

DESCRIPTION

NOVEL CRYSTAL OF 3-[5-[4-(CYCLOPENTYLOXY)-2-HYDROXYBENZOYL]-2-[(3-HYDROXY-1,2-BENZISOXAZOL-6-YL)METHOXY]-PHENYL]PROPIONIC ACID

FIELD OF THE INVENTION

[0001]

The present invention relates to novel crystals of 3-{5-[4-(cyclopentyloxy)-2-hydroxybenzoyl]-2-[(3-hydroxy-1,2-benzisoxazol-6-yl)methoxy]phenyl}propionic acid developed as an anti-rheumatic drug.

BACKGROUND ART

[0002]

10 3-{5-[4-(Cyclopentyloxy)-2-hydroxybenzoyl]-2-[3-hydroxy-1,2-benzisoxazol-6-yl)methoxy]phenyl}propionic acid (hereinafter called as "T-5224") has excellent anti-arthritis action and has an osteoclastic suppressing action by arthritic activity, and have been developed as an anti-rheumatic agent (patent document 1).

In patent document 1, a manufacturing process by the crystallization of T-5224 from mixed solvents of chloroform and methanol is described.

20 However, the crystal of T-5224 (hereinafter

called as "type I crystal") produced by this manufacturing process has following defects, (1) its specific volume is large, (2) it is easy to be charged with electricity, (3) it is not easy to be handled, (4) 5 in the crystal, it contains chloroform and methanol which are the solvents (class 2), the amount of residue of which in a medicine should be regulated, and so forth.

Further, it is hardly to say that this 10 manufacturing process is an industrially profitable manufacturing process because (5) waste liquid containing chloroform occurs in large quantities and environmental loads are large.

Therefore, the type I crystal cannot be 15 satisfied as an active pharmaceutical ingredient.

[0003]

[Patent document 1] international publication
No. WO03/042,150 pamphlet

DISCLOSURE OF THE INVENTION

20 PROBLEM TO BE SOLVED BY THE INVENTION

[0004]

As an active pharmaceutical ingredient, a crystal of T-5224, which (1) has a small specific volume, (2) is hard to be charged with electricity, (3) 25 is easily handled, (4) is produced by use of a solvent which is safe to human body, (5) is produced in the condition of low environmental loads and (6) mass

production of which is possible, is strongly expected.

MEANS TO SOLVE THE PROBLEM

[0005]

Under these circumstances, the present
5 inventors of the present invention have conducted
intensive research zealously, as a result, found that
the crystal of T-5224 having peaks at the positions of
14.0, 16.0, 23.3, 23.7 and 26.3° on 2θ of diffraction
angle in powder X-ray diffraction pattern (hereinafter
10 called as "type II crystal") and the crystal of T-5224
having peaks at the positions of 14.6, 23.1, 24.7, 25.6
and 26.0° on 2θ of diffraction angle in a powder X-ray
diffraction pattern (hereinafter called as "type III
crystal") are excellent as an active pharmaceutical
15 ingredient because (1) its specific volume is small,
(2) it is hard to be charged with electricity, (3) it
is easy to be handled, (4) it is produced by use of a
solvent which is safe to human body, (5) it is produced
in the condition of low environmental loads and (6)
20 mass production is possible, and they had completed the
invention.

EFFECT OF THE INVENTION

[0006]

The crystals of the present invention, which
25 (1) have a small specific volume, (2) are hard to be
charged with electricity, (3) are easily handled, (4)

are produced by use of a solvent which is safe to human body, (5) are produced in the condition of low environmental loads, and (6) mass production of which is possible, are useful for an active pharmaceutical ingredient.

BEST MODE FOR CARRYING OUT THE INVENTION

[0007]

The present invention is described in detail as follows.

10 The present invention relates to the type II crystal having peaks at the position of 14.0, 16.0, 23.3, 23.7 and 26.3° on 2θ of diffraction angle in a powder X-ray diffraction pattern and the type III crystal having peaks at the position of 14.6, 23.1, 15 24.7, 25.6 and 26.0° on 2θ of diffraction angle in a powder X-ray diffraction pattern.

