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Phenyl carbamate compounds for use in preventing or treating epilepsy

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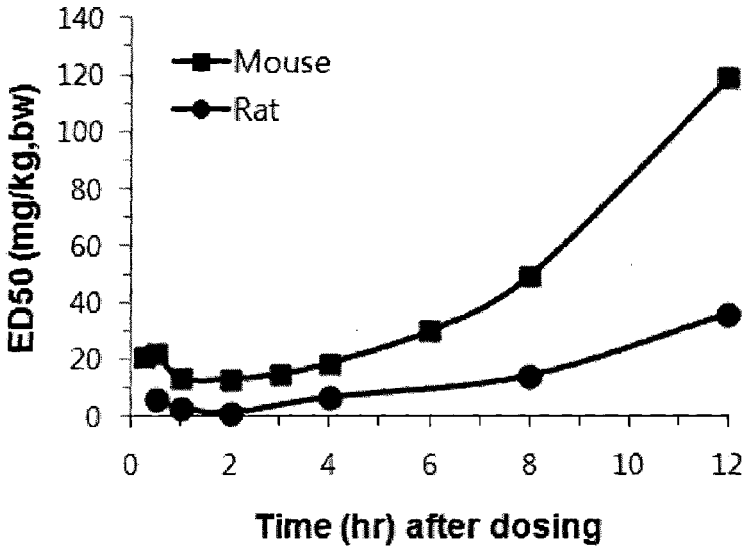
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(54) Title: PHENYL CARBAMATE COMPOUNDS FOR USE IN PREVENTING OR TREATING EPILESY



(57) Abstract: A phenyl carbamate compound, a pharmaceutical composition for preventing and/or treating epilepsy comprising the phenyl carbamate compound as an active ingredient, and a use of the phenyl carbamate compound for preventing and/or treating epilepsy, are provided.

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【Title of the Invention】

PHENYL CARBAMATE COMPOUNDS FOR USE IN PREVENTING OR TREATING EPILEPSY

【Technical Field】

The present invention provides a phenyl carbamate compound, a pharmaceutical composition for preventing and/or treating epilepsy comprising the phenyl carbamate compound as an active ingredient, and a use of the phenyl carbamate compound for preventing and/or treating epilepsy.

【Background Art】

Epilepsy is a chronic neurological disorder presenting a wide spectrum of diseases that affects approximately 50 million people worldwide, which corresponds to 1% of the world's burden of disease, equaling breast cancer in women and lung cancer in men. Epilepsy refers to a clinical phenomenon rather than a single disease entity, since there are many forms and causes of epilepsy.

An essential step in the diagnosis and treatment of a patient with a seizure is to determine the type of seizure that has occurred. The main characteristic that distinguishes the different categories of seizure is whether the seizure activity is partial or generalized.

On the basis of clinical and encephalographic phenomenon, four subdivisions of epilepsy are recognized: grand mal epilepsy (with subgroups: generalized, focal, jacksonian), petit mal epilepsy, psychomotor or temporal lobe epilepsy (with subgroups: psychomotor proper or tonic with adversive or torsion movements or masticatory phenomenon, automatic with amnesia, or sensory with hallucinations or dream states) and autonomic or diencephalic epilepsy (with flushing, pallor, tachycardia, hypertension, perspiration or other visceral symptoms).

Despite many trials to develop anti-epilepsy drugs, epilepsy is still unmet in efficacies. Therefore, there is a need for improved anti-epilepsy medications.

The discussion of documents, acts, materials, devices, articles and the like is included in this specification solely for the purpose of providing a context for the present invention. It is not suggested or represented that any or all of these matters formed part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification (including the claims) they are to be interpreted as specifying the presence of the stated features, integers, steps or components, but not precluding the presence of one or more other features, integers, steps or components, or group thereof.

【Summary of the Invention】

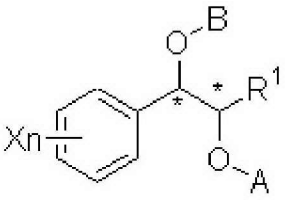
An embodiment provides an organic compound, i.e., phenyl carbamate compound. More particularly, the embodiment is directed to a phenyl carbamate compound of the following Chemical Formula 1, an enantiomer or a diastereomer thereof, or a mixture of enantiomers or diastereomers; or a pharmaceutically acceptable salt of organic acid or inorganic acid thereof; which has remarkably excellent treatment effect on epilepsy as well as very low toxicity. Also, the compounds of formula I may be useful as a drug especially for the treatment of epilepsy:

Another embodiment provides a method of preventing and/or treating epilepsy comprising administering a pharmaceutically effective amount of a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof, to a subject in need of preventing and/or treating epilepsy.

Another embodiment provides a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof, for use in the prevention and/or treatment of epilepsy or the manufacture of a pharmaceutical composition for preventing and/or treating epilepsy.

In one aspect, the present invention provides a use of a phenyl carbamate compound represented by Chemical Formula 1 or a pharmaceutically acceptable salt thereof in manufacturing a medicament for treating epilepsy:

[Chemical formula 1]

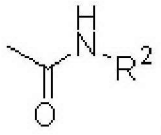


wherein the relative configuration at the carbon atoms bearing an asterisk (*) is (S);

X is a chlorine, fluorine or iodine;

n is 1 or 2;

R^1 is a methyl group;

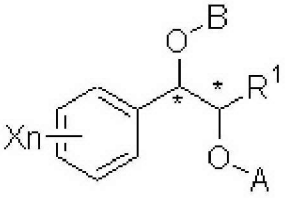
A is a carbamoyl derivative represented by  ;

B is hydrogen; and

R^2 is selected from the group consisting of hydrogen, a linear or branched alkyl group of C_1-C_4, a cycloalkyl group of C_3-C_8, and benzyl group.

In one embodiment, the present invention provides a phenyl carbamate compound represented by Chemical Formula 1:

[Chemical formula 1]

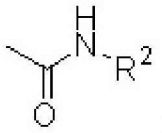


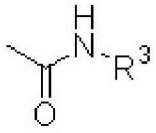
wherein

X is a halogen;

n is an integer from 1 to 5;

R1 is a linear or branched alkyl group of C1-C4;

A is hydrogen or a carbamoyl derivative represented by ;

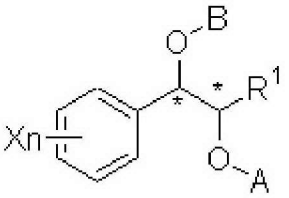
B is hydrogen, a carbamoyl derivative represented by , trialkyl silyl groups, trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three), or a trialkyl silyl ether group, wherein each alkyl group is independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group is independently selected from the group consisting of C5-C8 aryl groups;

A and B are not carbamoyl derivatives at same time; and

R2 and R3 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, a linear or branched alkyl group of C1-C4, a cycloalkyl group of C3-C8, and benzyl group.

In another embodiment, the present invention provides a pharmaceutical composition for preventing or treating epilepsy comprising a phenyl carbamate compound represented by Chemical Formula 1 or a pharmaceutically acceptable salt thereof, as an active ingredient:

[Chemical formula 1]

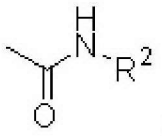


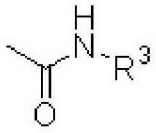
wherein

X is a halogen;

n is an integer from 1 to 5;

R1 is a linear or branched alkyl group of C1-C4;

A is hydrogen or a carbamoyl derivative represented by ;

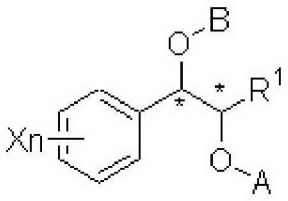
B is hydrogen, a carbamoyl derivative represented by , trialkyl silyl groups, trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three), or a trialkyl silyl ether group, wherein each alkyl group is independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group is independently selected from the group consisting of C5-C8 aryl groups;

A and B are not carbamoyl derivatives at same time; and

R2 and R3 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, a linear or branched alkyl group of C1-C4, a cycloalkyl group of C3-C8, and benzyl group.

In yet another embodiment, the present invention provides a phenyl carbamate compound represented by Chemical Formula 1 or a pharmaceutically acceptable salt thereof, for the use in preventing or treating epilepsy:

[Chemical formula 1]

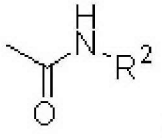


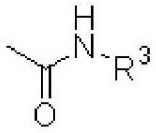
wherein

X is a halogen;

n is an integer from 1 to 5;

R1 is a linear or branched alkyl group of C1-C4;

A is hydrogen or a carbamoyl derivative represented by ;

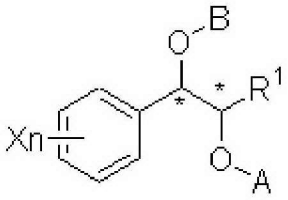
B is hydrogen, a carbamoyl derivative represented by , trialkyl silyl groups, trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three), or a trialkyl silyl ether group, wherein each alkyl group is independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group is independently selected from the group consisting of C5-C8 aryl groups;

A and B are not carbamoyl derivatives at same time; and

R2 and R3 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, a linear or branched alkyl group of C1-C4, a cycloalkyl group of C3-C8, and benzyl group.

