

DESCRIPTION

INDOLIN-2-ONE DERIVATIVES

Field of the Invention

This invention relates to an indolin-2-one derivative
5 which exhibits selective antagonism against gastrin
receptors without causing side effects attributed to CCK-A
receptor antagonism and is useful for the treatment and
prevention of diseases of digestive organs, such as peptic
ulcers, gastritis, reflux esophagitis, and Zollinger-Ellison
10 syndrome, and for the treatment of tumours originating in
the gastrointestinal system. The compounds also exhibit
selective antagonism against CCK-B receptors and are useful
for the treatment of CCK-related disorders in the appetite
control system, enhancement and prolongation of analgesia
15 through opiate or non-opiate, induction of anesthesia or
analgesia, and the treatment and prevention of symptoms of
psychotic disorders including anxiety and panic disorder.

Background of the Invention

Gastrin is a typical gastrointestinal hormone, like
20 CCK, secretin, etc. It is known that gastrin accelerates
secretion of gastric acid and pepsin and also accelerates
growth of gastric mucous cells and especially histamine
secretory cells. While gastric acid secretion is stimulated
by histamine, acetylcholine, and gastrin, gastrin is the
25 most powerful of these internal substances. Currently
known drugs for controlling gastric acid secretion include
muscarinic receptor antagonists such as Pirenzepine,
histamine H₂ receptor antagonists such as Cimetidine, and

H⁺-K⁺ ATPase inhibitors such as Omeprazole. However, it has been reported that these drugs induce hypergastrinemia during maintained administration due to the potent inhibitory activity on gastric acid secretion, and the high gastrin level induces an increase of histamine content in the gastric mucosa. The reports also reveal that discontinuation of administration of these drugs is followed by an increase of acid secretion, called rebound, and a high rate of relapses.

10 The study of gastrin has recently been progressed, and participation of gastrin in various diseases has been elucidated. As a result, it has been suggested that a selective antagonist to gastrin receptors would be useful for the treatment and prevention of diseases induced by disorders of physiological functions related to gastrin, i.e., diseases of digestive organs, particularly peptic ulcers, gastritis, reflux esophagitis, and Zollinger-Ellison syndrome; prevention of a relapse following treatment with an H₂ receptor antagonist or an H⁺-K⁺ ATPase inhibitor; or 15 the treatment and prevention of tumours originating in the gastrointestinal system.

 Recently, several gastrin receptor antagonists have been reported. For example, amino acid (glutamic acid) derivatives such as Proglumide and benzodiazepin derivatives 25 such as L-365,260 (Japanese Patent Application Laid-Open No. 238069/88) are known. Proglumide exhibits very weak binding activity to gastrin receptors. L-365,260, while having high binding activity to gastrin receptors, do not exert powerful

inhibitory activity on gastric acid secretion when administered in vivo.

On the other hand, CCK is widely distributed through the gastrointestinal system and the central nervous system. It is known that CCK exhibits its activities at the peripheries chiefly via CCK-A receptors accelerating pancreatic secretion, gastrointestinal motility and contractions of the gall bladder, inhibition of gastric emptying, and acceleration of growth of some kinds of tumor cells. It is also known that CCK participates in appetite control, analgesia through opiate, and symptoms of psychotic disorders including anxiety and panic disorder in the central nervous system via CCK-B receptors. Accordingly, drugs having a selective antagonistic action to CCK-B receptors are expected to be useful for the treatment of CCK-related disorders in the appetite control system, enhancement and prolongation of analgesia through opiate or non-opiate, induction of anesthesia or analgesia, and the treatment and prevention of symptoms of psychotic disorders including anxiety and panic disorders.

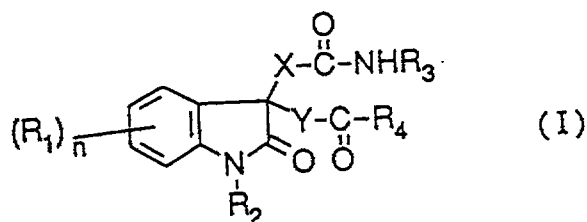
While amino acid (glutamic acid) derivatives such as Proglumide are reported as a CCK-B receptor antagonist, their binding activity to CCK-B receptors is very weak.

An object of the present invention is to provide a compound which selectively antagonizes to gastrin receptors without causing side effects attributed to the CCK-A receptor antagonism and inhibits gastric acid secretion in vivo and is useful for the treatment and prevention of

diseases of digestive organs, such as peptic ulcers, gastritis, reflux esophagitis, and Zollinger-Ellison syndrome, and for the treatment of tumour originating in the gastrointestinal system and which also selectively antagonizes to CCK-B receptors without causing side effects attributed to the CCK-A receptor antagonism and is useful for the treatment of CCK-related disorders in the appetite control system, enhancement and prolongation of analgesia through opiate or non-opiate, induction of anesthesia or analgesia, and the treatment and prevention of symptoms of psychotic disorders including anxiety and panic disorder, and an intermediate useful for the synthesis of the compound.

Disclosure of the Invention

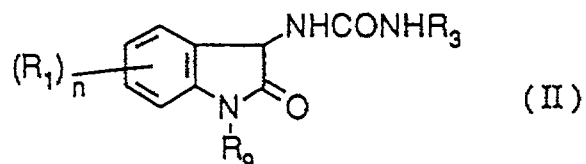
We have conducted extensive investigations for the purpose of developing a selective gastrin receptor antagonist and a selective CCK-B receptor antagonist. As a result, we have found that the above purpose can be achieved by a compound represented by formula (I):



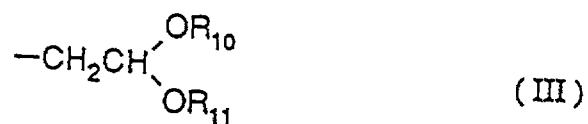
wherein R_1 represents a halogen atom, a lower alkyl group, a lower alkoxy group, a hydroxyl group, a nitro group, a trifluoromethyl group, a lower alkylthio group, an acyl group, a carboxyl group, a mercapto group, or a substituted

or unsubstituted amino group; R_2 represents a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted lower alkenyl group, a substituted or unsubstituted lower alkynyl group,
5 a substituted or unsubstituted lower alkoxy group, a substituted or unsubstituted acyl group, a substituted or unsubstituted aryl group, or a substituted or unsubstituted heterocyclic group; R_3 represents a substituted or unsubstituted lower alkyl group, a substituted or
10 unsubstituted cycloalkyl group, a substituted or unsubstituted aryl group, or a substituted or unsubstituted heterocyclic group; R_4 represents a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted aryl group, a substituted
15 or unsubstituted heterocyclic group, $-OR_5$, $-SR_5$, or $-NR_6R_7$, wherein R_5 , R_6 , and R_7 , which may be the same or different, each represent a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group, a substituted or unsub-
20 stituted aryl group, a substituted or unsubstituted heterocyclic group, a lower alkoxy group, or a substituted or unsubstituted amino group; or R_6 and R_7 are taken together to form $-(CH_2)_m-$ or $-(CH_2)_lNR_8(CH_2)_k-$ (wherein k , l , and m each represent an integer of from 1 to 8; and R_8 represents
25 a hydrogen atom or a lower alkyl group); X and Y , which may be the same or different, each represent $-CH_2-$, $-NH-$ or $-O-$; and n represents an integer of from 0 to 4, or a salt thereof, thus having reached the present invention. We have

also found that a compound represented by formula (II):



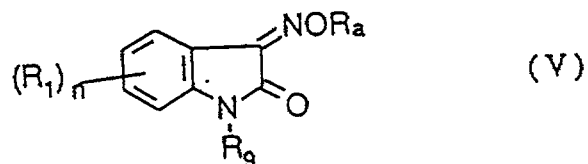
wherein R_1 , R_3 , and n are as defined above; and R_9 represents a group represented by formula (III):



wherein R_{10} and R_{11} each represent a substituted or
 5 unsubstituted lower alkyl group,
 or a group represented by formula (IV):



wherein Z represents a substituted or unsubstituted lower
 alkylene group,
 and a compound represented by formula (V):



10 wherein R_1 , R_9 , and n are as defined above,
 are useful intermediates for the synthesis of compound
 represented by formula (I).

In the present invention, the term "lower alkyl group" denotes a straight-chain or branched alkyl group having 1 to 6 carbon atoms, including a methyl group, an ethyl group, a *n*-propyl group, an isopropyl group, a *n*-butyl group, a *sec*-butyl group, a *t*-butyl group, a pentyl group, and a hexyl group. The term "lower alkenyl group" denotes a straight-chain or branched alkenyl group having from 2 to 6 carbon atoms, including a vinyl group, an allyl group, a butenyl group, a pentenyl group, and a hexenyl group.

10 The term "lower alkynyl group" means a straight-chain or branched alkynyl group having 2 to 6 carbon atoms, including an ethynyl group, a propynyl group, and a butynyl group. The term "lower alkoxy group" denotes a straight-chain or branched alkyloxy group having 1 to 6 carbon atoms,

15 including a methyloxy group, an ethyloxy group, a *n*-propyloxy group, an isopropyloxy group, a *n*-butyloxy group, a *sec*-butyloxy group, a *t*-butyloxy group, a pentyloxy group, and a hexyloxy group. The term "acyl group" indicates a carbonyl group attaching a hydrogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted alkoxy group, a substituted or unsubstituted amino group, etc., including an alkylcarbonyl group, such as an acetyl group, a propionyl group, a pivaloyl group, and a cyclohexanecarbonyl group;

20 and an arylcarbonyl group, such as a benzoyl group, a naphthoyl group and a toluoyl group. The term "aryl group" means an aromatic hydrocarbon with one hydrogen atom removed therefrom, such as a phenyl group, a tolyl group, a xylyl

25

group, a biphenyl group, a naphthyl group, an anthryl group, or a phenanthryl group. The term "alkylene group" denotes a straight-chain or branched alkylene group having 1 to 6 carbon atoms, including a methylene group, an ethylene group, a propylene group, a butylene group, a pentylene group, and a hexylene group. The term "cycloalkyl group" denotes a cyclic saturated hydrocarbon group having 3 to 8 carbon atoms, such as a cyclopropyl group, a cyclobutyl group, a cyclopentyl group, a cyclohexyl group or a cycloheptyl group. The substituted cycloalkyl group includes a menthyl group and an adamantyl group. The term "aralkyl group" denotes a lower alkyl group substituted with an aryl group, such as a benzyl group, a diphenylmethyl group, a trityl group, a phenethyl group or a naphthylmethyl group, with a benzyl group or phenethyl group being preferred. The term "heterocyclic group" means an aromatic heterocyclic group having at least one hetero atom, such as a pyridyl group, a furyl group, a thienyl group, an imidazolyl group, a pyrazinyl group or a pyrimidyl group. The substituent includes a halogen atom, a lower alkyl group, a cycloalkyl group, an aryl group, a hydroxyl group, an alkoxy group, an aryloxy group, an alkylthio group, a heterocyclic group, a formyl group (which may be protected with an acetal, etc.), an alkylcarbonyl group, an arylcarbonyl group, a carboxyl group, an alkoxycarbonyl group, a substituted or unsubstituted amino group, an imino group, a thioacetal group, a nitro group, a nitrile group, and a trifluoromethyl group.

R_1 is preferably a lower alkyl group or nil ($n=0$), still preferably nil ($n=0$).

R_2 is preferably an alkoxy-substituted lower alkyl group, still preferably a lower alkyl group having
5 two alkoxy groups or an -O-Z-O- group (wherein Z represents a substituted or unsubstituted lower alkylene group) on one carbon atom thereof. A 2,2-diethoxyethyl group is particularly preferred.

R_3 is preferably a substituted or unsubstituted
10 aryl group, still preferably a phenyl group substituted with a lower alkyl group or a lower alkoxy group. A phenyl group substituted with a methyl group or a methoxy group is particularly preferred.

R_4 is preferably $-NR_6R_7$ in which one of R_6 and R_7
15 is a hydrogen atom with the other being a substituted or unsubstituted aryl group or a substituted or unsubstituted heterocyclic group, still preferably $-NR_6R_7$ in which one of R_6 and R_7 is a hydrogen atom with the other being a phenyl group substituted with a lower alkyl group, a lower alkoxy
20 group or a substituted or unsubstituted amino group, particularly a phenyl group substituted with a methyl group or an N,N-dimethylamino group.

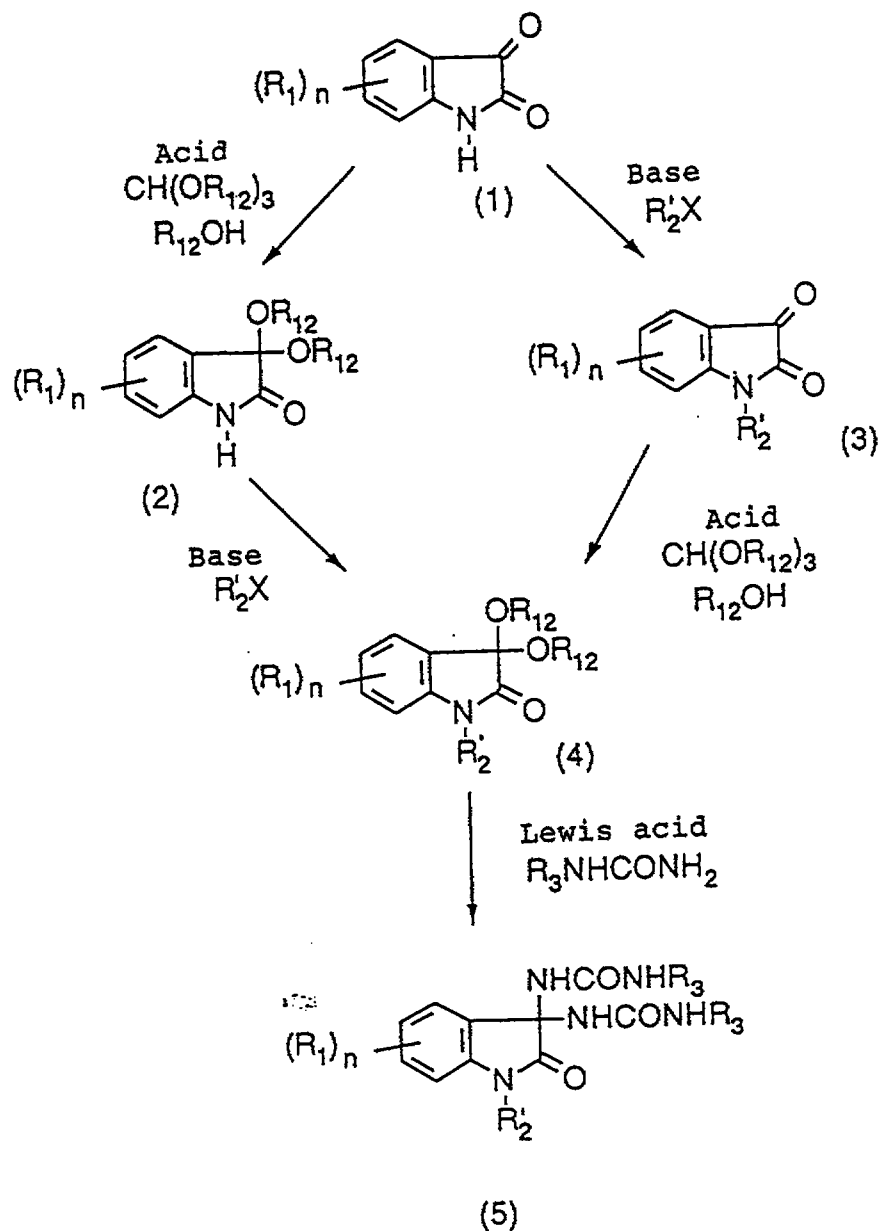
X is preferably -NH-.

Y is preferably $-CH_2-$.

25 Of optically active compounds of formula (I) or salts thereof preferred are (+)-compounds.

The compounds of the present invention are novel compounds which have not been reported in any literature and can be synthesized, for example, as follows.

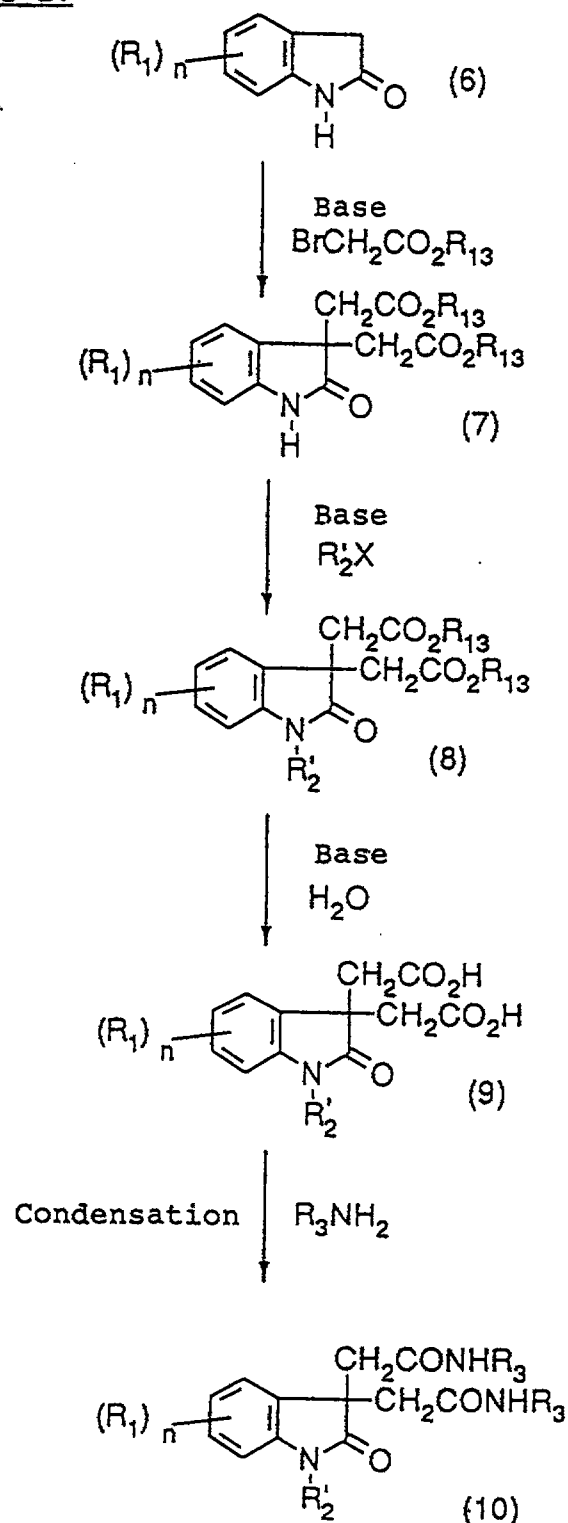
Reaction Route 1:



- 5 wherein R_1 , R_3 , and n are as defined above; R_{12} represents a lower alkyl group; R'_2 represents a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted lower alkenyl group, a substituted or

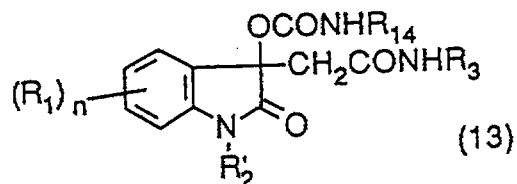
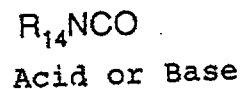
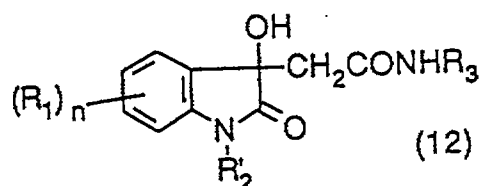
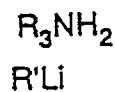
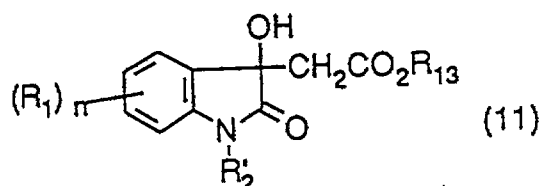
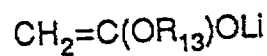
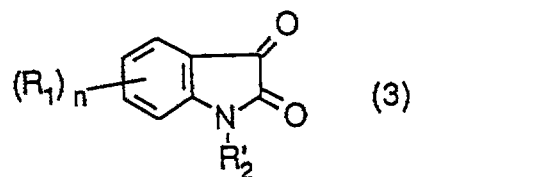
unsubstituted lower alkynyl group, a substituted or unsubstituted aryl group, or a substituted or unsubstituted heterocyclic group; and X represents a halogen atom or a trifluoromethanesulfonyloxy group.

5 Reaction Route 2:



wherein R_1 , R'_2 , R_3 , X , and n are as defined above; and R_{13} represents a lower alkyl group.

Reaction Route 3:

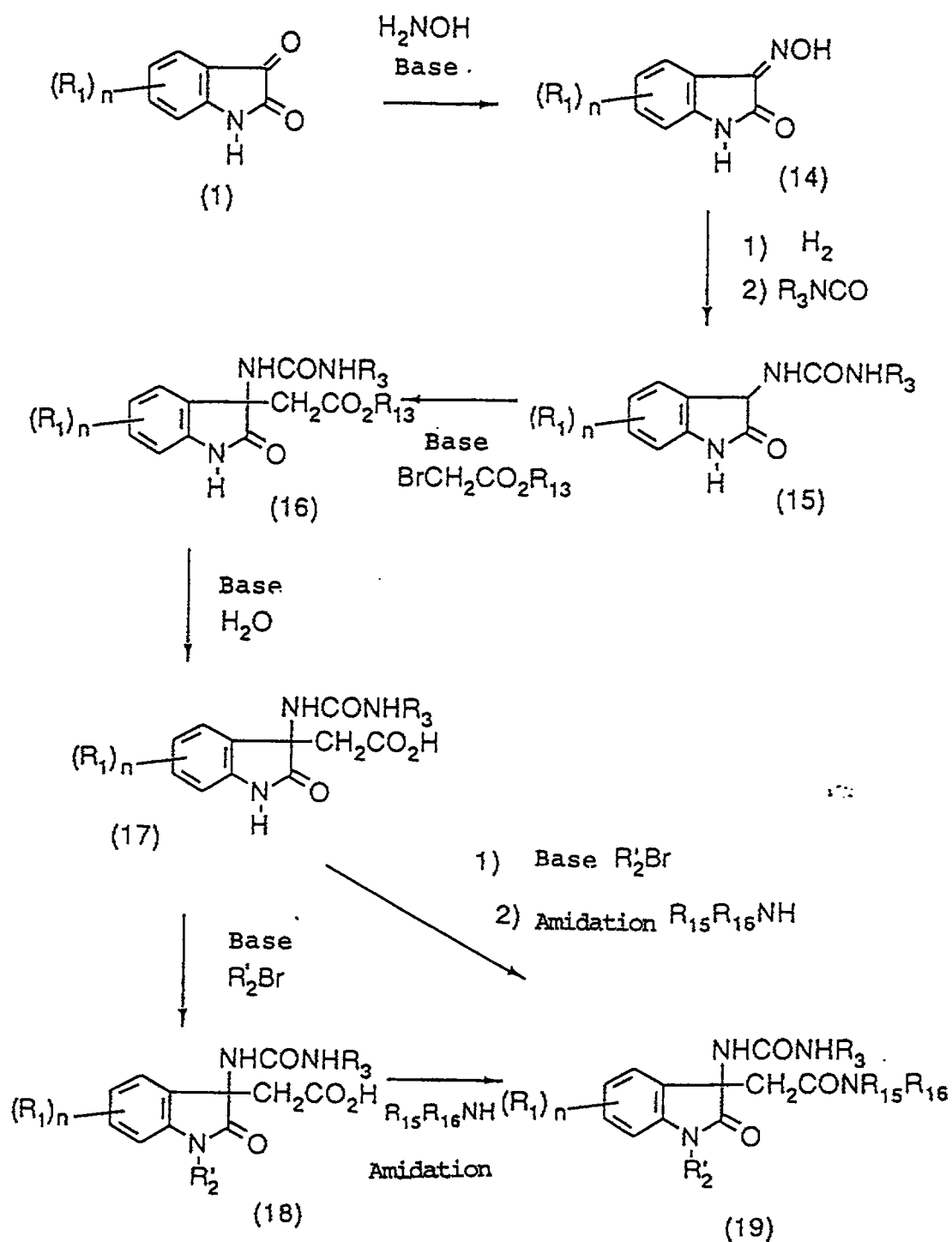


wherein R_1 , R'_2 , R_3 , R_{13} , and n are as defined above;

5 R' represents a lower alkyl group; and R_{14} represents

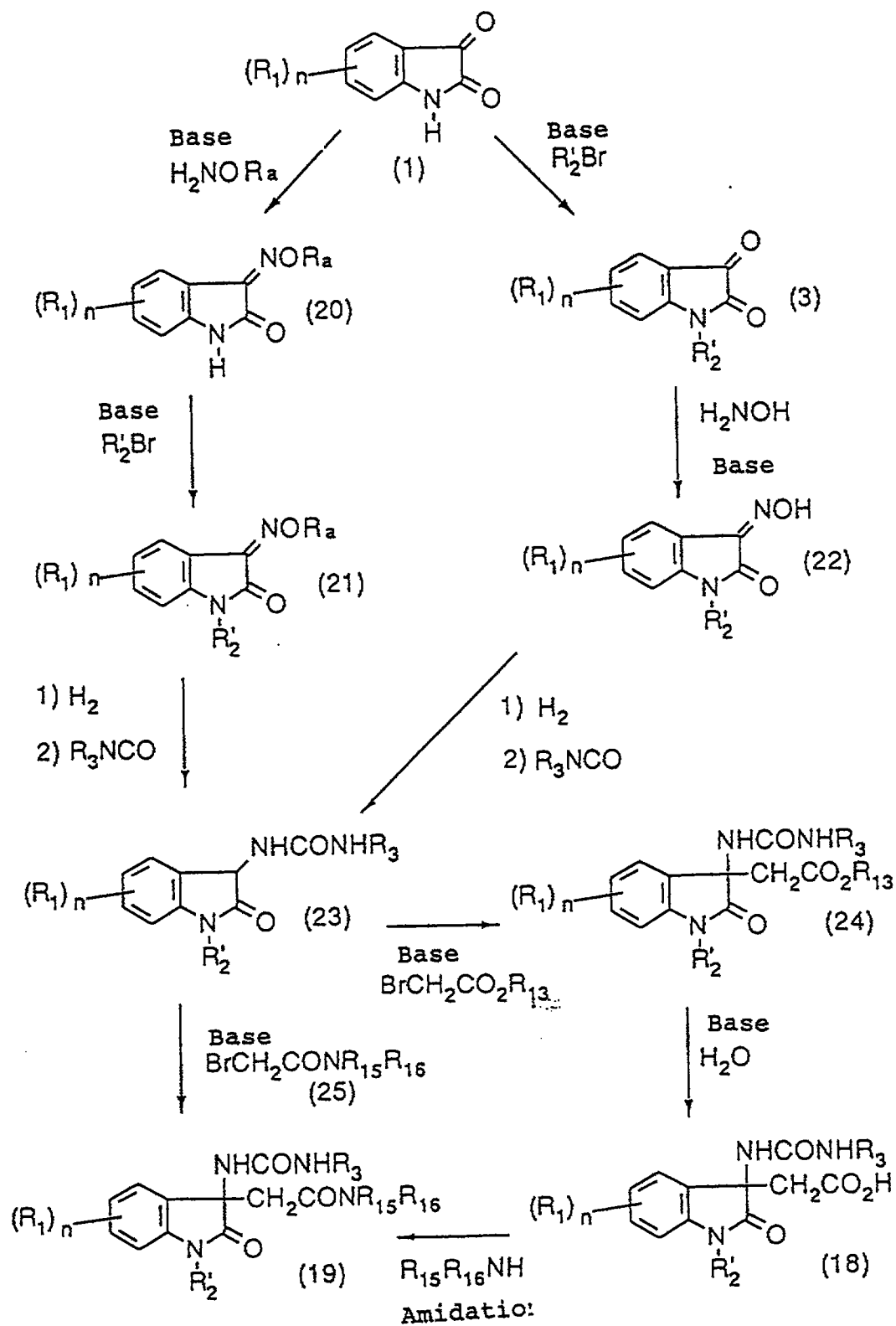
a substituted or unsubstituted lower alkyl group,
a substituted or unsubstituted cycloalkyl group,
a substituted or unsubstituted aryl group, or a substituted
or unsubstituted heterocyclic group.

5 Reaction Route 4:



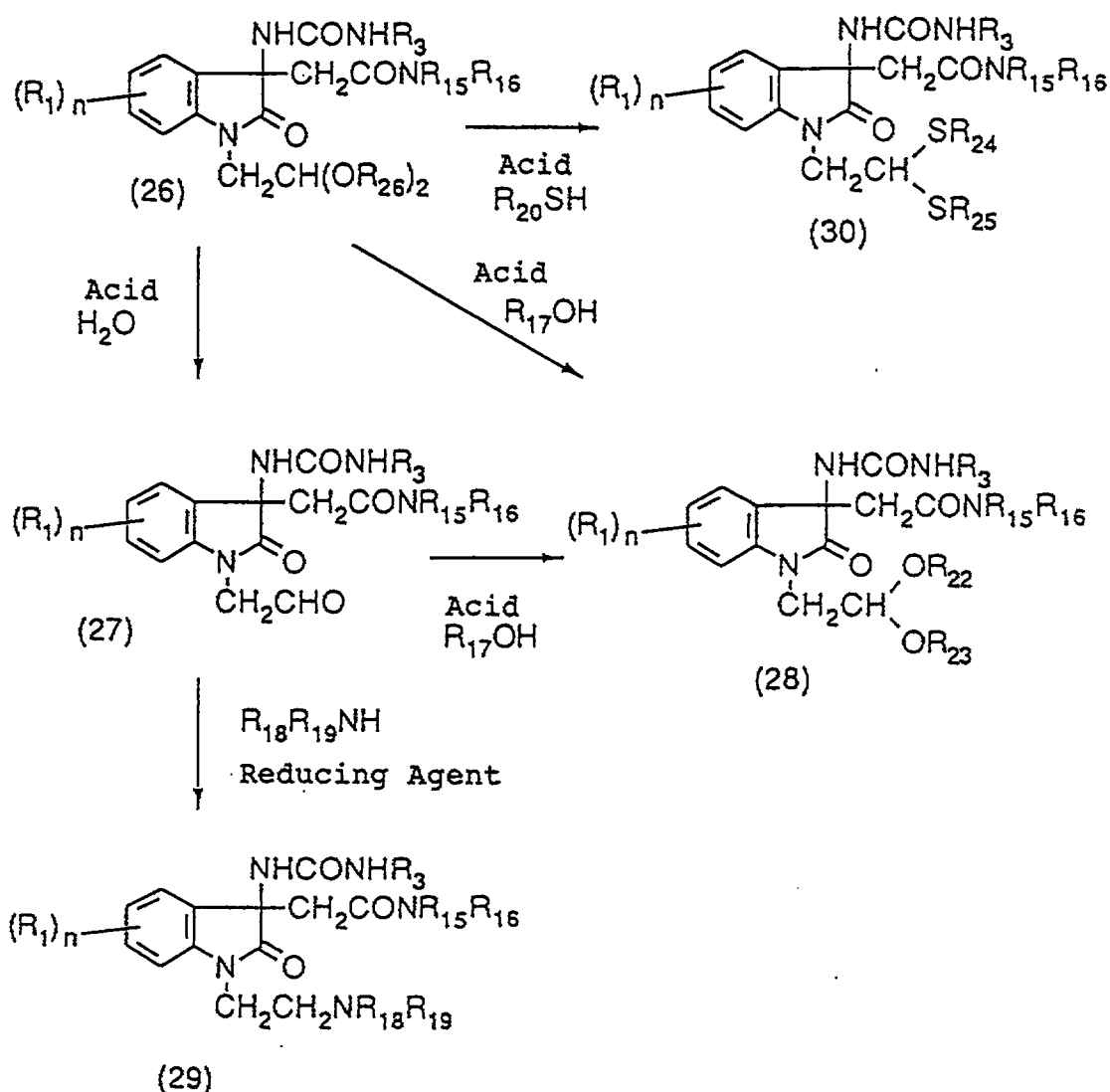
wherein R_1 , R'_2 , R_3 , R_{13} , and n are as defined above; and R_{15} and R_{16} , which may be the same or different, each represent a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group,
5 a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a lower alkoxy group, or a substituted or unsubstituted amino group; or R_{15} and R_{16} are taken together to form $-(CH_2)_m-$ or $-(CH_2)_lNR_8(CH_2)_k-$, wherein k , l , and m each represent an integer of from 1 to
10 8; and R_8 represents a hydrogen atom or a lower alkyl group.

Reaction Route 5:



wherein R_1 , R'_2 , R_3 , R_{13} , R_{15} , R_{16} , and n are as defined above;
 and R_4 preferably represents a substituted or unsubstituted
 lower alkyl group, still preferably a substituted or
 unsubstituted methyl group, most preferably a methyl group
 5 or a benzyl group.

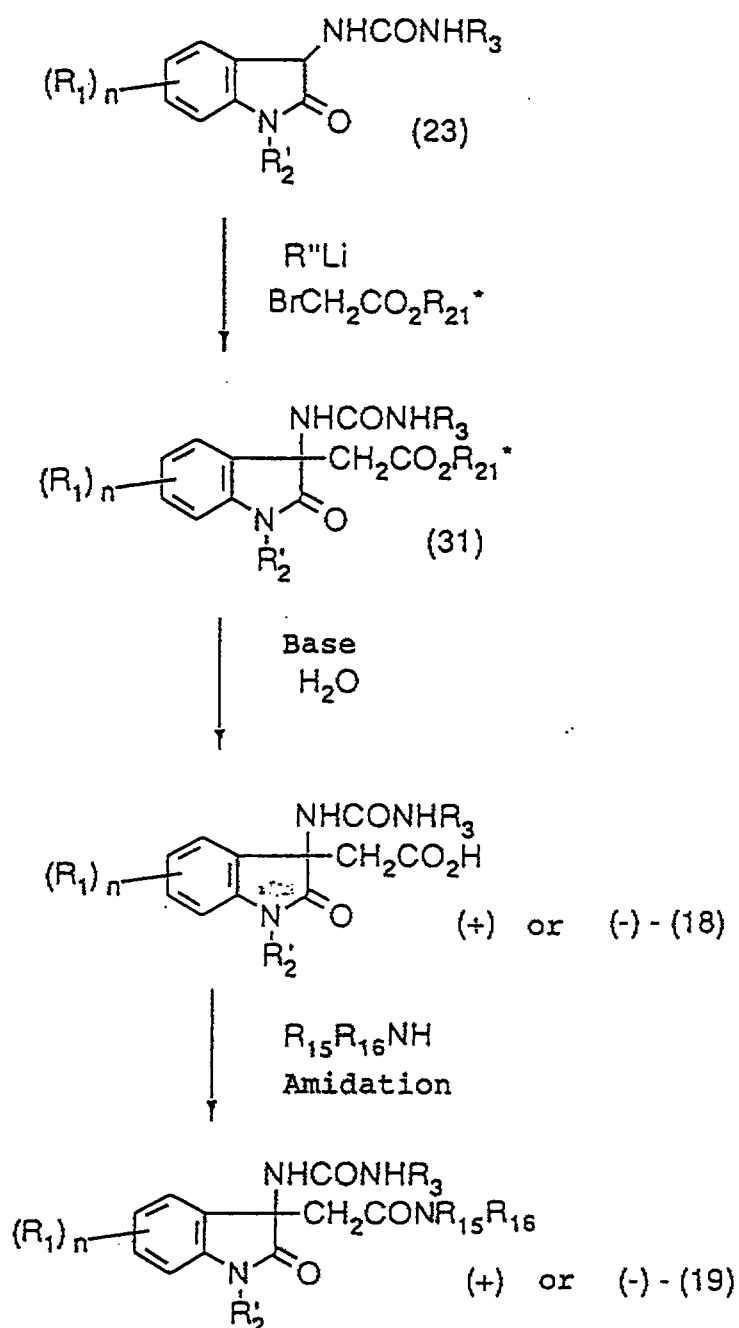
Reaction Route 6:



wherein R_1 , R_3 , R_{15} , R_{16} , and n are as defined above;
 R_{26} represents a lower alkyl group; R_{17} represents a lower
 alkyl group or a lower hydroxyalkyl group; R_{18} and R_{19} each
 10 represent a lower alkyl group, or they are taken together to

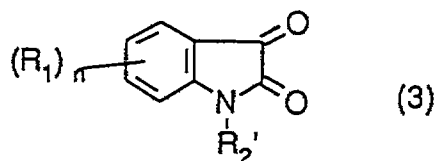
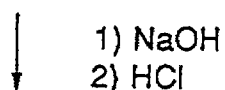
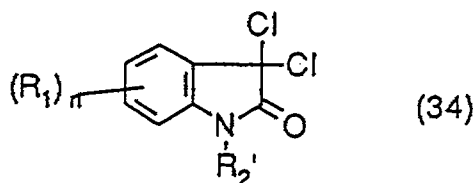
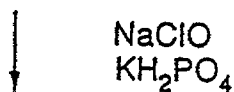
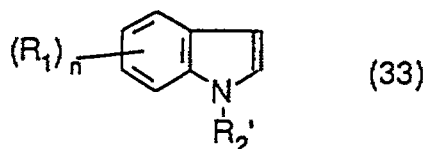
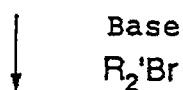
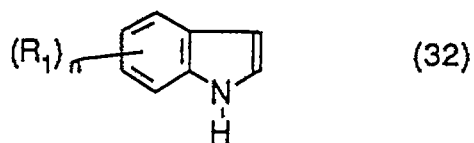
form an alkylene group; R_{20} represents a lower alkyl group or a lower mercaptoalkyl group; R_{22} and R_{23} each represent a lower alkyl group, or they are taken together to form an alkylene group; and R_{24} and R_{25} each represent a lower alkyl group, or they are taken together to form an alkylene group.

Reaction Route 7:



wherein R_1 , R'_2 , R_3 , R_{15} , R_{16} , and n are as defined above;
 R'' represents a lower alkyl group, a primary amino group,
 a secondary amino group or an alkoxy group; and R_{21}^*
 represents an optically active group.

5 Reaction Route 8:



wherein R_1 , R'_2 , and n are as defined above.

Diurea derivative (5) can be prepared by substitution
 reaction between the acetal moiety of acetal intermediate
 (4) and an urea derivative as shown in Reaction Route 1.

Intermediate (4) can be prepared by two reactions, i.e., alkylation and acetal formation, whichever may precede, as shown in Reaction Route 1.

