IN THE UNITED STATES DISTRICT COURT
FOR DELAWARE

ASTRAZENECA PHARMACEUTICALS LP,

and

ASTRAZENECA UK LIMITED,

and

IPR PHARMACEUTICALS, INC.,

and

SHIONOGI SEIYAKU KABUSHIKI KAISHA,

Plaintiffs,

v.

SUN PHARMACEUTICAL INDUSTRIES LTD.,

and

SUN PHARMACEUTICAL INDUSTRIES INC.,

and

CARACO PHARMACEUTICAL LABORATORIES LTD.,

Defendants.

Civil Action No.: _____

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiffs, AstraZeneca Pharmaceuticals LP, AstraZeneca UK Limited, IPR Pharmaceuticals, Inc., and Shionogi Seiyaku Kabushiki Kaisha, for their Complaint against Sun Pharmaceutical Industries Ltd., Sun Pharmaceutical Industries Inc., and Caraco Pharmaceutical Laboratories Ltd., hereby state as follows:

Nature of the Action

1. This is a civil action for patent infringement arising under the patent laws of the United States, 35 U.S.C. § 100 et seq., and in particular under 35 U.S.C. §§ 271(e) and (a). This action relates to an Abbreviated New Drug Application ("ANDA") filed by and/or for the benefit of Sun Pharmaceutical Industries Ltd., Sun Pharmaceutical Industries Inc., and Caraco Pharmaceutical Laboratories Ltd. ("the Sun ANDA") with the United States Food and Drug Administration ("FDA") for approval to market generic versions of Plaintiffs' highly successful Crestor® pharmaceutical products that are sold in the United States.

Parties

2. Plaintiff AstraZeneca Pharmaceuticals LP ("AstraZeneca") is a corporation operating and existing under the laws of Delaware with its principal place of business at 1800 Concord Pike, Wilmington, Delaware 19803 USA.

3. Plaintiff AstraZeneca UK Limited is a corporation operating and existing under the laws of the United Kingdom with its principal place of business at 15 Stanhope Gate, London W1K 1LN, England.

4. Plaintiff IPR Pharmaceuticals, Inc. ("IPR") is a corporation operating and existing under the laws of Puerto Rico with its principal place of business at Carr 188 Lote 17, San Isidro Industrial Park, Canovanas, Puerto Rico 00729.

5. Plaintiff Shionogi Seiyaku Kabushiki Kaisha is a corporation operating and existing under the laws of Japan with its principal place of business at 1-8, Doshomachi 3-chome, Chuo-ku, Osaka 541-0045 Japan.

6. On information and belief, Defendant Sun Pharmaceutical Industries Ltd. ("Sun Ltd.") is a corporation operating and existing under the laws of India with its principal place of business at Acme Plaza, Andheri-Kurla Road, Andheri (East), Mumbai 400059, Maharashtra, India.

7. On information and belief, Defendant Sun Pharmaceutical Industries Inc. ("Sun USA") is a wholly owned subsidiary of Sun Ltd. and is a corporation operating and existing under the laws of Delaware with its principal place of business at 270 Prospect Plains Road, Cranbury, New Jersey 08512 USA.

8. On information and belief, Caraco Pharmaceutical Laboratories's Ltd. ("Caraco") is a corporation operating and existing under the laws of Michigan with its principal place of business at 1150 Elijah McCoy Drive, Detroit, Michigan 48202 USA. On information and belief, a majority of Caraco's common stock is owned by Sun Ltd.

Background

9. IPR is the holder of approved New Drug Application ("NDA") No. 021366 for Crestor® Tablets, in 5 mg, 10 mg, 20 mg, and 40 mg dosage forms, containing rosuvastatin calcium. AstraZeneca is IPR's authorized agent for matters related to NDA No. 021366.

10. CRESTOR® (rosuvastatin calcium) is a prescription drug belonging to a group of medicines (called statins) that are used to treat high cholesterol. Crestor® is one of the most effective lipid-lowering statins available. Over 11 million patients have been prescribed Crestor®, and over 110 million prescriptions have been written worldwide for Crestor®.

11. Plaintiffs, among other things, manufacture, market, promote, educate the public and physicians about, and conduct research and development on existing and new indications for Crestor® Tablets. Plaintiffs financially benefit from sales of Crestor® Tablets in the United States.

12. On information and belief, Sun Ltd., Sun USA, and/or Caraco filed with the FDA, in Rockville, Maryland, ANDA No. 79-169 under 21 U.S.C. § 355(j) to obtain FDA approval for the commercial manufacture, use, importation, offer for sale, and sale in the United States of rosuvastatin calcium tablets in 5 mg, 10 mg, 20 mg, and 40 mg dosage strengths, which are generic versions of Plaintiffs' Crestor® Tablets in 5 mg, 10 mg, 20 mg, and 40 mg dosage strengths, respectively.

13. By letter dated November 16, 2007, Sun Ltd. notified Plaintiffs that it had filed an ANDA seeking FDA approval to market rosuvastatin calcium tablets in 5 mg, 10 mg, 20 mg, and 40 mg dosage strengths (hereinafter referred to as "the Sun Rosuvastatin Calcium Tablets"), and that it was providing information to Plaintiffs pursuant to 21 U.S.C. § 355(j)(2)(B)(ii) and 21 C.F.R. § 314.95.

14. On information and belief, Sun Ltd. is in the business of developing and manufacturing generic pharmaceutical products. On information and belief, Sun Ltd. claims to have a successful generic presence in the United States based on its subsidiaries, Caraco and Sun USA.

15. On information and belief, Sun Ltd. sells and delivers its pharmaceutical products to Sun USA in New Jersey and Caraco in Michigan. On information and belief Sun USA and Caraco are the agents, affiliates, representatives, and/or alter egos of, and/or act in concert with,

Sun Ltd. for the purposes of marketing, distributing, and selling generic pharmaceutical products within the United States, including the State of Delaware.

16. On information and belief, Sun USA and Caraco, as the authorized agents of Sun Ltd. and/or in their own capacity, participated in the preparation and filing with the FDA of the Sun ANDA for approval to market generic rosuvastatin calcium in the United States.

Jurisdiction and Venue

17. Subject matter jurisdiction is proper under 28 U.S.C. §§ 1331, 1338(a), 2201, and 2202.

18. On information and belief, Sun Ltd. develops and manufactures generic drugs and, directly or indirectly through Sun USA and/or Caraco, markets, distributes, and sells its generic drugs throughout the United States, including the State of Delaware.

19. Personal jurisdiction over Sun Ltd. is proper because it purposefully avails itself of the privilege of selling its generic products in the state of Delaware and can therefore reasonably expect to be subject to jurisdiction in Courts in Delaware. Among other things, upon information and belief, Sun Ltd., directly or through its subsidiaries Sun USA and/or Caraco, places goods into the stream of commerce for distribution throughout the United States, including the State of Delaware.

20. Personal jurisdiction over Sun USA is proper because it purposefully avails itself of the privilege of selling its generic products in the state of Delaware and can therefore reasonably expect to be subject to jurisdiction in Courts in Delaware. Among other things, upon

information and belief, Sun USA directly places goods into the stream of commerce for distribution throughout the United States, including the State of Delaware.

21. Personal jurisdiction over Caraco is proper because it purposefully avails itself of the privilege of selling its generic products in the state of Delaware and can therefore reasonably expect to be subject to jurisdiction in Courts in Delaware. Among other things, upon information and belief, Caraco directly places goods into the stream of commerce for distribution throughout the United States, including the State of Delaware.

22. Venue is proper in this judicial district under 28 U.S.C. §§ 1391(c) and 1400(b).

Count I

Infringement of United States Patent No. RE37,314 Under 35 U.S.C. § 271(e)(2)

23. Plaintiffs incorporate by reference paragraphs 1-22 of this Complaint as if fully set forth herein.

24. United States Patent No. RE37,314 ("the '314 patent"), entitled "Pyrimidine Derivatives," was duly and legally reissued by the United States Patent and Trademark Office on August 7, 2001. Plaintiffs hold all substantial rights in the '314 patent and have the right to sue for infringement thereof. A true and correct copy of the '314 patent is attached as Exhibit A.

25. On information and belief, Sun Ltd., Sun USA, and Caraco filed ANDA No. 79-169 in order to obtain approval to market the Sun Rosuvastatin Calcium Tablets in the United States before the expiration of the '314 patent. On information and belief, Sun Ltd., Sun USA, and Caraco also filed with the FDA, pursuant to 21 U.S.C. § 355(j)(2)(A)(vii)(IV) and 21 C.F.R. § 314.94(a)(12)(i)(A)(4), a certification alleging that the claims of the '314 patent are invalid and that the '314 patent is unenforceable.

26. On information and belief, Sun Ltd., Sun USA, and Caraco do not assert that Sun Rosuvastatin Calcium Tablets are not covered by one or more claims of the '314 patent.

27. Under 35 U.S.C. § 271(e)(2)(A), the submission by Sun Ltd., Sun USA, and/or Caraco to the FDA of ANDA No. 79-169 to obtain approval for the commercial manufacture, use, or sale of the Sun Rosuvastatin Calcium Tablets before the expiration date of the '314 patent constitutes infringement of one or more claims of the '314 patent, either literally or under the doctrine of equivalents.

