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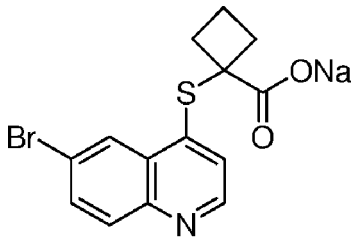
(54) **Title**: SODIUM SALT OF URIC ACID TRANSPORTER INHIBITOR AND CRYSTALLINE FORM THEREOF

(54) **发明名称** : 一种尿酸转运蛋白抑制剂的钠盐及其结晶形式



(I)

(57) **Abstract**: The present invention relates to a sodium salt of a uric acid transporter inhibitor and the crystalline form thereof. In particular, the present invention relates to the sodium salt of a uric acid transporter (URAT1) inhibitor, and the I-type crystal and the preparation method thereof. The present invention relates to 1-((6-bromo-quinoline-4-yl)thio)cyclobutyl sodium formate (the compound of formula (I)), and the I-type crystal and the preparation method thereof. The I-type crystal of the compound of formula (I) obtained in the present invention has a good crystal form stability and chemical stability, and the crystallization solvent used has a low toxicity and low residue, and can be better used in clinical treatment.

(57) **摘要**: 本发明涉及一种尿酸转运蛋白抑制剂的钠盐及其结晶形式。具体而言，本发明涉及一种尿酸转运蛋白(URAT1)抑制剂的钠盐、其 I 型结晶及制备方法。本发明涉及 1-((6-溴喹啉-4-基)硫基)环丁基甲酸钠(式(I)化合物)、其 I 型结晶及其制备方法。本发明所得到式(I)化合物的 I 型结晶具备良好的晶型稳定性和化学稳定性，并且所用结晶溶剂低毒低残留，可更好地用于临床治疗。

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SODIUM SALT OF URIC ACID TRANSPORTER INHIBITOR AND CRYSTALLINE FORM THEREOF

FIELD OF THE INVENTION

The present invention relates to sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate, crystal form I, preparation method and use thereof. The compound of formula (I) prepared according to the method of the present invention is useful in the treatment of gout disease.

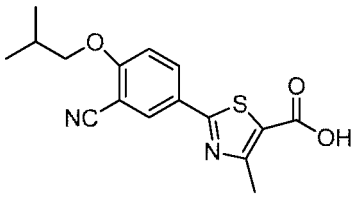
BACKGROUND OF THE INVENTION

Recently, the prevalence of gout has increased year by year, and the age of onset has shown younger-age trend due to the improvement of living standard. Men and menopausal women are vulnerable to gout, and the peak incidence is 40-50 years old. The clinical features of gout are hyperuricemia, recurrence of gouty acute arthritis, deposition of gouty tophus, characteristic chronic arthritis and joint deformity, kidney is generally involved to cause chronic interstitial nephritis and uratic nephrolithiasis. The prerequisite of gout is hyperuricemia, *i.e.* the saturated concentration of uric acid in serum at 37 °C is about 420 umol/L (70 mg/L), one is suffered from hyperuricemia when the concentration of uric acid thereof is higher than the above-mentioned value. However, only a part of hyperuricemia patients develop into gout, and its mechanism is unclear. Only hyperuricemia patients with deposition of urate crystal, arthritis and/or kidney disease, kidney stone etc are considered to suffer from gout. Therefore, hyperuricemia is an important biochemical basis index of gout, and is closely related to the onset of gout. Hyperuricemia is closely related to the onset of hypertension, hyperlipidemia, atherosclerosis, obesity and insulin resistance, and has become a serious metabolic disease that threatens human health.

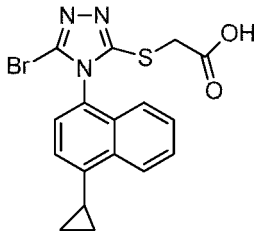
Uric acid is the final product of purine metabolism in human. Uricase is absent due to the gene mutation of uricase during human evolution, and uric acid thus can not be metabolized into soluble allantoin to remove from the body. Therefore, there is an excess of serum uric acid concentration in hyperuricemia patients. The onset of hyperuricemia is due to: (1) the increase of uric acid production, which accounts for 15% to 20% of onset of gout , for example, diets enriched with purine is consumed in excess, or more uric acid is synthesized from amino acid and nucleotide in vivo, and excessive uric acid is produced from the catabolism of nucleic acid; (2) the decrease of uric acid excretion and increase of uric acid reabsorption are the main pathogenesis of hyperuricemia and gout, which account for about 80% to 85%. About 95% of uric acid reabsorption is performed by the Uric Acid Transporter 1 (URAT1) located in the epithelial cell of renal proximal tubule. URAT1 is a complete membrane protein

located in the kidney, which belongs to the solute carrier 22 (SLC22) family. It performs urate-anion exchange, and is responsible for the regulation of uric acid level in blood. Therefore, URAT1 inhibitor could enhance the excretion of uric acid by inhibiting such reabsorption.