The isatin derivative which can be used as
5 a starting material in this process is a known compound and is commercially available or can easily be synthesized in a conventional manner. Various urea derivatives are also commercially available or can easily be synthesized in a conventional manner (J. Heterocyclic Chem., Vol. 19,
10 p. 1453 (1982)).

The preparation of diurea derivative (5) can preferably be carried out as follows. Isatin derivative (1) is dissolved or suspended in an inert solvent, such as dry N,N-dimethylformamide, dry dimethyl sulfoxide or dry
15 tetrahydrofuran, and a requisite amount of a base, such as a metal hydride or a metal alkoxide, preferably sodium hydride or potassium t-butoxide, is added thereto at a temperature in the range from ice-cooling to room temperature. After stirring the mixture for a while at a temperature in the
20 range from ice-cooling to room temperature, an equimolar amount or a slight excess, with respect to isatin derivative (1), of a halide is added thereto, followed by stirring for 1 to 15 hours at room temperature or under heating. After completion of the reaction, the solvent is removed by
25 evaporation under reduced pressure. Water is added to the residue, and the mixture is extracted with an appropriate solvent, such as chloroform or ethyl acetate, dried, and concentrated under reduced pressure. The resulting crude

product is purified by a proper method to obtain N-substituted isatin (3).

Then, N-substituted isatin (3) and an adequate amount of an appropriate trialkyl orthoformate are dissolved or suspended in an appropriate alcohol, and an adequate amount of an acid catalyst, for example, *p*-toluenesulfonic acid monohydrate, camphorsulfonic acid or sulfuric acid, is added thereto, followed by heating for 4 to 48 hours with stirring. The reaction mixture is concentrated under reduced pressure, and to the residue is added a base, for example, saturated aqueous sodium hydrogencarbonate, followed by extraction with an appropriate solvent, such as chloroform or ethyl acetate. The extract is dried and concentrated under reduced pressure. The resulting crude product is purified by an appropriate method to obtain acetal intermediate (4).

Alternatively, acetal intermediate (4) can be obtained by conducting the above-mentioned two reactions in reverse order, i.e., via intermediate (2) shown in Reaction Route 1. This process is preferred in case where the reaction for synthesizing N-substituted isatin (3) requires heating.

An excess, with reference to acetal intermediate (4), preferably 2 to 3 mol, per mol of acetal intermediate (4), of a Lewis acid, such as anhydrous aluminum chloride, boron trifluoride ethyl etherate, titanium tetrachloride, tin tetrachloride, magnesium bromide ethyl etherate, or zinc bromide, preferably anhydrous aluminum chloride, is

dissolved in an inert solvent, such as dry tetrahydrofuran, dichloromethane, toluene, or dry dioxane, preferably dry tetrahydrofuran. To the solution are added successively a solution of acetal intermediate (4) in dry tetrahydrofuran, etc. and an urea derivative in excess, preferably in an amount of 2 mol per mol of acetal intermediate (4) at a temperature in the range from ice-cooling to room temperature, followed by heating for 1 to 8 hours with stirring. After completion of the reaction, an appropriate organic solvent, such as ethyl acetate, is added to the reaction mixture, and the mixture is washed with water, dried, and concentrated under reduced pressure. The residue is purified by a proper method to obtain diurea derivative (5).

15 Diamide derivative (10) can be prepared by dialkylation of the 3-position of commercially available 2-oxindole (6), followed by alkylation of the 1-position, followed by conversion of ester to amide as illustrated in Reaction Route 2.

20 The preparation of diamide derivative (10) can preferably be carried out as follows. 2-Oxindole (6) is dissolved in an inert solvent, such as dry dimethyl sulfoxide, dry N,N-dimethylformamide or dry tetrahydrofuran, preferably dry dimethyl sulfoxide, and a solution of
25 an equimolar amount of a base, such as a metal hydride or a metal alkoxide, preferably sodium hydride or potassium t-butoxide, in dry dimethyl sulfoxide is added thereto at a temperature in the range from ice-cooling to room

temperature, followed by stirring at a temperature in the range from ice-cooling to room temperature for several minutes. An equimolar amount of an appropriate bromoacetic ester with reference to (6) is then added thereto, followed
5 by stirring at room temperature for several tens of minutes. To the reaction mixture are further added an equimolar amount of the same base as used above and an equimolar amount of the same bromoacetic ester as used above at the same temperature, followed by stirring at room temperature
10 for several tens of minutes. After completion of the reaction, water is added to the residue, and the mixture is extracted with an appropriate solvent, such as diethyl ether. The extract is dried and concentrated under reduced pressure. Since the resulting crude product contains a 1-
15 substituted derivative, it is purified by a proper method, such as silica gel column chromatography, to give both 3,3-bis(alkoxycarbonylmethyl)indolin-2-one (7) and 1,3,3-tris(alkoxycarbonylmethyl)indolin-2-one.

3,3-Bis(alkoxycarbonylmethyl)indolin-2-one (7)
20 is dissolved or suspended in an inert solvent, such as dry N,N-dimethylformamide, dry dimethyl sulfoxide or dry tetrahydrofuran, and a requisite amount of a base, such as a metal hydride or a metal alkoxide, preferably sodium hydride or potassium *t*-butoxide, is added thereto at a temperature
25 in the range from ice-cooling to room temperature, followed by stirring for several minutes at a temperature in the range from ice-cooling to room temperature. An equimolar amount or a slight excess, with respect to (7), of an

appropriate halide is added thereto, followed by stirring for 1 to 15 hours at room temperature or under heating. After completion of the reaction, the solvent is removed by evaporation under reduced pressure. Water is added to the
5 residue, and the mixture is extracted with an appropriate solvent, such as chloroform or ethyl acetate, dried, and concentrated under reduced pressure. The resulting crude product may be either purified by a proper method to obtain 1-substituted 3,3-bis(alkoxycarbonylmethyl)indolin-2-one
10 (8) or be used in the subsequent reaction without further purification.

1-Substituted 3,3-bis(alkoxycarbonylmethyl)indolin-2-one (8) is dissolved in a solvent uniformly miscible with water, such as ethanol or methanol, and an aqueous solution
15 of a moderately excess base, such as potassium hydroxide, sodium hydroxide or potassium carbonate, is added thereto at room temperature, followed by stirring for 1 to 24 hours at room temperature or under heating. After completion of the reaction, the reaction mixture is concentrated under reduced
20 pressure. The concentrate is dissolved in water and washed with an appropriate organic solvent, such as chloroform. The aqueous layer is acidified with an acid, e.g., 2N hydrochloric acid and then extracted with an appropriate organic solvent, such as ethyl acetate, to obtain 1-substituted
25 3,3-bis(hydroxycarbonylmethyl)indolin-2-one (9). The crude product as obtained may be used in the subsequent reaction either without purification or after being purified by an appropriate method.

1-Substituted 3,3-bis(hydroxycarbonylmethyl)indolin-2-one (9) is converted to an amide compound in a conventional manner to obtain diamide compound (10). For example, 1-substituted 3,3-bis(hydroxycarbonylmethyl)indolin-2-one (9) is dissolved in an inert solvent, such as dry N,N-dimethylformamide or dichloromethane, and 2 to 4 moles, per mol of (9), of dicyclohexylcarbodiimide or 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride is added thereto as a condensing agent. Subsequently, 0 to 4 mol of 1-hydroxybenzotriazole or 4-dimethylaminopyridine as an activating agent and 2 to 4 mol of an amine, each per mol of (9) are preferably added thereto at room temperature. The mixture is stirred at room temperature for 6 to 24 hours. To the reaction mixture, either as obtained or after concentration under reduced pressure, is added dilute hydrochloric acid. The product is extracted with an appropriate organic solvent, and the organic layer is washed with an appropriate base, such as saturated aqueous sodium hydrogencarbonate, dried, and concentrated. The concentrate is purified by an appropriate method to obtain diamide compound (10).

As shown in Reaction Route 3, monocarbamate (13) can be prepared by Aldol reaction of N-substituted isatin derivative (3) as a starting material, conversion of the reaction product to an amide compound, and reaction of the resulting tertiary alcohol (12) with an isocyanate using a catalyst.

The preparation of monocarbamate derivative (13) can preferably be carried out as follows. A lithium enolate of an acetic ester is prepared by mixing a lithium salt of a secondary amine, such as lithium diisopropylamide or lithium
5 hexamethyldisilazide, with an acetic ester at an equimolar ratio in a solvent which gives no adverse influence to the reaction, such as dry tetrahydrofuran, dry diethyl ether or dry dioxane, preferably dry tetrahydrofuran, by stirring under a nitrogen atmosphere at a low temperature for several
10 minutes. To the resulting reaction solution is added 0.5 mol of N-substituted isatin (3) per mol of the lithium enolate at a low temperature, followed by stirring at a low temperature for several tens of minutes, and the reaction mixture is poured into water to quench the reaction. The
15 reaction product is extracted with an appropriate organic solvent, and the extract is dried and concentrated to obtain ester intermediate (11). This crude product (11) may be used in the subsequent reaction either without purification or after purification by a proper method.

20 An amine is dissolved in a solvent giving no adverse influence to the reaction, such as dry tetrahydrofuran, dry diethyl ether or dry dioxane, preferably dry tetrahydrofuran, and an equimolar amount of an alkyl lithium, preferably n-butyl lithium, is added to the
25 solution under a nitrogen atmosphere at a low temperature, followed by stirring at a low temperature for several minutes. To the resulting solution is added 0.5 mol of ester intermediate (11) per mol of the amine, and the

mixture is stirred at a low temperature for several tens of minutes. The reaction mixture is poured into water to quench the reaction, and the product is extracted with an appropriate organic solvent. The extract is dried and concentrated, and the concentrate is purified by a proper method to obtain amide intermediate (12).

Amide intermediate (12) and excess isocyanate compound are dissolved in an inert solvent, such as dry tetrahydrofuran, dichloromethane, acetonitrile or toluene, preferably dry tetrahydrofuran, and a small proportion, with reference to (12), of an acid or a base, such as a titanium tetraalkoxide, a boron trifluoride ethyl etherate, dibutyltin diacetate or diisopropylethylamine, preferably dibutyltin diacetate, is added to the solution, followed by stirring for 10 to 24 hours at room temperature or under heating. The reaction mixture is washed with water, extracted with an appropriate solvent, dried, and concentrated. The concentrate is purified by a proper method to obtain monocarbamate compound (13).

Monourea compound (19) can be prepared through either of the processes illustrated in Reaction Routes 4 and 5.

Some ureido intermediates (15) shown in Reaction Route 4 are known compounds and can be synthesized by starting with isatin derivative (1) in accordance with the process described in patents (Japanese Patent Publication Nos. 6710/92 and 6711/92). An acetic ester is bonded to the thus prepared ureido intermediate (15), and the resulting ester is hydrolyzed to give carboxylic acid (17).

The 1-position of (17) is selectively alkylated to give compound (18), which is then converted to monourea compound (19) by amidation. The alkylation and the subsequent amidation of carboxylic acid (17) may be carried out in
5 one step.

Ureido intermediate (23) in Reaction Route 5 can be synthesized by starting with N-substituted isatin (3) in accordance with the process described in patents (Japanese Patent Publication Nos. 6710/92 and 6711/92).
10 Alternatively, it may be prepared by converting isatin derivative (1) to alkyloxime or aralkyloxime (20), for example, methyloxime or benzyloxime, alkylating the 1-position, hydrogenation of oxime, and then leading the product to urea. N-Substituted isatin (3) can also be
15 synthesized by alkylating the 1-position of starting indole (32) to obtain 1-substituted indole (33), followed by oxidizing the indole ring with, for example, sodium hypochlorite to give (34), which is then hydrolyzed as shown in Reaction Route 8. Where a bulky group, such as
20 a secondary alkyl group, a 2,2-dialkoxyethyl group or a 2,2-dialkylethyl group, is to be introduced to the 1-position, the reaction route by way of alkyloxime or aralkyloxime (20) or the route including oxidation of 1-substituted indole (33) are preferred. An acetic ester is bonded to the
25 thus prepared ureido intermediate (23), and the resulting ester is hydrolyzed to give carboxylic acid (18), which is then converted to monourea compound (19) by amidation. Alternatively, an acetamide derivative can directly be added

to (23) to prepare (19). Most of bromoacetamide derivatives (25) which can be used in this reaction are known compounds and can easily be synthesized by mixing bromoacetyl bromide and an amine in the presence of a base.

5 The preparation of monourea compound (19) through Reaction Route 4 can preferably be carried out as follows. Isatin derivative (1) is dissolved in an inert solvent, such as ethanol or methanol, and an equimolar or excessive molar amount, with reference to (1), of a hydroxylamine
10 hydrochloride or a hydroxylamine sulfate, and the same quantity of a base, such as a sodium acetate aqueous solution, are added thereto, followed by stirring for 1 to 10 hours at room temperature or under ice-cooling. The reaction mixture is concentrated, and the concentrate is
15 purified by a proper method to give oxime derivative (14). Oxime derivative (14) is stirred in an inert solvent, such as ethanol, methanol or acetic acid, in the presence of an appropriate catalyst, such as palladium-on-carbon, rhodium-on-carbon, platinum oxide, or Raney nickel, under a hydrogen
20 atmosphere of 1 to 6 atm at room temperature. After removal of the catalyst by filtration, the filtrate is concentrated to give an amine intermediate. Since this compound is susceptible to air oxidation, it is preferably subjected to the subsequent reaction without further purification. The
25 unpurified product is dissolved in an inert solvent, such as dichloromethane, chloroform, N,N-dimethylformamide, or acetonitrile, and an equimolar or slightly excessive amount, with reference to the amine, of an isocyanate is added

thereto at a temperature in the range from ice-cooling to room temperature, followed by stirring at a temperature in the range from ice-cooling to room temperature for 1 to 10 hours. The reaction product is purified by a proper
5 method to give ureido intermediate (15).

Ureido intermediate (15) is dissolved in an inert solvent, such as dry N,N-dimethylformamide, dry dimethyl sulfoxide or dry tetrahydrofuran, preferably dry dimethyl sulfoxide, and a solution of an equimolar amount, with
10 reference to ureido intermediate (15), of a base, such as a metal hydride or a metal alkoxide, preferably sodium hydride or potassium t-butoxide, in dry dimethyl sulfoxide is added thereto at a temperature in the range from ice-cooling to room temperature, followed by stirring at a temperature in
15 the range from ice-cooling to room temperature for 10 to 30 minutes. Then, a bromoacetic ester is added thereto in an equimolar amount with reference to ureido intermediate (15), and the mixture is stirred at room temperature for several tens of minutes. After completion of the reaction,
20 water is added to the reaction mixture, and the mixture is extracted with an appropriate solvent, such as diethyl ether. The extract is dried and concentrated under reduced pressure, and the residue is purified by a proper method to obtain ester compound (16).

25 Ester compound (16) is stirred in a solvent uniformly miscible with water, such as ethanol or methanol, together with an aqueous solution of a moderate excess of a base, such as potassium hydroxide, sodium hydroxide or potassium

carbonate, at room temperature for 1 to 24 hours. After completion of the reaction, the reaction mixture is concentrated under reduced pressure. The concentrate is dissolved in water and washed with an appropriate
5 organic solvent, such as chloroform. The aqueous layer is acidified with 2N hydrochloric acid and then extracted with an appropriate organic solvent, such as ethyl acetate, to obtain carboxylic acid (17). The resulting crude product may be used in the subsequent reaction either as it is or
10 after being purified by a proper method.

Carboxylic acid (17) is dissolved in a solvent giving no adverse influence to the reaction, such as dry dimethyl sulfoxide or dry tetrahydrofuran, preferably dry dimethyl sulfoxide, and a solution of 2 mol, per mol of
15 carboxylic acid (17), of a base, such as a metal hydride or a metal alkoxide, preferably sodium hydride or potassium *t*-butoxide, in dry dimethyl sulfoxide is added thereto at room temperature, followed by stirring at room temperature for 10 to 30 minutes. A halide is added thereto in an equimolar
20 amount with carboxylic acid (17), followed by stirring at room temperature for several tens of minutes. After completion of the reaction, water is added to the reaction mixture, and the mixture is extracted with an appropriate solvent, such as diethyl ether. The extract is dried and
25 concentrated under reduced pressure to obtain 1-alkyl compound (18). The resulting crude product may be used in the subsequent reaction either as it is or after being purified by a proper method.

1-Alkyl compound (18) is dissolved in an inert solvent, such as dry N,N-dimethylformamide or dichloromethane, and 1 to 4 mol, per mol of 1-alkyl compound (18), of a condensing agent, such as dicyclohexyl-
5 carbodiimide or 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride, is added to the solution. To the solution are further added successively 0 to 4 mol of 1-hydroxybenzotriazole or 4-dimethylaminopyridine as an activating agent and 1 to 4 mol of an amine, each per mol
10 of 1-alkyl compound (18) at room temperature. The mixture is stirred at room temperature for 1 to 24 hours.

Alternatively, 1-alkyl compound (18) is dissolved in an inert solvent, such as chloroform or dichloromethane, and an equimolar amount or a slight excess, with reference
15 to 1-alkyl compound (18), of a base, such as 4-dimethylaminopyridine, triethylamine, pyridine or a mixture thereof, and an equimolar amount of a halogenating agent, preferably thionyl chloride, are added thereto at 0°C to room temperature. After stirring the mixture for 30 minutes
20 to 2 hours, an equimolar amount or a slight excess, with reference to 1-alkyl compound (18), of a base, such as 4-dimethylaminopyridine, triethylamine, pyridine or a mixture thereof, and an equimolar amount or a slight excess of an amine are added thereto, followed by stirring at room
25 temperature or under ice-cooling for 30 minutes to 4 hours.

Dilute hydrochloric acid is added to the reaction mixture either as obtained or after being concentrated under reduced pressure, and the mixture is extracted with

an appropriate organic solvent. The organic layer is washed with an appropriate base, such as saturated aqueous sodium hydrogencarbonate, dried, and concentrated. The residue is purified by an appropriate method to give monourea compound (19).

Monourea compound (19) can also be prepared from carboxylic acid (17) without isolating (18). Carboxylic acid (17) is dissolved in a solvent giving no adverse influence to the reaction, such as dry N,N-dimethylformamide, dry dimethyl sulfoxide or dry tetrahydrofuran, preferably dry dimethyl sulfoxide. A solution of 2 mol, per mol of carboxylic acid (17), of a base, such as a metal hydride or a metal alkoxide, preferably sodium hydride or potassium t-butoxide, in dry dimethyl sulfoxide is added to the solution at room temperature, followed by stirring at room temperature for 10 to 30 minutes. To the mixture is further added a halide in an equimolar amount with carboxylic acid (17), followed by stirring at room temperature for several tens of minutes. After completion of the reaction, 1 to 3 mol, per mol of carboxylic acid (17), of a condensing agent, such as dicyclohexylcarbodiimide or 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride is added to the reaction mixture. Subsequently, 0 to 3 mol, per mol of 1-alkyl compound (18), of 1-hydroxybenzotriazole or 4-dimethylaminopyridine is preferably added thereto as an activating agent, and then 1 to 3 mol, per mol of 1-alkyl compound (18), of an amine is further added thereto,

followed by stirring at room temperature for 6 to 24 hours. Water is added to the reaction mixture, and the mixture is extracted with an appropriate solvent, such as diethyl ether. The extract is dried, concentrated under reduced
5 pressure, and purified by an appropriate method to give monourea compound (19).

The preparation of monourea compound (19) through Reaction Route 5 can preferably be carried out as follows. First of all, ureido intermediate (23) with its 1-position
10 alkylated is prepared by starting with N-substituted isatin (3), which is synthesized by the process shown in Reaction Route 8 or by alkylation of isatin derivative (1), in the same manner as in the preparation of ureido intermediate (15) shown in Reaction Route 4. Alternatively, ureido
15 intermediate (23) may be prepared as follows. Isatin derivative (1) is dissolved or suspended in an inert solvent, such as ethanol or methanol, and to the solution or suspension are added an equimolar or excess molar amount, with reference to (1), of an O-alkylhydroxylamine
20 or an O-aralkylhydroxylamine, such as O-methyl or benzylhydroxylamine hydrochloride, and an aqueous solution of excess base, such as sodium acetate, and the mixture is stirred at room temperature for 1 to 10 hours. The reaction mixture is concentrated and purified by a proper method to
25 obtain alkyloxime (e.g., methyloxime) or aralkyloxime (e.g., benzyloxime) derivative (20). Then, an equimolar amount or a slight excess, with reference to (20), of a base, such as sodium hydride or potassium t-butoxide, is dissolved or

suspended in an inert solvent, such as dry N,N-dimethylformamide, dry dimethyl sulfoxide or dry tetrahydrofuran. Alkyloxime derivative or aralkyloxime derivative (20) is added to the solution or suspension at room temperature or
5 under ice-cooling. After stirring at the same temperature for 30 minutes to 1 hour, an equimolar amount or a slight excess, with reference to (20), of a halide is added thereto, followed by further stirring at room temperature or under heating for 1 to 15 hours. After completion of
10 the reaction, the solvent was evaporated under reduced pressure, water is added to the residue, and the mixture is extracted with an appropriate solvent. The extract is dried and concentrated under reduced pressure. The resulting crude product is purified by a proper method to
15 obtain N-substituted compound (21), which is hydrogenated and reacted with isocyanate in the same manner as for the preparation of ureido intermediate (15) shown in Reaction Route 4 to thereby obtain ureido intermediate (23) with the 1-position alkylated.

20 The thus obtained ureido intermediate (23) is subjected to acetic ester addition reaction and ester hydrolysis reaction as shown in Reaction Route 5 in the same manner as in the preparation of carboxylic acid (17) shown in Reaction Route 4 to give intermediate (18) common
25 to both reaction routes, which is converted to monourea compound (19) in the same manner as in Reaction Route 4.

Alternatively, monourea compound (18) can be prepared from ureido intermediate (23) in one step as described below. Ureido intermediate (23) is dissolved in an inert solvent, such as dry N,N-dimethylformamide, dry
5 dimethyl sulfoxide or dry tetrahydrofuran, preferably dry dimethyl sulfoxide. To the solution is added a solution of an equimolar amount, with reference to ureido intermediate (23), of a base, such as a metal hydride or a metal alkoxide, preferably sodium hydride or potassium *t*-butoxide,
10 in dried dimethyl sulfoxide at a temperature in the range from ice-cooling to room temperature, followed by stirring at a temperature in the range from ice-cooling to room temperature for 10 to 30 minutes. To the solution is further added an equimolar amount or a slight excess, with
15 reference to ureido intermediate (23), of a bromoacetamide derivative (25), followed by stirring at room temperature for several tens of minutes. After completion of the reaction, water is added to the reaction mixture, and the mixture is extracted with an appropriate solvent, such as
20 diethyl ether. The extract is dried and concentrated under reduced pressure. The residue is purified by a proper method to give monourea compound (19).

The preparation of N-substituted isatin (3) according to Reaction Route 8 can preferably be carried
25 out as follows. Indole (32) is dissolved in a solvent giving no adverse influence to the reaction, such as dry N,N-dimethylformamide or dry tetrahydrofuran, preferably dry dimethyl sulfoxide, and a solution of an equimolar amount

or an excess, with reference to indole (32), of a base, such as sodium hydride or potassium t-butoxide, in dry dimethyl sulfoxide, is added thereto at room temperature, followed by stirring at room temperature for 10 minutes to 1 hour.

5 An equimolar amount or an excess molar amount, with reference to indole (32), of a halide is then added thereto, followed by stirring at room temperature or under heating for several tens of minutes to 10 hours. After completion of the reaction, water is added to the reaction mixture,

10 followed by extraction with an appropriate solvent, such as diethyl ether. The extract is dried and concentrated under reduced pressure to give 1-substituted indole (33). The resulting crude product may be used in the next reaction or may be purified by a proper method. Then, 1-substituted

15 indole (33) and, as a proton source, excess potassium dihydrogenphosphate or sodium dihydrogenphosphate are suspended in an appropriate solvent, such as ethyl acetate, and an aqueous solution of excess sodium hypochlorite is added thereto at room temperature or under ice-cooling,

20 followed by stirring at that temperature for 5 to 30 minutes. After completion of the reaction, the reaction mixture is washed successively with water and a base, dried, and concentrated to give dichloro compound (34). The resulting crude product may be used in the

25 subsequent reaction or may be purified by a proper method. Dichloro compound (34) is dissolved in an appropriate solvent, such as dimethyl sulfoxide, and excess base suitable for hydrolysis, for example, an aqueous solution

of sodium hydroxide, is added thereto dropwise, followed by stirring for 10 minutes to 1 hour. To the mixture is slowly added an acid, e.g., concentrated hydrochloric acid, in excess over the base previously added, followed by
5 stirring at room temperature for several hours. To the reaction mixture is added ethyl acetate, and the mixture is washed successively with water and a base. The organic layer is dried and concentrated to give N-substituted isatin (3). The resulting crude product can be used as an
10 intermediate in Reaction Route 5 either without purification or after being purified by a proper method.

Of monourea compounds (19), those containing an acetal group or an amino group in the substituent at the 1-position can be prepared by the processes shown in
15 Reaction Routes 4 and 5. In addition, monourea compound (19) containing acetal at the 1-substituent, i.e., monourea compound (28) can be prepared by acetal exchange from another acetal compound or by hydrolyzing the another acetal compound to once give aldehyde compound (27) which is
20 then converted to acetal compound (28). Monourea compound (19) containing an amino group at the 1-substituent, i.e., monourea compound (29) can be prepared by reductive amination reaction of aldehyde compound (27).

The preparation of monourea compound (28) containing
25 acetal at the 1-substituent can preferably be carried out as follows. Acetal compound (26) prepared by the process shown in Reaction Route 4 or 5 is dissolved in an alcohol for acetal exchange and stirred for 6 hours to 2 days while

heating in the presence of an appropriate acid, such as *p*-toluenesulfonic acid, sulfuric acid or camphorsulfonic acid, as a catalyst. The reaction mixture is concentrated, and an appropriate base, for example, an aqueous solution of sodium hydrogencarbonate, is added thereto, followed by extraction with an appropriate organic solvent. The extract is dried and concentrated under reduced pressure. The residue is purified by a proper method to obtain (28). Alternatively, (26) is dissolved or suspended in an inert solvent, such as acetone, an alcohol, water or a mixture thereof, and an adequate amount of an appropriate acid, such as *p*-toluenesulfonic acid, sulfuric acid or camphorsulfonic acid, is added thereto, followed by stirring at room temperature or under heating for 1 to 18 hours. The reaction mixture is concentrated, an appropriate base, e.g., a sodium hydrogencarbonate aqueous solution, is added thereto, the mixture is extracted with an appropriate organic solvent, and the extract is dried and concentrated under reduced pressure to give aldehyde compound (27). This crude product may be used in the subsequent reaction without purification or after being purified by a proper method. Aldehyde compound (27) and an appropriate alcohol or diol in excess over aldehyde compound (27) are dissolved or suspended in an inert solvent, preferably toluene or benzene, and stirred in the presence of an appropriate acid catalyst, such as *p*-toluenesulfonic acid, sulfuric acid or camphorsulfonic acid, for 6 to 48 hours under heating while azeotropically removing produced water together

with the solvent. The reaction mixture is washed with an appropriate base, such as an aqueous solution of sodium hydrogencarbonate, dried, and concentrated. The concentrate is purified by a proper method to give acetal compound (28).

5 The preparation of monourea compound (28) containing an amino group at the 1-substituent can preferably be carried out as follows. Aldehyde compound (27) and an equivalent or excess of an amine or an aqueous solution thereof are dissolved in an inert solvent, such as methanol.
10 After neutralizing the solution with an appropriate acid, such as acetic acid, trifluoroacetic acid or hydrochloric acid, an equivalent or excess, with reference to (27), of a hydrogenating agent, such as sodium cyanoborohydride, is added to the solution, followed by stirring at room
15 temperature for 4 to 48 hours. The reaction mixture is concentrated, water is added thereto, the mixture is extracted with an appropriate organic solvent. The extract is dried and concentrated, and the residue is purified by a proper method to give amino compound (29).

20 The preparation of monourea compound (30) containing thioacetal in the 1-substituent can preferably be carried out as follows. Acetal compound (26) prepared by the process shown in Reaction Route 4 or 5 is dissolved in an inert solvent, such as dry tetrahydrofuran, acetonitrile
25 or dichloromethane, preferably dichloromethane. A mercaptan in an amount of 2 mol per mol of (26) or in excess over (26) and 2 equivalents, with reference to acetal (26), of an appropriate Lewis acid, such as boron trifluoride ethyl

etherate, are added to the solution at room temperature or a low temperature, followed by stirring at room temperature for 10 minutes to 2 hours. The reaction mixture is concentrated, an appropriate base, such as 1N sodium
5 hydroxide, is added thereto, and the mixture is extracted with an appropriate organic solvent. The extract is dried and concentrated under reduced pressure, and the residue is purified by a proper method to give (30).

Each enantiomer of monourea compound (19) can be
10 prepared by stereospecifically bonding an optically active acetic ester to racemic ureido intermediate (23) to give (31), which is recrystallized to give a single diastereomer, hydrolyzing the diastereomer, and converting the resulting carboxylic acid to an amide as shown in Reaction Route 7.
15 The single diastereomer of (31) can also be obtained by once preparing a diastereomer mixture of (31) by nonselective addition of an optically active acetic ester to racemic ureido intermediate (23) or by esterification of racemic carboxylic acid intermediate (18) and then resolving the
20 mixture by recrystallization from an appropriate solvent.

The preparation of each enantiomer of monourea compound (19) by Reaction Route 7 can preferably be carried out as follows. Ureido intermediate (23) is dissolved in a solvent giving no adverse influence to the reaction,
25 preferably dry tetrahydrofuran or dry dioxane, under a nitrogen atmosphere, and an equivalent, with reference to (23), of a lithium agent, such as an alkyl lithium, lithium amide or a lithium alkoxide, is added thereto at

a low temperature, followed by stirring at a low temperature for 1 to 30 minutes. Additionally, an equivalent, with reference to (23), of an optically active bromoacetic ester, preferably L- or D-menthyl bromoacetate is added thereto
5 at a low temperature, followed by stirring at -10°C to room temperature for 4 to 24 hours. Water is added to the reaction mixture, and the mixture is extracted with an appropriate organic solvent. The extract is dried and concentrated, and the residue is recrystallized 1 to
10 5 times from an appropriate solvent, such as ethyl ether, isopropyl ether, hexane, an alcohol, water or a mixture thereof, to give a single diastereomer of (31). The optical purity of (31) can be analyzed by high performance liquid chromatography, high resolution nuclear magnetic resonance
15 spectrum, and the like. Subsequently, the single diastereomer of (31) is hydrolyzed in the same manner as in the preparation of carboxylic acid (17) in Reaction Route 4 to obtain optically active intermediate (18) common to both reaction routes, which is then led to optically
20 active monourea compound (19) in the same manner as in Reaction Route 4.

The present invention will now be illustrated in greater detail by way of Examples, but it should be understood that the present invention is not deemed to be
25 limited thereto.

REFERENCE EXAMPLE 1

3,3-Dimethoxyindolin-2-one

In 500 ml of methanol were dissolved 14.7 g of

isatin and 10.6 g of trimethyl orthoformate, and 100 mg of
p-toluenesulfonic acid was added thereto. The mixture was
heated under reflux for 7 hours, followed by concentration.
To the residue was added chloroform, and the mixture was
5 washed with saturated aqueous sodium hydrogencarbonate. The
organic layer was dried over anhydrous sodium sulfate and
concentrated. The resulting crude product was purified by
silica gel column chromatography (eluent: chloroform/ethyl
acetate = 10/1) to give 14.7 g (76%) of the title compound
10 as an oil.

Rf = 0.38 (chloroform/methanol = 20/1)

IR (CCl₄) : 1735, 1629, 1475 cm⁻¹

NMR (CDCl₃) δ: 8.16 (br, 1H), 7.42-7.26 (m, 2H), 7.07
(ddd, J=1.0, 7.3, 7.8Hz, 1H), 6.88 (d,
15 J=7.8Hz, 1H), 3.58 (s, 6H)

MS (m/e) : 193 (M⁺), 165, 162, 120, 92

REFERENCE EXAMPLE 2

3,3-Diethoxyindolin-2-one

In 500 ml of ethanol were dissolved 14.7 g of
20 isatin and 10.6 g of triethyl orthoformate, and 100 mg of
camphorsulfonic acid was added thereto. The mixture was
heated under reflux for 12 hours, followed by concentration.
To the residue was added chloroform, and the mixture was
washed with saturated aqueous sodium hydrogencarbonate. The
25 organic layer was dried over anhydrous sodium sulfate and
concentrated. The resulting crude product was purified by
silica gel column chromatography (chloroform/ethyl acetate =
10/1) to give 20.4 g (92%) of the title compound as an oil.

Rf = 0.50 (chloroform/methanol = 20/1)

NMR (CDCl₃) δ: 8.40 (br, 1H), 7.46-6.81 (m, 4H),
4.09-3.53 (m, 4H), 1.26 (t, J=7Hz, 6H)

REFERENCE EXAMPLE 3

5 N-Benzylisatin

A solution of 44 g of isatin in 200 ml of N,N-dimethylformamide was added dropwise to a suspension of 16.0 g of sodium hydride (60%) in 100 ml of N,N-dimethylformamide at 0°C in a nitrogen stream. After the mixture
10 was stirred at that temperature for 30 minutes, a solution of 61.5 g of benzyl bromide in 100 ml of N,N-dimethylformamide was added thereto. The whole mixture was stirred for 1 hour and then concentrated. Chloroform was added to the residue, and the mixture was washed with saturated
15 aqueous sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The resulting crude product was washed with hexane and recrystallized from ethanol to give 47.3 g (67%) of the title compound as red needles.

20 Rf = 0.22 (n-hexane/ethyl acetate = 5/1)

NMR (CDCl₃) δ: 7.59-8.27 (m, 7H), 7.11-7.04 (m, 1H),
6.75 (d, J=7.8Hz, 1H), 5.93 (s, 2H)

REFERENCE EXAMPLE 4

1-Benzyl-3,3-dimethoxyindolin-2-one

25 The title compound was obtained in the same manner as in Reference Example 1, except for starting with N-benzylisatin.

Rf = 0.33 (n-hexane/ethyl acetate = 5/1).

NMR (CDCl₃) δ: 7.41 (d, J=6.8Hz, 1H), 7.28-7.19 (m, 6H),
7.04 (t, J=7.8Hz, 1H), 6.70 (d, J=7.8Hz,
1H), 4.86 (s, 2H), 3.60 (s, 6H)

MS (m/e) : 283 (M⁺), 252, 210, 192, 132, 91

5 REFERENCE EXAMPLE 5

3,3-Dimethoxy-5-nitroindolin-2-one

The title compound was obtained in the same manner as in Reference Example 1, except for starting with 5-nitroisatin.

10 Rf = 0.32 (chloroform/methanol = 20/1)

NMR (CDCl₃) δ: 8.32 (s, 1H), 7.36-7.26 (m, 2H), 7.01
(d, J=9.2Hz, 1H), 3.62 (s, 6H)

MS (m/e) : 238 (M⁺), 210, 180, 165

REFERENCE EXAMPLE 6

15 3,3-Dimethoxy-1-phenylindolin-2-one

The title compound was obtained in the same manner as in Reference Example 1, except for starting with N-phenylisatin.

Rf = 0.38 (n-hexane/ethyl acetate = 5/1)

20 NMR (CDCl₃) δ: 7.60-6.72 (m, 9H), 3.64 (s, 6H)

MS (m/e) : 269 (M⁺), 241, 208, 195, 180, 166

REFERENCE EXAMPLE 7

1-Allyl-3,3-dimethoxyindolin-2-one

25 A solution of 3.86 g of 3,3-dimethoxyindolin-2-one in 30 ml of N,N-dimethylformamide was added dropwise to a suspension of 1.2 g of sodium hydride (60%) in 40 ml of N,N-dimethylformamide at 0°C in a nitrogen stream. After the mixture was stirred at that temperature for 30 minutes,

2.60 ml of allyl bromide was added thereto. The resulting mixture was stirred for 1 hour and then concentrated.

Chloroform was added to the residue, and the mixture was washed with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate and concentrated. The resulting crude product was purified by silica gel column chromatography (chloroform/hexane = 1/1) to give 4.19 g (90%) of the title compound.

Rf = 0.85 (chloroform/methanol = 20/1)

10 NMR (CDCl₃) δ: 7.52-6.71 (m, 4H), 6.20-5.55 (m, 1H),
5.41-5.00 (m, 2H), 4.30 (d, J=5Hz, 2H),
3.57 (s, 6H)

REFERENCE EXAMPLE 8

3,3-Dimethoxy-1-(2,2-dimethoxyethyl)indolin-2-one

15 A solution of 34.3 g of 3,3-dimethoxyindolin-2-one in 400 ml of N,N-dimethylformamide was added dropwise to a suspension of 8.56 g of sodium hydride (60%) in 100 ml of N,N-dimethylformamide at 0°C in a nitrogen stream. After the mixture was stirred at that temperature for 30 minutes, 20 36.2 g of bromoacetaldehyde dimethyl acetal was added thereto. The resulting mixture was stirred at 80°C for 1 day and then concentrated. Ethyl acetate was added to the residue, and the mixture was washed with an aqueous solution of sodium chloride. The organic layer was dried 25 over anhydrous sodium sulfate and concentrated. The resulting crude product was recrystallized from isopropyl alcohol/hexane to give 25.1 g (50%) of the title compound.
Rf = 0.43 (n-hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ: 7.51-6.90 (m, 4H), 4.59 (t, J=5.5Hz, 1H),
3.77 (d, J=5.5Hz, 2H), 3.55 (s, 6H),
3.40 (s, 6H)

REFERENCE EXAMPLE 9

5 1-(2,2-Diethoxyethyl)-3,3-dimethoxyindolin-2-one

The title compound was obtained in the same manner as in Reference Example 8, except for using bromoacetaldehyde diethyl acetal as a reactant.

R_f = 0.71 (chloroform/methanol = 20/1)

10 NMR (CDCl₃) δ: 7.48-6.70 (m, 4H), 4.66 (t, J=5Hz, 1H),
3.78-3.28 (m, 6H), 3.52 (s, 6H), 1.12
(t, J=7Hz, 6H)

MS (m/e) : 309 (M⁺), 232, 178, 132, 103

REFERENCE EXAMPLE 10

15 3,3-Diethoxy-1-(2,2-diethoxyethyl)indolin-2-one

The title compound was obtained in the same manner as in Reference Example 8, except for using 3,3-diethoxyindolin-2-one as a starting material and bromoacetaldehyde diethyl acetal as a reactant.