28. Plaintiffs will be substantially and irreparably harmed by the infringing activities described above unless those activities are precluded by this Court. Plaintiffs have no adequate remedy at law.

Count II

Declaratory Judgment of Infringement of United States Patent No. RE37,314 Under 35 U.S.C. § 271(a)

29. Plaintiffs incorporate by reference paragraphs 1-28 of this Complaint as if fully set forth herein.

30. Upon information and belief, Sun Ltd., Sun USA, and Caraco have made substantial preparations to sell Sun Rosuvastatin Calcium Tablets labeled for the same dosages as the Crestor® products.

31. Upon information and belief, Sun Ltd., Sun USA, and Caraco intend to commence sale of Sun Rosuvastatin Calcium Tablets immediately upon receiving approval from the FDA.

32. The manufacture, importation, sale, and offer for sale of Sun Rosuvastatin Calcium Tablets, once approved by the FDA, will directly infringe, induce and/or contribute to the infringement of one or more claims of the '314 patent under 35 U.S.C. § 271(a).

33. Plaintiffs will be substantially and irreparably harmed by the infringing activities described above unless those activities are enjoined by this Court. Plaintiffs have no adequate remedy at law.

34. An actual controversy exists relating to Sun Ltd., Sun USA, and Caraco's threatened infringement of the '314 patent.

PRAYER FOR RELIEF

WHEREFORE, Plaintiffs respectfully request that this Court enter judgment in its favor as follows:

(1) holding that the claims of the '314 patent are valid and enforceable;

(2) holding that the submission of ANDA No. 79-169 by Sun Ltd., Sun USA, and/or Caraco infringes one or more claims of the '314 patent under 35 U.S.C. § 271(e)(2);

(3) declaring that the manufacture, use, offering for sale, or sale of the Sun Rosuvastatin Calcium Tablets within the United States or importing the Sun Rosuvastatin Calcium Tablets into the United States before expiration of the '314 patent will infringe one or more claims of the '314 patent;

(4) ordering, pursuant to 35 U.S.C. § 271(e)(4)(A), that the effective date of any FDA approval of the Sun Rosuvastatin Calcium Tablets shall be no earlier than the expiration date of the '314 patent;

(5) enjoining Sun Ltd., Sun USA, and Caraco, and all persons acting in concert with them, from commercially manufacturing, using, offering for sale, or selling the Sun Rosuvastatin Calcium Tablets within the United States or importing into the United States the Sun Rosuvastatin Calcium Tablets, prior to the expiration of the '314 patent;

(6) declaring this to be an exceptional case and awarding Plaintiffs their attorney fees under 35 U.S.C. § 285;

(7) awarding Plaintiffs their costs and expenses in this action; and

(8) awarding Plaintiffs any further and additional relief as this Court deems just and proper.

This 11th day of December 2007.

Respectfully submitted,

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580392

EXHIBIT A

(19) **United States**

(12) **Reissued Patent**

Hirai et al.

(10) **Patent Number: US RE37,314 E**

(45) **Date of Reissued Patent: Aug. 7, 2001**

(54) **PYRIMIDINE DERIVATIVES**

(75) Inventors: **Kentaro Hirai**, Kyoto; **Teruyuki Ishiba**, Osaka; **Haruo Koike**, Kyoto; **Masamichi Watanabe**, Shiga, all of (JP)

(73) Assignee: **Shionogi Seiyaku Kabushiki Kaisha**, Osaka (JP)

(21) Appl. No.: **09/141,731**

(22) Filed: **Aug. 27, 1998**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **5,260,440**
Issued: **Nov. 9, 1993**
Appl. No.: **07/897,793**
Filed: **Jun. 12, 1992**

(30) **Foreign Application Priority Data**

Jul. 1, 1991 (JP) 3-188015

(51) **Int. Cl.**[7] **A61K 31/505**; C07D 239/34; C07D 239/38; C07D 239/42

(52) **U.S. Cl.** **514/316**; 544/318; 544/322

(58) **Field of Search** 514/756; 544/297

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,868,185	9/1989	Chucholowski et al.	514/256
4,925,852	5/1990	Kesseler et al.	514/256
5,026,708	6/1991	Fujikawa et al.	514/256

FOREIGN PATENT DOCUMENTS

0 330 057	8/1989	(EP) .
0 367 895	5/1990	(EP) .

OTHER PUBLICATIONS

Moore et al, J. Am. Chem. Soc., vol. 107, pp. 3694–3701, 1985.*

G. Beck et al., *J. Med. Chem.,* 33, 52–60 (1990).

B. Roth et al., *J. Med. Chem.,* 34, 463–466 (1991).

* cited by examiner

Primary Examiner—Richard L. Raymond

(74) *Attorney, Agent, or Firm*—Pillsbury Madison & Sutro, LLP Intellectual Property Group

(57) **ABSTRACT**

The compounds of the present invention inhibit the HMG-CoA reductase, and subsequently suppress the biosynthesis of cholesterol. And they are useful in the treatment of hypercholesterolemia, hyperlipoproteinemia, and atherosclerosis.

3 Claims, No Drawings

PYRIMIDINE DERIVATIVES

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This application is a reissue of U.S. Pat. No. 5,260,440, issued Nov. 8, 1993.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase inhibitor.

2. Prior Art

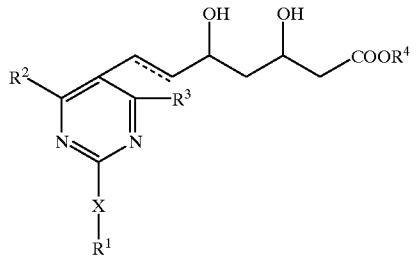
As the first generation of drugs for the treatment of atherosclerosis by inhibiting the activity of HMG-CoA reductase, there are known Mevinolin (U.S. Pat. No. 4,231,938), pravastatin sodium (U.S. Pat No. 4,346,227), and, simvastatin (U.S. Pat. No. 4,444,784), which are fungal metabolites or of the chemical modifications. Recently, synthetic inhibitors of HMG-CoA reductase such as fluvastatin (F. G. Kathawala et al., 8th Int'l Symp. on Atherosclerosis, Abstract Papers, p. 445, Rome (1988)) and BMY 22089 (GB Pat. No. 2,202,846) are developed as the second generation drugs.

SUMMARY OF THE INVENTION

The compounds of the present invention inhibit the HMG-CoA reductase, which plays a main role in the synthesis of cholesterol, and subsequently they suppress the biosynthesis of cholesterol. Therefore, they are useful in the treatment of hypercholesterolemia, hyperlipoproteinemia, and atherosclerosis.

DETAILED DESCRIPTION

The present invention relates to compounds of the formula (I):



wherein R^1 is lower alkyl, aryl or aralkyl, each of which may have one or more substituents: R^2 and R^3 each is independently hydrogen, lower alkyl, or aryl, and each of said lower alkyl and aryl may have one or more substituents; R^4 is hydrogen, lower alkyl, or a cation capable of forming a non-toxic pharmaceutically acceptable salt; X is sulfur, oxygen, or sulfonyl, or imino which may have a stubstituent; the dotted line represents the presence or absence of a double bond, or the corresponding ring-closed lactone. This invention also provides a pharmaceutical composition comprising the same.

In the specification, the term "lower alkyl" refers to a straight, branched, or cyclic C_1 to C_6 alkyl, including methyl, ethyl, n-propyl, isopropyl, cyclopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, cyclobutyl, n-pentyl, isopentyl, neopentyl, tert-pentyl, cyclopentyl, n-hexyl, and

isohexyl and the like. Further, the lower alkyl may be substituted by 1 to 3 substituents independently selected from the group consisting of halogen, amino, and cyano. Halogen means fluorine, chlorine, bromine and iodine.

The term "aryl" refers to C_6 to C_{12} aromatic group including phenyl, tolyl, xylyl, biphenyl, naphthyl, and the like. The aryl may have 1 to 3 substituents independently selected from the group consisting of lower alkyl, halogen, amino, and cyano. Preferred aryl is phenyl substituted by 1 to 3 halogens.

The term "aralkyl" refers to C_1 to C_6 lower alkyl substituted by C_6 to C_{12} aromatic aryl group defined above. Examples of them are benzyl, phenethyl, phenylpropyl and the like, each of which may have 1 to 3 substituents independently selected from the group consisting of lower alkyl halogen, amino, cyano, and the like.

The term "a cation capable of forming a non-toxic pharmaceutically acceptable salt" refers to alkali metal ion, alkaline earth metal ion, and ammonium ion. Examples of alkali metal are lithium, sodium, potassium, and cesium, and examples of alkaline earth metal are beryllium, magnesium, and calcium. Especially, sodium and calcium are preferred.

Examples of "acyl" are formyl acetyl, propionyl, butyryl, isobutyryl, valeryl, and isovaleryl.

