steroids (9)

1. Digitoxin

Digitoxin, obtained from the Digitalis leaf, is a kind of cardiac glycoside and has a structure in which digitoxigenin, an aglycon, binds with three digitoxose molecules.[1)] Digitoxin is used as both a cardiotonic and antiarrhythmic agent.[2)]

Figure 1 shows the CD/ORD/UV spectra of digitoxin. The UV absorption in the wavelength region below 250nm, showing hypsochromic effect with the decreasing polarity of the solvent, is assigned to the π-π* transition of the α-β-unsaturated-five-membered lactone (enolide) located at C-17b in the steroid ring. The absorption band assigned to the n-π* transition, however, is concealed by this strong absorption band and is not clearly observed. On the other hand, the positive CD band, having its maximum at approximately 240 nm, is assigned to the n-π* transition of enolide, which characteristically shows a vibrational structure in the nonpolar solvent. Another weak CD band, assigned to the π-π* transition, is observed at approximately 220 nm, where the sign changes from negative to positive with the decreasing polarity of the solvent. These CD bands are generated by the achiral enolide ring affected by the asymmetric field of the steroid ring; they are not the CD band[3)] generated by the chirality of the enolide ring itself. The ORD curve reflects the whole steric environment formed by the steroid ring, enolide ring and sugar chain.

2. Digoxin

Digoxin, obtained from the leaves of *digitalis lanata*, a member of the digitalis family, is a kind of cardiac glycoside and has a structure in which digoxigenin linearly binds with three digitoxose molecules.[1)] Digoxin is also used as both a cardiotonic and antiarrhythmic agent.[2)]

Figure 2 shows the CD/ORD/UV spectra of digoxin, which closely resemble those of digitoxin.

3. G-strophanthin

G-strophanthin, known also by the name of ouabain and obtained from the plant of the *apocynaceae*, is a fast-acting cardiac glycoside[1)] and is used as both a cardiotonic and antiarrhythmic agent.[2)]

Figure 3 shows the CD/ORD/UV spectra of G-strophanthin. The UV spectrum and the positive CD band at approximately 240 nm closely resemble those of the two substances above. On the other hand, the negative sign of the ORD curve in the longer wavelength region above 300 nm is opposite to those of the two substances. This is considered to be mainly due to the difference in their sugar chains.

References

1) Imabori, K., Yamakawa, T. Ed.: The Dictionary of Biochemistry, Tokyo Kagaku Dojin, 1st Edition, 1984.
2) The Manual of Japanese Pharmacopoeia, 12th Edition, Hirokawa Shoten, 1991.

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1] Wavelength (nm)
2] Sample: SIGMA D-5878
1. Ethanol solution, 2. Dioxane solution
350 - 260 nm: 0.1% (1.3 mM), 10 mm Cell
260 - 193 nm: 0.06% (0.65 mM), 1 mm Cell
3] Measurement apparatus
CD: J-720WI Circular Dichroism Spectrophotometer
UV: Ubest V-560 Ultraviolet and Visible Light Spectrophotometer
4] The structure of digitoxin
5] IR spectrum (KBr tablet method)
6] Measurement apparatus: FT/IR-350
7] Figure 1. The CD/ORD/UV and IR spectra of digitoxin
8] Sample: SIGMA D-6003, Ethanol solution
350 - 254 nm: 0.1% (1.3 mM), 10mm Cell
254 - 193 nm: 0.05% (0.64 mM), 1mm Cell
9] The structure of digoxin
10] Figure 2. The CD/ORD/UV and IR spectra of digoxin
11] Sample: SIGMA O-3125, Ethanol solution
350 - 255 nm: 0.1% (1.4 mM), 10 mm Cell
255 - 193 nm: 0.05% (0.69 mM), 1 mm Cell
12] The structure of G-strophanthin
13] Figure 3. The CD/ORD/UV and IR spectra of G-strophanthin

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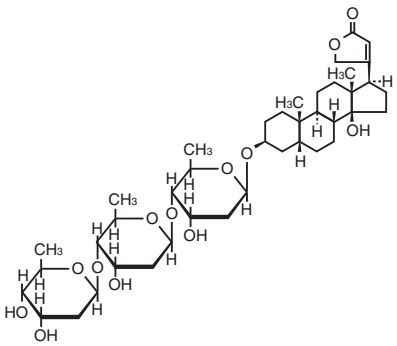
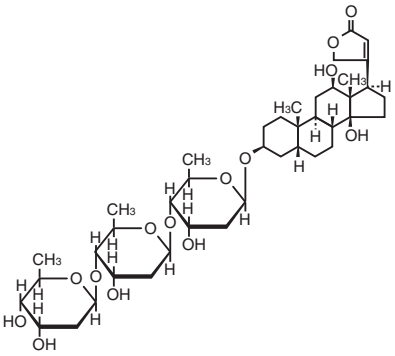
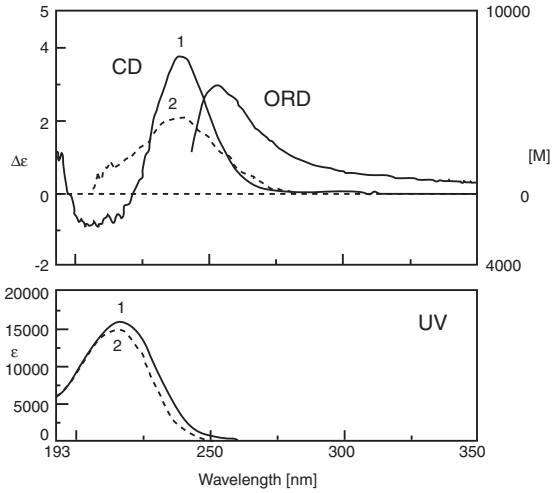
CD spectra of pharmaceutical substances - Steroids (9)