20 NMR (CDCl₃) δ: 7.39-7.26 (m, 2H), 7.09-7.01 (m, 2H), 4.71
(t, J=5.4Hz, 1H), 3.95-3.67 (m, 8H), 3.57-
3.43 (m, 2H), 1.22 (t, J=7.4Hz, 6H), 1.12
(t, J=7.4Hz, 6H)

REFERENCE EXAMPLE 11

25 3,3-Di-n-propoxy-1-(2,2-di-n-propoxyethyl)indolin-2-one

To a solution of 7.18 g of 3,3-dimethoxy-1-(2,2-dimethoxyethyl)indolin-2-one in 200 ml of n-propanol was added 0.1 g of camphorsulfonic acid, and the mixture was

heat-refluxed for 4 days. The reaction mixture was concentrated, dichloromethane was added to the residue, and the mixture was washed with saturated aqueous sodium hydrogencarbonate. The organic layer was dried over
5 anhydrous sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 10/1) to yield 9.35 g (93%) of the title compound as a colorless oil.

10 NMR (CDCl₃) δ: 7.45-6.85 (m, 4H), 4.67 (t, J=5Hz, 1H),
3.85-3.18 (m, 10H), 1.82-1.16 (m, 8H),
1.10-0.67 (m, 12H)

MS (m/e) : 393 (M⁺), 334, 232, 162, 131, 89

EXAMPLE 1

1-Benzyl-3,3-bis(N'-(4-methylphenyl)ureido)indolin-2-one

15 To a solution of 0.80 g of anhydrous aluminum chloride in 20 ml of dry tetrahydrofuran were added successively a solution of 0.57 g of 1-benzyl-3,3-dimethoxy-indolin-2-one in 10 ml of dry tetrahydrofuran and 0.60 g of p-tolylurea at 0°C under a nitrogen atmosphere, and the
20 mixture was heated under reflux for 2 hours. Ethyl acetate was added to the reaction mixture, and the mixture was washed twice with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate, followed by concentration. The residue was purified by
25 silica gel column chromatography (chloroform/ethyl acetate = 4/1) to obtain 0.24 g (23%) of 1-benzyl-3,3-bis(N'-(4-methylphenyl)ureido)indolin-2-one as a white powder.
R_f = 0.49 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 8.71 (s, 2H), 7.82 (d, J=7.8Hz, 1H),
7.44-7.13 (m, 17H), 6.76 (d, J=7.8Hz,
1H), 4.96 (s, 2H), 2.21 (s, 6H)

FAB MS : 520 (M+H)⁺, 370, 263, 237, 147, 107

5 EXAMPLE 2

3,3-Bis(N'-(4-methylphenyl)ureido)-5-nitroindolin-2-one

The title compound was prepared in the same manner as
in Example 1, except for replacing 1-benzyl-3,3-dimethoxy-
indolin-2-one used in Example 1 as a starting material with
10 3,3-dimethoxy-5-nitroindolin-2-one.

NMR (DMSO-d₆) δ: 11.32 (br, 1H), 8.69 (s, 2H), 8.64 (d,
J=2.4Hz, 1H), 8.18 (dd, J=2.4, 8.8Hz,
1H), 7.38 (s, 2H), 7.29-6.99 (m, 9H),
2.21 (s, 6H)

15 EXAMPLES 3 TO 7

The following compounds were prepared in the same
manner as in Example 1, except for replacing 1-benzyl-3,3-
dimethoxyindolin-2-one used in Example 1 as a starting
material with 3,3-dimethoxyindolin-2-one having a different
20 substituent at the 1-position thereof.

EXAMPLE 3

1-Allyl-3,3-bis(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 8.70 (s, 2H), 7.83 (d, J=6.8Hz, 1H),
7.27-6.89 (m, 13H), 5.90-5.81 (m, 1H),
25 5.38 (d, J=16.1Hz, 1H), 5.20 (d, J=8.8Hz,
1H), 4.37 (br, 2H), 2.21 (s, 6H)

EXAMPLE 4

3,3-Bis(N'-(4-methylphenyl)ureido)-1-phenylindolin-2-one

Rf = 0.37 (CHCl₃/AcOEt = 5/1)

NMR (DMSO-d₆) δ: 8.74 (s, 2H), 7.91 (d, J=6.3Hz, 1H),
7.65-7.01 (m, 17H), 6.68 (d, J=7.8Hz,
1H), 2.21 (s, 6H)

5 EXAMPLE 5

1-(2,2-Dimethoxyethyl)-3,3-bis(N'-(4-methyl-
phenyl)ureido)indolin-2-one

10 NMR (DMSO-d₆) δ: 8.72 (s, 2H), 7.84 (d, J=7.3Hz, 1H),
7.26-6.98 (m, 13H), 4.63 (t, J=4.9Hz,
1H), 3.81 (d, J=4.9Hz, 2H), 3.36 (s, 6H),
2.20 (s, 6H)

EXAMPLE 6

3,3-Bis(N'-(4-methylphenyl)ureido)-1-(2,2-di-n-
propoxyethyl)indolin-2-one

15 Rf = 0.29 (CHCl₃/MeOH = 20/1)

20 NMR (CDCl₃) δ: 7.82 (br, 2H), 7.63 (d, J=7.3Hz, 1H), 7.26
(t, J=4.4Hz, 1H), 7.11 (d, J=8.3Hz, 4H),
7.03-6.91 (m, 2H), 6.89 (d, J=8.3Hz, 4H),
6.68 (br, 2H), 4.76 (t, J=5.4Hz, 1H), 3.85
(d, J=5.4Hz, 2H), 3.69-3.42 (m, 4H), 2.20
(s, 6H), 1.52 (q, J=7.3Hz, 4H), 0.82 (t,
J=7.3Hz, 6H)

EXAMPLE 7

25 (RS)-1-(2-Ethoxy-2-methoxyethyl)-3,3-bis(N'-(4-
methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 7.79 (br, 2H), 7.76 (d, J=8.2Hz, 1H), 7.26-
6.82 (m, 13H), 4.77 (t, J=5.6Hz, 1H), 3.87-
3.53 (m, 4H), 3.41 (s, 3H), 2.16 (s, 6H),
1.13 (t, J=7.1Hz, 3H)

EXAMPLE 8

3,3-Bis(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 12.0 g of anhydrous aluminum chloride in 150 ml of dry tetrahydrofuran were added successively a solution of 5.79 g of isatin-3,3-dimethyl-acetal in 150 ml of dry tetrahydrofuran and 9.0 g of p-tolylurea at 0°C under a nitrogen atmosphere, and the mixture was heated under reflux for 40 minutes. Ethyl acetate was added to the reaction mixture, and the mixture was washed twice with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate, followed by concentration. To the residue was added 150 ml of ethyl ether, and insoluble matter was removed by filtration. The filtrate was concentrated and recrystallized from acetone to yield 4.61 g (36%) of the title compound as a white powder.

R_f = 0.38 (chloroform/ethyl acetate = 1/2)

NMR (DMSO-d₆) δ: 10.57 (s, 1H), 8.68 (s, 2H), 7.77 (d, J=7.8Hz, 1H), 7.21-7.14 (m, 7H), 7.02-6.79 (m, 6H), 2.21 (s, 6H)

FAB MS : 430 (M+H)⁺, 280, 147

IR (KBr) : 3350, 1730, 1675, 1652, 1607, 1548, 1515, 1314, 1242 cm⁻¹

EXAMPLE 9

3,3-Bis(N'-phenylureido)indolin-2-one

The title compound was prepared in the same manner as in Example 8, except for starting with phenylurea in place of p-tolylurea used in Example 8. Yield: 28%

Rf = 0.31 (chloroform/ethyl acetate = 1/2)

NMR (DMSO-d₆) δ: 10.61 (s, 1H), 8.80 (s, 2H), 7.78
(d, J=7.8Hz, 1H), 7.33-7.16 (m, 11H),
6.94-6.79 (m, 4H)

5 EXAMPLE 10

1-(2,2-Diethoxyethyl)-3,3-bis(N'-(4-methyl-phenyl)ureido)indolin-2-one

To a solution of 4.00 g of anhydrous aluminum chloride in 30 ml of dry tetrahydrofuran were added
10 successively a solution of 3.37 g of N-(2,2-diethoxy-ethyl)isatin-3,3-diethylacetal in 30 ml of dry tetrahydrofuran and 3.01 g of p-tolylurea at 0°C in a nitrogen stream, and the mixture was heated under reflux for 2 hours.
Ethyl acetate was added to the reaction mixture, and the
15 mixture was washed twice with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate, followed by concentration. The residue was chromatographed on silica gel (chloroform/methanol = 50/1) and recrystallized from ethyl ether to afford 0.744 g (14%)
20 of the title compound as a white powder.

Rf = 0.44 (chloroform/methanol = 20/1)

NMR (CDCl₃) δ: 7.79 (br, 2H), 7.76 (d, J = 8.2Hz, 1H),
7.26-6.82 (m, 13H), 4.77 (t, J=4.9Hz, 1H),
3.82-3.57 (m, 6H), 2.16 (s, 6H), 1.13
25 (t, J=7.1Hz, 6H)

EXAMPLES 11 TO 21

The following compounds were prepared in the same manner as in Example 10, except for replacing p-tolylurea

used in Example 10 with various arylureas.

EXAMPLE 11

1-(2,2-Diethoxyethyl)-3,3-bis(N'-(4-methoxy-phenyl)ureido)indolin-2-one

5 Rf = 0.33 (CHCl₃/MeOH = 20/1)

NMR (CDCl₃) δ: 7.73 (br, 2H), 7.70 (d, J=7.3Hz, 1H), 7.28
(t, J=7.8Hz, 1H), 7.12 (d, J=9.2Hz, 4H),
7.08-6.96 (m, 2H), 6.67 (br, 2H), 6.64
(d, J=9.2Hz, 4H), 4.77 (t, J=4.8Hz, 1H),
10 3.86 (d, J=4.8Hz, 2H), 3.81-3.49 (m, 4H),
3.68 (s, 6H), 1.12 (t, J=7.3Hz, 6H)

EXAMPLE 12

1-(2,2-Diethoxyethyl)-3,3-bis(N'-(4-methoxycarbonyl-phenyl)ureido)indolin-2-one

15 Rf = 0.15 (CHCl₃/MeOH = 20/1)

NMR (CDCl₃) δ: 8.17 (s, 2H), 7.83 (d, J=7.8Hz, 1H), 7.63
(d, J=8.3Hz, 4H), 7.33-7.17 (m, 7H), 7.10-
6.97 (m, 2H), 4.84 (t, J=4.9Hz, 1H), 3.81
(s, 6H), 3.85-3.60 (m, 6H), 1.16 (t,
20 J=6.8Hz, 6H)

EXAMPLE 13

3,3-Bis(N'-(4-cyanophenyl)ureido)-1-(2,2-diethoxy-ethyl)indolin-2-one

Rf = 0.16 (CHCl₃/MeOH = 20/1)

25 NMR (DMSO-d₆) δ: 9.30 (s, 2H), 7.84 (d, J=7.4Hz, 1H),
7.67-7.46 (m, 10H), 7.29 (t, J=7.4Hz,
1H), 7.12 (d, J=7.8Hz, 1H), 7.01 (t,
J=7.8Hz, 1H), 4.73 (t, J=5.4Hz, 1H),
3.80 (d, J=5.4Hz, 2H), 3.73-3.49 (m, 4H),

1.08 (t, J=7.4Hz, 6H)

EXAMPLE 14

1-(2,2-Diethoxyethyl)-3,3-bis(N'-(4-fluoro-phenyl)ureido)indolin-2-one

5 Rf = 0.22 (CHCl₃/MeOH = 20/1)

NMR (CDCl₃) δ: 7.88 (s, 2H), 7.79 (d, J=6.8Hz, 1H), 7.31
(t, J=6.8Hz, 1H), 7.17-6.97 (m, 8H), 6.75
(t, J=8.8Hz, 4H), 4.79 (t, J=5.3Hz, 1H),
3.85 (d, J=5.3Hz, 2H), 3.79-3.56 (m, 4H),
10 1.13 (t, J=7.8Hz, 6H)

EXAMPLE 15

1-(2,2-Diethoxyethyl)-3,3-Bis(N'-(3-fluoro-phenyl)ureido)indolin-2-one

Rf = 0.27 (CHCl₃/MeOH = 20/1)

15 NMR (CDCl₃) δ: 8.01 (s, 2H), 7.82 (d, J=7.3Hz, 1H), 7.35-
6.90 (m, 10H), 6.82 (d, J=7.3Hz, 1H), 6.57
(t, J=7.3Hz, 2H), 4.82 (t, J=4.8Hz, 1H),
3.88 (d, J=4.8Hz, 2H), 3.83-3.60 (m, 4H),
1.15 (t, J=6.8Hz, 6H)

20 EXAMPLE 16

1-(2,2-Diethoxyethyl)-3,3-bis(N'-(4-nitro-phenyl)ureido)indolin-2-one

Rf = 0.21 (CHCl₃/MeOH = 20/1)

NMR (CDCl₃-DMSO-d₆) δ: 9.24 (s, 2H), 8.07 (d, J=9.5Hz, 4H),
25 7.95 (d, J=6.3Hz, 1H), 7.50 (d, J=9.5Hz,
4H), 7.45 (s, 2H), 7.30 (t, J=7.8Hz, 1H),
7.12-7.02 (m, 2H), 4.82 (t, J=5.4Hz, 1H),
3.91 (d, J=5.4Hz, 2H), 3.81-3.65 (m, 4H),
1.17 (t, J=6.8Hz, 6H)

EXAMPLE 17

1-(2,2-Diethoxyethyl)-3,3-bis(N'-(4-trifluoromethyl-phenyl)ureido)indolin-2-one

R_f = 0.29 (CHCl₃/MeOH = 20/1)

- 5 NMR (CDCl₃) δ: 8.03 (br, 2H), 7.86 (d, J=7.8Hz, 1H),
7.46-6.95 (m, 13H), 4.84 (t, J=5.4Hz, 1H),
3.90-3.61 (m, 6H), 1.27-1.12 (m, 6H)

EXAMPLE 18

10 1-(2,2-Diethoxyethyl)-3,3-bis(N'-(2-fluoro-phenyl)ureido)indolin-2-one

R_f = 0.35 (n-hexane/ethyl acetate = 2/1)

- NMR (CDCl₃) δ: 7.89-7.82 (m, 3H), 7.71 (s, 2H), 7.28
(t, J=6.1Hz, 1H), 7.18 (br, 2H), 7.10-6.98
(m, 2H), 6.89-6.78 (m, 6H), 4.82
15 (t, J=5.3Hz, 1H), 3.91 (d, J=5.3Hz, 2H),
3.82-3.71 (m, 2H), 3.67-3.58 (m, 2H),
1.13 (t, J=6.9Hz, 6H)

EXAMPLE 19

20 3,3-Bis(N'-(2-cyanophenyl)ureido)-1-(2,2-diethoxy-ethyl)indolin-2-one

R_f = 0.25 (n-hexane/ethyl acetate = 2/1)

- NMR (CDCl₃-DMSO-d₆) δ: 8.79 (s, 2H), 8.30 (s, 2H),
8.17 (d, J=8.3Hz, 2H), 7.98 (d, J=5.6Hz,
1H), 7.49-7.38 (m, 4H), 7.27 (dt, J=1.3,
6.3Hz, 1H), 7.09-6.95 (m, 4H), 4.79 (t,
25 J=5.3Hz, 1H), 3.89 (d, J=5.3Hz, 2H),
3.79-3.73 (m, 2H), 3.63-3.53 (m, 2H),
1.17 (t, J=6.9Hz, 6H)

EXAMPLE 20

3,3-Bis(N'-(4-bromophenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

Rf = 0.48 (CHCl₃/MeOH = 20/1)

- 5 NMR (CDCl₃-DMSO-d⁶) δ: 8.65 (s, 2H), 7.84 (d, J=7.3Hz, 1H),
7.30-7.25 (m, 10H), 7.10-6.96 (m, 3H), 4.79
(t, J=5.3Hz, 1H), 3.88 (d, J=5.3Hz, 2H),
3.81-3.48 (m, 4H), 1.17-1.12 (m, 6H)

EXAMPLE 21

- 10 3,3-Bis(N'-(3-bromophenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

Rf = 0.48 (CHCl₃/MeOH = 20/1)

- 15 NMR (CDCl₃) δ: 7.99 (br, 2H), 7.82 (d, J=7.6Hz, 1H), 7.57
(s, 2H), 7.33-7.24 (m, 3H), 7.09-6.93 (m,
6H), 6.96-6.80 (m, 2H), 4.86 (t, J=5.0Hz,
1H), 3.88 (d, J=5.0Hz, 2H), 3.84-3.62 (m,
4H), 1.19-1.12 (m, 6H)

REFERENCE EXAMPLE 12

3,3-Bis(ethoxycarbonylmethyl)indolin-2-one

- 20 To a solution of 1.33 g of oxindole in 20 ml of
dry dimethyl sulfoxide was added 10 ml of a 1M solution of
potassium t-butoxide in dry dimethyl sulfoxide at room
temperature under a nitrogen atmosphere, followed by
stirring for 10 minutes. To the resulting mixture was
25 added dropwise 1.11 ml of ethyl bromoacetate, followed
by stirring at the same temperature for 20 minutes. To
the mixture was further added 10 ml of a 1M solution of
potassium t-butoxide in dry dimethyl sulfoxide, followed
by stirring for 10 minutes. To the mixture was added

dropwise 1.11 ml of ethyl bromoacetate. The resulting mixture was stirred at the same temperature for 20 minutes. The reaction mixture was treated with a sodium chloride aqueous solution and extracted with ethyl ether. The ethyl ether layer was dried over anhydrous magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to afford 0.79 g (26%) of the title compound.

Rf = 0.22 (hexane/ethyl acetate = 2/1)

10 NMR (CDCl₃) δ: 7.87 (s, 1H), 7.30-7.18 (m, 2H),
7.04-6.86 (m, 2H), 4.03-3.91 (m, 4H),
3.03 (d, J=16.1Hz, 2H), 2.88 (d, J=16.1Hz,
2H), 1.07 (t, J=7.3Hz, 6H)

MS (m/e): 305 (M⁺), 232, 186, 174, 146, 130

15 REFERENCE EXAMPLE 13

3,3-Bis((1,1-dimethylethoxy)carbonylmethyl)indolin-2-one

The title compound was prepared in the same manner as in Reference Example 12, except for starting with t-butyl bromoacetate in place of ethyl bromoacetate used in

20 Reference Example 12.

Rf = 0.29 (hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ: 9.03 (br, 1H), 7.42-6.80 (m, 4H),
2.83 (s, 4H), 1.19 (s, 18H)

MS (m/e): 361 (M⁺), 249, 204, 191, 145

25 REFERENCE EXAMPLE 14

3,3-Bis(hydroxycarbonylmethyl)indolin-2-one

To a solution of 0.73 g of 3,3-bis(ethoxy-carbonylmethyl)indolin-2-one in 40 ml of ethanol was added

a solution of 1.25 g of potassium hydroxide (85%) in 5 ml of water at room temperature, and the mixture was stirred at that temperature for 15 hours, followed by concentration. The concentrate was dissolved in water, washed with chloroform, adjusted to pH 2 with 10% hydrochloric acid, and concentrated. Ethyl acetate was added to the residue, and any insoluble matter was removed by filtration. The filtrate was concentrated and purified by LH-20 column chromatography (eluent: methanol). Yield: 86%.

10 Rf = 0.27 (chloroform/methanol = 1/1)

NMR (DMSO- d_6) δ : 12.14 (br, 2H), 10.35 (s, 1H), 7.27 (d, J=7.2Hz, 1H), 7.17-7.09 (m, 1H), 6.92-6.76 (m, 2H), 2.88 (d, J=16.0Hz, 2H), 2.64 (d, J=16.0Hz, 2H)

15 EXAMPLE 22

3,3-Bis((4-methylphenyl)carbamoylmethyl)indolin-2-one

To a solution of 0.25 g of 3,3-bis(hydroxycarbonylmethyl)indolin-2-one and 1.24 g of dicyclohexylcarbodiimide in 30 ml of N,N-dimethylformamide were added successively 0.92 g of 1-hydroxybenzotriazole and 0.64 g of p-toluidine at room temperature. The resulting mixture was stirred at room temperature for 12 hours and concentrated. Ethyl acetate was added to the residue, and the mixture was washed successively with dilute hydrochloric acid and saturated aqueous sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The crude product was applied on silica gel column chromatography (chloroform/methanol = 50/1) and then recrystallized

from benzene to give 0.54 g (63%) of the title compound as a white powder.

NMR (DMSO- d_6) δ : 10.32 (s, 1H), 9.77 (s, 2H), 7.33-6.81
(m, 12H), 3.09 (d, $J=14.9$ Hz, 2H), 2.72
5 (d, $J=14.9$ Hz, 2H), 2.21 (s, 6H)

MS (m/e) : 427 (M^+), 321, 293, 172, 159, 107

EXAMPLE 23

1-Benzyl-3,3-bis((4-methylphenyl)carbamoylmethyl)indolin-2-one

10 To a suspension of 0.05 g of sodium hydride
(60%) in 5 ml of N,N-dimethylformamide was added dropwise a
solution of 0.36 g of 3,3-bis((1,1-dimethylethoxy)carbonyl-
methyl)indolin-2-one in 5 ml of N,N-dimethylformamide at 0°C
in a nitrogen stream. After stirring the mixture at that
15 temperature for 30 minutes, 0.12 ml of benzyl bromide was
added thereto. The whole mixture was stirred for 1 hour and
then concentrated. Chloroform was added to the concentrate,
and the mixture was washed with an aqueous solution of
sodium chloride. The organic layer was dried over anhydrous
20 sodium sulfate and concentrated to obtain 1-benzyl-3,3-
bis((1,1-dimethylethoxy)carbonylmethyl)indolin-2-one.

R_f = 0.66 (hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ : 7.35-6.50 (m, 9H), 4.89 (s, 2H), 3.04-2.78
(m, 4H), 1.17 (s, 18H)

25 The above-prepared 1-benzyl-3,3-bis((1,1-dimethyl-
ethoxy)carbonylmethyl)indolin-2-one was dissolved in 15 ml
of ethanol, and to the solution was added a solution of
0.66 g of potassium hydroxide (85%) in 2 ml of water at room

temperature. The resulting mixture was heated under reflux for 5 hours, followed by concentration. The residue was dissolved in water, washed with chloroform, and adjusted to pH 2 with 10% hydrochloric acid. The resulting product was
5 extracted with ethyl acetate, and the organic layer was dried over anhydrous sodium sulfate and concentrated. The residue was dissolved in 10 ml of chloroform, and 0.62 g of dicyclohexylcarbodiimide, 0.46 g of 1-hydroxybenzotriazole, and 0.32 g of p-toluidine were successively added to the
10 solution, followed by stirring at room temperature for 5 hours. The resulting precipitates were removed by filtration, and the filtrate was washed successively with dilute hydrochloric acid and saturated aqueous sodium hydrogencarbonate. The organic layer was dried over
15 anhydrous sodium sulfate, and concentrated. The crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 1/1) to obtain 0.29 g (57%) of the title compound as a white powder.

Rf = 0.26 (hexane/ethyl acetate = 1/1)

20 NMR (CDCl₃) δ: 9.83 (s, 2H), 7.46-6.61 (m, 17H),
4.92 (s, 2H), 3.20 (d, J=15.1Hz, 2H),
2.83 (d, J=15.1Hz, 2H), 2.21 (s, 6H)

MS (m/e) : 517 (M⁺), 411, 383, 369, 262, 107, 91

EXAMPLES 24 TO 26

25 The following compounds were prepared in the same manner as in Example 23, except for replacing benzyl bromide used in Example 23 with various alkyl halides.

EXAMPLE 24

1-Methyl-3,3-bis((4-methylphenyl)carbamoylmethyl)indolin-2-one

R_f = 0.16 (n-hexane/ethyl acetate = 1/1)

- 5 NMR (DMSO-d₆) δ: 9.77 (s, 2H), 7.31-6.88 (m, 12H),
3.16 (s, 3H), 3.11 (d, J=15.1Hz, 2H),
2.74 (d, J=15.1Hz, 2H), 2.21 (s, 6H)

MS (m/e) : 441 (M⁺), 335, 307, 186, 107

EXAMPLE 25

- 10 3,3-Bis((4-methylphenyl)carbamoylmethyl)-1-(phenylcarbonylmethyl)indolin-2-one

R_f = 0.41 (n-hexane/ethyl acetate = 1/1)

- NMR (DMSO-d₆) δ: 9.91 (s, 2H), 8.14 (d, J=7.3Hz, 2H),
7.73-6.86 (m, 15H), 5.35 (s, 2H), 3.30
15 (d, J=16.1Hz, 2H), 2.78 (d, J=16.1Hz,
2H), 2.22 (s, 6H)

MS (m/e) : 545 (M⁺), 439, 411, 333, 290, 107

EXAMPLE 26

- 20 3,3-Bis((4-methylphenyl)carbamoylmethyl)-1-(2-pyridylmethyl)indolin-2-one

- NMR (DMSO-d₆) δ: 9.83 (s, 2H), 8.55 (d, J=4.9Hz, 1H),
7.66-7.50 (m, 2H), 7.38-7.01 (m, 11H),
6.89 (t, J=7.3Hz, 1H), 6.68 (d, J=7.8Hz,
1H), 4.98 (s, 2H), 3.20 (d, J=15.1Hz,
25 2H), 2.84 (d, J=15.1Hz, 2H), 2.21 (s, 6H)

MS (m/e) : 518 (M⁺), 412, 384, 237, 107, 92

REFERENCE EXAMPLE 15

(RS)-1-Benzyl-3-(ethoxycarbonylmethyl)-3-hydroxyindolin-2-one

To a solution of 2.4 ml of 1,1,1,3,3,3-hexamethyldisilazane in 10 ml of dry tetrahydrofuran was added dropwise 6.4 ml of a 1.59M hexane solution of n-butyl lithium at -78°C under a nitrogen atmosphere, followed by stirring at that temperature for 10 minutes. To the mixture was slowly added 0.976 ml of ethyl acetate, followed by stirring at -78°C for 30 minutes. To the mixture was further added a solution of 2.00 g of 1-benzylisatin in 10 ml of dry tetrahydrofuran, followed by stirring at that temperature for 1 hour. Water was added to the reaction mixture, and the product was extracted with ethyl acetate. The organic layer was dried over anhydrous sodium sulfate to give 2.23 g (81%) of the title compound.

NMR (CDCl₃) δ: 7.45-6.55 (m, 9H), 4.84 (s, 2H), 4.12 (q, J=6.9Hz, 2H), 2.97 (s, 2H), 1.40 (br, 1H), 1.13 (t, J=6.9Hz, 3H)

REFERENCE EXAMPLE 16

(RS)-1-Benzyl-3-hydroxy-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

To a solution of 0.254 g of p-toluidine in 10 ml of dry tetrahydrofuran was added dropwise 1.3 ml of a 1.59M hexane solution of n-butyl lithium at -78°C under a nitrogen atmosphere, followed by stirring at that temperature for 10 minutes. To the mixture was added a solution of 0.299 g of 1-benzyl-3-(ethoxycarbonylmethyl)-3-hydroxyindolin-2-one in 5 ml of dry tetrahydrofuran at -78°C, followed by stirring at that temperature for 30 minutes. Water was added to the reaction mixture, and the product was extracted

with chloroform. The organic layer was dried over anhydrous sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 5/1) to give 0.161 g (44%) of the title compound.

5 NMR (CDCl₃) δ: 8.38 (s, 1H), 7.47-6.92 (m, 12H), 6.67 (d, J=8.6Hz, 1H), 5.38 (s, 1H), 4.88 (d, J=16.0Hz, 1H), 4.74 (d, J=16.0Hz, 1H), 3.06 (d, J=14.9Hz, 1H), 2.69 (d, J=14.9Hz, 1H), 2.29 (s, 3H)

10 EXAMPLE 27

(RS)-1-Benzyl-3-((4-methylphenyl)aminocarbonylmethyl)-3-((4-methylphenyl)aminocarbonyloxa)indolin-2-one

To a solution of 0.155 g of 1-benzyl-3-hydroxy-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one and 0.097 ml
15 of p-tolyl isocyanate in 10 ml of dry tetrahydrofuran was added 10 mg of dibutyltin diacetate at room temperature under a nitrogen atmosphere, and the mixture was stirred at that temperature for 18 hours. Water was added to the reaction mixture, and the product was extracted with
20 dichloromethane. The organic layer was dried over anhydrous sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 3/1) to give 0.178 g (89%) of the title compound.

NMR (CDCl₃) δ: 9.42-9.12 (br, 1H), 7.60-6.88 (m, 17H), 6.68
25 (d, J=7.8Hz, 1H), 5.04 (d, J=14.8Hz, 1H), 4.94 (d, J=14.8Hz, 1H), 3.14 (d, J=15.2Hz, 1H), 2.99 (d, J=15.2Hz, 1H), 2.28 (s, 3H), 2.21 (s, 3H)

REFERENCE EXAMPLE 17

1-Benzyl-3-(hydroxyimino)indolin-2-one

To a suspension of 7.11 g of N-benzylisatin in 75 ml of ethanol was added a solution of 3.84 g of hydroxylamine hydrochloride and 3.84 g of sodium acetate in 500 ml of water. The mixture was stirred at room temperature for 1 hour, followed by concentration. The residue was washed with water and recrystallized from ethanol to give 6.11 g (81%) of the title compound as yellow crystals.

10 Rf = 0.33 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 13.51 (br, 1H), 8.00 (d, J=7.3Hz, 1H),
7.39-7.26 (m, 6H), 7.10-6.96 (m, 2H),
4.94 (s, 2H)

MS (m/e): 252 (M⁺), 235, 207, 91

15 REFERENCE EXAMPLE 18

(RS)-3-(N'-(4-Methylphenyl)ureido)indolin-2-one

To a suspension of 73.6 g of isatin in 1.2 l of ethanol was added a solution of 64.1 g of hydroxylamine hydrochloride and 64.1 g of sodium acetate in 500 ml of water. The mixture was stirred at room temperature for 30 minutes and concentrated. The residue was washed with water and recrystallized from ethanol to give 51.8 g (64%) of 3-(hydroxyimino)indolin-2-one as yellow crystals.

Rf = 0.41 (chloroform/methanol = 10/1)

25 NMR (CDCl₃/DMSO-d₆) δ: 12.52 (s, 1H), 7.39-6.81 (m, 4H)

MS (m/e) : 162 (M⁺), 145, 117

A suspension of 4.86 g of 3-(hydroxyimino)indolin-2-one and 100 mg of 5% Rh/C in 300 ml of ethanol was stirred

at room temperature under a hydrogen atmosphere for 1 day. The reaction mixture was filtered through Cerite, and the filtrate was concentrated. The concentrate was dissolved in 300 ml of dichloromethane, and 4.16 ml of p-tolyl isocyanate was added thereto at 0°C. The mixture was stirred at that temperature for 2 hours, whereupon a precipitate formed. The precipitate was collected by filtration and washed with ethanol to obtain 7.59 g (90%) of the title compound.

NMR (DMSO-d₆) δ: 10.30 (s, 1H), 8.61 (s, 1H), 7.27-6.77 (m, 9H), 4.95 (d, J=7.3Hz, 1H), 2.21 (s, 3H)

MS (m/e): 281 (M⁺), 174, 148, 132, 107

REFERENCE EXAMPLE 19

(RS)-3-((4-Methylbenzyl)carbonylamino)indolin-2-one

A solution of 4.86 g of 3-(hydroxyimino)indolin-2-one and 100 mg of 5% Rh/C in 300 ml of ethanol was stirred at room temperature under a hydrogen atmosphere for 1 day. The reaction mixture was filtered through Cerite, and the filtrate was concentrated. The concentrate was dissolved in 50 ml of N,N-dimethylformamide, and 5.15 g of dicyclohexylcarbodiimide, 3.83 g of 1-hydroxybenzotriazole, and 3.75 g of p-tolylacetic acid were added thereto successively. The mixture was stirred at the same temperature for 12 hours, whereupon a precipitate formed. The precipitate was filtered off, and the filtrate was concentrated. The concentrate was diluted with ethyl acetate and washed successively with dilute hydrochloric acid and saturated aqueous sodium hydrogencarbonate. The organic layer was

dried over anhydrous sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (chloroform/methanol = 40/1) to afford 1.01 g (18%) of the title compound.

5 Rf = 0.32 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 10.39 (s, 1H), 8.80 (d, J=8.3Hz, 1H),
7.21-7.02 (m, 6H), 6.91 (dd, J=1.0,
6.3Hz, 1H), 6.79 (d, J=6.3Hz, 1H),
5.08 (d, J=8.3Hz, 1H), 3.44 (s, 2H),
10 2.27 (s, 3H)

MS (m/e): 280 (M⁺), 262, 148, 132, 105

REFERENCE EXAMPLE 20

(RS)-1-Benzyl-3-(methylcarbonylamino)indolin-2-one

A suspension of 2.52 g of 1-benzyl-3-(hydroxy-
15 imino)indolin-2-one and 100 mg of 5% Rh/C in 200 ml of
methanol was stirred under a hydrogen atmosphere at room
temperature for 1 day. The reaction mixture was filtered
through Cerite, and the filtrate was concentrated. The
residue was dissolved in 200 ml of dichloromethane, and
20 2.79 ml of triethylamine and 0.85 ml of acetyl chloride
were successively added thereto at room temperature. The
mixture was stirred at that temperature for 1 hour, and
then was washed successively with dilute hydrochloric
acid and saturated aqueous sodium hydrogencarbonate. The
25 organic layer was dried over anhydrous sodium sulfate and
concentrated. Recrystallization of the residue from
chloroform-hexane gave 1.28 g (45%) of the title compound.
Rf = 0.30 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 8.79 (d, J=7.8Hz, 1H), 7.41-7.13 (m, 7H),
6.98 (dd, J=6.8, 7.8Hz, 1H), 6.76 (d,
J=7.3Hz, 1H), 5.22 (d, J=7.8Hz, 1H),
4.97 (d, J=15.8Hz, 1H), 4.81 (d,
5 J=15.8Hz, 1H), 1.92 (s, 3H)

REFERENCE EXAMPLE 21

1-(2,2-Diethoxyethyl)isatin

A solution of 31.8 g of isatin in 300 ml of dry
dimethyl sulfoxide was added dropwise to a suspension of
10 25.4 g of potassium t-butoxide in 200 ml of dry dimethyl
sulfoxide at 10°C in a nitrogen stream. After stirring the
mixture at that temperature for 30 minutes, 39 ml of bromo-
acetaldehyde diethyl acetal was added thereto, followed by
stirring at 70°C for 6 hours. The reaction mixture was
15 poured into dilute hydrochloric acid and extracted with
ethyl ether. The organic layer was dried over anhydrous
magnesium sulfate and concentrated. The residue was
purified by silica gel column chromatography (chloro-
form/ethyl acetate = 20/1) to give 31.4 g (55%) of the
20 title compound as a red powder.

R_f = 0.83 (chloroform/methanol = 20/1)

NMR (CDCl₃) δ: 7.75-6.95 (m, 4H), 4.71 (t, J=5Hz, 1H),
3.89-3.40 (m, 6H), 1.16 (t, J=7Hz, 6H)

EXAMPLE 28

25 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

A solution of 5.38 g of hydroxylamine hydrochloride
and 5.38 g of sodium acetate in 40 ml of water was added

to a suspension of 11.1 g of 1-(2,2-diethoxyethyl)isatin in 100 ml of ethanol. The mixture was stirred at room temperature for 1 hour, followed by concentration. The concentrate was diluted with chloroform and washed with an aqueous solution of sodium chloride. The chloroform layer was dried over anhydrous sodium sulfate and concentrated, and the residue was recrystallized from ethyl acetate to obtain 7.10 g (61%) of 1-(2,2-diethoxyethyl)-3-(hydroxyimino)indolin-2-one as yellow crystals.

10 Rf = 0.32 (chloroform/methanol = 20/1)

NMR (CDCl₃/DMSO-d₆) δ: 12.85 (s, 1H), 8.09 (d, J=7.8Hz, 1H),
7.39-7.31 (m, 1H), 7.08-7.01 (m, 2H), 4.70
(t, J=5.4Hz, 1H), 3.84 (d, J=5.4Hz, 2H),
3.82-3.43 (m, 4H), 1.14 (t, J=6.8Hz, 6H)

15 A suspension of 30.0 g of 1-(2,2-diethoxyethyl)-3-(hydroxyimino)indolin-2-one and 200 mg of 5% Rh/C in 1.5 l of ethanol was stirred under a hydrogen atmosphere at room temperature for 2 days. The reaction mixture was filtered through Cerite, and the filtrate was concentrated. The residue was dissolved in 600 ml of dichloromethane, and a solution of 15.0 ml of p-tolyl isocyanate in 200 ml of dichloromethane was added thereto at 0°C. The mixture was stirred at that temperature for 1 hour, followed by concentration. The resulting crude product was washed with ethyl ether to yield 30.8 g (72%) of the title compound as a white powder.

25 NMR (DMSO-d₆) δ: 8.63 (s, 1H), 7.33-7.16 (m, 4H), 7.12-6.87 (m, 5H), 5.05 (d, J=7.4Hz, 1H),

4.77-4.63 (m, 1H), 3.84 (dd, J=5.7,
14.6Hz, 1H), 3.77-3.40 (m, 5H), 2.22
(s, 3H), 1.08 (t, J=7.4Hz, 3H), 1.06
(t, J=7.4Hz, 3H)

5 EXAMPLES 29 TO 32

The following compounds were prepared in the same manner as in Example 28, except for replacing 1-(2,2-diethoxyethyl)isatin used as a starting material in Example 28 with various isatin derivatives.