There are very few anti-gout drugs on the pharmaceutical market of China, no novel and better anti-gout drug has been developed. Allopurinol and benzbromarone are still the main drugs. Febuxostat, approved by FDA in 2009, belongs to a xanthine oxidase (XO) inhibitor. It treats gout by reducing the production of uric acid. RDEA-594 (Lesinurad), developed by Ardea Biosciences Inc., enhances the excretion of uric acid by inhibiting the Uric Acid Transporter 1 (URAT1), thereby achieving the purpose of reducing the concentration of uric acid in serum. Its efficacy is not affected by renal function and the dosage of allopurinol. It does not affect the transport effect of Organic Anion Transporter 1/3 (OAT1/OAT3) within clinical dosage. In addition, it is more specific to the targets compared with other uricosuric drugs, and has less interactions with other drugs.



Febuxostat

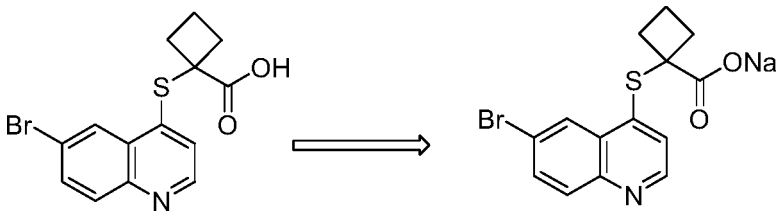


RDEA-594

The structural formulas of febuxostat and RDEA-594

However, RDEA-594 is found in the clinical trial of drugs for treating HIV infection, and its activity against uric acid transporter URAT1 is not high, IC50 is about 7 uM. Moreover, the dosage in clinical use is relatively high. Therefore, there is still much exploring space for the target uric acid transporter URAT1.

WO2014183555 discloses a series of compounds with higher inhibitory activity on uric acid transporter URAT1. These compounds can effectively inhibit the reabsorption of uric acid and excrete uric acid from the body, thereby reducing the blood uric acid content continuously to achieve the purpose of treating gout. A compound as shown below is included,



A compound disclosed in the application

Formula (I)

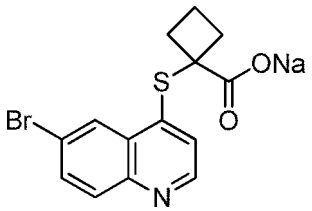
In order to further improve the solubility in water of this compound, the applicant has developed a sodium salt thereof (formula I). The solubility in water has increased from almost insoluble to 0.14 mg/mL. On the other hand, the crystal structure of the pharmaceutically active ingredient often affects the chemical stability of the drug. Different crystallization conditions and storage conditions can lead to changes in the crystal structure of the compound, and sometimes the accompanying production of other forms of crystal form. In general, an amorphous drug product does not have a regular crystal structure, and often has other defects such as poor product stability, smaller particle size, difficult filtration, easy agglomeration, and poor liquidity. Therefore, it is necessary to improve the various properties of the above-mentioned product. On the basis of finding novel developing form thereof, there is a need to search a new crystal form with high purity and good chemical stability.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present disclosure as it existed before he priority date of each of the appended claims.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

SUMMARY

It is desirable to provide a compound of formula (I), *i.e.* sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate.



(I)

The compound of formula (I) can be obtained by reacting 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylic acid with sodium hydroxide.

The applicant has investigated a series of crystal products of the compound of formula (I) obtained under various crystallization conditions, and X-ray diffraction and differential scanning calorimetry (DSC) measurement have been conducted on the crystal products obtained. It was found that a stable crystal form, which is referred to as crystal form I, can be obtained under specific crystallization condition. The DSC

spectrum of crystal form I of the present application shows no absorption within 300 °C, indicating that its melting point is greater than 300 °C. The X-ray powder diffraction spectrum, which is obtained by using Cu-Ka radiation and represented by 2θ angle and interplanar distance (d value), is shown in Figure 1, in which there are characteristic peaks at 9.08 (9.73), 11.73 (7.54), 12.19 (7.26), 15.59 (5.68), 16.28 (5.44), 17.73 (5.00), 18.16 (4.88), 18.80 (4.72), 19.48 (4.55), 20.80 (4.27), 23.16 (3.84), 27.54 (3.24) and 30.37 (2.94).