These crystals of the present invention are not known at all until now, are not described in the patent document 1 at all, and are novel crystals.

20 In addition, characteristic peaks of powder X-ray diffraction may change by conditions of measurement.

Therefore, peaks of powder X-ray diffraction of the compounds of the present invention are not 25 interpreted strictly.

[0008]

The manufacturing process of the compounds of

the present invention is explained.

The type II crystal, for example, can be produced by a manufacturing process shown as follows.

In addition, an abbreviation of "Tr" has a
5 meaning of "triphenylmethyl" in the following.

[0009]

[Manufacturing process 1]

The type II crystal can be produced by recrystallizing the type I crystal from mixed solvents
10 comprising one or more solvents selected from 2-propanol, butanol and acetone; water; and dimethyl sulfoxide.

A method for dissolving the type I crystal is not limited in particular, for example, (1) a method
15 for having the type I crystal heated and dissolved in mixed solvents comprising one or more solvents selected from 2-propanol, butanol and acetone; water; and dimethyl sulfoxide, (2) a method for heating and dissolving the type I crystal in mixed solvents
20 comprising one or more solvents selected from 2-propanol, butanol and acetone; and dimethyl sulfoxide, and adding water as keeping the dissolved state, are given.

Subsequently, the type II crystal can be
25 produced by cooling this solution.

Seed crystal of the type II crystal may be added if necessary.

In the case that seed crystal of the type II

crystal is added, temperature of addition may be the temperature of the state that the type I crystal dissolved, and may be preferably 60-65°C.

The additive amount of seed crystal is not
5 limited in particular.

The amount of water used is preferably 7.5 to 15 times volume (v/w) as the standard of the weight of the type I crystal.

The amount of dimethyl sulfoxide used is
10 preferably 0.3 to 0.6 times volume (v/v) as the standard of the volume of water.

The amount of one or more solvents used selected from 2-propanol, butanol and acetone is preferably within the range in which (the one or more
15 solvents selected from 2-propanol, butanol and acetone and dimethyl sulfoxide) / (water) is 70/30 to 75/25.

In addition, the type II crystal can be produced by use of the type III crystal in stead of the type I crystal according to the method described above.
20 [0010]

[Manufacturing process 2]

The type II crystal can be produced by neutralization-crystallization with acid after the suspension of the type I crystal is dissolved by
25 addition of base.

The neutralization-crystallization may be conducted by addition of seed crystal of the type II crystal if necessary.

For solvents used in this production, mixed solvents comprising ketones such as acetone and 2-butanone; and water are given.

For a base, for example, hydroxides of alkali metal or alkaline earth metal such as sodium hydroxide, potassium hydroxide, lithium hydroxide, cesium hydroxide and barium hydroxide; hydrogen carbonates of alkali metal such as sodium hydrogen carbonate and potassium hydrogen carbonate; carbonates of alkali metal or alkaline earth metal such as sodium carbonate, potassium carbonate and barium carbonate; and ammonia, and the like are given.

As a preferable base, a hydroxide of alkali metal is given, and sodium hydroxide and potassium hydroxide are more preferable.

A base can be added in solid form, but it is preferred that the base is dissolved in water and added.

For an acid, for example, a mineral acid such as hydrochloric acid, sulfuric acid, nitric acid and hydrobromic acid is given, and hydrochloric acid is preferable.

For ketones, acetone is preferable.

Sulfoxides such as dimethyl sulfoxide and amides such as N,N-dimethylformamide may be mixed as a solubilizer.

For a solubilizer, dimethyl sulfoxide is preferable.

The amount of the mixed solvents used is preferably 15 to 100 times volume (v/w) as the standard of the weight of the type I crystal, and is more preferably 15 to 30 times volume (v/w).

5 The ratio of mixed solvents is preferably within the range in which (ketones and solubilizer) / (water) is 60/40 to 90/10, and is more preferably within the range in which (ketones and solubilizer) / (water) is 65/35 to 75/25.