In a further embodiment, the present invention provides a use of phenyl carbamate compound represented by Chemical Formula 1 or a pharmaceutically acceptable salt thereof in manufacturing a pharmaceutical composition for preventing or treating epilepsy:

[Chemical formula 1]

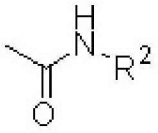


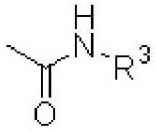
wherein

X is a halogen;

n is an integer from 1 to 5;

R1 is a linear or branched alkyl group of C1-C4;

A is hydrogen or a carbamoyl derivative represented by ;

B is hydrogen, a carbamoyl derivative represented by , trialkyl silyl groups, trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three), or a trialkyl silyl ether group, wherein each alkyl group is independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group is

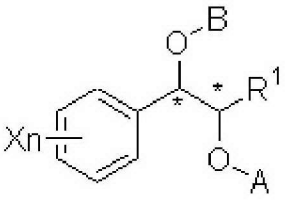
independently selected from the group consisting of C5-C8 aryl groups;

A and B are not carbamoyl derivatives at same time; and

R2 and R3 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, a linear or branched alkyl group of C1-C4, a cycloalkyl group of C3-C8, and benzyl group.

In yet a further embodiment, the present invention provides a method of preventing or treating epilepsy comprising administering to a person in need thereof a therapeutically effective amount of a phenyl carbamate compound represented by Chemical Formula 1 or a pharmaceutically acceptable salt thereof:

[Chemical formula 1]

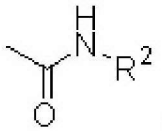


wherein

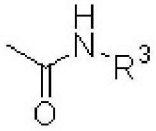
X is a halogen;

n is an integer from 1 to 5;

R1 is a linear or branched alkyl group of C1-C4;

A is hydrogen or a carbamoyl derivative represented by 

;

B is hydrogen, a carbamoyl derivative represented by 

, trialkyl silyl groups, trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three), or a trialkyl silyl ether group, wherein each alkyl group is independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group is independently selected from the group consisting of C5-C8 aryl groups;

A and B are not carbamoyl derivatives at same time; and

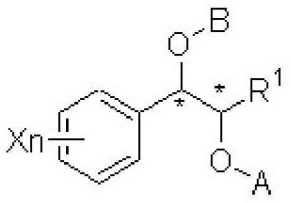
R2 and R3 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, a linear or branched alkyl group of C1-C4, a cycloalkyl group of C3-C8, and benzyl group.

【DETAILED DESCRIPTION OF THE EMBODIMENTS】

Continuing its research work in the field of epilepsy, the present inventors, as results of studies on the development of anti-epilepsy drugs, found that a substituted phenyl carbamate compounds of the following Chemical Formula 1 exhibits remarkably excellent anti-epilepsy activity in various emulation models and simultaneously has very low toxicity, and completed the invention.

Therefore, an embodiment provides an organic compound, i.e., phenyl carbamate derivatives, more particularly, a phenyl carbamate compound represented by following Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof:

[Chemical Formula 1]

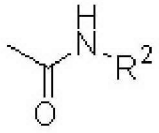


wherein,

X is a halogen, for example, chlorine, fluorine, iodine, or bromine,

n, that means the number of substituent X, is an integer from 1 to 5, for example, 1 or 2,

R1 is a linear or branched alkyl group of C1-C4, for example, methyl group, ethyl group, isopropyl group, or butyl group,

A is hydrogen or a carbamoyl derivative represented by 

,

Another embodiment provides a method of preventing and/or treating epilepsy comprising administering a pharmaceutically effective amount of a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof, to a subject in need of preventing and/or treating epilepsy.

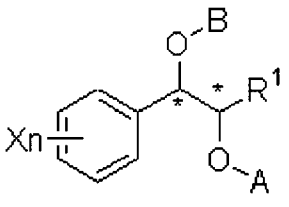
Another embodiment provides a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof, for use in the prevention and/or treatment of epilepsy or the manufacture of a pharmaceutical composition for preventing and/or treating epilepsy.

【DETAILED DESCRIPTION OF THE EMBODIMENTS】

Continuing its research work in the field of epilepsy, the present inventors, as results of studies on the development of anti-epilepsy drugs, found that a substituted phenyl carbamate compounds of the following Chemical Formula 1 exhibits remarkably excellent anti-epilepsy activity in various emulation models and simultaneously has very low toxicity, and completed the invention.

Therefore, an embodiment provides an organic compound, i.e., phenyl carbamate derivatives, more particularly, a phenyl carbamate compound represented by following Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof:

[Chemical Formula 1]

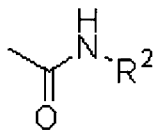


wherein,

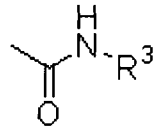
X is a halogen, for example, chlorine, fluorine, iodine, or bromine,

n, that means the number of substituent X, is an integer from 1 to 5, for example, 1 or 2,

R1 is a linear or branched alkyl group of C1-C4, for example, methyl group, ethyl group, isopropyl group, or butyl group,

A is hydrogen or a carbamoyl derivative represented by 

,

B is hydrogen, a carbamoyl derivative represented by , trialkyl silyl groups (e.g., a trimethyl silyl (TMS) group, a triethyl silyl (TES) group, a triisopropyl silyl (TIPS) group, t-butyl dimethyl silyl (TBDMS) group, and the like), trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three; e.g., a t-butyl diphenyl silyl (TBDPS) group and the like), or a trialkyl silyl ether group, wherein each alkyl group may be independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group may be independently selected from the group consisting of C5-C8 aryl groups, preferably a phenyl group,

A and B are not carbamoyl derivatives at same time, and

R2 and R3 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, a linear or branched alkyl group of C1-C4, for example C1-C3, a cycloalkyl group of C3-C8, for example C3-C7, and benzyl group, and more specifically, R2 and R3 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, methyl group, propyl group, isopropyl group, cyclopropyl group, cyclohexyl group, bicycloheptane group, and benzyl group.

In a concrete embodiment, the phenyl carbamate compound may be selected from the group consisting of:

1-(2-chlorophenyl)-1-hydroxypropyl-2-carbamate,

1-(2-chlorophenyl)-1-hydroxybutyl-2-carbamate,

1-(2-chlorophenyl)-1-hydroxy-3-methyl-butyl-2-carbamate,

1-(2-chlorophenyl)-1-hydroxyhexyl-2-carbamate,

1-(2-chlorophenyl)-1-hydroxypropyl-2-N-methylcarbamate,

1-(2-chlorophenyl)-1-hydroxypropyl-2-N-propylcarbamate,

1-(2-chlorophenyl)-1-hydroxypropyl-2-N-isopropylcarbamate,

1-(2-chlorophenyl)-1-hydroxypropyl-2-N-cyclopropylcarbamate,

1-(2-chlorophenyl)-1-hydroxypropyl-2-N-cyclohexylcarbamate,

1-(2-chlorophenyl)-1-hydroxypropyl-2-N-benzylcarbamate,

1-(2-chlorophenyl)-1-hydroxypropyl-2-N-bicyclo[2,2,1]heptanecarbamate,

1-(2,4-dichlorophenyl)-1-hydroxypropyl-2-carbamate,

1-(2,6-dichlorophenyl)-1-hydroxypropyl-2-carbamate,

1-(2,4-dichlorophenyl)-1-hydroxybutyl-2-carbamate,

1-(2,6-dichlorophenyl)-1-hydroxybutyl-2-carbamate,
1-(2,4-dichlorophenyl)-1-hydroxy-3-methyl-butyl-2-carbamate,
1-(2,6-dichlorophenyl)-1-hydroxy-3-methyl-butyl-2-carbamate,
1-(2,4-dichlorophenyl)-1-hydroxyhexyl-2-carbamate,
1-(2,6-dichlorophenyl)-1-hydroxyhexyl-2-carbamate,
1-(2-chlorophenyl)-2-hydroxypropyl-1-carbamate,
1-(2-chlorophenyl)-2-hydroxypropyl-1-N-methylcarbamate,
1-(2-chlorophenyl)-2-hydroxypropyl-1-N-propylcarbamate,
1-(2-chlorophenyl)-2-hydroxypropyl-1-N-isopropylcarbamate,
1-(2-chlorophenyl)-2-hydroxypropyl-1-N-cyclopropylcarbamate,
1-(2-chlorophenyl)-2-hydroxypropyl-1-N-cyclohexylcarbamate,
1-(2-chlorophenyl)-2-hydroxypropyl-1-N-benzylcarbamate,
1-(2,4-dichlorophenyl)-2-hydroxypropyl-1-carbamate,
1-(2,6-dichlorophenyl)-2-hydroxypropyl-1-carbamate,
1-(2,4-dichlorophenyl)-2-hydroxybutyl-1-carbamate,
1-(2,6-dichlorophenyl)-2-hydroxybutyl-1-carbamate,
1-(2,4-dichlorophenyl)-2-hydroxy-3-methyl-butyl-1-carbamate,
1-(2,6-dichlorophenyl)-2-hydroxy-3-methyl-butyl-1-carbamate,
1-(2,4-dichlorophenyl)-2-hydroxyhexyl-1-carbamate,
1-(2,6-dichlorophenyl)-2-hydroxyhexyl-1-carbamate,
1-(2-fluorophenyl)-1-hydroxypropyl-2-carbamate,
1-(2-iodophenyl)-1-hydroxypropyl-2-carbamate,
1-(2-iodophenyl)-1-hydroxybutyl-2-carbamate,
1-(2,3-dichlorophenyl)-1-hydroxypropyl-2-carbamate, and
1-(2,3-dichlorophenyl)-2-hydroxypropyl-1-carbamate.

In another concrete embodiment, the compound may not include 1-(2-chlorophenyl)-1,2-propanediol, 1-(2-chlorophenyl)-1-hydroxybutyl-2-carbamate, and 1-(2,6-dichlorophenyl)-1-hydroxybutyl-2-carbamate.

In this compound, 2 chiral carbons exist at positions 1 and 2 from phenyl group substituted with X; thus, the compound may exist in the form of an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers, as well as a racemate.

Alternatively, the compound may be in the form of a pharmaceutically acceptable salt.