10 EXAMPLE 29

(RS)-1-Benzyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 8.70 (s, 1H), 7.39-7.00 (m, 13H), 6.78
(d, J=7.3Hz, 1H), 5.13 (d, J=7.3Hz, 1H),
4.90 (s, 2H), 2.21 (s, 3H)

15 MS (m/e): 371 (M⁺), 238, 147, 107, 91

EXAMPLE 30

(RS)-3-(N'-(4-Methylphenyl)ureido)-1-phenylindolin-2-one

NMR (DMSO-d₆) δ: 8.76 (s, 1H), 7.61-6.99 (m, 13H), 6.71
(d, J=7.3Hz, 1H), 5.20 (d, J=7.3Hz, 1H),
2.22 (s, 3H)

20

MS (m/e): 357 (M⁺), 250, 223, 194, 180, 106

EXAMPLE 31

(RS)-1-(2,2-Diethoxyethyl)-5-methyl-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

25 NMR (DMSO-d₆) δ: 8.62 (s, 1H), 7.25 (d, J=8.3Hz, 2H),
7.06-6.86 (m, 6H), 5.03 (d, J=7.8Hz, 1H),
4.71-4.66 (m, 1H), 3.81 (dd, J=5.4,
14.2Hz, 1H), 3.72-3.29 (m, 5H), 2.27 (s,

3H), 2.21 (s, 3H), 1.07 (t, J=6.8Hz, 3H),
1.06 (t, J=6.8Hz, 3H)

MS (m/e): 411 (M⁺), 365, 232, 103

EXAMPLE 32

5 (RS)-5-Bromo-1-(2,2-diethoxyethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 8.74 (s, 1H), 7.48-7.15 (m, 4H), 7.10-
6.88 (m, 4H), 5.03 (d, J=7.4Hz, 1H),
4.72-4.60 (m, 1H), 3.90-3.37 (m, 6H),
10 2.21 (s, 3H), 1.07 (t, J=6.4Hz, 6H)

EXAMPLES 33 TO 41

The following compounds were prepared in the
same manner as in Example 28, except for replacing p-tolyl
isocyanate used as a reactant in Example 28 with various
15 isocyanates.

EXAMPLE 33

(RS)-3-(N'-(4-Chlorophenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

NMR (DMSO-d₆) δ: 8.97 (s, 1H), 7.40 (d, J=9.4Hz, 2H),
20 7.29-6.96 (m, 7H), 5.06 (d, J=7.3Hz, 1H),
4.72-4.67 (m, 1H), 3.84 (dd, J=5.4,
14.1Hz, 1H), 3.70-3.41 (m, 5H), 1.13-1.03
(m, 6H)

MS (m/e): 419, 417 (M⁺), 374, 371, 153, 103

25 EXAMPLE 34

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methoxy-phenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 7.37 (d, J=7.3Hz, 1H), 7.26-7.01 (m, 6H),
6.76 (d, J=8.8Hz, 2H), 5.80 (d, J=7.8Hz,

1H), 5.19 (d, J=7.8Hz, 1H), 4.70-4.65 (m, 1H), 3.91 (dd, J=5.4, 14.6Hz, 1H), 3.74-3.43 (m, 5H), 3.70 (s, 3H), 1.65-1.12 (m, 6H)

MS (m/e): 413 (M⁺), 367, 218, 103

5 EXAMPLE 35

(RS)-3-(N'-Cyclohexylureido)-1-(2,2-diethoxyethyl)indolin-2-one

10 NMR (CDCl₃) δ: 7.39 (d, J=7.8Hz, 1H), 7.27 (dd, J=7.3, 7.8Hz, 1H), 7.08-7.01 (m, 2H), 5.18-5.05 (m, 3H), 4.71-4.65 (m, 1H), 3.92 (dd, J=5.4, 14.1Hz, 1H), 3.80-3.42 (m, 6H), 2.02-1.88 (m, 2H), 1.78-1.51 (m, 4H), 1.48-1.02 (m, 10H)

MS (m/e): 389 (M⁺), 343, 218, 103

15 EXAMPLE 36

(RS)-3-(N'-(2-Chlorophenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

20 NMR (CDCl₃-DMSO-d₆) δ: 8.25 (dd, J=1.5, 6.8Hz, 1H), 8.05 (s, 1H), 7.66 (d, J=7.3Hz, 1H), 7.41-7.00 (m, 6H), 6.91 (dt, J=1.5, 7.8Hz, 1H), 5.23 (d, J=7.3Hz, 1H), 4.75-4.69 (m, 1H), 3.95 (dd, J=5.4, 14.1Hz, 1H), 3.82-3.42 (m, 5H), 1.16 (t, J=7.3Hz, 3H), 1.15 (t, J=6.8Hz, 3H)

25 MS (m/e): 419, 417 (M⁺), 373, 371, 103

EXAMPLE 37

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-fluorophenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 8.81 (s, 1H), 7.42-6.95 (m, 9H), 5.07 (d,

J=7.8Hz, 1H), 4.70 (dd, J=3.4Hz, 5.4Hz, 1H), 3.85 (dd, J=5.4, 14.1Hz, 1H), 3.74-3.34 (m, 5H), 1.074 (t, J=6.8Hz, 3H), 1.067 (t, J=6.8Hz, 3H)

5 MS (m/e): 401 (M⁺), 355, 218, 202, 146, 103, 75

EXAMPLE 38

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-phenylureido)indolin-2-one

10 NMR (DMSO-d₆) δ: 8.78 (s, 1H), 7.39-6.86 (m, 10H), 5.07 (d, J=7.3Hz, 1H), 4.70 (dd, J=4.9Hz, 5.4Hz, 1H), 3.84 (dd, J=5.4, 14.1Hz, 1H), 3.70-3.41 (m, 5H), 1.07 (t, J=6.8Hz, 3H), 1.06 (t, J=6.8Hz, 3H)

MS (m/e): 383 (M⁺), 337, 202, 174, 119, 103, 75

EXAMPLE 39

15 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxy-phenyl)ureido)indolin-2-one

20 NMR (CDCl₃) δ: 7.65 (s, 1H), 7.40-7.00 (m, 6H), 6.79 (d, J=9.3Hz, 1H), 6.53 (dd, J=2.4, 8.3Hz, 1H), 6.07 (d, J=7.8Hz, 1H), 5.17 (d, J=7.3Hz, 1H), 4.69 (dd, J=5.4, 5.9Hz, 1H), 3.92 (dd, J=5.4, 14.1Hz, 1H), 3.79-3.45 (m, 5H), 3.70 (s, 3H), 1.14 (t, J=7.3Hz, 3H), 1.13 (t, J=7.3Hz, 3H)

MS (m/e): 413 (M⁺), 367, 218, 202, 174, 103, 75

25 EXAMPLE 40

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-ethylureido)indolin-2-one

NMR (CDCl₃) δ: 7.40-7.01 (m, 4H), 5.26-5.16 (m, 3H), 4.68 (dd, J=5.4, 5.4Hz, 1H), 3.91 (dd,

J=5.4, 14.6Hz, 1H), 3.77-3.65 (m, 3H),
3.56-3.45 (m, 2H), 3.30-3.17 (m, 2H), 1.15
(t, J=7.3Hz, 3H), 1.14 (t, J=6.8Hz, 3H),
1.13 (t, J=7.3Hz, 3H)

5 MS (m/e): 335 (M⁺), 289, 218, 189, 146, 131, 117, 103, 75

EXAMPLE 41

(RS)-3-(N'-(4-Ethoxycarbonylphenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

NMR (CDCl₃) δ: 8.07 (s, 1H), 7.77 (d, J=8.8Hz, 2H),
10 7.41-7.06 (m, 6H), 6.36 (br, 1H), 5.15 (d,
J=6.8Hz, 1H), 4.73 (dd, J=4.9, 4.9Hz, 1H),
4.31 (q, J=7.3Hz, 2H), 3.99 (dd, J=4.9,
14.1Hz, 1H), 3.86-3.48 (m, 5H), 1.36 (t,
J=7.3Hz, 3H), 1.15 (t, J=6.8Hz, 3H), 1.14
15 (t, J=6.8Hz, 3H)

REFERENCE EXAMPLE 22

3-(Benzyloxyimino)-7-methylindolin-2-one

To a suspension of 4.91 g of 7-methylisatin in
100 ml of ethanol was added a solution of 5.59 g of O-
20 benzylhydroxylamine hydrochloride and 3.29 g of sodium
acetate in 40 ml of water at room temperature. The mixture
was stirred at room temperature for 3 hours and concen-
trated. The concentrate was diluted with chloroform and
washed with water. The organic layer was dried over
25 anhydrous sodium sulfate and concentrated. Recrystalliza-
tion of the crude product from benzene yielded 5.40 g (68%)
of the title compound.

R_f = 0.46 (chloroform/methanol = 10/1)

NMR (DMSO-d₆) δ: 10.81 (s, 1H), 7.69 (d, J=7.8Hz, 1H),
7.43-7.34 (m, 5H), 7.20 (d, J=7.8Hz, 1H),
6.93 (t, J=7.8Hz, 1H), 5.45 (s, 2H), 2.19
(s, 3H)

5 MS (m/e): 266 (M⁺), 249, 131, 91

REFERENCE EXAMPLE 23

(RS)-7-Methyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

A suspension of 1.30 g of 3-(benzyloxyimino)-7-methylindolin-2-one and 50 mg of 5% Pd/C in 500 ml of
10 methanol was stirred under a hydrogen atmosphere at room temperature for 2 days. The reaction mixture was filtered through Cerite, and the filtrate was concentrated. The residue was dissolved in 20 ml of dichloromethane, and 0.67 g of p-tolyl isocyanate was added thereto at 0°C. The
15 mixture was stirred at that temperature for 2 hours, followed by concentration. The concentrate was washed with ethyl ether to yield 1.00 g (69%) of the title compound.

R_f = 0.51 (hexane/ethyl acetate = 2/1)

NMR (DMSO-d₆) δ: 10.36 (s, 1H), 8.60 (s, 1H), 7.31-6.79
20 (m, 8H), 4.96 (d, J=7.8Hz, 1H), 2.21 (s, 3H), 2.20 (s, 3H)

MS (m/e): 295 (M⁺), 188, 162, 107

EXAMPLE 42

25 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methylphenyl)ureido)indolin-2-one

To a suspension of 5.0 g of isatin in 200 ml of ethanol was added a solution of 9.75 g of O-benzylhydroxylamine hydrochloride and 4.18 g of sodium

acetate in 50 ml of water at room temperature. The mixture was stirred at room temperature for 3 hours and concentrated. The concentrate was diluted with ethyl acetate and then washed with water. The organic layer was
5 dried over anhydrous sodium sulfate and concentrated. Recrystallization of the crude product from ethanol gave 6.06 g (71%) of 3-(benzyloxyimino)indolin-2-one as yellow crystals.

Rf = 0.49 (dichloromethane/methanol = 100/3)

10 NMR (CDCl₃) δ: 9.70-9.40 (br, 1H), 7.85 (d, J=7.4Hz, 1H),
7.50-6.70 (m, 3H), 7.34 (s, 5H), 5.46 (s,
2H)

To a suspension of 0.35 g of sodium hydride (60%) in 20 ml of N,N-dimethylformamide was added dropwise a solution
15 of 2.00 g of 3-(benzyloxyimino)indolin-2-one in 20 ml of N,N-dimethylformamide at 0°C in a nitrogen stream. After stirring the mixture at room temperature for 1 hour, 1.40 ml of bromoacetaldehyde diethyl acetal was added thereto, and the mixture was stirred for 12 hours at 70°C. The reaction
20 mixture was concentrated, and the residue was diluted with ethyl acetate and washed with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate and concentrated. The resulting crude product was purified by silica gel column chromatography
25 (chloroform/methanol = 100/1) to give 2.20 g (76%) of 3-(benzyloxyimino)-1-(2,2-diethoxyethyl)indolin-2-one.

Rf = 0.27 (dichloromethane/methanol = 100/1)

NMR (CDCl₃) δ: 8.00-7.80 (m, 1H), 7.60-6.80 (m, 3H), 7.38

(s, 5H), 5.51 (s, 2H), 4.71 (t, J=5.4Hz, 1H), 4.00-3.20 (m, 6H), 1.14 (t, J=7.2Hz, 6H)

A suspension of 2.20 g of 3-(benzyloxyimino)-1-(2,2-diethoxyethyl)indolin-2-one and 100 mg of 5% Pd/C in 50 ml of methanol was stirred under a hydrogen atmosphere at room temperature for 2 days. The reaction mixture was filtered through Cerite, and the filtrate was concentrated. The residue was dissolved in 20 ml of dichloromethane, and 0.89 ml of *m*-tolyl isocyanate was added thereto at 0°C. The mixture was stirred at room temperature for 2 hours, followed by concentration. The concentrate was recrystallized from ethyl ether to yield 1.13 g (47%) of the title compound.

R_f = 0.14 (hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ: 8.69 (s, 1H), 8.29 (s, 1H), 7.29-6.94 (m, 7H), 6.72 (d, J=6.8Hz, 1H), 5.05 (d, J=7.8Hz, 1H), 4.70 (dd, J=4.4, 5.4Hz, 1H), 3.81 (dd, J=5.4, 14.1Hz, 1H), 3.70-3.29 (m, 5H), 2.22 (s, 3H), 1.074 (t, J=6.8Hz, 3H), 1.067 (t, J=6.8Hz, 3H)

EXAMPLE 43

(RS)-1-(2,2-Diethoxyethyl)-5-fluoro-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The title compound was prepared in the same manner as in Example 42, except for using 5-fluoroisatin as a starting material in place of isatin used in Example 42.

NMR (CDCl₃) δ: 7.20-6.82 (m, 8H), 6.10 (d, J=6.9Hz, 1H),

5.09 (d, J=6.9Hz, 1H), 4.71-4.66 (m, 1H),
4.02-3.64 (m, 6H), 2.25 (s, 3H), 1.17-1.09
(m, 6H)

EXAMPLE 44

5 (RS)-1-(2,2-Ethoxyethyl)-5-methoxy-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The title compound was prepared in the same manner as in Example 42, except for using 5-methoxyisatin as a starting material in place of isatin used in Example 42.

10 NMR (CDCl₃) δ: 7.46 (br, 1H), 7.17 (d, J=8.2Hz, 2H), 7.11-
6.93 (m, 4H), 6.78 (dd, J=2.6, 8.2Hz, 1H),
5.97 (d, J=6.9Hz, 1H), 5.14 (d, J=6.9Hz,
1H), 4.69-4.64 (m, 1H), 3.90 (dd, J=5.3,
14.2Hz, 1H), 3.76 (s, 3H), 3.74-3.64 (m,
15 3H), 3.54-3.42 (m, 2H), 2.25 (s, 3H), 1.16-
1.10 (m, 6H)

EXAMPLES 45 TO 52

The following compounds were prepared in the same manner as in Example 42, except for replacing p-tolyl
20 isocyanate used as a reactant in Example 42 with various
isocyanate compounds.

EXAMPLE 45

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(2-methylphenyl)ureido)indolin-2-one

25 NMR (DMSO-d₆) δ: 7.91 (s, 1H), 7.74 (d, J=7.8Hz, 1H),
7.37-6.84 (m, 8H), 5.12 (d, J=7.3Hz, 1H),
4.70 (dd, J=5.4, 5.4Hz, 1H), 3.84 (dd,
J=5.4, 14.6Hz, 1H), 3.70-3.26 (m, 5H),
2.20 (s, 3H), 1.07 (t, J=7.3Hz, 3H), 1.06

(t, J=7.3Hz, 3H)

EXAMPLE 46

(RS)-3-(N'-(3-Chlorophenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

5 NMR (DMSO-d₆) δ: 9.03 (s, 1H), 7.63 (s, 1H), 7.30-6.89 (m, 8H), 5.06 (d, J=7.8Hz, 1H), 4.70 (dd, J=3.4, 5.4Hz, 1H), 3.86 (dd, J=5.4, 14.6Hz, 1H), 3.71-3.30 (m, 5H), 1.09 (t, J=7.3Hz, 3H), 1.08 (t, J=7.3Hz, 3H)

10 EXAMPLE 47

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(2-methoxyphenyl)ureido)indolin-2-one

15 NMR (DMSO-d₆) δ: 8.14 (s, 1H), 8.00 (d, J=7.8Hz, 1H), 7.67 (d, J=7.8Hz, 1H), 7.30-6.76 (m, 7H), 5.12 (d, J=7.8Hz, 1H), 4.70 (dd, J=4.9, 5.4Hz, 1H), 3.85 (s, 3H), 3.88-3.29 (m, 6H), 1.08 (t, J=6.8Hz, 3H), 1.07 (t, J=6.8Hz, 3H)

EXAMPLE 48

20 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-nitrophenyl)ureido)indolin-2-one

25 NMR (DMSO-d₆) δ: 9.61 (s, 1H), 8.11 (d, J=9.3Hz, 2H), 7.61 (d, J=9.3Hz, 2H), 7.34-6.97 (m, 5H), 5.01 (d, J=7.3Hz, 1H), 4.70 (dd, J=2.9, 5.4Hz, 1H), 3.86 (dd, J=5.4, 14.1Hz, 1H), 3.71-3.42 (m, 5H), 1.08 (t, J=7.3Hz, 6H)

EXAMPLE 49

(RS)-3-(N'-(4-Cyanophenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

5 NMR (DMSO- d_6) δ : 9.36 (s, 1H), 7.70-7.53 (m, 5H), 7.30-7.21 (m, 2H), 7.09-6.96 (m, 2H), 5.09 (d, 7.3Hz, 1H), 4.70 (dd, $J=3.4, 5.4$ Hz, 1H), 3.86 (dd, $J=5.4, 14.1$ Hz, 1H), 3.71-3.41 (m, 5H), 1.08 (t, $J=7.3$ Hz, 3H), 1.07 (t, $J=7.3$ Hz, 3H)

EXAMPLE 50

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-trifluoromethyl-phenyl)ureido)indolin-2-one

10 NMR (CDCl₃) δ : 8.04 (s, 1H), 7.55 (s, 1H), 7.39-7.03 (m, 7H), 6.62 (d, $J=6.8$ Hz, 1H), 5.06 (d, $J=6.8$ Hz, 1H), 4.73 (dd, $J=4.9, 4.9$ Hz, 1H), 3.98-3.46 (m, 6H), 1.14 (t, $J=6.8$ Hz, 3H), 1.13 (t, $J=6.8$ Hz, 3H)

15 EXAMPLE 51

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-fluoro-phenyl)ureido)indolin-2-one

20 NMR (DMSO- d_6) δ : 9.05 (s, 1H), 7.42-6.96 (m, 8H), 6.68 (dt, $J=2.4, 8.3$ Hz, 1H), 5.07 (d, $J=7.8$ Hz, 1H), 4.70 (dd, $J=4.9, 5.4$ Hz, 1H), 3.85 (dd, $J=5.4, 14.1$ Hz, 1H), 3.70-3.30 (m, 5H), 1.08 (t, $J=7.3$ Hz, 3H), 1.06 (t, $J=7.3$ Hz, 3H)

EXAMPLE 52

25 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-trifluoromethyl-phenyl)ureido)indolin-2-one

R_f = 0.28 (n-hexane/ethyl acetate = 1/1)

NMR (DMSO- d_6) δ : 9.26 (s, 1H), 7.61-6.97 (m, 9H), 5.09 (d, $J=7.8$ Hz, 1H), 4.70 (dd, $J=4.9, 5.4$ Hz,

1H), 3.86 (dd, J=5.4, 14.1Hz, 1H), 3.74-
3.42 (m, 5H), 1.07 (t, J=7.3Hz, 6H)

EXAMPLE 53

5 (RS)-1,3-Bis(ethoxycarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one (53a) and (RS)-3-(Ethoxy-
carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one
(53b)

To a solution of 2.81 g of (RS)-3-(N'-(4-
methylphenyl)ureido)indolin-2-one in 80 ml of dry dimethyl
10 sulfoxide was added 10 ml of a 1M solution of potassium t-
butoxide in dry dimethyl sulfoxide at room temperature under
a nitrogen atmosphere. After stirring for 1 hour, 1.11 ml
of ethyl bromoacetate was dropwise added thereto, followed
by stirring at the same temperature for 1 hour. The
15 reaction mixture was treated with an aqueous solution of
sodium chloride and extracted with ethyl ether. The ethyl
ether layer was dried over anhydrous magnesium sulfate, and
concentrated. The concentrate was purified by silica gel
column chromatography (chloroform/methanol = 40/1) to give
20 0.68 g (15%) of (RS)-1,3-bis(ethoxycarbonylmethyl)-3-(N'-
(4-methylphenyl)ureido)indolin-2-one:

Rf = 0.57 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 8.97 (s, 1H), 7.24-6.94 (m, 9H), 4.59
(d, J=16.1Hz, 1H), 4.51 (d, J=16.1Hz,
25 1H), 4.17-4.00 (m, 4H), 2.89 (d,
J=15.1Hz, 1H), 2.53 (d, J=15.1Hz, 1H),
2.18 (s, 3H), 1.22 (t, J=6.8Hz, 3H),
1.11 (t, J=7.3Hz, 3H)

MS (m/e): 453 (M⁺), 408, 346, 320, 233, 107

and 1.64 g (45%) of (RS)-3-(ethoxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one:

Rf = 0.22 (chloroform/methanol = 20/1)

5 NMR (DMSO-d₆) δ: 10.39 (s, 1H), 8.79 (s, 1H), 7.24-6.77 (m, 9H), 3.99 (q, J=6.8Hz, 2H), 2.84 (d, J=14.6Hz, 1H), 2.63 (d, J=14.6Hz, 1H), 2.18 (s, 3H), 1.06 (t, J=6.8Hz, 3H)

MS (m/e): 367 (M⁺), 321, 206, 133, 107

EXAMPLE 54

10 (RS)-3-(N'-(4-Methylphenyl)ureido)-1,3-bis(phenylcarbonylmethyl)indolin-2-one (54a) and (RS)-3-(N'-(4-Methylphenyl)ureido)-3-(phenylcarbonylmethyl)indolin-2-one (54b)

The two title compounds were prepared in the same manner as in Example 53, except for replacing ethyl

15 bromoacetate used in Example 53 with 2-bromoacetophenone.

(RS)-3-(N'-(4-Methylphenyl)ureido)-1,3-bis(phenylcarbonylmethyl)indolin-2-one:

Rf = 0.73 (chloroform/methanol = 20/1)

20 NMR (DMSO-d₆) δ: 9.01 (s, 1H), 8.14 (d, J=6.8Hz, 2H), 7.85 (d, J=6.8Hz, 2H), 7.67-6.88 (m, 15H), 5.37 (s, 2H), 3.63 (d, J=15.1Hz, 1H), 3.42 (d, J=15.1Hz, 1H), 2.19 (s, 3H)

MS (m/e): 517 (M⁺), 410, 367, 262, 150, 105

25 (RS)-3-(N'-(4-Methylphenyl)ureido)-3-(phenylcarbonylmethyl)indolin-2-one (54b):

Rf = 0.33 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 10.41 (s, 1H), 8.81 (s, 1H), 7.88 (d, J=7.3Hz, 2H), 7.65-7.44 (m, 3H), 7.30-6.77 (m, 9H), 3.68 (d, J=16.5Hz, 1H),

3.44 (d, J=16.5Hz, 1H), 2.19 (s, 3H)

MS (m/e): 399 (M⁺), 381, 338, 266, 249, 107

EXAMPLE 55

5 (RS)-3-(Hydroxycarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

A solution of 300 mg of potassium hydroxide (85%) in 2 ml of water was added to a solution of 0.35 g of (RS)-3-(ethoxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 10 ml of ethanol at room temperature, and the
10 mixture was stirred for 4 hours, followed by concentration. The concentrate was diluted with water, and washed with chloroform. The aqueous layer was adjusted to pH 3 by addition of 2N hydrochloric acid, and extracted with ethyl acetate. The organic layer was dried over sodium sulfate
15 and concentrated. The resulting crude product was recrystallized from isopropyl alcohol to give 0.088 g (27%) of the title compound.

R_f = 0.16 (chloroform/methanol = 2/1)

20 NMR (DMSO-d₆) δ: 12.70 (br, 1H), 10.36 (s, 1H), 8.88 (s, 1H), 7.26-6.75 (m, 9H), 2.77 (d, J=16.1Hz, 1H), 2.49 (d, J=16.1Hz, 1H), 2.18 (s, 3H)

MS (m/e): 339 (M⁺), 321, 160, 133, 107

EXAMPLE 56

25 (RS)-1,3-Bis(hydroxycarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

The title compound was obtained (yield: 75%) in the same manner as in Example 55, except for replacing (RS)-3-(ethoxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-

2-one used in Example 55 with (RS)-1,3-bis(ethoxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one.

Rf = 0.17 (chloroform/methanol = 1/1)

NMR (DMSO-d₆) δ: 12.71 (br, 2H), 9.07 (s, 1H), 7.31-6.93
5 (m, 9H), 4.42 (d, J=17.5Hz, 1H), 4.37
(d, J=17.5Hz, 1H), 2.82 (d, J=14.9Hz,
1H), 2.37 (d, J=14.9Hz, 1H), 2.18 (s, 3H)

MS (m/e): 379 (M⁺-18), 335, 133, 107

EXAMPLE 57

10 (RS)-3-(4-Methylphenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 0.150 g of (RS)-3-(hydroxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one and
0.103 g of dicyclohexylcarbodiimide in 10 ml of N,N-
15 dimethylformamide were added successively 0.074 g of 1-
hydroxybenzotriazole and 0.052 g of p-toluidine. The
resulting mixture was stirred at room temperature for
18 hours, followed by concentration. The residue was
diluted with ethyl acetate and washed successively with
20 dilute hydrochloric acid and saturated aqueous sodium
hydrogencarbonate. The organic layer was dried over
anhydrous sodium sulfate and concentrated. The crude
product was purified by silica gel column chromatography
(chloroform/methanol = 20/1) to obtain 0.083 g (44%) of
25 the title compound as a white powder.

Rf = 0.11 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 10.37 (s, 1H), 9.89 (s, 1H), 9.15 (s,
1H), 8.29 (s, 1H), 7.51-6.80 (m, 12H),

2.75 (d, J=14.1Hz, 1H), 2.50 (d,
J=14.1Hz, 1H), 2.25 (s, 3H), 2.18 (s, 3H)

MS (m/e): 428 (M⁺), 410, 321, 295, 147, 133, 107

EXAMPLES 58 TO 59

5 The following compounds were prepared in the same manner as in Example 57, except for starting with various amines in place of p-toluidine used in Example 57.

EXAMPLE 58

10 (RS)-3-(N'-(4-Methylphenyl)ureido)-3-(N-(N'-methylpiperazinyl)carbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 9.12 (br, 1H), 7.50 (s, 1H), 7.38-7.15
(m, 2H), 7.15-6.70 (m, 7H), 3.60 (br, 2H),
3.30-2.95 (m, 2H), 2.98 (d, J=14.5Hz, 1H),
2.75 (d, J=14.5Hz, 1H), 2.57-1.80 (br, 7H),
15 2.22 (s, 3H)

EXAMPLE 59

(RS)-3-(N'-(4-Methylphenyl)ureido)-3-((N-piperidyl)carbonylmethyl)indolin-2-one

NMR (DMSO-d₆) δ: 10.31 (s, 1H), 9.11 (s, 1H), 7.45
20 (s, 1H), 7.40-7.05 (m, 4H), 7.05-6.74
(m, 4H), 3.48 (br, 2H), 3.27-3.00 (br,
2H), 2.71 (d, J=15.1Hz, 1H), 2.64 (d,
J=15.1Hz, 1H), 2.18 (s, 3H), 1.70-1.12
(br, 6H)

25 REFERENCE EXAMPLE 24

(RS)-3-(Ethoxycarbonylmethyl)-3-((4-methylbenzyl)carbonylamino)indolin-2-one

To a solution of 0.72 g of (RS)-3-((4-methylbenzyl)carbonylamino)indolin-2-one in 20 ml of dry dimethyl

sulfoxide was added 3 ml of a 1M solution of potassium t-butoxide in dry dimethyl sulfoxide at room temperature under a nitrogen atmosphere, followed by stirring for 30 minutes. To the mixture was added dropwise 0.37 ml of ethyl bromoacetate, followed by stirring at the same temperature for 30 minutes. The reaction mixture was treated with an aqueous solution of sodium chloride and extracted with ethyl ether. The ethyl ether layer was dried over anhydrous magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (chloroform/methanol = 40/1) to give 0.30 g (32%) of the title compound.

Rf = 0.36 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 10.35 (s, 1H), 8.63 (s, 1H), 7.16-7.05 (m, 6H), 6.88-6.71 (m, 2H), 3.82 (q, J=6.8Hz, 2H), 3.40 (d, J=12.7Hz, 1H), 3.32 (d, J=12.7Hz, 1H), 2.95 (d, J=14.6Hz, 1H), 2.74 (d, J=14.6Hz, 1H), 2.25 (s, 3H), 0.96 (t, J=6.8Hz, 3H)

MS (m/e): 366 (M⁺), 322, 233, 218, 146, 132, 105

REFERENCE EXAMPLE 25

(RS)-1-Benzyl-3-ethoxycarbonylmethyl-3-(methylcarbonylamino)indolin-2-one

To a solution of 0.84 g of (RS)-1-benzyl-3-(methylcarbonylamino)indolin-2-one in 15 ml of dry dimethyl sulfoxide was added 3 ml of a 1M solution of potassium t-butoxide in dry dimethyl sulfoxide at room temperature under a nitrogen atmosphere, followed by stirring for 10 minutes.

To the solution was added dropwise 1.11 ml of ethyl bromoacetate, followed by stirring at the same temperature for 30 minutes. The reaction mixture was poured into an aqueous solution of sodium chloride and extracted with ethyl ether.

5 The ethyl ether layer was dried over anhydrous magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (chloroform/ethyl acetate =3/1) to give 0.83 g (76%) of the title compound as a colorless oil.

10 Rf = 0.21 (chloroform/ethyl acetate = 5/1)

NMR (CDCl₃) δ: 7.58 (s, 1H), 7.43-7.11 (m, 7H), 6.96 (t, J=7.3Hz, 1H), 6.66 (d, J=7.8Hz, 1H), 5.02 (d, J=16.1Hz, 1H), 4.92 (d, J=16.1Hz, 1H), 4.21 (q, J=7.3Hz, 2H), 2.99 (d, J=15.1Hz, 1H), 2.50 (d, J=15.1Hz, 1H), 2.02 (s, 3H), 1.25 (t, J=7.3Hz, 3H)

MS (m/e): 366 (M⁺), 307, 278, 238, 91

EXAMPLE 60

20 (RS)-3-((4-Methylbenzyl)carbonylamino)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

To a solution of 0.29 g of (RS)-3-(ethoxycarbonylmethyl)-3-((4-methylbenzyl)carbonylamino)indolin-2-one in 10 ml of ethanol was added 2 ml of an aqueous solution of 0.16 g of potassium hydroxide (85%) at room temperature, and the mixture was stirred for 4 hours, followed by concentration. The concentrate was diluted with water, and washed with chloroform. The aqueous layer was adjusted to pH 2 by addition of 2N hydrochloric acid and extracted

with ethyl acetate. The organic layer was dried over sodium sulfate and concentrated to obtain (RS)-3-(hydroxycarbonylmethyl)-3-((4-methylbenzyl)carbonylamino)indolin-2-one.

R_f = 0.24 (chloroform/methanol = 2/1)

5 NMR (DMSO-d₆) δ: 12.32 (br, 1H), 10.32 (s, 1H), 8.59 (s, 1H), 7.19-7.05 (m, 6H), 6.88-6.71 (m, 2H), 3.40 (d, J=15.1Hz, 1H), 3.28 (d, J=15.1Hz, 1H), 2.89 (d, J=15.1Hz, 1H), 2.62 (d, J=15.1Hz, 1H), 2.23 (s, 3H)

10 MS (m/e): 388 (M⁺), 294, 205, 146, 132, 105

The above obtained (RS)-3-(hydroxycarbonylmethyl)-3-((4-methylbenzyl)carbonylamino)indolin-2-one was dissolved in 20 ml of N,N-dimethylformamide, and 0.248 g of dicyclohexylcarbodiimide, 0.184 g of 1-hydroxybenzotriazole, and
15 0.128 g of p-toluidine were successively added thereto. The resulting mixture was stirred at room temperature for 12 hours, followed by concentration. The concentrate was diluted with ethyl acetate, washed successively with dilute hydrochloric acid and saturated aqueous sodium hydrogen-
20 carbonate. The organic layer was dried over anhydrous sodium sulfate, and concentrated. The resulting crude product was purified by silica gel column chromatography (chloroform/methanol = 40/1) to afford 0.273 g (81%) of the title compound as a white powder.

25 R_f = 0.28 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 10.36 (s, 1H), 9.81 (s, 1H), 8.68 (s, 1H), 7.31 (d, J=8.3Hz, 2H), 7.14-7.04 (m, 8H), 6.85-6.73 (m, 2H), 3.45 (d,

J=15.2Hz, 1H), 3.35 (d, J=15.2Hz, 1H),
2.86 (d, J=14.1Hz, 1H), 2.58 (d,
J=14.1Hz, 1H), 2.26 (s, 3H), 2.23 (s, 3H)

MS (m/e): 427 (M⁺), 322, 293, 279, 172, 149, 107

5 EXAMPLE 61

(RS)-1-Benzyl-3-methylcarbonylamino-3-((4-methyl-phenyl)aminocarbonylmethyl)indolin-2-one

The title compound was prepared in the same manner as in Example 60, except for starting with (RS)-1-benzyl-3-ethoxycarbonylmethyl-3-(methylcarbonylamino)indolin-2-one in
10 place of (RS)-3-(ethoxycarbonylmethyl)-3-((4-methylbenzyl)carbonylamino)indolin-2-one used in Example 60.

R_f = 0.43 (chloroform/methanol = 10/1)

15 NMR (CDCl₃) δ: 8.23 (s, 1H), 7.57 (s 1H), 7.42-7.12 (m, 11H), 6.95 (t, J=7.3Hz, 1H), 6.67 (d, J=7.8Hz, 1H), 4.95 (s, 2H), 3.04 (d, J=14.1Hz, 1H), 2.33 (s, 3H), 2.25 (d, J=14.1Hz, 1H), 1.96 (s, 3H)

MS (m/e): 427 (M⁺), 293, 262, 237, 107, 91

20 EXAMPLE 62

(RS)-1-Benzyl-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 0.404 g of (RS)-3-(hydroxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one
25 in 20 ml of dry dimethyl sulfoxide was added 2.5 ml of a 1M solution of sodium hydride in dry dimethyl sulfoxide at room temperature under a nitrogen atmosphere. After stirring the mixture for 15 minutes, 0.19 ml of benzyl bromide was added thereto, followed by stirring at the same temperature for

30 minutes. The reaction mixture was poured into an aqueous solution of sodium chloride and extracted with ethyl ether. The ethyl ether layer was dried over anhydrous magnesium sulfate and concentrated to give (RS)-1-benzyl-3-(hydroxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one.
5 R_f = 0.41 (chloroform/methanol = 2/1)

(RS)-1-Benzyl-3-(hydroxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one was dissolved in 15 ml of dry N,N-dimethylformamide, and 0.080 g of 1-hydroxybenzotriazole, 0.1 ml of diisopropylethylamine, 0.111 g of 1-ethyl-10 3-(3-dimethylaminopropyl)carbodiimide hydrochloride, and 0.065 g of p-toluidine were successively added to the solution. The mixture was stirred for 6 hours and concentrated. The concentrate was diluted with ethyl acetate and washed successively with dilute hydrochloric acid and a saturated aqueous solution of sodium hydrogen-carbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The crude product was purified by silica gel column chromatography
15 (chloroform/ethyl acetate = 4/1) to give 0.350 g (57%) of the title compound as a white powder.

NMR (DMSO-d₆) δ: 9.93 (s, 1H), 9.16 (s, 1H), 7.51 (s, 1H),
7.53-6.70 (m, 17H), 4.94 (s, 2H), 2.90
(d, J=14.8Hz, 1H), 2.57 (d, J=14.8Hz,
25 1H), 2.26 (s, 3H), 2.19 (s, 3H)

EXAMPLES 63 TO 70

The following compounds were prepared in the same manner as in Example 62, except for starting with various

alkyl halides in place of benzyl bromide used in Example 62.

EXAMPLE 63

(RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-(phenylcarbonylmethyl)indolin-2-one

5 NMR (DMSO-d₆) δ: 10.18 (s, 1H), 9.28 (s, 1H), 8.19 (s, 1H), 7.85-6.80 (m, 17H), 5.57 (d, J=8.6Hz, 1H), 5.36 (d, J=8.6Hz, 1H), 2.90 (d, J=15.4Hz, 1H), 2.65 (d, J=15.4Hz, 1H), 2.82 (s, 3H), 2.20 (s, 3H)

10 EXAMPLE 64

(RS)-1-(Ethoxycarbonylmethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 10.08 (s, 1H), 9.24 (s, 1H), 7.74 (s, 1H), 7.46 (d, J=7.2Hz, 2H), 7.40-6.88 (m, 10H), 4.78-4.46 (m, 2H), 4.16 (q, J=7.2Hz, 2H), 2.90 (d, J=14.8Hz, 1H), 2.57 (d, J=14.8Hz, 1H), 2.26 (s, 3H), 2.18 (s, 3H), 1.26 (t, J=7.2Hz, 3H)

15

EXAMPLE 65

20 (RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-(2-pyridylmethyl)indolin-2-one

NMR (DMSO-d₆) δ: 9.96 (s, 1H), 9.21 (s, 1H), 8.30 (s, 1H), 7.80-6.70 (m, 16H), 5.00 (s, 2H), 2.86 (d, J=14.3Hz, 1H), 2.59 (d, J=14.3Hz, 1H), 2.50 (s, 3H), 2.25 (s, 3H)

25

EXAMPLE 66

(RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-(2-phenylethyl)indolin-2-one

NMR (DMSO-d₆) δ: 9.90 (s, 1H), 9.13 (s, 1H), 7.56 (s, 1H), 7.45-6.85 (m, 17H), 4.98-4.77 (br, 2H),

30

2.99-2.80 (br, 2H), 2.81 (d, J=14.2Hz, 1H), 2.48 (d, J=14.2Hz, 1H), 2.26 (s, 3H), 2.17 (s, 3H)

EXAMPLE 67

5 (RS)-1-Methyl-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 9.88 (s, 1H), 9.12 (s, 1H), 7.54 (s, 1H), 7.39 (d, J=8.2Hz, 2H), 7.31-6.95 (m, 10H), 3.17 (s, 3H), 2.80 (d, J=14.6Hz, 1H), 2.52 (d, J=14.6Hz, 1H), 2.25 (s, 3H), 2.18 (s, 3H)

EXAMPLE 68

(RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-(4-pyridylmethyl)indolin-2-one

15 NMR (DMSO-d₆) δ: 9.92 (s, 1H), 9.18 (s, 1H), 8.51 (d, J=6.0Hz, 2H), 7.65 (s, 1H), 7.50 (d, J=5.8Hz, 2H), 7.40 (d, J=9.8Hz, 2H), 7.28-6.86 (m, 9H), 6.75 (d, J=7.2Hz, 1H), 5.03 (d, J=16.6Hz, 1H), 4.93 (d, J=16.6Hz, 1H), 2.90 (d, J=14.6Hz, 1H), 2.63 (d, J=14.6Hz, 1H), 2.26 (s, 3H), 2.20 (s, 3H)

EXAMPLE 69

(RS)-1-(Methoxymethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

25 NMR (DMSO-d₆) δ: 9.90 (s, 1H), 9.14 (s, 1H), 7.61 (s, 1H), 7.39 (d, J=7.8Hz, 2H), 7.45-6.86 (m, 10H), 5.11 (s, 2H), 3.34 (s, 3H), 2.84 (d, J=14.0Hz, 1H), 2.56 (d, J=14.0Hz, 1H), 2.25 (s, 3H), 2.17 (s, 3H)

EXAMPLE 70

(RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-(2,2-di-n-propylethyl)indolin-2-one

NMR (CDCl₃) δ: 8.62 (s, 1H), 7.40-6.78 (m, 14H), 3.71

5 (dd, J=7.4, 13.7Hz, 1H), 3.52 (dd, J=6.9, 13.7Hz, 1H), 2.97 (d, J=14.3Hz, 1H), 2.62 (d, J=14.3Hz, 1H), 2.29 (s, 3H), 2.19 (s, 3H), 1.93 (br, 1H), 1.50-1.10 (br, 8H), 0.98-0.70 (br, 6H)

10 EXAMPLE 71

(RS)-1-(2,2-Diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 0.397 g of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 4 ml
15 of dry dimethyl sulfoxide was added 1 ml of a 1M solution of potassium t-butoxide in dry dimethyl sulfoxide at room temperature under a nitrogen atmosphere, followed by stirring for 30 minutes. To the mixture was added dropwise a solution of 0.228 g of N-p-tolyl-2-bromoacetamide in 2 ml
20 of dry dimethyl sulfoxide, followed by stirring at the same temperature for 30 minutes. The reaction mixture was poured into an aqueous solution of sodium chloride and extracted with ethyl ether. The ethyl ether layer was dried over anhydrous magnesium sulfate and concentrated. The
25 residue was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to give 0.35 g (65%) of the title compound.