10 The amount of the solubilizer used is preferably within the range in which (ketones) / (solubilizer) is 100/0 to 70/30.

 Temperature of neutralization is not limited in particular, but the temperature is preferably 10°C to
15 reflux temperature, and is more preferably 10-60°C.

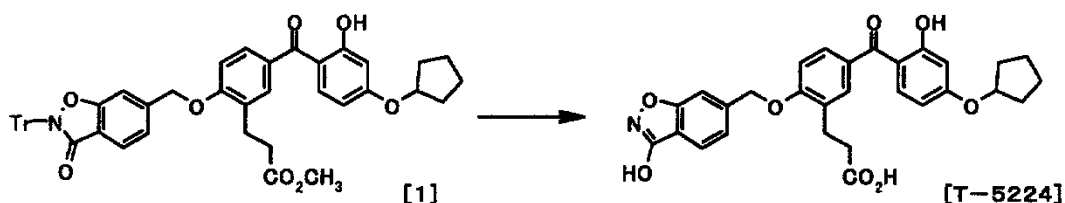
 In the case that seed crystal of the type II crystal is added, it is preferable to add to liquid of pH 6.0 to 7.5.

 The additive amount of seed crystal is not
20 limited in particular.

 In addition, the type II crystal can be produced by use of the type III crystal in stead of the type I crystal according to the method described above.

[0011]

25 [Manufacturing process 3]



After the compound of formula [1] is subjected to deprotection reaction, the type II crystal can be produced by adding base to the reaction mixture to dissolve T-5224, and subsequently by neutralizing
 5 and crystallizing with acid.

The neutralization-crystallization may be conducted by addition of seed crystal of the type II crystal if necessary.

Deprotection reaction may be conducted by the
 10 method, for example, described in Protective Groups In Organic Synthesis, T.W.Greene, John Wiley & Sons INC., 1999, the third edition, p.369-387, 583-584 and the like method.

For solvents used in this reaction, mixed
 15 solvents comprising ketones such as acetone and 2-butanone; and water, are given.
 Sulfoxides such as dimethyl sulfoxide and amides such as N,N-dimethylformamide may be mixed as a solubilizer.

For a solubilizer, dimethyl sulfoxide is
 20 preferable.

Addition of base and neutralization-crystallization may be conducted according to the manufacturing process 2.

[0012]

The type III crystal, for example, can be produced by a manufacturing process shown as follows.

[0013]

5 [Manufacturing process 4]

After the suspension of the type I crystal was dissolved by addition of base, the type III crystal can be produced by neutralization-crystallization with acid and subsequent heating and stirring.

10 The neutralization-crystallization may be conducted by addition of seed crystal of the type III crystal if necessary.

For the solvent used in this production, mixed solvents comprising one or more solvents selected
15 from ethyl acetate, butyl acetate and 4-methyl-2-pentanone; one or more solvents selected from acetone and 2-butanone; and water are given.

For a base, for example, hydroxides of alkali metal or alkaline earth metal such as sodium hydroxide,
20 potassium hydroxide, lithium hydroxide, cesium hydroxide and barium hydroxide; hydrogen carbonates of alkali metal such as sodium hydrogen carbonate and potassium hydrogen carbonate; carbonates of alkali metal or alkaline earth metal such as sodium carbonate,
25 potassium carbonate and barium carbonate; and ammonia are given.

For a preferable base, hydroxide of alkali metal is given, and sodium hydroxide and potassium

hydroxide are more preferable.

A base can be added in solid form, but it is preferred that the base is dissolved in water and added.

5 For an acid, for example, a mineral acid such as hydrochloric acid, sulfuric acid, nitric acid and hydrobromic acid is given, and hydrochloric acid is preferable.

 The amount of one or more solvents used
10 selected from ethyl acetate, butyl acetate and 4-methyl-2-pentanone is preferably 5 to 10 times volume (v/w) as the standard of the weight of the type I crystal.

 The amount of one or more solvents used
15 selected from acetone and 2-butanone is preferably 0.5 to 1.0 times volume (v/v) as the standard of the volume of one or more solvents selected from ethyl acetate, butyl acetate and 4-methyl-2-pentanone.

