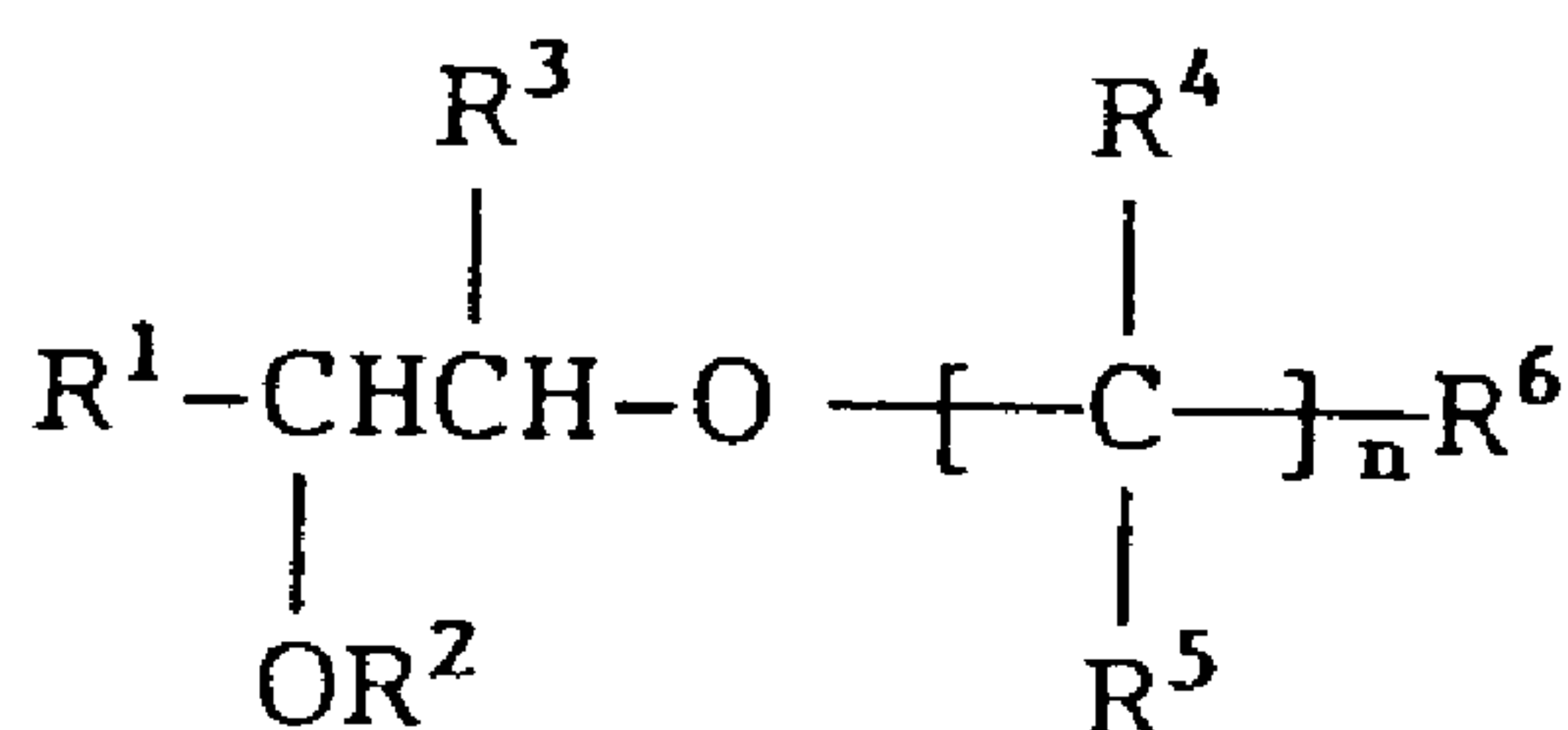




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(72) Inventeurs/Inventors:
ONO, SATOSHI, JP;
MAEKAWA, MUTSUOKO, JP;
HIRATA, KAZUNARI, JP;
NARITA, HIROKAZU, JP
(73) Propriétaire/Owner:
TOYAMA CHEMICAL CO. LTD., JP
(74) Agent: MARKS & CLERK

(54) Titre : POTENTIALISATEUR DE L'ACTIVITE DU FACTEUR DE CROISSANCE NERVEUSE CONTENANT UN
DERIVE DE 1,2-ETHANEDIOL OU UN SEL DE CELUI-CI
(54) Title: AGENT FOR POTENTIATING NERVE GROWTH FACTOR ACTIVITY CONTAINING 1,2-ETHANEDIOL
DERIVATIVE OR SALT THEREOF



[I]

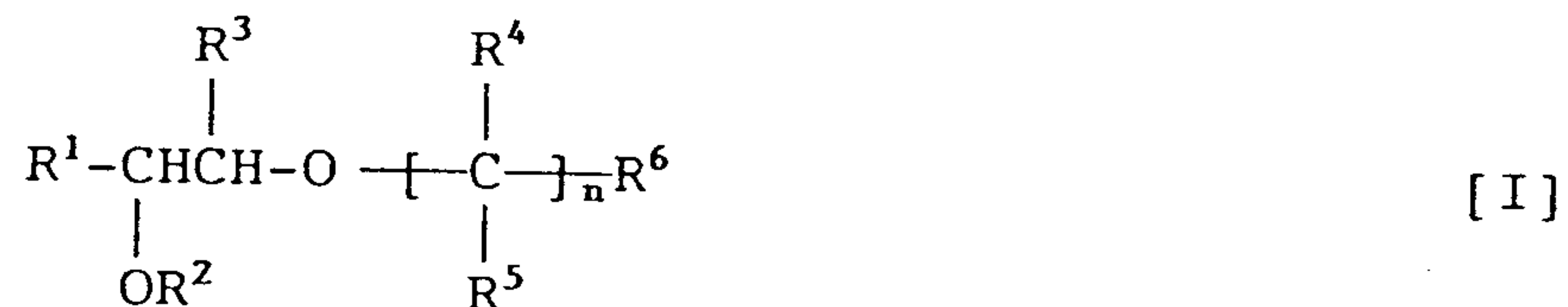
(57) **Abrégé/Abstract:**

A 1,2-ethanediol derivative represented by the general formula [I] or its salt: (see formula I) has a NGF activity-potentiating effect and is useful as a remedy for various diseases caused by degeneration of the peripheral nervous system such as senile dementia of Alzheimer type, Huntington's chorea, various neuropathies, Riley-Day syndrome, traumatic nerve injury, amyotrophic lateral sclerosis (ALS) and the like.



ABSTRACT

A 1,2-ethanediol derivative represented by the general formula [I] or its salt:



has a NGF activity-potentiating effect and is useful as a remedy for various diseases caused by degeneration of the peripheral nervous system such as senile dementia of Alzheimer type, Huntington's chorea, various neuropathies, Riley-Day syndrome, traumatic nerve injury, amyotrophic lateral sclerosis (ALS) and the like.

DESCRIPTION

AGENT FOR POTENTIATING NERVE GROWTH FACTOR ACTIVITY
CONTAINING 1,2-ETHANEDIOL DERIVATIVE OR SALT THEREOF

TECHNICAL FIELD

This invention relates to a 1,2-ethanediol derivative or a salt thereof which potentiates the activity of a nerve growth factor (referred to herein-
5 after as NGF).

BACKGROUND ART

It has been known that NGF acts as a survival and maintenance as well as neurite outgrowth factor for sympathetic neurons and sensory neurons in the peripheral
10 nervous system [Physiol. Rev., vol. 60, pages 1284-1335 (1980) and Ann. Rev. Biochem., vol. 51, pages 845-868 (1982)] and that high NGF levels were found in the regions innervated by the magnocellular neurons (hippocampus, neocortex, olfactory bulb), and in the
15 regions containing the cell bodies of these neurons (septum, nucleus of the diagonal band of Broca, nucleus basalis of Meynert) and that NGF acts as neurotrophic factor for magnocellular cholinergic neurons [EMBO J., vol. 4, pages 1389-1393 (1985)].

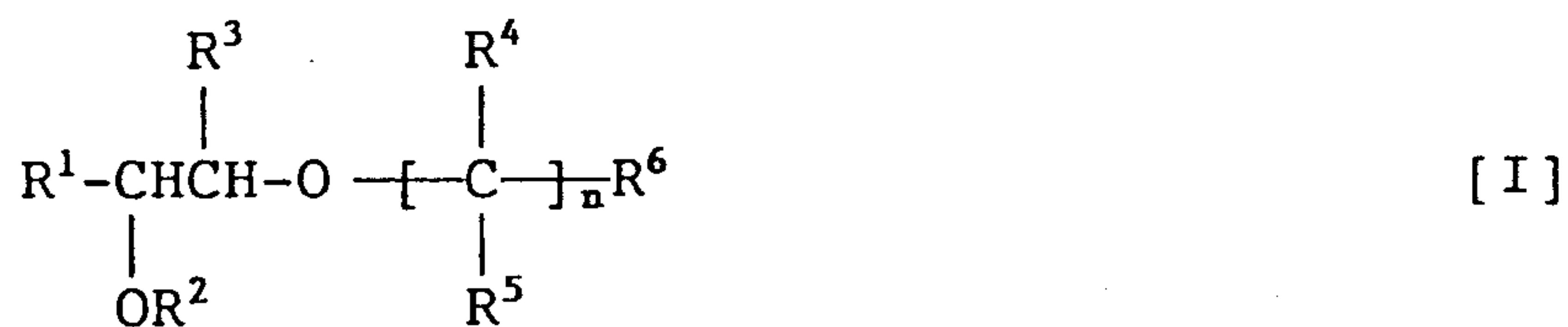
20 NGF has also been drawing attention in terms of relation to central nervous diseases such as senile dementia of Alzheimer type [Science, vol. 232, page 1341 (1986)], Huntington's chorea [Neurosci. Lett., vol. 40,

No. 2, pages 161-164 (1992)], and to peripheral nervous diseases such as various neuropathies {diabetic neuropathy [Brain Res., vol. 634, pages 7-12 (1994)], neuropathy caused by drugs (Brain Res., vol. 640, pages 5 195-204 (1994)) and the like}, Riley-Day syndrome [Japanese J. of Clinical Medicine, vol. 50, No. 4, pages 178-183 (1992)], traumatic neuropathy [Pharmacol. Ther., vol. 65, No. 1, pages 1-16 (1995)], amyotrophic lateral sclerosis (ALS) [Nature Medicine, vol. 1, No. 2, pages 10 168-172 (1995) and the like.

An attempt has been made to use NGF or a NGF-like substance for the treatment of central and peripheral nervous diseases described above [Brain and Nerve, vol. 43, No. 12, pages 1101-1112 (1991) and the 15 like]. However, these substances are all proteins, and when they are used as drugs, their stability, antigenicity and the like will become a problem. Therefore, a compound useful as a drug for potentiating the NGF activity has been desired.

20 DISCLOSURE OF THE INVENTION

Under such circumstances, the present inventors have made extensive research and have consequently found that a 1,2-ethanediol derivative represented by the following general formula [I] or a salt thereof 25 potentiates the NGF activity:



5 wherein R¹ represents a substituted or unsubstituted
 phenyl, naphthyl, indanyl, indenyl, tetrahydronaphthyl or
 heterocyclic group; R² represents a hydrogen atom, a lower
 alkyl group or a hydroxyl-protecting group; R³ represents
 a hydrogen atom or a lower alkyl group; nR⁴'s may be the
 same as or different from one another and each represents
 10 a hydrogen atom or a lower alkyl group; nR⁵'s may be the
 same as or different from one another and each represents
 a hydrogen atom or a lower alkyl group; R⁶ represents a
 substituted or unsubstituted amino or nitrogen-containing
 heterocyclic group or an ammonio group; and n represents
 15 0 or an integer of 1 to 6.

In one preferred embodiment of the invention:

R¹ represents a phenyl group which is optionally
 substituted by a halogen atom, substituted or unsubstituted
 amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl,
 20 C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy,
 C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio,
 ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino,
 arylsulfonylamino, protected amino, protected or
 unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;
 25 R² represents a hydrogen atom or a C₁₋₆alkyl,

3a

C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

nR^{4'}'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR^{5'}'s are hydrogen atoms;

- 5 R⁶ represents an amino or benzothienylmethylamino group, which group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected
- 10 amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-
- 15 C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

In another preferred embodiment:

- 20 R¹ is a phenyl, halogen-substituted phenyl, C₁₋₆alkylsubstituted phenyl or C₁₋₄alkylsubstituted biphenyl group;

R² is a hydrogen atom;

nR^{4'}'s are hydrogen atoms;

- 25 nR^{5'}'s are hydrogen atoms;

3b

R⁶ is an amino group which is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

In yet another preferred embodiment:

R¹ is a naphthyl group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² is a hydrogen atom, or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

3c

nR^4 's may be the same as or different from one another and each represents a hydrogen atom or a C_{1-6} alkyl group;

nR^5 's are hydrogen atoms;

R^6 is an ammonio group or an amino, pyrrolyl, piperazinyll, imidazolyl, pyrazolyl, pyridyl, pyrimidyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, quinuclidinyl, thiazolyl or thiadiazolyl group, which group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C_{1-6} alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C_{1-6} alkoxy group-substituted or unsubstituted C_{1-6} alkoxy group, a halo- C_{1-6} alkyl group, a C_{1-6} acyl group, an ar- C_{1-4} alkyl group, an ar- C_{2-4} alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C_{1-6} alkylsulfonyl group or an arylsulfonyl group.

In a further preferred embodiment:

R^1 is a naphthyl group;

R^2 is a hydrogen atom;

R^3 is a hydrogen atom;

nR^4 's are hydrogen atoms;

3d

R⁶ is an amino group which is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

In yet a further preferred embodiment:

R¹ is a heterocyclic group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy.

Another embodiment of the invention is disclosed in which:

3e

R¹ is a benzothienyl, benzofuranyl or 2,3-dihydrobenzothienyl group which is unsubstituted or substituted by a halogen atom, a C₁₋₆alkyl group, a C₁₋₆alkoxy group or a phenyl group;

5 R² is a hydrogen atom;

R³ is a hydrogen atom;

nR⁴'s and nR⁵'s are hydrogen atoms;

R⁶ is an amino, pyrrolidinyl, piperazinyl, tetrahydropyridyl or morpholinyl group which is
10 unsubstituted or substituted by a C₁₋₆alkyl group, or a halogen-substituted or unsubstituted aroyl group.

More preferably:

R¹ is a benzothienyl group which is unsubstituted or substituted by a halogen atom or a C₁₋₆alkyl group;

15 R⁶ is an amino group which is unsubstituted or substituted by a C₁₋₆alkyl group; and

n is 2.

In a particular preferred embodiment:

R¹ is an unsubstituted or halogen-substituted
20 benzo[b]thiophen-5-yl group;

R⁶ is a di-C₁₋₆alkyl amino group.

The invention discloses further preferred embodiments,
one in which:

3f

R¹ represents a phenyl group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl,

C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy,

5 C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy,

ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl,

C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino,

protected or unprotected hydroxyl, nitro, oxo, or

C₁₋₄alkylenedioxy;

10 R² represents a hydrogen atom or a C₁₋₆alkyl,

C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s are hydrogen atoms; and

15 R⁶ represents an amino or benzothienylmethylamino group,

which group is optionally substituted by at least one

substituent which at each occurrence is a halogen atom, a

protected or unprotected hydroxyl group, a protected or

unprotected carboxyl group, a protected or unprotected

20 amino group, a C₁₋₆alkyl group which is unsubstituted or

substituted by a protected or unprotected hydroxyl group, a

halogen-substituted or unsubstituted aryl group, a halogen-

substituted or unsubstituted aroyl group, a C₁₋₆alkoxy

group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-

25 C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group,

3g

an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

In another:

5 R¹ is a phenyl, halogen-substituted phenyl, C₁₋₆alkylsubstituted phenyl or C₁₋₄alkylsubstituted biphenyl group;

 R² is a hydrogen atom;

 nR^{4'}s are hydrogen atoms;

10 nR^{5'}s are hydrogen atoms; and

 R⁶ is an amino group which is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

And another:

3h

R¹ is a naphthyl group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² is a hydrogen atom or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, ar-C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s are hydrogen atoms;

R⁶ is an ammonio group or an amino, pyrrolyl, piperazinyll, imidazolyl, pyrazolyl, pyridyl, pyrimidyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, quinuclidinyl, thiazolyl or thiadiazolyl group, which group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or

3i

unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or
 unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group,
 a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl
 group, a heterocyclic group, a heterocyclic carbonyl group,
 5 an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl
 group.

In yet another embodiment:

R¹ is a naphthyl group;

R² is a hydrogen atom;

10 R³ is a hydrogen atom;

nR^{4'}s are hydrogen atoms;

R⁶ is an amino group which is optionally substituted by at
 least one substituent which at each occurrence is a halogen
 atom, a protected or unprotected hydroxyl group, a
 15 protected or unprotected carboxyl group, a protected or
 unprotected amino group, a C₁₋₆alkyl group which is
 unsubstituted or substituted by a protected or unprotected
 hydroxyl group, a halogen-substituted or unsubstituted aryl
 group, a halogen-substituted or unsubstituted aroyl group,
 20 a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy
 group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group,
 an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group,
 a heterocyclic group, a heterocyclic carbonyl group, an oxo
 group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

25 And yet another:

3j

R¹ is a heterocyclic group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy.

In still another embodiment of the invention:

R¹ is a benzothienyl, benzofuranyl or 2,3-dihydrobenzothienyl group which is unsubstituted or substituted by a halogen atom, a C₁₋₆alkyl group, a C₁₋₆alkoxy group or a phenyl group;

R² is a hydrogen atom;

R³ is a hydrogen atom;

nR⁴'s and nR⁵'s are hydrogen atoms;

R⁶ is an amino, pyrrolidinyl, piperazinyl, tetrahydropyridyl or morpholinyl group which is unsubstituted or substituted by a C₁₋₆alkyl group, or a halogen-substituted or unsubstituted aroyl group.

In a further preferred embodiment:

R¹ is a benzothienyl group which is unsubstituted or substituted by a halogen atom or a C₁₋₆alkyl group;

R⁶ is an amino group which is unsubstituted or substituted by a C₁₋₆alkyl group; and

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n is 2.

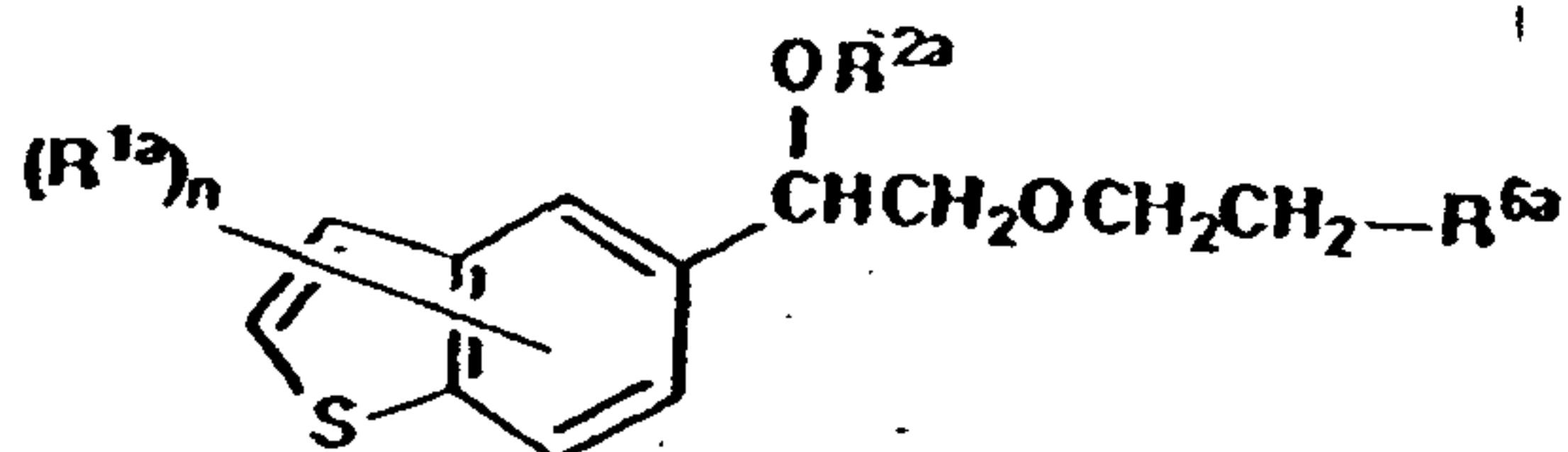
And more preferably:

R^1 is an unsubstituted or halogen-substituted benzo[b]thiophen-5-yl group; and

5 R^6 is a di- C_{1-6} alkyl amino group.

The invention also discloses another compound useful in the preparation of a medicament for potentiating nerve growth factor activity for the treatment of a disease caused by degeneration of the peripheral nervous system, the
10 compound being a 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:

15



wherein:

R^{1a} at each occurrence is fluorine, chlorine, bromine,
20 iodine, C_{1-6} alkyl, C_{1-6} alkoxy or phenyl;

R^{2a} represents a hydrogen atom or a C_{1-6} alkyl, C_{1-6} acyl, tetrahydropyranyl, or ar- C_{1-6} alkyl group;

R^{6a} represents a C_{1-6} alkylsubstituted amino group or a pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl,
25 pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl,

morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl,
 tetrahydroquinolinyl, tetrahydroisoquinolinyl,
 quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl,
 pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl,
 5 pyrazolidinyl, purinyl, indazolyl, furyl, thienyl,
 benzothienyl, pyranyl, isobenzofuranyl, oxazolyl,
 benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl,
 benzothiazolyl, quinoxalyl, dihydroquinoxalinyl,
 2,3-dihydrobenzothienyl, 2,3-dihydrobenzopyrrolyl,
 10 2,3-dihydro-4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl,
 benzo[b]dioxanyl, imidazo[2,3-a]pyridyl,
 benzo[b]piperazinyl, chromenyl, isothiazolyl, isoxazolyl,
 thiadiazolyl, oxadiazolyl, pyridazinyl, isoindolyl or
 isoquinolyl group; and

15 n represents an integer of 1 to 5.