R_f = 0.21 (hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ: 8.33 (s, 1H), 7.33-6.91 (m, 14H), 4.77 (dd,

J=4.4, 5.6Hz, 1H), 4.03 (dd, J=5.6, 14.1Hz, 1H), 3.82-3.48 (m, 5H), 2.97 (d, J=14.6Hz, 1H), 2.57 (d, J=14.6Hz, 1H), 2.30 (s, 3H), 2.22 (s, 3H), 1.16 (t, J=6.8Hz, 3H), 1.11 (t, J=6.8Hz, 3H)

MS (m/e): 544 (M⁺), 498, 437, 365, 103, 75

EXAMPLE 72

(RS)-7-Methyl-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The title compound was prepared (yield: 30%) in the same manner as in Example 71, except for starting with 7-methyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one in place of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one used in Example 71.

R_f = 0.21 (chloroform/methanol = 20/1)

NMR (CDCl₃) δ: 9.10 (br, 1H), 8.61 (br, 1H), 7.42 (br, 1H), 7.26-6.73 (m, 12H), 3.06 (d, J=14.5Hz, 1H), 2.56 (d, J=14.5Hz, 1H), 2.24 (s, 3H), 2.19 (s, 3H), 2.03 (s, 3H)

MS (m/e): 442 (M⁺), 424, 381, 335, 161, 107

EXAMPLE 73

(RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-phenylindolin-2-one

The title compound was prepared (yield: 57%) in the same manner as in Example 71, except for starting with 3-(N'-(4-methylphenyl)ureido)-1-phenylindolin-2-one in place of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one used in Example 71.

R_f = 0.40 (chloroform/methanol = 20/1)

NMR (DMSO-d₆) δ: 9.97 (s, 1H), 9.12 (s, 1H), 7.63-6.95
(m, 17H), 6.71 (d, J=7.8Hz, 1H), 2.95
(d, J=14.1Hz, 1H), 2.75 (d, J=14.1Hz,
1H), 2.25 (s, 3H), 2.19 (s, 3H)

5 MS (m/e): 504 (M⁺), 397, 365, 224, 132, 107

EXAMPLES 74 TO 77

The following compounds were prepared in the same
manner as in Example 71, except for starting with (RS)-1-
(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-
10 one, used in Example 71, having a varied substituent at the
5-position thereof.

EXAMPLE 74

15 (RS)-1-(2,2-Diethoxyethyl)-5-methyl-3-((4-methyl-
phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.25 (s, 1H), 7.32 (d, J=8.3Hz, 2H), 7.11-
6.93 (m, 10H), 6.84 (s, 1H), 4.78 (dd,
J=4.4, 5.9Hz, 1H), 3.99 (dd, J=5.9, 14.6Hz,
1H), 3.81-3.54 (m, 5H), 2.94 (d, J=14.6Hz,
20 1H), 2.54 (d, J=14.6Hz, 1H), 2.30 (s, 3H),
2.24 (s, 3H), 2.23 (s, 3H), 1.17 (t,
J=6.8Hz, 3H), 1.12 (t, J=6.8Hz, 3H)

MS (m/e): 558 (M⁺), 512, 451, 406, 379, 306, 103

EXAMPLE 75

25 (RS)-1-(2,2-Diethoxyethyl)-5-fluoro-3-((4-methyl-
phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.61 (s, 1H), 7.35-6.86 (m, 13H), 4.72 (dd,
J=4.5, 5.4Hz, 1H), 3.96 (dd, J=5.4, 14.6Hz,
30 1H), 3.74-3.44 (m, 5H), 2.95 (d, J=14.6Hz,

1H), 2.65 (d, J=14.6Hz, 1H), 2.27 (s, 3H),
2.19 (s, 3H), 1.12 (t, J=6.8Hz, 3H), 1.09
(t, J=6.8Hz, 3H)

EXAMPLE 76

5 (RS)-1-(2,2-Diethoxyethyl)-5-methoxy-3-((4-methyl-phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

R_f = 0.20 (n-hexane/ethyl acetate = 2/1)

10 NMR (CDCl₃) δ: 8.35 (s, 1H), 7.34-6.75 (m, 13H), 4.76 (dd,
J=4.3, 6.1Hz, 1H), 3.99 (dd, J=6.1, 14.5Hz,
1H), 3.79-3.48 (m, 5H), 3.67 (s, 3H), 2.97
(d, J=14.8Hz, 1H), 2.61 (d, J=14.8Hz, 1H),
2.29 (s, 3H), 2.22 (s, 3H), 1.16 (t,
J=6.9Hz, 3H), 1.12 (t, J=6.9Hz, 3H)

15 EXAMPLE 77

(RS)-5-Bromo-1-(2,2-diethoxyethyl)-3-((4-methyl-phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

20 NMR (CDCl₃) δ: 8.23 (s, 1H), 7.45-6.85 (m, 13H), 4.73
(dd, J=3.9, 5.9Hz, 1H), 3.98 (dd, J=5.9Hz,
14.8Hz, 1H), 3.83-3.40 (m, 5H), 2.94 (d,
J=14.6Hz, 1H), 2.56 (d, J=14.6Hz, 1H), 2.29
(s, 3H), 2.21 (s, 3H), 1.15 (t, J=6.8Hz,
3H), 1.11 (t, J=7.0Hz, 3H)

25 EXAMPLES 78 TO 95

The following compounds were prepared in the same
manner as in Example 71, except for starting with (RS)-1-
(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-
one, used in Example 71, with its (4-methylphenyl)ureido
30 moiety replaced with various substituted ureides.

EXAMPLE 78

(RS)-3-(N'-(4-Chlorophenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

Rf = 0.33 (n-hexane/ethyl acetate = 1/1)

- 5 NMR (CDCl₃) δ: 8.34 (s, 1H), 7.54 (s, 1H), 7.31-7.24 (m, 4H), 7.12-6.97 (m, 9H), 4.78 (dd, J=4.4, 5.8Hz, 1H), 4.03 (dd, J=5.8, 14.6Hz, 1H), 3.84-3.48 (m, 5H), 3.03 (d, J=14.6Hz, 1H), 2.65 (d, J=14.6Hz, 1H), 2.28 (s, 3H), 1.19-1.07 (m, 6H)

EXAMPLE 79

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methoxyphenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

Rf = 0.23 (n-hexane/ethyl acetate = 1/1)

- 15 NMR (CDCl₃) δ: 8.33 (s, 1H), 7.33-6.95 (m, 12H), 6.67 (d, J=8.8Hz, 2H), 4.76 (dd, J=4.5, 5.9Hz, 1H), 4.04 (dd, J=5.9, 14.1Hz, 1H), 3.79-3.48 (m, 5H), 3.70 (s, 3H), 2.95 (d, J=14.6Hz, 1H), 2.56 (d, J=14.6Hz, 1H), 2.29 (s, 3H), 1.15 (t, J=6.9Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

MS (m/e): 560 (M⁺), 514, 365, 217, 103

EXAMPLE 80

(RS)-1-(2,2-Diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-cyclohexylureido)indolin-2-one

- 25 Rf = 0.25 (n-hexane/ethyl acetate = 2/1)
- NMR (CDCl₃) δ: 8.14 (s, 1H), 7.38-6.93 (m, 9H), 6.80 (s, 1H), 4.80-4.75 (m, 1H), 4.12 (dd, J=5.8, 14.6Hz, 1H), 3.78-3.34 (m, 6H), 2.94 (d, J=14.6Hz, 1H), 2.45 (d, J=14.6Hz,

1H), 2.31 (s, 3H), 1.95-1.48 (m, 6H), 1.38-0.92 (m, 10H)

MS (m/e): 536 (M⁺), 490, 462, 391, 103

EXAMPLE 81

5 (RS)-1-(2,2-Diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(3-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.39 (s, 1H), 7.34-6.97 (m, 13H), 6.75 (d, J=6.8Hz, 1H), 4.79 (dd, J=4.4, 5.9Hz, 1H), 4.01 (dd, J=5.9, 14.4Hz, 1H), 3.84-3.46
10 (m, 5H), 2.98 (d, J=14.6Hz, 1H), 2.59 (d, J=14.6Hz, 1H), 2.30 (s, 3H), 2.19 (s, 3H), 1.16 (t, J=6.8Hz, 3H), 1.11 (t, J=6.8Hz, 3H)

MS (m/e): 544 (M⁺), 498, 470, 437, 365, 292, 157, 103, 75

EXAMPLE 82

15 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-fluorophenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (DMSO-d₆) δ: 9.27 (s, 1H), 7.62 (s, 1H), 7.40-6.86 (m, 13H), 4.71 (dd, J=4.6, 5.6Hz, 1H), 3.86 (dd, J=5.6, 14.2Hz, 1H), 3.70-3.35 (m, 5H), 2.84 (d, J=15.2Hz, 1H), 2.50 (d, J=15.2Hz, 1H), 2.24 (s, 3H), 1.11 (t, J=6.4Hz, 3H), 1.07 (t, J=6.4Hz, 3H)
20

MS (m/e): 548 (M⁺), 502, 365, 292, 158, 103, 75

EXAMPLE 83

25 (RS)-3-(N'-(2-Chlorophenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (DMSO-d₆) δ: 9.85 (s, 1H), 8.63 (s, 1H), 8.15 (s, 1H), 7.83 (d, J=7.3Hz, 1H), 7.38-6.88 (m, 11H), 4.70 (dd, J=4.9, 5.4Hz, 1H), 3.84

(dd, J=5.4, 13.7Hz, 1H), 3.70-3.37 (m, 5H), 2.97 (d, J=14.6Hz, 1H), 2.61 (d, J=14.6Hz, 1H), 2.23 (s, 3H), 1.07 (t, J=7.3Hz, 6H)

5 MS (m/e): 564 (M⁺), 490, 365, 292, 173, 103, 75

EXAMPLE 84

(RS)-1-(2,2-Diethoxyethyl)-3-((4-methylphenyl)amino-carbonylmethyl)-3-(N'-phenylureido)indolin-2-one

10 NMR (CDCl₃) δ: 8.58 (s, 1H), 7.46 (s, 1H), 7.31-6.84 (m, 14H), 4.77 (dd, J=3.9, 5.9Hz, 1H), 4.00 (dd, J=5.9, 14.1Hz, 1H), 3.82-3.46 (m, 5H), 2.99 (d, J=14.6Hz, 1H), 2.67 (d, J=14.6Hz, 1H), 2.27 (s, 3H), 1.13 (t, J=7.3Hz, 3H), 1.10 (t, J=7.3Hz, 3H)

15 MS (m/e): 530 (M⁺), 365, 292, 217, 158, 103, 75

EXAMPLE 85

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

20 NMR (CDCl₃) δ: 8.24 (s, 1H), 7.35-6.91 (m, 12H), 6.73 (d, J=7.3Hz, 1H), 6.50 (dd, J=2.4, 7.8Hz, 1H), 4.79 (dd, J=3.9, 6.3Hz, 1H), 3.98 (dd, J=6.3, 14.1Hz, 1H), 3.86-3.52 (m, 5H), 3.67 (s, 3H), 2.98 (d, J=14.6Hz, 1H), 2.54 (d, J=14.6Hz, 1H), 2.30 (s, 3H), 1.18 (t, J=6.8Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

25

MS (m/e): 560 (M⁺), 365, 350, 292, 217, 149, 103, 75

EXAMPLE 86

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-ethylureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 7.97 (s, 1H), 7.37-6.88 (m, 9H), 4.79 (dd, J=3.9, 6.3Hz, 1H), 4.57 (br, 1H), 4.09 (dd, J=6.3, 14.6Hz, 1H), 3.74-3.52 (m, 5H), 3.11-3.05 (m, 2H), 2.94 (d, J=14.6Hz, 1H), 2.44 (d, J=14.6Hz, 1H), 2.32 (s, 3H), 1.18 (t, J=7.3Hz, 3H), 1.14 (t, J=6.8Hz, 3H), 1.02 (t, J=7.3Hz, 3H)

MS (m/e): 482 (M⁺), 416, 408, 216, 103, 75

EXAMPLE 87

10 (RS)-3-(N'-(4-Ethoxycarbonylphenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 8.16 (br, 1H), 7.79 (d, J=8.8Hz, 2H), 7.49-6.97 (m, 12H), 4.81 (dd, J=4.9, 6.3Hz, 1H), 4.30 (q, J=7.3Hz, 2H), 4.02 (dd, J=6.3, 15.1Hz, 1H), 3.89-3.57 (m, 5H), 3.02 (d, J=14.6Hz, 1H), 2.57 (d, J=14.6Hz, 1H), 2.30 (s, 3H), 1.34 (t, J=7.3Hz, 3H), 1.19 (t, J=6.8Hz, 3H), 1.12 (t, J=7.3Hz, 3H)

MS (m/e): 602 (M⁺), 365, 146, 120, 103, 75

20 EXAMPLE 88

(RS)-1-(2,2-Diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(2-methylphenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 9.86 (s, 1H), 8.28 (s, 1H), 7.80 (s, 1H), 7.52 (d, J=8.3Hz, 1H), 7.39-6.79 (m, 11H), 4.71 (dd, J=4.9, 5.4Hz, 1H), 3.85 (dd, J=5.4, 14.1Hz, 1H), 3.70-3.37 (m, 5H), 2.93 (d, J=14.6Hz, 1H), 2.55 (d, J=14.6Hz, 1H), 2.25 (s, 3H), 2.17 (s, 3H), 1.10 (t, J=6.8Hz, 3H), 1.07 (t,

J=6.8Hz, 3H)

EXAMPLE 89

(RS)-3-(N'-(3-Chlorophenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

5 NMR (DMSO-d₆) δ: 9.97 (s, 1H), 9.49 (s, 1H), 7.76 (s, 1H),
7.54 (s, 1H), 7.41 (d, J=8.3Hz, 2H),
7.24-6.89 (m, 9H), 4.75 (dd, J=4.3,
5.9Hz, 1H), 3.86 (dd, J=5.9, 14.2Hz, 1H),
3.76-3.51 (m, 5H), 2.84 (d, J=15.2Hz,
10 1H), 2.09 (d, J=15.2Hz, 1H), 2.26 (s,
3H), 1.14 (t, J=6.8Hz, 3H), 1.08 (t,
J=6.8Hz, 3H)

EXAMPLE 90

15 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(2-methoxyphenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (DMSO-d₆) δ: 9.80 (br, 1H), 8.44 (s, 1H), 7.95 (s,
1H), 7.79 (d, J=8.3Hz, 1H), 7.35-6.71
(m, 11H), 4.70 (dd, J=5.0, 5.0Hz, 1H),
3.92-3.42 (m, 6H), 3.84 (s, 3H), 2.94
20 (d, J=14.4Hz, 1H), 2.60 (d, J=14.4Hz,
1H), 2.23 (s, 3H), 1.08 (t, J=7.3Hz, 6H)

MS (m/e): 560 (M⁺), 514, 392, 365, 173, 158, 130, 103, 75

EXAMPLE 91

25 (RS)-1-(2,2-Diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-nitrophenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 10.03 (d, J=10.2Hz, 2H), 8.04 (t,
J=9.3Hz, 3H), 7.53-6.89 (m, 10H), 4.74
(dd, J=5.3, 5.9Hz, 1H), 3.89 (dd, J=5.9,
14.2Hz, 1H), 3.72-3.50 (m, 5H), 2.86 (d,

J=15.1Hz, 1H), 2.51 (d, J=15.1Hz, 1H),
2.26 (s, 3H), 1.13 (t, J=6.8Hz, 3H),
1.09 (t, J=7.3Hz, 3H)

EXAMPLE 92

5 (RS)-3-(N'-(4-Cyanophenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 8.05 (s, 1H), 7.89 (s, 1H), 7.57 (s, 1H),
7.37-6.98 (m, 12H), 4.82 (dd, J=3.9, 6.3Hz,
1H), 4.07 (dd, J=6.3, 15.2Hz, 1H), 3.87-3.54
10 (m, 5H), 3.09 (d, J=14.6Hz, 1H), 2.58
(d, J=14.6Hz, 1H), 2.30 (s, 3H), 1.20
(t, J=7.3Hz, 3H), 1.14 (t, J=7.3Hz, 3H)

EXAMPLE 93

15 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-trifluoromethyl-phenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 8.32 (s, 1H), 7.62 (d, J=4.4Hz, 2H), 7.43
(s, 1H), 7.34-6.97 (m, 11H), 4.81 (dd,
J=3.9, 5.9Hz, 1H), 3.96-3.57 (m, 6H), 3.07
20 (d, J=14.6Hz, 1H), 2.62 (d, J=14.6Hz, 1H),
2.29 (s, 3H), 1.19 (t, J=6.8Hz, 3H), 1.09
(t, J=7.3Hz, 3H)

EXAMPLE 94

25 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-fluorophenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 8.46 (s, 1H), 7.68 (s, 1H), 7.35-6.93 (m,
11H), 6.79 (d, J=7.8Hz, 1H), 6.55 (split-t,
J=8.8Hz, 1H), 4.79 (dd, J=3.9, 5.9Hz, 1H),
3.98 (dd, J=5.9, 14.4Hz, 1H), 3.88-3.49
30 (m, 5H), 3.04 (d, J=14.6Hz, 1H), 2.66 (d,

J=14.6Hz, 1H), 2.28 (s, 3H), 1.16 (t,
J=7.3Hz, 3H), 1.11 (t, J=7.3Hz, 3H)

EXAMPLE 95

5 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-trifluoromethylphenyl)
ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

Rf = 0.43 (n-hexane/ethyl acetate = 1/1)

NMR (DMSO-d₆) δ: 9.99 (s, 1H), 9.71 (s, 1H), 7.84 (s, 1H),
7.48-6.89 (m, 12H), 4.74 (dd, J=3.2,
5.8Hz, 1H), 3.88 (dd, J=5.8, 13.6Hz, 1H),
10 3.72-3.51 (m, 5H), 2.86 (d, J=13.7Hz,
1H), 2.51 (d, J=13.7Hz, 1H), 2.26 (s,
3H), 1.13 (t, J=7.3Hz, 3H), 1.09 (t,
J=7.3Hz, 3H)

EXAMPLE 96

15 (RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-
methylphenyl)ureido)-1-(2,2-dipropoxyethyl)indolin-2-one

To a solution of 0.411 g of (RS)-1-(2,2-diethoxy-
ethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-
methylphenyl)ureido)indolin-2-one in 50 ml of n-propanol was
20 added 10 mg of p-toluenesulfonic acid, and the mixture was
heated under reflux for 2 hours. The reaction mixture was
concentrated, and the residue was purified by silica gel
column chromatography (hexane/ethyl acetate = 3/1) to give
0.394 g (91%) of the title compound.

25 Rf = 0.64 (hexane/ethyl acetate = 1/1)

NMR (CDCl₃) δ: 8.55 (s, 1H), 7.35-6.80 (m, 14H), 4.74 (dd,
J=4.4, 5.4Hz, 1H), 3.99 (dd, J=5.4, 14.6Hz,
1H), 3.75 (dd, J=4.4, 14.6Hz, 1H), 3.68-3.32
(m, 4H), 2.95 (d, J=14.6Hz, 1H), 2.62 (d,

J=14.6Hz, 1H), 2.29 (s, 3H), 2.20 (s, 3H),
1.62-1.38 (m, 4H), 0.91-0.70 (m, 6H)

EXAMPLE 97

5 (RS)-1-(Formylmethyl)-3-((4-methylphenyl)aminocarbonyl-
methyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 4.32 g of (RS)-1-(2,2-diethoxy-
ethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-
methylphenyl)ureido)indolin-2-one in 50 ml of acetone
was added 5 ml of 2N hydrochloric acid, and the mixture
10 was stirred at room temperature for 2 hours. The reaction
mixture was poured into water, and the thus formed
precipitate was collected by filtration and washed with
ethyl ether to obtain 2.94 g (79%) of the title compound.
NMR (DMSO-d₆) δ: 10.03 (s, 1H), 9.66 (s, 1H), 7.70 (s,
15 1H), 7.43 (d, J=8.2Hz, 2H), 7.28-6.81
(m, 11H), 4.76 (d, J=18.0Hz, 1H), 4.58
(d, J=18.0Hz, 1H), 2.87 (d, J=14.8Hz,
1H), 2.58 (d, J=14.6Hz), 2.26 (s, 3H),
2.18 (s, 3H)

20 EXAMPLE 98

(RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-
methylphenyl)ureido)-1-((2,5-dioxacyclo-
pentyl)methyl)indolin-2-one

To a solution of 0.294 g of (RS)-1-(formylmethyl)-
25 3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one in 50 ml of toluene were added
0.5 ml of ethylene glycol and 10 mg of p-toluenesulfonic
acid. The mixture was heated under reflux for 6 hours
while azeotropically removing produced water together with

toluene. The reaction mixture was washed with saturated aqueous sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to give 0.220 g (68%) of the title compound.

NMR (DMSO- d_6) δ : 9.94 (s, 1H), 9.15 (s, 1H), 7.62 (s, 1H), 7.41 (d, J=8.2Hz, 2H), 7.27-7.01 (m, 7H), 6.99-6.85 (m, 3H), 5.15-5.03 (m, 1H), 4.05-3.63 (m, 6H), 2.83 (d, J=14.3Hz, 1H), 2.47 (d, J=14.3Hz, 1H), 2.25 (s, 3H), 2.17 (s, 3H)

EXAMPLES 99 TO 101

The following compounds were prepared in the same manner as in Example 98, except for replacing ethylene glycol used in Example 98 with various alcohols.

EXAMPLE 99

(RS)-1-(2,2-Dibenzyloxyethyl)-3-((4-methylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (DMSO- d_6) δ : 9.90 (s, 1H), 9.11 (s, 1H), 7.60 (s, 1H), 7.45-6.85 (m, 22H), 5.03 (dd, J=5.1, 6.8Hz, 1H), 4.71 (d, J=11.7Hz, 2H), 4.61 (d, J=11.7Hz, 2H), 4.10-3.83 (m, 2H), 2.84 (d, J=14.8Hz, 1H), 2.51 (d, J=14.8Hz, 1H), 2.25 (s, 3H), 2.17 (s, 3H)

EXAMPLE 100

(RS)-1-(2,2-Dimethoxyethyl)-3-((4-methylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (DMSO- d_6) δ : 9.96 (s, 1H), 9.15 (s, 1H), 7.63 (s, 1H),

7.41 (d, J=8.2Hz, 2H), 7.30-7.00 (m, 7H),
7.00-6.80 (m, 3H), 4.63 (dd, J=4.3,
5.9Hz, 1H), 3.91 (dd, J=5.9Hz, 14.3Hz,
1H), 3.69 (dd, J=4.3Hz, 14.3Hz, 1H),
5 3.36 (s, 3H), 3.34 (s, 3H), 2.86 (d,
J=14.3Hz, 1H)

EXAMPLE 101

10 (RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-((2,6-dioxa-3,5-dimethylcyclohexyl)methyl)indolin-2-one

NMR (CDCl₃) δ: 8.46 (s, 1H), 7.33-6.80 (m, 14H), 4.83 (dd,
J=4.9, 4.9Hz, 1H), 4.12 (dd, J=4.9, 14.3Hz,
1H), 3.78 (dd, J=4.9, 14.3Hz, 1H), 3.62
(br, 2H), 2.99 (d, J=14.6Hz, 1H), 2.68 (d,
15 J=14.6Hz, 1H), 2.26 (s, 3H), 2.19 (s, 3H),
1.50-0.95 (m, 8H)

EXAMPLE 102

(RS)-1-(2-Methylamino)ethyl-3-((4-methylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

20 To a solution of 0.439 of (RS)-1-(formylmethyl)-
3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one in 15 ml of methanol was added
1 ml of a 40% aqueous solution of methylamine at room
temperature. After adjusting the mixture to pH 7 with
25 trifluoroacetic acid, 0.30 g of sodium cyanoborohydride
was added thereto. The resulting mixture was stirred at
room temperature for 1 day and then concentrated. The
concentrate was diluted with ethyl acetate and washed with
an aqueous solution of sodium chloride. The organic layer

was dried over anhydrous sodium sulfate and concentrated.

The crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 1/1) to afford 0.39 g (90%) of the title compound.

- 5 NMR (CDCl₃, for hydrochloride) δ : 9.10-8.75 (br, 1H), 7.95-7.50 (br, 2H), 7.30-6.65 (m, 12H), 4.15-3.70 (br, 2H), 3.10-2.38 (br, 7H), 2.24 (brs, 3H), 2.16 (brs, 3H)

EXAMPLE 103

- 10 (RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-(2-(1-piperidyl)ethyl)indolin-2-one

The title compound was prepared (yield: 63%) in the same manner as in Example 102, except for replacing methylamine used in Example 102 with piperidine.

- 15 NMR (CDCl₃) δ : 9.10 (s, 1H), 8.04 (s, 1H), 7.73 (s, 1H), 7.40-6.70 (m, 12H), 4.10 (br, 2H), 3.10 (br, 8H), 2.23 (br, 3H), 2.20 (br, 3H)

EXAMPLE 104

- 20 (RS)-1-(2-Dimethylaminoethyl)-3-((4-methylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The title compound was prepared in the same manner as in Example 102, except for replacing methylamine used in Example 102 with dimethylamine.

- 25 NMR (DMSO-d₆) δ : 9.92 (s, 1H), 9.13 (s, 1H), 7.57 (s, 1H), 7.40 (d, J=8.4Hz, 2H), 7.30-6.86 (m, 10H), 3.99-3.58 (m, 2H), 3.60-3.10 (m, 1H), 2.82 (d, J=14.6Hz, 1H), 2.70-2.35 (m, 2H), 2.28 (s, 6H), 2.25 (s, 3H), 2.18 (s, 3H)

EXAMPLE 105

(RS)-3-((4-Methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)-1-(2,2-bis(methylthio)ethyl)indolin-2-one

5 Excess methyl mercaptan was bubbled through
a solution of 0.538 g of (RS)-1-(2,2-diethoxyethyl)-
3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one in 30 ml of dichloromethane at
-10°C, and 0.30 ml of boron trifluoride ethyl etherate was
10 added thereto, followed by stirring at room temperature for
1 hour. The reaction mixture was diluted with dichloro-
methane and washed successively with a 1N sodium hydroxide
aqueous solution and water. The organic layer was dried
over anhydrous sodium sulfate and concentrated. The residue
15 was washed with hexane/ethyl acetate = 1/1 to give 0.495 g
(91%) of the title compound.

Rf = 0.48 (hexane/ethyl acetate = 1/1)

NMR (DMSO-d₆) δ: 10.02 (s, 1H), 9.19 (s, 1H), 7.65 (s,
1H), 7.52-6.83 (m, 12H), 4.30-3.94 (m,
20 2H), 3.85 (dd, J=6.4, 14.2Hz, 1H), 2.86
(d, J=14.2Hz, 1H), 2.54 (d, J=14.2Hz,
1H), 2.25 (s, 3H), 2.20 (s, 3H), 2.17
(s, 3H), 2.13 (s, 3H)

EXAMPLE 106

25 (RS)-1-(2,2-Bis(ethylthio)ethyl)-3-((4-methylphenyl)amino-
carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 0.512 g of (RS)-1-(2,2-diethoxy-
ethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-
methylphenyl)ureido)indolin-2-one in 30 ml of dichloro-

methane were added successively 0.8 ml of ethyl mercaptan and 0.30 ml of boron trifluoride ethyl etherate at room temperature, and the mixture was stirred at room temperature for 1 hour. The reaction mixture was washed with a 1N sodium hydroxide aqueous solution, and the organic layer was dried over anhydrous sodium sulfate and concentrated. The residue was washed with hexane/ethyl acetate = 1/1 to give 0.542 g (100%) of the title compound.

Rf = 0.62 (n-hexane/ethyl acetate = 1/1)

10 NMR (DMSO-d₆) δ: 10.00 (s, 1H), 9.17 (s, 1H), 7.64 (s, 1H), 7.43 (d, J=8.2Hz, 2H), 7.30-6.78 (m, 10H), 4.38-4.26 (m, 1H), 4.14-3.79 (m, 2H), 2.86 (d, J=14.8Hz, 1H), 2.75 (q, J=7.3Hz, 2H), 2.69 (q, J=7.3Hz, 2H), 15 2.38 (d, J=14.8Hz, 1H), 2.26 (s, 3H), 2.17 (s, 3H), 1.23 (t, J=7.3Hz, 3H), 1.17 (t, J=7.3Hz, 3H)

EXAMPLE 107

20 (RS)-3-(Ethoxycarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 7.50 g of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 100 ml of dry dimethyl sulfoxide was added 20 ml of a 1M solution of potassium t-butoxide in dry dimethyl sulfoxide at room temperature under a nitrogen atmosphere, followed by stirring for 30 minutes. To the mixture was added dropwise a solution of 2.30 ml of ethyl bromoacetate in 20 ml of dry dimethyl sulfoxide, followed by stirring at the same

temperature for 30 minutes. A sodium chloride aqueous solution was added thereto, and the mixture was extracted with ethyl ether. The ethyl ether layer was dried over anhydrous magnesium sulfate and concentrated. The

5 residue was purified by silica gel column chromatography (hexane/ethyl acetate = 3/1) to afford 8.21 g (90%) of the title compound.

NMR (CDCl₃) δ: 7.34-7.24 (m, 2H), 7.19-6.95 (m, 7H), 6.76 (s, 1H), 4.76 (dd, J=4.6, 5.9Hz, 1H), 4.16-3.95 (m, 3H), 3.89-3.50 (m, 5H), 2.93 (d, J=15.4Hz, 1H), 2.59 (d, J=15.4Hz, 1H), 2.26 (s, 3H), 1.23-1.10 (m, 9H)

EXAMPLE 108

15 (RS)-1-(2,2-Diethoxyethyl)-3-(hydroxycarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 8.21 g of (RS)-3-(ethoxy-carbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 100 ml of methanol was added 30 ml of an aqueous solution of 2.0 g of potassium hydroxide (85%) at room temperature, followed by stirring for 6 hours. The reaction mixture was concentrated, and the concentrate was diluted with water, which was washed with chloroform. The aqueous layer was adjusted to pH 2 by addition of 2N hydrochloric acid, and extracted with chloroform, and the organic layer was dried over anhydrous sodium sulfate and concentrated to yield 6.63 g (86%) of the title compound.

25 NMR (CDCl₃) δ: 7.74 (s, 1H), 7.35-6.70 (m, 10H), 4.73 (dd, J=4.4, 5.9Hz, 1H), 4.01 (dd, J=5.9, 14.6Hz,

1H), 3.86-3.38 (m, 5H), 2.90 (d, J=15.9Hz, 1H), 2.65 (d, J=15.9Hz, 1H), 2.18 (s, 3H), 1.13 (t, J=6.8Hz, 3H), 1.08 (t, J=6.8Hz, 3H)

EXAMPLE 109

5 (RS)-1-(2,2-Diethoxyethyl)-3-((N-methyl)-(N-phenyl)amino)carbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

In 50 ml of dichloromethane was dissolved 0.360 g of (RS)-1-(2,2-ethoxyethyl)-3-(hydroxycarbonylmethyl)-3-
10 (N'-(4-methylphenyl)ureido)indolin-2-one, and 0.180 g of 4-dimethylaminopyridine, 0.180 g of 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride, and 0.095 ml of N-methylaniline were successively added to the solution. The mixture was stirred for 8 hours, followed by concentration.
15 The residue was diluted with ethyl acetate and washed successively with dilute hydrochloric acid and saturated aqueous sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The crude product was purified by silica gel column
20 chromatography (hexane/ethyl acetate = 2/1) to give 0.278 g (65%) of the title compound as a white powder.

NMR (CDCl₃) δ: 7.83 (s, 1H), 7.39-6.83 (m, 12H), 6.63 (br, 2H), 4.55 (dd, J=5.4, 5.8Hz, 1H), 3.87 (dd, J=5.8, 14.2Hz, 1H), 3.75-3.28 (m, 5H), 3.24
25 (s, 3H), 2.64 (d, J=14.6Hz, 1H), 2.27 (d, J=14.6Hz, 1H), 2.24 (s, 3H), 1.06 (t, J=6.8Hz, 3H), 1.03 (t, J=6.8Hz, 3H)

EXAMPLES 110 TO 137

The following compounds were prepared in the same manner as in Example 109, except for using various amines in place of N-methylaniline used in Example 109 as a starting material.