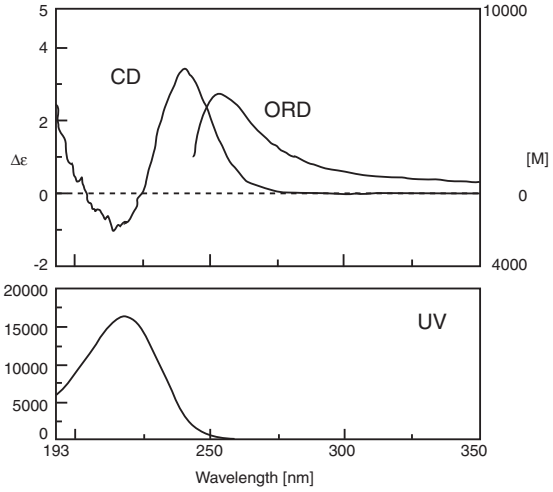


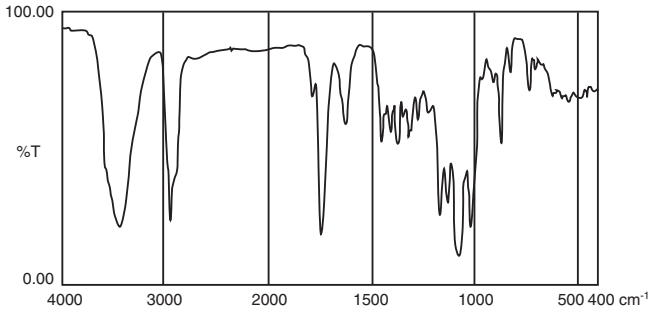
Digitoxin $C_{41}H_{64}O_{13}$=764.95

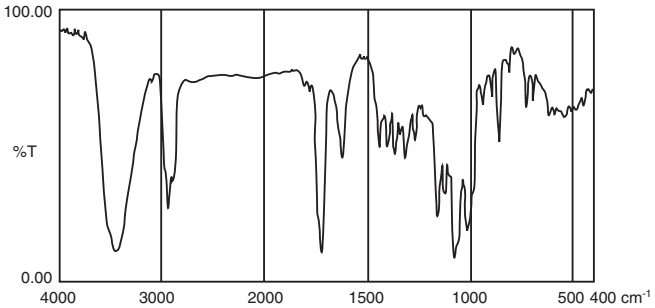


Digoxin $C_{41}H_{64}O_{14}$=780.95









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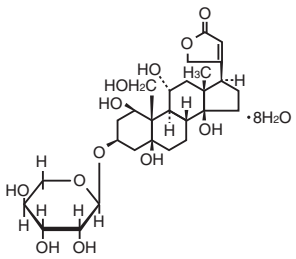
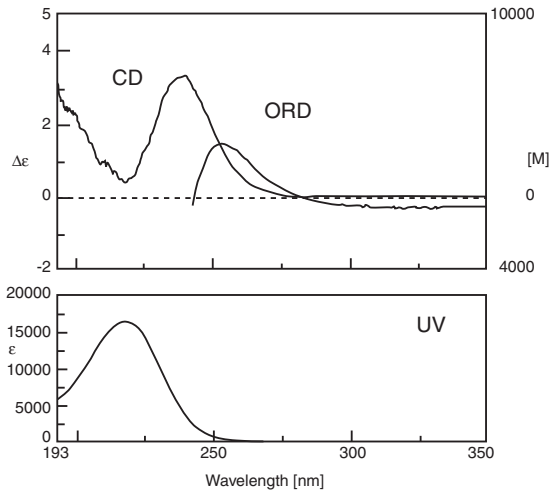
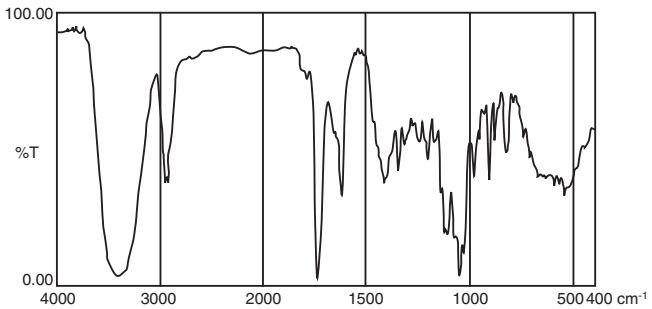


G-Strophantin (Ouabain octahydrate)
$C_{29}H_{44}O_{12} \cdot 8H_2O$=728.78





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