Various preferred embodiments of this aspect of the invention include embodiments in which:

each R^{1a} is a C_{1-6} alkyl group; and n is an integer of 1 to 5; or

20 R^{1a} at each occurrence is fluorine, chlorine, bromine or iodine; and n is an integer of 1 to 5; or

R^{1a} is a fluorine atom; and n is an integer of 1 to 5; or

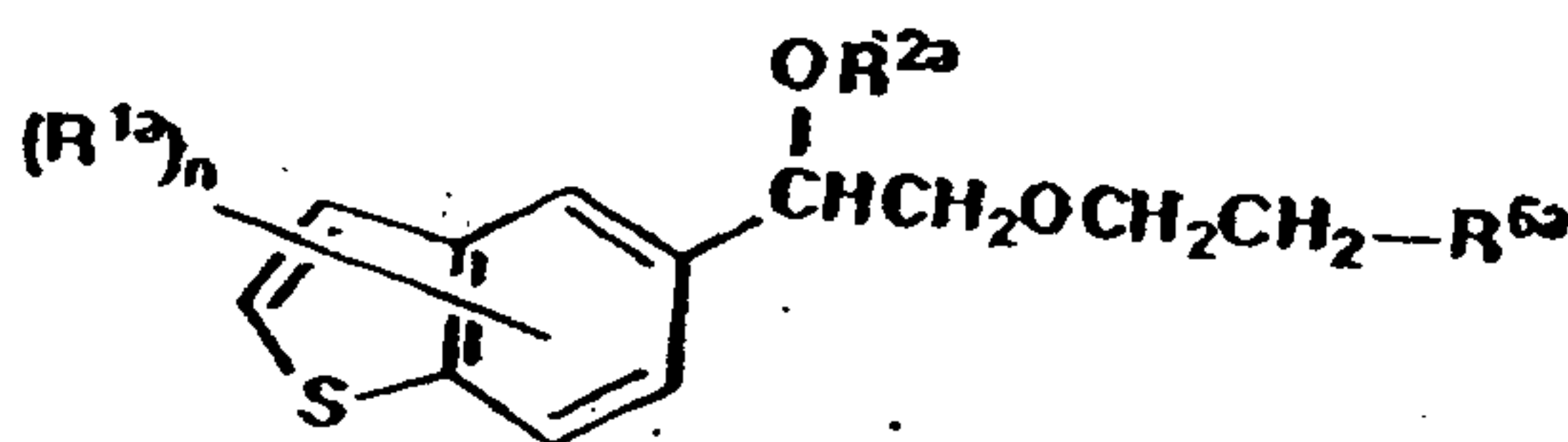
R^{1a} is a fluorine atom bonded to the 6-position; R^{2a} is a hydrogen atom; a C_{1-6} alkylsubstituted amino group of R^{6a} is a
 25 diethylamino group; and n is an integer of 1; or

3m

R^{1a} is a fluorine atom bonded to the 4-position; R^{2a} is a hydrogen atom; a C_{1-6} alkyl-substituted amino group of R^{6a} is a diethylamino group; and n is an integer of 1.

The 1,2-ethanediol derivative may be an optically active compound.

The invention also discloses a nerve growth factor activity-potentiating pharmaceutical composition for the treatment of a disease caused by degeneration of the peripheral nervous system, comprising a pharmaceutically acceptable diluent or carrier and a 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:



wherein:

R^{1a} at each occurrence is fluorine, chlorine, bromine, iodine, C_{1-6} alkyl, C_{1-6} alkoxy or phenyl;

R^{2a} represents a hydrogen atom or a C_{1-6} alkyl, C_{1-6} acyl, tetrahydropyranyl, or ar- C_{1-6} alkyl group;

R^{6a} represents a C_{1-6} alkylsubstituted amino group or a pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl,

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pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl,
 pyrazolidinyl, purinyl, indazolyl, furyl, thienyl,
 benzothienyl, pyranyl, isobenzofuranyl, oxazolyl,
 benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl,
 5 benzothiazolyl, quinoxalyl, dihydroquinoxalyl, 2,3-
 dihydrobenzothienyl, 2,3-dihydrobenzopyrrolyl, 2,3-dihydro-
 4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl,
 benzo[b]dioxanyl, imidazo[2,3-a]pyridyl,
 benzo[b]piperazinyl, chromenyl, isothiazolyl, isoxazolyl,
 10 thiadiazolyl, oxadiazolyl, pyridazinyl, isoindolyl or
 isoquinolyl group; and

n represents an integer of 1 to 5.

In preferred embodiments of the pharmaceutical
 composition:

15 R^{1a} is a C_{1-6} alkyl group; and n is an integer of 1 to 5; or

R^{1a} at each occurrence is fluorine, chlorine, bromine or
 iodine; and n is an integer of 1 to 5; or

R^{1a} is a fluorine atom; and n is an integer of 1 to 5; or

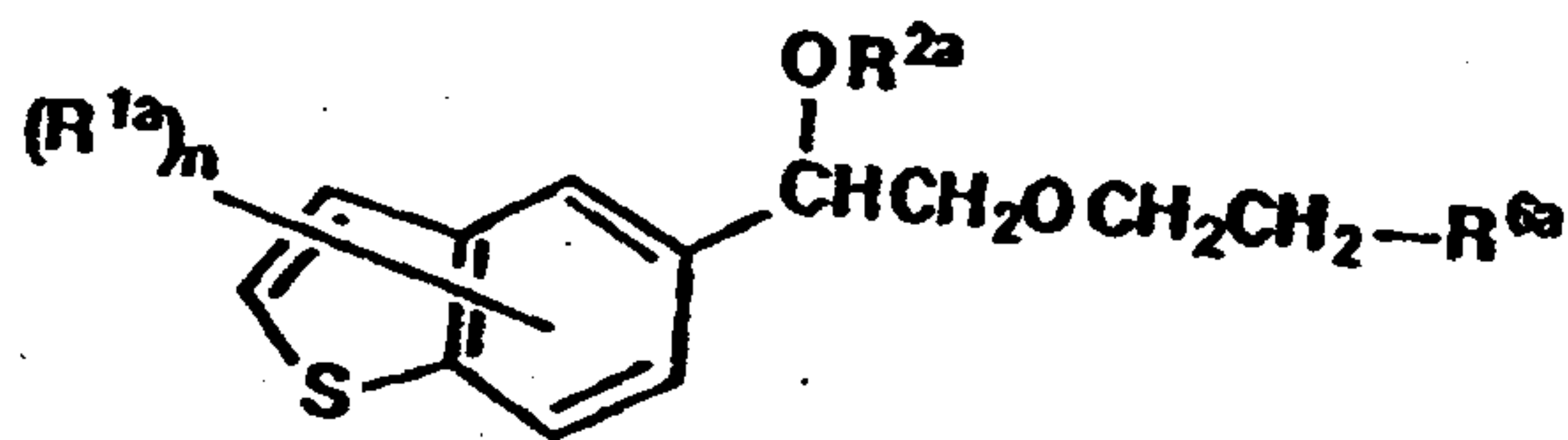
20 R^{1a} is a fluorine atom bonded to the 6-position; R^{2a} is a
 hydrogen atom; a C_{1-6} alkyl substituted amino group of R^{6a} is
 a diethylamino group; and n is an integer of 1; or

R^{1a} is a fluorine atom bonded to the 4-position; R^{2a} is a
 hydrogen atom; a C_{1-6} alkyl-substituted amino group of R^{6a} is
 a diethylamino group; and n is an integer of 1.

30

The 1,2-ethanediol derivative in the pharmaceutical composition may also be an optically active compound.

The invention also discloses a 1,2-ethanediol derivative represented by the following general formula or
5 a pharmaceutically acceptable salt thereof:



10

wherein nR^{1a} 's may be the same as or different from one another and each represents a fluorine, chlorine, bromine or iodine atom, C_{1-6} alkyl, C_{1-6} alkoxy or phenyl group; R^{2a}
15 represents a hydrogen atom; R^{6a} represents a C_{1-6} alkyl-substituted amino, piperidyl or morpholinyl group; and n represents an integer of 1 to 5.

In preferred embodiments of the invention:

each R^{1a} is a C_{1-6} alkyl group; and n is an integer of 1 to
20 5; or

R^{1a} at each occurrence is fluorine, chlorine, bromine or iodine; and n is an integer of 1 to 5; or

R^{1a} is a fluorine atom; and n is an integer of 1 to 5; or

3p

R^{1a} is a fluorine atom bonded to 6-position; R^{2a} is a hydrogen atom; a C_{1-6} alkyl-substituted amino group of R^{6a} is a diethylamino group; and n is an integer of 1; or

R^{1a} is a fluorine atom bonded to 4-position; R^{2a} is a hydrogen atom; a C_{1-6} alkyl-substituted amino group of R^{6a} is a diethylamino group; and n is an integer of 1.

The 1,2-ethanediol derivative may be an optically active compound as well.

This invention is explained in detail below.

10 In the present specification, unless otherwise specified, the terms used herein have the following meanings.

The term "halogen atom" means fluorine atom, chlorine atom, bromine atom or iodine atom. The term "lower alkyl group" means a C_{1-6} alkyl group such as methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, pentyl, hexyl or the like. The term "lower alkenyl group" means a C_{2-6} alkenyl group such as vinyl, propenyl, butenyl, pentenyl, hexenyl or the like. The term "lower alkenyloxy group" means a C_{2-6} alkenyl-O-

15

20

group. The term "cycloalkyl group" means a C_{3-6} cycloalkyl group such as cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl or the like. The term "lower alkoxy group" means a C_{1-6} alkyl-O- group. The term "lower alkylthio group" means a C_{1-6} alkyl-S- group. The term "halo-lower alkyl group" means a halogen- C_{1-6} alkyl group. The term "aryl group" means a phenyl, naphthyl, indanyl or indenyl group. The term "aryloxy group" means an aryl-O- group. The term "ar-lower alkyl group" means an ar- C_{1-4} alkyl group such as benzyl, diphenylmethyl, trityl, phenethyl or the like. The term "ar-lower alkoxy group" means an ar- C_{1-4} alkyl-O- group. The term "ar-lower alkylthio group" means an ar- C_{1-4} alkyl-S- group. The term "ar-lower alkenyl group" means an ar- C_{2-4} alkenyl group. The term "lower alkylenedioxy group" means a C_{1-4} alkylenedioxy group such as methylenedioxy, ethylenedioxy or the like. The term "lower acyl group" means a C_{1-6} acyl group such as formyl, acetyl, butyryl or the like. The term "aroyl group" means an aryl-CO- group. The term "lower alkylsulfonyl group" means a C_{1-6} alkyl-SO₂ group. The term "ar-lower alkylsulfonyl group" means an ar- C_{1-6} alkyl-SO₂- group. The term "arylsulfonyl group" means an aryl-SO₂- group. The term "arylsulfonylamino group" means an aryl-SO₂NH₂- group. The term "lower alkylsulfonylamino group" means a C_{1-6} alkyl-SO₂NH- group. The term "di-lower alkyl amino group" means a $(C_{1-6}alkyl)_2N$ - group such as dimethylamino, diethylamino or the like. The term "ammonio

group" means a tri-lower alkylammonio group such as trimethylammonio, triethylammonio or the like. The term "nitrogen-containing heterocyclic group" means a heterocyclic group of a 5-membered or 6-membered ring, fused
5 ring or bridged ring containing at least one nitrogen atom as hetero atom forming the ring which may further contain at least one oxygen or sulfur atom such as pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl,
10 pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl, indazolyl or the
15 like. The term "heterocyclic group" means the above-mentioned nitrogen-containing heterocyclic group or a 5-membered or 6-membered ring, a fused ring or a bridged ring containing at least one hetero atom selected from the group consisting of nitrogen, oxygen or sulfur atom
20 which may contain at least one oxygen or sulfur atom as hetero atom forming the ring such as furyl, thienyl, benzothienyl, pyranyl, isobenzofuranyl, oxazolyl, benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl, benzothiazolyl, quinoxalyl, dihydroquinoxaliny, 2,3-dihydro-
25 benzothienyl, 2,3-dihydrobenzopyrrolyl, 2,3-dihydro-4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl, benzo[b]dioxanyl, imidazo[2,3-a]pyridyl, benzo[b]piperazinyl, chromenyl, isothiazolyl, isoxazolyl, thiadiazolyl, oxadiazolyl,

pyridazinyl, isoindolyl, isoquinolyl or the like. The term "heterocyclic carbonyl group" means a heterocyclic-CO- group.

The substituents of the phenyl, naphthyl, indanyl, indenyl, tetrahydronaphthyl and heterocyclic groups in R^1 include, for example, halogen atoms; substituted or unsubstituted amino, lower alkyl, aryl, ar-lower alkyl, lower alkoxy, ar-lower alkoxy, aryloxy, carbamoyloxy, lower alkylthio, lower alkenyl, lower alkenyloxy, ar-lower alkylthio, ar-lower alkylsulfonyl, arylsulfonyl, lower alkylsulfonylmaino, arylsulfonylamino and heterocyclic groups; protected amino groups; protected or unprotected hydroxyl groups; nitro group; oxo group; lower alkylenedioxy groups and the like.

The substituents of the lower alkyl, aryl, ar-lower alkyl, lower alkoxy, ar-lower alkoxy, aryloxy, carbamoyloxy, lower alkylthio, lower alkenyl, lower alkenyloxy, ar-lower alkylthio, ar-lower alkylsulfonyl, arylsulfonyl, lower alkylsulfonylmaino, arylsulfonylamino and heterocyclic groups in the substituent of the phenyl, naphthyl, indanyl, indenyl, tetrahydronaphthyl and heterocyclic groups of R^1 ; and the substituents of the nitrogen-containing heterocyclic group in R^6 include halogen atoms, protected or unprotected hydroxyl groups, protected or unprotected carboxyl groups, protected or unprotected amino groups, lower alkyl groups which is unsubstituted or substituted by a protected or unprotected hydroxyl group, halogen-substituted or

unsubstituted aryl groups, halogen-substituted or
unsubstituted aroyl groups, lower alkoxy group-
substituted or unsubstituted lower alkoxy groups, halo-
lower alkyl groups, lower acyl groups, ar-lower alkyl
5 groups, ar-lower alkenyl groups, heterocyclic groups,
heterocyclic carbonyl groups, oxo group, lower alkyl-
sulfonyl groups and arylsulfonyl groups and these may be
substituted by at least one of these substituents.

The substituents of the amino group in R^1 and
10 the substituted amino group in R^6 include protected or
unprotected hydroxyl groups, lower alkyl groups which are
unsubstituted or substituted by a protected or
unprotected hydroxyl or carboxyl group, cycloalkyl
groups, aryl groups, lower acyl groups, ar-lower alkyl
15 groups, heterocyclic groups, oxo group-substituted or
unsubstituted heterocyclic carbonyl groups, adamantyl
group, lower alkylsulfonyl groups and arylsulfonyl
groups, and these may be substituted by at least one of
these substituents.

20 Hydroxyl-protecting group of R^2 and the
protective group of hydroxyl, carboxyl and amino groups
included in the substituents include usual hydroxyl-,
carboxyl- and amino-protecting groups mentioned in
"Protective Groups in Organic Synthesis" by Theodora W.
25 Greene (1981), published by John Wiley & Sons, Inc. and
in particular, as the hydroxyl-protecting group, there
are mentioned lower alkyl groups, lower acyl groups,
tetrahydropyranyl group and substituted or unsubstituted

ar-lower alkyl groups such as benzyl.

The salt of the 1,2-ethanediol derivative represented by the general formula [I] may be any pharmaceutically acceptable salt and includes salts with
5 mineral acids such as hydrochloric acid, hydrobromic acid, sulfuric acid, phosphoric acid and the like; salts with carboxylic acids such as formic acid, acetic acid, oxalic acid, fumaric acid, maleic acid, malic acid, tartaric acid, aspartic acid and the like; salts with
10 sulfonic acids, such as methanesulfonic acid, benzene-sulfonic acid, p-toluenesulfonic acid, naphthalene-sulfonic acid and the like; salts with alkali metals such as sodium, potassium and the like; etc.

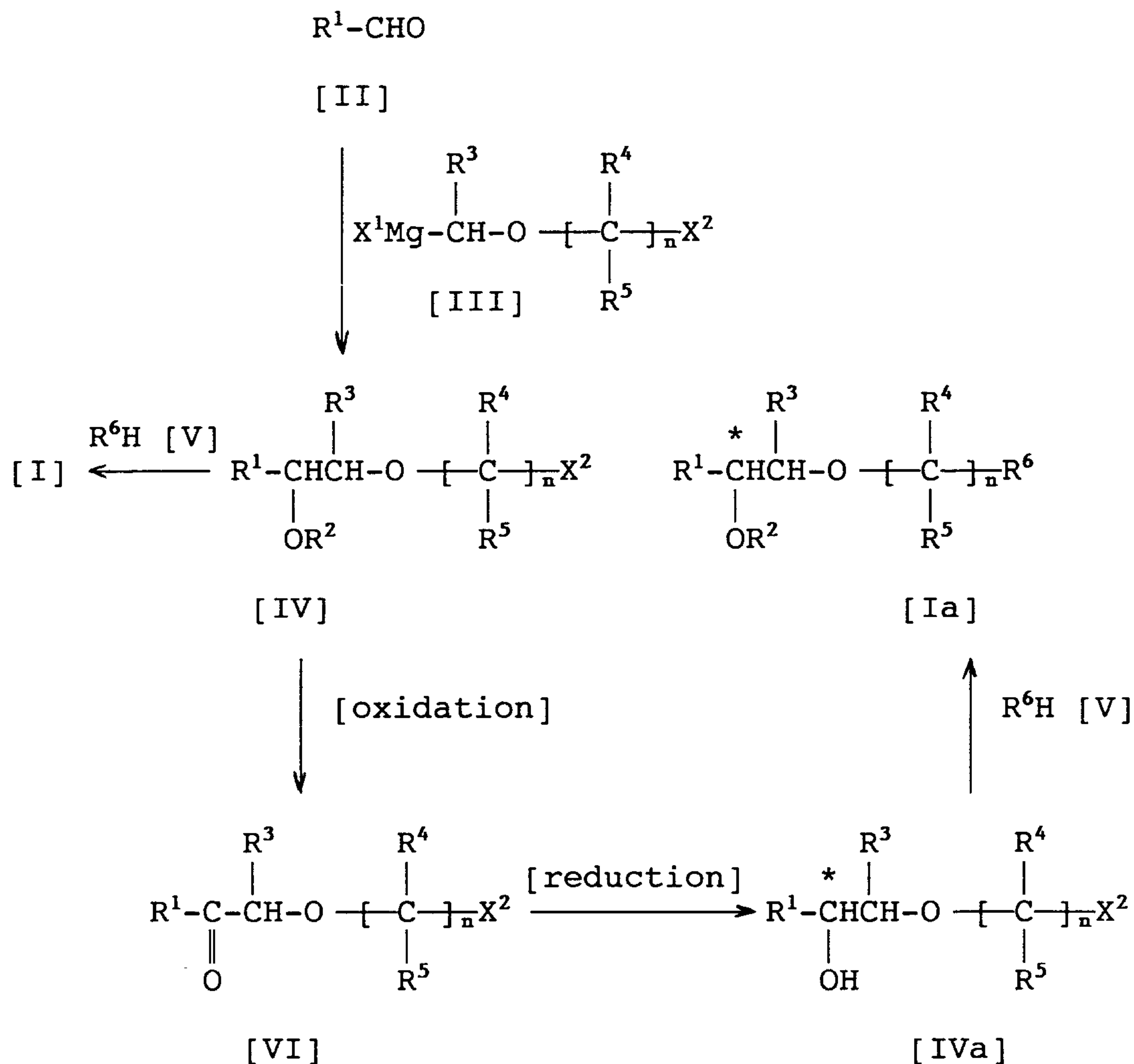
When the 1,2-ethanediol derivative represented
15 by the general formula [I] or its salt has isomers (for example, optical isomers, geometrical isomers, tautomers and the like), this invention includes all these isomers, and also include hydrates, solvates and all crystal forms of the above compound or its salt.

20 The 1,2-ethanediol derivative represented by the general formula [I] or its salt can be formed into a preparation such as tablet, capsule, powder, granules, fine granules, pill, suspension, emulsion, solution, syrup, injection or the like using a pharmaceutically
25 acceptable preparation adjuvant such as excipient, carrier, diluent or the like in a conventional manner, and the resulting preparation can be administered orally or parenterally. The administration route, dosage and

number of administrations may be adequately varied depending upon the age, weight and symptom of a patient and in the case of oral administration, the dosage is usually 0.01 to 500 mg/day per adult and this may be
5 administered in one to several portions.

An explanation is made below of a process for producing the 1,2-ethanediol derivative represented by the general formula [I] or its salt.

The 1,2-ethanediol derivative represented by the
10 general formula [I] or its salt can be produced by the methods described in JP-A-3-47,158; JP-A-3-197,422; JP-A-3-232,830; and JP-A-4-95,070 and the like or methods known per se or in appropriate combinations thereof, for example, according to each of the following production
15 processes.



wherein R^1 , R^2 , R^3 , R^4 , R^5 , R^6 and n have the same meanings as described above, * represents an asymmetric carbon and X^1 and X^2 represent halogen atoms.

Production Process 1

- 5 (1) A compound of the general formula [IV] or its salt can be produced by reacting a compound of the general formula [II] with a compound of the general formula [III].

In this reaction, any solvent may be used as
 10 far as it does not adversely affect the reaction, and the

solvent includes ethers such as diethyl ether, tetrahydrofuran, dioxane and the like; aromatic hydrocarbons such as benzene, toluene and the like; etc. These solvents may be used alone or in admixture of two or
5 more.

In the above reaction, the amount of the compound of the general formula [III] used is 0.8 to 100 moles, preferably 0.8 to 10 moles, per mole of the compound of the general formula [II].

10 Said reaction may be carried out usually at a temperature of -78°C to $+100^{\circ}\text{C}$, preferably -78°C to $+50^{\circ}\text{C}$, for a period of 5 minutes to 24 hours.

The compound of the general formula [IV] or its salt thus obtained may be used in the subsequent reaction
15 as it is without being isolated.