EXAMPLE 110

(RS)-1-(2,2-Diethoxyethyl)-3-((4-methoxycarbonyl-phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

- 10 NMR (CDCl₃) δ: 9.03 (s, 1H), 7.89 (d, J=8.8Hz, 2H), 7.49 (d, J=8.8Hz, 2H), 7.48-7.26 (m, 4H), 7.26-6.82 (m, 6H), 4.76 (dd, J=4.4, 6.0Hz, 1H), 3.99 (dd, J=6.0Hz, 14.3Hz, 1H), 3.89 (s, 3H), 3.89-3.40 (m, 5H), 3.01 (d, J=15.2Hz, 1H), 2.75 (d, J=15.2Hz, 1H), 2.19 (s, 3H), 1.12 (t, J=7.0Hz, 3H), 1.09 (t, J=6.8Hz, 3H)

EXAMPLE 111

(RS)-1-(2,2-Diethoxyethyl)-3-((3-methylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

- 20 NMR (CDCl₃) δ: 8.51 (s, 1H), 7.35-6.86 (m, 14H), 4.77 (dd, J=4.4, 5.9Hz, 1H), 4.01 (dd, J=5.9, 13.7Hz, 1H), 3.85-3.40 (m, 5H), 2.98 (d, J=14.3Hz, 1H), 2.64 (d, J=14.3Hz, 1H), 2.27 (s, 3H), 2.20 (s, 3H), 1.14 (t, J=7.4Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

EXAMPLE 112

(RS)-1-(2,2-Diethoxyethyl)-3-((2-methylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

- 30 NMR (DMSO-d₆) δ: 9.43 (s, 1H), 9.04 (s, 1H), 7.56 (s, 1H), 7.34-6.80 (m, 12H), 4.77-4.65 (m, 1H),

3.86 (dd, J=5.7, 13.1Hz, 1H), 3.76-3.40
(m, 5H), 2.89 (d, J=14.3Hz, 1H), 2.62 (d,
J=14.3Hz, 1H), 2.18 (s, 3H), 2.06 (s, 3H)

EXAMPLE 113

5 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-(n-propylaminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 7.41 (s, 1H), 7.34-6.90 (m, 9H), 6.28 (br,
1H), 4.78 (dd, J=4.4Hz, 5.8Hz, 1H), 4.00
(dd, J=5.8, 13.7Hz, 1H), 3.89-3.44 (m, 5H),
10 3.17 (br, 2H), 2.83 (d, J=14.8Hz, 1H), 2.36
(d, J=14.8Hz, 1H), 2.23 (s, 3H), 1.47 (q,
J=7.4Hz, 2H), 1.18 (t, J=7.4Hz, 3H), 1.11
(t, J=7.4Hz, 3H), 0.86 (t, J=7.4Hz, 3H)

EXAMPLE 114

15 (RS)-3-((4-Chlorophenyl)aminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.79 (s, 1H), 7.40-6.80 (m, 14H), 4.74 (dd,
J=4.4, 5.4Hz, 1H), 3.98 (dd, J=5.4, 14.2Hz,
1H), 3.80-3.35 (m, 5H), 2.98 (d, J=14.6Hz,
20 1H), 2.72 (d, J=14.6Hz, 1H), 2.19 (s, 3H),
1.11 (t, J=7.4Hz, 3H), 1.09 (t, J=6.8Hz, 3H)

EXAMPLE 115

(RS)-1-(2,2-Diethoxyethyl)-3-((4-methoxyphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

25 NMR (CDCl₃) δ: 7.40-6.60 (m, 15H), 4.75 (dd, J=4.8, 5.8Hz,
1H), 3.99 (dd, J=5.8, 14.1Hz, 1H), 3.88-3.40
(m, 5H), 3.64 (s, 3H), 2.86 (d, J=15.2Hz,
1H), 2.58 (d, J=15.2Hz, 1H), 2.27 (s, 3H),
1.17 (t, J=6.8Hz, 3H), 1.13 (t, J=7.4Hz, 3H)

EXAMPLE 116

(RS)-3-((3-Ethoxycarbonylpropyl)aminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

5 NMR (CDCl₃) δ: 7.40-6.70 (m, 10H), 6.40 (br, t, J=5.7Hz, 1H), 4.78 (dd, J=4.4, 6.3Hz, 1H), 4.18-3.90 (m, 3H), 3.86-3.47 (m, 5H), 3.38-3.20 (m, 2H), 2.78 (d, J=14.2Hz, 1H), 2.37 (d, J=14.2Hz, 1H), 2.25 (s, 3H), 1.90-1.75 (m, 2H), 1.33-1.05 (m, 11H)

10 EXAMPLE 117

(RS)-1-(2,2-Diethoxyethyl)-3-(methoxyaminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

15 NMR (CDCl₃) δ: 7.33-6.80 (m, 9H), 6.68 (s, 1H), 6.62 (s, 1H), 4.76 (dd, J=4.4, 5.8Hz, 1H), 3.98 (dd, J=5.8, 14.2Hz, 1H), 3.86-3.40 (m, 5H), 3.66 (s, 3H), 2.91 (d, J=15.0Hz, 1H), 2.57 (d, J=15.0Hz, 1H), 2.28 (s, 3H), 1.17 (t, J=6.8Hz, 3H), 1.13 (t, J=6.8Hz, 3H)

EXAMPLE 118

20 (RS)-1-(2,2-Diethoxyethyl)-3-((4-methoxycarbonylmethyl-phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

25 NMR (CDCl₃) δ: 8.42 (s, 1H), 7.41 (d, J=8.4Hz, 2H), 7.28-6.80 (m, 12H), 4.78 (dd, J=3.9, 5.7Hz, 1H), 4.02 (dd, J=5.7, 14.3Hz, 1H), 3.86-3.40 (m, 5H), 3.69 (s, 3H), 3.58 (s, 2H), 2.94 (d, J=14.6Hz, 1H), 2.55 (d, J=14.6Hz, 1H), 2.23 (s, 3H), 1.16 (t, J=7.0Hz, 3H), 1.11 (t, J=6.8Hz, 3H)

EXAMPLE 119

(RS)-1-(2,2-Diethoxyethyl)-3-((2,2-diethoxyethyl)amino-carbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

5 NMR (CDCl₃) δ: 7.35-6.81 (m, 9H), 6.80 (s, 1H), 6.20 (br, 1H), 4.77 (dd, J=4.4Hz, 6.2Hz, 1H), 4.49 (t, J=4.8Hz, 1H), 4.00 (dd, J=6.2, 14.2Hz, 1H), 3.84-3.20 (m, 11H), 2.85 (d, J=14.6Hz, 1H), 2.30 (d, J=14.6Hz, 1H), 2.24 (s, 3H), 1.30-0.95 (m, 12H)

10 EXAMPLE 120

(RS)-1-(2,2-Diethoxyethyl)-3-((4-hexylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

15 NMR (CDCl₃) δ: 8.28 (s, 1H), 7.36-6.75 (m, 14H), 4.76 (dd, J=4.3, 5.7Hz, 1H), 3.99 (dd, J=5.7, 13.7Hz, 1H), 3.85-3.40 (m, 5H), 2.96 (d, J=14.3Hz, 1H), 2.59 (d, J=14.3Hz, 1H), 2.53 (t, J=7.4Hz, 2H), 2.22 (s, 3H), 1.70-1.42 (m, 2H), 1.42-0.97 (m, 12H), 0.87 (t, J=5.7Hz, 3H)

20 EXAMPLE 121

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-((4-nitrophenyl)aminocarbonylmethyl)indolin-2-one

25 NMR (CDCl₃) δ: 9.45 (s, 1H), 8.05 (d, J=9.0Hz, 2H), 7.58 (d, J=9.0Hz, 2H), 7.38-7.15 (m, 3H), 7.10-6.80 (m, 7H), 4.77 (dd, J=4.4, 5.8Hz, 1H), 4.01 (dd, J=5.8, 14.6Hz, 1H), 3.79-3.40 (m, 5H), 3.06 (d, J=15.0Hz, 1H), 2.80 (d, J=15.0Hz, 1H), 2.20 (s, 3H), 1.14 (t, J=6.8Hz, 3H), 1.10 (t, J=7.2Hz, 3H)

EXAMPLE 122

(RS)-1-(2,2-Diethoxyethyl)-3-((3,4-dimethylphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

5 NMR (CDCl₃) δ: 8.44 (s, 1H), 7.30-6.85 (m, 13H), 4.77 (dd, J=4.4, 5.7Hz, 1H), 3.99 (dd, J=5.7, 14.9Hz, 1H), 3.85-3.43 (m, 5H), 2.97 (d, J=15.2Hz, 1H), 2.60 (d, J=15.2Hz, 1H), 2.21 (s, 3H), 2.19 (s, 3H), 2.16 (s, 3H), 1.15 (t, J=6.8Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

10 EXAMPLE 123

(RS)-3-((3-Chlorophenyl)aminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

15 NMR (CDCl₃) δ: 8.64 (s, 1H), 7.58 (s, 1H), 7.35-6.84 (m, 13H), 4.76 (dd, J=4.4, 5.7Hz, 1H), 4.02 (dd, J=5.7, 13.7Hz, 1H), 3.81-3.40 (m, 5H), 2.99 (d, J=14.6Hz, 1H), 2.72 (d, J=14.6Hz, 1H), 2.21 (s, 3H), 1.14 (t, J=6.8Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

EXAMPLE 124

20 (RS)-1-(2,2-Diethoxyethyl)-3-((4-fluorophenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

25 NMR (CDCl₃) δ: 8.60 (s, 1H), 7.42-6.83 (m, 14H), 4.74 (dd, J=4.3, 5.7Hz, 1H), 3.98 (dd, J=5.7, 14.3Hz, 1H), 3.80-3.40 (m, 5H), 2.95 (d, J=14.3Hz, 1H), 2.67 (d, J=14.3Hz, 1H), 2.21 (s, 3H), 1.14 (t, J=7.2Hz, 3H), 1.10 (t, J=7.4Hz, 3H)

EXAMPLE 125

(RS)-3-((4-Aminophenyl)aminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

30 NMR (CDCl₃) δ: 8.38 (s, 1H), 7.35-6.80 (m, 12H), 6.53 (d,

J=8.2Hz, 2H), 4.76 (dd, J=4.4, 5.9Hz, 1H),
 4.01 (dd, J=5.9, 13.7Hz, 1H), 3.85-3.40
 (m, 5H), 2.91 (d, J=14.6Hz, 1H), 2.56 (d,
 J=14.6Hz, 1H), 2.20-1.70 (br, 2H), 2.19
 5 (s, 3H), 1.14 (t, J=7.0Hz, 3H), 1.09 (t,
 J=7.4Hz, 3H)

EXAMPLE 126

(RS)-3-(Benzylaminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-
(N'-(4-methylphenyl)ureido)indolin-2-one

10 NMR (CDCl₃) δ: 7.40-6.84 (m, 15H), 6.63 (t, J=5.4Hz, 1H),
 4.75 (dd, J=4.4, 5.7Hz, 1H), 4.33 (d,
 J=5.4Hz, 2H), 3.98 (dd, J=5.7Hz, 14.3Hz,
 1H), 3.84-3.39 (m, 5H), 2.86 (d, J=14.6Hz,
 1H), 2.44 (d, J=14.6Hz, 1H), 2.22 (s, 3H),
 15 1.13 (t, J=6.8Hz, 3H), 1.08 (t, J=7.4Hz, 3H)

EXAMPLE 127

(RS)-1-(2,2-Diethoxyethyl)-3-((4-hydroxyphenyl)amino-
carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 9.72 (s, 1H), 9.09 (s, 1H), 9.07 (s, 1H),
 20 8.13 (s, 1H), 7.67 (s, 1H), 7.33-6.83
 (m, 9H), 6.68 (d, J=8.8Hz, 1H), 4.81-4.69
 (m, 1H), 3.88 (dd, J=5.7, 14.3Hz, 1H),
 3.80-3.40 (m, 5H), 2.80 (d, J=14.0Hz,
 1H), 2.44 (d, J=14.0Hz, 1H), 2.19 (s,
 25 3H), 1.16 (t, J=7.4Hz, 3H), 1.11 (t,
 J=7.4Hz, 3H)

EXAMPLE 128

(RS)-1-(2,2-Diethoxyethyl)-3-((4-trifluoromethyl-
phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
 30 phenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.87 (s, 1H), 7.56 (dd, J=8.8Hz, 2H), 7.48 (d, J=8.8Hz, 2H), 7.27 (t, J=7.8Hz, 2H), 7.18-6.85 (m, 8H), 4.77 (dd, J=4.6Hz, 5.7Hz, 1H), 4.01 (dd, J=5.7, 13.1Hz, 1H), 3.83-3.45 (m, 5H), 2.99 (d, J=14.8Hz, 1H), 2.71 (d, J=14.8Hz, 1H), 2.22 (s, 3H), 1.15 (t, J=6.8Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

EXAMPLE 129

10 (RS)-1-(2,2-Diethoxyethyl)-3-((3-methoxyphenyl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.35-8.14 (m, 1H), 7.34-6.90 (m, 12H), 6.90-6.63 (m, 2H), 4.78 (dd, J=3.8, 5.7Hz, 1H), 4.02 (dd, J=5.7, 13.7Hz, 1H), 3.77 (s, 3H), 3.85-3.45 (m, 5H), 2.97 (d, J=14.2Hz, 1H), 2.54 (d, J=14.2Hz, 1H), 2.24 (s, 3H), 1.18 (t, J=6.8Hz, 3H), 1.12 (t, J=7.2Hz, 3H)

EXAMPLE 130

20 (RS)-1-(2,2-Diethoxyethyl)-3-((4-(N,N-dimethyl-amino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.31 (s, 1H), 7.33-6.85 (m, 12H), 6.61 (d, J=8.8Hz, 2H), 4.78 (dd, J=3.9, 5.7Hz, 1H), 4.00 (dd, J=5.7Hz, 14.3Hz, 1H), 3.85-3.40 (m, 5H), 2.94 (d, J=14.6Hz, 1H), 2.89 (s, 6H), 2.55 (d, J=14.6Hz, 1H), 2.22 (s, 3H), 1.16 (t, J=6.8Hz, 3H), 1.11 (t, J=7.4Hz, 3H)

EXAMPLE 131

30 (RS)-1-(2,2-Diethoxyethyl)-3-((4-(N-trifluoromethylcarbonyl-N-methylamino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.83 (s, 1H), 7.54 (d, J=8.6Hz, 2H),
 7.36-7.17 (m, 3H), 7.16-6.87 (m, 9H), 4.78
 (dd, J=4.3, 5.9Hz, 1H), 4.01 (dd, J=5.9Hz,
 14.2Hz, 1H), 3.82-3.50 (m, 5H), 3.29 (s,
 3H), 2.95 (d, J=14.8Hz, 1H), 2.66 (d,
 J=14.8Hz, 1H), 2.22 (s, 3H), 1.15 (t,
 J=6.9Hz, 3H), 1.10 (t, J=6.9Hz, 3H)

EXAMPLE 132

10 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-((2-pyrimidinyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 8.42 (d, J=5.0Hz, 2H), 7.79 (br, 1H), 7.46-
 6.80 (m, 11H), 4.84 (dd, J=4.4, 5.9Hz, 1H),
 4.04 (dd, J=5.9Hz, 14.2Hz, 1H), 3.88 (dd,
 J=4.4, 14.2Hz, 1H), 3.81-3.47 (m, 4H), 3.16
 (br, 2H), 2.20 (s, 3H), 1.18 (t, J=7.0Hz,
 3H), 1.14 (t, J=7.2Hz, 3H)

EXAMPLE 133

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-(phenylaminocarbonylmethyl)indolin-2-one

20 NMR (CDCl₃) δ: 8.49 (s, 1H), 7.42 (d, J=7.8Hz, 2H), 7.35-
 6.86 (m, 13H), 4.77 (dd, J=4.4, 5.9Hz, 1H),
 4.00 (dd, J=5.9, 14.1Hz, 1H), 3.85-3.40
 (m, 5H), 2.97 (d, J=14.6Hz, 1H), 2.64
 (d, J=14.6Hz, 1H), 2.21 (s, 3H), 1.14
 (t, J=7.3Hz, 3H), 1.10 (t, J=7.3Hz, 3H)

EXAMPLE 134

(RS)-1-(2,2-Diethoxyethyl)-3-((4-(N,N-diethyl-amino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

30 NMR (CDCl₃) δ: 8.18 (s, 1H), 7.38-6.77 (m, 12H), 6.55 (d,

J=9.4Hz, 2H), 4.78 (dd, J=4.4, 5.8Hz, 1H),
4.02 (dd, J=5.8Hz, 14.2Hz, 1H), 3.85-3.41
(m, 5H), 3.29 (q, J=6.8Hz, 4H), 2.95 (d,
J=14.6Hz, 1H), 2.53 (d, J=14.6Hz, 1H),
5 2.21 (s, 3H), 1.22-0.92 (m, 12H)

EXAMPLE 135

(RS)-1-(2,2-Diethoxyethyl)-3-((4-trifluoromethylcarbonyl-
amino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one

10 NMR (CDCl₃) δ: 8.88 (s, 1H), 8.27 (s, 1H), 7.43-7.12 (m,
7H), 7.12-6.77 (m, 7H), 4.78 (dd, J=3.9,
5.8Hz, 1H), 4.03 (dd, J=5.8Hz, 14.6Hz, 1H),
3.84-3.39 (m, 5H), 2.95 (d, J=14.8Hz, 1H),
2.72 (d, J=14.8Hz, 1H), 2.19 (s, 3H), 1.14
15 (t, J=7.0Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

EXAMPLE 136

(RS)-1-(2,2-Diethoxyethyl)-3-(((1-trifluoromethyl-
carbonyl)indolin-5-yl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one

20 NMR (CDCl₃) δ: 8.99 (s, 1H), 8.01 (d, J=8.3Hz, 1H), 7.54
(s, 1H), 7.40-6.80 (m, 11H), 4.79 (dd,
J=3.8, 5.9Hz, 1H), 4.22-3.94 (m, 3H),
3.88-3.41 (m, 5H), 3.13-2.86 (m, 3H), 2.77
(d, J=15.1Hz, 1H), 2.19 (s, 3H), 1.15 (t,
25 J=6.8Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

EXAMPLE 137

(RS)-1-(2,2-Diethoxyethyl)-3-((5-indolylamino))carbonyl-
methyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.72 (s, 1H), 8.27 (s, 1H), 7.58 (s, 1H),
30 7.46 (s, 1H), 7.33 (s, 1H), 7.24-6.72

(m, 11H), 6.32 (s, 1H), 4.79-4.67 (m, 1H),
3.99 (dd, J=5.5Hz, 14.6Hz, 1H), 3.84-3.38
(m, 5H), 2.87 (d, J=14.6Hz, 1H), 2.49 (d,
J=14.6Hz, 1H), 2.13 (s, 3H), 1.08 (t,
5 J=6.8Hz, 3H), 1.05 (t, J=6.8Hz, 3H)

EXAMPLE 138

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-
((5-methylpyrido-2-yl)aminocarbonylmethyl)indolin-2-one

To a solution of 0.223 g of (RS)-1-(2,2-
10 diethoxyethyl)-3-(hydroxycarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one in 15 ml of dichloromethane were
added successively 0.140 g of 4-dimethylaminopyridine and
0.040 ml of thionyl chloride at 0°C, followed by stirring
at 0°C for 30 minutes. To the mixture were further added
15 0.070 g of 4-dimethylaminopyridine and 0.130 g of 6-amino-3-
picoline at 0°C. The resulting mixture was stirred at room
temperature for 1 hour, and then washed with an aqueous
solution of sodium chloride. The organic layer was dried
over anhydrous sodium sulfate and concentrated. The crude
20 product was purified by silica gel column chromatography
(hexane/ethyl acetate = 2/1) to give 0.169 g (73%) of the
title compound.

NMR (CDCl₃) δ: 9.01 (s, 1H), 7.98 (d, J=8.8Hz, 1H), 7.93
(s, 1H), 7.46 (dd, J=2.6, 8.8Hz, 1H), 7.30-
25 6.87 (m, 10H), 4.77 (dd, J=4.4, 6.2Hz, 1H),
3.97 (dd, J=6.2, 14.2Hz, 1H), 3.87-3.42
(m, 5H), 3.06 (d, J=14.2Hz, 1H), 2.57 (d,
J=14.2Hz, 1H), 2.25 (s, 3H), 2.23 (s, 3H),

1.14 (t, J=7.4Hz, 3H), 1.11 (t, J=7.2Hz, 3H)

EXAMPLES 139 TO 145

The following compounds were prepared in the same manner as in Example 138, except for using various amines in place of 6-amino-3-picoline used in Example 138.

EXAMPLE 139

(RS)-3-((2-Chlorophenyl)aminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.15 (d, J=8.0Hz, 1H), 7.89 (s, 1H), 7.35-6.85 (m, 13H), 4.78 (dd, J=4.4, 5.8Hz, 1H), 4.02 (dd, J=5.8Hz, 14.3Hz, 1H), 3.85-3.40 (m, 5H), 3.10 (d, J=14.6Hz, 1H), 2.62 (d, J=14.6Hz, 1H), 2.24 (s, 3H), 1.14 (t, J=7.0Hz, 3H), 1.12 (t, J=7.2Hz, 3H)

EXAMPLE 140

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-((4-pyridylamino)carbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 9.68 (s, 1H), 8.32 (d, J=5.8Hz, 2H), 7.73 (s, 1H), 7.45-6.80 (m, 11H), 4.77 (dd, J=4.6, 5.7Hz, 1H), 4.02 (dd, J=5.7Hz, 14.3Hz, 1H), 3.85-3.40 (m, 5H), 2.99 (d, J=15.0Hz, 1H), 2.74 (d, J=15.0Hz, 1H), 2.20 (s, 3H), 1.14 (t, J=7.0Hz, 3H), 1.10 (t, J=7.4Hz, 3H)

EXAMPLE 141

(RS)-1-(2,2-Diethoxyethyl)-3-((2-methoxyphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.22 (dd, J=1.4Hz, 7.8Hz, 1H), 7.88 (s, 1H), 7.40-6.75 (m, 13H), 4.78 (dd, J=4.4, 5.8Hz,

1H), 4.03 (dd, J=5.8Hz, 13.7Hz, 1H),
 3.74 (s, 3H), 3.90-3.43 (m, 5H), 3.12 (d,
 J=14.6Hz, 1H), 2.53 (d, J=14.6Hz, 1H), 2.21
 (s, 3H), 1.15 (t, J=7.4Hz, 3H), 1.12 (t,
 J=6.8Hz, 3H)

5

EXAMPLE 142

(RS)-1-(2,2-Diethoxyethyl)-3-((2-hydroxy-4-methyl-phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

10 NMR (CDCl₃) δ: 8.57 (s, 1H), 8.65-8.20 (br, 1H), 7.32-7.15
 (m, 3H), 7.15-6.79 (m, 8H), 6.73 (s, 1H),
 6.57 (d, J=8.4Hz, 1H), 4.73 (dd, J=4.9,
 5.7Hz, 1H), 4.01 (dd, J=5.7, 14.3Hz, 1H),
 3.80-3.43 (m, 5H), 2.87 (d, J=14.3Hz, 1H),
 15 2.72 (d, J=14.3Hz, 1H), 2.21 (s, 3H), 2.19
 (s, 3H), 1.11 (t, J=6.8Hz, 3H), 1.08 (t,
 J=7.4Hz, 3H)

EXAMPLE 143

20 (RS)-1-(2,2-Diethoxyethyl)-3-((2-methoxypyrido-5-yl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.61 (s, 1H), 8.11 (d, J=2.4Hz, 1H), 7.65
 (dd, J=3.0Hz, 8.8Hz, 1H), 7.35-6.79 (m,
 10H), 6.61 (d, J=8.8Hz, 1H), 4.76 (dd,
 J=3.0, 5.7Hz, 1H), 4.00 (dd, J=5.7Hz,
 14.3Hz, 1H), 3.87 (s, 3H), 3.87-3.38
 25 (m, 5H), 2.96 (d, J=14.3Hz, 1H), 2.68
 (d, J=14.3Hz, 1H), 2.20 (s, 3H), 1.13
 (t, J=7.2Hz, 3H), 1.09 (t, J=7.0Hz, 3H)

EXAMPLE 144

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-((2-pyridyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 8.97 (brs, 1H), 8.14 (d, J=4.9Hz, 1H), 8.08
5 (d, J=7.9Hz, 1H), 7.65 (t, J=7.3Hz, 1H),
7.35-6.85 (m, 11H), 4.77 (dd, J=4.3, 5.9Hz,
1H), 3.99 (dd, J=5.9Hz, 14.2Hz, 1H), 3.90-
3.47 (m, 5H), 3.10 (d, J=14.8Hz, 1H), 2.61
(d, J=14.8Hz, 1H), 2.23 (s, 3H), 1.14 (t,
10 J=6.9Hz, 3H), 1.11 (t, J=7.3Hz, 3H)

EXAMPLE 145

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-((3-pyridyl)aminocarbonylmethyl)indolin-2-one

NMR (CDCl₃) δ: 9.21 (s, 1H), 8.61 (d, J=2.6Hz, 1H), 8.26
15 (d, J=4.6Hz, 1H), 7.90 (d, J=7.9Hz, 1H),
7.64 (s, 1H), 7.38-6.94 (m, 10H), 4.77
(dd, J=4.3, 5.9Hz, 1H), 4.03 (dd, J=5.9Hz,
14.5Hz, 1H), 3.85-3.45 (m, 5H), 3.01 (d,
J=14.8Hz, 1H), 2.74 (d, J=14.8Hz, 1H), 2.20
20 (s, 3H), 1.13 (t, J=6.9Hz, 3H), 1.09 (t,
J=7.3Hz, 3H)

EXAMPLE 146

(RS)-3-(Ethoxycarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

25 The title compound was prepared in the same manner
as in Example 107, except for starting with (RS)-1-(2,2-
diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one
in place of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one used in Example 107.

NMR (CDCl₃) δ: 7.32-6.90 (m, 9H), 6.56 (dd, J=1.8, 8.2Hz, 1H), 4.79-4.75 (m, 1H), 4.11 (q, J=6.3Hz, 2H), 4.01 (dd, J=6.0, 14.2Hz, 1H), 3.82-3.65 (m, 5H), 3.73 (s, 3H), 2.93 (d, J=15.2Hz, 1H), 2.55 (d, J=15.2Hz, 1H), 1.20-1.05 (m, 9H)

EXAMPLE 147

(RS)-1-(2,2-Diethoxyethyl)-3-(hydroxycarbonylmethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

The title compound was prepared in the same manner as in Example 108, except for starting with (RS)-3-(ethoxycarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one in place of (RS)-3-(ethoxycarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one as used in Example 108.

NMR (CDCl₃) δ: 7.85 (s, 1H), 7.29-7.20 (m, 3H), 7.06-6.92 (m, 5H), 6.69 (d, J=8.9Hz, 1H), 6.48 (dd, J=2.2, 8.3Hz, 1H), 4.77-4.74 (m, 1H), 4.04 (dd, J=6.1, 14.5Hz, 1H), 3.79-3.49 (m, 5H), 3.61 (s, 3H), 2.90 (d, 15.8Hz, 1H), 2.70 (d, 15.8Hz, 1H), 1.17-1.08 (m, 6H)

EXAMPLE 148

(RS)-1-(2,2-Diethoxyethyl)-3-((4-methoxyphenyl)amino-carbonylmethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

To a solution of 0.50 g of (RS)-1-(2,2-diethoxyethyl)-3-(hydroxycarbonylmethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one in 50 ml of dichloromethane were added successively 0.140 g of 4-dimethylaminopyridine and 0.090 ml of thionyl chloride at 0°C, followed by stirring

at 0°C for 30 minutes. To the mixture were further added 0.140 g of 4-dimethylaminopyridine and 0.190 g of 4-methoxyaniline at 0°C. The resulting mixture was stirred at room temperature for 1 hour, and then washed with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate and concentrated. The crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to give 0.54 g (88%) of the title compound.

10 Rf = 0.76 (dichloromethane/methanol = 10/1)

NMR (CDCl₃) δ: 8.51 (s, 1H), 7.45-6.44 (m, 14H), 4.78 (dd, J=4.4, 5.9Hz, 1H), 3.98 (dd, J=5.9, 14.2Hz, 1H), 3.84-3.47 (m, 5H), 3.74 (s, 3H), 3.63 (s, 3H), 2.97 (d, J=14.8Hz, 1H), 2.63 (d, J=14.8Hz, 1H), 1.15 (t, J=6.9Hz, 3H), 1.09 (t, J=6.9Hz, 3H)

15

EXAMPLES 149 TO 158

The following compounds were prepared in the same manner as in Example 148, except for using various amines in place of 4-methoxyaniline used in Example 148.

20

EXAMPLE 149

(RS)-3-((4-Chlorophenyl)aminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

Rf = 0.76 (dichloromethane/methanol = 10/1)

25 NMR (CDCl₃) δ: 8.80 (s, 1H), 7.55 (s, 1H), 7.33-6.90 (m, 11H), 6.67 (d, J=9.2Hz, 1H), 6.45 (dd, J=2.0, 8.2Hz, 1H), 4.76 (dd, J=4.0, 5.6Hz, 1H), 3.99 (dd, J=5.6, 14.2Hz, 1H), 3.79-3.49

(m, 5H), 3.61 (s, 3H), 2.99 (d, J=14.8Hz, 1H), 2.71 (d, J=14.8Hz, 1H), 1.13 (t, J=6.9Hz, 3H), 1.09 (t, J=6.9Hz, 3H)

EXAMPLE 150

5 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((2-methylphenyl)aminocarbonylmethyl)indolin-2-one

Rf = 0.25 (dichloromethane/methanol = 100/3)

10 NMR (CDCl₃) δ: 8.85 (s, 1H), 7.76 (s, 1H), 7.46-7.43 (m, 1H), 7.25-6.95 (m, 10H), 6.69 (d, J=7.9Hz, 1H), 6.44 (d, J=8.3Hz, 1H), 4.75 (dd, J=4.3, 5.9Hz, 1H), 3.97 (dd, J=5.9, 14.5Hz, 1H), 3.81-3.44 (m, 5H), 3.61 (s, 3H), 3.00 (d, J=14.9Hz, 1H), 2.75 (d, J=14.9Hz, 1H), 2.14 (s, 3H), 1.10 (t, J=6.6Hz, 3H), 1.07 (t, J=6.6Hz, 3H)

15

EXAMPLE 151

(RS)-1-(2,2-Diethoxyethyl)-3-((3-methoxyphenyl)amino-carbonylmethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

Rf = 0.06 (dichloromethane/methanol = 100/3)

20 NMR (CDCl₃) δ: 8.72 (s, 1H), 7.62 (s, 1H), 7.30-6.92 (m, 10H), 6.69 (d, J=9.2Hz, 1H), 6.61 (dd, J=2.3, 8.2Hz, 1H), 6.43 (dd, J=2.3, 7.9Hz, 1H), 4.75 (dd, J=4.3, 5.9Hz, 1H), 3.94 (dd, J=5.9, 14.2Hz, 1H), 3.80-3.43 (m, 5H), 3.67 (s, 3H), 3.59 (s, 3H), 3.00 (d, J=14.9Hz, 1H), 2.69 (d, J=14.9Hz, 1H), 1.12 (t, J=6.9Hz, 3H), 1.07 (t, J=6.9Hz, 3H)

25

EXAMPLE 152

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((3-methylphenyl)aminocarbonylmethyl)indolin-2-one

Rf = 0.25 (dichloromethane/methanol = 100/3)

5 NMR (CDCl₃) δ: 8.66 (s, 1H), 7.57 (s, 1H), 7.28-6.87
(m, 11H), 6.68 (d, J=7.9Hz, 1H), 6.44 (d,
J=8.2Hz, 1H), 4.76 (dd, J=4.3, 5.9Hz, 1H),
3.96 (dd, J=5.9, 14.5Hz, 1H), 3.81-3.42 (m,
5H), 3.60 (s, 3H), 3.00 (d, J=14.9Hz, 1H),
10 2.69 (d, J=14.9Hz, 1H), 2.22 (s, 3H), 1.13
(t, J=6.9Hz, 3H), 1.08 (t, J=6.9Hz, 3H)

EXAMPLE 153

(RS)-1-(2,2-Diethoxyethyl)-3-((2-methoxyphenyl)amino-
carbonylmethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

15 Rf = 0.10 (dichloromethane/methanol = 100/3)

NMR (CDCl₃) δ: 8.20 (d, J=7.9Hz, 1H), 7.90 (s, 1H), 7.73
(s, 1H), 7.42 (s, 1H), 7.30 (d, J=7.3Hz,
1H), 7.22 (t, J=8.2Hz, 1H), 7.09-6.71 (m,
8H), 6.44 (d, J=6.6Hz, 1H), 4.78 (dd, J=4.3,
5.9Hz, 1H), 4.00 (dd, J=5.9, 14.2Hz, 1H),
20 3.83-3.49 (m, 5H), 3.70 (s, 3H), 3.60
(s, 3H), 3.17 (d, J=14.5Hz, 1H), 2.57
(d, J=14.5Hz, 1H), 1.14 (t, J=6.9Hz, 3H),
1.10 (t, J=6.9Hz, 3H)

25 EXAMPLE 154

(RS)-1-(2,2-Diethoxyethyl)-3-((4-fluorophenyl)aminocarbonyl-
methyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

Rf = 0.16 (dichloromethane/methanol = 100/3)

NMR (CDCl₃) δ: 8.70 (s, 1H), 7.65 (s, 1H), 7.31-6.84

(m, 11H), 6.68 (d, J=7.9Hz, 1H), 6.44 (d, J=6.6Hz, 1H), 4.75 (dd, J=4.3, 5.6Hz, 1H), 3.96 (dd, J=5.6, 14.2Hz, 1H), 3.80-3.45 (m, 5H), 3.59 (s, 3H), 3.00 (d, J=14.9Hz, 1H),
5 2.73 (d, J=14.9Hz, 1H), 1.11 (t, J=6.9Hz, 3H), 1.07 (t, J=6.9Hz, 3H)

EXAMPLE 155

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-(n-propylaminocarbonylmethyl)indolin-2-one

10 R_f = 0.09 (dichloromethane/methanol = 100/3)

NMR (CDCl₃) δ: 7.84 (s, 1H), 7.44 (s, 1H), 7.31-6.96 (m, 6H), 6.76 (d, J=8.6Hz, 1H), 6.55 (t, J=5.6Hz, 1H), 6.44 (dd, J=2.3, 8.3Hz, 1H), 4.79 (dd, J=4.3, 6.3Hz, 1H), 3.98 (dd, J=6.3, 14.2Hz, 1H), 3.86-3.50 (m, 5H),
15 3.63 (s, 3H), 3.17-3.06 (m, 2H), 2.89 (d, J=14.5Hz, 1H), 2.50 (d, J=14.5Hz, 1H), 1.40 (m, 2H), 1.17 (t, J=7.3Hz, 3H), 1.09 (t, J=6.9Hz, 3H), 0.81 (t, J=7.3Hz, 3H)

20 EXAMPLE 156

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((4-(N,N'-dimethylaminophenyl)aminocarbonylmethyl)indolin-2-one

R_f = 0.21 (dichloromethane/methanol = 100/3)

25 NMR (CDCl₃) δ: 8.58 (s, 1H), 7.78 (s, 1H), 7.37 (s, 1H), 7.26-6.90 (m, 8H), 6.67 (d, J=7.9Hz, 1H), 6.54 (d, J=8.9Hz, 2H), 6.41 (d, J=9.9Hz, 1H), 4.79-4.73 (m, 1H), 3.96 (dd, J=5.9, 14.2Hz, 1H), 3.84-3.45 (m, 5H), 3.58 (s,

3H), 2.97 (d, J=14.5Hz, 1H), 2.83 (s, 6H),
2.65 (d, J=14.5Hz, 1H), 1.12 (t, J=6.9Hz,
3H), 1.07 (t, J=6.9Hz, 3H)

EXAMPLE 157

5 (RS)-1-(2,2-Diethoxyethyl)-3-((4-methoxycarbonyl-
phenyl)aminocarbonylmethyl)-3-(N'-(3-methoxy-
phenyl)ureido)indolin-2-one

Rf = 0.27 (dichloromethane/methanol = 100/3)

10 NMR (CDCl₃) δ: 9.10 (s, 1H), 7.88 (s, 1H), 7.83 (d,
J=8.6Hz, 2H), 7.46 (d, J=8.6Hz, 2H), 7.32-
7.17 (m, 3H), 7.01-6.90 (m, 4H), 6.68 (d,
J=7.9Hz, 1H), 6.42 (dd, J=2.3, 8.3Hz, 1H),
4.75 (dd, J=4.3, 5.9Hz, 1H), 3.95 (dd,
J=5.9, 14.2Hz, 1H), 3.85 (s, 3H), 3.80-3.44
15 (m, 5H), 3.56 (s, 3H), 3.05 (d, J=15.2Hz,
1H), 2.74 (d, J=15.2Hz, 1H), 1.09 (t,
J=6.9Hz, 3H), 1.06 (t, J=6.9Hz, 3H)

EXAMPLE 158

20 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-
((5-methylpyrido-2-yl)aminocarbonylmethyl)indolin-2-one

Rf = 0.24 (dichloromethane/methanol = 100/3)

25 NMR (CDCl₃) δ: 9.48 (s, 1H), 7.93 (d, J=8.3Hz, 1H), 7.79
(s, 1H), 7.73 (s, 1H), 7.41-6.90 (m, 8H),
6.71 (d, J=7.9Hz, 1H), 6.46 (d, J=8.3Hz,
1H), 4.78-4.75 (m, 1H), 3.90 (br, 2H),
3.72-3.45 (m, 4H), 3.62 (s, 3H), 3.10 (d,
J=14.5Hz, 1H), 2.61 (d, J=14.5Hz, 1H), 2.21
(s, 3H), 1.13 (t, 7.3Hz, 3H), 1.07 (t,
7.3Hz, 3H)

EXAMPLE 159

(RS)-1-(Formylmethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

To a solution of 1.61 g of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one in 40 ml of acetone were added 10 ml of water and 1 ml of concentrated hydrochloric acid, and the mixture was heated under reflux for 2 hours. The reaction mixture was poured into water, and the thus formed precipitate was collected by filtration and washed with ethyl ether to obtain 1.11 g (79%) of the title compound.

NMR (DMSO- d_6) δ : 10.06 (s, 1H), 9.66 (s, 1H), 9.32 (s, 1H), 7.75 (s, 1H), 7.44 (d, J=8.3Hz, 2H), 7.28-6.82 (m, 8H), 6.82 (d, J=8.3Hz, 1H), 6.44 (dd, J=2.0, 7.8Hz, 1H), 4.77 (d, J=18.5Hz, 1H), 4.60 (d, J=18.5Hz, 1H), 3.66 (s, 3H), 2.89 (d, J=14.6Hz, 1H), 2.60 (d, J=14.1Hz, 1H), 2.26 (s, 3H)

EXAMPLE 160

(RS)-3-(N'-(3-Methoxyphenyl)ureido)-1-(2-(N,N-dimethylamino)ethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

To a solution of 0.386 g of (RS)-1-(formylmethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one in 50 ml of methanol was added 0.8 g of dimethylamine hydrochloride at room temperature, and 1.0 g of sodium cyanoborohydride was then added thereto. The mixture was stirred at room temperature for 1 day,

followed by concentration. The concentrate was diluted with dichloromethane and washed with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate and concentrated. The crude
5 product was washed with dichloromethane to afford 0.107 g (26%) of the title compound.

NMR (CDCl₃) δ: 10.21 (s, 1H), 9.26 (s, 1H), 7.62 (s, 1H),
7.32-6.84 (m, 10H), 6.79 (d, J=8.3Hz, 1H),
6.44 (dd, J=1.9, 7.8Hz, 1H), 3.94-3.59 (m,
10 2H), 3.65 (s, 3H), 2.82 (d, J=14.6Hz, 1H),
2.62-2.08 (m, 3H), 2.25 (s, 9H)

EXAMPLE 161

(RS)-1-(2,2-Diethoxyethyl)-3-((4-(N-methyl-
15 amino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-
phenyl)ureido)indolin-2-one

To a solution of 0.475 g of (RS)-1-(2,2-diethoxyethyl)-3-((4-trifluoromethylcarbonyl-N-methyl-amino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one in 50 ml of methanol was
20 added 10 ml of an aqueous solution of 0.50 g of potassium carbonate at room temperature, and the mixture was stirred for 1 day, followed by concentration. The residue was diluted with water and extracted with dichloromethane. The organic layer was dried over anhydrous sodium sulfate and
25 concentrated. The crude product was recrystallized from chloroform to afford 0.26 g (65%) of the title compound.

NMR (DMSO-d₆) δ: 9.67 (s, 1H), 9.16 (s, 1H), 7.68 (s, 1H),
7.27-7.06 (m, 7H), 6.98-6.89 (m, 3H),
6.47 (d, J=8.8Hz, 2H), 5.49 (q, J=5.9Hz,

1H), 4.76-4.67 (m, 1H), 3.86 (dd, J=5.6, 13.8Hz, 1H), 3.76-3.46 (m, 5H), 2.76 (d, J=14.2Hz, 1H), 2.64 (d, J=5.9Hz, 3H), 2.41 (d, J=14.2Hz, 1H), 2.17 (s, 3H), 1.12 (t, J=6.9Hz, 3H), 1.07 (t, J=5.0Hz, 3H)

EXAMPLE 162

(RS)-1-(2,2-Diethoxyethyl)-3-((5-indolinyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

10 The title compound was prepared in the same manner as in Example 161, except for starting with (RS)-1-(2,2-diethoxyethyl)-3-(((1-trifluoromethylcarbonyl)indolin-5-yl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one in place of (RS)-1-
15 (2,2-diethoxyethyl)-3-((4-(N-trifluoromethylcarbonyl-N-methylamino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one used in Example 161.
NMR (DMSO-d₆) δ: 9.67 (s, 1H), 9.15 (s, 1H), 7.68 (s, 1H), 7.36-6.86 (m, 10H), 6.41 (d, J=8.6Hz, 1H), 5.35 (s, 1H), 4.77-4.67 (m, 1H),
20 3.85 (dd, J=5.9, 14.2Hz, 1H), 3.76-3.24 (m, 7H), 2.87 (t, J=8.3Hz, 2H), 2.75 (d, J=14.2Hz, 1H), 2.41 (d, J=14.2Hz, 1H), 2.17 (s, 3H), 1.11 (t, J=6.9Hz, 3H),
25 1.07 (t, J=6.9Hz, 3H)

EXAMPLE 163

(RS)-1-(2,2-Diethoxyethyl)-3-((4-hydroxycarbonylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 0.588 g of (RS)-1-(2,2-diethoxyethyl)-3-((4-methoxycarbonylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 30 ml of methanol was added 5 ml of an aqueous solution of 0.20 g of potassium hydroxide (85%) at room temperature. The mixture was stirred for 1 day, followed by concentration. The concentrate was diluted with water, and washed with chloroform. The aqueous layer was adjusted to pH 2 with 2N hydrochloric acid and extracted with ethyl acetate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The resulting crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 1/1) to give 0.56 g (98%) of the title compound.