The pharmaceutically acceptable salt may include an additional salt of acid or base, and its stereochemical isomer. For example, the compound may be in the form of an additional salt of an organic or inorganic acid. The salt may not be specially limited, and include any salts that maintain the activities of their parent compounds, with no undesirable effects, in the subject, when they are administered to the subject. Such salts may include inorganic and organic salts, such as salts of acetic acid, nitric acid, aspartic acid, sulfonic acid, sulfuric acid, maleic acid, glutamic acid, formic acid, succinic acid, phosphoric acid, phthalic acid, tannic acid, tartaric acid, hydrobromic acid, propionic acid, benzene sulfonic acid, benzoic acid, stearic acid, lactic acid, bicarbonic acid, bisulfuric acid, bitartaric acid, oxalic acid, butyric acid, calcium edetate, carbonic acid, chlorobezoic acid, citric acid, edetic acid, toluenesulfonic acid, fumaric acid, gluceptic acid, esilic acid, pamoic acid, gluconic acid, methyl nitric acid, malonic acid, hydrochloric acid, hydroiodic, hydroxynaphtholic acid, isethionic acid, lactobionic acid, mandelic acid, mucic acid, naphthylic acid, muconic acid, p-nitromethanesulfonic acid, hexamic acid, pantothenic acid, monohydrogen phosphoric acid, dihydrogen phosphoric acid, salicylic acid, sulfamic acid, sulfanilic acid, methane sulfonic acid, and the like. The additional salts of base may include salts of akali metal or alkaline earth metal, such as salts of ammonium, lithium, sodium, potassium, magnesium, calcium, and the like; salts having an organic base, such as benzathine, N-methyl-D- glucamine, hydrabamine, and the like; and salts having an amino acid such as arginine, lysine, and the like. In addition, these salts may be converted to a released form by treating with a proper base or acid.

As demonstrated in the following experimental examples, the compound of Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or pharmaceutically acceptable salt thereof exhibits an excellent effect on preventing, improving and/or treating epilepsy. Therefore, another embodiment provides a pharmaceutical composition for preventing and/or treating epilepsy containing a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof, as an active ingredient.

Another embodiment provides a method of preventing and/or treating epilepsy comprising administering a pharmaceutically effective amount of a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof, to a subject in need of preventing and/or treating epilepsy. The method may further comprise a

step of identifying the subject in need of preventing and/or treating epilepsy prior to the step of administering. Another embodiment provides a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof, for use in the prevention and/or treatment of epilepsy. Another embodiment provides a use of a phenyl carbamate compound represented by Chemical Formula 1; a racemate, an enantiomer, a diastereomer, a mixture of enantiomers, or a mixture of diastereomers thereof; or a pharmaceutically acceptable salt thereof for the manufacture of a pharmaceutical composition for preventing and/or treating epilepsy.

In a concrete embodiment, the epilepsy may include a neurodegeneration (in brain) associated epilepsy. In another concrete embodiment, the epilepsy may not be a muscle spasm associated epilepsy.

The pharmaceutical composition may be formulated in various forms for oral or parenteral administration. For example, the pharmaceutical composition may be formulated in the oral administration form, such as a tablet, pill, soft or hard capsule, liquid, suspension, emulsion, syrup, granules, elixirs, and the like. In addition to the active ingredient, the oral administration form may further include pharmaceutically acceptable and conventional components, for example, a diluent such as lactose, dextrose, sucrose, mannitol, sorbitol, cellulose, glycine, and the like; a lubricant such as silica, talc, stearic acid, magnesium or calcium salt thereof, polyethyleneglycol, and the like. In the case that the oral administration form is a tablet, it may further include a binder such as magnesium aluminium silicate, starch paste, gelatin, tragacanth, methylcellulose, sodium carboxymethylcellulose, polyvinylpirrolidine, and the like; and optionally include one or more additives selected from the group consisting of a disintegrant such as starch, agar, arginic acid or sodium salt thereof, an absorbent, a colorant, a flavoring, a sweetener, and the like. Alternatively, the pharmaceutical composition may also be formulated in a parenteral administration form, which can be administered by subcutaneous injection, intravenous injection, intramuscular injection, injection into thoracic cavity, and the like. In order to formulate the parenteral administration form, the pharmaceutical composition may be prepared as a solution or suspension wherein the active ingredient is dissolved in water together with a stabilizer and/or a buffering agent, and such solution or suspension formulation may be prepared as a dosage form in ample or vial.

The pharmaceutical composition may be sterilized, and/or include further additives such as a preservative, a stabilizer, a hydrating agent, an emulsification accelerator, a salt and/or buffering

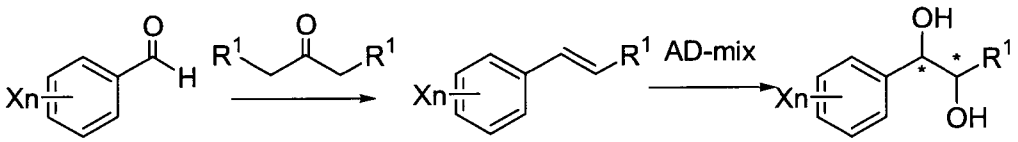
agent for osmoregulation, and the like, and/or further therapeutically effective ingredients. The pharmaceutical composition may be formulated by any conventional method for mixing, granulating, coating, and the like.

The pharmaceutical composition may be administered to a mammal including human, in the pharmaceutically effective amount of 0.01 to 750 mg/kg(body weight), preferably 0.1 to 500 mg/kg(body weight) per one day, based on the active ingredient. The pharmaceutically effective amount may refers to an amount capable of exhibiting a desired effect, i,e., an effect of treating and/or preventing epilepsy. The pharmaceutically effective amount may be administered through oral or parenteral pathway (e.g., an intravenous injection, an intramusclular injection, etc.), one or two or more times per one day.

The pharmaceutically effective amount and the administration pathway of the present pharmaceutical composition may be properly adjusted by a person skilled in the relevant field considering the conditions of the subject (patient), desired effects, and the like. The subject may be a mammal including human or cells and/or tissues obtained therefrom.

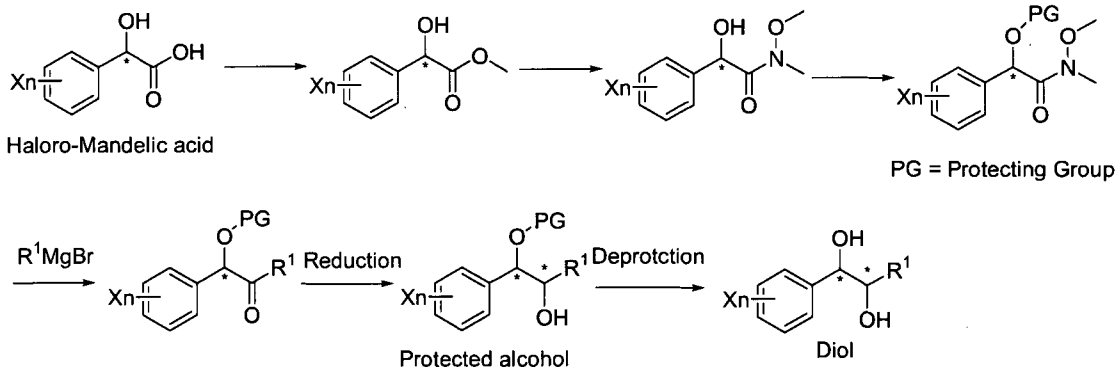
The carbamate compound of the present invention may prepared by the following reaction formula.

Reaction Formula I: Synthesis of Diol-1



A diol compound used in the synthesis of the carbamate compound may be synthesized by dihydroxylation of a trans-olefin compound. A diol compound having optical activity may be synthesized using a sharpless asymmetric dihydroxylation catalyst.

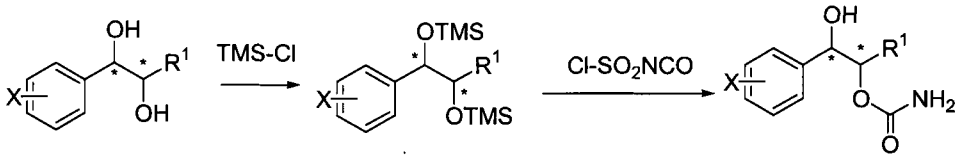
Reaction Formula II: Synthesis of Diol-2



As indicated in the Reaction Formula II, the optically active substance of diol may also be synthesized using a reduction reagent after synthesizing a hydroxy-ketone compound using

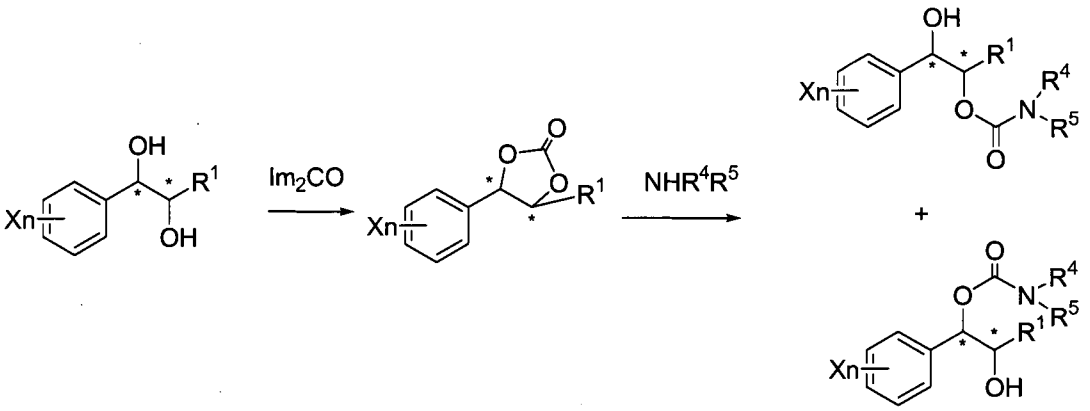
Haloro-Mandelic acid. In the Reaction Formula II, PG(protecting group) may be selected from the group consisting of trialkyl silyl group(e.g., a trimethyl silyl (TMS) group, a triethyl silyl (TES) group, a triisopropyl silyl (TIPS) group, t-butyl dimethyl silyl (TBDMS) group, and the like), trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three; e.g., a t-butyl diphenyl silyl (TBDPS) group and the like), ester group[Ac(acetate), Bz(benzoate), Pv(pivaloate), Cbz(benzyl carbonate), BOC(t-butyl carbonate), Fmoc(9-fluoroenylmethyl)carbaonate, Alloc(allyl Carbonate), Troc(trichloroethyl carbonate), p-methoxybenzoate, methyl carbonate, and so on] and the like, wherein each alkyl group may be independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group may be independently selected from the group consisting of C5-C8 aryl groups, preferably a phenyl group.