The present invention also provides a method of preparing crystal form I of the compound of formula (I). Specifically, the method comprises the following steps of:

(1) dissolving a solid sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate in any crystal form or amorphous form into an appropriate amount of solvent under heating, then cooling the solution to precipitate a crystal;

(2) filtering the crystal, then washing and drying it.

In step (1), the solvent is a mixed solvent of water and any of alcohols and ketones having 3 or less carbon atoms; more preferably water/isopropanol, water/acetone, acetone/water/acetone, acetone/water/isopropanol.

In an embodiment of the present invention, the preferred mixed solvent is a mixed solvent of acetone/water/acetone, and the ratio is not particularly limited. In a preferred embodiment of the present invention, the volume ratio of the three is 1:1:5. When the mixed solvent is acetone/water/acetone, it means that sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate is dissolved in a mixed solvent of acetone/water until the solution is clear, then another part of acetone is added to precipitate a crystal. Acetone/water/isopropanol also refers to a similar meaning.

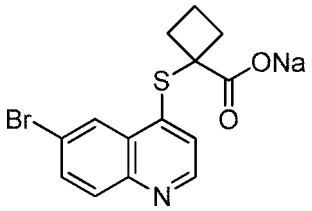
The recrystallization method is not particularly limited, and can be carried out by a conventional recrystallization process. For example, the material, i.e., the compound of formula (I), can be dissolved in an organic solvent under heating, and then the solution is cooled slowly to precipitate a crystal under stirring. After the completion of crystallization, the desired crystal can be obtained via filtering and drying. In particular, the crystal obtained by filtration is usually dried in vacuum under reduced pressure at a heating temperature of about 30~100°C, preferably 40~60°C, to remove the recrystallization solvent.

The resulting crystal form is determined by differential scanning calorimetry (DSC) and X-ray diffraction spectrum. Meanwhile, the residual solvent in the obtained crystal is also determined.

The crystal form of the compound of formula (I) prepared according to the method of the present invention does not contain or contains only a relatively low content of residual solvent, which meets the requirement of the National Pharmacopoeia concerning the limitation of the residual solvent of drug products. Therefore, the crystal of the present invention is suitable for use as a pharmaceutical active ingredient.

The research results show that crystal form I of the compound of formula (I) prepared according to present invention is stable under conditions of lighting, high temperature and high humidity, crystal form I is also stable under conditions of grinding, pressure and heating, which meets the production, transportation and storage requirements of drug products. The preparation process thereof is stable, repeatable and controllable, which is suitable for industrial production.

In one aspect, there is provided sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I),



(I).

There is also provided crystal form I of the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) as defined herein, characterized in that the crystal has an X-ray powder diffraction spectrum, which is obtained by using Cu-Ka radiation and represented by 2θ angle and interplanar distance, as shown in Figure 1, in which there are characteristic peaks at about 9.08 (9.73), 11.73 (7.54), 12.19 (7.26), 15.59 (5.68), 16.28 (5.44), 17.73 (5.00), 18.16 (4.88), 18.80 (4.72), 19.48 (4.55), 20.80 (4.27), 23.16 (3.84), 27.54 (3.24) and 30.37 (2.94).

There is also provided a method of preparing the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) as defined herein, comprising a step of reacting 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylic acid with sodium hydroxide.

There is also provided a method of preparing the crystal form I as defined herein, comprising the following steps of:

1) dissolving a solid sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate in any crystal form or amorphous form into an appropriate amount of solvent under heating, then cooling the solution to precipitate a crystal, wherein the solvent is a mixed solvent of water and any

of alcohols and ketones having 3 or less carbon atoms;

2) filtering the crystal, then washing and drying it.

There is also provided a pharmaceutical composition comprising the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) as defined herein or the crystal form I as defined herein, and a pharmaceutically acceptable carrier.

There is further provided use of the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) as defined herein, the crystal form I as defined herein, or the pharmaceutical composition as defined herein in the preparation of a medicament for the treatment of disease related to Uric Acid Transporter (URAT1).

There is further provided a method for treating a disease related to Uric Acid Transporter (URAT1) in a subject, comprising administering to the subject sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) as defined herein, the crystal form I as defined herein, or the pharmaceutical composition as defined herein.

There is further provided sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) as defined herein, the crystal form I as defined herein, or the pharmaceutical composition as defined herein, when used for treating a disease related to Uric Acid Transporter (URAT1).