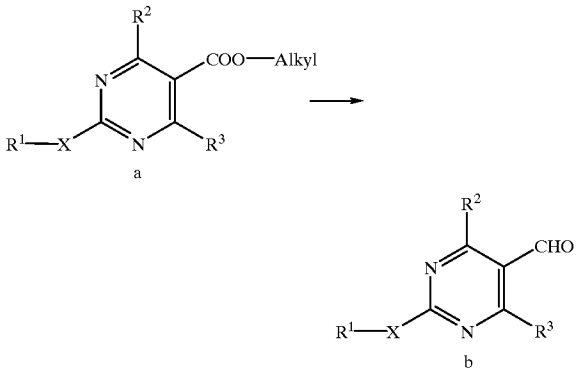
In the term "imino which may have a substituent", preferred substituents are acyl, optionally substituted amino, and substituted sulfonyl.

The term "substituted amino as substituent" means amino group substituted by sulfonyl and alkylsulfonyl. Examples of them are sulfonyl amino and methanesulfonyl amino.

The term "substituted sulfonyl as substituent" means sulfonyl group substituted by alkyl, amino, or alkylamino. Examples of them are methanesulfonyl, sulfamoyl, methylsulfamoyl, and N-methylsulfamoyl.

The compounds of the present invention can be prepared by the following method.

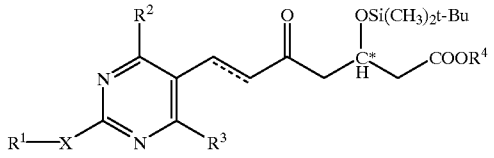
(1) The carboxylate group of the compound a is converted into the alcohol group by the reduction in an appropriate inactive solvent such as THF, ether, and toluene in the presence of the reductant such as LiAlH and DIBAL-H. The reaction is performed at −70° to 50° C., preferably at near room temperature, for 10 minutes to 10 hours, preferably for 30 minutes to 3 hours. Then the obtained alcohol is subjected to oxidation in an appropriate solvent such as methylene chloride in the presence of the oxidizing agent such as TPAP/4-methylmorpholin-N-oxide or pyridium chlorochromate to give aldehyde compound b. The reaction is performed at 0°–60° C., preferably at near room temperature, for 10 minutes to 10 hours, preferably 30 minutes to 3 hours.



wherein R^1, R^2, and R^3 each has the same meaning as defined above, and Alkyl means lower alkyl.

(2) The obtained compound b is subjected to reaction with (3R)-or (3S)-3-(tert-butyldimethylsilyloxy-5-oxo-6-triphenylphosphoranylidene hexanoic acid derivatives in an appropriate solvent such as acetonitrile, diethylether, tetrahydrofuran, and dimethylformamide to give the compound c. The reaction is performed for 1–30 hours, preferably for 10–15 hours under heating.

c



wherein C* means asymmetric carbon atom, the dotted line means the presence or absence of the double bond, R^1, R^2, R^3, and R^4each has the same meaning as defined above.

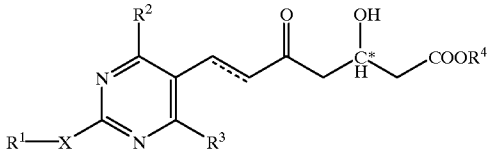
(3) The compound c is subjected to elimination of the tertbutyldimethylsilyl group in an appropriate organic solvent in the presence of hydrogen halogenide to give the compound d.

Every sort of halogen can be used for hydrogen halogenide. Amongst all, hydrogen fluoride is preferred.

The same organic solvents as used in the step (2) may be employed. Acetonitrile is especially preferred.

The reaction is performed in a range of from 0° to 60° C., preferably at room temperature, for 0.5–10 hours, preferably for 1–2 hours.

d



wherein C*, the dotted line, R^1, R^2, R^3, and R^4 each has the same meaning as defined above.

(4) The compound d is reacted with diethylmethoxyborane and $NaBH_4$ in an alcohol-organic solvent mixture and subjected to column chromatography of silica gel to give the compound (I) (in case R^4 is lower alkyl). The reaction is performed at a temperature between −100° to 20° C., preferably between −85° to −70° C. under cooling, for 10 minutes to 5 hours, preferably for 30 minutes to 2 hours.

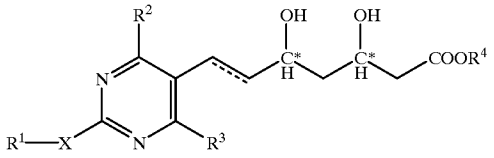
Here, the alcohol includes methanol, ethanol, propanol, and butanol; and the organic solvent includes the same as in the step (3).

Further, if necessary, the obtained compound may be subjected to saponification with the solution of metalic hydroxide (R^4: cation), and after the saponification, the reaction mixture is neutralized with an acid and extracted with an organic solvent (R^4: hydrogen). The saponification is performed in a popular solvent such as water, acetonitrile, dioxane, acetone, and the mixture thereof, preferably in the presence of a base, by a conventional method. The reaction is performed at 0° to 50° C., preferably at near room temperature.

As metalic hydroxide which may be used are sodium hydroxide, potassium hydroxide, and their analogue.

Acids which may be used include inorganic acids such as hydrochloric acid, sulfuric acid and the like.

(I)



wherein C*, the dotted line, R^1, R^2, R^3, and R^4 each has the same meaning as defined above.

Further, if necessary, the obtained compounds (I) are subjected to reflux under heating to give the corresponding lactones.

The compound of the present invention can be administered orally or parenterally. For example, the compound of the present invention may be orally administered in the form of tablets, powders, capsules and granules, aqueous or oily suspension, or liquid form such as syrup or elixir, and parenterally in the form of aqueous or oily suspension.

These preparations can be prepared in a conventional manner by using excipients, binders, lubricants, aqueous or oily solubilizers, emulsifier, suspending agents, and the like. And preservatives and stabilizers can be further used.

The dosages may vary with the administration route, age, weight, condition, and the kind of disease of the patients, but are usually 0.5–200 mg/day, preferably 1–100 mg/day through oral route, and 0.1–100 mg/day, preferably 0.5–50 mg/day through parenteral route. They may be used in a single or divided doses.

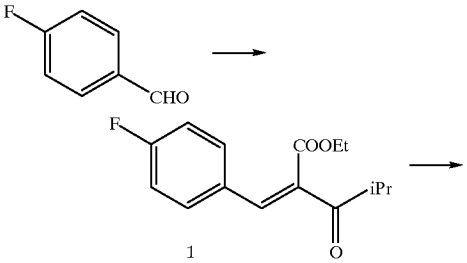
The present invention is illustrated by the following examples and reference examples, which are not to be considered as limiting.

The abbreviations used in examples and reference examples have the following meanings.

Me: methyl,
Et: ethyl,
i-Pr: isopropyl
t-Bu: tert-butyl,
Ph: phenyl,
DMF: dimethylformamide,
THF: tetrahydrofuran
DDQ: 2,3-dichloro-5,6-dicyano-1,4-benzoquinone
TPAP: tetrapropylammonium perruthenate
HMPA: hexamethylphosphoramide
DIBAL-H: diisobutylaluminum hydride.

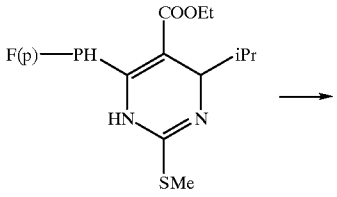
REFERENCE EXAMPLE 1

Ethyl 4-(4-fluorophenyl)-6-isopropyl-2-methylthiopyrimidine-5-carboxylate (III-1) and
Ethyl 4-(4-fluorophenyl)-6-isopropyl-2-methylsulfonylpyrimidine-5-carboxylate (III-2)

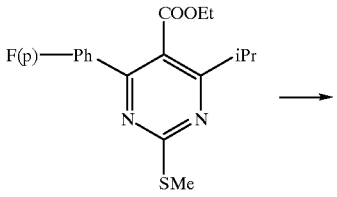


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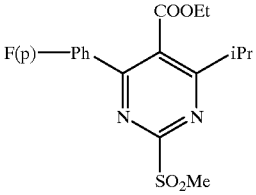
-continued



2



(III-1)



(III-2)

p-Fluorobenzaldehyde 81.81 g is reacted in the same manner as disclosed in the specification of JP Unexamed. Pat. Publn. No. 61-40272 to give 151.0 g (Yield: 86.7%) of the compound 1. Then the mixture of a solution of 44.68 g of the compound 1 in 65 ml of HMPA and 28.24 g of s-methylisourea hydrogen sulfate is stirred at 100° C. for 22 hours. Then the reaction mixture is extracted with ether, and washed with saturated sodium hydrogencarbonate and water in order. The organic layer is dried, and the solvent is distilled away. The obtained residue is subjected to column chromatography of silica gel to give 26.61 g (yield: 46.8%) of the compound 2.

To a solution of the obtained compound 2 in 400 ml of benzene is added 21.64 g (0.095 mmol) or DDQ, and the mixture is stirred for 30 minutes. Then the mixture is subjected to column chromatography of silica gel to give 24.31 g (Yield: 91.9%) of the compound (III-1).

NMR ($CDCl_3$) δ: 1.10 (t, J=7,3H): 1.31 (d, J=7,6 Hz); 2.61 (s, 3H); 3.18 (hept, J=7,1H); 4.18 (q, J=7,2H); 7.12 (m, 2H), 7.65 (m, 2H).