 The amount water used is preferably 0.5 to
20 2.0 times volume (v/v) as the standard of the volume of one or more solvents selected from ethyl acetate, butyl acetate and 4-methyl-2-pentanone.

 Temperature of neutralization is not limited in particular, but the temperature is preferably 10°C to
25 reflux temperature, and is more preferably 10-60°C.

 In the case that seed crystal of the type III crystal is added, it is preferable to add to liquid of pH 6.0 to 7.5.

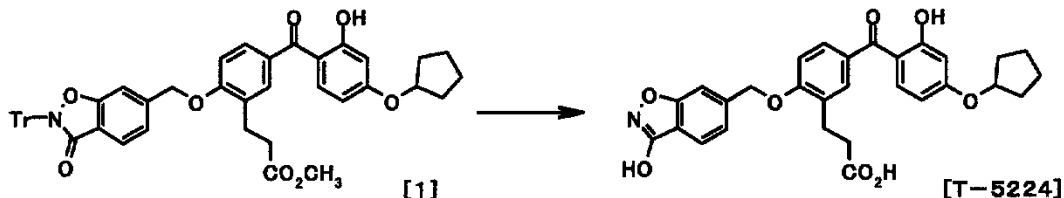
The additive amount of seed crystal is not limited in particular.

The high-purity type III crystal can be produced by stirring at equal to or more than 50°C for equal to or more than 1 hour, preferably by stirring at 50-70°C for equal to or more than 1 hour, and more preferably by stirring at 50-70°C for 1 to 3 hours after neutralization-crystallization.

In addition, the type III crystal can be produced by use of the type II crystal in stead of the type I crystal according to the method described above.

[0014]

[Manufacturing process 5]



After the compound of formula [1] was subjected to deprotection reaction, the type III crystal can be produced by adding base to the reaction mixture to dissolve T-5224, subsequently by neutralizing and crystallizing with acid, and subsequently by heating and stirring.

The neutralization-crystallization may be conducted by addition of seed crystal of the type III crystal if necessary. Deprotection reaction may be conducted according to the manufacturing process 3.

For the solvent used in this reaction, mixed solvents comprising one or more solvents selected from ethyl acetate, butyl acetate and 4-methyl-2-pentanone; one or more solvents selected from acetone and 2-
5 butanone; and water are given.

Addition of base, neutralization-crystallization and heating-stirring may be conducted according to the manufacturing process 4.

[0015]

10 In the case that the compounds of the present invention (the type II crystal and the type III crystal) are used as a medicine, they can be used alone or mixed.

In addition, the compound of the present
15 invention, for example, may be mixed with pharmaceutical auxiliaries such as an excipient, a carrier, and a diluent, used for formulation.

These can be administrated by orally or parenterally in the forms such as tablets, capsules,
20 powders, syrups, granules, pills, suspensions, emulsions, liquids, fine particles, suppositories or ointments according to conventional methods.

Even more particularly, the present invention compound is mixed with the type I crystal, and it may
25 be used.

[0016]

Next, utility of the compound of the present invention is explained with the following tests.

[0017]

Test example 1

Measurement of specific volume

Test materials were the compound of the
5 present invention (the type II crystal and the type III
crystal) and the type I crystal.

After 3.0 g of the test material was put in a
measuring cylinder and the measuring cylinder was
shaken for 1 minute, the volume was measured.

10 Furthermore, after the measuring cylinder was shaken
for 1 minute until the volume of the test material did
not decrease, the procedure of measuring the volume was
repeated. The volume of the test material is measured,
and the specific volume was calculated. The results
15 are shown in Table 1.

[0018]

[TABLE 1]

crystal form	specific volume (cm ³ /g)
type I crystal	5.0
type II crystal	1.3
type III crystal	2.5

[0019]

The specific volume of the compounds of the
20 present invention (the type II crystal and the type III
crystal) was small in comparison with it of the type I
crystal.