DESCRIPTION OF THE DRAWINGS

Figure 1 shows the X-ray powder diffraction spectrum of crystal form I of the compound of formula (I).

Figure 2 shows the DSC spectrum of crystal form I of the compound of formula (I).

DETAILED DESCRIPTION OF THE INVENTION

The present invention is illustrated by the following examples in detail. The examples of the present invention are merely intended to describe the technical solution of the present invention, and should not be considered as limiting the scope of the present invention.

Test instruments used in the experiments

1. DSC spectrum
Instrument type: Mettler Toledo DSC 1 Stare^{e} System
Purging gas: Nitrogen
Heating rate: 10.0 °C/min
Temperature range: 40-300 °C

2. X-ray diffraction spectrum
Instrument type: Bruker D8 Focus X-ray powder diffractometer
Ray: monochromatic Cu-Kα ray (λ=1.5406)
Scanning mode: θ/2θ, Scanning range: 2-40°
Voltage: 40 KV, Electric current: 40 mA

Example 1

1-((6-Bromoquinolin-4-yl)thio)cyclobutane-1-carboxylic acid (prepared according to the method disclosed in WO 2014/183555) (1.0 g, 2.96 mmol) was added to a 50 mL three-necked reaction flask at 25°C, then 4.0 g of anhydrous ethanol was added. A 0.5 ml aqueous solution of sodium hydroxide (118 mg, 2.96 mmol) was added dropwise

under stirring, then the reaction was stirred. The reaction was filtered, the filter cake was washed with anhydrous ethanol and dried in vacuum at 40°C. 850 mg of white to pale yellow powder was obtained in a yield of 84.0%. The X-ray powder diffraction spectrum of the crystal sample is shown in Figure 1, in which there are characteristic peaks at about 9.08 (9.73), 11.73 (7.54), 12.19 (7.26), 15.59 (5.68), 16.28 (5.44), 17.73 (5.00), 18.16 (4.88), 18.80 (4.72), 19.48 (4.55), 20.80 (4.27), 23.16 (3.84), 27.54 (3.24) and 30.37 (2.94). The DSC spectrum is shown in Figure 2, which shows no absorption within 300 °C, indicating that its melting point is greater than 300 °C. The crystal form was defined as crystal form I.

Example 2

The compound of formula (I) (prepared according to Example 1) (1.0 g, 2.78 mmol) was added to a 250 mL one-necked flask, then 30 ml of water was added. The mixture was heated to reflux until the solution was clear, then concentrated to about 3 ml under reduced pressure. 150 ml of isopropanol was added slowly to precipitate a crystal under stirring. On the next day, the mixture was filtered and dried to obtain 689 mg of a white solid in a yield of 68.9%. The crystal sample was identified as crystal form I after studying and comparing the X-ray diffraction and DSC spectra.

Example 3

The compound of formula (I) (prepared according to Example 1) (1.0 g, 2.78 mmol) was added to a 150 mL one-necked flask, then 30 ml of water was added. The mixture was heated to reflux until the solution was clear, then concentrated to dryness under reduced pressure. 30 ml of isopropanol was added directly to precipitate a crystal under stirring. On the next day, the mixture was filtered and dried to obtain 812 mg of a white solid in a yield of 81.2%. The crystal sample was identified as crystal form I after studying and comparing the X-ray diffraction and DSC spectra.

Example 4

The compound of formula (I) (prepared according to Example 1) (1.0 g, 2.78 mmol) was added to a 150 mL one-necked flask, then 30 ml of water was added. The mixture was heated to reflux until the solution was clear, then concentrated to about 3 ml under reduced pressure. 30 ml of acetone was added slowly to precipitate a crystal under stirring. On the next day, the mixture was filtered and dried to obtain 918 mg of a white solid in a yield of 91.8%. The crystal sample was identified as crystal form I after studying and comparing the X-ray diffraction and DSC spectra.

Example 5

The compound of formula (I) (prepared according to Example 1) (1.0 g, 2.78 mmol) was added to a 150 mL one-necked flask, then 24 ml of acetone/water (v/v=1:1) was added. The mixture was heated to reflux until the solution was clear, then 60 ml of

acetone was added slowly. The mixture was continuously refluxed for 10 min before the heating was stopped. Then, the mixture was stirred to precipitate a crystal. On the next day, the mixture was filtered and dried to obtain 688 mg of a white solid in a yield of 68.8%. The crystal sample was identified as crystal form I after studying and comparing the X-ray diffraction and DSC spectra.