To a solution of 13.28 g (0.04 mmol) of the compound (III-1) in chloroform is added 17.98 g of m-chloroperbenzoic acid, and the reaction mixture is stirred at room temperature. Then it is washed with sodium sulfate and saturated sodium hydrogencarbonate in order. The solution is dried, and the solvent is distilled away and washed with n-hexane to give 13.93 g (Yield 95.7%) of the compound (III-2).

NMR ($CDCl_3$) δ: 1.16 (t, J=7,3H); 1.37 (d, J=7,6H); 3.26 (hept, J=7,1H); 3.42 (s, 3H), 4.28 (q, 2H); 7.18 (m, 2H); 7.76 (m, 2H).

REFERENCE EXAMPLE 2

Another synthetic method of the compound (III-1)

To a solution of 200 mg (0.594 mmol) of the compound 2 in 5 ml of dichloromethane are added 0.5 g (6.10 equivalent) of potassium carbonic anhydride and 166 mg (1.1 equivalent) of iodine, and the mixture is stirred at room temperature for 2.5 hours. After reaction, to the mixture is added saturated sodium hydrogensulfite and extracted with ether. The organic layer is washed with water and dried. The solvent is distilled away under reduced pressure to give 166 mg (Yield: 83.6%) of the compound (III-1) as resinous substance.

NMR ($CDCl_3$) δ: 1.10 (t, 3H, J=7); 1.31 (d, 6H, J=7); 2.61 (s, 3H) 3.17 (heptet, 1H, J=7); 4.18 (q, 2H, J=7); 7.07–7.17 (m, 2H); 7.61–7.69 (m, 2H)

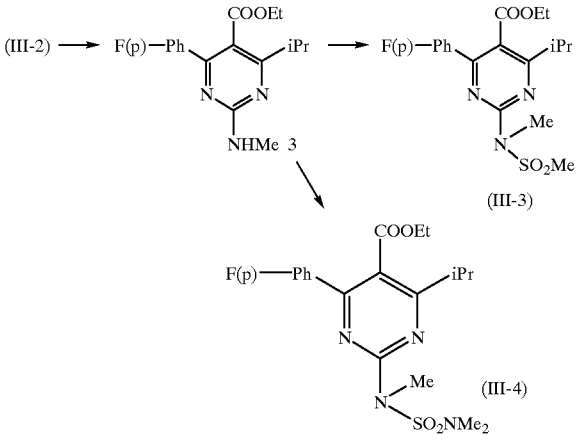
REFERENCE EXAMPLE 3

Another synthetic method of the compound (III-2)

To a solution of 1.0 g (2.97 mmol) of the compound 2 in 10 ml of acetone is added 1.5 g (9.48 mmol) of potassium permanganate, and the mixture is stirred at room temperature for 15 minutes. Acetic acid 1.0 ml is added thereto, and the mixture is stirred at room temperature for further 30 minutes and water is added thereto. The reaction mixture is extracted with ether, washed with saturated sodium hydrogencarbonate and saturated brine and dried over anhydrous magnesium sulfate. The solvent is distilled away under reduced pressure to give 1.07 g (2.94 mmol) (Yield: 99.1%) of the compound (III-2) as crystals.

REFERENCE EXAMPLE 4

Ethyl 4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methyl-sulfonylamino)pyrimidine-5-carboxylate (III-3) and Ethyl 4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-dimethylsulfamoylamino)pyrimidine-5-carboxylate (III-4)



To a solution of 52.7 g (144 mmol) of the compound (III-2) in 500 ml of absolute ethanol is added gradually a solution of 71.9 ml of 5N methylamine in ethanol under ice-cooling. The reaction mixture is warmed to room temperature, stirred for 1 hour and evaporated under reduced pressure. To the residue is added water, and the mixture is extracted with ether, dried and evaporated under reduced pressure to give 46.9 g (Yield: 100%) of the compound 3. mp. 85°–86° C.

Anal Calcd. (%) for $C_{17}H_{20}N_3FO_2$: C,64.34; H,6.35; N,13.24: F,5.99. Found: C,64.42, H,6.46: N,13.30; F,6.14.

To a solution of 370 mg (1.213 mmol) of the compound 3 in 5 ml of DMF is added 60 mg of 60% NaH under ice-cooling, and the reaction mixture is stirred for 30 min-

utes. Methanesulfonyl chloride 208 mg is added thereto, and the mixture is warmed to room temperature and stirred for 2 hours further. To the mixture is added ice-water, and the mixture is extracted with ether. The organic layer is washed with water and dried. The solvent is evaporated under reduced pressure, and the resulting residue is washed with ether-n-pentane to give 322 mg (Yield: 57.6%) of the compound (III-3).

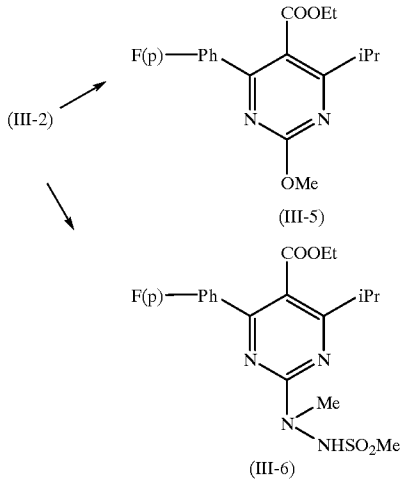
NMR ($CDCl_3$) δ: 1.10 (t, J=7,3H); 1.32 (d, J=7,6H); 3.24 (hept,J=7,1H); 3.52 (s,3H); 3.60 (s, 3H); 4.19 (q, J=7,2H); 7.14 (m, 2H); 7.68 (m, 2H).

To a solution of 4.13 g (13.0 mmol) of the compound 3 in 40 ml of DMF is added 0.57 g of 60% NaH under ice-cooling, and the mixture is warmed to room temperature and stirred for 1 hours. After cooling again, dimethylsulfamoyl chloride 2.43 g (16.9 mmol) is dropwise added thereto, and the mixture is stirred for 2.5 hours. To the mixture is added icewater, and the mixture is extracted with ether washed with water, dried and evaporated under reduced pressure to distill ether. The resulting residue is washed with ether-hexane to give 4.10 g (Yield: 74.2%) of the compound (III-4). mp. 114°–116° C.

Anal Calcd. (%) for $C_{19}H_{25}N_4SFO_4$: C,53.76; H,5.94; N,13.20; F,4.48. Found: C,53.74: H,5.96; N,13.19; F,4.78.

REFERENCE EXAMPLE 5

Ethyl 4-(4-fluorophenyl)-6-isopropyl-2-methoxypyrimidine-5-carboxylate (III-5) and Ethyl 4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methylsulfonylhydrazino)pyrimidine-5-carboxylate (III-6)



To a solution of 1.39 g (3.8 mmol) of the compound (III-2) in 60 ml of absolute methanol is added a solution of 0.41 g (7.6 mmol) of sodium methoxide under ice-cooling. The reaction mixture is warmed to room temperature gradually and stirred for 1 hour. The mixture is neutralized with acetic acid and extracted with ether. The organic layer is washed with sodium bicarbonate and water in order, dried and evaporated under reduced pressure to distill ether. The residue is subjected to column chromatography of silica gel to give 1.17 g (Yield: 96.7%) of the compound (III-5).

NMR ($CDCl_3$) δ: 1.10 (t, 3H, J=7 Hz); 1.32 (d, 6H, J=6.6 Hz); 3.21 (m, 1H); 4.08 (s, 3H); 4.18 (q, 2H, J=7 Hz); 7.07–7.74 (m, 4H).

To a solution of 2.50 g (6.77 mmol) of the compound (III-2) in 50 ml of absolute ethanol is added 0.80 g (16.93 mmol) of methyl hydrazine under ice-cooling. The reaction mixture is warmed to room temperature and stirred for 2 hours and extracted with ether. The organic layer is washed with saturated brine and dried to distill the solvent. To a mixture of 2.37 g of the thus obtained compound and a mixture of anhydrous THF and anhydrous pyridine is added 1.03 g (7.84 mmol) of methanesulfonyl chloride under testing. The reaction mixture is warmed to room temperature and stirred for 1.5 hours. To the mixture are added 3 ml of anhydrous pyridine and 1.53 g (11.65 mmol) of methanesulfonyl chloride, and the mixture is stirred for 2 hours. To the reaction mixture is added ice-water and extracted with ether. The organic layer is washed with water and the resulting oily residue is subjected to column chromatography of silica gel to give 2.75 g (Yield: 94.0%) of the compound (III6).

NMR ($CDCl_3$) δ: 1.08 (t, J=7,3H); 1.29 (d, J=7,6H); 2.96 (s, 3H); 3.24 (hept, J=7,1H); 3.59 (s, 3H); 4.16 (q, J=7,2H); 7.14 (m, 2H), 7.63 (m, 2H).