Incidentally, the compound of the general formula [III] used here can be produced by a method known per se, for example, the method described in Bull. Soc. Chim. Fr., 1967(5), pages 1533-1540.

20 (2) The compound of the general formula [I] or its salt can be produced by reacting the compound of the general formula [IV] or its salt with a compound of the general formula [V] or its salt in the presence or absence of a catalyst and in the presence or absence of a
25 base.

In this reaction, any solvent may be used as far as it does not adversely affect the reaction, and the solvent includes halogenated hydrocarbons such as

methylene chloride, chloroform and the like; ethers such as tetrahydrofuran, dioxane and the like; alcohols such as ethanol, propanol, butanol and the like; nitriles such as acetonitrile and the like; amides such as N,N-
5 dimethylformamide and the like; water; etc. These solvents may be used alone or in admixture of two or more.

The optionally used catalyst includes, for example, potassium iodide, sodium iodide and the like.

10 The amount of the catalyst used is 0.1 to 1 mole per mole of the compound of the general formula [IV] or its salt.

The optionally used base includes organic and inorganic bases such as triethylamine, diisopropylethyl-
15 amine, 1,8-diazobicyclo[5.4.0]undec-7-ene (DBU), pyridine, potassium tert-butoxide, sodium carbonate, potassium carbonate, sodium hydride and the like. Also, the compound of the general formula [V] or its salt can be used as the base.

20 The amount of the compound of the general formula [V] or its salt or the base used is at least one mole, preferably 1 to 20 moles, per mole of the compound of the general formula [IV] or its salt.

Said reaction may be carried out usually at a
25 temperature of 10°C to 150°C, preferably 20°C to 100°C, for a period of 10 minutes to 20 hours.

The compounds or bases used in each of the above production processes can also be used as solvents

depending upon their properties.

When the compounds of the general formulas [II], [III], [IV] and [V] in the above-mentioned production processes have isomers (for example, optical
5 isomers, geometrical isomers, tautomers and the like), all of them can be used, and also, they can be used in the form of hydrates and solvates and in all crystal forms.

When the compounds of the general formulas
10 [II], [III], [IV] and [V] have a hydroxyl group, an amino group or a carboxyl group, said hydroxyl, amino or carboxyl group may previously be protected with a conventional protective group and, after the reaction, the protective group can, if necessary, be removed in a
15 manner known per se.

Production Process 2

(1) A compound represented by the general formula [VI] or its salt can be produced by oxidizing the compound represented by the general formula [IV] or its
20 salt by a conventional method as described in "Modern Synthetic Reactions", Second Edition by Herbert O. House (1972) published by W.A. Benjamin, Inc., or the like.

Any solvent may be used in this reaction as far as it does not adversely affect the reaction, and the
25 solvent includes ethers such as diethyl ether, tetrahydrofuran, dioxane and the like; aromatic hydrocarbons such as benzene, toluene and the like; etc. These

solvents may be used alone or in admixture of two or more.

The compound represented by the general formula [VI] or its salt thus obtained can be used in the subsequent reaction as it is without being isolated.

(2) A compound represented by the general formula [IVa] or its salt can be produced by reducing the compound represented by the general formula [VI] or its salt in the presence or absence of a catalyst and in the presence or absence of a base by a method known per se, for example, the method described in Tetrahedron Letters, vol. 33, No. 29, page 4102, or the like.

(3) The compound of the general formula [I] or its salt can be produced by reacting the compound represented by the general formula [IVa] or its salt with the compound represented by the general formula [V] in the presence or absence of a catalyst and in the presence or absence of a base in the same manner as in the Production Process 1 (2) mentioned above.

The 1,2-ethanediol derivative represented by the general formula [I] or its salt thus obtained can be purified and isolated by a conventional method such as extraction, crystallization, distillation, column chromatography or the like. Also, the 1,2-ethanediol derivative represented by the general formula [I] or its salt can be converted to another 1,2-ethanediol derivative or its salt by an adequate combination of known methods per se such as oxidation reaction,

- 15 -

reduction reaction, addition reaction, acylation reaction, alkylation reaction, sulfonylation reaction, deacylation reaction, substitution reaction, dehydration reaction, hydrolysis reaction and the like.

5 Reference Examples and Production Examples are shown below for more specifically explaining the processes for producing the compounds of this invention.

 In the following Reference Examples and Production Examples, the mixing ratio of the solvents is all
10 indicated in volume basis. In column chromatographic purification, Silica gel (70-230 meshes, mfd. by Merck & Co., Inc.) is used as a support. In moderate pressure column chromatographic purification, LC Sorb SP-A-SiTM (mfd. by Chemco) are used as a support.

15 The compound of the general formula [II], a starting material for producing the compound of the present invention, is known per se. Otherwise, it can be prepared by a method known per se or an adequate combination of methods known per se in accordance with the
20 following Reference Examples.

Reference Example 1

(1) In 250 ml of water is suspended 25.0 g of 3-fluoro-4-methylaniline, and 34.7 ml of conc. hydrochloric acid is added to the suspension. Thereafter, the
25 resulting mixture is cooled to 5°C. To this mixture is dropwise added a solution of 15.2 g of sodium nitrite in 20 ml of water at a temperature of 5°C to 10°C over one

hour. The reaction mixture thus obtained is dropwise added to a solution of 64.0 g of potassium O-ethyl dithiocarbonate in 200 ml of water at a temperature of 50°C to 60°C over one hour. The resulting reaction
5 mixture is cooled to room temperature, and thereafter, 300 ml of ethyl acetate is added thereto. Thereafter, the resulting organic layer is separated, washed with a saturated saline solution and then dried over anhydrous magnesium sulfate. Then, the solvent is removed by
10 distillation under reduced pressure, to obtain brown, oily O-ethyl S-(3-fluoro-4-methyl)phenyl dithiocarbonate.

(2) To a solution of O-ethyl S-(3-fluoro-4-methyl)-phenyl dithiocarbonate in 150 ml of methanol is added 22.4 g of potassium hydroxide at room temperature under a
15 nitrogen atmosphere. The resulting mixture is stirred at room temperature for five hours. Thereafter, 34.8 ml of bromoacetaldehyde diethyl acetal is added to the thus stirred mixture. The resulting mixture is refluxed for six hours and then cooled. Thereafter, insolubles are
20 removed from the thus cooled mixture by filtration. The resulting filtrate is concentrated under reduced pressure. To the residue obtained are added 300 ml of water and 150 ml of ethyl acetate, and the resulting organic layer is separated, washed with a saturated
25 saline solution and dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue thus obtained is purified by a column

chromatography [eluent: hexane : ethyl acetate = 10 : 1], to obtain 43.6 g of oily 1,1-diethoxy-2-(3-fluoro-4-methylphenylthio)ethane.

NMR (CDCl₃) δ value: 1.19 (6H, t, J=7.0Hz), 2.22
5 (3H, d, J=2.0Hz), 3.09 (2H, d, J=5.4Hz), 3.58 (2H, q, J=7.0Hz), 3.63 (2H, q, J=7.0Hz), 4.63 (1H, t, J=5.4Hz), 6.9-7.3 (3H, m)

(3) To a solution of 43.6 g of 1,1-diethoxy-2-(3-fluoro-4-methylphenylthio)ethane in 400 ml of toluene is
10 added 80 ml of 85% phosphoric acid. The resulting solution is refluxed for 2.5 hours using an azeotropic dehydration apparatus. After cooling, to the thus cooled reaction mixture are added 600 ml of water and 200 ml of ethyl acetate, and the resulting organic layer is
15 separated, washed successively with water and a saturated saline solution and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue thus obtained is purified by a column
20 chromatography [eluent: hexane], to obtain 15.9 g of a colorless, solid mixture of 4-fluoro-5-methyl-benzo[b]thiophene and 6-fluoro-5-methyl-benzo[b]thiophene.

(4) To a solution of 15.9 g of a mixture of 4-fluoro-5-methyl-benzo[b]thiophene and 6-fluoro-5-methyl-
25 benzo[b]thiophene in 160 ml of carbon tetrachloride are added 17 g of N-bromosuccinimide and 0.31 g of 2,2'-azobisisobutyronitrile. The resulting mixture is refluxed for two hours. After cooling, insolubles are removed

from the thus cooled mixture by filtration, and the filtrate obtained is concentrated under reduced pressure. The residue obtained is suspended in 75 ml of acetic acid and 75 ml of water, and 26.8 g of hexamethylenetetramine is added thereto, after which the resulting mixture is refluxed for two hours. After cooling, 150 ml of water and 200 ml of ethyl acetate are added to the thus cooled mixture, and the resulting organic layer is separated, washed successively with water, an aqueous saturated sodium carbonate solution and a saturated saline solution and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue thus obtained is purified by a moderate pressure column chromatography [eluent: hexane : ethyl acetate = 15 : 1], to obtain 1.71 g of 4-fluorobenzo[b]thiophene-5-carbaldehyde and 5.82 g of 6-fluorobenzo[b]thiophene-5-carbaldehyde.

Physical properties of each of the compounds are as follows:

- 4-Fluorobenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1684

NMR (CDCl_3) δ value: 7.5-8.1 (4H, m), 10.55 (1H, s)

- 6-Fluorobenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1684

NMR (CDCl_3) δ value: 7.3-7.6 (2H, m), 7.67 (1H, d, $J=10.3\text{Hz}$), 8.34 (1H, d, $J=6.4\text{Hz}$), 10.46 (1H, s)

In the same manner, the following compounds are

obtained:

- 7-Fluorobenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1678

NMR (CDCl_3) δ value: 7.2-7.8 (3H, m), 8.16 (1H, s),
5 10.60 (1H, s)

- 4-Bromobenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1674

NMR (CDCl_3) δ value: 7.1-8.0 (4H, m), 10.54 (1H, s)

- 6-Bromobenzo[b]thiophene-5-carbaldehyde

10 IR (KBr) cm^{-1} : 1681

NMR (CDCl_3) δ value: 7.3-7.6 (2H, m), 8.18 (1H, s),
8.41 (1H, s), 10.51 (1H, s)

- 4-Chlorobenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1678

15 NMR (CDCl_3) δ value: 7.3-8.2 (4H, m), 10.66 (1H, s)

- 6-Chlorobenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1678

NMR (CDCl_3) δ value: 7.2-7.7 (2H, m), 7.98 (1H, s),
8.42 (1H, s), 10.60 (1H, s)

20 Reference Example 2

(1) In a solution of 5 g of benzo[b]thiophene-5-carbaldehyde in 100 ml of benzene are added 20 ml of ethylene glycol and a catalytic amount of p-toluene-sulfonic acid, and the resulting mixture is refluxed for
25 two hours using an azeotropic dehydration apparatus. After cooling, 200 ml of water and 100 ml of ethyl acetate are added to the thus cooled mixture, and the

resulting organic layer is separated, washed successively with water and a saturated saline solution and dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a moderate pressure column chromatography [eluent: hexane : ethyl acetate = 10 : 1], to obtain 6.12 g of colorless, solid 5-(1,3-dioxoran-2-yl)benzo[b]thiophene.

NMR (CDCl₃) δ value: 3.9-4.3 (4H, m), 5.94 (1H, s), 7.2-7.6 (3H, m), 7.7-8.1 (2H, m)

(2) A solution of 1.5 g of 5-(1,3-dioxoran-2-yl)benzo[b]thiophene in 15 ml of tetrahydrofuran is cooled to -40°C, at which temperature 4.55 ml of 1.6 M hexane solution of n-butyllithium is then dropwise added to the solution. The temperature of the resulting reaction mixture is elevated to -10°C, and then lowered to -40°C again, at which 0.45 ml of methyl iodide is added to the thus re-cooled reaction mixture. The temperature of the resulting mixture is elevated to room temperature. 30 Milliliters of water and 30 ml of ethyl acetate are added thereto, and the resulting organic layer is separated, washed successively with water and a saturated saline solution and dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a moderate pressure column chromatography [eluent: hexane : ethyl acetate = 10 : 1], to obtain 1.45 g of colorless, solid 2-methyl-5-

(1,3-dioxoran-2-yl)benzo[b]thiophene.

NMR (CDCl₃) δ value: 2.55 (3H, s), 3.9-4.3 (4H, m),
5.89 (1H, s), 6.9-8.0 (4H, m)

(3) A catalytic amount of p-toluenesulfonic acid is
5 added to a solution of 1.5 g of 2-methyl-5-(1,3-dioxoran-
2-yl)benzo[b]thiophene in 20 ml of acetone at room
temperature, at which temperature the resulting mixture
is stirred for 30 minutes. After the reaction, the
solvent is removed from the reaction mixture by
10 distillation under reduced pressure. The residue
obtained are added 20 ml of water and 20 ml of ethyl
acetate, after which the resulting organic layer is
separated, washed successively with water and a saturated
saline solution and then dried over anhydrous magnesium
15 sulfate. The solvent is thereafter removed from the thus
dried layer by distillation under reduced pressure, to
obtain 1.15 g of colorless, solid 2-methylbenzo[b]-
thiophene-5-carbaldehyde.

IR (KBr) cm⁻¹: 1694

20 NMR (CDCl₃) δ value: 2.60 (3H, s), 5.89 (1H, s),
7.0-8.4 (4H, m), 10.10 (1H, s)

Reference Example 3

(1) To a solution of 3 g of benzo[b]thiophene-5-
carbaldehyde in 30 ml of acetic acid is dropwise added
25 1.43 ml of bromine with ice-cooling. The temperature of
the reaction mixture is elevated to room temperature, at
which temperature the mixture is stirred for three hours.

After the reaction, 50 ml of water and 50 ml of ethyl acetate are added to the thus stirred reaction mixture, and the resulting organic layer was separated, washed successively with water, a saturated aqueous sodium hydrogencarbonate solution and a saturated saline solution and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a moderate pressure column chromatography [eluent: hexane : ethyl acetate = 20 : 1], to obtain 4.2 g of 3-bromobenzo[b]thiophene-5-carbaldehyde.

NMR (CDCl₃) δ value: 7.5-8.4 (4H, m), 10.19 (1H, s)

(2) The same procedure as in Reference Example 2 (1) is repeated, except that 3-bromobenzo[b]thiophene-5-carbaldehyde is substituted for the benzo[b]thiophene-5-carbaldehyde, to obtain 3-bromo-5-(1,3-dioxoran-2-yl)-benzo[b]thiophene.

NMR (CDCl₃) δ value: 3.9-4.2 (4H, m), 5.93 (1H, s), 7.3-8.0 (4H, m)

(3) The same procedure as in Reference Example 2 (2) is repeated, except that 3-bromo-5-(1,3-dioxoran-2-yl)benzo[b]thiophene is substituted for the 5-(1,3-dioxoran-2-yl)benzo[b]thiophene and diethyl ether is substituted for the tetrahydrofuran, to obtain 3-methylbenzo[b]thiophene-5-carbaldehyde.

NMR (CDCl₃) δ value: 2.51 (3H, s), 7.0-8.4 (4H, m), 10.15 (1H, s)

Reference Example 4

The same procedure as in Reference Example 2 (2) and Reference Example 2 (3) is repeated, except that N-fluorobenzenesulfonimide is substituted for the methyl iodide to obtain 2-fluorobenzo[b]thiophene-5-carbaldehyde from 5-(1,3-dioxoran-2-yl)benzo[b]thiophene.

NMR (CDCl₃) δ value: 6.84 (1H, d J=2.0Hz), 7.6-8.4 (3H, m), 10.09 (1H, s)

Reference Example 5

10 The same procedure as in Reference Example 2 (2) and Reference Example 2 (3) is repeated, except that 3-bromo-5-(1,3-dioxoran-2-yl)benzo[b]thiophene is substituted for the 5-(1,3-dioxoran-2-yl)benzo[b]thiophene; diethyl ether is substituted for the tetra-
15 hydrofuran; and N-fluorobenzenesulfonimide is substituted for the methyl iodide, to obtain 3-fluorobenzo[b]thiophene-5-carbaldehyde from 3-bromo-5-(1,3-dioxoran-2-yl)benzo[b]thiophene.

NMR (CDCl₃) δ value: 6.99 (1H, d, J=2.0Hz), 7.7-8.4
20 (3H, m), 10.14 (1H, s)

Reference Example 6

(1) To a solution of 2.0 g of 5-(1,3-dioxoran-2-yl)benzo[b]thiophene in 15 ml of tetrahydrofuran is added dropwise 6.06 ml of a 1.6 M hexane solution of
25 n-butyllithium at -78°C. The temperature of the reaction mixture was elevated to -10°C and thereafter lowered

again to -78°C , after which 1.55 g of bromine is added to the thus re-cooled reaction mixture. The temperature of the resulting mixture is elevated to room temperature, and thereafter, 30 ml of water and 30 ml of ethyl acetate
5 are added thereto. The resulting organic layer is separated, washed successively with water and a saturated saline solution, and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure.
10 The residue obtained is purified by a moderate pressure column chromatography [elueant: toluene], to obtain 2.45 g of colorless, solid 2-bromo-5-(1,3-dioxoran-2-yl)benzo-
[b]thiophene.

NMR (CDCl_3) δ value: 3.9-4.3 (4H, m), 5.89 (1H, s),
15 7.2-8.0 (4H, m)

(2) To a solution of 2.5 g of 2-bromo-5-(1,3-dioxoran-2-yl)benzo[b]thiophene in 50 ml of toluene are added 6.44 g of phenyltri-n-butyltin and 0.05 g of tetra-
kis(triphenylphosphine)palladium (0), and the resulting
20 mixture is refluxed under a nitrogen atmosphere for five hours. The reaction mixture is cooled to room temperature. Thereafter, 30 ml of water and 30 ml of ethyl acetate are added to the thus cooled reaction mixture. Thereafter, insolubles are removed from the resulting
25 mixture by filtration. Thereafter, the resulting organic layer is separated, washed successively with water and a saturated saline solution and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed

from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a column chromatography [eluent: hexane : ethyl acetate = 20 : 1], to obtain 1.20 g of colorless, solid 2-phenyl-5-(1,3-dioxoran-2-yl)benzo[b]thiophene.

(3) In the same manner as in Reference Example 2 (3), 2-phenylbenzo[b]thiophene-5-carbaldehyde is obtained from 2-phenyl-5-(1,3-dioxoran-2-yl)benzo[b]thiophene.

IR (KBr) cm^{-1} : 1692

10 NMR (CDCl_3) δ value: 7.2-8.4 (9H, m), 10.13 (1H, s)

In the same manner, the following compound is obtained:

• 3-Phenylbenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1686

15 NMR (CDCl_3) δ value: 7.3-8.1 (8H, m), 8.37 (1H, m), 10.09 (1H, s)

Reference Example 7

(1) The same procedure as in Reference Example 1 (1) and Reference Example 1 (2) is repeated, except that 20 methyl 4-amino-2-methylbenzoate is substituted for the 3-fluoro-4-methylaniline, to obtain methyl 4-(2,2-diethoxyethylthio)-2-methylbenzoate.

NMR (CDCl_3) δ value: 1.20 (6H, t, $J=7.0\text{Hz}$), 2.57 (3H, s), 3.18 (2H, d, $J=5.4\text{Hz}$), 3.3-3.8 (4H, m), 3.86 (3H, s), 4.67 (1H, t, $J=5.4\text{Hz}$), 7.0-7.3 (2H, m), 7.7-7.9 (1H, m)

(2) The same procedure as in Reference Example 1

(3) is repeated, except that methyl 4-(2,2-diethoxy-ethylthio)-2-methylbenzoate is substituted for the 1,1-diethoxy-2-(3-fluoro-4-methylphenylthio)ethane, to obtain a mixture of methyl 4-methylbenzo[b]thiophene-5-carboxylate and methyl 6-methylbenzo[b]thiophene-5-carboxylate.

(3) In 20 ml of tetrahydrofuran is suspended 0.37 g of lithium aluminum hydride. Thereafter, a solution of 2 g of a mixture of methyl 4-methylbenzo[b]thiophene-5-carboxylate and methyl 6-methylbenzo[b]thiophene-5-carboxylate in 20 ml of tetrahydrofuran is dropwise added to the suspension. The temperature of the resulting suspension is elevated to room temperature, and 30 ml of water and 30 ml of ethyl acetate are added thereto, and the resulting mixture is filtered. The resulting organic layer is separated, washed successively with water and a saturated saline solution and then dried over anhydrous magnesium sulfate. The solvent is removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a column chromatography [eluent: hexane : ethyl acetate = 10 : 1], to obtain 1.7 g of a mixture of 4-methylbenzo[b]thiophene-5-methanol and 6-methylbenzo[b]thiophene-5-methanol as colorless solid.

(4) In 17 ml of chloroform is dissolved 1.7 g of a mixture of 4-methylbenzo[b]thiophene-5-methanol and 6-methylbenzo[b]thiophene-5-methanol, and 4.1 g of manganese dioxide is added thereto at room temperature.

Thereafter, the resulting mixture is refluxed for one hour. After the reaction, insolubles are removed from the resulting reaction mixture by filtration and the filtrate obtained is concentrated under reduced pressure.

5 The residue obtained is purified by a moderate pressure column chromatography [eluent: hexane : toluene = 1 : 1], to obtain 0.65 g of 4-methylbenzo[b]thiophene-5-carbaldehyde as colorless solid and 0.48 g of 6-methylbenzo[b]thiophene-5-carbaldehyde as colorless solid.

10 Physical properties of each of the compounds are as follows:

- 4-Methylbenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1673

NMR (CDCl_3) δ value: 2.95 (3H, s), 7.5-7.9 (4H, m),
15 10.50 (1H, s)

- 6-Methylbenzo[b]thiophene-5-carbaldehyde

IR (KBr) cm^{-1} : 1696

NMR (CDCl_3) δ value: 2.77 (3H, s), 7.2-7.6 (2H, m),
7.75 (1H, s), 8.26 (1H, s), 10.35 (1H, s)

20 Reference Example 8

In the same manner as in Reference Example 6, 6-methoxybenzo[b]thiophene-5-carbaldehyde is obtained from 4-amino-2-methoxybenzoic acid.