[0020]

Test example 2

The amount of electrostatic charge

Test materials were the compounds of the present invention (the type II crystal and the type III crystal) and the type I crystal.

20 g of the test material was put on a paper, and the electric potential of charge was measured. Measurement was conducted 3 times, and the average-value was to be the electric potential of charge. The results are shown in Table 2.

Measuring instrument: electrostatic measuring instrument FMX-003 (Simucojapan Co., Ltd.)

Measurement distance: 25mm

15 [0021]

[TABLE 2]

crystal form	electric potential of charge (V)
type I crystal	-3270
type II crystal	+30
type III crystal	-560

[0022]

The amount of electrostatic charge of the compounds of the present invention (the type II crystal and the type III crystal) was small in comparison with it of the type I crystal, and was hard to be charged with static electricity.

[0023]

Next, the present invention is explained with examples and manufacturing examples, but the present invention is not limited thereto.

5 [0024]

Condition of measurement for powder X-ray diffraction anti-cathode: Cu, tube voltage: 40kV, tube current: 20mA

[0025]

10 Example 1

Production of the type II crystal (1)

6.0 mL of dimethyl sulfoxide, 10 mL of water and 20 mL of acetone were added to 1.00 g of the type I crystal, and it was heated and dissolved. After
15 cooling, the crystal which separated out was filtrated and collected, and air-dried to give 0.85 g of the type II crystal.

The powder X-ray diffraction data were shown in Table 3, and the pattern was shown in FIG. 1.

20 IR(ATR): $1,704\text{cm}^{-1}$

[0026]

[TABLE 3]

2θ	d	relative intensity
5.5000	16.0539	17.4
11.0800	7.9789	30.2
13.9800	6.3295	70.3
16.0400	5.5209	52.0
17.1200	5.1752	42.2
18.4800	4.7971	18.9
19.2600	4.6047	27.6
19.8000	4.4803	49.3
20.8800	4.2508	18.6
22.1600	4.0082	39.3
23.2600	3.8210	89.4
23.6800	3.7542	100.0
26.3400	3.3808	68.5
28.4000	3.1400	32.4
29.8600	2.9898	21.3

[0027]

Example 2

Production of the type II crystal (2)

12 mL of dimethyl sulfoxide and 40 mL of acetone were added to 2.00 g of the type I crystal, and it was dissolved. 20 mL of water was added dropwise at 60–61°C, after cooling, the crystal which separated out was filtrated and collected, and air-dried to give 1.66 g of the type II crystal. The powder X-ray diffraction pattern accorded with the example 1.

IR(ATR): 1,703cm⁻¹

[0028]

Example 3

Production of the type II crystal (3)

0.50 g of the type I crystal was added to 2.0 mL of dimethyl sulfoxide, 8.0 mL of acetone and 5.0 mL

of water, and 0.40 mL of 20% sodium hydroxide aqueous solution was added, and it was dissolved. It was heated to 40°C, and 0.45 mL of 6 mol/L hydrochloric acid was added dropwise. After cooling, the crystal which
5 separated out was filtrated and collected, and air-dried to give 0.47 g of the type II crystal.

The powder X-ray diffraction pattern accorded with the example 1.

IR(ATR): 1,703cm⁻¹

10 [0029]

Example 4

Production of the type III crystal (1)

0.50 g of the type I crystal was added to 5.0 mL of butyl acetate, 2.5 mL of acetone and 5.0 mL of
15 water, and 0.43 mL of 20% sodium hydroxide aqueous solution was added, and it was dissolved. 0.37 mL of 6 mol/L hydrochloric acid was added dropwise, it was heated to 50°C, and stirred for 2.5 hours. After cooling, the crystal which separated out was filtrated
20 and collected, and air-dried to give 0.45 g of the type III crystal.

The powder X-ray diffraction data were shown in Table 4, and the pattern was shown in FIG. 2.