Reaction Formula III: Carbamation reaction-1



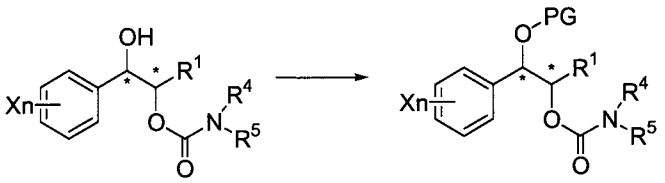
As a highly selectivity form of regioisomer of single carbamate of diol having halogen substituent at phenyl ring. (Example 1~14 and 36~67 are synthesized by reaction formula III)

Reaction Formula IV: Carbamation reaction-2



Two substances in the form of regioisomers of a single carbamate of diol having halogen substituent at phenyl ring may be separated by flash column chromatography to obtain two kinds of single carbamate compounds. (Example 15~35 and 68~115 are synthesized by reaction formula IV)

Reaction Formula V: Protection reaction



In the Reaction Formula V, PG(protecting group) may be selected from the group consisting of trialkyl silyl group(e.g., a trimethyl silyl (TMS) group, a triethyl silyl (TES) group, a triisopropyl silyl (TIPS) group, t-butyl dimethyl silyl (TBDMS) group, and the like), trialkylaryl silyl groups (wherein the total number of alkyl and aryl groups is three; e.g., a t-butyl diphenyl silyl (TBDPS) group and the like), ester group[Ac(acetate), Bz(benzoate), Pv(pivaloate), Cbz(benzyl carbonate), BOC(t-butyl carbonate), Fmoc(9-fluoroenylmethyl)carbaonate, Alloc(allyl Carbonate), Troc(trichloroethyl carbonate), p-methoxybenzoate, methyl carbonate, and so on] and the like, wherein each alkyl group may be independently selected from the group consisting of linear, branched, or cyclic C1-C4 alkyl groups, and each aryl group may be independently selected from the group consisting of C5-C8 aryl groups, preferably a phenyl group.

In the Reaction Formula IV and V, R4 and R5 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, a linear or branched alkyl group of C1-C4, for example C1-C3, a cycloalkyl group of C3-C8, for example C3-C7, and benzyl group, and more specifically, R4 and R5 may be the same as or different from each other, and independently selected from the group consisting of hydrogen, methyl group, propyl group, isopropyl group, cyclopropyl group, cyclohexyl group, bicycloheptane group, and benzyl group.

Two substances in the form of regioisomers of a single carbamate of diol having halogen substituent at phenyl ring may be separated by flash column chromatography to obtain two kinds of single carbamate compounds.

【BREIF DESCRIPTION OF DRAWINGS】

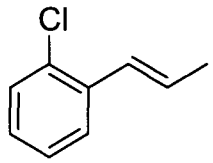
Fig. 1 is a graph showing ED50 values according to time measured through MES.

Fig. 2 is a graph showing ED50 values according to time measured through scPTZ.

【EXAMPLE】

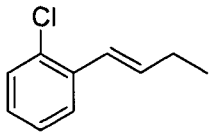
The present invention is further explained in more detail with reference to the following examples. These examples, however, should not be interpreted as limiting the scope of the present invention in any manner.

Preparation Example 1: Synthesis of 1-(2-chlorophenyl)-trans-1-propene



48ml of 2-chlorobenzenaldehyde (0.42mol) and 49.7ml of 3-pentanone (0.47mol) were dissolved in 600mL of hexane in flask, and then stirred with raising the temperature. 53.6ml of Boron trifluoride etherate (BF_3OEt_2, 0.42mol) was added to the resultant under reflux conditions. When the reaction was completed, water was added thereto. After layer separation, the obtained organic layer was washed twice with 1M sodium hydroxide solution (1M NaOH), and then the separated organic layer was washed with water. The separated organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$) and concentrated. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (38g, yield 58%). ^{1}H NMR(400MHz, $CDCl_3$) δ1.94(d, *J*=4.8Hz, 3H), 6.24(m, 1H), 6.78(d, *J*=14Hz, 1H), 7.11~7.51(m, 4H)

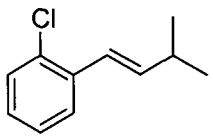
Preparation Example 2: Synthesis of 1-(2-chlorophenyl)-trans-1-butene



The substantially same method as described in Preparation Example 1 was conducted, except that 3-heptanone was used instead of 3-pentanone, to obtain the title compound (2.9g, yield 83%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.14(d, *J*=7.6Hz, 3H), 2.29~2.33(m, 2H), 6.28(dt, *J*=16Hz, 6.4Hz, 1H), 6.78(d, *J*=15.6Hz, 1H), 7.13~7.54(m, 4H)

Preparation Example 3: Synthesis of 1-(2-chlorophenyl)-3-methyl-trans-1-butene

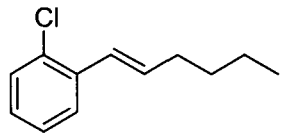


The substantially same method as described in Preparation Example 1 was conducted, except that 2,6-dimethyl-heptan-4-one was used instead of 3-pentanone, to obtain the title compound (8.0g, yield 50~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.14(d, *J*=6.8Hz, 6H), 2.25~2.57(m, 1H), 6.20(dd, *J*=16Hz,

7.2Hz, 1H), 7.64(d, *J*=16Hz, 1H), 7.12~7.54(m, 4H)

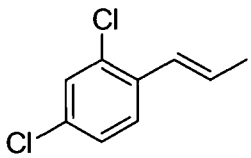
Preparation Example 4: Synthesis of 1-(2-chlorophenyl)-trans-1-hexene



The substantially same method as described in Preparation Example 1 was conducted, except that 6-undecanone was used instead of 3-pentanone, to obtain the title compound (10g, yield 85%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.96(t, *J*=7.2Hz, 3H), 1.33~1.56(m, 4H), 2.26~2.32(m, 4H), 6.24(dt, *J*=15.6Hz, 7Hz, 1H), 6.78(d, *J*=16Hz, 1H), 7.13~7.54(m, 4H)

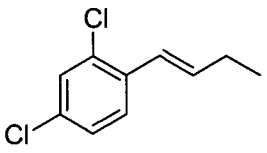
Preparation Example 5: Synthesis of 1-(2,4-dichlorophenyl)-trans-1-propene



The substantially same method as described in Preparation Example 1 was conducted, except that 2,4-dichlorobenzenaldehyde was used instead of 2-chlorobenzenaldehyde, to obtain the title compound (2.4g, yield 57%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.95(dd, *J*=6.8Hz, 1.6Hz, 3H), 6.24(m, 1H), 6.72(d, *J*=15.6Hz, 1H), 7.18~7.44(m, 3H)

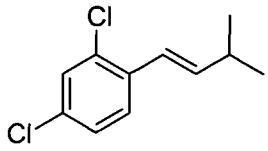
Preparation Example 6: Synthesis of 1-(2,4-dichlorophenyl)-trans-1-butene



The substantially same method as described in Preparation Example 5 was conducted, except that 3-heptanone was used instead of 3-pentanone, to obtain the title compound (2.1g, yield 90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.14(d, *J*=7.6Hz, 3H), 2.20~2.33(m, 2H), 6.26(dt, *J*=16Hz, 6.8Hz, 1H), 6.70(d, *J*=15.6Hz, 1H), 7.18~7.46(m, 3H)

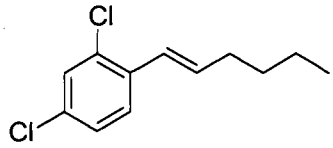
Preparation Example 7: Synthesis of 1-(2,6-dichlorophenyl)-3-methyl-trans-1-butene



The substantially same method as described in Preparation Example 5 was conducted, except that 2,6-dimethyl-heptan-4-one was used instead of 3-pentanone, to obtain the title compound (0.23g, yield 10~40%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, *J*=6.8Hz, 6H), 2.53~2.58(m, 1H), 6.19(dd, *J*=16.4Hz, 6.8Hz, 1H), 6.31(d, *J*=16.4Hz, 1H), 7.18~7.46(m, 3H)

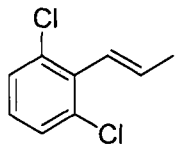
Preparation Example 8: Synthesis of 1-(2,4-dichlorophenyl)-trans-1-hexene



The substantially same method as described in Preparation Example 5 was conducted, except that 6-undecanone was used instead of 3-pentanone, to obtain the title compound (3.2g, yield 40~80%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.96(t, *J*=7.2Hz, 3H), 1.38~1.52(m, 4H), 2.25~2.31(m, 2H), 6.22(dt, *J*=15.6Hz, 6.8Hz, 1H), 6.70(d, *J*=15.6Hz, 1H), 7.18~7.46(m, 3H)

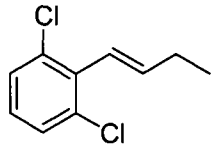
Preparation Example 9: Synthesis of 1-(2,6-dichlorophenyl)-trans-1-propene