NMR (CDCl_3) δ value: 3.99 (3H, s), 7.33 (2H, m),
25 7.42 (1H, s), 8.28 (1H, s), 10.56 (1H, s)

Reference Example 9

(1) To a solution of 2.04 g of diisopropylamine in 30 ml of tetrahydrofuran is dropwise added 9.19 ml of 1.6 M n-hexane solution of n-butyllithium at -20°C. At the same temperature, the resulting mixture is stirred for one hour and then cooled to -70°C, at which temperature a solution of 3 g of 3,5-difluorobromobenzene in 10 ml of tetrahydrofuran is dropwise added thereto over 30 minutes. The temperature of the resulting reaction mixture is elevated to -40°C and then lowered again to -70°C, at which temperature 0.97 ml of methyl iodide is then added thereto. The temperature of the resulting mixture is elevated to room temperature, and 80 ml of water and 80 ml of ethyl acetate are then added thereto, after which the resulting organic layer is separated, washed successively with water and a saturated saline solution and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a column chromatography [eluent: hexane : ethyl acetate = 10 : 1], to obtain 1.98 g of colorless, oily 4-bromo-2,6-difluorotoluene.

NMR (CDCl₃) δ value: 2.23 (3H, t, J=1.5Hz), 7.00 (2H, d, J=6.3Hz)

(2) To a solution of 1.98 g of 4-bromo-2,6-difluorotoluene in 20 ml of tetrahydrofuran is dropwise added 5.7 ml of 1.6 M n-hexane solution of n-butyllithium at -70°C. The resulting mixture is then stirred at the

same temperature for one hour. Then, a solution of 2.88 g of 2,2,2',2'-tetraethoxydiethyl disulfide in 5 ml of tetrahydrofuran is dropwise added to the thus stirred reaction mixture at the same temperature. The
5 temperature of the resulting mixture is elevated to room temperature and 80 ml of water and 80 ml of ethyl acetate are added thereto. The resulting organic layer is separated, washed successively with water and a saturated saline solution and then dried over anhydrous magnesium
10 sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a column chromatography [eluent: hexane : ethyl acetate = 20 : 1], to obtain 2.1 g of colorless, oily 1,1-diethoxy-
15 2-(3,5-difluoro-4-methylphenylthio)ethane.

NMR (CDCl₃) δ value: 1.20 (3H, t, J=7.0Hz), 1.23 (3H, t, J=7.2Hz), 2.1 (3H, t, J=1.7Hz), 3.10 (2H, d, J=5.6Hz), 3.4-3.9 (4H, m), 4.64 (1H, t, J=5.6Hz), 6.87 (2H, d, J=7.6Hz)

20 (3) The same procedure as in Reference Example 1 (3) is repeated, except that 1,1-diethoxy-2-(3,5-difluoro-4-methylphenylthio)ethane is substituted for the 1,1-diethoxy-2-(3-fluoro-4-methylphenylthio)ethane, to obtain 4,6-difluoro-5-methylbenzo[b]thiophene.

25 NMR (CDCl₃) δ value: 2.31 (3H, t, J=1.9Hz), 7.2-7.5 (3H, m)

(4) To a solution of 0.48 g of 4,6-difluoro-5-methylbenzo[b]thiophene in 5 ml of carbon tetrachloride

are added 0.92 g of N-bromosuccinimide and 0.01 g of 2,2'-azobisisobutyronitrile, and the resulting mixture is refluxed for 16 hours. After cooling, insolubles are removed from the thus cooled mixture by filtration, and the filtrate obtained is concentrated under reduced pressure. The residue obtained is purified by a column chromatography [eluent: hexane], to obtain 0.18 g of colorless, solid 5-bromomethyl-4,6-difluorobenzo[b]thiophene.

10 NMR (CDCl₃) δ value: 4.67 (2H, t, J=1.2Hz), 7.2-7.5 (3H, m)

(5) To a solution of 0.18 g of 5-bromomethyl-4,6-difluorobenzo[b]thiophene in 5 ml of N,N-dimethylformamide is added 0.23 g of potassium acetate, and the resulting mixture is stirred at 60°C for one hour. The temperature of the thus stirred mixture is lowered to room temperature, and 10 ml of water and 10 ml of ethyl acetate are added thereto. Thereafter, the resulting organic layer is separated, washed successively with water and a saturated saline solution and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure, to obtain 0.14 g of colorless, oily 5-acetoxymethyl-4,6-difluorobenzo[b]thiophene.

25 NMR (CDCl₃) δ value: 2.07 (3H, s), 5.31 (2H, t, J=1.2Hz), 7.3-7.6 (3H, m)

(6) To a solution of 0.14 g of 5-acetoxymethyl-4,6-difluorobenzo[b]thiophene in 5 ml of methanol is added

0.03 g of potassium hydroxide at room temperature, and thereafter, the resulting mixture is stirred at the same temperature for 30 minutes. After the reaction, 10 ml of water and 10 ml of ethyl acetate are added to the thus
5 stirred reaction mixture. The resulting organic layer is separated, washed successively with water and a saturated saline solution, and then dried over anhydrous magnesium sulfate. Thereafter, the solvent is removed from the thus dried layer by distillation under reduced pressure
10 to obtain 0.12 g of colorless, oily 5-hydroxymethyl-4,6-difluorobenzo[b]thiophene.

NMR (CDCl₃) δ value: 4.88 (2H, bs), 7.2-7.6 (3H, m)

(7) To a solution of 0.22 ml of oxalyl chloride in 10 ml of methylene chloride is added 0.35 ml of dimethyl
15 sulfoxide at -78°C. Then, to the resulting solution is added dropwise a solution of 0.20 g of 5-hydroxymethyl-4,6-difluorobenzo[b]thiophene in 3 ml of methylene chloride. At the same temperature, the resulting mixture is stirred for one hour, and then, 0.70 ml of
20 triethylamine is added thereto. The temperature of the resulting mixture is elevated to room temperature, and thereafter, 10 ml of water and 10 ml of ethyl acetate are added thereto, after which the resulting organic layer is separated, washed successively with water and a saturated
25 saline solution and then dried over anhydrous magnesium sulfate. Then, the solvent is removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a column chromatography

[eluent: hexane], to obtain 0.20 g of colorless, solid 4,6-difluorobenzo[b]thiophene-5-carbaldehyde.

IR (KBr) cm^{-1} : 1696

NMR (CDCl_3) δ value: 7.4-7.6 (3H, m), 10.49 (1H, s)

5 Production Example 1

(1) To a solution of 1.6 g of 6-fluorobenzo[b]thiophene-5-carbaldehyde in 30 ml of tetrahydrofuran is dropwise added 10 ml of 1.6 M tetrahydrofuran solution of 2-chloroethoxymethylmagnesium chloride at -30°C over ten minutes, and thereafter, the resulting mixture is stirred while ice-cooling for one hour. Subsequently, the thus stirred reaction mixture is introduced into a mixture of 50 ml of ice water, 50 ml of ethyl acetate and 2 g of ammonium chloride, and the resulting mixture is adjusted to pH 2 with 6 N hydrochloric acid. Thereafter, the thus pH-adjusted mixture is stirred at the same temperature for five minutes. Subsequently, the thus stirred reaction mixture is adjusted to pH 6 with a saturated aqueous sodium hydrogencarbonate solution. Thereafter, the resulting organic layer is separated, washed successively with water and a saturated saline solution, and then dried over anhydrous magnesium sulfate. The solvent is then removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a column chromatography [eluent: toluene : ethyl acetate = 4 : 1], to obtain 1.3 g of oily 2-(2-chloroethoxy)-1-(6-fluorobenzo[b]thiophen-5-

yl)ethanol.

(2) A mixture of 0.61 g of 2-(2-chloroethoxy)-1-(6-fluorobenzo[b]thiophen-5-yl)ethanol, 3 ml of 50% aqueous diethylamine solution, 0.45 mg of potassium iodide and 20 ml of ethanol is refluxed for three hours. Subsequently, 3 ml of 50% aqueous diethylamine solution is added to the thus refluxed reaction mixture, and the resulting reaction mixture is further refluxed for three hours. The solvent is removed from the thus refluxed mixture by distillation under reduced pressure. To the residue obtained are added 30 ml of ethyl acetate and 30 ml of water, after which the resulting mixture is adjusted to pH 1.5 with 6 N hydrochloric acid. Thereafter, the aqueous layer is separated and washed with 10 ml of ethyl acetate. 30 Milliliters of ethyl acetate is then added to the thus washed layer, after which the resulting mixture is adjusted to pH 10.5 with potassium carbonate. The organic layer is separated again, washed successively with 10 ml of water and 10 ml of a saturated saline solution, and then dried over anhydrous magnesium sulfate. The solvent is then removed from the thus dried layer by distillation under reduced pressure. The residue obtained is dissolved in 6 ml of ethanol. To the resulting solution are added 0.6 ml of 5 N dried hydrochloric acid-ethanol solution and 6 ml of diethyl ether. The mixture thus obtained is stirred at room temperature for one hour. The crystals precipitated are collected by filtration and washed with 2 ml of a liquid

mixture of diethyl ether and ethanol (1 : 1) and then dried, to obtain 0.28 g of 2-[2-(N,N-diethylamino)-ethoxy]-1-(6-fluorobenzo[b]thiophen-5-yl)ethanol hydrochloride.

5 Melting point: 125-126°C

 NMR (DMSO-d₆) δ value: 1.18 (6H, t, J=7.3Hz),
2.9-4.0 (10H, m), 5.0-5.4 (1H, m), 5.6-5.8 (1H, m),
7.4-8.2 (4H, m)

 In the same manner, the following compounds are
10 obtained:

• 2-[2-(N,N-Diethylamino)ethoxy]-1-(4-fluorobenzo[b]-thiophen-5-yl)ethanol hydrochloride

 Melting point: 127-128°C

 NMR (DMSO-d₆) δ value: 1.18 (6H, t, J=7.3Hz),
15 2.9-4.1 (10H, m), 5.1-5.4 (1H, m), 5.6-5.8 (1H, m),
7.4-8.0 (4H, m)

• 2-[2-(N,N-Diethylamino)ethoxy]-1-(7-fluorobenzo[b]-thiophen-5-yl)ethanol hydrochloride

 Melting point: 119-120°C

20 NMR (DMSO-d₆) δ value: 1.15 (6H, t, J=7.3Hz),
2.8-4.0 (10H, m), 4.7-5.1 (1H, m), 5.6-5.9 (1H, m),
7.1-8.0 (4H, m)

• 2-[2-(N,N-Diethylamino)ethoxy]-1-(2-fluorobenzo[b]-thiophen-5-yl)ethanol hydrochloride

25 Melting point: 130-131°C

 NMR (DMSO-d₆) δ value: 1.17 (6H, t, J=7.3Hz),
2.8-4.0 (10H, m), 4.86 (1H, m), 5.6-5.9 (1H, m), 7.1-8.0
(4H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(3-fluorobenzo[b]-thiophen-5-yl)ethanol hydrochloride

Melting point: 106-107°C

NMR (DMSO-d₆) δ value: 1.17 (6H, t, J=7.3Hz),

5 2.8-4.0 (10H, m), 4.8-5.2 (1H, m), 5.4-6.0 (1H, m),
7.4-8.2 (4H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(2-methylbenzo[b]-thiophen-5-yl)ethanol hydrochloride

Melting point: 136-137°C

10 NMR (DMSO-d₆) δ value: 1.18 (6H, t, J=7.3Hz), 2.54
(3H, s), 2.8-4.0 (10H, m), 4.7-5.0 (1H, m), 5.3-5.8 (1H,
m), 7.0-8.0 (4H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(3-methylbenzo[b]-thiophen-5-yl)ethanol 1/2 fumarate

15 Melting point: 137-138°C

NMR (DMSO-d₆) δ value: 0.99 (6H, t, J=7.3Hz),

2.3-3.1 (9H, m), 3.4-3.8 (4H, m), 4.2-5.1 (3H, m), 6.53
(1H, s), 7.2-8.0 (4H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(4-methylbenzo[b]-thiophen-5-yl)ethanol hydrochloride

20

Melting point: 189-190°C

NMR (DMSO-d₆) δ value: 1.17 (6H, t, J=7.2Hz), 2.57

(3H, s), 2.8-4.0 (10H, m), 4.9-5.3 (1H, m), 5.4-5.7 (1H,
m), 7.2-8.0 (4H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(6-methylbenzo[b]-thiophen-5-yl)ethanol hydrochloride

25

Melting point: 144-145°C

NMR (DMSO-d₆) δ value: 1.17 (6H, t, J=7.2Hz), 2.41

(3H, s), 2.7-4.1 (10H, m), 4.8-5.3 (1H, m), 5.4-5.8 (1H, m), 7.2-8.1 (4H, m)

- 1-(4-Chlorobenzo[b]thiophen-5-yl)-2-[2-(N,N-dimethylamino)ethoxy]ethanol hydrochloride

5 Melting point: 148-149°C

NMR (DMSO-d₆) δ value: 1.17 (6H, t, J=7.2Hz),
2.8-4.1 (10H, m), 5.1-5.4 (1H, m), 5.7-6.0 (1H, m),
7.3-8.2 (4H, m)

- 1-(6-Chlorobenzo[b]thiophen-5-yl)-2-[2-(N,N-diethylamino)ethoxy]ethanol hydrochloride

10

Melting point: 140-141°C

NMR (DMSO-d₆) δ value: 1.17 (6H, t, J=7.2Hz),
2.6-4.1 (10H, m), 5.0-5.4 (1H, m), 5.7-6.1 (1H, m),
7.3-8.2 (4H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(2-phenylbenzo[b]thiophen-5-yl)ethanol hydrochloride

15

Melting point: 131-135°C

NMR (DMSO-d₆) δ value: 1.18 (6H, t, J=7.1Hz), 2.8-4.2
(10H, m), 4.7-5.1 (1H, m), 7.2-8.1 (9H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(3-phenylbenzo[b]thiophen-5-yl)ethanol hydrochloride

20

Melting point: 158-160°C

NMR (DMSO-d₆) δ value: 1.14 (6H, t, J=7.2Hz),
2.8-4.2 (10H, m), 4.7-5.1 (1H, m), 7.2-8.2 (9H, m)

- 2-[2-(N,N-Diethylamino)ethoxy]-1-(6-methoxybenzo[b]thiophen-5-yl)ethanol hydrochloride

25

Melting point: 161-162°C

NMR (DMSO-d₆), δ value: 1.19 (6H, t, J=7.3Hz),

2.8-4.2 (10H, m), 3.87 (3H, s), 5.1-5.3 (1H, m), 7.2-7.6 (3H, m), 7.92 (1H, s)

• 1-(4,6-Difluorobenzo[b]thiophen-5-yl)-2-[2-(N,N-diethylamino)ethoxy]ethanol 1/2 fumarate

5 Melting point: 135-136°C

NMR (DMSO-d₆) δ value: 0.92 (6H, t, J=7.0Hz), 2.4-2.9 (6H, m), 3.4-3.9 (4H, m), 5.1-5.5 (3H, m), 6.50 (1H, s), 7.4-7.9 (3H, m)

• 1-(4-Bromobenzo[b]thiophen-5-yl)-2-[2-(N,N-dimethyl-10 amino)ethoxy]ethanol hydrochloride

Melting point: 150-151°C

NMR (CDCl₃) δ value: 1.35 (6H, t, J=7.5Hz), 2.8-4.2 (10H, m), 5.2-5.6 (2H, m), 7.3-7.4 (4H, m)

• 1-(6-Bromobenzo[b]thiophen-5-yl)-2-[2-(N,N-diethyl-15 amino)ethoxy]ethanol hydrochloride

Melting point: 153-154°C

NMR (CDCl₃) δ value: 1.41 (6H, t, J=7.5Hz), 2.6-4.2 (10H, m), 5.3-5.6 (2H, m), 7.2-7.5 (2H, m), 7.99 (1H, s), 8.17 (1H, s)

20 • 2-[2-(N,N-Di-n-propylamino)ethoxy]-1-(6-fluorobenzo[b]thiophen-5-yl)ethanol

Melting point: 143-144°C

NMR (CDCl₃) δ value: 0.95 (6H, t, J=7.0Hz), 1.4-2.2 (4H, m), 2.8-3.4 (6H, m), 3.5-4.2 (4H, m), 5.1-5.5 (2H, 25 m), 7.1-7.6 (3H, m), 8.0-8.2 (1H, s)

• 1-(6-Fluorobenzo[b]thiophen-5-yl)-2-(1-piperazinyl)-ethanol

Melting point: 172-174°C

NMR (CDCl₃) δ value: 1.4-2.4 (6H, m), 2.6-4.2 (11H, m), 5.2-5.4 (1H, m), 7.1-7.6 (3H, m), 7.9-8.2 (1H, m)

• 1-(6-Fluorobenzo[b]thiophen-5-yl)-2-(1-morpholinyl)-ethanol

5 Melting point: 198-200°C

NMR (DMSO-d₆) δ value: 2.6-4.8 (15H, m), 4.9-5.3 (1H, m), 7.4-8.2 (4H, m)

Production Example 2

(1) To a solution of 8.73 ml of oxalyl chloride in
10 90 ml of methylene chloride is dropwise added 14.2 ml of dimethyl sulfoxide at -70°C over 30 minutes. The solution is stirred at the same temperature for ten minutes, after which a solution of 11 g of 2-(2-chloroethoxy)-1-(6-fluorobenzo[b]thiophen-5-yl)ethanol in
15 90 ml of methylene chloride is dropwise added thereto at the same temperature over 30 minutes. The resulting mixture is stirred at the same temperature for 30 minutes, and then, 50.2 ml of triethylamine is dropwise added thereto. The temperature of the resulting mixture
20 is elevated to room temperature, and thereafter, 200 ml of diethyl ether is added thereto. Then, insolubles are removed from the diethyl ether-added mixture by filtration. Then, the solvent is removed from the resulting filtrate by distillation under reduced pressure. To the
25 residue obtained are added 200 ml of water and 200 ml of ethyl acetate, and then, the pH is adjusted to 1 with 1 N hydrochloric acid. Thereafter, the resulting organic

layer is separated, washed successively with water and a saturated saline solution and then dried over anhydrous magnesium sulfate. The solvent is removed from the thus dried layer by distillation under reduced pressure. To
5 the residue obtained is added 50 ml of diethyl ether, after which insolubles are collected by filtration, to obtain 9.5 g of colorless, solid 2-(2-chloroethoxy)-1-(6-fluorobenzo[b]thiophen-5-yl)ethanone.

(2) To a solution of 4.5 g of 2-(2-chloroethoxy)-1-
10 (6-fluorobenzo[b]thiophen-5-yl)ethanone in 45 ml of tetrahydrofuran is added 0.46 g of (R)-5,5-diphenyl-2-methyl-3,4-propano-1,3,2-oxazaborolidine at -10°C, and thereafter, 9.9 ml of 1 M borane solution of tetrahydro-
15 furan is dropwise added thereto. The temperature of the resulting mixture is elevated to room temperature, and the mixture is stirred at the same temperature for 1.5 hours, after which 100 ml of water and 100 ml of ethyl acetate are added thereto. The resulting organic layer is separated, washed successively with water and a
20 saturated saline solution and then dried over anhydrous magnesium sulfate. The solvent is then removed from the thus dried layer by distillation under reduced pressure. The residue obtained is purified by a column chromatography [eluent: toluene : ethyl acetate = 10 : 1], to
25 obtain 4.5 g of oily (+)-2-(2-chloroethoxy)-1-(6-fluorobenzo[b]thiophen-5-yl)ethanol.

(3) In the same manner as in Production Example 1 (2), (+)-1-(6-fluorobenzo[b]thiophen-5-yl)-2-[2-(N,N-di-

ethylamino)ethoxy]ethanol hydrochloride is obtained from (+)-2-(2-chloroethoxy)-1-(6-fluorobenzo[b]thiophen-5-yl)-ethanol.