IR(ATR): 1,743cm⁻¹

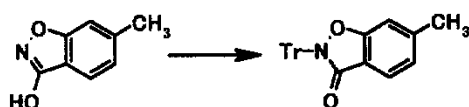
25 [0030]

[TABLE 4]

2θ	d	relative intensity
13.6000	6.5053	68.5
14.6000	6.0621	93.6
15.5000	5.7120	40.4
15.8600	5.5832	70.2
17.1400	5.1690	73.4
21.0000	4.2269	57.3
21.5000	4.1297	47.6
21.9000	4.0552	31.8
23.0600	3.8537	95.6
23.8800	3.7232	83.8
24.7399	3.5957	94.7
25.5600	3.4821	100.0
26.0200	3.4216	87.9
26.8600	3.3165	56.4
28.6000	3.1186	49.9

[0031]

Preparation 1



20.0 g of 6-methyl-1,2-benzisoxazol-3-ol,
 9.93 g of pyridine and 35.0 g of triphenylmethyl
 5 chloride were added to 100 mL of methylene chloride,
 and this was stirred for 1 hour at 35-45°C. 40 mL of
 water and 24 mL of 20% sodium hydroxide aqueous
 solution were added to the reaction mixture, and the
 organic layer was separated. The aqueous layer was
 10 extracted with 20 mL of methylene chloride, and the
 organic layers were combined, and 70 mL of the solvent
 was distilled off under atmospheric pressure, and 100
 mL of 2-propanol was added, and 40 mL of the solvent

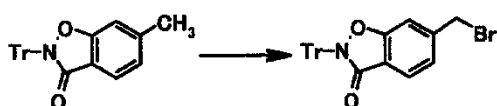
was distilled off under atmospheric pressure. 40 mL of water was added to the reaction mixture, and after stirring for 30 minutes at 10-25°C, the solid was filtered and collected, and 46.0 g of a light yellow solid of 6-methyl-2-triphenylmethyl-1,2-benzisoxazol-3(2H)-one was obtained.

$^1\text{H-NMR}$ (DMSO- d_6) δ value:

2.36 (3H, s), 7.03 (1H, d, $J=8.0\text{Hz}$), 7.18-7.33 (10H, m), 7.43-7.47 (7H, m)

10 [0032]

Preparation 2



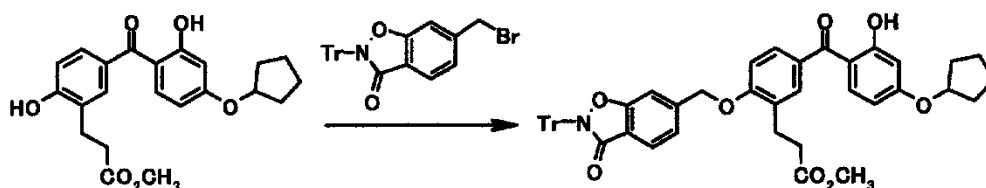
24.0 kg of 6-methyl-2-triphenylmethyl-1,2-benzisoxazol-3(2H)-one and 18.6 kg of N-bromosuccinimide were added to 48 L of chlorobenzene.

15 A solution of 0.30 kg of 2,2'-azobis(2,4-dimethylvaleronitrile) in 4.8 L of methylene chloride was added dropwise 5 times every 1 hour at 70-80°C. After completing the instillation, this was stirred for 1 hour at the same temperature. 96 L of methylene

20 chloride, 2.40 kg of celite, 24 L of 20% sodium hydroxide aqueous solution, 0.77 kg of sodium sulfite and 48 L of water were added to the reaction mixture. The insoluble matter was filtered off, and the cake was washed with 72 L of methylene chloride. The filtrate

20 4.72 (2H, s), 7.22-7.34 (10H, m), 7.44-
7.49 (7H, m), 7.58 (1H, d, J=8.0 Hz)