Example 6

The compound of formula (I) (prepared according to Example 1) (1.0 g, 2.78 mmol) was added to a 150 mL one-necked flask, then 24 ml of acetone/water (v/v=1:1) was added. The mixture was heated to reflux until the solution was clear, then 60 ml of isopropanol was added slowly. The mixture was continuously refluxed for 10 min before the heating was stopped. Then, the mixture was stirred to precipitate a crystal. On the next day, the mixture was filtered and dried to obtain 752 mg of a white solid in a yield of 75.2%. The crystal sample was identified as crystal form I after studying and comparing the X-ray diffraction and DSC spectra.

Example 7

The compound of formula (I) (prepared according to Example 1) (1.0 g, 2.78 mmol) was added to a 500 mL one-necked flask, then 30 ml of water was added. The mixture was heated to reflux until the solution was clear, then 300 ml of acetone was added slowly to precipitate a crystal under stirring. On the next day, the mixture was filtered and dried to obtain 728 mg of a white solid in a yield of 72.8%. The crystal sample was identified as crystal form I after studying and comparing the X-ray diffraction and DSC spectra.

Example 8

The sample of crystal form I prepared in Example 1 was spread flat in the air to test its stability under conditions of lighting (4500 Lux), heating (40 °C, 60 °C), and high humidity (RH 75%, RH 90%). Samplings were carried out on Day 5 and Day 10. The purity as detected by HPLC is shown in Table 1.

Table 1. Stability of the sample of crystal form I of the compound of formula (I)

Batch number	Time (day)	Lighting	40°C	60°C	RH 75%	RH 90%
S011303130715	0	99.76%	99.76%	99.76%	99.76%	99.76%
	5	99.75%	99.73%	99.73%	99.74%	99.74%
	10	99.70%	99.73%	99.71%	99.74%	99.73%

The results of the stability study showed that the sample of crystal form I had good stability when it was spread flat in the air under conditions of lighting, high temperature and high humidity.

Example 9

Crystal form I of the compound of formula (I) prepared according to the method of Example 1 was ground, heated and pressed. The results showed that the crystal form is stable. The detailed experimental data are shown in Table 2 below.

Table 2. Special stability study of crystal form I of the compound of formula (I)

Batch number	Treatment Process	Experimental procedure	Crystal form	DSC peak
S011303130715G	Grinding treatment for 10 min	1 g of the sample of crystal form I of the compound of formula (I) was ground for 10 min in a mortar under nitrogen atmosphere.	Crystal form I	> 300 °C
S011303130715H	Heating treatment for 3 h at 80°C	1 g of the sample of crystal form I of the compound of formula (I) was spread flat and heated at 80°C for 3 h.	Crystal form I	> 300 °C
S011303130715P	Pressing treatment	The sample of crystal form I of the compound of formula (I) was pressed to a slice.	Crystal form I	> 300 °C

Example 10

In the pharmacokinetic assay of the compound of Example 1 of the present invention, Sprague-Dawley (SD) rats were used as test animals. The compound of Example 1 was administrated intragastrically and intravenously to rats, then the drug concentration in plasma at different time points was determined by a LC/MS/MS method to study the pharmacokinetic behavior and to evaluate the pharmacokinetic characteristics of the compound of the present invention in rats. The pharmacokinetic parameters of the compound of the present invention are shown in Table 3. The results showed that: the compound of the present invention is well absorbed, and have a remarkable oral absorption effect. According to the mean value of AUC0-t, the absolute bioavailability of the compound after a single intragastric administration of 3 mg/kg in rats was calculated as 74.1%.

Table 3. Pharmacokinetic parameters of the compound after a single intragastric or intravenous administration in rats (n=6, half male and half female)

Mode of administration	Dosage (mg/kg)	Plasma concentration C_{max} (μg/mL)	Area under curve AUC_{0-t} (μg·h/mL)	Resistance time $MRT_{0-\infty}$(h)	Half life $t_{1/2}$ (h)
Intragastric administration	3	10.5 ± 7.9	41.5 ± 27.2	6.15 ± 1.51	4.58 ± 0.85
	9	22.0 ± 11.0	119 ± 65	7.11 ± 1.75	5.07 ± 2.08
	27	38.8 ± 17.0	336 ± 241	7.09 ± 1.33	4.59 ± 0.50