Melting point: 138-139°C

5 $[\alpha]_D +40.8$ (C = 1.40, CH₃OH)

In the same manner, the following compound is obtained:

• (-)-1-(6-Fluorobenzo[b]thiophen-5-yl)-2-[2-(N,N-diethylamino)ethoxy]ethanol hydrochloride

10 Melting point: 138-139°C

$[\alpha]_D -40.3$ (C = 1.13, CH₃OH)

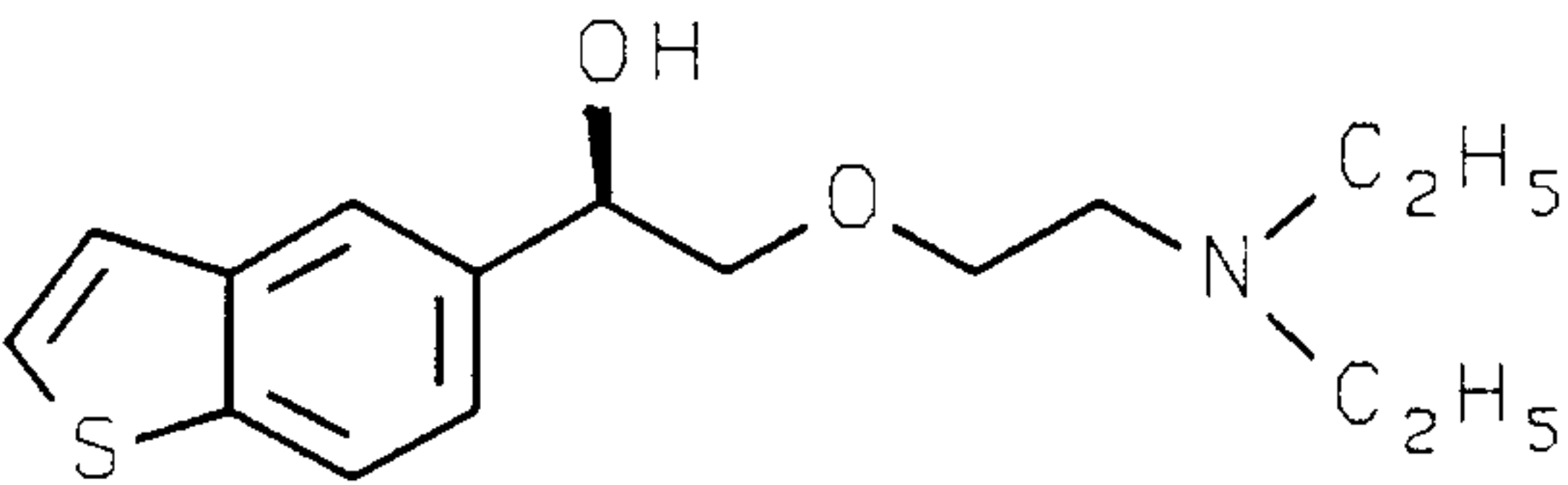
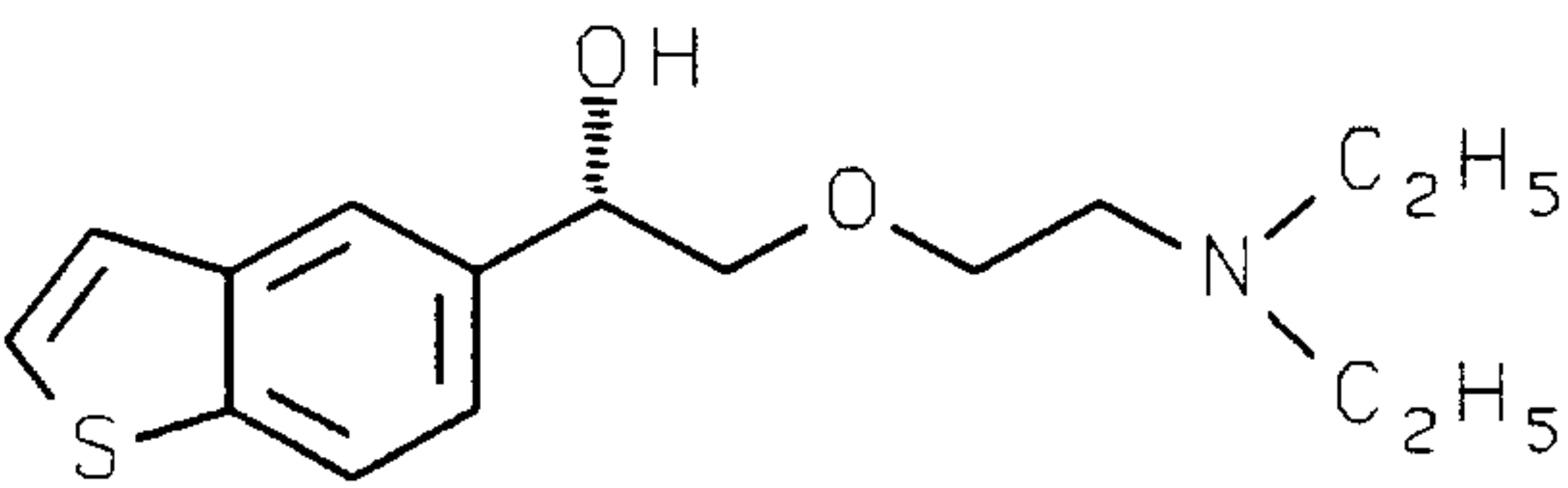
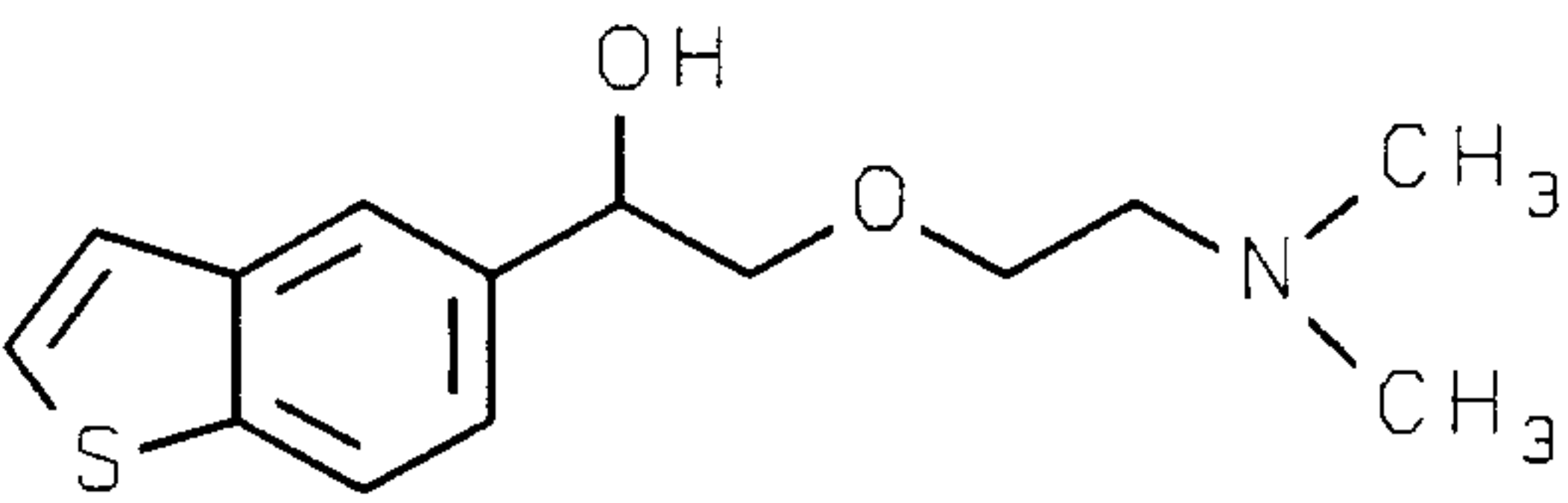
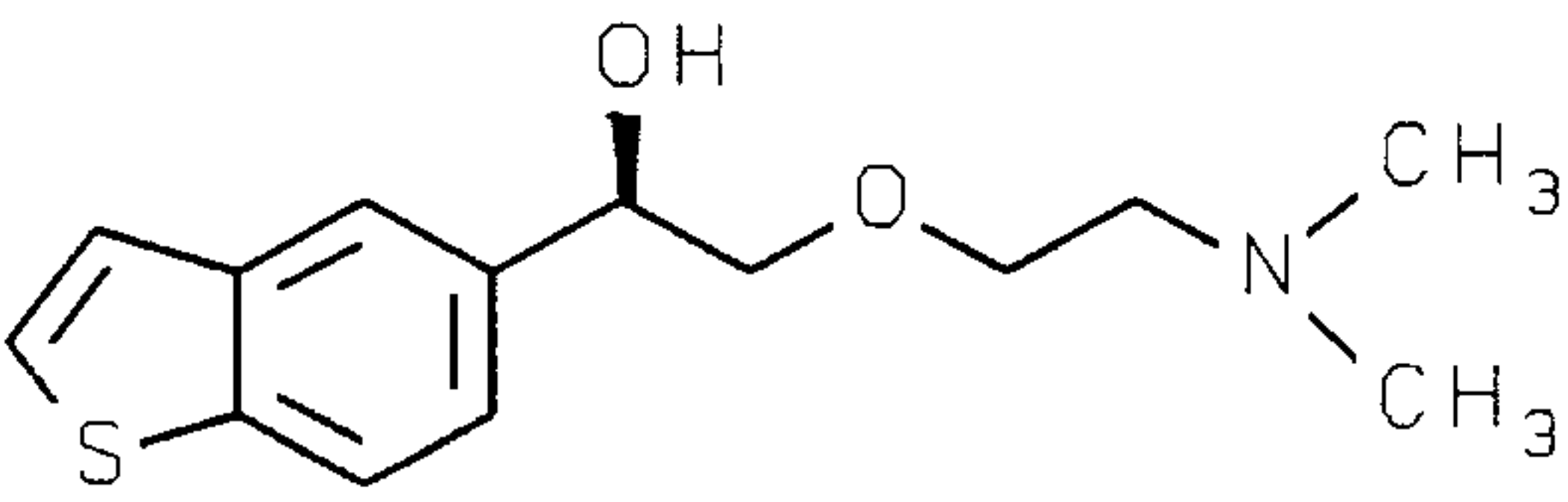
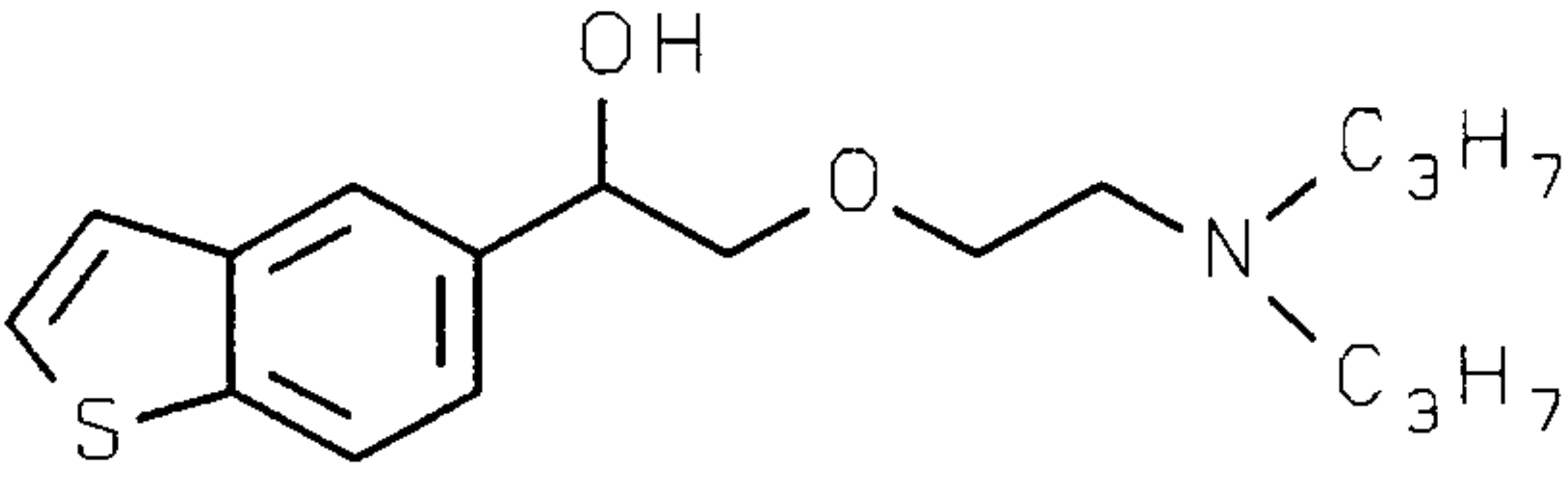
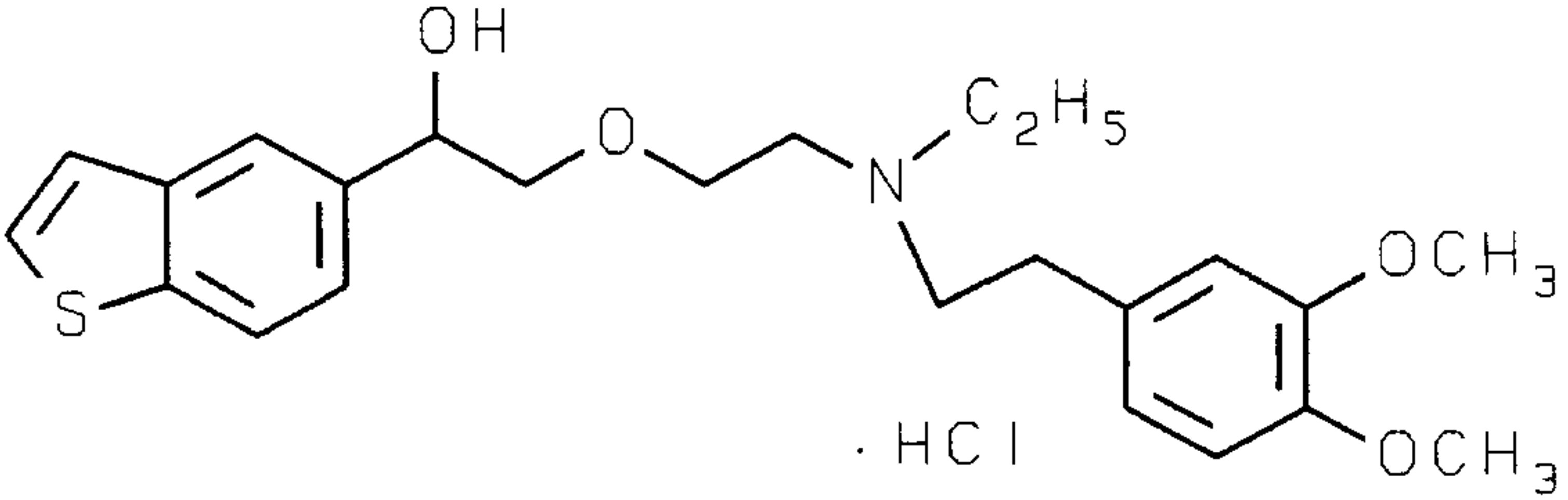
An explanation is made below of the NGF activity-potentiating effect of the 1,2-ethanediol derivative represented by the general formula [I] or its salt.

[Nervous process-elongating activity]

Test compound

As test compounds, there are used the compounds disclosed in JP-A-3-47,158; JP-A-3-232,830 and JP-A-4-95,070 and the compounds obtained in Production Examples 1 and 2 which are shown in Tables 1 to 6. The melting points of the compounds other than those obtained in Production Examples 1 and 2 are also shown in Table 7. Incidentally, the compounds were dissolved in water or dimethyl sulfoxide.

Table 1

No.	Compound
1	 <chem>CCN(CC)CCOC[C@H](O)c1ccc2ccsc2c1</chem> · HCl
2	 <chem>CCN(CC)CCOC[C@@H](O)c1ccc2ccsc2c1</chem> · HCl
3	 <chem>CN(C)CCOC[C@H](O)c1ccc2ccsc2c1</chem> · HCl
4	 <chem>CN(C)CCOC[C@H](O)c1ccc2ccsc2c1</chem> · HCl
5	 <chem>CC(C)N(CC)CCOC[C@H](O)c1ccc2ccsc2c1</chem> · HCl
6	 <chem>COc1ccc(cc1CNCNCCOC[C@H](O)c2ccc3ccsc3c2)OC</chem> · HCl

No.

Compound

No.	Compound
7	<chem>Fc1ccc(cc1C2=CC=CS2)C(O)COCCN(CC)CC</chem> · HCl
8	<chem>Fc1ccccc1C2=CC=CS2C(O)COCCN(CC)CC</chem> · HCl
9	<chem>C1CCC2=C(C1)c3ccccc3C(O)COCCN(C)C</chem> · HCl
10	<chem>c1ccc2c(c1)sc(C(O)COCCN3CCOCC3)c2</chem> · HCl
11	<chem>CN1CCN(CC1)CCOC(O)Cc2cccc3c2SC=C3</chem> · 2HCl
12	<chem>O=C(c1ccc2c(c1)OCO2)N3CCN(CC3)CCOC(O)Cc4ccc5c4SC=C5</chem> · HCl

Table 3

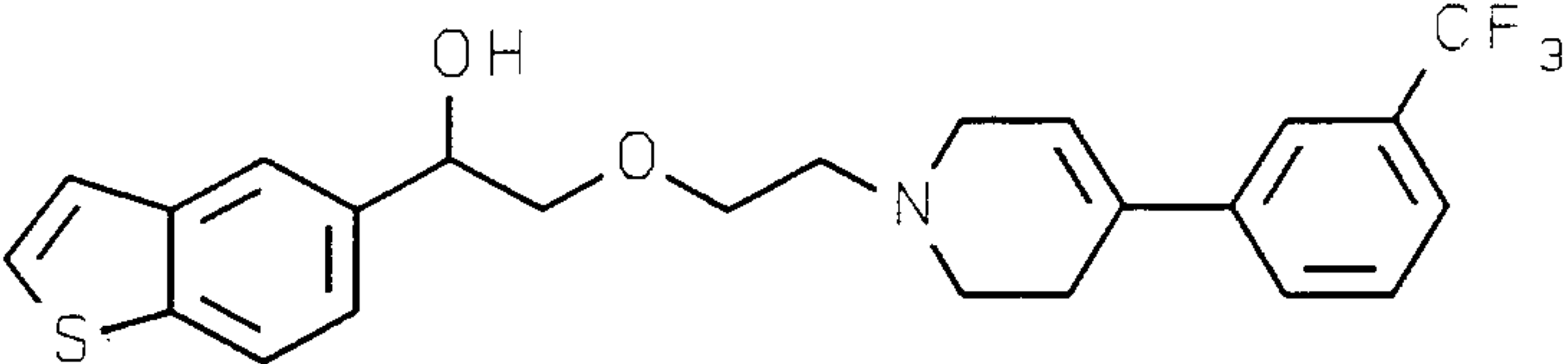
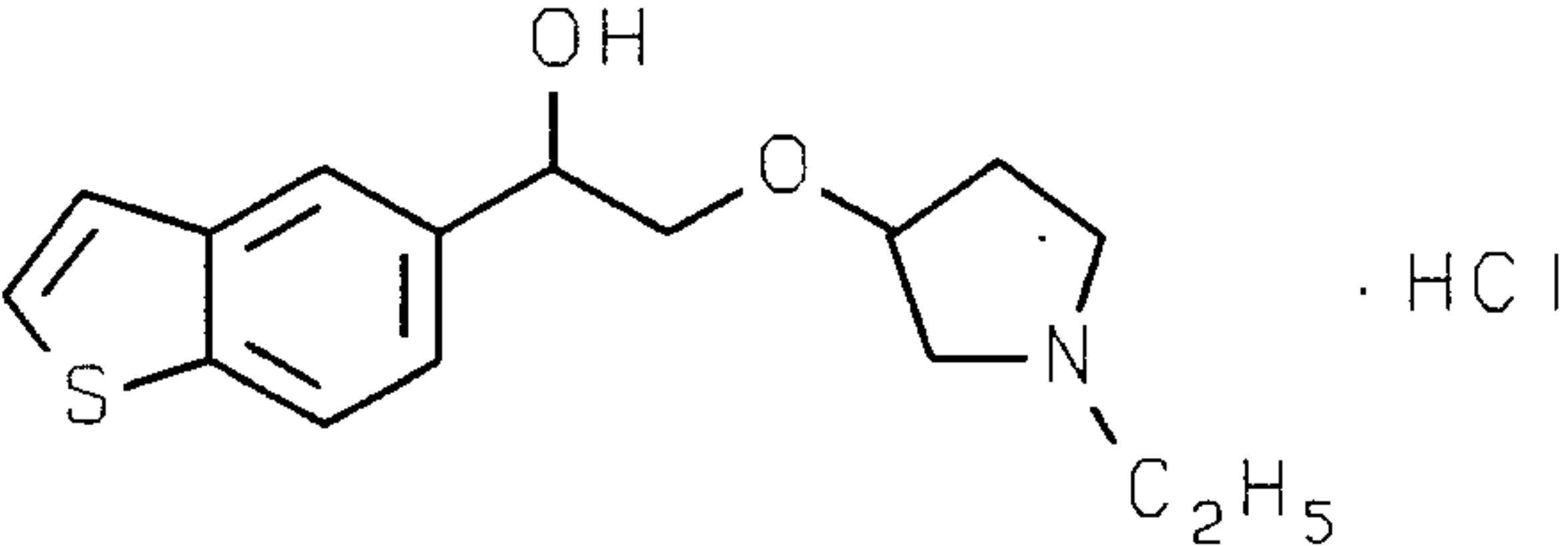
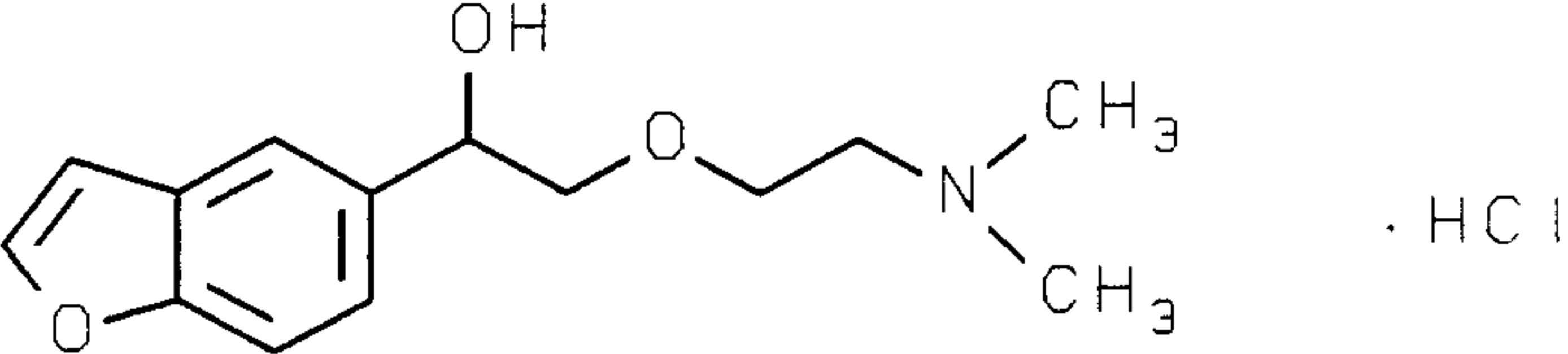
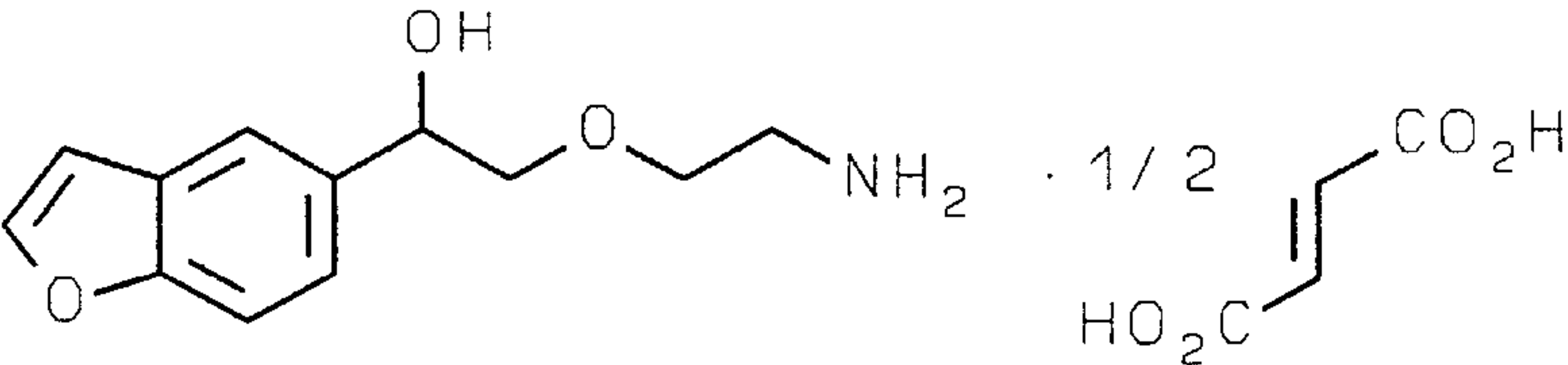
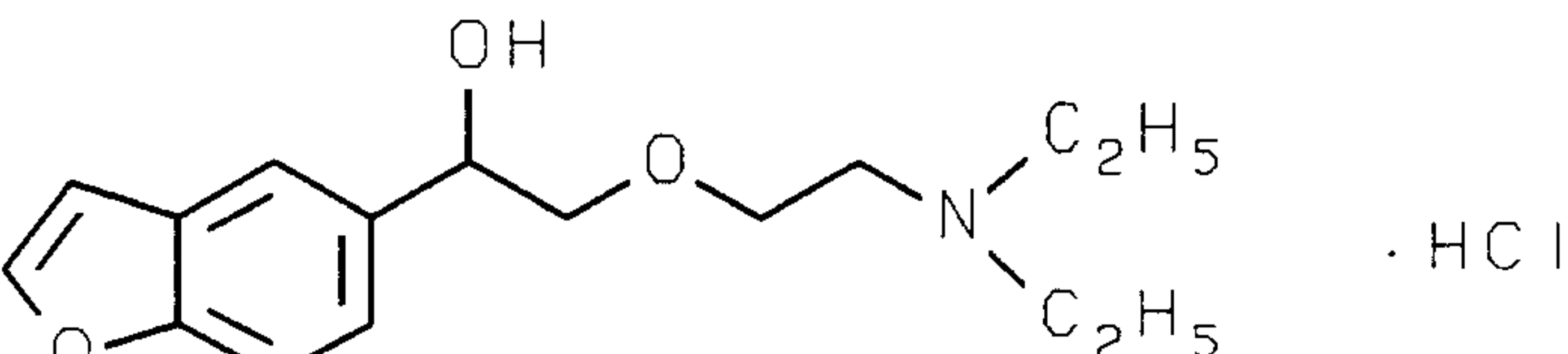
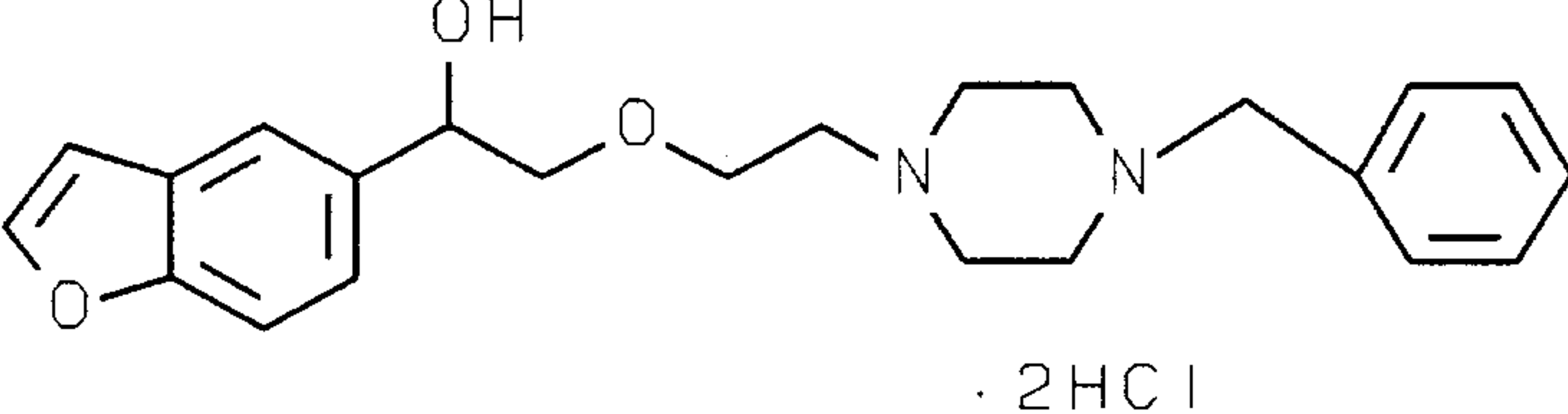
No.	Compound
13	
14	
15	
16	
17	
18	