REFERENCE EXAMPLE 6

Methyl (3R)-3-(tert-butyldimethylsilyloxy)-5-oxo-6-triphenylphosphoranylidene hexanate

(1) (3R)-3-(tert-butyldimethylsilyloxy)glutaric acid-1-((R)-(−)mandelic acid ester*[1] 65 g (164 mmol) is dissolved into 60 ml of methanol, a solution of sodium methoxide in methanol (28% methanol 310 ml, 1.6 mol) is added dropwise thereto under nitrogen atmosphere at 0° C. for 45 minutes at internal temperature under 7° C. The reaction mixture is stirred at 0° C. for 30 minutes and poured into a mixture of 150 ml of conc.HCl, 300 ml of water, and 500 ml of methylene chloride being stirred under ice-cooling and the organic layer is collected. The aqueous layer is extracted with 200 ml of methylene chloride, and each organic layer is washed with dil.HCl and brine in order. Each organic layer are collected and dried over anhydrous magnesium sulfate and evaporated to distill the solvent to give half ester compound.

*[1]: This compound can be prepared by the method described at page 10 in the specification of KOKAI 2-250852.

^{1}HNMR($CDCl_3$) δ: 0.08 (s, 3H); 0.09 (s, 3H); 0.86 (s, 9H); 2.52–2.73 (m, 4H); 3.08 (s, 3H); 4.55 (quint, 1H, J=6Hz).

IR ($CHCl_3$): 2880, 1734, 1712, 1438, 1305, 1096, 836 cm^{-1}.

[α]D=−5.0±0.4° (C=1.04, 23.5° C., $CHCl_3$).

Rf 0.32 ($CHCl_3$/MeOH=9/1).

(2) To a solution of the thus obtained half ester compound in 10 ml of ether are added dropwise triethylamine and ethyl chlorocarboxylate in order under nitrogen atmosphere at −78° C. The resulting white suspension is stirred at 0° C. for 1 hour and cooled to −78° C. The resulting precipitate is filtered under nitrogen atmosphere and the filtrate is washed with 15 ml of ether. To a suspension of 1.29 g (3.6 mmol) of methyl bromide triphenylphosphonium in 5 ml of THF is added dropwise butyllithium (1.6M hexane, 2.25 ml, 3.6 mmol) under nitrogen atmosphere at −78° C. The reaction mixture is stirred at 0° C. for 1 hour and cooled to −78° C. and added dropwise to the solution of thus obtained active ester compound in ether. The reaction mixture is washed with 5 ml of THF and stirred at 0° C. for 1 hour, and 10 ml of 5% sodium hydrogencarbonate is added thereto. The reaction mixture is stirred for 5 minutes and extracted with ethyl acetate and the organic layer is separated and the

remaining aqueous layer is extracted with ethyl acetate. Each organic layer is collected and washed with brine, dried over anhydrous magnesium sulfate and concentrated. The obtained residue is subjected to column chromatography of silica gel eluting with ether-ethyl acetate and crystallized from ether-hexane to give objective compound.

^{1}HNMR ($CDCl_3$)δ: 0.04 (s, 3H); 0.06 (s, 3H); 0.83 (s, 9H); 2.4–2.9 (m, 4H); 3.64 (s, 3H); 3.74 (d, 1H); 4.5–4.7 (m, 1H); 7.4–7.8 (m, 15H).

IR ($CHCl_3$): 2380, 1730, 1528, 1437, 1250, 1106, 835 cm^{-1}.

[α]D=−6.2° (C=1.27, 22.0° C., $CHCl_3$).

mp.:77.5°–78.5° C., Rf=0.48 ($CHCl_3$/MeOH=9/1).

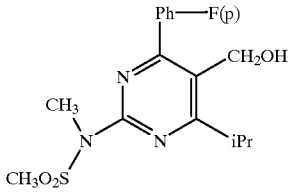
Anal Calcd. (%) for $C_{31}H_{39}O_4PS$: C, 69.63; H,7.35; P,5.79. Found: C, 69.35; H,7.35; P,6.09.

EXAMPLE 1

Sodium (+)-7-[4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methylsulfonylaminopyrimidin)-5-yl]-(3R,5S)-dihydroxy-(E)-6-heptenate (I a-1)

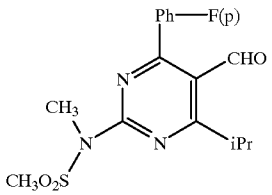
(1) To a solution of 322 mg of the compound (III-3) obtained in Reference Example 2 in 7 ml of anhydrous toluene is added dropwise 1.4 ml of DIBAL-H in 1.5M toluene at −74° C., and the reaction mixture is stirred for 1 hour and acetic acid is added thereto. The mixture is extracted with ether, and the organic layer is washed with sodium bicarbonate and water, dried and evaporated under reduced pressure to distil ether. The obtained residue is subjected to column chromatography of silica gel eluting with methylene chloride/ether (20/1) to give 277 mg (Yield: 96.1%) of [4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methylsulfonylamino)pyrimidin-5-yl]methanol 4.

4



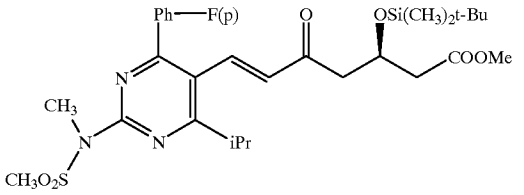
(2) A suspension of 277 mg of the thus obtained compound 4, 190 mg of 4-methylmorpholin-N-oxide, 6 mg of TPAP, 1.0 g of powder molecular sieve 4A, and 10 ml of methylene chloride is stirred for 2 hours. The insoluble matter is filtered off and the two-thirds of the filtrate is distilled away under reduced pressure. The resulting residue is subjected to column chromatography of silica gel eluting with methylene chloride to give 196 mg (Yield: 71.2%) of 4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methylsulfonylamino)-5-pyrimidinecarbardehyde as crystals.

5



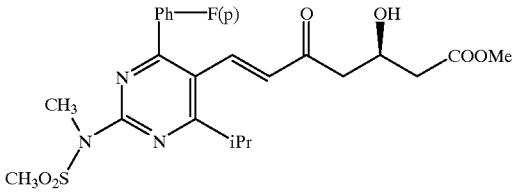
(3) A solution of 190 mg of the compound 5, 450 mg of methyl (3R)-3-(tert-butyldimethylsilyloxy)-5-oxo-6-triphenylphosphoranylidene hexanate (Reference Example 6), and 5 ml of acetonitrile is refluxed under heating for 14 hours and evaporated under reduced pressure to distill acetonitrile. The resulting residue is subjected to column chromatography of silica gel eluting with methylene chloride to give 233 mg (Yield: 71.3%) of methyl 7-[4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methylsulfonylamino)pyrimidin-5-yl]-(3R)-3-(tert-butyldimethylsilyloxy)-5-oxo-(E)-6-heptenate 6 as syrup.

6



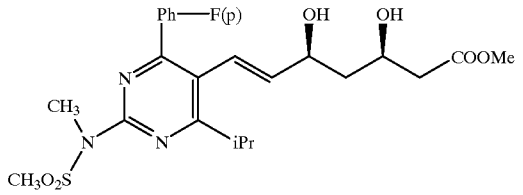
(4) To a solution of 16 g of the compound 6 in 100 ml of acetonitrile is added dropwise a solution of 48% hydrogen flouride in 400 ml of acetonitrile (1:19) under ice-cooling, and the mixture is warmed to room temperature and stirred for 1.5 hours. The reaction mixture is neutralized with sodium bicarbonate and extracted with ether. The organic layer is washed with sodium chloride, dried and evaporated under reduced pressure to distil ether to give 13 g (Yield: 100%) of methyl 7-[4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methylsulfonylamino)pyrimidin-5-yl]-(3R)-3-hydroxy-5-oxo-(E)-6-heptenate 7 as syrup.

7



(5) To a solution of 13 g of the compound 7 in 350 ml of anhydrous THF and 90 ml of methanol is added a solution of 29.7 ml of 1M diethylmethoxyborane-THF at −78° C., and the mixture is stirred at the same temperature for 30 minutes. To the mixture is added 1.3 g of $NaBH_4$, and the mixture is stirred for 3 hours. Acetic acid 16 ml is added thereto, and the mixture is adjusted to pH 8 with saturated sodium bicarbonate and extracted with ether. The organic layer is washed with water, dried and evaporated ether under reduced pressure. To the resulting residue is added methanol and the mixture is evaporated under reduced pressure for three times. The resulting residue is subjected to column chromatography of silica gel eluting with methylene chloride/ether (3/1) to give 11.4 g (Yield: 85.2%) of methyl 7-[4-(4-fluorophenyl)-6-iso-propyl-2-methyl-N-methylsulfonylamino)pyrimidin-5-yl]-(3R,5S)-dihydroxy-(E)-6-heptenate as syrup.

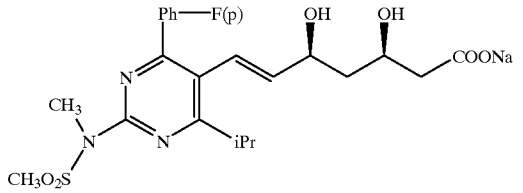
(Ib-1)



NMR ($CDCl_3$) δ: 1.27 (d, J=7,6H); 1.53 (m, 2H); 2.47 (d, J=6,2H); 3.36 (hept, J=2H); 3.52 (s, 3H); 3.57 (s, 3H); 3.73 (s, 3H); 4.20 (m, 1H); 4.43 (m, 1H); 5.45 (dd, J=5,16, 1H); 6.64 (dd, J=2,16, 1H); 7.09 (m, 2H); 7.64 (m, 2H).