Intravenous administration	3	-	56.0 ± 19.6	6.18 ± 1.33	5.50 ± 1.88

Example 11

In the pharmacokinetic assay of the compound of Example 1 of the present invention, the Beagle dogs were used as test animals. The compound of Example 1 was administrated intragastrically and intravenously to dogs, then the drug concentration in plasma at different time points was determined by a LC/MS/MS method to study the pharmacokinetic behavior and to evaluate the pharmacokinetic characteristics of the compound of the present invention in dogs. The pharmacokinetic parameters of the compound of the present invention are shown in Table 4. The results showed that: the compound of the present invention is well absorbed, and have a remarkable oral absorption effect. According to the mean value of AUC0-t, the absolute bioavailability of the compound after a single intragastric administration of 3 mg/kg in dogs was calculated as 59.5%

Table 4. Pharmacokinetic parameters of the compound after a single intragastric or intravenous administration in dogs (n=6, half male and half female)

Mode of administration	Dosage (mg/kg)	Plasma concentration C_{max} (μg/mL)	Area under curve AUC_{0-t} (μg·h/mL)	Resistance time $MRT_{0-\infty}$(h)	Half life $t_{1/2}$ (h)
Intragastric administration	3	8.45 ± 2.1	8.63 ± 3.44	3.03 ± 1.03	3.49 ± 1.20
	9	27.6 ± 4.8	37.5 ± 10.8	3.48 ± 1.36	3.83 ± 2.00
	27	78.6 ± 22.0	105 ± 30.9	3.38 ± 0.96	4.31 ± 1.60
Intravenous administration	3	-	14.5 ± 3.6	3.57 ± 1.89	4.51 ± 2.25

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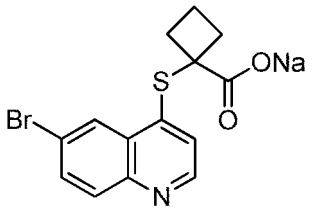
CLAIMS:

1. Sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I),



(I).

2. Crystal form I of the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) according to claim 1, characterized in that the crystal has an X-ray powder diffraction spectrum, which is obtained by using Cu-Ka radiation and represented by 2θ angle and interplanar distance, as shown in Figure 1, in which there are characteristic peaks at about 9.08 (9.73), 11.73 (7.54), 12.19 (7.26), 15.59 (5.68), 16.28 (5.44), 17.73 (5.00), 18.16 (4.88), 18.80 (4.72), 19.48 (4.55), 20.80 (4.27), 23.16 (3.84), 27.54 (3.24) and 30.37 (2.94).

3. A method of preparing the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) according to claim 1, comprising a step of reacting 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylic acid with sodium hydroxide.

4. A method of preparing the crystal form I according to claim 2, comprising the following steps of:

1) dissolving a solid sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate in any crystal form or amorphous form into an appropriate amount of solvent under heating, then cooling the solution to precipitate a crystal, wherein the solvent is a mixed solvent of water and any of alcohols and ketones having 3 or less carbon atoms;

2) filtering the crystal, then washing and drying it.

5. The method according to claim 4, characterized in that the solvent in step 1) is preferably water/isopropanol, water/acetone, acetone/water/acetone, acetone/water/isopropanol.

6. A pharmaceutical composition, comprising the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) according to claim 1 or the crystal form I according to claim 2, and a pharmaceutically acceptable carrier.

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7. Use of the sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) according to claim 1, the crystal form I according to claim 2, or the pharmaceutical composition according to claim 6 in the preparation of a medicament for the treatment of disease related to Uric Acid Transporter (URAT1).

8. A method for treating a disease related to Uric Acid Transporter (URAT1) in a subject, comprising administering to the subject sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) according to claim 1, the crystal form I according to claim 2, or the pharmaceutical composition according to claim 6.

9. Sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) according to claim 1, the crystal form I according to claim 2, or the pharmaceutical composition according to claim 6, when used for treating a disease related to Uric Acid Transporter (URAT1).

10. The use, method, or sodium 1-((6-bromoquinolin-4-yl)thio)cyclobutane-1-carboxylate of formula (I) according to claim 1, the crystal form I according to claim 2, or the pharmaceutical composition according to claim 6, when used as claimed in any one of claims 7 to 9, wherein the disease is gout.