The substantially same method as described in Preparation Example 1 was conducted, except that 2,6-dichlorobenzenaldehyde was used instead of 2-chlorobenzenaldehyde, to obtain the title compound (0.4g, yield 10~40%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.98(d, *J*=8Hz, 3H), 6.23~6.31(m, 1H), 6.40(d, *J*=16Hz, 1H), 7.05~7.32(m, 3H)

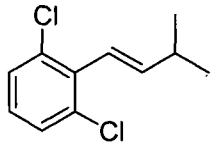
Preparation Example 10: Synthesis of 1-(2,6-dichlorophenyl)-trans-1-butene



The substantially same method as described in Preparation Example 9 was conducted, except that 3-heptanone was used instead of 3-pentanone, to obtain the title compound (1.2g, yield 10~40%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.17(t, *J*=7.6Hz, 3H), 2.30~2.37(m, 2H), 6.29(dt, *J*=16.4Hz, 6Hz, 1H), 6.37(d, *J*=16.4Hz, 1H), 7.05~7.32(m, 3H)

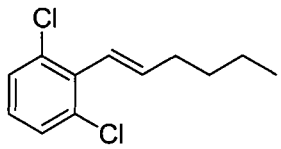
Preparation Example 11: Synthesis of 1-(2,6-dichlorophenyl)-3-methyl-trans-1-butene



The substantially same method as described in Preparation Example 9 was conducted, except that 2,6-dimethyl-heptan-4-one was used instead of 3-pentanone, to obtain the title compound (0.23g, yield 10~40%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, *J*=6.8Hz, 6H), 2.53~2.58(m, 1H), 6.19(dd, *J*=16.4Hz, 6.8Hz, 1H), 6.31(d, *J*=16.4Hz, 1H), 7.05~7.32(m, 3H)

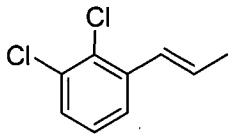
Preparation Example 12: Synthesis of 1-(2,6-dichlorophenyl)-trans-1-hexene



The substantially same method as described in Preparation Example 9 was conducted, except that 6-undecanone was used instead of 3-pentanone, to obtain the title compound (0.2g, yield 10~40%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.99(t, *J*=7.2Hz, 3H),1.14~1.59(m, 4H), 2.30~2.36(m, 2H), 6.24(dt, *J*=16Hz, 6.6Hz, 1H), 6.38(d, *J*=16.4Hz, 1H), 7.05~7.33(m, 3H)

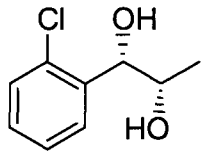
Preparation Example 13: Synthesis of 1-(2,3-dichlorophenyl)-trans-1-propene



The substantially same method as described in Preparation Example 1 was conducted, except that 2,3-dichlorobenzenaldehyde was used instead of 2-chlorobenzenaldehyde, to obtain the title compound (0.2g, yield 10~40%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.94(d, *J*=4.8Hz, 3H), 6.24(m, 1H), 6.78(d, *J*=14Hz, 1H), 7.11~7.51(m, 3H)

Preparation Example 14: Synthesis of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol

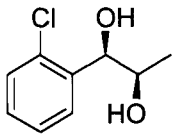


1-(2-chlorophenyl)-trans-1-propene(1.5g, Preparation Example 1) was dissolved in 30mL of the mixture of t-BuOH/H_2O (1:1(V/V)). At 0℃, AD-mix-α (Aldrich, U.S.A.) (13.7g) and methane sulfone amide ($CH_3SO_2NH_2$, 0.76g, 0.0080mol) were added thereto and stirred for overnight. When the reaction was completed, the obtained product was washed with an aqueous solution of sodium sulfite (Na_2SO_3) and ethylacetate (EA). Then, the organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (1.65g, yield 90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.20(d, *J*=6.4Hz, 3H), 2.48(d, *J*=4.0Hz 1H), 2.92(d, *J*=4.4Hz, 1H), 3.93~3.97(m, 1H), 4.97(t, *J*=4.8Hz, 1H), 7.22~7.51(m, 4H)

^{13}CNMR(100MHz,$CDCl_3$) δ18.8, 71.5, 74.4, 127.1, 128.1, 128.9, 129.5, 132.6, 138.9

Preparation Example 15: Synthesis of 1-(2-chlorophenyl)-(R,R)-1,2-propanediol

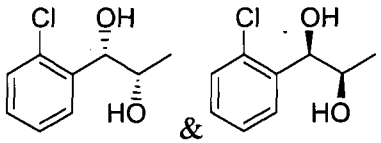


1-(2-chlorophenyl)-trans-1-propene (2.5g, Preparation Example 1) was dissolved in 50mL of the mixture of t-BuOH/H_2O (1:1(V/V)). At 0℃, AD-mix-α (Aldrich, U.S.A.) (23.5g) and methane sulfone amide ($CH_3SO_2NH_2$, 1.27g, 0.013mol) were added thereto and stirred for

overnight. When the reaction was completed, the obtained product was washed with an aqueous solution of sodium sulfite (Na_2SO_3) and ethylacetate (EA). Then, the organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (2.96g, yield 90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.20(d, *J*=6.4Hz, 3H), 2.48(d, *J*=4.0Hz, 1H), 2.92(d, *J*=4.4Hz, 1H), 3.93~3.97(m, 1H), 4.97(t, *J*=4.8Hz, 1H), 7.22~7.51(m, 4H)

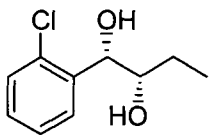
Preparation Example 16: Synthesis of the mixture of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol and 1-(2-chlorophenyl)-(R,R)-1,2-propanediol



1-(2-chlorophenyl)-trans-1-propene(6.53g, Preparation Example 1) was dissolved in 45mL of the mixture of acetone/t-BuOH/H_2O(5:1:1 V/V). At the room temperature, N-methylmorpholine-N-oxide (7.51g) and OsO_4 (0.54g) were added thereto and stirred for 2-3 hours. When the reaction was completed, the obtained product was washed with water and methylenechloride (MC). Then, the organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (6.42g, yield 80%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.20(d, *J*=6.4Hz, 3H), 2.48(d, *J*=4.0Hz, 1H), 2.92(d, *J*=4.4Hz, 1H), 3.93~3.97(m, 1H), 4.97(t, *J*=4.8Hz, 1H), 7.22~7.51(m, 4H)

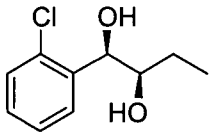
Preparation Example 17: Synthesis of 1-(2-chlorophenyl)-(S,S)-1,2-butanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2-chlorophenyl)-trans-1-butene(Preparation Example 2) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.36g, yield 95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.01(t, *J*=7.4Hz, 3H), 1.52~1.65(m, 2H), 2.01(d, *J*=4.4Hz, 1H), 2.74(d, *J*=5.2Hz, 1H), 3.69~3.75(m, 1H), 5.05(t, *J*=5.0Hz, 1H), 7.23~7.54(m, 4H)

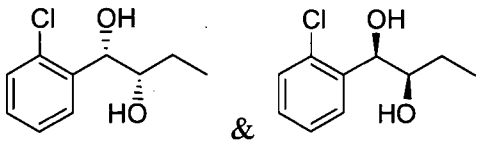
Preparation Example 18: Synthesis of 1-(2-chlorophenyl)-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2-chlorophenyl)-trans-1-butene(Preparation Example 2) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.84g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.01(t, *J*=7.4Hz, 3H), 1.52~1.65(m, 2H), 2.01(d, *J*=4.4Hz, 1H), 2.74(d, *J*=5.2Hz, 1H), 3.69~3.75(m, 1H), 5.05(t, *J*=5.0Hz, 1H), 7.23~7.54(m, 4H)

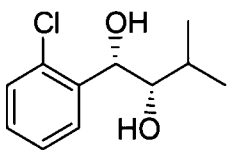
Preparation Example 19: Synthesis of the mixture of 1-(2-chlorophenyl)-(S,S)-1,2-butanediol and 1-(2-chlorophenyl)-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2-chlorophenyl)-trans-1-butene(Preparation Example 2) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (5.1g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.01(t, *J*=7.4Hz, 3H), 1.52~1.65(m, 2H), 2.01(d, *J*=4.4Hz, 1H), 2.74(d, *J*=5.2Hz, 1H), 3.69~3.75(m, 1H), 5.05(t, *J*=5.0Hz, 1H), 7.23~7.54(m, 4H)

Preparation Example 20: Synthesis of 1-(2-chlorophenyl)-3-methyl-(S,S)-1,2-butanediol

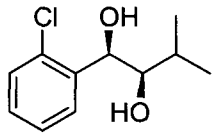


The substantially same method as described in Preparation Example 14 was conducted,

except that 1-(2-chlorophenyl)-3-methyl-trans-1-butene(Preparation Example 3) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.96g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.07(t, *J*=7.2Hz, 6H), 1.83~1.89(m, 1H), 1.92(d, *J*=5.6Hz, 1H), 2.69(d, *J*=6.4Hz, 1H), 3.53~3.56(m, 1H), 5.22~5.25(m, 1H), 7.23~7.55(m, 4H)

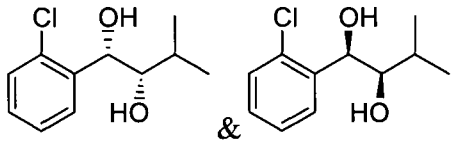
Preparation Example 21: Synthesis of 1-(2-chlorophenyl)-3-methyl-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2-chlorophenyl)-3-methyl-trans-1-butene(Preparation Example 3) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (4.2g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.07(t, *J*=7.2Hz, 6H), 1.82~1.90(m, 1H), 1.93(d, *J*=5.6Hz, 1H), 2.79(d, *J*=6Hz, 1H), 3.53~3.57(m, 1H), 5.23~5.25(m, 1H), 7.23~7.54(m, 4H)