Table 4

No.	Compound
19	<chem>CCN(CC)CCOC(CO)c1ccc2ccccc2c1</chem> · HCl
20	<chem>CN(C)CCOC(CO)c1ccccc1</chem> · HCl
21	<chem>CN(C)CCOC(CO)c1cccc(C)c1</chem> · HCl
22	<chem>CN(C)CCOC(CO)c1ccc(F)cc1</chem> · HCl
23	<chem>CN(C)CCOC(CO)c1ccc(cc1-c2ccccc2)C</chem> · HCl
24	<chem>c1ccc2c(c1)sc(c2)CNCCOC(CO)c3ccccc3</chem> · HCl

Table 5

No.	Compound
25	<chem>CC1=CC=C(C=C1)C(CO)COCCN(CC)CC</chem> · HCl
26	<chem>ClC1=CC=C(C=C1)C(CO)COCCN(CC)CC</chem> · HCl
27	<chem>c1ccc(cc1)-c2ccc(cc2)C(CO)COCCN(CC)CC</chem> · HCl
28	<chem>COc1ccc(cc1)C(CO)COCCN(CC)CC</chem> · HCl
29	<chem>Fc1ccc(cc1)C(CO)COCCN(CC)CC</chem> · HCl
30	<chem>Fc1ccc(cc1)C(CO)COCCN(CC)CC</chem> · HCl

Table 6

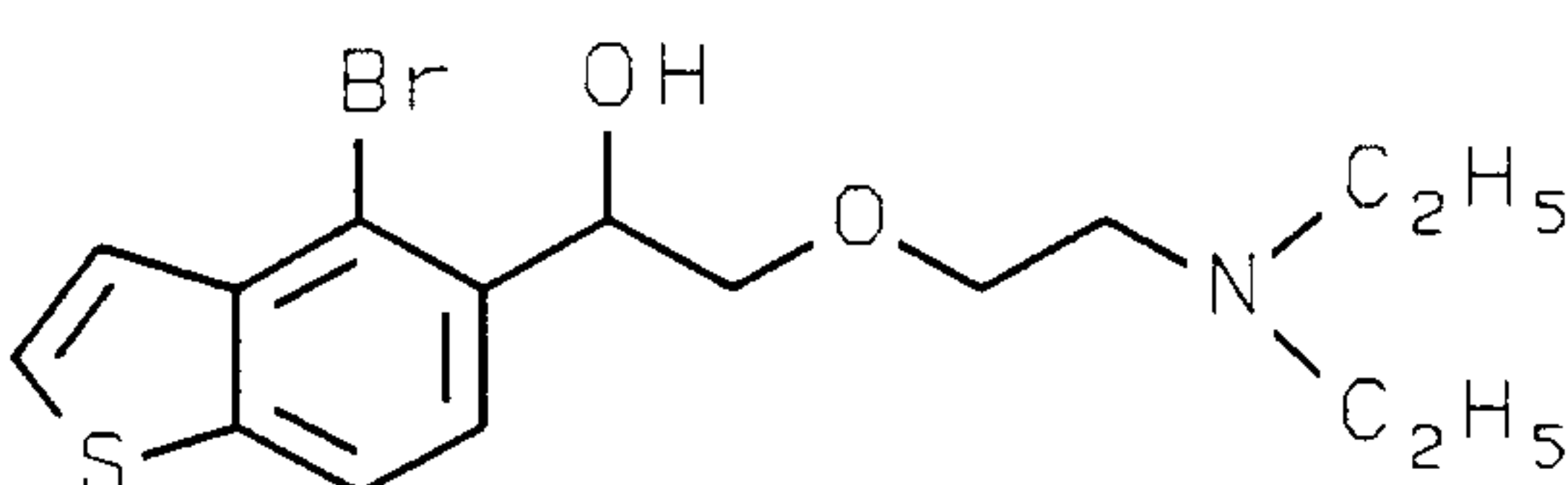
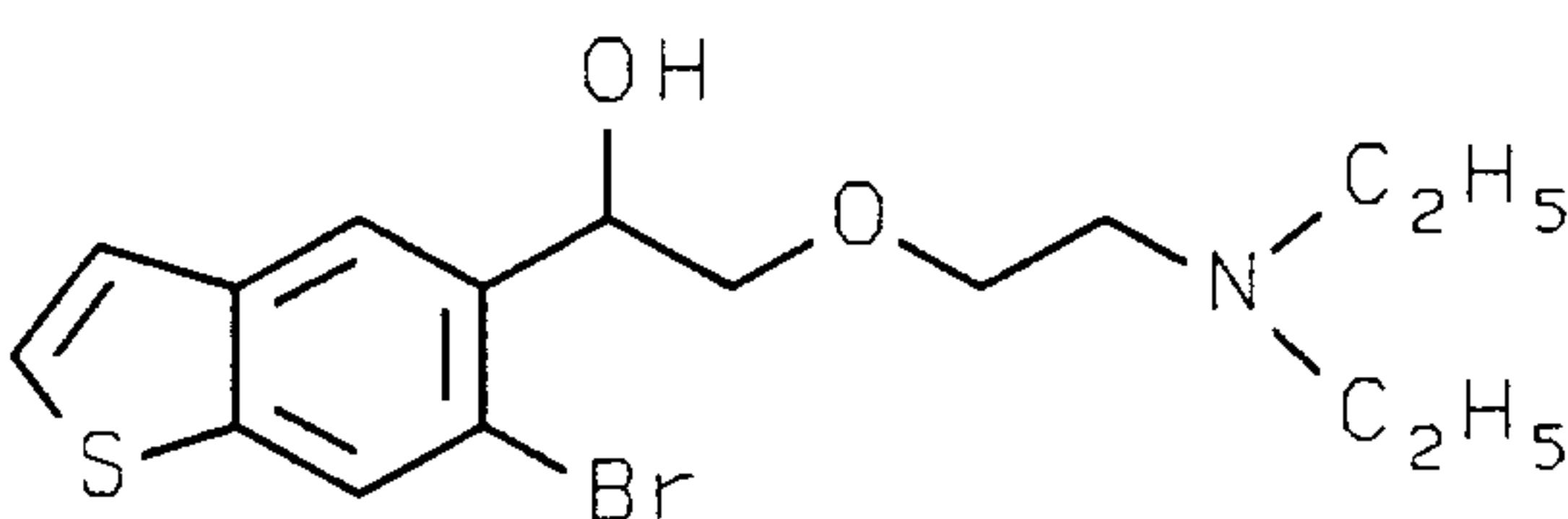
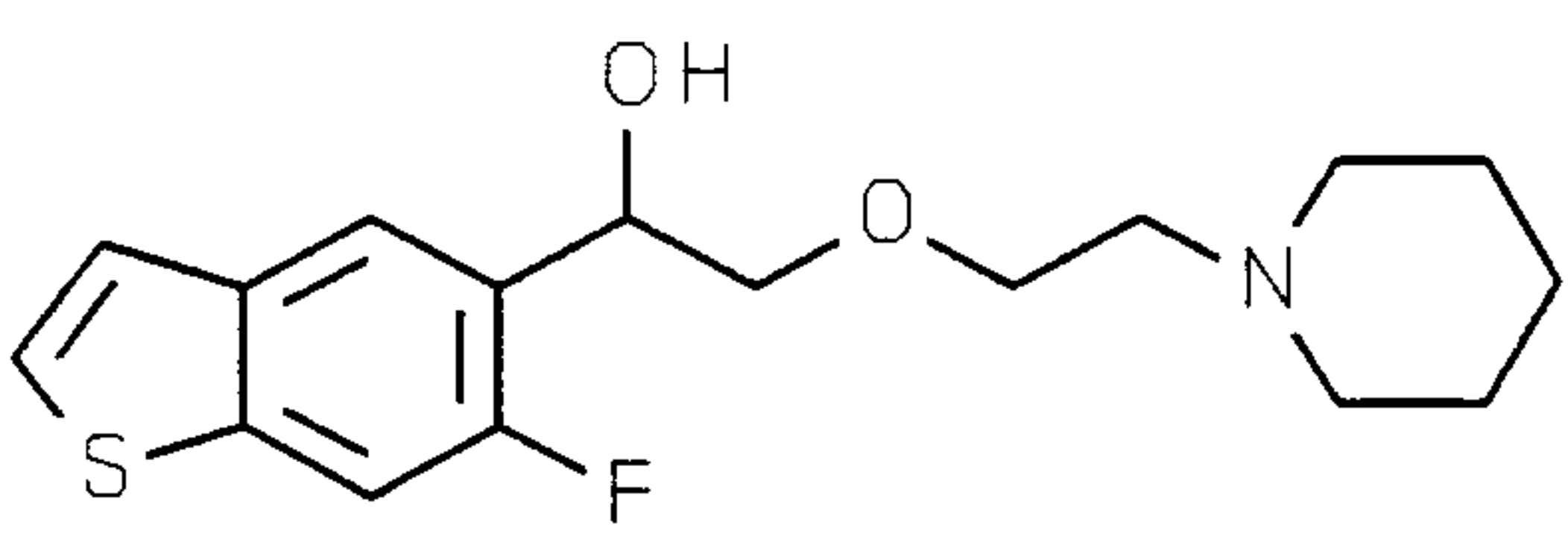
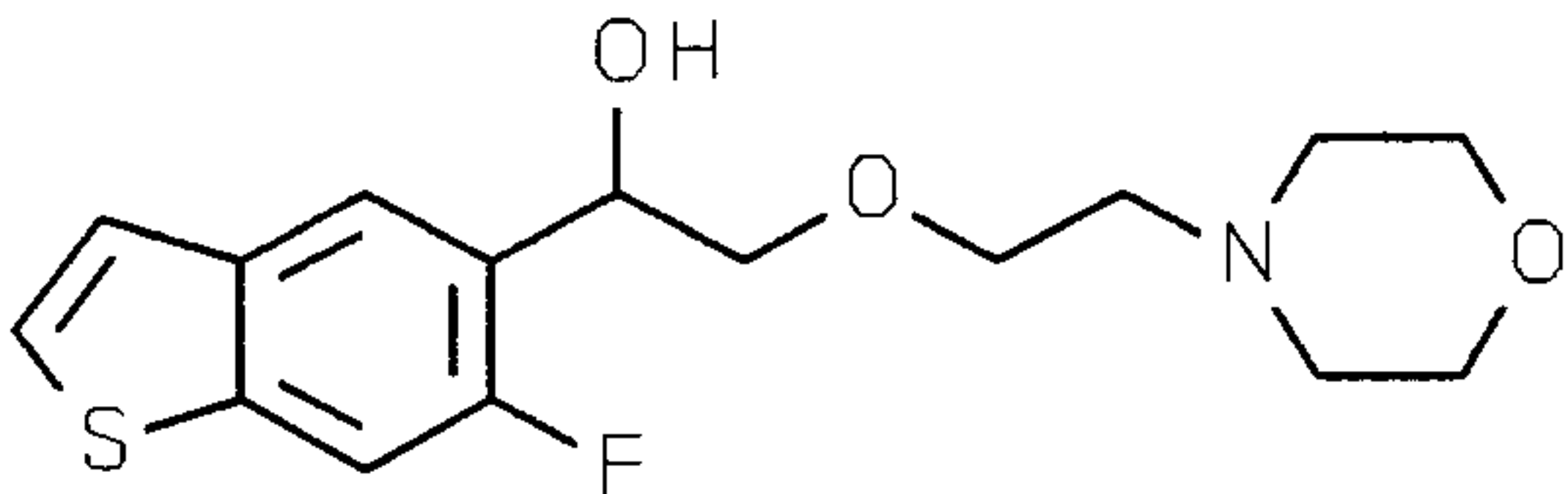
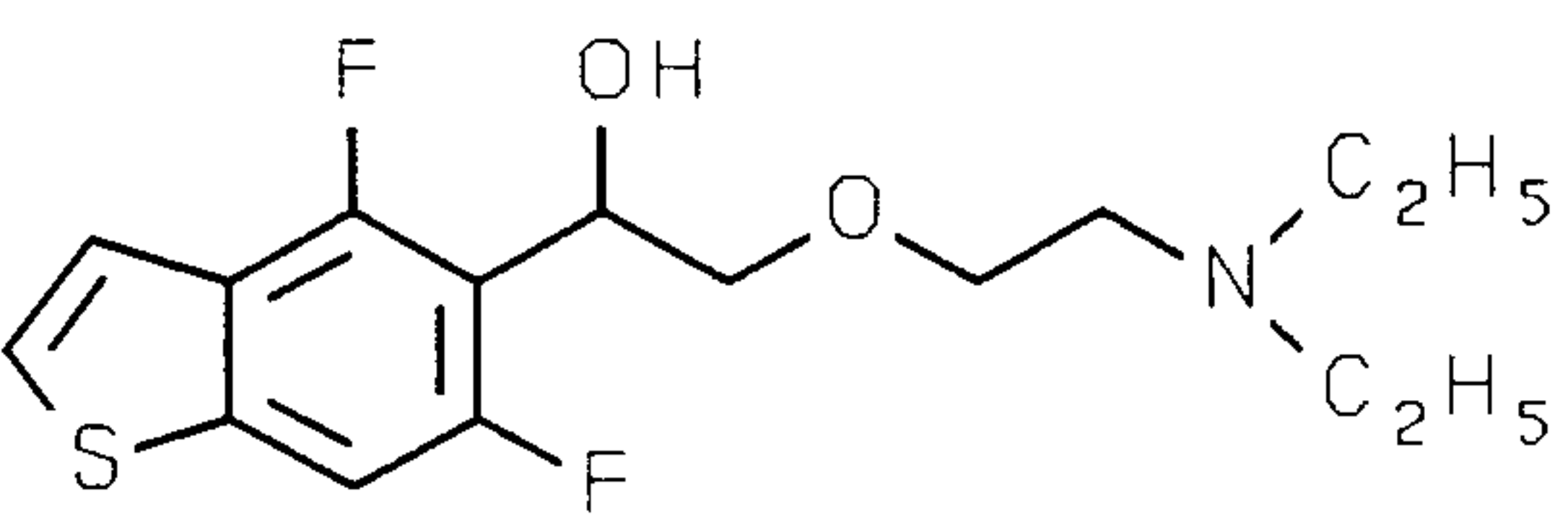
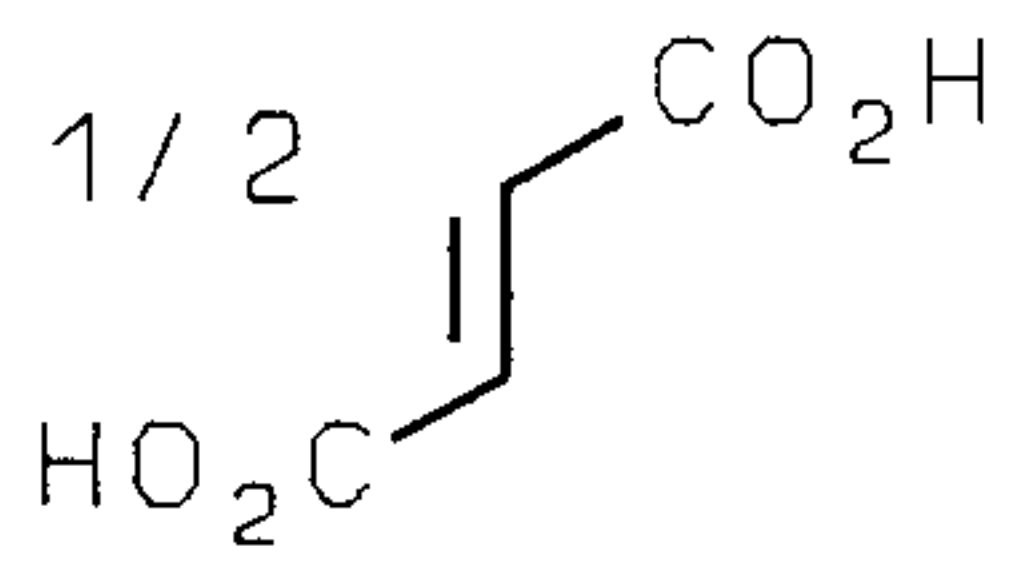
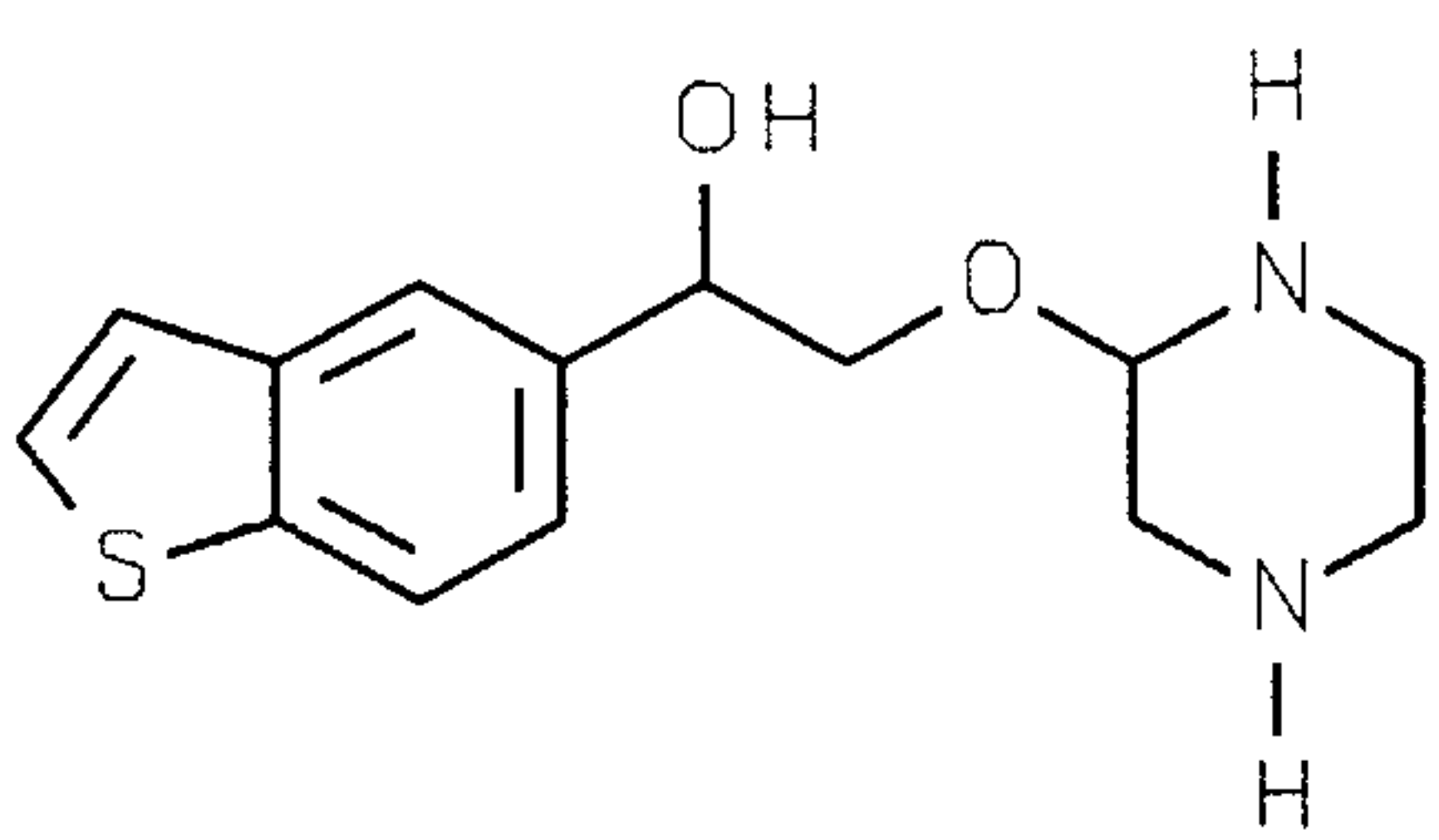
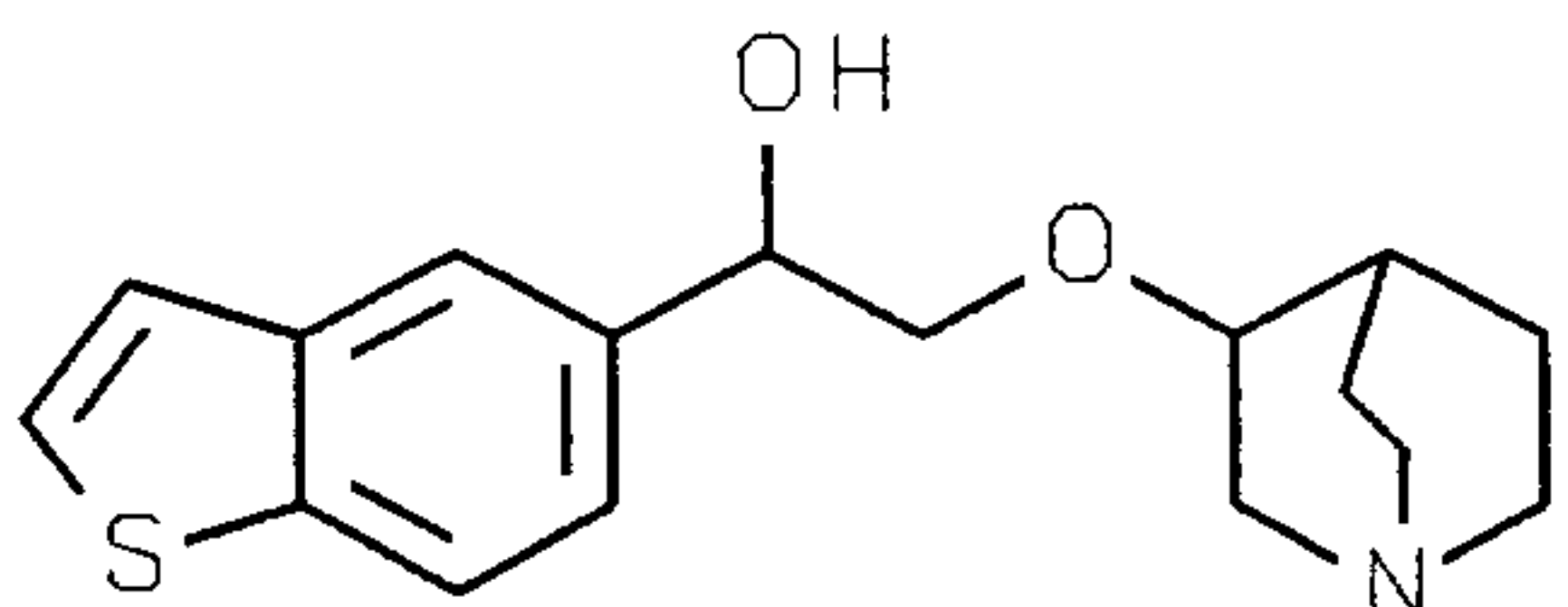
No.	Compound
31	 · HCl
32	 · HCl
33	 · HCl
34	 · HCl
35	 · 1/2 
36	 · 2HCl
37	 · HCl