(6) To a solution of 11.4 g of the compound (I b-1) in 160 ml of ethanol is added 223 ml of 0.1N sodium hydroxide under ice-cooling. The reaction mixture is warmed to room temperature and stirred for 1 hour. The solvent is distilled away under reduced pressure, and ether is added to the resulting residue and the mixture is stirred to give 11.0 g (Yield: 95.0%) of the objective compound (I a-1) as powdery crystals.

(Ia-1)



$[\alpha]_D$=+18.9±0.6° (C=1.012, 25.0° C., H_2O).

NMR ($CDCl_3$) δ: 1.24 (d, J=7,6H); 1.48 (m, 1H); 1.65 (m, 1H); 2.27 (dd,J=2,6.2H); 3.41 (hept, J=7,1H); 3.48 (s, 3H); 3.59 (s, 3H); 3.73 (m, 1H); 4.32 (m 1H); 5.49 (dd, J=7,16 1H); 6.62 (d, J=16,1H); 7.19 (m, 2H); 7.56 (m, 2H).

EXAMPLE 2

Sodium (+)-7-[4-(4-fluorophenyl)-6-isopropyl-2-(N-acetyl-N-methylamino)pyrimidin-5-yl]-(3R,5S)-dihydroxy-(E)-6-heptenate (I a-2)

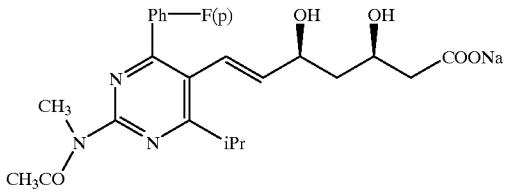
(1) Ethyl 4-(4-fluorophenyl-6-isopropyl-2-methylaminopyrimidine-5-carboxylate 3 838 mg obtained in Reference Example 4 is allowed to react in the same manner as in Example 1 (1) and (2) to give 157 mg of 4-(4-fluorophenyl)-6-isopropyl-2-methylaminopyrimidine-5-carbaldehyde.

(2) A solution of 157 mg of thus obtained aldehyde compound in 4 ml of anhydrous DMF is reacted with 25 mg of 60% NaH under ice-cooling for 30 minutes, 0.05 ml of acetylchloride is added thereto and the mixture is stirred for 1 hour. The mixture is added with ice and extracted with ether. The organic layer is washed with water and dried and concentrated to distill the solvent to give 167 mg (Yield: 93.4%) of 4-(4-fluorophenyl)-6-isopropyl-2-(N-acetyl-N-methylamino)pyrimidine-5-carbardehyde. Thus obtained aldehyde compound is reacted in the same manner as in Example 1 (3)–(5) to give methyl 7-[4-(4-fluorophenyl)-6-isopropyl-2-(N-acetyl-N-methylaminopyrimidin)-5-yl]-(3R,5S)-dihydroxy-(E)-6-heptenate (I b-2).

NMR ($CDCl_3$)δ: 1.27 (d, J=7,6H); 1.54 (m, 2H); 2.48 (d, J=6,2H); 2.52 (s, 3H); 3.39 (hept, J=7, 1H); 3.60 (s, 3H); 3.58 (brs, 1H); 3.74 (s, 3H): 4.21 (m, 1H); 4.48 (m, 1H); 5.50 (dd, J=5,16, 1H); 6.66 (dd, J=2,16); 7.11 (m, 2H); 7.61 (m, 2H).

(3) The thus obtained compound (I b-2) is reacted in the same manner as Example 1 (6) to give the objective compound (I a-2).

(Ia-2)



NMR ($CDCl_3$)δ: 1.27 (d, J=7,6H); 1.57 (m, 2H): 2.17 (s, 3H); 2.27 (d, J=6,2H); 3.72 (s, 3H); 3.50 (hept, J=7, 1H); 3.70 (m, 1H); 4.35 (q, J=6,1H); 5.59 (dd, J=5,16, 1H); 6.54 (d, J=16, 1H); 7.24 (m, 2H): 7.59 (m, 2H).

EXAMPLE 3–6

As a starting material, each pyrimidine carboxylate (III) obtained in Reference Example 1–3 is reacted in the same manner as Example 1 or 2 to give the compound (I b) and (I a). Their physical constants are shown in Table 1–3.

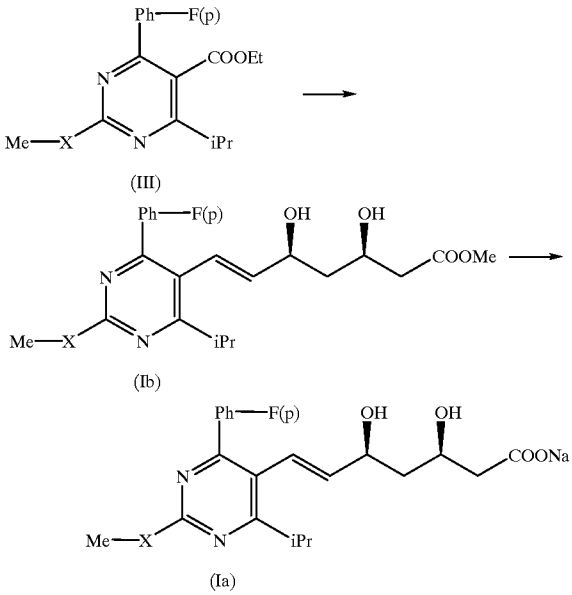


TABLE 1

Ex. No.	Startup material	Product NMR δ
3	(Ill-1)	1b-3(X: S)Yield 96.0% ($CDCl_3$, 1.26(d, J = 7.6H): 1.52(m, 2H): 2.47(d, J = 6, 2H): 2.60(s, 3H): 3.33(hept, J = 7, 1H): 3.73 (s, 3H): 4.18(m, 1H): 4.44(m, 1H): 5.44(dd, J = 5, 16, 1H): 6.60(dd, J = 2, 16, 1H), 7.07(m, 2H): 7.58(m, 2H) 1a-3(X: S)Yield 87.3% (D_2O) 1.20(d, J = 7, 6H): 1.47(m, 1H): 1.61(m, 1H): 2.26(m, 2H), 2.54(s, 3H): 3.36(hept, J = 7, 1H):

TABLE 1-continued

		3.71(m, 1H): 4.29(m, 1H): 5.43(dd, J = 6, 16, 1H): 6.55(d, J = 16, 1H): 7.16(m, 2H), 7.47 (m, 2H)
4	(Ill-2)	1b-4(X: SO_2): Yield 93.7% ($CDCl_3$) 1.31(d, J = 7, 6H): 1.52(m, 2H): 2.48(d, J = 6, 2H): 3.40(s, 3H); 3.47(hept, J = 7, 1H); 3.74 (s, 3H): 3.87(brs, 1H): 4.23(m, 1H): 4.49 (m, 1H); 5.59(dd, J = 5, 16H, 1H); 6.74(d, d, J = 2, 16, 1H); 7.12(m, 2H): 7.69(m, 2H) 1a-4(X: SO_2): Yield 70.9% (D_2O) 1.27(d, d, J = 7, 2, 6H); 1.60(m, 2H); 2.25(J = 6, d, 2H): 3.44(s, 3H): 3.51(hept, J = 7, 1H): 3.70(m, 1H): 4.33(q, J = 6, 1H): 5.65(d, d, J = 5, 16, 1H): 6.71(d, J = 16, 1H): 7.23(m, 2H); 7.60 7.60(m, 2H)

TABLE 2

Ex. No.	Starting material	Product NMR δ
5	(Ill-5)	1b-5(X: O): ($CDCl_3$) 1.27(d, 6H, J = 6.6 Hz): 1.35–1.68(m, 2H): 2.47 (m, 2H): 3.34(m, 1H): 3.78(s, 3H): 4.03(s, 3H): 4.19(m, 1H); 4.43(m, 1H): 5.43(dd, 1H, J = 5.6, 16 Hz): 6.59(dd, 1H, J = 1.4, 16 Hz): 7.03–7.64(m, 4H) 1a-5(X: O) Yield 57.7% ($CDCl_3$, CD_3OD) 1.27(d, 6H, J = 6.6 Hz): 1.35–1.68(m, 2H): 2.17–2.43(m, 2H): 3.36(m, 2H), 4.05(s, 3H): 4.37 (m, 2H): 5.48(dd, 1H, J = 5.6, 16 Hz): 6.54(dd, 1H, J = 1.4, 16 Hz): 7.06–7.65(m, 4H)
6	(Ill-4)	1b-6(X: N—SO_2NMe_2): ($CDCl_3$) 1.26(d, 6H, J = 6.6 Hz); 1.38–1.62(m, 2H): 2.47 (d, 2H, J = 5.8); 2.84(s, 6H), 3.35(m, 1H): 3.64(s, 3H); 3.74(s, 3H); 4.20(m, 1H): 4.44 (m, 1H); 5.42(dd, 1H, J = 5.4, 16 Hz): 6.60 (dd, 1H, J = 1.2, 16 Hz): 7.03–7.64(m, 4H) 1a-6: Yield: 91.2% ($CDCl_3$, CD_3OD) 1.26(d, 6H, J = 6.6 Hz); 1.36–1.69(m, 2H): 2.15–2.50(m, 2H); 2.85 (s, 6H); 3.41(m, 2H): 3.64 (s, 3H): 4.04(m, 1H): 4.37(m, 1H); 5.48 (dd, 1H, J-5.6, 16 Hz): 6.54(dd, 1H, J-1, 16 Hz): 7.05–7.66(m, 4H)

