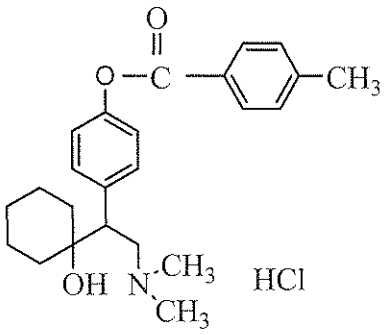
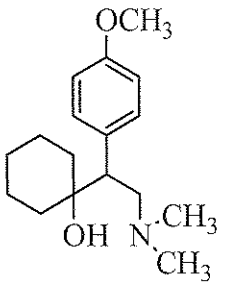
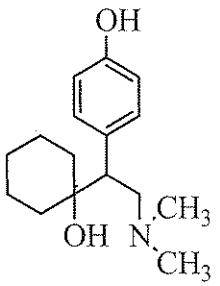
203.2°C-206.5°C.



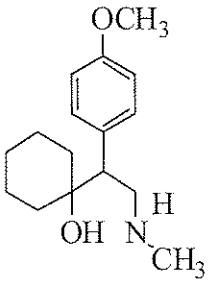
I



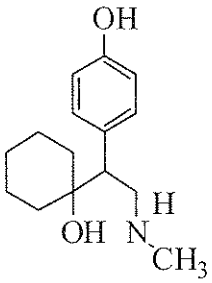
II



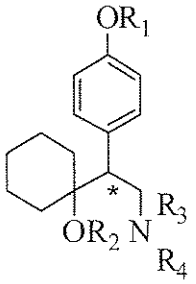
III



IV



V



VI

SUMMARY

In one aspect, there is pProvided ~~herein is~~ a crystal form Ⅰ of 4-[2-dimethylamino-1-(1-hydroxycyclohexyl)ethyl]phenyl 4-methylbenzoate hydrochloride, characterized in that the crystal form Ⅰ exhibits a powder X-ray diffraction pattern obtained using CuKα radiation and having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 10.690, 14.290, 16.030, 17.931, 19.009, 21.009 and 22.350.

The crystal form Ⅰ exhibits a powder X-ray diffraction pattern having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 10.690, 14.290, 15.328, 16.030, 17.931, 19.009, 21.009, 21.469, 22.350, 23.130, 24.969 and 25.232.

The crystal form Ⅰ exhibits a powder X-ray diffraction pattern having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 4.751, 8.329, 9.307, 10.690, 12.372, 14.290, 15.328, 16.030, 16.711, 17.432, 17.931, 18.433, 19.009, 19.750, 21.009, 21.469, 22.350, 23.130, 23.791, 24.149, 24.470, 24.969, 25.232, 26.491, 27.610, 28.449, 28.670, 29.511, 31.010, 31.572, 32.111, 32.789, 33.387, 34.590, 35.210, 36.070, 36.953, 38.027, 38.751 and 39.711.

The crystal form Ⅰ exhibits a powder X-ray diffraction pattern substantially as shown

in Fig. 1.

The crystal form Ⅰ has a melting point of 213.0°C-213.8°C.

The crystal form Ⅰ has a DSC spectrum substantially as shown in Fig. 2.

In another aspect, there is~~Also~~ provided ~~herein is~~ a crystal form Ⅱ of 4-[2-dimethylamino-1-(1-hydroxycyclohexyl)ethyl]phenyl 4-methylbenzoate hydrochloride, characterized in that the crystal form Ⅱ exhibits a powder X-ray diffraction pattern obtained using CuK_α radiation and having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 5.899, 11.799, 14.481, 15.440, 18.420, 19.800 and 23.620.

The crystal form Ⅱ exhibits a powder X-ray diffraction pattern having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 5.899, 11.799, 13.779, 14.481, 15.039, 15.440, 17.701, 18.420, 19.800, 23.620 and 25.220.

The crystal form Ⅱ exhibits a powder X-ray diffraction pattern having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 5.899, 10.280, 11.799, 13.779, 14.481, 15.039, 15.440, 15.920, 16.901, 17.701, 17.900, 18.420, 19.800, 20.679, 20.938, 21.819, 22.761, 23.242, 23.620, 24.799, 25.220, 26.001, 26.440, 26.717, 27.241, 27.780, 28.160, 28.719, 29.279, 29.796, 30.604, 31.340, 31.723, 31.901, 32.425, 32.939, 33.880, 34.282, 34.460, 35.141, 36.400, 37.225, 38.377 and 39.501.

The crystal form Ⅱ exhibits a powder X-ray diffraction pattern substantially as shown in Fig. 3.

The crystal form Ⅱ has a melting point of 209.5°C-210.2°C.

The crystal form Ⅱ has a DSC spectrum substantially as shown in Fig. .4.

In still another aspect, there is provided a pharmaceutical composition comprising [4-[2-dimethylamino-1-(1-hydroxycyclohexyl)ethyl]phenyl 4-methylbenzoate hydrochloride] in any one or a combination of crystal form I or crystal form II, and a pharmaceutically acceptable carrier, wherein the crystal form I exhibits a powder X-ray diffraction pattern obtained using CuKα radiation and having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 10.690, 14.290, 16.030, 17.931, 19.009, 21.009 and 22.350, and wherein the crystal form II exhibits a powder X-ray diffraction pattern obtained using CuK_α radiation and having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 5.899, 11.799, 14.481, 15.440, 18.420, 19.800 and 23.620.

Also provided herein is a crystal form Ⅲ of 4-[2-dimethylamino-1-(1-hydroxycyclohexyl)ethyl]phenyl 4-methylbenzoate hydrochloride, wherein the melting point is 210.1-211.9°C.

A crystal form III of 4-[2-dimethylamino-1-(1-hydroxycyclohexyl)ethyl]phenyl 4-methylbenzoate hydrochloride has a DSC spectrum substantially as shown in Fig. 6.

Also provided herein is a crystal form IV of 4-[2-dimethylamino-1-(1-hydroxycyclohexyl)ethyl]phenyl 4-methylbenzoate hydrochloride, characterized in that the crystal form IV exhibits a powder X-ray diffraction pattern obtained using CuK_α radiation and having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 9.495, 11.135, 14.576, 15.954, 17.755, 19.114, 21.415, 23.475, 25.455 and 29.174.

The crystal form IV exhibits a powder X-ray diffraction pattern having characteristic peaks expressed in degrees 2θ (±0.2° 2θ) at 7.653, 9.136, 9.495, 11.135, 11.456, 11.714, 14.576, 15.954, 16.694, 16.995, 17.755, 18.234, 19.114, 20.176, 20.975, 21.415, 22.916,