Preparation 3



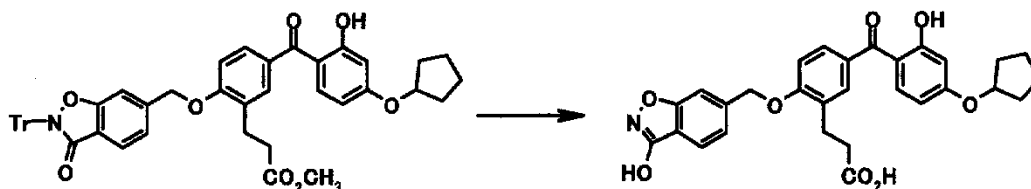
12.5 kg of 3-{5-[4-(cyclopentyloxy)-2-hydroxybenzoyl]-2-hydroxyphenyl}propionic acid methyl ester, 15.6 kg of 6-(bromomethyl)-2-triphenylmethyl-1,2-benzisoxazol-3(2H)-one and 4.49 kg of potassium carbonate were added to 125 L of acetone. This was stirred for 5 hours under heating reflux. After cooling the reaction mixture, 29 L of water was added, 2.9 L of hydrochloric acid was added dropwise, and solids were filtered. This resulted in 19.7 kg of 3-{5-[4-(cyclopentyloxy)-2-hydroxybenzoyl]-2-[(3-oxo-2-triphenylmethyl-2,3-dihydro-1,2-benzisoxazol-6-yl)methoxy]phenyl}propionic acid methyl ester in the form of a light yellowish-white solid.

¹H-NMR(DMSO-d₆) δ value:

1.55-1.78 (6H,m), 1.90-2.00 (2H,m), 2.63 (2H,t, J=7.6Hz), 2.93 (2H,t, J=7.6Hz), 3.49 (3H,s), 4.88-4.94 (1H,m), 5.33 (2H,s), 6.46-6.51 (2H,m), 7.13 (1H,d, J=8.3Hz), 7.22-7.25 (3H,m), 7.30-7.34 (7H,m), 7.42-7.56 (10H,m), 7.63 (1H,d, J=8.0Hz), 12.00 (1H,s)

[0034]

Preparation 4



(1) 100 g of 3-{5-[4-(cyclopentyloxy)-2-hydroxybenzoyl]-2-[(3-oxo-2-triphenylmethyl-2,3-

dihydro-1,2-benzisoxazol-6-yl)methoxy]phenyl}propionic acid methyl ester was suspended in 500 mL of acetone, and 240 mL of water and 60 mL of water of 15.5 g of sodium hydroxide were added, it was stirred at 20-30°C for 2 hour and was stirred at 5-15°C for 1 hour, and then the solid was filtrated and collected to give 146 g of a yellow solid.

(2) 146 g of the yellow solid was suspended in a mixed solution of 130 mL of 4-methyl-2-pentanone and 300 mL of acetone, and subsequently 50 mL of hydrochloric acid and 25 mL of water were added dropwise, and it was stirred at 45-55°C for 2 hours.

After 40 mL of 4-methyl-2-pentanone, 130 mL of water, 90 mL of dimethyl sulfoxide and 117 mL of 20% sodium hydroxide aqueous solution were added to the reaction mixture, 13 mL of hydrochloric acid was added dropwise at 45-55°C. The aqueous layer was separated and collected, 100 mL of acetone was added, the insoluble matter was filtrated, and the residue was washed with a mixture of 120 mL of acetone and 80 mL of water, subsequently washed with 200 mL of acetone. The filtrate and the washings were combined, and 21 mL of acetone was added. Seed crystal of the type II crystal was added at 45-55°C, 50 mL of dimethyl sulfoxide solution of 29 mL of hydrochloric acid was added dropwise at the same temperature, subsequently it was stirred at 5-15°C for 1 hour, and the solid was filtrated and collected to give the type II crystal

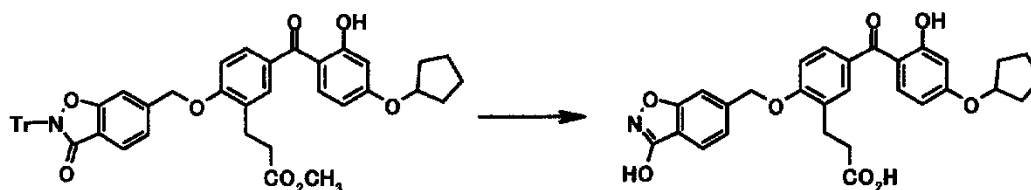
59.0 g of a light yellow.