NMR (DMSO-d₆) δ: 12.95-12.45 (br, 1H), 10.33 (s, 1H), 9.05 (s, 1H), 7.89 (d, J=8.4Hz, 2H), 7.64 (d, J=8.4Hz, 2H), 7.48 (s, 1H), 7.30-6.83 (m, 8H), 4.76-4.66 (m, 1H), 3.86 (dd, J=5.7, 13.7Hz, 1H), 3.78-3.40 (m, 5H), 2.94 (d, J=14.6Hz, 1H), 2.58 (d, J=14.6Hz, 1H), 2.18 (s, 3H), 1.11 (t, J=6.8Hz, 3H), 1.08 (t, J=6.8Hz, 3H)

EXAMPLE 164

(RS)-1-(2,2-Diethoxyethyl)-3-((4-hydroxycarbonylmethylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The title compound was prepared in the same manner as in Example 163, except for starting with (RS)-1-(2,2-diethoxyethyl)-3-((4-methoxycarbonylmethylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-

one in place of (RS)-1-(2,2-diethoxyethyl)-3-((4-methoxycarbonylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one used in Example 163.

NMR (CDCl₃) δ: 8.73 (s, 1H), 7.55-7.37 (br, 1H), 7.32-6.77
5 (m, 14H), 4.85-4.74 (m, 1H), 4.08 (dd,
J=5.7, 14.3Hz, 1H), 3.85-3.35 (m, 7H), 2.95
(d, J=15.2Hz, 1H), 2.64 (d, J=15.2Hz, 1H),
2.17 (s, 3H), 1.15 (t, J=6.4Hz, 3H), 1.11
(t, J=6.8Hz, 3H)

10 EXAMPLE 165

(RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-hydroxycarbonylphenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

The title compound was prepared in the same
15 manner as in Example 163, except for starting with (RS)-3-(N'-(4-ethoxycarbonylphenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one in place of (RS)-1-(2,2-diethoxyethyl)-3-((4-methoxycarbonylphenyl)aminocarbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one used in Example 163.
20

R_f = 0.05 (n-hexane/ethyl acetate = 1/1)

NMR (DMSO-d₆) δ: 9.97 (s, 1H), 9.64 (s, 1H), 7.84 (s, 1H),
7.75 (d, J=8.3Hz, 2H), 7.44-6.89 (m,
11H), 4.75 (dd, J=4.0, 5.4Hz, 1H), 3.88
25 (dd, J=5.4, 13.2Hz, 1H), 3.74-3.22 (m,
5H), 2.86 (d, J=15.1Hz, 1H), 2.51 (d,
J=15.1Hz, 1H), 2.27 (s, 3H), 1.14 (t,
J=7.3Hz, 3H), 1.10 (t, J=7.3Hz, 3H)

EXAMPLE 166

(RS)-3-(N'-(4-Aminophenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

A suspension of 0.62 g of (RS)-1-(2,2-diethoxy-
5 ethyl)-3-((4-methylphenyl)aminocarbonylmethyl)-3-(N'-(4-nitrophenyl)ureido)indolin-2-one and 20 mg of 5% Pd/C in 100 ml of ethanol was stirred at room temperature for 12 hours under a hydrogen atmosphere. The reaction mixture was filtered through Cerite, and the filtrate was
10 concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 1/1) to give 0.33 g (57%) of the title compound.

NMR (CDCl₃) δ: 8.31 (s, 1H), 7.33-6.94 (m, 11H), 6.62 (s, 1H), 6.50 (d, J=8.3Hz, 2H), 4.75 (dd, J=4.4, 5.9Hz, 1H), 4.00 (dd, J=5.9, 14.1Hz, 1H),
15 3.79-3.52 (m, 7H), 2.92 (d, J=14.6Hz, 1H), 2.51 (d, J=14.6Hz, 1H), 2.30 (s, 3H), 1.16 (t, J=7.3Hz, 3H), 1.10 (t, J=7.3Hz, 3H)

EXAMPLE 167

20 (RS)-1-(2,2-Diethoxyethyl)-3-(N'-(4-dimethylamino-phenyl)ureido)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one

To a solution of 0.148 g of (RS)-3-(N'-(4-aminophenyl)ureido)-1-(2,2-diethoxyethyl)-3-((4-methylphenyl)aminocarbonylmethyl)indolin-2-one in 20 ml
25 of methanol were added successively 0.1 ml of a formalin aqueous solution and 0.104 g of sodium cyanoborohydride. The mixture was neutralized with 2N hydrochloric acid, and Molecular Sieves 4A was added thereto, followed by stirring

at room temperature for 3 hours. The reaction mixture was filtered through Cerite, and the filtrate was concentrated. The concentrate was diluted with ethyl acetate and washed with a saturated aqueous sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The resulting crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 1/1) to give 0.120 g (77%) of the title compound.

Rf = 0.11 (hexane/ethyl acetate = 1/1)

10 NMR (CDCl₃) δ: 8.32 (s, 1H), 7.35-6.54 (m, 13H), 6.41 (s, 1H), 4.76 (dd, J=3.9, 6.3Hz, 1H), 3.99 (dd, J=6.3, 13.7Hz, 1H), 3.81-3.53 (m, 5H), 2.91 (d, J=15.1Hz, 1H), 2.89 (s, 6H), 2.51 (d, J=15.1Hz, 1H), 2.31 (s, 3H), 1.16 (t, J=6.3Hz, 3H), 1.11 (t, J=6.3Hz, 3H)

EXAMPLES 168 TO 170

The following compounds were prepared in the same manner as in Example 71, except for using (RS)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one, used in Example 71, with the (4-methylphenyl)ureido moiety replaced with various substituted ureides as a starting material and replacing N-p-tolyl-2-bromoacetamide used in Example 71 with various bromoacetamide derivatives as a reactant.

25 EXAMPLE 168

(RS)-3-((4-Chlorophenyl)aminocarbonylmethyl)-3-(N'-(4-chlorophenyl)ureido)-1-(2,2-diethoxyethyl)indolin-2-one

Rf = 0.29 (n-hexane/ethyl acetate = 1/1)

NMR (CDCl₃) δ: 8.51 (s, 1H), 7.44-7.00 (m, 14H), 4.78 (dd, J=4.9, 5.4Hz, 1H), 4.04 (dd, J=5.4, 14.2Hz, 1H), 3.83-3.48 (m, 5H), 2.99 (d, J=14.6Hz, 1H), 2.68 (d, J=14.6Hz, 1H), 2.00-1.08 (m, 6H)

EXAMPLE 169

(RS)-3-((4-Chlorophenyl)aminocarbonylmethyl)-1-(2,2-diethoxyethyl)-3-(N'-(4-methoxyphenyl)ureido)indolin-2-one

NMR (DMSO-d₆) δ: 10.14 (s, 1H), 8.98 (s, 1H), 7.57-6.70 (m, 13H), 4.72 (dd, J=4.3, 5.9Hz, 1H), 3.84 (dd, J=5.9, 14.4Hz, 1H), 3.71-3.50 (m, 5H), 3.66 (s, 3H), 2.88 (d, J=14.8Hz, 1H), 2.52 (d, J=14.8Hz, 1H), 1.11 (t, J=7.8Hz, 3H), 1.08 (t, J=7.3Hz, 3H)

15 EXAMPLE 170

(RS)-1-(2,2-Diethoxyethyl)-3-((4-fluorophenyl)aminocarbonylmethyl)-3-(N'-(4-fluorophenyl)ureido)indolin-2-one

NMR (CDCl₃) δ: 8.40 (s, 1H), 7.42-6.78 (m, 14H), 4.78 (dd, J=4.3, 5.9Hz, 1H), 4.02 (dd, J=5.9, 14.5Hz, 1H), 3.81-3.52 (m, 5H), 2.98 (d, J=14.5Hz, 1H), 2.63 (d, J=14.5Hz, 1H), 1.17 (t, J=6.9Hz, 3H), 1.12 (t, J=6.9Hz, 3H)

REFERENCE EXAMPLE 26

L-Menthyl Bromoacetate and D-Menthyl Bromoacetate

25 To a solution of 83.4 g of bromoacetic acid and 78.1 g of L- (or D-)menthol in 1 l of toluene was added 300 mg of p-toluenesulfonic acid, and the mixture was refluxed for 6 hours while azeotropically removing produced water together with toluene. The reaction mixture was

washed with saturated aqueous sodium hydrogencarbonate, and the organic layer was dried over anhydrous sodium sulfate and concentrated. The residue was distilled under reduced pressure to obtain 128 g (93%) of the titled compound.

- 5 NMR (CDCl₃) δ: 4.73 (dt, J=5, 10Hz, 1H), 3.79 (s, 2H),
2.20-0.80 (m, 9H), 0.89 (d, J=7Hz, 6H),
0.79 (d, J=7Hz, 3H)

EXAMPLE 171

- 10 3-(RS)-1-(2,2-Diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one and Single Diastereomer of 1-(2,2-Diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one (HPLC second fraction)

- 15 3-(RS)-1-(2,2-Diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one was prepared in the same manner as in Example 71, except for using L-menthyl bromoacetate as a reactant in place of N-p-tolyl-2-bromoacetamide used in Example 71. The product was analyzed by high performance liquid chromatography.

- 20 HPLC Conditions:

Column: YMC-Pack CN A-514 (6.0 mm (diameter) x 30 cm)

Developing solvent: hexane/isopropyl alcohol = 100/1

Flow rate: 1.0 ml/min

Detection: UV 254 nm

- 25 First fraction: 53 parts (retention time = 38 min)

Second fraction: 47 parts (retention time = 42 min)

- 30 The diastereomeric mixture was recrystallized twice from diisopropyl ether to give a single diastereomer of 1-(2,2-diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one as needles.

NMR (CDCl₃) δ: 7.33-7.18 (m, 3H), 7.18-6.91 (m, 5H),
6.87 (s, 2H), 4.76 (dd, J=4.4, 5.5Hz, 1H),
4.69 (dt, J=3.8, 10.8Hz, 1H), 3.97 (dd,
J=5.5, 13.1Hz, 1H), 3.88-3.45 (m, 5H), 2.96
5 (d, J=13.2Hz, 1H), 2.51 (d, J=13.2Hz, 1H),
2.26 (s, 3H), 1.88-0.99 (m, 9H), 1.16 (t,
J=7.0Hz, 3H), 1.12 (t, J=7.4Hz, 3H), 0.88
(d, J=6.2Hz, 3H), 0.78 (d, J=7.4Hz, 3H),
0.70 (d, J=6.8Hz, 3H)

10 The product was analyzed by high performance liquid
chromatography.

HPLC Conditions:

Column: YMC-Pack CN A-514 (6.0 mm (diameter) x 30 cm)
Developing solvent: hexane/isopropyl alcohol = 100/1
15 Flow rate: 1.0 ml/min
Detection: UV 254 nm
Fraction : retention time = 42 min

EXAMPLE 172

20 Single Diastereomer of 1-(2,2-Diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one (HPLC first fraction)

To a solution of 10.4 g of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 500 ml of dry tetrahydrofuran was added slowly 52.5 ml of a 0.5M
25 solution of lithium t-butoxide (prepared from n-butyl lithium and t-butanol) in dry tetrahydrofuran at room temperature under a nitrogen atmosphere, and the mixture was stirred at that temperature for 30 minutes. To the mixture was added dropwise a solution of 8.10 g of L-menthyl

bromoacetate in 30 ml of dry tetrahydrofuran at 0°C, followed by stirring at 0°C for 8 hours. The reaction mixture was poured into an aqueous solution of sodium chloride and extracted with ethyl acetate. The organic
5 layer was dried over anhydrous sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 3/1) and then recrystallized from methanolic water to afford 7.55 g (48%) of the title compound.

10 HPLC Conditions:

Column: YMC-Pack CN A-514 (6.0 mm (diameter) x 30 cm)

Developing solvent: hexane/isopropyl alcohol = 100/1

Flow rate: 1.0 ml/min

Detection: UV 254 nm

15 Fraction: retention time = 38 min

R_f = 0.44 (hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ: 7.41-6.91 (m, 8H), 6.88 (s, 1H), 6.73 (s, 1H), 4.75 (dd, J=4.6, 5.7Hz, 1H), 4.64 (dt, J=4.1, 11.1Hz, 1H), 3.95 (dd, J=5.7, 14.6Hz, 1H), 3.89-3.45 (m, 5H), 3.03 (d, J=15.1Hz, 1H), 2.61 (d, J=15.1Hz, 1H), 2.26 (s, 3H), 1.98-1.80 (br, 1H), 1.80-1.55 (br, 3H), 1.55-1.30 (br, 1H), 1.30-0.75 (br, 4H), 1.17 (t, J=6.8Hz, 3H), 1.11 (t, J=7.0Hz, 3H),
20 0.88 (d, J=6.5Hz, 3H), 0.83 (d, J=7.0Hz, 3H), 0.64 (d, J=6.8Hz, 3H)

EXAMPLE 173

Single Diastereomer of 1-(2,2-Diethoxyethyl)-3-(D-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one (HPLC first fraction)

- 5 The title compound was prepared in the same manner as in Example 172, except for replacing L-menthyl bromoacetate used in Example 172 with D-menthyl bromoacetate.

HPLC Conditions:

Column: YMC-Pack CN A-514 (6.0 mm (diameter) x 30 cm)

- 10 Developing solvent: hexane/isopropyl alcohol = 100/1

Flow rate: 1.0 ml/min

Detection: UV 254 nm

Retention time: 38 min

Rf = 0.44 (hexane/ethyl acetate = 2/1)

- 15 NMR (CDCl₃) δ: 7.41-6.91 (m, 8H), 6.88 (s, 1H), 6.73 (s, 1H), 4.75 (dd, J=4.6, 5.7Hz, 1H), 4.64 (dt, J=4.1, 11.1Hz, 1H), 3.95 (dd, J=5.7, 14.6Hz, 1H), 3.89-3.45 (m, 5H), 3.03 (d, J=15.1Hz, 1H), 2.61 (d, J=15.1Hz, 1H), 2.26 (s, 3H),
20 1.98-1.80 (br, 1H), 1.80-1.55 (br, 3H), 1.55-1.30 (br, 1H), 1.30-0.75 (br, 4H), 1.17 (t, J=6.8Hz, 3H), 1.11 (t, J=7.0Hz, 3H), 0.88 (d, J=6.5Hz, 3H), 0.83 (d, J=7.0Hz, 3H), 0.64 (d, J=6.8Hz, 3H)

25 EXAMPLE 174

(+)-1-(2,2-Diethoxyethyl)-3-(4-methylphenyl)amino-carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

(1) (+)-1-(2,2-Diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 5.30 g of 3-(+)-1-(2,2-diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 150 ml of methanol was added 30 ml of an aqueous solution of 1.00 g of potassium hydroxide (85%) at room temperature. The mixture was refluxed for 3 hours and concentrated. To the residue was added water, and the mixture was washed with chloroform. The aqueous layer was adjusted to pH 2 with 2N hydrochloric acid and extracted with ethyl acetate. The organic layer was washed with an aqueous solution of sodium chloride, dried over anhydrous sodium sulfate, and concentrated to obtain 2.8 g of the title compound.

NMR (CDCl₃) δ: 7.74 (s, 1H), 7.35-6.70 (m, 10H), 4.73 (dd, J=4.4, 5.9Hz, 1H), 4.01 (dd, J=5.9, 14.6Hz, 1H), 3.86-3.38 (m, 5H), 2.90 (d, J=15.9Hz, 1H), 2.65 (d, J=15.9Hz, 1H), 2.18 (s, 3H), 1.13 (t, J=6.8Hz, 3H), 1.08 (t, J=6.8Hz, 3H)

(2) (+)-1-(2,2-Diethoxyethyl)-3-(4-methylphenyl)amino-carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

In 100 ml of dichloromethane was dissolved 2.8 g of (+)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one, and 1.20 g of 4-dimethylaminopyridine, 1.90 g of 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride, and 1.10 g of p-toluidine were successively added thereto. The mixture was stirred for 18 hours and concentrated. The concentrate was diluted with ethyl acetate, washed successively with dilute hydrochloric acid and saturated aqueous sodium

hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate, and concentrated. The crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to yield 3.90 g (81%) of the
5 title compound as a white powder. The resulting compound was found to be optically pure as analyzed by high performance liquid chromatography using an optically active column (CHIRALCEL OD, produced by Daicel Chemical Industries, Ltd.).

10 Rf = 0.21 (hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ: 8.33 (s, 1H), 7.33-6.91 (m, 14H), 4.77 (dd, J=4.4, 5.6Hz, 1H), 4.03 (dd, J=5.6, 14.1Hz, 1H), 3.82-3.48 (m, 5H), 2.97 (d, J=14.6Hz, 1H), 2.57 (d, J=14.6Hz, 1H), 2.30 (s, 3H),
15 2.22 (s, 3H), 1.16 (t, J=6.8Hz, 3H), 1.11 (t, J=6.8Hz, 1H)

$[\alpha]_D^{25} = 27.9^\circ$ (c = 3.05, CHCl₃)

EXAMPLE 175

20 (-)-1-(2,2-Diethoxyethyl)-3-(4-methylphenyl)amino-carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 1.26 g of a single diastereomer of 1-(2,2-diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one (HPLC first fraction) in 20 ml of ethanol was added 10 ml of an aqueous solution of
25 0.07 g of potassium hydroxide (85%) at room temperature, and the mixture was stirred at 70°C for 1 hour, followed by concentration. Water was added to the residue, and the mixture was washed with chloroform. The aqueous layer was

adjusted to pH 2 by addition of 2N hydrochloric acid and
extracted with ethyl acetate. The organic layer was dried
over anhydrous sodium sulfate and concentrated to give
0.88 g of (-)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-
5 3-(N'-(4-methylphenyl)ureido)indolin-2-one. The resulting
product was dissolved in 50 ml of dichloromethane, and
0.52 g of 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide
hydrochloride and 0.29 g of p-toluidine were successively
added thereto. The mixture was stirred for 18 hours and
10 diluted with ethyl acetate, washed successively with dilute
hydrochloric acid and saturated aqueous sodium hydrogen-
carbonate. The organic layer was dried over anhydrous
sodium sulfate, and concentrated. The resulting crude
product was purified by silica gel column chromatography
15 (hexane/ethyl acetate = 2/1) to give 0.90 g (90%) of the
title compound as a white powder. The resulting compound
was found to be optically pure as analyzed by high
performance liquid chromatography using an optically
active column (CHIRALCEL OD, produced by Daicel Chemical
20 Industries, Ltd.). The Rf and NMR data were equal to those
of the compound of Example 174.

$[\alpha]_D^{25} = -27.6^\circ\text{C}$ (c = 1.00, CHCl_3)

EXAMPLES 176 TO 181

The following compounds were prepared in the same
25 manner as in Example 174, except for replacing p-toluidine
used in Example 174 with various amines or alcohols as
a reactant.

EXAMPLE 176

(+)-1-(2,2-Diethoxyethyl)-3-(4-iodophenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

5 NMR (CDCl₃) δ: 8.60 (s, 1H), 7.55 (d, J=8.8Hz, 2H), 7.32-6.94 (m, 11H), 6.84 (s, 1H), 4.77 (dd, J=4.4, 6.3Hz, 1H), 4.00 (dd, J=6.3, 10.4Hz, 1H), 3.82-3.46 (m, 5H), 2.96 (d, J=14.8Hz, 1H), 2.65 (d, J=14.8Hz, 1H), 2.23 (s, 3H), 1.20-1.07 (m, 6H)

10 EXAMPLE 177

(+)-1-(2,2-Diethoxyethyl)-3-(2-bromoethoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

Rf = 0.14 (n-hexane/ethyl acetate = 2/1)

15 NMR (CDCl₃) δ: 7.31-7.22 (m, 2H), 7.16-6.98 (m, 6H), 6.61 (s, 1H), 6.52 (s, 1H), 4.73 (dd, J=4.9, 5.9Hz, 1H), 4.38 (t, J=6.3Hz, 2H), 3.97 (dd, J=5.9, 8.3Hz, 1H), 3.84-3.51 (m, 5H), 3.42 (t, J=6.3Hz, 2H), 2.28 (s, 3H), 1.17 (t, J=7.3Hz, 3H), 1.13 (t, J=7.8Hz, 3H)

20 MS (m/e): 563, 561 (M⁺), 517, 515, 438, 158, 103

EXAMPLE 178

(+)-1-(2,2-Diethoxyethyl)-3-(2-iodoethoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

Rf = 0.14 (n-hexane/ethyl acetate = 2/1)

25 NMR (CDCl₃) δ: 7.31-6.98 (m, 8H), 6.50 (s, 2H), 4.75 (dd, J=4.9, 5.8Hz, 1H), 4.34 (dt, J=1.5, 6.9Hz, 2H), 3.96 (dd, J=5.8Hz, 14.2Hz, 1H), 3.85-3.52 (m, 5H), 3.19 (t, J=6.9Hz, 2H), 2.93 (d, J=15.1Hz, 1H), 2.64 (d, J=15.1Hz, 1H),

2.29 (s, 3H), 1.17 (t, J=7.3Hz, 3H), 1.13
(t, J=7.3Hz, 3H)

MS (m/e): 609 (M⁺), 563, 535, 414, 103

$[\alpha]_D^{25} = +8.6^\circ$ (c = 1.00, CHCl₃)

5 EXAMPLE 179

(+)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-(5-methylpyrido-2-yl)aminocarbonylmethyl)indolin-2-one

The NMR data were equal to those of the compound of Example 138.

10 $[\alpha]_D^{25} = +53.76^\circ$ (c = 1.09, CHCl₃)

EXAMPLE 180

(+)-1-(2,2-Diethoxyethyl)-3-((4-(N,N-dimethyl-amino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

15 The NMR data were equal to those of the compound of Example 130.

$[\alpha]_D^{25} = +55.09^\circ$ (c = 1.02, CHCl₃)

EXAMPLE 181

20 (+)-1-(2,2-Diethoxyethyl)-3-((2-methoxypyrido-5-yl)amino-carbonylmethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The NMR data were equal to those of the compound of Example 143.

$[\alpha]_D^{25} = +22.54^\circ$ (c = 1.02, CHCl₃)

EXAMPLES 182 TO 184

25 The following compounds were prepared in the same manner as in Example 175, except for using various amines as a reactant in place of p-toluidine used in Example 175.

EXAMPLE 182

30 (-)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-((5-methylpyrido-2-yl)aminocarbonylmethyl)indolin-2-one

The NMR data were equal to those of the compound of Example 138.

$[\alpha]_D^{25} = -58.83^\circ$ (c = 1.03, CHCl_3)

EXAMPLE 183

5 $(-)-1-(2,2\text{-Diethoxyethyl})-3-((4-(N,N\text{-dimethyl-amino})\text{phenyl})\text{aminocarbonylmethyl})-3-(N'-(4\text{-methyl-phenyl})\text{ureido})\text{indolin-2-one}$

The NMR data were equal to those of the compound of Example 130.

10 $[\alpha]_D^{25} = -60.91^\circ$ (c = 1.06, CHCl_3)

EXAMPLE 184

$(-)-1-(2,2\text{-Diethoxyethyl})-3-((2\text{-methoxypyrido-5-yl})\text{amino-carbonylmethyl})-3-(N'-(4\text{-methylphenyl})\text{ureido})\text{indolin-2-one}$

The NMR data were equal to those of the compound of Example 143.

15 $[\alpha]_D^{25} = -25.19^\circ$ (c = 1.04, CHCl_3)

EXAMPLE 185

$(3\text{RS})-1-(2,2\text{-Diethoxyethyl})-3-(\text{L-menthoxy})\text{carbonylmethyl-3-(N'-(3-methoxyphenyl})\text{ureido})\text{indolin-2-one}$

20 To a solution of 0.207 g of (RS)-1-(2,2-diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one in 4 ml of dry dimethyl sulfoxide was added 0.5 ml of a 1M solution of potassium t-butoxide in dry dimethyl sulfoxide at room temperature under a nitrogen atmosphere. After stirring the mixture for 30 minutes, a solution of 0.166 g of L-menthyl bromoacetate in 2 ml of dry dimethyl sulfoxide was added thereto dropwise, followed by stirring at that temperature for 30 minutes. The reaction mixture was poured into an aqueous solution of sodium chloride and extracted with ethyl ether. The ethyl ether layer was dried over anhydrous

25

30

magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 3/1) to give 0.170 g (56%) of the title compound. As a result of analysis by high performance liquid chromatography, the product was found to consist of both diastereomers at a ratio of approximately 1:1.

HPLC Conditions:

Column: YMC-Pack CN A-514 (6.0 mm (diameter) x 30 cm)
Developing solvent: hexane/isopropyl alcohol = 100/1
10 Flow rate: 1.0 ml/min
Detection: UV 254 nm
Fractions: 56 parts (retention time = 47 min)
44 parts (retention time = 52 min)

R_f = 0.36 (hexane/ethyl acetate = 2/1)

15 NMR (CHCl₃) δ: 7.30-7.20 (m, 2H), 7.16-6.92 (m, 5H), 6.79-6.75 (m, 2H), 6.57-6.52 (m, 1H), 4.80-4.75 (m, 1H), 4.72-4.62 (m, 1H), 3.99-3.51 (m, 6H), 3.71 (s, 3H), 3.01 (d, J=14.8Hz, 0.5H), 2.96 (d, J=15.2Hz, 0.5H), 2.62 (d, J=15.2Hz, 0.5H), 2.54 (d, J=14.8Hz, 0.5H), 1.83-1.71 (br, 1H), 1.65-1.59 (m, 4H), 1.42-0.57 (m, 3H), 1.21-1.09 (m, 6H), 0.89 (d, J=6.9Hz, 1.5H), 0.88 (d, J=6.9Hz, 1.5H), 0.82 (d, J=6.9Hz, 1.5H), 0.77 (d, J=6.9Hz, 1.5H), 0.70 (d, J=6.9Hz, 1.5H), 0.64 (d, J=6.9Hz, 1.5H)

EXAMPLE 186

Single Diastereomer of 1-(2,2-Diethoxyethyl)-
3-(L-menthoxy)carbonylmethyl-3-(N'-(3-methoxy-
phenyl)ureido)indolin-2-one (HPLC first fraction)

5 The same procedure of Example 172 was repeated
except for using (RS)-1-(2,2-diethoxyethyl)-3-(N'-(3-
methoxyphenyl)ureido)indolin-2-one as a starting material.
The crude product was recrystallized from isopropyl ether
to obtain the title compound as needles in a 32% yield. As
10 a result of high performance liquid chromatography analysis,
the product was confirmed to consist of a single
diastereomer.

HPLC Conditions:

Column: YMC-Pack CN A-514 (6.0 mm (diameter) x 30 cm)
15 Developing solvent: hexane/isopropyl alcohol = 100/1
Flow rate: 1.0 ml/min
Detection: UV 254 nm
Retention time: 47 min

R_f = 0.36 (hexane/ethyl acetate = 2/1)

20 NMR (CHCl₃) δ: 7.29-7.24 (m, 2H), 7.15-7.09 (m, 2H), 6.70
(t, J=7.6Hz, 1H), 6.95-6.91 (m, 2H), 6.79-
6.73 (m, 2H), 6.53 (dd, J=2.0, 8.2Hz, 1H),
4.77 (dd, J=5.3, 5.9Hz, 1H), 4.75-4.61 (m,
1H), 3.93 (dd, J=5.9, 15.9Hz, 1H), 3.85 (dd,
25 J=5.3, 15.9Hz, 1H), 3.73-3.54 (m, 4H), 3.70
(s, 3H), 1.91 (br, 1H), 1.87 (br, 1H), 1.67
(m, 4H), 1.36-0.71 (m, 3H), 1.19 (t,
J=6.9Hz, 3H), 1.11 (t, J=6.9Hz, 3H), 0.88
(d, J=6.9Hz, 3H), 0.83 (d, J=7.3Hz, 1H),

0.66 (d, J=7.0Hz, 3H)

EXAMPLE 187

Single Diastereomer of 1-(2,2-Diethoxyethyl)-
3-(D-menthoxy)carbonylmethyl-3-(N'-(3-methoxy-
5 phenyl)ureido)indolin-2-one (HPLC first fraction)

The same procedure as in Example 172 was repeated, except for using (RS)-1-(2,2-diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one as a starting material and replacing L-menthyl bromoacetate as a reactant with
10 D-menthyl bromoacetate. Recrystallization of the crude product from isopropyl ether gave the title compound as needles in a 32% yield. As a result of high performance liquid chromatography analysis, the compound was confirmed to consist of a single diastereomer. Because the compound
15 is an enantiomer of the compound of Example 186, the HPLC and NMR data are the same as those of the latter compound.

EXAMPLE 188

(+)-1-(2,2-Diethoxyethyl)-3-(4-methylphenyl)aminocarbonyl-
methyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

20 To a solution of 2.57 g of a single diastereomer of 1-(2,2-diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one (HPLC first fraction) in 150 ml of ethanol was added 50 ml of an aqueous solution of 0.60 g of potassium hydroxide (85%) at room temperature.
25 The mixture was heated under reflux for 1 hour, followed by concentration. Water was added to the residue, and the mixture was washed with chloroform. The aqueous layer was adjusted to pH 2 with 2N hydrochloric acid, and extracted with ethyl acetate. The organic layer was dried over

anhydrous sodium sulfate and concentrated to yield 1.90 g of (+)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one.

In 30 ml of dichloromethane was dissolved 0.5 g of (+)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one, and 0.22 g of 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride and 0.20 g of p-toluidine were successively added thereto. After stirring the mixture for 9 hours, the reaction mixture was diluted with ethyl acetate and washed successively with dilute hydrochloric acid and saturated aqueous sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to yield 0.49 g of the title compound as a white powder.

Rf = 0.21 (hexane/ethyl acetate = 2/1)

NMR (CDCl₃) δ: 8.15 (s, 1H), 7.35-7.23 (m, 6H), 7.13-6.91 (m, 6H), 6.73 (d, J=7.3Hz, 1H), 6.50 (dd, J=2.4, 7.8Hz, 1H), 4.79 (dd, J=4.4, 5.9Hz, 1H), 3.98 (dd, J=5.9, 14.1Hz, 1H), 3.86-3.52 (m, 5H), 3.67 (s, 3H), 2.98 (d, J=14.6Hz, 1H), 2.54 (d, J=14.6Hz, 1H), 2.30 (s, 3H), 1.18 (t, J=6.8Hz, 3H), 1.10 (t, J=6.8Hz, 3H)

[α]_D²⁵ = +33.8° (c = 1.07, CHCl₃)

EXAMPLE 189

(-)-1-(2,2-Diethoxyethyl)-3-(4-methylphenyl)aminocarbonylmethyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one

To a solution of 1.89 g of a single diastereomer of 1-(2,2-diethoxyethyl)-3-(D-menthoxy)carbonylmethyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one (HPLC first fraction) in 100 ml of ethanol was added 30 ml of an aqueous solution of 0.46 g of potassium hydroxide (85%) at room temperature, and the mixture was stirred at 80°C for 2 hours followed by concentration. Water was added to the concentrate, and the mixture was washed with chloroform. The aqueous layer was adjusted to pH 2 by addition of 2N hydrochloric acid and extracted with ethyl acetate. The organic layer was dried over anhydrous sodium sulfate and concentrated to afford 1.76 g of (-)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one.

In 30 ml of dichloromethane was dissolved 0.50 g of (-)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(3-methoxyphenyl)ureido)indolin-2-one, and 0.22 g of 1-ethyl-3-(3-dimethylaminopropyl)-carbodiimide hydrochloride and 0.20 g of p-toluidine were successively added thereto. After stirring the mixture for 9 hours, the reaction mixture was diluted with ethyl acetate and washed successively with dilute hydrochloric acid and saturated aqueous sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated. The crude product was purified by silica gel column chromatography (hexane/ethyl acetate = 2/1) to give 0.46 g of the title compound as a white powder. Because the compound is an enantiomer of the compound of Example 188, the NMR data are the same as those of the latter compound.

$[\alpha]_D^{25} = -36.9^\circ$ (c = 1.02, CHCl₃)

EXAMPLES 190 TO 191

The following compounds were prepared in the same manner as in Example 188, except for using various amines as
5 a reactant in place of p-toluidine used in Example 188.

EXAMPLE 190

(+)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((5-methylpyrido-2-yl)aminocarbonylmethyl)indolin-2-one

10 The Rf and NMR data were equal to those of the compound of Example 158.

$[\alpha]_D^{25} = +54.08^\circ$ (c = 1.03, CHCl₃)

EXAMPLE 191

15 (+)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((4-(N,N-dimethylaminophenyl)aminocarbonylmethyl)indolin-2-one

The Rf and NMR data were equal to those of the compound of Example 156.

$[\alpha]_D^{25} = +61.79^\circ$ (c = 1.00, CHCl₃)

EXAMPLES 192 TO 193

20 The following compounds were prepared in the same manner as in Example 189, except for using various amines as a reactant in place of p-toluidine used in Example 189.

EXAMPLE 192

25 (-)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((5-methylpyrido-2-yl)aminocarbonylmethyl)indolin-2-one

The Rf and NMR data were equal to those of the compound of Example 158.

$[\alpha]_D^{25} = -54.91^\circ$ (c = 1.01, CHCl₃)

EXAMPLE 193

(-)-1-(2,2-Diethoxyethyl)-3-(N'-(3-methoxyphenyl)ureido)-3-((4-N,N-dimethylamino)phenyl)aminocarbonylmethyl)indolin-2-one

5 The Rf and NMR data were equal to those of the compound of Example 156.

$[\alpha]_D^{25} = -63.99^\circ$ (c = 1.00, CHCl₃)

EXAMPLE 194

10 (+)-1-(2,2-Diethoxyethyl)-3-((4-(N,N-dimethyl-amino)phenyl)aminocarbonylmethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one Potassium Hydrogensulfate

 The compound obtained in Example 180 was mixed with 1 equivalent of potassium hydrogensulfate, and the mixture was recrystallized from methanol to obtain the title
15 compound as needles.

Melting point: 180°C (decomposition)

NMR (DMSO-d₆) δ : 9.98 (br, 1H), 9.13 (s, 1H), 7.57 (s, 1H), 7.46 (d, J=8.2Hz, 2H), 7.25-6.80 (m, 11H), 4.75-4.69 (m, 1H), 3.85 (dd, J=5.8, 14.6Hz, 1H), 3.77-3.44 (m, 5H), 2.83 (d, J=14.1Hz, 1H), 2.51 (s, 6H), 2.47 (d, J=14.1Hz, 1H), 2.18 (s, 3H), 1.11 (t, J=7.3Hz, 3H), 1.07 (t, J=6.8Hz, 3H)

$[\alpha]_D^{24} = +98.88^\circ$ (c = 0.72, MeOH)

25 REFERENCE EXAMPLE 27

1-(2,2-Diethoxyethyl)indole

 To a solution of 12 g of indole in 100 ml of dimethyl sulfoxide was added 6.5 g of sodium hydride at room temperature. The mixture was stirred at the same
30 temperature for 1 hour, and 20 ml of bromoacetaldehyde

diethyl acetal was added thereto, followed by further stirring at 50°C for 1 hour. After cooling, the reaction mixture was poured into water, and the product was extracted with ethyl ether. The organic layer was dried
5 over anhydrous magnesium sulfate and concentrated to give 23 g of the title compound.

NMR (CDCl₃) δ: 7.60 (d, J=6.9Hz, 1H), 7.39 (d, J=9.1Hz, 1H), 7.26-7.03 (m, 3H), 6.48 (d, J=3.4Hz, 1H), 4.64 (t, J=5.1Hz, 1H), 4.20 (d, J=5.1Hz, 2H), 3.79-3.47 (m, 2H), 3.42-3.24 (m, 2H), 1.12 (t, J=7.3Hz, 6H)
10

REFERENCE EXAMPLE 28

1-(2,2-Diethoxyethyl)-3,3-dichloroindolin-2-one

To a suspension of 23 g of 1-(2,2-diethoxy-ethyl)indole and 31 g of potassium dihydrogenphosphate in 1 l of ethyl acetate was added 700 ml of a 5% aqueous solution of sodium hypochlorite under ice-cooling, followed by stirring at that temperature for 10 minutes. The mixture was washed successively with water and an aqueous solution
15 of potassium carbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated under reduced pressure to give 31 g of the title compound.

Rf = 0.50 (hexane/ethyl acetate = 3/1)

NMR (CDCl₃) δ: 7.61 (d, J=8.2Hz, 1H), 7.40-7.30 (m, 1H), 7.22-6.98 (m, 2H), 4.74 (t, J=5.4Hz, 1H), 3.84 (d, J=5.4Hz, 2H), 3.86-3.67 (m, 2H), 3.60-3.40 (m, 2H), 1.14 (t, J=7.3Hz, 6H)
25

REFERENCE EXAMPLE 29

1-(2,2-Diethoxyethyl)isatin

To a solution of 31 g of 1-(2,2-diethoxyethyl)-3,3-dichloroindolin-2-one in 200 ml of dimethyl sulfoxide was
5 added dropwise 50 ml of an aqueous solution of 14.5 g of sodium hydroxide in such a manner that the reaction temperature might not exceed 20°C, followed by stirring at the same temperature for 45 minutes. To the mixture was slowly added 15.5 ml of concentrated hydrochloric acid,
10 followed by stirring at room temperature for 1.5 hours. Ethyl acetate was added to the reaction mixture, and the mixture was washed successively with water and an aqueous solution of sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate and concentrated
15 to give 25 g of the title compound.

R_f = 0.83 (chloroform/methanol = 20/1)

NMR (CDCl₃) δ: 7.75-6.95 (m, 4H), 4.71 (t, J=5Hz, 1H),
3.89-3.40 (m, 6H), 1.16 (t, J=7Hz, 6H)

EXAMPLE 195

20 1-(RS)-1-(2,2-Ethoxyethyl)-3-(N'-(4-methyl-phenyl)ureido)indolin-2-one

In 3.8 l of methanol was dissolved 176 g of isatin while heating, and a solution of 100 g of O-methylhydroxylamine hydrochloride and 136 g of sodium acetate trihydrate
25 in 400 ml of water was added thereto. The resulting mixture was stirred at room temperature for 10 minutes, followed by concentration. Water was added to the residue, and the mixture was extracted with ethyl acetate. The organic layer

was washed with saturated aqueous sodium hydrogencarbonate, dried over anhydrous sodium sulfate, and concentrated to give 192 g (91%) of 3-methoxyiminoindolin-2-one. The resulting crude product was used in the subsequent reaction without being purified.