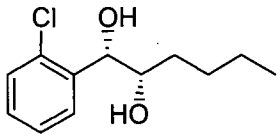
Preparation Example 22: Synthesis of the mixture of 1-(2-chlorophenyl)-3-methyl-(S,S)-1,2-butanediol and 1-(2-chlorophenyl)-3-methyl-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2-chlorophenyl)-3-methyl-trans-1-butene(Preparation Example 3) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.8g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.07(t, *J*=7.2Hz, 6H), 1.83~1.90(m, 1H), 1.92(d, *J*=5.6Hz, 1H), 2.69(d, *J*=6.4Hz, 1H), 3.53~3.56(m, 1H), 5.22~5.25(m, 1H), 7.23~7.55(m, 4H)

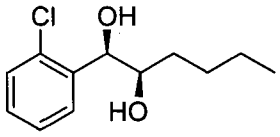
Preparation Example 23: Synthesis of 1-(2-chlorophenyl)-(S,S)-1,2-hexanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2-chlorophenyl)-trans-1-hexene(Preparation Example 4) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.37g, yield 90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.90(t, *J*=7.2Hz, 3H), 1.35~1.65(m, 6H), 2.08(d, *J*=4.4Hz, 1H), 2.71(d, *J*=5.2Hz, 1H), 3.78~3.83(m, 1H), 5.04(t, *J*=5.0Hz, 1H), 7.23~7.53(m, 4H)

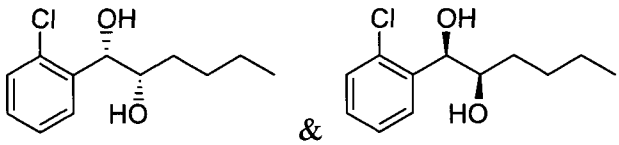
Preparation Example 24: Synthesis of 1-(2-chlorophenyl)-(R,R)-1,2-hexanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2-chlorophenyl)-trans-1-hexene(Preparation Example 4) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (4.2g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.91(t, *J*=6.6Hz, 3H), 1.35~1.65(m, 6H), 2.08(d, *J*=4.8Hz, 1H), 2.70(d, *J*=5.2Hz, 1H), 3.80~3.83(m, 1H), 5.05(t, *J*=5.0Hz, 1H), 7.24~7.56(m, 4H)

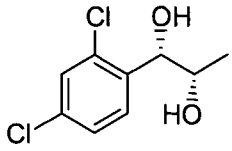
Preparation Example 25: Synthesis of the mixture of 1-(2-chlorophenyl)-(S,S)-1,2-hexanediol and 1-(2-chlorophenyl)-(R,R)-1,2-hexanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2-chlorophenyl)-trans-1-hexene(Preparation Example 4) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (7.9g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.90(t, *J*=7.2Hz, 3H), 1.26~1.55(m, 6H), 2.08(d, *J*=4.4Hz, 1H), 2.71(d, *J*=5.6Hz, 1H), 3.78~3.84(m, 1H), 5.04(t, *J*=3.2Hz, 1H), 7.24~7.55(m, 4H)

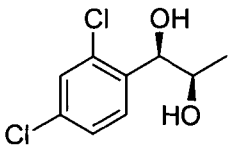
Preparation Example 26: Synthesis of 1-(2,4-dichlorophenyl)-(S,S)-1,2-propanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,4-ichlorophenyl)-trans-1-propene(Preparation Example 5) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.33g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.22(d, *J*=6.4Hz, 3H), 2.10(d, *J*=4.4Hz, 1H), 2.71(d, *J*=4.8Hz, 1H), 3.90~3.95(m, 1H), 4.94(t, *J*=5.0Hz, 1H), 7.31(dd, *J*=2.0Hz, *J*=8.0Hz, 1H), 7.40(d, *J*=2.0Hz, 1H), 7.49(d, *J*=8.4Hz, 1H)

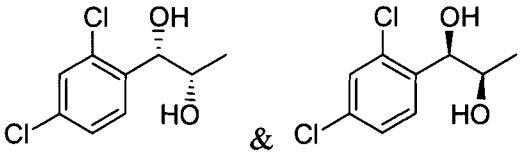
Preparation Example 27: Synthesis of 1-(2,4-dichlorophenyl)-(R,R)-1,2-propanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,4-ichlorophenyl)-trans-1-propene(Preparation Example 5) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.45g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.22(d, *J*=6.4Hz, 3H), 2.10(d, *J*=4.4Hz, 1H), 2.71(d, *J*=4.8Hz, 1H), 3.90~3.95(m, 1H), 4.94(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

Preparation Example 28: Synthesis of the mixture of 1-(2,4-dichlorophenyl)-(S,S)-1,2-propanediol and 1-(2,4-dichlorophenyl)-(R,R)-1,2-propanediol

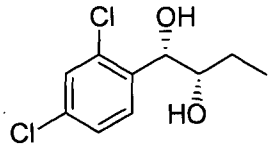


The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,4-ichlorophenyl)-trans-1-propene(Preparation Example 5) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.45g,

yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.22(d, *J*=6.4Hz, 3H), 2.10(d, *J*=4.4Hz, 1H), 2.71(d, *J*=4.8Hz, 1H), 3.90~3.95(m, 1H), 4.94(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

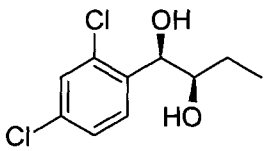
Preparation Example 29: Synthesis of 1-(2,4-dichlorophenyl)-(S,S)-1,2-butanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,4-dichlorophenyl)-trans-1-butene(Preparation Example 6) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.32g, yield 90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.02(t, *J*=7.4Hz, 3H), 1.54~1.61(m, 2H), 2.07(d, *J*=4.8Hz, 1H), 2.74(d, *J*=4.8Hz, 1H), 3.65~3.68(m, 1H), 5.01(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

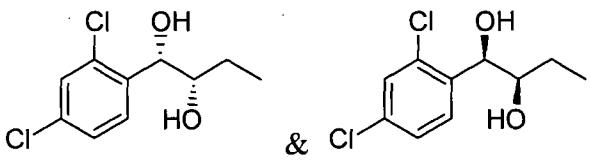
Preparation Example 30: Synthesis of 1-(2,4-dichlorophenyl)-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,4-dichlorophenyl)-trans-1-butene(Preparation Example 6) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.43g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.02(t, *J*=7.4Hz, 3H), 1.54~1.61(m, 2H), 2.07(d, *J*=4.8Hz, 1H), 2.74(d, *J*=4.8Hz, 1H), 3.65~3.68(m, 1H), 5.01(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

Preparation Example 31: Synthesis of the mixture of 1-(2,4-dichlorophenyl)-(S,S)-1,2-butanediol and 1-(2,4-dichlorophenyl)-(R,R)-1,2-butanediol

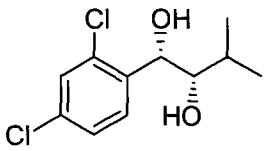


The substantially same method as described in Preparation Example 16 was conducted,

except that 1-(2,4-dichlorophenyl)-trans-1-butene(Preparation Example 6) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.33g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.02(t, *J*=7.4Hz, 3H), 1.54~1.61(m, 2H), 2.07(d, *J*=4.8Hz, 1H), 2.74(d, *J*=4.8Hz, 1H), 3.65~3.68(m, 1H), 5.01(t, *J*=5.0Hz, 1H), 77.31~7.49(m, 3H)

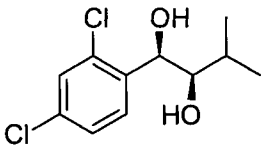
Preparation Example 32: Synthesis of 1-(2,4-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-trans-1-butene(Preparation Example 7) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.25g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 2.35(d, *J*=4.0Hz, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

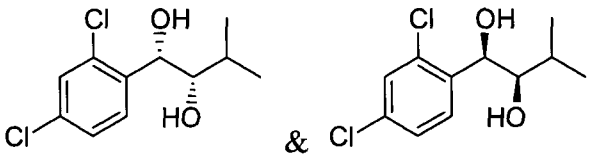
Preparation Example 33: Synthesis of 1-(2,4-dichlorophenyl)-3-methyl-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-trans-1-butene(Preparation Example 7) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.36g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 2.35(d, *J*=4.0Hz, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

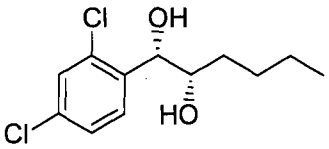
Preparation Example 34: Synthesis of the mixture of 1-(2,4-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol and 1-(2,4-dichlorophenyl)-3-methyl-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-trans-1-butene(Preparation Example 7) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.26g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 2.35(d, *J*=4.0Hz, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

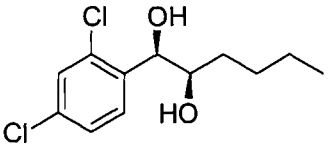
Preparation Example 35: Synthesis of 1-(2,4-dichlorophenyl)-(S,S)-1,2-hexanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,4-dichlorophenyl)-trans-1-hexene(Preparation Example 8) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (1.1g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.89~0.93(m, 3H), 1.30~1.39(m, 2H), 1.49~1.52(m, 2H), 1.56~1.62(m, 2H), 2.05(d, *J*=5.2Hz, 1H), 2.74(d, *J*=5.2Hz, 1H), 3.72~3.77(m, 1H), 4.98(t, *J*=4.8Hz, 1H), 7.28~7.50(m, 3H)