The powder X-ray diffraction pattern accorded with the example 1.

IR(ATR): $1,704\text{cm}^{-1}$

5 [0035]

Preparation 5



(1) 270 g of 3-{5-[4-(cyclopentyloxy)-2-hydroxybenzoyl]-2-[(3-oxo-2-triphenylmethyl-2,3-dihydro-1,2-benzisoxazol-6-yl)methoxy]phenyl}propionic acid methyl ester was suspended in 1.35L of acetone, and 540 mL of water and 270 mL of water of 41.9 g of sodium hydroxide were added, it was stirred at 25-35°C for 3 hours and was stirred at 5-15°C for 30 minutes, and the solid was filtrated and collected to give 315 g of a yellow solid.

(2) 5.84 g of the yellow solid was suspended in a mixed solution of 10 mL of 4-methyl-2-pentanone, 10 mL of 2-butanone and 1.5 mL of water, subsequently 2.5 mL of hydrochloric acid was added dropwise, and it was stirred at 45-55°C for 3 hours. 15 mL of water and 7 mL of 20% sodium hydroxide aqueous solution were added to the reaction mixture, and it was stirred at 30-40°C. The aqueous layer was separated and collected, 7.5 mL

of water, 20 mL of 4-methyl-2-pentanone, 10 mL of 2-butanone and 0.7 mL of hydrochloric acid were added, subsequently 1 mL of hydrochloric acid and seed crystal of the type III crystal were added at 60-70°C, and 1 mL
5 of hydrochloric acid was added dropwise and it was stirred at 60-70°C for 2 hours. The organic layer was separated and collected, 5 mL of acetone was added, subsequently it was stirred at 20-25°C for 30 minutes, and the solid was filtrated and collected to give the
10 type III crystal 2.95 g of a light yellow.

The powder X-ray diffraction pattern accorded with the example 4.

IR(ATR): $1,743\text{cm}^{-1}$

[0036]

15 Reference example 1

In the manner described in example 35 of international publication No. 03/042,150 pamphlet, the type I crystal was produced.

The powder X-ray diffraction pattern is shown
20 in FIG. 3.

BRIEF DESCRIPTION OF DRAWINGS

[0037]

FIG. 1 represents the powder X-ray diffraction pattern of the type II crystal (the
25 ordinate represents Intensity (cps)); the abscissa represents an angle of diffraction ($2\theta(^{\circ})$).

FIG. 2 represents the powder X-ray

diffraction pattern of the type III crystal (the ordinate represents Intensity (cps)); the abscissa represents an angle of diffraction ($2\theta(^{\circ})$).

FIG. 3 represents the powder X-ray
5 diffraction pattern of the type I crystal (the ordinate is Intensity (cps)); the abscissa represents an angle of diffraction ($2\theta(^{\circ})$).

INDUSTRIAL APPLICABILITY

[0038]

10 The crystal of the present invention, (1) has a small specific volume, (2) is hard to be charged with electricity, (3) is easily handled, (4) is produced by use of a solvent which is safe to human body, (5) is produced in the condition of low environmental loads,
15 and (6) mass production of which is possible, is useful for an active pharmaceutical ingredient.

CLAIMS

1. The crystal of 3-{5-[4-(cyclopentyloxy)-2-hydroxybenzoyl]-2-[(3-hydroxy-1,2-benzisoxazol-6-yl)methoxy]phenyl}propionic acid having peaks at the position of 14.0, 16.0, 23.3, 23.7 and 26.3° on 2θ of diffraction angle in a powder X-ray diffraction pattern.
2. The crystal of 3-{5-[4-(cyclopentyloxy)-2-hydroxybenzoyl]-2-[(3-hydroxy-1,2-benzisoxazol-6-yl)methoxy]phenyl}propionic acid having peaks at the position of 14.6, 23.1, 24.7, 25.6 and 26.0° on 2θ of diffraction angle in a powder X-ray diffraction pattern.