Table 7

Compound No.	Melting point (°C)
1	120-120.5
2	119.5-120.5
3	191.5-192.5
4	180-180.5
5	134-137.5
6	143.5-145
9	207.5-210
10	166.5-167.5
11	232-234
12	191.5-193
13	199-202
14	163-169
15	168-169.5
16	170-173
17	109-110
18	234-234.5
19	155.5-157
20	184-185
21	165-166
22	171-172
23	223-225
24	157-161

Test cell

PC12 cell [rat adrenal medullary xanthoma (NGF-responding cell)]

Test medium

5 RPMI 1640 (mfd. by Nissui pharmaceutical Co., Ltd.) supplemented with 10% heat-inactivated (56°C, 30 min.) horse serum (Summit Biotechnology Inc.), 5% heat-inactivated (56°C, 30 min.) fetal calf serum (mfd. by Gibco Inc.) and 60 µg/ml of Kanamycine sulfate is used.

10 Test method

PC12 cells are adjusted at a density of 8×10^3 cells/ml with the above culture medium and plated out into 6-well plate (mfd. by Falcon Inc.) in a portion of 2 ml/well. Subsequently, 2.5S-NGF (mfd. by Wako Inc.)
15 dissolved in 0.1% bovine serum albumin/phosphate-buffered saline solution, is added at a final concentration of 100 ng/ml and the test compounds are added at final concentration of $10^{-5}M$ at the same time. Cells are incubated at 37°C in a humidified incubator with 5% CO₂
20 atmosphere. On the 5th day after the treatment of the test compounds, cells from three randomly chosen phase contrast microscope fields are counted. The proportion of cells bearing neurites longer than cell body to the other cells is determined. Besides, the proportion of
25 the control group free from the test compound is taken as 100%. The results are shown in Table 8.

Table 8

Compound No.	Concentration of test compound added (M)	Nervous process elongation activity (%)
1	10^{-5}	136
2	10^{-5}	129
3	10^{-5}	123
4	10^{-5}	117
5	10^{-5}	121
6	10^{-5}	113
7	10^{-5}	125
8	10^{-5}	130
9	10^{-5}	123
10	10^{-5}	131
11	10^{-5}	112
12	10^{-5}	124
13	10^{-5}	118
14	10^{-5}	126
15	10^{-5}	116
16	10^{-5}	123
17	10^{-5}	113
18	10^{-5}	121
19	10^{-5}	112
20	10^{-5}	124
21	10^{-5}	114
22	10^{-5}	112
23	10^{-5}	112

Table 8 (Cont'd)

Compound No.	Concentration of test compound added (M)	Nervous process elongation activity (%)
24	10^{-5}	110
25	10^{-5}	111
26	10^{-5}	112
27	10^{-6}	125
28	10^{-5}	127
29	10^{-5}	116
30	10^{-5}	124
31	10^{-5}	111
32	10^{-5}	112
33	10^{-6}	111
34	10^{-5}	116
35	10^{-5}	110
36	10^{-5}	124
37	10^{-5}	117

Best Mode for Carrying out the Invention

Preparation Example 1 (Tablet)

Tablets each containing 50 mg of 2-[2-(N,N-diethylamino)ethoxy]-1-(benzo[b]thiophen-5-yl)ethanol

5 hydrochloride (Compound No. 1) are prepared by the following method using the following recipe:

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Per one tablet:

	Compound No. 1 compound	50 mg	}	(1)
	Milk sugar	20 mg		
	Kollidon TM CL (mfd. by BASF)	15 mg		
5	Corn starch	30 mg		
	Avicel TM (mfd. by Asahi Chemical)	50 mg	}	(2)
	Polyvinylpyrrolidone K-90	5 mg		
	Light silicic acid anhydride	18 mg		
	Magnesium stearate	2 mg		
10	Total	175 mg		

A mixture of the components (1) is kneaded with 8% aqueous solution of polyvinylpyrrolidone K-90, and dried at 60°C, and thereafter, mixed with the components (2), after which the resulting mixture is tableted into 15 circular tablets each having a diameter of 8 mm and a weight of 175 mg.

Preparation Example 2 (Capsule)

Capsules each containing 50 mg of 2-[2-(N,N-diethylamino)ethoxy]-1-(benzo[b]thiophen-5-yl)ethanol hydrochloride (Compound No. 1) are prepared by the following method using the following recipe:

Per one capsule:

	Compound No. 1 compound	50 mg	}	(1)
	Milk sugar	20 mg		
25	Corn starch	53 mg		
	Kollidon TM CL (mfd. by BASF)	2 mg		

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Polyvinylpyrrolidone K-90	5 mg	} (2)
Avicel PH302 (mfd. by Asahi Chemical)	18 mg	
Magnesium stearate	2 mg	
Total	150 mg	

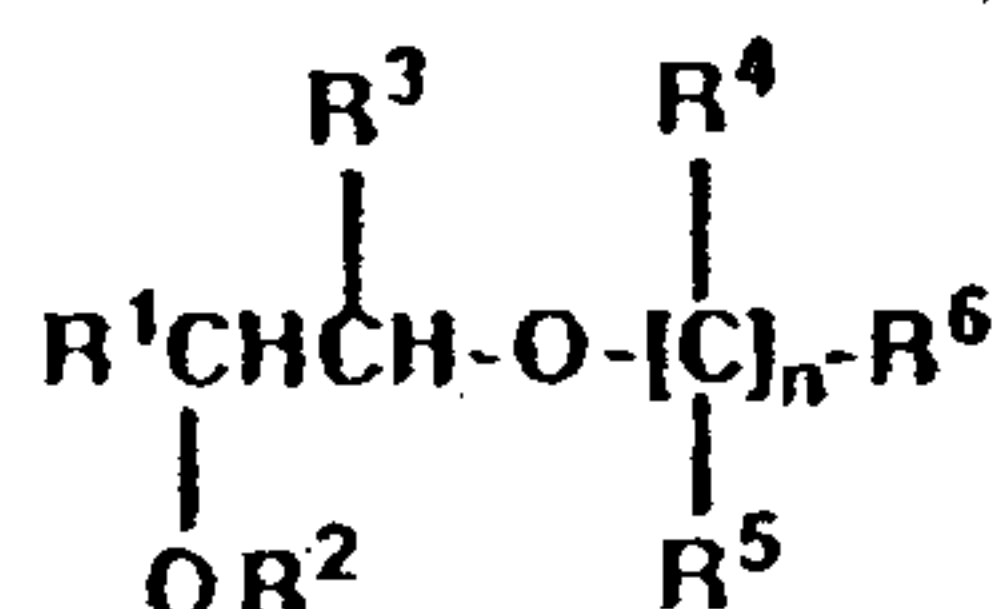
5 A mixture of the components (1) is kneaded with
8% aqueous solution of polyvinylpyrrolidone K-90, and the
resulting mixture is dried at 60°C and then mixed with
the components (2). No. 3 gelatine capsules are filled
with the resulting mixture in a proportion of 150 mg per.
10 one capsule to obtain capsules.

Utilizability in Industry

 The 1,2-ethanediol derivative represented by
the general formula [I] or its salt has a NGF activity-
potentiating effect, and is useful as a remedy for
15 various diseases caused by degeneration of the peripheral
nervous system such as senile dementia of Alzheimer type,
Huntington's chorea, various neuropathies, Riley-Day
syndrome, traumatic nerve injury, amyotrophic lateral
sclerosis (ALS) and the like.

The embodiments of the present invention in which an exclusive property or privilege is claimed are defined as follows:

1. Use, in the preparation of a medicament for the treatment of a disease caused by degeneration of the peripheral nervous system, by potentiating nerve growth factor activity, of a 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:



wherein:

R¹ represents a phenyl, naphthyl, indanyl, indenyl, tetrahydronaphthyl or heterocyclic group, which group is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄ alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² represents a hydrogen atom, or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

R³ represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

R⁶ represents an ammonio group, a substituted or unsubstituted amino or nitrogen-containing heterocyclic

group, wherein the nitrogen-containing heterocyclic group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group;

wherein at each occurrence the substituent of the amino group in R¹ and the substituted amino group in R⁶ is a protected or unprotected hydroxyl group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl or carboxyl group, a cycloalkyl group, an aryl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, a heterocyclic group, an oxo group-substituted or unsubstituted heterocyclic carbonyl group, an adamantyl group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group;

wherein the heterocyclic group mentioned above means pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl, indazolyl, furyl, thienyl, benzothienyl, pyranyl, isobenzofuranyl, oxazolyl, benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl,

benzothiazolyl, quinoxalyl, dihydroquinoxaliny, 2,3-dihydrobenzothienyl, 2,3-dihydrobenzopyrrolyl, 2,3 dihydro-4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl, benzo[b]dioxanyl, imidazo[2,3-a]pyridyl, benzo[b]piperaziny, chromenyl, isothiazolyl, isoxazolyl, thiadiazolyl, oxadiazolyl, pyridaziny, isoindolyl or isoquinolyl group;

wherein the nitrogen-containing heterocyclic group mentioned above means pyrrolyl, pyrrolidinyl, piperidyl, piperaziny, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholiny, thiomorpholiny, quinolyl, quinolidiny, tetrahydroquinoliny, tetrahydroisoquinoliny, quinuclidiny, thiazolyl, tetrazolyl, thiadiazolyl, pyrroliny, imidazoliny, imidazolidiny, pyrazoliny, pyrazolidiny, puriny or indazolyl group; and

n represents 0 or an integer of 1 to 6.

2. The use according to claim 1, wherein:

R¹ represents a phenyl group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² represents a hydrogen atom or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s are hydrogen atoms;

R⁶ represents an amino or benzothienylmethylamino group, which group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

3. The use according to claim 2, wherein:

R¹ is a phenyl, halogen-substituted phenyl, C₁₋₆alkylsubstituted phenyl or C₁₋₄alkylsubstituted biphenyl group;

R² is a hydrogen atom;

nR^{4'}s are hydrogen atoms;

nR^{5'}s are hydrogen atoms;

R⁶ is an amino group which is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group,

an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

4. The use according to claim 1, wherein:

R¹ is a naphthyl group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² is a hydrogen atom, or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s are hydrogen atoms;

R⁶ is an ammonio group or an amino, pyrrolyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, pyrimidyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, quinuclidinyl, thiazolyl or thiadiazolyl group, which group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group,

an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

5. The use according to claim 4, wherein:

R¹ is a naphthyl group;

R² is a hydrogen atom;

R³ is a hydrogen atom;

nR⁴'s are hydrogen atoms;

R⁶ is an amino group which is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

6. The use according to claim 1, wherein:

R¹ is a heterocyclic group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy.

7. The use according to claim 6, wherein:

R^1 is a benzothienyl, benzofuranyl or 2,3-dihydrobenzothienyl group which is unsubstituted or substituted by a halogen atom, a C_{1-6} alkyl group, a C_{1-6} alkoxy group or a phenyl group;

R^2 is a hydrogen atom;

R^3 is a hydrogen atom;

nR^4 's and nR^5 's are hydrogen atoms;

R^6 is an amino, pyrrolidinyl, piperazinyl, tetrahydropyridyl or morpholinyl group which is unsubstituted or substituted by a C_{1-6} alkyl group, or a halogen-substituted or unsubstituted aroyl group.

8. The use according to claim 7, wherein:

R^1 is a benzothienyl group which is unsubstituted or substituted by a halogen atom or a C_{1-6} alkyl group;

R^6 is an amino group which is unsubstituted or substituted by a C_{1-6} alkyl group; and

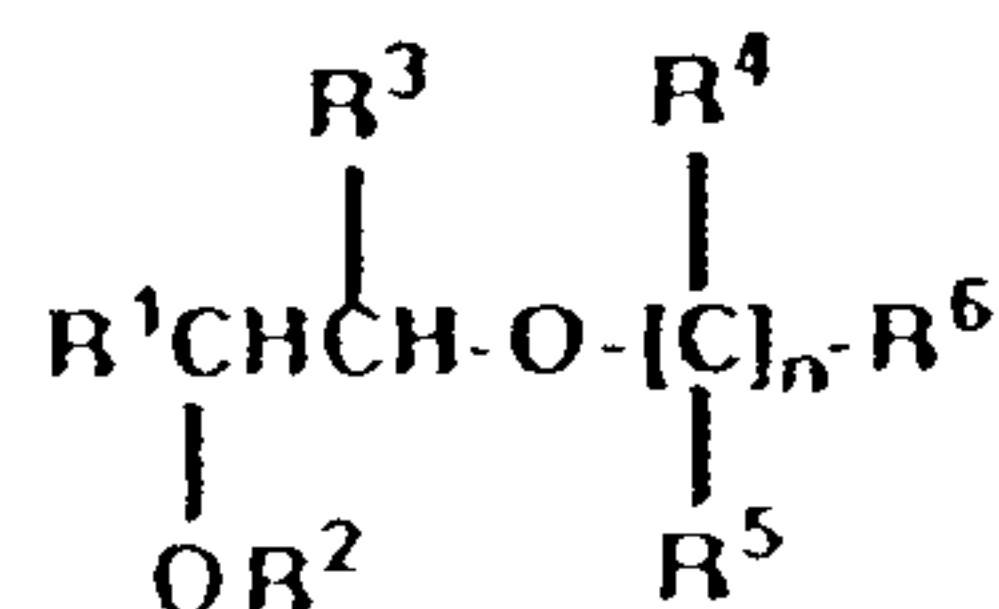
n is 2.

9. The use according to claim 8, wherein:

R^1 is an unsubstituted or halogen-substituted benzo[b]thiophen-5-yl group;

R^6 is a di- C_{1-6} alkyl amino group.

10. A nerve growth factor activity-potentiating pharmaceutical composition for the treatment of a disease caused by degeneration of the peripheral nervous system, the composition comprising a pharmaceutically acceptable diluent or carrier and a 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:



wherein:

R¹ represents a phenyl, naphthyl, indanyl, indenyl, tetrahydronaphthyl or heterocyclic group, which group is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄ alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² represents a hydrogen atom, or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

R³ represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

R⁶ represents an ammonio group, a substituted or unsubstituted amino or nitrogen-containing heterocyclic group, wherein the nitrogen-containing heterocyclic group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-

substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group;

wherein at each occurrence the substituent of the amino group in R¹ and the substituted amino group in R⁶ is a protected or unprotected hydroxyl group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl or carboxyl group, a cycloalkyl group, an aryl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, a heterocyclic group, an oxo group-substituted or unsubstituted heterocyclic carbonyl group, an adamantyl group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group;

wherein the heterocyclic group mentioned above means pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl, indazolyl, furyl, thienyl, benzothienyl, pyranyl, isobenzofuranyl, oxazolyl, benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl, benzothiazolyl, quinoxalyl, dihydroquinoxalinyl, 2,3-dihydrobenzothienyl, 2,3-dihydrobenzopyrrolyl, 2,3 dihydro-4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl, benzo[b]dioxanyl, imidazo[2,3-a]pyridyl, benzo[b]piperazinyl, chromenyl, isothiazolyl, isoxazolyl, thiadiazolyl, oxadiazolyl, pyridazinyl, isoindolyl or isoquinolyl group;

wherein the nitrogen-containing heterocyclic group mentioned above means pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl or indazolyl group; and

n represents 0 or an integer of 1 to 6.

11. The pharmaceutical composition according to claim 10, wherein:

R¹ represents a phenyl group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² represents a hydrogen atom or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s are hydrogen atoms; and

R⁶ represents an amino or benzothienylmethylamino group, which group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or

substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

12. The pharmaceutical composition according to claim 11, wherein:

R¹ is a phenyl, halogen-substituted phenyl, C₁₋₆alkylsubstituted phenyl or C₁₋₄alkylsubstituted biphenyl group;

R² is a hydrogen atom;

nR^{4'}s are hydrogen atoms;

nR^{5'}s are hydrogen atoms; and

R⁶ is an amino group which is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group.

13. The pharmaceutical composition according to claim 10, wherein:

R^1 is a naphthyl group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C_{1-6} alkyl, aryl, ar- C_{1-4} alkyl, C_{1-6} alkoxy, ar- C_{1-4} alkoxy, aryloxy, carbamoyloxy, C_{1-6} alkylthio, C_{2-6} alkenyl, C_{2-6} alkenyloxy, ar- C_{1-4} alkylthio, ar- C_{1-6} alkylsulfonyl, arylsulfonyl, C_{1-6} alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C_{1-4} alkylenedioxy;

R^2 is a hydrogen atom or a C_{1-6} alkyl, C_{1-6} acyl, tetrahydropyranyl, ar- C_{1-6} alkyl group;

nR^4 's may be the same as or different from one another and each represents a hydrogen atom or a C_{1-6} alkyl group;

nR^5 's are hydrogen atoms;

R^6 is an ammonio group or an amino, pyrrolyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, pyrimidyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, quinuclidinyl, thiazolyl or thiadiazolyl group, which group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C_{1-6} alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C_{1-6} alkoxy group-substituted or unsubstituted C_{1-6} alkoxy group, a halo- C_{1-6} alkyl group, a C_{1-6} acyl group, an ar- C_{1-4} alkyl group, an ar- C_{2-4} alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C_{1-6} alkylsulfonyl group or an arylsulfonyl group.