NMR (CDCl₃) δ: 9.36 (br, 1H), 7.94 (d, J=7.6Hz, 1H), 7.34 (dt, J=1.3, 7.6Hz, 1H), 7.05 (dt, J=1.0, 7.6Hz, 1H), 6.92 (d, J=7.6Hz, 1H), 4.31 (s, 3H)

To a suspension of sodium hydride (prepared by washing 50 g of 60% oily sodium hydride with hexane) in 1 l of N,N-dimethylformamide was added dropwise a solution of 176 g of 3-methoxyiminoindolin-2-one in 3 l of N,N-dimethylformamide at 0°C in a nitrogen stream. To the mixture were added 1 l of N,N-dimethylformamide and 330 ml of bromoacetaldehyde diethyl acetal, and the mixture was heated to 70°C, at which it was stirred for 45 hours. The reaction mixture was concentrated, and the concentrate was diluted with ethyl acetate and washed with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous sodium sulfate and concentrated to give 284 g (97%) of 1-(2,2-diethoxyethyl)-3-methoxyiminoindolin-2-one.

NMR (CDCl₃) δ: 7.93 (d, J=7.8Hz, 1H), 7.36 (dt, J=1.5, 7.8Hz, 1H), 7.08-7.00 (m, 2H), 4.70 (t, J=5.4Hz, 1H), 4.29 (s, 3H), 3.85 (d, J=5.4Hz, 2H), 3.79-3.43 (m, 4H), 1.14 (t, J=7.3Hz, 6H)

To a solution of 0.51 g of 1-(2,2-diethoxyethyl)-3-methoxyiminoindolin-2-one in 30 ml of ethanol were added 50 mg of 5% Pd/C and 1 ml of 2N hydrochloric acid, and the resulting suspension was stirred at room temperature for 5 18 hours under a hydrogen atmosphere. The reaction mixture was filtered through Cerite, and the filtrate was concentrated. The residue was suspended in 30 ml of toluene, and 0.25 ml of triethylamine and 0.27 ml of p-tolyl isocyanate were added thereto, followed by stirring at room temperature 10 for 1 hour. The reaction mixture was concentrated and washed with water to give 0.55 g of the title compound.

NMR (DMSO-d₆) δ: 8.63 (s, 1H), 7.33-7.16 (m, 4H), 7.12-7.16 (m, 4H), 5.05 (d, J=7.4Hz, 1H), 4.77-4.63 (m, 1H), 3.84 (dd, J=5.7, 14.6Hz, 1H), 3.77-3.40 (m, 5H), 2.22 (s, 3H), 1.08 (t, J=7.4Hz, 3H), 1.06 (t, J=7.4Hz, 3H) 15

EXAMPLE 196

20 (+)-3-(p-Bromobenzyloxy)carbonylmethyl-1-(2,2-diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)indolin-2-one

In 10 ml of dimethyl sulfoxide was dissolved 0.336 g of (+)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one. To the solution were added successively 0.108 g of 4-dimethylaminopyridine, 25 0.170 g of 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride and 0.166 g of 4-bromobenzyl alcohol. The resulting mixture was stirred for 18 hours, followed by concentration. The concentrate was diluted with ethyl

ether, washed successively with dilute hydrochloric acid and a saturated aqueous solution of sodium hydrogencarbonate. The organic layer was dried over anhydrous sodium sulfate, and concentrated. The crude product was purified by silica
5 gel column chromatography (hexane/ethyl acetate = 2/1) to give 0.219 g (48%) of the title compound as a white powder.
NMR (CDCl₃) δ: 7.45 (d, J=8.8Hz, 2H), 7.30-6.80 (m, 10H),
6.71 (s, 1H), 6.60 (s, 1H), 5.05 (d,
J=12.7Hz, 1H), 5.00 (d, J=12.7Hz, 1H), 4.73
10 (dd, J=4.9, 5.9Hz, 1H), 3.93 (dd, J=5.9,
14.6Hz, 1H), 3.83-3.30 (m, 5H), 2.97 (d,
J=15.1Hz, 1H), 2.65 (d, J=15.1Hz, 1H), 2.28
(s, 3H), 1.15 (t, J=7.3Hz, 3H), 1.10 (t,
J=7.3Hz, 3H)

15 EXAMPLE 197

3-(+)-1-(2,2-Diethoxyethyl)-3-(N'-(4-methylphenyl)ureido)-3-
((1R-1-methylpropoxy)carbonylmethyl)indolin-2-one

The title compound was prepared in the same manner as in Example 196, except for using R-2-butanol as a reactant
20 in place of 4-bromobenzyl alcohol used in Example 196.

NMR (CDCl₃) δ: 7.30-7.20 (m, 2H), 7.13-6.92 (m, 6H), 6.89
(s, 1H), 6.79 (s, 1H), 4.87-4.70 (m, 2H),
3.95 (dd, J=5.9, 14.1Hz, 1H), 3.86-3.46
(m, 5H), 2.95 (d, J=15.1Hz, 1H), 2.56
25 (d, J=15.1z, 1H), 2.26 (s, 3H), 1.55-1.37
(m, 2H), 1.21-1.00 (m, 9H), 0.81 (t,
J=8.1Hz, 3H)

EXAMPLE 198

(+)-1-Formylmethyl-3-(4-methylphenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

To a solution of 0.227 g of (+)-1-(2,2-diethoxy-
5 ethyl)-3-(4-methylphenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one in 5 ml of acetone was added 5 ml of 6N hydrochloric acid, followed by heating under reflux for 10 minutes. The reaction mixture was concentrated, and the residue was diluted with ethyl
10 acetate and washed twice with an aqueous solution of sodium chloride. The organic layer was dried over anhydrous magnesium sulfate and concentrated to give 0.189 g of the title compound as a crude product.

NMR (CDCl₃) δ: 9.59 (s, 1H), 8.12 (s, 1H), 7.42 (s, 1H),
15 7.31-6.84 (m, 12H), 6.57 (d, J=7.6Hz, 1H),
4.62 (d, J=18.8Hz, 1H), 4.29 (d, J=18.8Hz, 1H), 2.90 (d, J=15.9Hz, 1H), 2.58 (d, J=15.9Hz, 1H), 2.25 (s, 3H), 2.18 (s, 3H)

EXAMPLE 199

20 (+)-1-Formylmethyl-3-hydroxycarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The title compound was prepared in the same manner as in Example 198, except for starting with (+)-1-(2,2-diethoxyethyl)-3-hydroxycarbonylmethyl-3-(N'-(4-methyl-
25 phenyl)ureido)indolin-2-one in place of (+)-1-(2,2-diethoxyethyl)-3-(4-methylphenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one used in Example 198.

NMR (DMSO-d₆) δ: 9.61 (s, 1H), 8.95 (s, 1H), 7.33-6.94 (m, 10H), 4.68 (d, J=18.5Hz, 1H), 4.54 (d,

J=18.5Hz, 1H), 2.87 (d, J=15.8Hz, 1H),
2.56 (d, J=15.8Hz, 1H), 2.17 (s, 3H)

EXAMPLE 200

5 3-(+)-1-Formylmethyl-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

The title compound was prepared in the same manner as in Example 198, except for starting with (+)-1-(2,2-diethoxyethyl)-3-(L-menthoxy)carbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one in place of (+)-1-(2,2-diethoxyethyl)-3-(4-methylphenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one used in Example 198.

10 NMR (CDCl₃) δ: 9.72 (s, 1H), 7.33-6.68 (m, 10H), 4.75-4.61 (m, 2H), 4.47 (d, J=17.8Hz, 1H), 2.99 (d, J=15.4Hz, 1H), 2.63 (d, J=15.4Hz, 1H), 2.26 (s, 3H), 1.92-1.84 (br, 1H), 1.71-1.59 (br, 3H), 1.43-1.38 (br, 1H), 1.30-1.14 (br, 4H), 0.89 (d, J=6.6Hz, 3H), 0.82 (d, J=6.9Hz, 3H), 0.64 (d, J=6.9Hz, 3H)

EXAMPLE 201

20 (+)-1-(2-Hydroxyiminoethyl)-3-(4-methylphenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one

In 1 ml of methanol was dissolved 0.050 g of (+)-1-formylmethyl-3-(4-methylphenyl)aminocarbonylmethyl-3-(N'-(4-methylphenyl)ureido)indolin-2-one, and a solution of 0.021 g of hydroxylamine hydrochloride and 0.021 g of sodium acetate

25 in 1 ml of water was added thereto. The resulting mixture was stirred at room temperature for 1 hour and concentrated. Water was added to the residue, and the mixture was extracted with ethyl acetate. The organic layer was washed

with saturated aqueous sodium hydrogencarbonate, dried over anhydrous sodium sulfate, and concentrated. The residue was purified by silica gel column chromatography (dichloromethane/ethyl acetate = 1/1) to give 0.045 g of
5 the title compound.

Rf = 0.18 (dichloromethane/ethyl acetate = 2/1)

NMR (CDCl₃-DMSO-d₆) δ:

10.09 (br, 0.5H), 9.62 (br, 0.5H), 8.69 (br, 0.5H),
7.57 (br, 0.5H), 7.43-7.38 (m, 1H), 7.30-7.14 (m,
10 5H), 7.06-6.77 (m, 9H), 4.71-4.52 (m, 1.5H), 4.30-
4.18 (m, 0.5H), 2.89 (d, J=14.5Hz, 0.5H), 2.85 (d,
J=14.5Hz, 0.5H), 2.51-2.40 (m, 1H), 2.26 (s, 3H),
2.19 (s, 3H)

15 Structural formulae of the compounds prepared in the foregoing Examples are shown in Tables A and B below.

TEST EXAMPLE 1

Gastrin Receptor Binding Test in Guinea Pig Gastric Glands

Preparation of Gastric Glands:

Guinea pig gastric glands were prepared according
20 to the method of Chang, et al., Biochem. Biophys. Res. Commun., 134, 895 (1986). The gastric mucosa of a Hartley male guinea pig was peeled off. After washing, the mucosa was minced with scissors in buffer A (Eagle's MEM containing 2 mM L-glutamine and 25 mM HEPES; pH 7.4). After washing,
25 the minced tissue was incubated in buffer A containing 0.025% collagenase, 0.01% soy bean trypsin inhibitor, and 0.1% BSA at 37°C for 60 minutes under 95% O₂ and 5% CO₂. The gastric glands were isolated from the tissue with a pipette,

washed twice with buffer A, and filtered through a mesh.
Then, the gastric glands were obtained by centrifugation.

Binding Test:

Guinea pig gastric glands were resuspended in buffer
5 B (Hank's solution containing 10 mM HEPES and 0.2% BSA; pH
7.4) (10 ml of buffer B per guinea pig).

To 200 μ l of the suspension containing the
resuspended isolated gastric glands were added 20 μ l of
 125 I-gastrin I human (final concentration: 22.5 pM). Then,
10 10 μ l of a test compound or a solvent (for total binding)
or 10 μ M Pentagastrin (for nonspecific binding), and buffer
B was added there to make a total volume of 1 ml. The
reaction mixture was incubated at 25°C for 45 minutes and
then centrifuged at 12000 g. The supernatant was removed
15 by suction, and the radioactivity of the isolated gastric
glands was measured with a gamma-counter.

The specific binding of gastrin to gastrin receptors
was obtained from a difference between the total binding and
the nonspecific binding. The IC_{50} of the test compound in
20 inhibition of specific binding was calculated.

The results obtained are shown in Table C.

TEST EXAMPLE 2

Inhibitory Activity on Gastric Acid Secretion in Pyrolus Ligated Rats

25 Sprague-Dawley male rats weighing about 200 g
were deprived of food for 24 hours while allowed water ad
libitum. The abdomen was opened under anesthesia with ethyl
ether, the pyrolus ligated, and the abdomen closed. The

rats were deprived of food and water for 4 hours until they were sacrificed with ethyl ether. The stomach was removed, and gastric juice was collected and measured. The gastric juice was centrifuged at 3000 rpm, and the supernatant was
5 titrated up to pH 7.0 with 0.1N NaOH solution to obtain the acidity of the gastric juice. The amount of the gastric acid output was calculated by multiplying the gastric juice volume by the acidity, and the percent inhibition of acid secretion was obtained according to the following equation.
10 A test compound, suspended in a 3% gum arabic solution, was administered intraduodenally at a dose of 2 ml/kg immediately after the pylorus ligation.

Inhibition (%) = [(Average amount of gastric acid output in control group - Average amount of gastric acid output in
15 test group) / Average amount of gastric acid secreted in test group] × 100

The results obtained are shown in Table C.

TEST EXAMPLE 3

CCK-B Receptor Binding Test in Rat Cerebral Cortex

20 A rat cortical membrane fraction was prepared in accordance with the method of Chang, et al., Proc. Natl. Acad. Sci., U.S.A., 83, 4923 (1986). Sprague-Dawley male rats were sacrificed and the brains were removed and immersed in a 50 mM Tris-HCl buffer (pH 7.4) under ice-cooling, and
25 the cortex was dissected. Cerebral cortex was minced in the same buffer, and homogenized with Polytron. The homogenate was centrifuged at 2,500 g, and the supernatant was further centrifuged at 50,000 g. The pellet was resuspended in a

reaction buffer solution (10 mM HEPES, 5 mM MgCl₂, 1 mM EGTA, 130 mM NaCl; pH 6.5).

Binding Test:

To 150 μ l of the resulting rat cerebral cortex
5 suspension were added 20 μ l of ¹²⁵I-CCK-8 sulfated (final concentration: 15 pM) and 10 μ l of a test compound or a solvent (for total binding) or 1 μ M CCK-8 sulfated (for nonspecific binding), and the reaction buffer solution was added there to make 1 ml. The reaction mixture was
10 incubated at 25°C for 120 minutes, followed by filtration through a GF/B filter (produced by Whatman). The radioactivity of the membrane fraction adsorbed onto the filter was measured with a gamma-counter.

The specific binding to CCK-B receptors was
15 obtained from a difference between the total binding and the nonspecific binding. The IC₅₀ of the test compound in inhibition of specific binding was calculated.

The results obtained are shown in Table D.

As is apparent from Table C, it was confirmed that
20 the compound of the present invention exhibits excellent gastrin receptor antagonism as well as inhibitory effect on gastric acid secretion.

As is apparent from Table D, it was confirmed that
the compound of the present invention exhibits excellent
25 antagonism against CCK-B receptors.

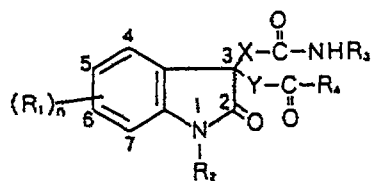


Table A-1

Ex. No.	(R ₁) _n	R ₂	X	R ₃	Y	R ₄
1	—	—CH ₂ —	NH	——CH ₂ —	NH	—NH——CH ₃
2	5-NO ₂	H	"	"	"	"
3	—	—CH ₂ CH=CH ₂	"	"	"	"
4	—	—	"	"	"	"
5	—	—CH ₂ CH(OCH ₃) ₂	"	"	"	"
6	—	—CH ₂ CH(OC ₂ H ₅) ₂	"	"	"	"
7	—	—CH ₂ CH(OCH ₃ OC ₂ H ₅)	"	"	"	"
8	—	H	"	"	"	"
9	—	H	"	—	"	—NH—
10	—	—CH ₂ CH(OC ₂ H ₅) ₂	"	——CH ₂ —	"	—NH——CH ₃
11	—	"	"	——OCH ₃	"	—NH——OCH ₃
12	—	"	"	——COOCH ₃	"	—NH——COOCH ₃
13	—	"	"	——CN	"	—NH——CN
14	—	"	"	——F	"	—NH——F
15	—	"	"	——F	"	—NH——F
16	—	"	"	——NO ₂	"	—NH——NO ₂
17	—	"	"	——CF ₃	"	—NH——CF ₃
18	—	"	"	——F	"	—NH——F
19	—	"	"	——NC	"	—NH——NC
20	—	"	"	——Br	"	—NH——Br

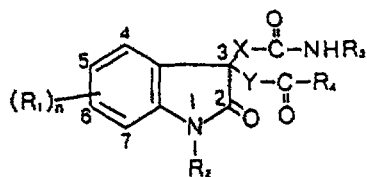


Table A-2

Ex. No.	(R ₁) _n	R ₂	X	R ₃	Y	R ₄
21	—	—CH ₂ CH(OC ₂ H ₅) ₂	NH		NH	—NH—
22	—	H	CH ₂		CH ₂	—NH—
23	—	—CH ₂ —	"	"	"	"
24	—	CH ₃	"	"	"	"
25	—	—CH ₂ CO—	"	"	"	"
26	—	—CH ₂ —	"	"	"	"
27	—	—CH ₂ —	O	"	"	"
53a	—	—CH ₂ COOC ₂ H ₅	NH	"	"	OC ₂ H ₅
53b	—	H	"	"	"	"
54a	—	—CH ₂ CO—	"	"	"	
54b	—	H	"	"	"	"
55	—	"	"	"	"	OH
56	—	—CH ₂ COOH	"	"	"	"
57	—	H	"	"	"	—NH—
58	—	"	"	"	"	—N——CH ₃
59	—	"	"	"	"	—N—
60	—	"	CH ₂	"	NH	—CH ₂ —
61	—	—CH ₂ —	"	"	"	CH ₃
62	—	"	"	"	"	—NH—
63	—	—CH ₂ CO—	NH	"	CH ₂	"

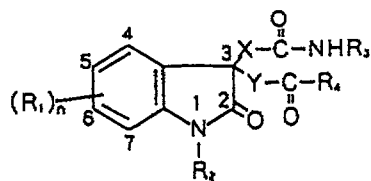


Table A-3

Ex. No.	(R ₁) _n	R ₁	X	R ₂	Y	R ₃
64	—	—CH ₂ COOC ₂ H ₅	NH		CH ₂	—NH—
65	—	—CH ₂ —	"	"	"	"
66	—	—CH ₂ CH ₂ —	"	"	"	"
67	—	CH ₃	"	"	"	"
68	—	—CH ₂ —	"	"	"	"
69	—	—CH ₂ OCH ₃	"	"	"	"
70	—	—CH ₂ CH(C ₂ H ₅) ₂	"	"	"	"
71	—	—CH ₂ CH(OC ₂ H ₅) ₂	"	"	"	"
72	7-CH ₃	H	"	"	"	"
73	—		"	"	"	"
74	5-CH ₃	—CH ₂ CH(OC ₂ H ₅) ₂	"	"	"	"
75	5-F	"	"	"	"	"
76	5-OCH ₃	"	"	"	"	"
77	5-Br	"	"	"	"	"
78	—	"	"		"	"
79	—	"	"		"	"
80	—	"	"		"	"
81	—	"	"		"	"
82	—	"	"		"	"
83	—	"	"		"	"

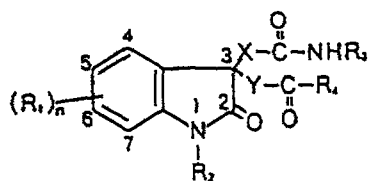


Table A-4

Ex. No.	(R ₁) _n	R ₂	X	R ₃	Y	R ₄
84	—	—CH ₂ CH(OC ₂ H ₅) ₂	NH		CH ₂	—NH——CH ₃
85	—	"	"		"	"
86	—	"	"	C ₂ H ₅	"	"
87	—	"	"		"	"
88	—	"	"		"	"
89	—	"	"		"	"
90	—	"	"		"	"
91	—	"	"		"	"
92	—	"	"		"	"
93	—	"	"		"	"
94	—	"	"		"	"
95	—	"	"		"	"
96	—	—CH ₂ CH(OC ₂ H ₅) ₂	"		"	"
97	—	—CH ₂ CHO	"	"	"	"
98	—		"	"	"	"
99	—	—CH ₂ CH(OCH ₂ —) ₂	"	"	"	"
100	—	—CH ₂ CH(OCH ₃) ₂	"	"	"	"
101	—		"	"	"	"
102	—	—CH ₂ CH ₂ NHCH ₃ · HC l	"	"	"	"
103	—	—CH ₂ CH ₂ —N	"	"	"	"

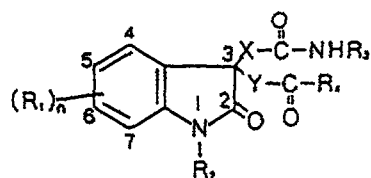


Table A-5

Ex. No.	(R ₁) _n	R ₂	X	R ₃	Y	R ₄
104	—	—CH ₂ CH ₂ N(CH ₃) ₂	NH		CH ₂	—NH—
105	—	—CH ₂ CH(SCH ₃) ₂	"	"	"	"
106	—	—CH ₂ CH(SC ₂ H ₅) ₂	"	"	"	"
107	—	—CH ₂ CH(OC ₂ H ₅) ₂	"	"	"	OC ₂ H ₅
108	—	"	"	"	"	OH
109	—	"	"	"	"	
110	—	"	"	"	"	—NH—
111	—	"	"	"	"	—NH—
112	—	"	"	"	"	—NH—
113	—	"	"	"	"	—NHC ₂ H ₅
114	—	"	"	"	"	—NH—
115	—	"	"	"	"	—NH—
116	—	"	"	"	"	—NH(CH ₂) ₃ COOC ₂ H ₅
117	—	"	"	"	"	—NHOCH ₃
118	—	"	"	"	"	—NH—
119	—	"	"	"	"	—NHCH ₂ CH(OC ₂ H ₅) ₂
120	—	"	"	"	"	—NH—
121	—	"	"	"	"	—NH—
122	—	"	"	"	"	—NH—
123	—	"	"	"	"	—NH—

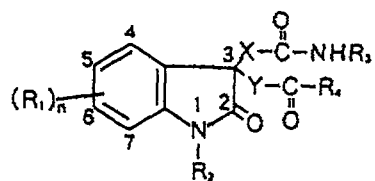


Table A-6

Ex. No.	(R ₁) _n	R ₁	X	R ₃	Y	R ₄
124	—	—CH ₂ CH(OC ₂ H ₅) ₂	NH		CH ₂	
125	—	"	"	"	"	
126	—	"	"	"	"	
127	—	"	"	"	"	
128	—	"	"	"	"	
129	—	"	"	"	"	
130	—	"	"	"	"	
131	—	"	"	"	"	
132	—	"	"	"	"	
133	—	"	"	"	"	
134	—	"	"	"	"	
135	—	"	"	"	"	
136	—	"	"	"	"	
137	—	"	"	"	"	
138	—	"	"	"	"	
139	—	"	"	"	"	
140	—	"	"	"	"	
141	—	"	"	"	"	
142	—	"	"	"	"	
143	—	"	"	"	"	

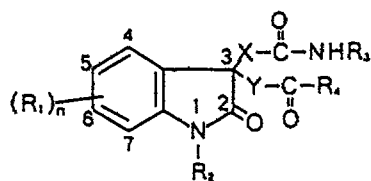


Table A-7

Ex. No.	(R ₁) _n	R ₂	X	R ₃	Y	R ₄
144	—	—CH ₂ CH(OC ₂ H ₅) ₂	NH		CH ₂	—NH—
145	—	"	"	"	"	—NH—
146	—	"	"		"	—OC ₂ H ₅
147	—	"	"	"	"	—OH
148	—	"	"	"	"	—NH—
149	—	"	"	"	"	—NH—
150	—	"	"	"	"	—NH—
151	—	"	"	"	"	—NH—
152	—	"	"	"	"	—NH—
153	—	"	"	"	"	—NH—
154	—	"	"	"	"	—NH—
155	—	"	"	"	"	—NHC ₃ H ₇ -n
156	—	"	"	"	"	—NH—
157	—	"	"	"	"	—NH—
158	—	"	"	"	"	—NH—
159	—	—CH ₂ CHO	"	"	"	—NH—
160	—	—CH ₂ CH ₂ N(CH ₃) ₂	"	"	"	"
161	—	—CH ₂ CH(OC ₂ H ₅) ₂	"		"	—NH—
162	—	"	"	"	"	—NH—
163	—	"	"	"	"	—NH—

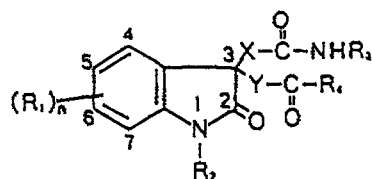


Table A-8

Ex. No.	(R ₁) _n	R ₁	X	R ₂	Y	R ₃
164	—	—CH ₂ CH (OC ₂ H ₅) ₂	NH		CH ₂	—NH——CH ₂ COOH
165	—	"	CH ₂	"	NH	—NH——COOH
166	—	"	"	"	"	—NH——NH ₂
167	—	"	"	"	"	—NH——N(CH ₃) ₂
168	—	"	NH		CH ₂	—NH——Cl
169	—	"	"		"	"
170	—	"	"		"	—NH——F
171	—	"	"		"	—O—(L-Menthyl)
172	—	"	"	"	"	"
173	—	"	"		"	—O—(D-Menthyl)
174	—	"	"		"	—NH——CH ₃
175	—	"	"	"	"	"
176	—	"	"	"	"	—NH——I
177	—	"	"	"	"	—OCH ₂ CH ₂ Br
178	—	"	"	"	"	—OCH ₂ CH ₂ I
179	—	"	"	"	"	—NH——CH ₃
180	—	"	"	"	"	—NH——N(CH ₃) ₂
181	—	"	"	"	"	—NH——OCH ₃
182	—	"	"	"	"	—NH——CH ₃
183	—	"	"	"	"	—NH——N(CH ₃) ₂

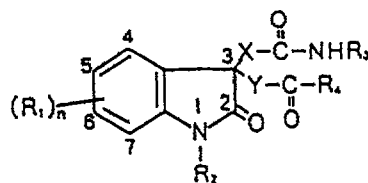


Table A-9

Ex. No.	(R ₁) _n	R ₁	X	R ₂	Y	R ₃
184	—	—CH ₂ CH (OC ₂ H ₅) ₂	NH		CH ₂	—NH—
185	—	"	"		"	—O—(L-Menthyl)
186	—	"	"	"	"	"
187	—	"	"	"	"	—O—(D-Menthyl)
188	—	"	"	"	"	—NH—
189	—	"	"	"	"	"
190	—	"	"	"	"	—NH—
191	—	"	"	"	"	—NH—
192	—	"	"	"	"	—NH—
193	—	"	"	"	"	—NH—
194	—	"	"	"	"	"
196	—	"	"		"	—OCH ₂ —
197	—	"	"	"	"	—O—
198	—	—CH ₂ CHO	"	"	"	—NH—
199	—	"	"	"	"	—OH
200	—	"	"	"	"	—O—(L-Menthyl)
201	—	—CH ₂ CH=NOH	"	"	"	—ONH—



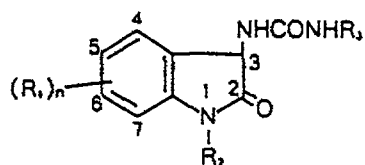


Table B-1

Ex. No.	(R ₁) _n	R ₂	R ₃
28	—	—CH ₂ CH(OC ₂ H ₅) ₂	
29	—	—CH ₂ —	"
30	—	—	"
31	5-CH ₃	—CH ₂ CH(OC ₂ H ₅) ₂	"
32	5-Br	"	"
33	—	"	
34	—	"	
35	—	"	
36	—	"	
37	—	"	
38	—	"	
39	—	"	
40	—	"	—C ₂ H ₅

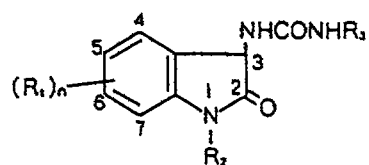


Table B-2

Ex. No.	(R ₁) _n	R ₂	R ₃
41	—	—CH ₂ CH(OC ₂ H ₅) ₂	
42	—	"	
43	5-F	"	
44	5-OCH ₃	"	"
45	—	"	
46	—	"	
47	—	"	
48	—	"	
49	—	"	
50	—	"	
51	—	"	
52	—	"	
195	—	"	

TABLE C

Test Compound (Example No.)	Gastric Receptor Binding Test (Test Example 1) IC ₅₀ (nM)	Gastric Acid Secretion Inhibition (%) (Test Example 2) 10 mg/kg, i.d.
10	2.5	59
14	2.2	49
71	1.1	48
79	1.9	47
81	1.6	59
82	6.2	56
84	3.4	68
85	1.2	72
89	5.8	65
92	4.3	57
94	3.5	70
111	5.1	69
114	2.4	56
122	2.9	62
124	5.3	54
125	2.5	54
129	3.6	71
130	4.9	71
131	23	65
132	8.9	52
138	2.2	69
143	1.5	64
148	1.1	63
149	0.93	69
151	2.9	62
152	2.1	64
154	1.0	59

TABLE C (cont.)

Test Compound (Example No.)	Gastric Receptor Binding Test (Test Example 1) IC ₅₀ (nM)	Gastric Acid Secretion Inhibition (%) (Test Example 2) 10 mg/kg, i.d.
156	6.5	69
158	1.4	66
168	2.6	61
169	1.9	52
170	5.1	63
174	0.54	70
179	1.6	63
180	4.6	73
181	2.2	69
188	0.35	76 (3 mg/kg)
190	0.68	70
191	5.5	78

TABLE D

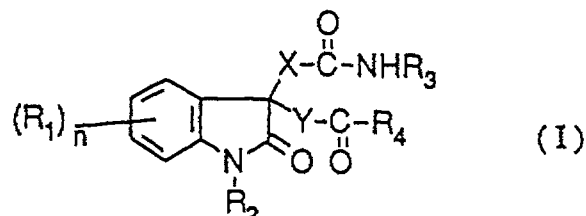
Compound No. (Example No.)	CCK-B Receptor Binding Test (Test Example 3) IC ₅₀ (nM)	Compound No. (Example No.)	CCK-B Receptor Binding Test (Test Example 3) IC ₅₀ (nM)
62	1.2	129	0.39
65	0.76	130	2.3
66	0.76	180	0.36
71	1.2	92	0.90
174	0.42	143	1.9
7	0.07	181	0.78
111	0.35	156	2.8
114	0.64	191	0.45
138	0.50	158	0.56
179	0.14	190	0.10
122	0.18		

Industrial Applicability

The compounds according to the present invention exhibit selective antagonism against gastrin receptors without causing side effects attributed to CCK-A receptor antagonism and are useful for the treatment and prevention of diseases of digestive organs, such as peptic ulcers, gastritis, reflux esophagitis, and Zollinger-Ellison syndrome. The compounds are also useful for the treatment of tumours originating in the gastrointestinal system and which also antagonizes selectively against CCK-B receptors and are useful for the treatment of CCK-related disorders in the appetite control system, enhancement and prolongation of analgesia through opiate or non-opiate, induction of anesthesia or analgesia, and the treatment and prevention of symptoms of psychotic disorders, including anxiety and panic disorders.

CLAIMS

1. A compound represented by formula (I):



wherein R_1 represents a halogen atom, a lower alkyl group, a lower alkoxy group, a hydroxyl group, a nitro group, a trifluoromethyl group, a lower alkylthio group, an acyl group, a carboxyl group, a mercapto group, or a substituted or unsubstituted amino group; R_2 represents a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted lower alkenyl group, a substituted or unsubstituted lower alkynyl group, a substituted or unsubstituted lower alkoxy group, a substituted or unsubstituted acyl group, a substituted or unsubstituted aryl group, or a substituted or unsubstituted heterocyclic group; R_3 represents a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group, a substituted or unsubstituted aryl group, or a substituted or unsubstituted heterocyclic group; R_4 represents a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, $-OR_5$, $-SR_5$, or $-NR_6R_7$, wherein R_5 , R_6 , and R_7 , which may be the same or different, each represent a hydrogen atom, a substituted



or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a lower alkoxy group, or a substituted or unsubstituted amino group; or R_6 and R_7 are taken together to form $-(CH_2)_m-$ or $-(CH_2)_lNR_8(CH_2)_k-$ (wherein k , l , and m each represent an integer of from 1 to 8; and R_8 represents a hydrogen atom or a lower alkyl group); X and Y , which may be the same or different, each represent $-CH_2-$, $-NH-$ or $-O-$; and n represents an integer of from 0 to 4, or a salt thereof.

2. A compound or a salt thereof according to claim 1, wherein, in the general formula (I), R_1 represents a halogen atom, a lower alkyl group, a lower alkoxy group or a nitro group; R_2 represents a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted lower alkenyl group or a substituted or unsubstituted aryl group; R_3 represents a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group or a substituted or unsubstituted aryl group; R_4 represents a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, $-OR_5$ or $-NR_6R_7$, wherein R_5 , R_6 , and R_7 , which may be the same or different, each represent a hydrogen atom, a substituted or unsubstituted lower alkenyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a lower



alkoxy group, or a substituted or unsubstituted amino group; or R_6 and R_7 are taken together to form $-(CH_2)_m-$ or $-(CH_2)_lNR_8(CH_2)_k-$ (wherein k , l , and m each represent an integer of from 1 to 8; and R_8 represents a hydrogen atom or a lower alkyl group); X represents $-CH_2-$, $-NH-$ or $-O-$; Y represents $-CH_2-$ or $-NH-$; and n represents 0 or 1,.

3. A compound or a salt thereof according to claim 2, wherein, in the general formula (I), R_1 represents a halogen atom, a lower alkyl group, a lower alkoxy group or a nitro group; R_2 represents a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted lower alkenyl group or a substituted or unsubstituted aryl group; R_3 represents a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group or a substituted or unsubstituted aryl group; R_4 represents a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, $-OR_5$ or $-NR_5R_7$, wherein R_5 represents a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group or a substituted or unsubstituted amino group; and R_6 and R_7 , which may be the same or different, each represent a hydrogen atom, a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group or a lower alkoxy group.



4. A compound or a salt thereof according to claim 1, wherein, in the general formula (I), R_1 represents a methyl group; R_2 represents a substituted or unsubstituted lower alkyl group; R_3 represents a substituted or unsubstituted aryl group; R_4 represents $-NR_6R_7$, wherein R_6 and R_7 , which may be the same or different, each represent a hydrogen atom, a substituted or unsubstituted aryl group or a substituted or unsubstituted heterocyclic group; X and Y, which may be the same or different, each represent $-CH_2-$ or $-NH-$; and n represents 0 or 1.

5. A compound or a salt thereof according to claim 1, wherein, in the general formula (I), R_2 represents a lower alkyl group, a lower alkyl group having two alkoxy groups or an $-O-Z-O-$ group (wherein Z represents a substituted or unsubstituted lower alkylene group) on one carbon atom thereof, a lower alkyl group having a lower alkyl ester group, or a lower alkyl group having a heterocyclic group; R_3 represents an aryl group, an aryl group having a lower alkyl group, or an aryl group having a lower alkoxy group; R_4 represents $-NR_6R_7$, wherein R_6 and R_7 , which may be the same or different, each represent a hydrogen atom, an aryl group, an aryl group having a lower alkyl group, an aryl group having a lower alkoxy group, or an aryl group having a hydroxyl group; X and Y, which may be the same or different, each represent $-CH_2-$ or $-NH-$; and n represents 0.

6. A compound or a salt thereof according to claim 1, wherein, in the general formula (I), R_2 represents a lower alkyl group having two alkoxy groups or an $-O-Z-O-$ group



(wherein Z represents a substituted or unsubstituted lower alkylene group) on one carbon atom thereof; R₃ represents a phenyl group, a phenyl group having a lower alkyl group, or a phenyl group having a lower alkoxy group; R₄ represents -NR₆R₇, wherein R₆ represents a hydrogen atom, and R₇ represents a phenyl group, a phenyl having a lower alkyl group, a phenyl group having a lower alkoxy group, or a phenyl group having a hydroxyl group; X represents -NH-; Y represents -CH₂-; and n represents 0.

7. A compound or a salt thereof according to claim 5, wherein, in the general formula (I), R₂ represents a group represented by formula (III):



wherein R₁₀ and R₁₁ each represent a substituted or unsubstituted lower alkyl group, or a group represented by formula (IV):



wherein Z represents a substituted or unsubstituted lower alkylene group.

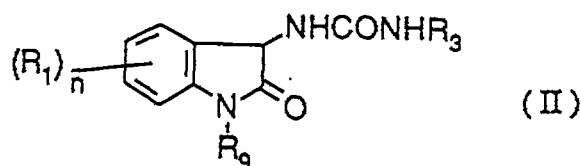
8. A compound or a salt thereof according to claim 1, wherein, in the general formula (I), R₂ represents a 2,2-diethoxyethyl group; R₃ represents a 4-methylphenyl group, R₄ represents -NR₆R₇, wherein R₆ represents a hydrogen atom, and R₇ represents a 4-methylphenyl group; X represents -NH-; Y represents -CH₂-; and n represents 0.



9. A compound or a salt thereof according to claim 1, wherein, in the general formula (I), R₂ represents a 2,2-diethoxyethyl group; R₃ represents a 4-methylphenyl group; R₄ represents -NR₆R₇, wherein R₆ represents a hydrogen atom, and R₇ represents a 4-(N,N-dimethylamino)phenyl group; X represents -NH-; Y represents -CH₂-; and n represents 0.

10. An optically active isomer of a compound according to any of claims 1 to 9, or a salt thereof.

11. A compound represented by formula (II):



wherein R_1 represents a halogen atom, a lower alkyl group, a lower alkoxy group, a hydroxyl group, a nitro group, a trifluoromethyl group, a lower alkylthio group, an acyl group, a carboxyl group, a mercapto group or a substituted or unsubstituted amino group; R_2 represents a substituted or unsubstituted lower alkyl group, a substituted or unsubstituted cycloalkyl group, a substituted or unsubstituted aryl group or a substituted or unsubstituted heterocyclic group; n represents an integer of from 0 to 4; and R_3 represents a group represented by formula (III):



wherein R_{10} and R_{11} each represent a substituted or unsubstituted lower alkyl group,

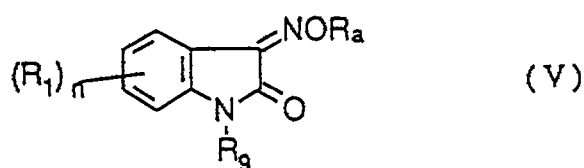


or a group represented by formula (IV):



wherein Z represents a substituted or unsubstituted lower alkylene group, or a salt thereof.

12. A compound represented by formula (V):



wherein R_1 represents a halogen atom, a lower alkyl group, a lower alkoxy group, a hydroxyl group, a nitro group, a trifluoromethyl group, a lower alkylthio group, an acyl group, a carboxyl group, a mercapto group or a substituted or unsubstituted amino group; R_9 represents a group represented by formula (III):



wherein R_{10} and R_{11} each represent a substituted or unsubstituted lower alkyl group, or a group represented by formula (IV):



wherein Z represents a substituted or unsubstituted lower alkylene group, n represents an integer of from 0 to 4; and



R_a represents a lower alkyl group or an aralkyl group, or a salt thereof.