TABLE 3

Ex. No.	Starting material	Product NMR δ
7	(Ill-6)	1b-7(X: N—$NHSO_2Me$): Yield: 87.8% ($CDCl_3$) 1.24(d, J = 7, 6H): 1.51(m, 2H): 2.47(d, J = 6, 2H); 2.95(s, 3H); 3.35(hept, J = 7, 1H); 3.46 (d, J = 2, 1H): 3.55(s, 3H); 3.66(d, J = 2, 1H): 3.74 (s, 3H): 4.18(m, 1H): 4.44(m, 1H): 5.41 (dd, J = 5, 16, 1H); 6.58(dd, J = 2, 16, 1H); 7.09(m, 2H); 7.58(m, 2H), 7.70(s, 1H) 1a-7(X: N—$NHSO_2Me$): Yield: 74.7% (D_2O) 1.23(d, J = 7, 6H): 1.51(m, 2H): 2.26(d, J = 6, 2H) 3.10(s, 3H); 3.37(hept, J = 7, 1H): 3.44 (s, 3H): 3.70(m, 1H). 4.29(q, J = 6, 1H): 5.39 (dd, J = 5, 16, 1H): 6.58(d, J = 16, 1H): 7.19(m, 2H):7.52(m, 2H)

EXAMPLE 7

Calcium salt of the compound (I a-1) (sodium salt) 1.50 g (3.00 mmol) is dissolved in 15 ml of water and stirred at room temperature under nitrogen atmosphere, successively 3.00 ml (3.00 mmol) of 1 mol/L calcium chloride 3.00 ml (3.00 mmol) is added dropwise thereto over 3 minutes. The reaction mixture is stirred at the same temperature for 2 hours, and the resulting precipitate is collected, washed with water and dried to give 1.32 g of calcium salt as powdery. This compound started to melt at a temperature of 155° C., but the definitive melting point is ambiguous.

$[\alpha]D=+6.3° \pm 0.2°$ (C=2.011, 25.0° C., MeOH).

Anal Calcd. (%) for $C_{22}H_{27}N_3O_6SF$. 0.5Ca . $0.5H_2O$: C,51.85; H,5.53; N,8.25; F,3.73; Ca,3.93. Found: C,51.65; H,5.51; N,8.47; F,3.74; Ca,4.07.

Biological Activity

Experiment

The HMG-CoA reductase inhibitory effect

(1) Preparation of rat liver microsome

Sprague-Dawley rats, which were in free access to ordinary dietes containing 2% cholestyramine and water for 2 weeks, were used for the preparation of rat liver microsome. The thus obtained microsome was the purified according to the manner by Juroda et al., Biochem. Biophys. Act, 486, 70 (1977). The microsomal fraction obtained by centrifugation at 105,000×g was washed once with a buffered solution containing 15 mM nicotinamide and 2 mM magnesium chloride (in a 100 mM potassium phosphate buffer, pH 7.4). It was homogenized with a buffer containing nicotinamide and magnesium chloride at the same weight as the liver employed. The thus obtained homogenate was cooled down and kept at −80° C.

(2) Measurement of the HMG-CoA reductase inhibitory activities

The rat liver microsome sample (100 μl), which was preserved at −80° C., was fused at 0° C. and diluted with 0.7 ml of a cold potassium phosphate buffer (100 mM, pH7.4). This was mixed with 0.8 ml of 50 mM EDTA (buffered with the aforementioned potassium phosphate buffer) and 0.4 ml of 100 mM dithiothreitol solution (buffered with the aforementioned potassium phosphate buffer), and the mixture was kept at 0° C. The microsome solution (1.675 ml) was mixed with 670 μl of 25 mM NADPH (buffered with the aformentioned potassium phosphate buffer), and the solution was added to the solution of 0.5 mM [3^{-14}](HMG-CoA (3mCi/mmol). A solution (5 μl) of sodium salt of the test compound dissolved in potassium phosphate buffer is added to 45 μl of the mixture. The resulting mixture was incubated at 37° C. for 30 minutes and cooled. After termination of the reaction by addition of 10 μl of 2N·HCl, the mixture was incubated again at 37° C. for 15 minutes and then 30 μl of this mixture was applied to thin-layer chromatography of silica gel of 0.5 mm in thickness (Merck AG, Art 5744). The chromatograms were developed in toluene/acetone (1/1) and the spot, whose Rf value was between 0.45 to 0.60, were scraped. The obtained products were put into a vial containing 10 ml of scintillator to measure specific radio-activity with scintillation counter. The activities of the present compounds are shown in Table 4 as comparative ones based on the assumption that the activity of Mevinolin (sodium salt) as reference drug is 100.

TABLE 4

Test Compound	HMG-CoA reductase inhibitory activities
1a-1	442
1a-3	385
1a-5	279

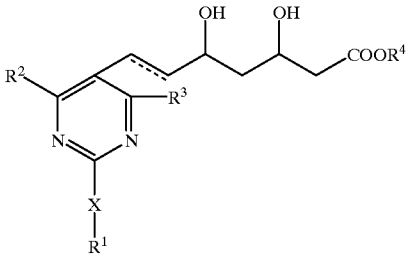
TABLE 4-continued

Test Compound	HMG-CoA reductase inhibitory activities
1a-7	260
Mevinolin Na	100

From the test data, the compounds of the present invention exhibit HMG-CoA reductase inhibition activities superior to Mevinolin.

What is claimed is:

[1. A compound represented by the formula (I):



wherein

R^1 is (1) lower alkyl which may have 1 to 3 substitutents independently selected from the group consisting of halogen, amino, and cyano, (2) C_6 to C_{12} aromatic group which may have 1 to 3 substituents independently selected from the group consisting of lower alkyl, halogen, amino, and cyano, or (3) C_1 to C_6 lower alkyl substituted by C_6 to C_{12} aromatic group which may have 1 to 3 substituents independently sel-ected from the group consisting of lower alkyl, halo-gen, amino, and cyano; R^2 and R^3 each is independently (1) hydrogen, (2) lower alkyl which may have 1 to 3 substituents independently selected from the group consisting of halogen, amino, and cyano, or (3) C_6 to C_{12} aromatic group which may have 1 to 3 substituents independently selected from the group consisting of lower alkyl, halogen, amino, and cyano; R^4 is (1) hydro-gen, (2) lower alkyl, or a cation capable of forming a non-toxic pharmaceutically acceptable salt; X is sulfur, oxygen, or sulfonyl, or imino which may be substituted by formyl, acetyl, propionyl, butyryl, isobutyryl, vale-ryl, isovaleryl, amino substituted by sulfonyl or alkyl-sulfonyl, and sulfonyl substituted by alkyl, amino or alkylamino, the dotted line represents the presence or absence of a double bond, or the corresponding ring-closed lactone.**]**

[2. The compound claimed in claim **1**, wherein X is imino which may be substituted by formyl, acetyl, pro-pionyl, butyryl, isobutyryl, valeryl, isovaleryl, amino substituted by sulfonyl or alkylsulfonyl, or sulfonyl substituted by alkyl, amino or alkylamino.**]**

[3. The compound claimed in claim **2**, wherein X is imino which may be substituted by formyl, acetyl, pro-pionyl, butyryl, isobutyryl, valeryl, isovaleryl, alkylsul-fonylamino, or alkylsulfonyl.**]**

[4. The compound claimed in claim **1** having the (3R, 5S)-dihydroxy configuration.**]**

[5. A pharmaceutical composition comprising an ef-fective amount of the compound claimed in claim **1** as an active ingredient, in combination with a pharmaceu-tical excipient.**]**

6. The compound 7-(4-(4-fluorophenyl)-6-isopropyl-2-(N-methyl-N-methylsulfonylamino)pyrimidin-5-yl)-(3R,5S)-dihydroxy-(E)-6-heptenoic acid in the form of a non-toxic pharmaceutically acceptable salt thereof.

7. The compound of claim 6 in the form of a sodium salt.

8. The compound of claim 6 in the form of a calcium salt.

* * * * *

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM.)

I. (a) PLAINTIFFS
ASTRAZENECA PHARMACEUTICALS LP, AND
ASTRAZENECA UK LIMITED, AND
IPR PHARMACEUTICALS, INC., AND
SHIONOGI SEIYAKU KABUSHIKI KAISHA

(b) COUNTY OF RESIDENCE OF FIRST LISTED PLAINTIFF
(EXCEPT IN U.S. PLAINTIFF CASES) NEW CASTLE COUNTY, DELAWARE

DEFENDANTS
SUN PHARMACEUTICAL INDUSTRIES LTD., AND
SUN PHARMACEUTICAL INDUSTRIES INC., AND
CARACO PHARMACEUTICAL LABORATORIES LTD.