14. The pharmaceutical composition according to claim 13, wherein:

R^1 is a naphthyl group;

R^2 is a hydrogen atom;

R^3 is a hydrogen atom;

$nR^{4'}$ s are hydrogen atoms;

R^6 is an amino group which is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a C_{1-6} alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C_{1-6} alkoxy group-substituted or unsubstituted C_{1-6} alkoxy group, a halo- C_{1-6} alkyl group, a C_{1-6} acyl group, an ar- C_{1-4} alkyl group, an ar- C_{2-4} alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, a C_{1-6} alkylsulfonyl group or an arylsulfonyl group.

15. The pharmaceutical composition according to claim 10, wherein:

R^1 is a heterocyclic group which is optionally substituted by a halogen atom, substituted or unsubstituted amino, C_{1-6} alkyl, aryl, ar- C_{1-4} alkyl, C_{1-6} alkoxy, ar- C_{1-4} alkoxy, aryloxy, carbamoyloxy, C_{1-6} alkylthio, C_{2-6} alkenyl, C_{2-6} alkenyloxy, ar- C_{1-4} alkylthio, ar- C_{1-6} alkylsulfonyl, arylsulfonyl, C_{1-6} alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C_{1-4} alkylenedioxy.

16. The pharmaceutical composition according to claim 15, wherein:

R^1 is a benzothienyl, benzofuranyl or 2,3-dihydrobenzothienyl group which is unsubstituted or substituted by a halogen atom, a C_{1-6} alkyl group, a C_{1-6} alkoxy group or a phenyl group;

R^2 is a hydrogen atom;

R^3 is a hydrogen atom;

nR^4 's and nR^5 's are hydrogen atoms;

R^6 is an amino, pyrrolidinyl, piperazinyl, tetrahydropyridyl or morpholinyl group which is unsubstituted or substituted by a C_{1-6} alkyl group, or a halogen-substituted or unsubstituted aroyl group.

17. The pharmaceutical composition according to claim 16, wherein:

R^1 is a benzothienyl group which is unsubstituted or substituted by a halogen atom or a C_{1-6} alkyl group;

R^6 is an amino group which is unsubstituted or substituted by a C_{1-6} alkyl group; and

n is 2.

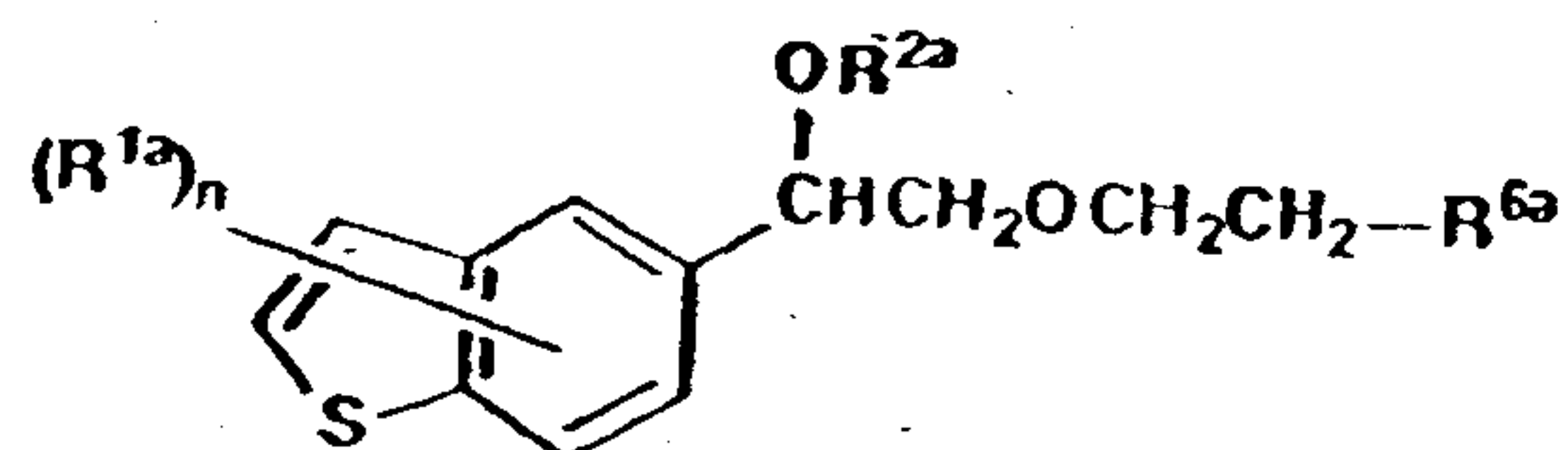
18. The pharmaceutical composition according to claim 17, wherein:

R^1 is an unsubstituted or halogen-substituted benzo[b]thiophen-5-yl group; and

R^6 is a di- C_{1-6} alkyl amino group.

19. Use, in the preparation of a medicament for potentiating nerve growth factor activity for the treatment of a disease caused by degeneration of the peripheral nervous system, of a 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:

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wherein:

R^{1a} at each occurrence is fluorine, chlorine, bromine, iodine, C_{1-6} alkyl, C_{1-6} alkoxy or phenyl;

R^{2a} represents a hydrogen atom or a C_{1-6} alkyl, C_{1-6} acyl, tetrahydropyranyl, or ar- C_{1-6} alkyl group;

R^{6a} represents a C_{1-6} alkylsubstituted amino group or a pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl, indazolyl, furyl, thienyl, benzothienyl, pyranyl, isobenzofuranyl, oxazolyl, benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl, benzothiazolyl, quinoxalyl, dihydroquinoxalyl, 2,3-dihydrobenzothienyl, 2,3-dihydrobenzopyrrolyl, 2,3-dihydro-4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl, benzo[b]dioxanyl, imidazo[2,3-a]pyridyl, benzo[b]piperazinyl, chromenyl, isothiazolyl, isoxazolyl, thiadiazolyl, oxadiazolyl, pyridazinyl, isoindolyl or isoquinolyl group; and

n represents an integer of 1 to 5.

20. The use according to claim 19, wherein:

each R^{1a} is a C_{1-6} alkyl group; and

n is an integer of 1 to 5.

21. The use according to claim 19, wherein:

R^{1a} at each occurrence is fluorine, chlorine, bromine or iodine; and

n is an integer of 1 to 5.

22. The use according to claim 19, wherein:

R^{1a} is a fluorine atom; and

n is an integer of 1 to 5.

23. The use according to claim 19, wherein:

R^{1a} is a fluorine atom bonded to the 6-position;

R^{2a} is a hydrogen atom;

a C_{1-6} alkylsubstituted amino group of R^{6a} is a diethylamino group; and

n is an integer of 1.

24. The use according to claim 19, wherein:

R^{1a} is a fluorine atom bonded to the 4-position;

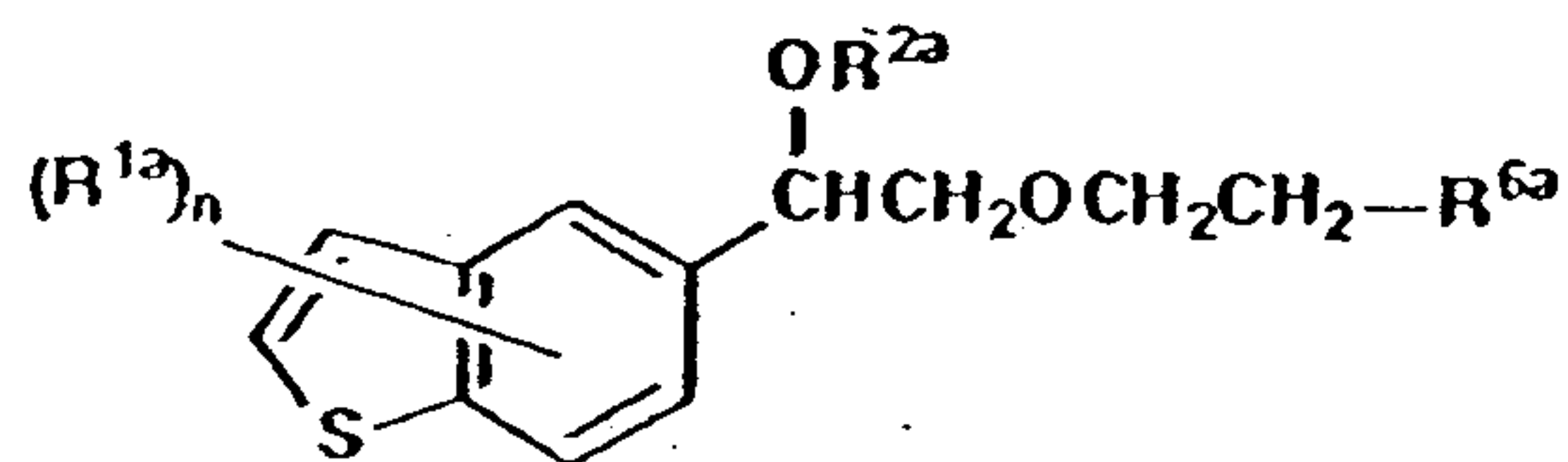
R^{2a} is a hydrogen atom;

a C_{1-6} alkyl-substituted amino group of R^{6a} is a diethylamino group; and

n is an integer of 1.

25. The use according to any one of claims 19 to 24, wherein the 1,2-ethanediol derivative is an optically active compound.

26. A nerve growth factor activity-potentiating pharmaceutical composition for the treatment of a disease caused by degeneration of the peripheral nervous system, comprising a pharmaceutically acceptable diluent or carrier and a 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:



wherein:

R^{1a} at each occurrence is fluorine, chlorine, bromine, iodine, C_{1-6} alkyl, C_{1-6} alkoxy or phenyl;

R^{2a} represents a hydrogen atom or a C_{1-6} alkyl, C_{1-6} acyl, tetrahydropyranyl, or ar- C_{1-6} alkyl group;

R^{6a} represents a C_{1-6} alkylsubstituted amino group or a pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl, indazolyl, furyl, thienyl, benzothienyl, pyranyl, isobenzofuranyl, oxazolyl, benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl, benzothiazolyl, quinoxalyl, dihydroquinoxalyl, 2,3-dihydrobenzothienyl, 2,3-dihydrobenzopyrrolyl, 2,3-dihydro-4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl, benzo[b]dioxanyl, imidazo[2,3-a]pyridyl, benzo[b]piperazinyl, chromenyl, isothiazolyl, isoxazolyl, thiadiazolyl, oxadiazolyl, pyridazinyl, isoindolyl or isoquinolyl group; and

n represents an integer of 1 to 5.

27. The pharmaceutical composition according to claim 26, wherein:

R^{1a} is a C_{1-6} alkyl group; and

n is an integer of 1 to 5.

28. The pharmaceutical composition according to claim 26, wherein:

R^{1a} at each occurrence is fluorine, chlorine, bromine or iodine; and

n is an integer of 1 to 5.

29. The pharmaceutical composition according to claim 26, wherein:

R^{1a} is a fluorine atom; and

n is an integer of 1 to 5.

30. The pharmaceutical composition according to claim 26, wherein:

R^{1a} is a fluorine atom bonded to the 6-position;

R^{2a} is a hydrogen atom;

a C_{1-6} alkyl substituted amino group of R^{6a} is a diethylamino group; and

n is an integer of 1.

31. The pharmaceutical composition according to claim 26, wherein:

R^{1a} is a fluorine atom bonded to the 4-position;

R^{2a} is a hydrogen atom;

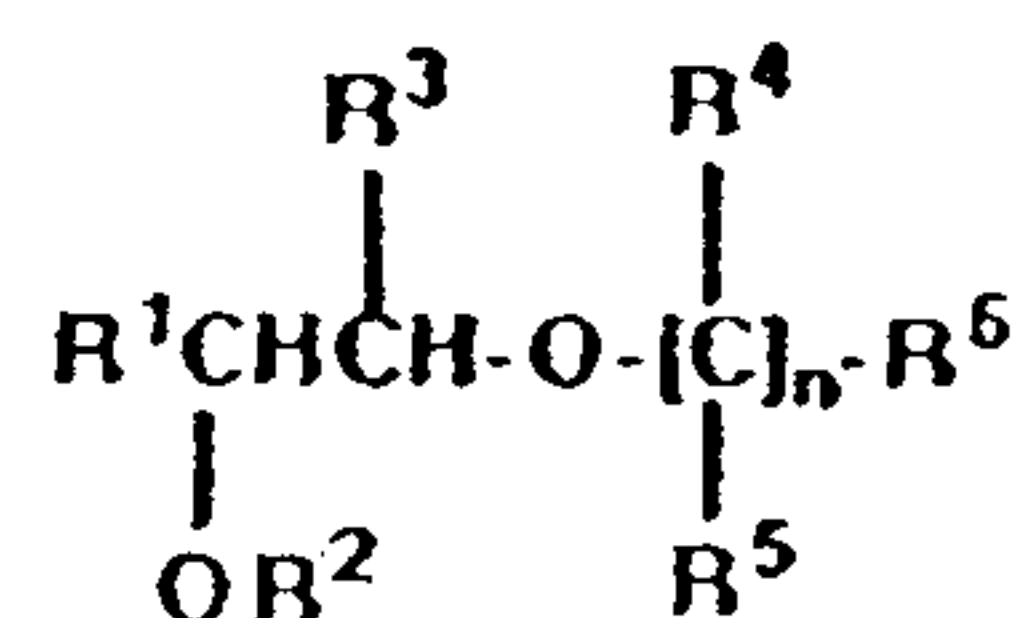
a C_{1-6} alkyl-substituted amino group of R^{6a} is a diethylamino group; and

n is an integer of 1.

32. The pharmaceutical composition according to any one of claims 26 to 31, wherein the 1,2-ethanediol derivative is an optically active compound.

33. Use, in the manufacture of a medicament for the treatment of a disease caused by degeneration of the

peripheral nervous system, of a 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:



wherein:

R¹ represents a phenyl, naphthyl, indanyl, indenyl, tetrahydronaphthyl or heterocyclic group, which group is optionally substituted by a halogen atom, substituted or unsubstituted amino, C₁₋₆alkyl, aryl, ar-C₁₋₄alkyl, C₁₋₆alkoxy, ar-C₁₋₄alkoxy, aryloxy, carbamoyloxy, C₁₋₆alkylthio, C₂₋₆alkenyl, C₂₋₆alkenyloxy, ar-C₁₋₄alkylthio, ar-C₁₋₆alkylsulfonyl, arylsulfonyl, C₁₋₆alkylsulfonylamino, arylsulfonylamino, protected amino, protected or unprotected hydroxyl, nitro, oxo, or C₁₋₄alkylenedioxy;

R² represents a hydrogen atom, or a C₁₋₆alkyl, C₁₋₆acyl, tetrahydropyranyl, or ar-C₁₋₆alkyl group;

R³ represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁴'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

nR⁵'s may be the same as or different from one another and each represents a hydrogen atom or a C₁₋₆alkyl group;

R⁶ represents an ammonio group, a substituted or unsubstituted amino or nitrogen-containing heterocyclic group, wherein the nitrogen-containing heterocyclic group is optionally substituted by at least one substituent which at each occurrence is a halogen atom, a protected or unprotected hydroxyl group, a protected or unprotected carboxyl group, a protected or unprotected amino group, a

C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl group, a halogen-substituted or unsubstituted aryl group, a halogen-substituted or unsubstituted aroyl group, a C₁₋₆alkoxy group-substituted or unsubstituted C₁₋₆alkoxy group, a halo-C₁₋₆alkyl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, an ar-C₂₋₄alkenyl group, a heterocyclic group, a heterocyclic carbonyl group, an oxo group, C₁₋₆alkylsulfonyl group or an arylsulfonyl group;

wherein at each occurrence the substituent of the amino group in R¹ and the substituted amino group in R⁶ is a protected or unprotected hydroxyl group, a C₁₋₆alkyl group which is unsubstituted or substituted by a protected or unprotected hydroxyl or carboxyl group, a cycloalkyl group, an aryl group, a C₁₋₆acyl group, an ar-C₁₋₄alkyl group, a heterocyclic group, an oxo group-substituted or unsubstituted heterocyclic carbonyl group, an adamantyl group, a C₁₋₆alkylsulfonyl group or an arylsulfonyl group;

wherein the heterocyclic group mentioned above means pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl, indazolyl, furyl, thienyl, benzothienyl, pyranyl, isobenzofuranyl, oxazolyl, benzofuranyl, indolyl, benzimidazolyl, benzoxazolyl, benzothiazolyl, quinoxalyl, dihydroquinoxalinyl, 2,3-dihydrobenzothienyl, 2,3-dihydrobenzopyrrolyl, 2,3-dihydro-4H-1-thianaphthyl, 2,3-dihydrobenzofuranyl, benzo[b]dioxanyl, imidazo [2,3-a]pyridyl, benzo[b]piperazinyl, chromenyl, isothiazolyl, isoxazolyl,

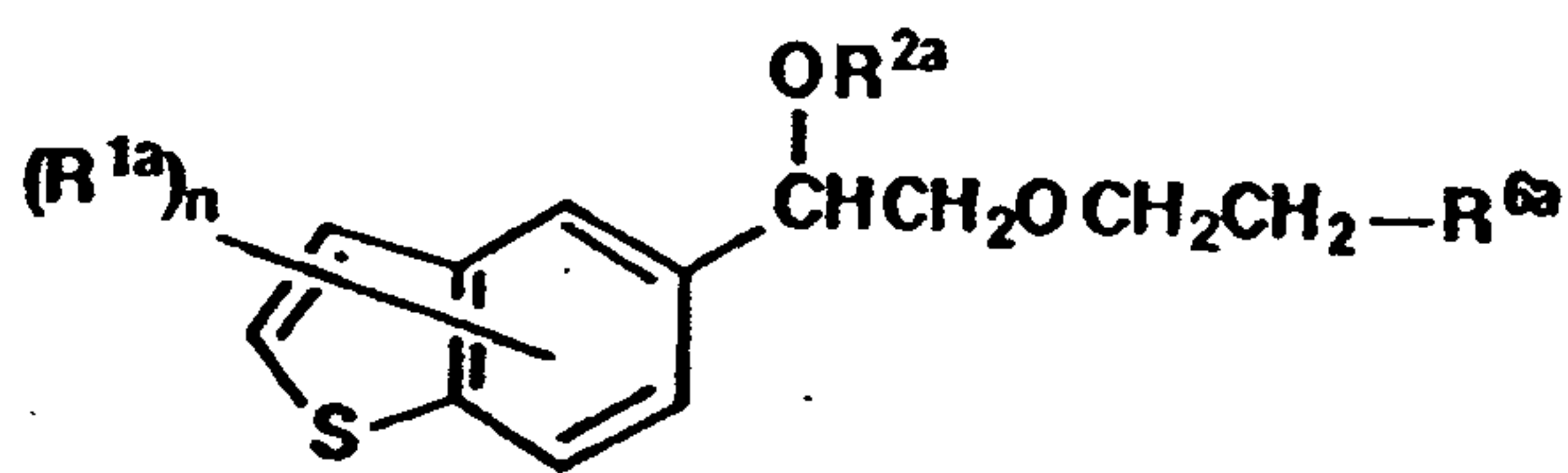
thiadiazolyl, oxadiazolyl, pyridazinyl, isoindolyl or isoquinolyl group;

wherein the nitrogen-containing heterocyclic group mentioned above means pyrrolyl, pyrrolidinyl, piperidyl, piperazinyl, imidazolyl, pyrazolyl, pyridyl, tetrahydropyridyl, pyrimidinyl, morpholinyl, thiomorpholinyl, quinolyl, quinolidinyl, tetrahydroquinolinyl, tetrahydroisoquinolinyl, quinuclidinyl, thiazolyl, tetrazolyl, thiadiazolyl, pyrrolinyl, imidazolinyl, imidazolidinyl, pyrazolinyl, pyrazolidinyl, purinyl or indazolyl group;

n represents 0 or an integer of 1 to 6; and

wherein the disease is senile dementia, Alzheimer-type, Huntington's chorea, amyotrophic lateral sclerosis, neuropathy, Riley-Day syndrome or traumatic nerve injury.

34. A 1,2-ethanediol derivative represented by the following general formula or a pharmaceutically acceptable salt thereof:



wherein $n\text{R}^{1a}$'s may be the same as or different from one another and each represents a fluorine, chlorine, bromine or iodine atom, C_{1-6} alkyl, C_{1-6} alkoxy or phenyl group; R^{2a} represents a hydrogen atom; R^{6a} represents a C_{1-6} alkyl-substituted amino, piperidyl or morpholinyl group; and n represents an integer of 1 to 5.

35. A 1,2-ethanediol derivative or a pharmaceutically acceptable salt thereof according to claim 34, wherein each R^{1a} is a C_{1-6} alkyl group; and

n is an integer of 1 to 5.

36. A 1,2-ethanediol derivative or a pharmaceutically acceptable salt thereof according to claim 34, wherein R^{1a} at each occurrence is fluorine, chlorine, bromine or iodine; and

n is an integer of 1 to 5.

37. A 1,2-ethanediol derivative or a pharmaceutically acceptable salt thereof according to claim 34, wherein R^{1a} is a fluorine atom; and

n is an integer of 1 to 5.

38. A 1,2-ethanediol derivative or a pharmaceutically acceptable salt thereof according to claim 34, wherein R^{1a} is a fluorine atom bonded to 6-position; R^{2a} is a hydrogen atom; a C_{1-6} alkyl-substituted amino group of R^{6a} is a diethylamino group; and

n is an integer of 1.

39. A 1,2-ethanediol derivative or a pharmaceutically acceptable salt thereof according to claim 34, wherein R^{1a} is a fluorine atom bonded to 4-position; R^{2a} is a hydrogen atom; a C_{1-6} alkyl-substituted amino group of R^{6a} is a diethylamino group; and

n is an integer of 1.

40. A 1,2-ethanediol derivative or a pharmaceutically acceptable salt thereof according to any one of claims 34

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to 39, wherein the 1,2-ethanediol derivative is an optically active compound.