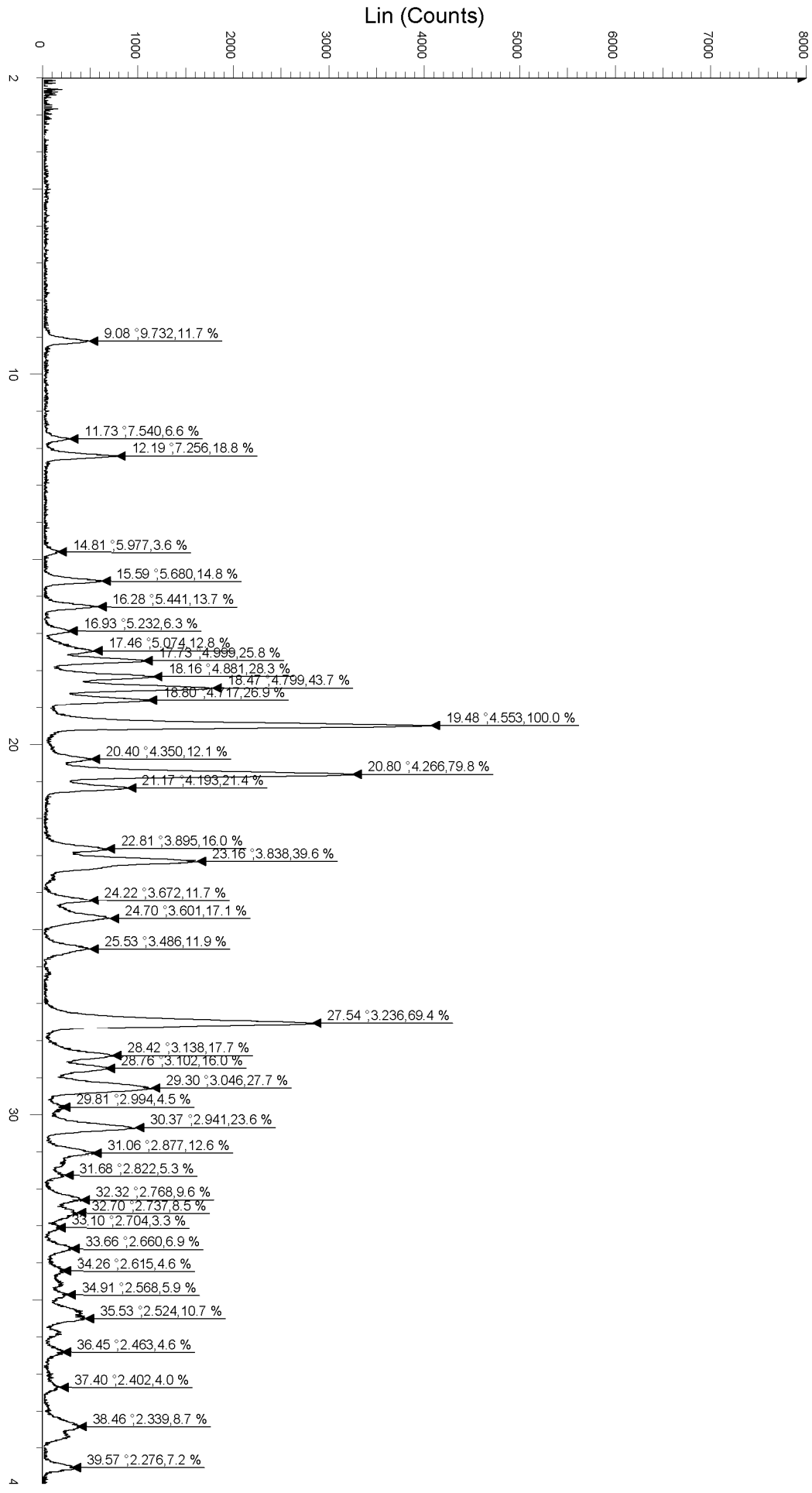
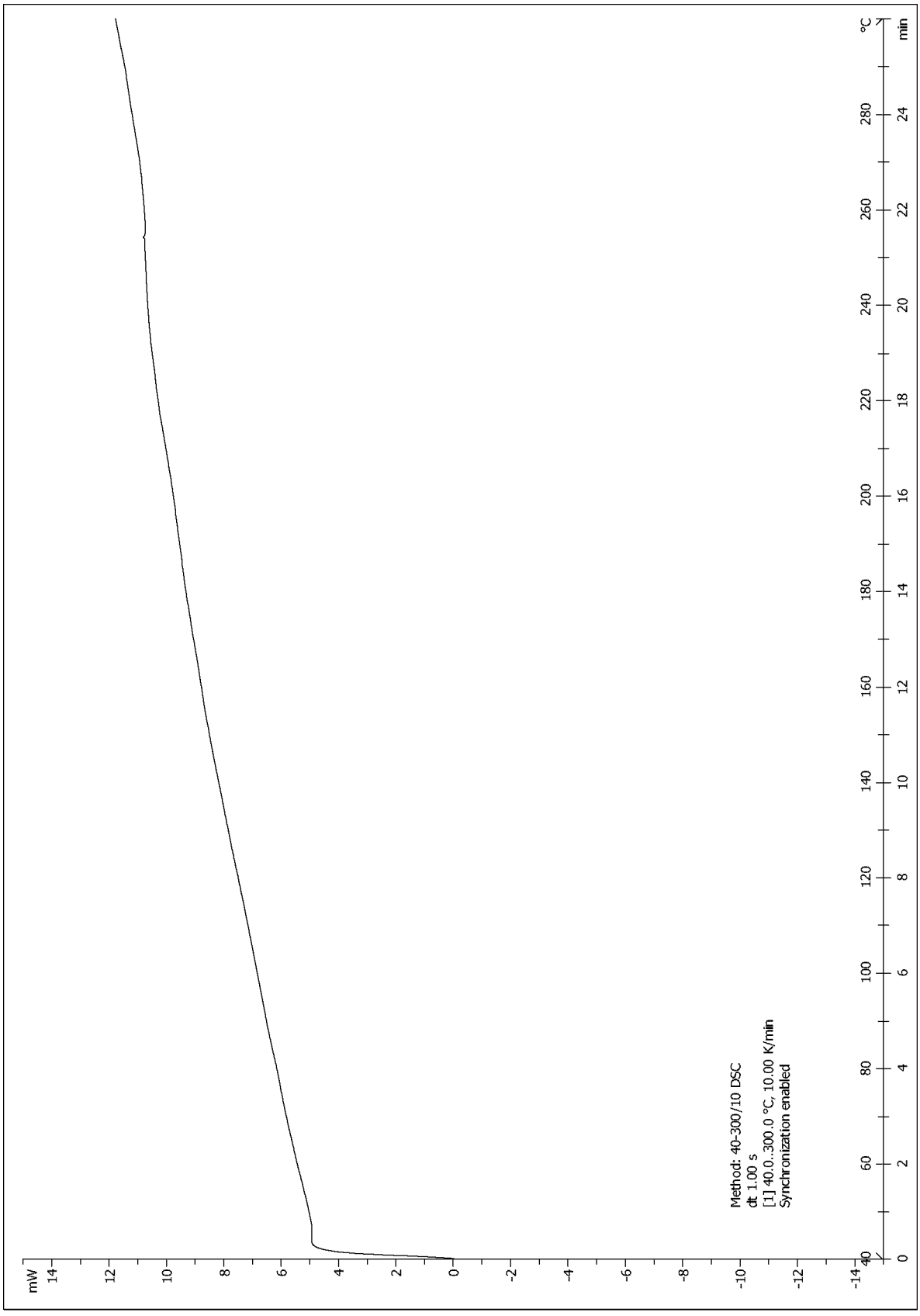