COUNTY OF RESIDENCE OF FIRST LISTED DEFENDANT
(IN U.S. PLAINTIFF CASES ONLY)

(c) ATTORNEYS (FIRM NAME, ADDRESS AND TELEPHONE NUMBER)
Mary W. Bourke
Connolly Bove Lodge & Hutz LLP
P.O. Box 2207, 1007 North Orange Street
Wilmington, Delaware 19899-2207
(302) 658-9141

ATTORNEYS (IF KNOWN)

II. BASIS OF JURISDICTION (PLACE AN "X" IN ONE BOX ONLY)

- ☐ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question (U.S. Government Not a Party)
- ☐ 2 U.S. Government Defendant
- ☐ 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (PLACE AN "X" IN ONE BOX FOR PLAINTIFF AND ONE BOX FOR DEFENDANT)
(For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	☐ 1	☐ 1	Incorporated *or* Principal Place of Business in This State	☐ 4	☐ 4
Citizen of Another State	☐ 2	☐ 2	Incorporated *and* Principal Place of Business in Another State	☐ 5	☐ 5
Citizen or Subject of a Foreign Country	☐ 3	☐ 3	Foreign Nation	☐ 6	☐ 6

IV. ORIGIN (PLACE AN "X" IN ONE BOX ONLY)

☒ 1 Original Proceeding | ☐ 2 Removed from State Court | ☐ 3 Remanded from Appellate Court | ☐ 4 Reinstated or Reopened | ☐ 5 Transferred from another district (specify) | ☐ 6 Multidistrict Litigation | ☐ 7 Appeal to District Judge from Magistrate Judgment

V. NATURE OF SUIT (PLACE AN "X" IN ONE BOX ONLY)

CONTRACT
- ☐ 110 Insurance
- ☐ 120 Marine
- ☐ 130 Miller Act
- ☐ 140 Negotiable Instrument
- ☐ 150 Recovery of Overpayment & Enforcement of Judgment
- ☐ 151 Medicare Act
- ☐ 152 Recovery of Defaulted Student Loans (Excl Veterans)
- ☐ 153 Recovery of Overpayment of Veteran's Benefits
- ☐ 160 Stockholders Suits
- ☐ 190 Other Contract
- ☐ 195 Contract Product Liability

REAL PROPERTY
- ☐ 210 Land Condemnation
- ☐ 220 Foreclosure
- ☐ 230 Rent Lease & Ejectment
- ☐ 240 Torts to Land
- ☐ 245 Tort Product Liability
- ☐ 290 All Other Real Property

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- ☐ 310 Airplane
- ☐ 315 Airplane Product Liability
- ☐ 320 Assault. Libel & Slander
- ☐ 330 Federal Employers Liability
- ☐ 340 Marine
- ☐ 345 Marine Product Liability
- ☐ 350 Motor Vehicle
- ☐ 355 Motor Vehicle Product Liability
- ☐ 360 Other Personal Injury

PERSONAL INJURY
- ☐ 362 Personal Injury - Med. Malpractice
- ☐ 365 Personal Injury - Product Liability
- ☐ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
- ☐ 370 Other Fraud
- ☐ 371 Truth in Lending
- ☐ 380 Other Personal Property Damage
- ☐ 385 Property Damage Product Liability

CIVIL RIGHTS
- ☐ 441 Voting
- ☐ 442 Employment
- ☐ 443 Housing/ Accommodations
- ☐ 444 Welfare
- ☐ 440 Other Civil Rights

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- ☐ 510 Motions to Vacate Sentence

HABEAS CORPUS:
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- ☐ 535 Death Penalty
- ☐ 540 Mandamus & Other
- ☐ 550 Civil Rights
- ☐ 555 Prison Condition

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- ☐ 610 Agriculture
- ☐ 620 Other Food & Drug
- ☐ 625 Drug Related Seizure of Property 21 USC 881
- ☐ 630 Liquor Laws
- ☐ 640 R.R. & Truck
- ☐ 650 Airline Regs.
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- ☐ 690 Other

LABOR
- ☐ 710 Fair Labor Standards Act
- ☐ 720 Labor Mgmt Relations
- ☐ 730 Labor Mgmt Reporting & Disclosure Act
- ☐ 740 Labor Railway Act
- ☐ 790 Other Labor Litigation
- ☐ 791 Empl. Ret. Inc. Security Act

BANKRUPTCY
- ☐ 422 Appeal 28 USC 158
- ☐ 423 Withdrawal 28 USC 157

PROPERTY RIGHTS
- ☐ 820 Copyrights
- ☒ 830 Patent
- ☐ 840 Trademark

SOCIAL SECURITY
- ☐ 861 HIA (1395ff)
- ☐ 862 Black Lung (923)
- ☐ 863 DIWC/DIWW (405(g))
- ☐ 864 SSID Title XVI
- ☐ 865 RSI (405(g))

FEDERAL TAX SUITS
- ☐ 870 Taxes (U.S. Plaintiff or Defendant)
- ☐ 871 IRS - Third Party 26 USC 7609

OTHER STATUTES
- ☐ 400 State Reapportionment
- ☐ 410 Antitrust
- ☐ 430 Banks and Banking
- ☐ 450 Commerce/CC Rates/etc.
- ☐ 460 Deportation
- ☐ 470 Racketeer Influenced and Corrupt Organizations
- ☐ 810 Selective Service
- ☐ 850 Securities/ Commodities/ Exchange
- ☐ 875 Customer Challenge 12 USC 3410
- ☐ 891 Agricultural Acts
- ☐ 892 Economic Stabilization Act
- ☐ 893 Environmental Matters
- ☐ 894 Energy Allocation Act
- ☐ 895 Freedom of Information Act
- ☐ 900 Appeal of Fee Determination Under Equal Access to Justice
- ☐ 950 Constitutionality of State Statutes
- ☒ 890 Other Statutory Actions

VI. CAUSE OF ACTION (CITE THE U.S. CIVIL STATUTE UNDER WHICH YOU ARE FILING AND WRITE BRIEF STATEMENT OF CAUSE. DO NOT CITE JURISDICTIONAL STATUTES UNLESS DIVERSITY.)

Action for infringement of U.S. Patent No. RE37,314 arising under 35 U.S.C. § 271.

VII. REQUESTED IN
COMPLAINT: ☐ UNDER F.R.C.P. 23

CHECK IF THIS IS A **CLASS ACTION**

DEMAND: Amount to be determined, Permanent Injunction sought

CHECK YES only if demanded in complaint:
JURY DEMAND: ☐ YES ☒ NO

SEE NEXT PAGE FOR RELATED CASES

VIII. RELATED CASE(S) (See instructions):

IF ANY: ASTRAZENECA PHARMACEUTICALS LP, ASTRAZENECA UK LIMITED, IPR PHARMACEUTICALS, INC., SHIONOGI SEIYAKU KABUSHIKI KAISHA VS. COBALT PHARMACEUTICALS INC. AND COBALT LABORATORIES INC.; ASTRAZENECA PHARMACEUTICALS LP, ASTRAZENECA UK LIMITED, IPR PHARMACEUTICALS, INC., SHIONOGI SEIYAKU KABUSHIKI KAISHA VS. AUROBINDO PHARMA LTD. AND AUROBINDO PHARMA USA INC.; ASTRAZENECA PHARMACEUTICALS LP, ASTRAZENECA UK LIMITED, IPR PHARMACEUTICALS, INC., SHIONOGI SEIYAKU KABUSHIKI KAISHA VS. MYLAN PHARMACEUTICALS INC.; ASTRAZENECA PHARMACEUTICALS LP, ASTRAZENECA UK LIMITED, IPR PHARMACEUTICALS, INC., SHIONOGI SEIYAKU KABUSHIKI KAISHA VS. PAR PHARMACEUTICAL, INC.; ASTRAZENECA PHARMACEUTICALS LP, ASTRAZENECA UK LIMITED, IPR PHARMACEUTICALS, INC., SHIONOGI SEIYAKU KABUSHIKI KAISHA VS. SANDOZ INC.; ASTRAZENECA PHARMACEUTICALS LP, ASTRAZENECA UK LIMITED, IPR PHARMACEUTICALS, INC., SHIONOGI SEIYAKU KABUSHIKI KAISHA VS. APOTEX INC. AND APOTEX CORP.

DATE SIGNATURE OF ATTORNEY OF RECORD

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RECEIPT # AMOUNT APPLYING IFP JUDGE MAG. JUDGE

FILED
CLERK U.S. DISTRICT COURT
DISTRICT OF DELAWARE

2007 DEC 11 AM 10:56

AO FORM 85 RECEIPT (REV. 9/04)

United States District Court for the District of Delaware

Civil Action No. 806

ACKNOWLEDGMENT OF RECEIPT FOR AO FORM 85

NOTICE OF AVAILABILITY OF A UNITED STATES MAGISTRATE JUDGE TO EXERCISE JURISDICTION

I HEREBY ACKNOWLEDGE RECEIPT OF 2 COPIES OF AO FORM 85.

DEC 11 2007

(Date forms issued)

(Signature of Party or their Representative)

Lauren R Morrison

(Printed name of Party or their Representative)

Note: Completed receipt will be filed in the Civil Action