Preparation Example 36: Synthesis of 1-(2,4-dichlorophenyl)-(R,R)-1,2-hexanediol

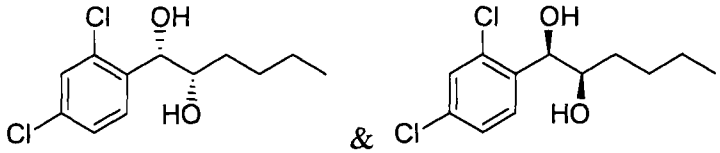


The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,4-dichlorophenyl)-trans-1-hexene(Preparation Example 8) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (1.2g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.89~0.93(m, 3H), 1.30~1.39(m, 2H), 1.49~1.52(m, 2H), 1.56~1.62(m, 2H), 2.05(d, *J*=5.2Hz, 1H), 2.74(d, *J*=5.2Hz, 1H), 3.72~3.77(m, 1H), 4.98(t,

J=4.8Hz, 1H), 7.28~7.50(m, 3H)

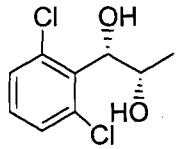
Preparation Example 37: Synthesis of the mixture of 1-(2,4-dichlorophenyl)-(S,S)-1,2-hexanediol and 1-(2,4-dichlorophenyl)-(R,R)-1,2-hexanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,4-dichlorophenyl)-trans-1-hexene(Preparation Example 8) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.67g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.89~0.93(m, 3H), 1.30~1.39(m, 2H), 1.49~1.52(m, 2H), 1.56~1.62(m, 2H), 2.05(d, *J*=5.2Hz, 1H), 2.74(d, *J*=5.2Hz, 1H), 3.72~3.77(m, 1H), 4.98(t, *J*=4.8Hz, 1H), 7.28~7.50(m, 3H)

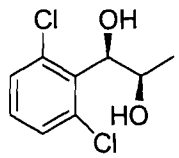
Preparation Example 38: Synthesis of 1-(2,6-dichlorophenyl)-(S,S)-1,2-propanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-propene(Preparation Example 9) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.9g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10(d, *J*=6.4Hz, 3H), 2.72(d, *J*=2.4Hz, 1H), 3.10(d, *J*=8.4Hz, 1H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.36(m, 3H)

Preparation Example 39: Synthesis of 1-(2,6-dichlorophenyl)-(R,R)-1,2-propanediol

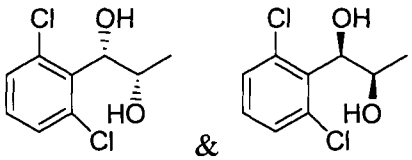


The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-propene(Preparation Example 9) was used instead of

1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.84g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10(d, *J*=6.4Hz, 3H), 2.72(d, *J*=2.4Hz, 1H), 3.10(d, *J*=8.4Hz, 1H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.36(m, 3H)

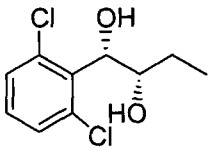
Preparation Example 40: Synthesis of the mixture of 1-(2,6-dichlorophenyl)-(S,S)-1,2-propanediol and 1-(2,6-dichlorophenyl)-(R,R)-1,2-propanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-propene(Preparation Example 9) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.91g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10(d, *J*=6.4Hz, 3H), 2.72(d, *J*=2.4Hz, 1H), 3.10(d, *J*=8.4Hz, 1H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.36(m, 3H)

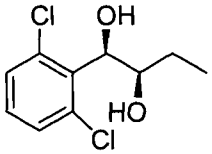
Preparation Example 41: Synthesis of 1-(2,6-dichlorophenyl)-(S,S)-1,2-butanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-butene(Preparation Example 10) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (1.23g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.97(t, *J*=7.6Hz, 3H), 1.26~1.53(m, 2H), 2.64(dd, *J*=0.8Hz, *J*=4.0Hz, 1H), 3.14(d, *J*=8.4Hz, 1H), 4.22~4.26(m, 1H), 5.26(t, *J*=8.4Hz, 1H), 7.17~7.35(m, 3H)

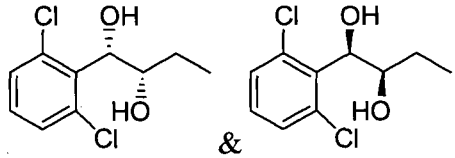
Preparation Example 42: Synthesis of 1-(2,6-dichlorophenyl)-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-butene(Preparation Example 10) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.96g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.97(t, *J*=7.6Hz, 3H), 1.26~1.53(m, 2H), 2.64(dd, *J*=0.8Hz, *J*=4.0Hz, 1H), 3.14(d, *J*=8.4Hz, 1H), 4.22~4.26(m, 1H), 5.26(t, *J*=8.4Hz, 1H), 7.17~7.35(m, 3H)

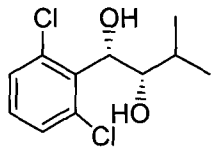
Preparation Example 43: Synthesis of the mixture of 1-(2,6-dichlorophenyl)-(S,S)-1,2-butanediol and 1-(2,6-dichlorophenyl)-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-butene(Preparation Example 10) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.86g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.97(t, *J*=7.6Hz, 3H), 1.26~1.53(m, 2H), 2.64(dd, *J*=0.8Hz, *J*=4.0Hz, 1H), 3.14(d, *J*=8.4Hz, 1H), 4.22~4.26(m, 1H), 5.26(t, *J*=8.4Hz, 1H), 7.17~7.35(m, 3H)

Preparation Example 44: Synthesis of 1-(2,6-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol

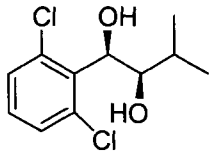


The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-trans-1-butene(Preparation Example 11) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.25g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 2.35(d, *J*=4.0Hz, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

Preparation Example 45: Synthesis of 1-(2,6-dichlorophenyl)-3-methyl-(R,R)-1,2-

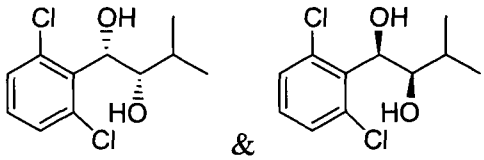
butanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-trans-1-butene(Preparation Example 11) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.37g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 2.35(d, *J*=4.0Hz, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

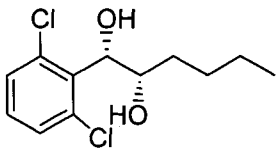
Preparation Example 46: Synthesis of the mixture of 1-(2,6-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol and 1-(2,6-dichlorophenyl)-3-methyl-(R,R)-1,2-butanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-trans-1-butene(Preparation Example 11) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.47g, yield 60~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 2.35(d, *J*=4.0Hz, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

Preparation Example 47: Synthesis of 1-(2,6-dichlorophenyl)-(S,S)-1,2-hexanediol

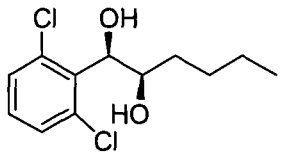


The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-hexene(Preparation Example 12) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.36g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, *J*=6.8Hz, 3H), 1.20~1.31(m, 4H), 1.45~1.53(m, 2H),

2.61~2.62(m, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.28~4.33(m, 1H), 5.25(t, *J*=8.4Hz, 1H), 7.18~7.35(m, 3H)

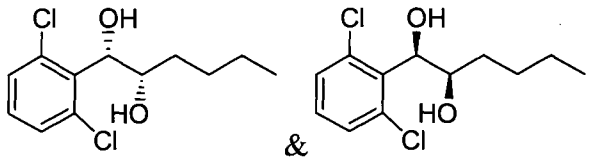
Preparation Example 48: Synthesis of 1-(2,6-dichlorophenyl)-(R,R)-1,2-hexanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-hexene(Preparation Example 12) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.58g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, *J*=6.8Hz, 3H), 1.20~1.31(m, 4H), 1.45~1.53(m, 2H), 2.61~2.62(m, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.28~4.33(m, 1H), 5.25(t, *J*=8.4Hz, 1H), 7.18~7.35(m, 3H)

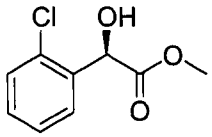
Preparation Example 49: Synthesis of the mixture of 1-(2,6-dichlorophenyl)-(S,S)-1,2-hexanediol and 1-(2,6-dichlorophenyl)-(R,R)-1,2-hexanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,6-dichlorophenyl)-trans-1-hexene(Preparation Example 12) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.62g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, *J*=6.8Hz, 3H), 1.20~1.31(m, 4H), 1.45~1.53(m, 2H), 2.61~2.62(m, 1H), 3.12(d, *J*=8.4Hz, 1H), 4.28~4.33(m, 1H), 5.25(t, *J*=8.4Hz, 1H), 7.18~7.35(m, 3H)

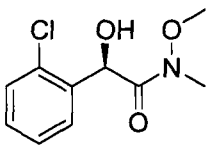
Preparation Example 50: Synthesis of methyl 2-(2-chlorophenyl)-(R)-2-hydroxyacetate



15g of (R)-2-chloromandelic acid was mixed with methanol (CH_3OH, 150ml) and phosphorus chloride oxide ($POCl_3$, 0.76ml) in a flask by stirring using a magnetic stirrer at the room temperature for 6 hours. When the reaction was completed, the obtained product was washed with an aqueous solution of sodium sulfite (Na_2SO_3) and ethylacetate (EA). Then, the organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (15.64g, yield 95%).