Lin (Counts)
0
1000
2000
3000
4000
5000
6000
7000
8000
2-Theta
2
10
20
30
4
9.08 °;9.732,11.7 %
11.73 °;7.540,6.6 %
12.19 °;7.256,18.8 %
14.81 °;5.977,3.6 %
15.59 °;5.680,14.8 %
16.28 °;5.441,13.7 %
16.93 °;5.232,6.3 %
17.46 °;5.074,12.8 %
17.73 °;4.999,25.8 %
18.16 °;4.881,28.3 %
18.47 °;4.799,43.7 %
18.80 °;4.717,26.9 %
19.48 °;4.553,100.0 %
20.40 °;4.350,12.1 %
20.80 °;4.266,79.8 %
21.17 °;4.193,21.4 %
22.81 °;3.895,16.0 %
23.16 °;3.838,39.6 %
24.22 °;3.672,11.7 %
24.70 °;3.601,17.1 %
25.53 °;3.486,11.9 %
27.54 °;3.236,69.4 %
28.42 °;3.138,17.7 %
28.76 °;3.102,16.0 %
29.30 °;3.046,27.7 %
29.81 °;2.994,4.5 %
30.37 °;2.941,23.6 %
31.06 °;2.877,12.6 %
31.68 °;2.822,5.3 %
32.32 °;2.768,9.6 %
32.70 °;2.737,8.5 %
33.10 °;2.704,3.3 %
33.66 °;2.660,6.9 %
34.26 °;2.615,4.6 %
34.91 °;2.568,5.9 %
35.53 °;2.524,10.7 %
36.45 °;2.463,4.6 %
37.40 °;2.402,4.0 %
38.46 °;2.339,8.7 %
39.57 °;2.276,7.2 %

Figure 1


mW
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10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
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dt 1.00 s
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Synchronization enabled
0
2
4
6
8
10
12
14
16
18
20
22
24
min
40
60
80
100
120
140
160
180
200
220
240
260
280
°C

Figure 2