^{1}H NMR(400MHz, $CDCl_3$) δ 3.59(d, *J*=5.2, 1H), 3.79(t, *J*=6.0, 3H), 5.59(d, *J*=5.2, 1H), 7.28~7.43(m, 4H)

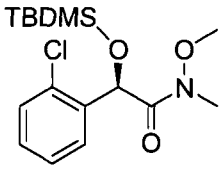
Preparation Example 51: Synthesis of 2-(2-chlorophenyl)-(R)-2-hydroxy-N-methoxy-N-methylacetamide



N,O-dimethylhydroxylamine hydrochloride (N,O-dimethylhydroxylamine.HCl, 15.2g) was dissolved in dichloromethane (DCM, 150ml), and cooled to 0℃ using an ice-bath. Then, 77.7ml of 2.0M trimethylaluminium in hexane was slowly added thereto in drop-wise manner for 30 minutes. Thereafter, the ice-bath was removed, and the obtained product was stirred at the room temperature for 2 hours. Methyl-2-(2-chlorophenyl)-(R)-2-hydroxyacetate(15.64g) dissolved in dichloromethane(DCM, 150ml) was added in drop-wise manner thereto at the room temperature for 30 minutes, and subjected to reflux for 12 hours. When the reaction was completed, the obtained product was cooled to 0℃, and washed by a slow drop-wise addition of hydrochloric acid (HCl, 200ml). The obtained organic layer was washed with distilled water and brine, dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (14.68g, yield 82%).

^{1}H NMR(400MHz, $CDCl_3$) δ3.23(s, 3H), 3.28(s, 3H), 4.33(d, *J*=6.0Hz, 1H), 5.81(d, *J*=5.6Hz, 1H), 7.23~7.42(m, 4H)

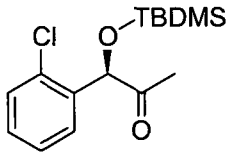
Preparation Example 52: Synthesis of 2-(2-chlorophenyl)-N-methoxy-(R)-2-(t-butyl dimethlysiloxy)-N-methylacetamide



2-(2-chlorophenyl)-(R)-2-hydroxy-N-methoxy-N-methylacetamide (0.81g, 3.52mmol) obtained in Preparation Example 51 was dissolved in dichloromethane (DCM), and cooled to 0℃. Imedazole (0.36g, 5.28mmol) was slowly added, and stirred. TBDMS-Cl (t-butyldimethylsily chloride, 0.79g, 5.28mmol) was slowly added. When the reaction was completed, the reaction mixture was quenched with H_2O. The organic layer was separated and collected. The aqueous layer was extracted with CH_2Cl_2 (300mL), dried over $MgSO_4$. Concentration under vacuum provided a title compound.(0.97g, 80~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ-0.03(s, 3H), 0.14(s, 3H), 0.94(s, 9H), 2.97(s, 3H), 3.02(s, 3H), 5.83(s, 1H), 7.25~7.60(m, 4H)

Preparation Example 53: Synthesis of 1-(2-chlorophenyl)-(R)-1-(t-butyldimethyl-siloxy)propane-2-on

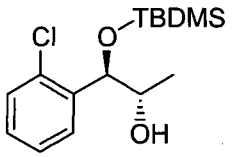


2-(2-chlorophenyl)-N-methoxy-(R)-2-(t-butyldimethylsiloxy)-N-methylacetamide(0.9g) obtained in Preparation Example 52 was dissolved in tetrahydrofuran(THF), and cooled to 0℃. 3.0M methyl magnesium bromide (MeMgBr, 2.18ml) solution in ether was added thereto in drop-wise manner for 30 minutes, and the obtained product was stirred at 0℃. When the reaction was completed, diethylether was added thereto. The obtained product was washed with 10%(w/v) potassium hydrogen sulfate ($KHSO_4$, 100ml) and then, washed again with brine. The obtained organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concentrated under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (0.69g, yield 85~95%).

^{1}H NMR(400MHz, $CDCl_3$) δ-0.3(s, 3H), 0.14(s, 3H), 0.94(s, 9H), 2.18(s, 3H), 5.50(s,

1H), 7.27~7.56(m, 4H)

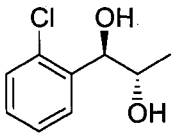
Preparation Example 54: Synthesis of 1-(2-chlorophenyl)-(R)-1-(t-butyldimethyl-siloxy)-(S)-2-propanol



1-(2-chlorophenyl)-(R)-1-(t-butyldimethyl-siloxy)propane-2-on(0.14g) obtained in Preparation Example 53 was dissolved in ether, and cooled to -78℃. Zinc borohydride($Zn(BH_4)_2$) was slowly added thereto and the obtained product was stirred. When the reaction was completed, the obtained product was washed by H_2O. The obtained organic layer was washed with H_2O, dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concentrated under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (0.04g, yield 25~33%, cis : trans = 2 : 1).

^{1}H NMR(400MHz, $CDCl_3$) δ-0.11(s, 3H), 0.11(s, 3H), 0.93(S, 9H), 1.07(d, J=6.4 3H), 2.05(d, J=6.4 1H), 4.01~4.05(m, 1H), 5.18(d, *J*=4.0, 1H), 7.20~7.56(m, 4H))

Preparation Example 55: Synthesis of 1-(2-chlorophenyl)-(R,S)-1,2-propanediol

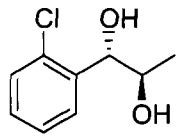


1-(2-chlorophenyl)-(R)-1-(t-butyldimethyl-siloxy)-(S)-2-propanol(10.38g) obtained in Preparation Example 54 was dissolved in methanol (CH_3OH, 100ml), and then, cooled to 0℃. 8M hydrochloric acid(HCl, 56.2ml) was slowly added in drop-wise manner to the obtained product, and then, the obtained product was warmed to the room temperature, and stirred for 15 hours. When the reaction was completed, the obtained product was cooled to 0℃. 5N sodium hydroxide (NaOH, 30ml) was slowly added thereto, and the obtained product was subjected to vacuum concentration. The obtained product was diluted with ethylacetate. The obtained organic layer was washed with distilled water, dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column chromatography to produce the title compound (7.05g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.07(d, *J*=6.8, 3H), 2.01(d, *J*=5.6, 1H), 2.61(s, 1H),

4.21~4.27(m, 1H), 5.24(d, *J*=3.6, 1H), 7.22~7.64(m, 4H)

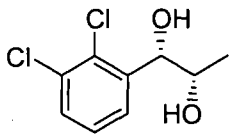
Preparation Example 56: Synthesis of 1-(2-chlorophenyl)-(S,R)-1,2-propanediol



The substantially same method as described in Preparation Example 50~55 was conducted, except that (S)-2-chloromandelic acid was used instead of (R)-2-chloromandelic acid, to obtain the title compound (5.04g, yield 84%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.07(d, *J*=6.8, 3H), 2.00(d, *J*=5.6, 1H), 2.54(d, *J*=3.6, 1H), 4.22~4.26(m, 1H), 5.25(t, *J*=3.2, 1H), 7.22~7.65(m, 4H)

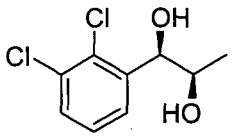
Preparation Example 57: Synthesis of 1-(2,3-dichlorophenyl)-(S,S)-1,2-propanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2,3-dichlorophenyl)-trans-1-propene(Preparation Example 13) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.9g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10(d, *J*=6.4Hz, 3H), 2.72(d, *J*=2.4Hz, 1H), 3.10(d, *J*=8.4Hz, 1H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~ (m, 3H)

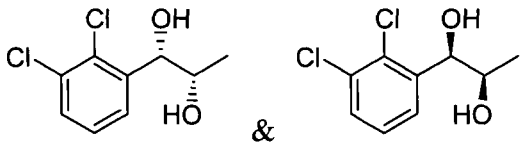
Preparation Example 58: Synthesis of 1-(2,3-dichlorophenyl)-(R,R)-1,2-propanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2,3-dichlorophenyl)-trans-1-propene(Preparation Example 13) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.84g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10(d, *J*=6.4Hz, 3H), 2.72(d, *J*=2.4Hz, 1H), 3.10(d, *J*=8.4Hz, 1H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~ (m, 3H)

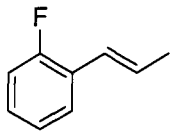
Preparation Example 59: Synthesis of the mixture of 1-(2,3-dichlorophenyl)-(S,S)-1,2-propanediol and 1-(2,3-dichlorophenyl)-(R,R)-1,2-propanediol



The substantially same method as described in Preparation Example 16 was conducted, except that 1-(2,3-dichlorophenyl)-trans-1-propene(Preparation Example 13) was used instead of 1-(2-chlorophenyl)-trans-1-propene(Preparation Example 1), to obtain the title compound (0.91g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10(d, *J*=6.4Hz, 3H), 2.72(d, *J*=2.4Hz, 1H), 3.10(d, *J*=8.4Hz, 1H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~(m, 3H)

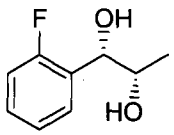
Preparation Example 60: Synthesis of 1-(2-fluorophenyl)-trans-1-propene



The substantially same method as described in Preparation Example 1 was conducted, except that 2-fluorobenzenaldehyde was used instead of 2-chlorobenzenealdehyde, to obtain the title compound (6.67g, yield 61%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.94(d, *J*=6.8Hz, 3H), 6.30~6.38(m, 1H), 6.57(d, *J*=16Hz, 1H), 7.00~7.41(m, 4H)

Preparation Example 61: Synthesis of 1-(2-fluorophenyl)-(S,S)-1,2-propanediol

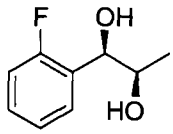


The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2-fluorophenyl)-trans-1-propene (Preparation Example 60) was used instead of 1-(2-chlorophenyl)-trans-1-propene (Preparation Example 1), to obtain the title compound (6.46g, yield 78%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, *J*=6.4Hz, 3H), 2.43(d, *J*=3.6Hz, 1H), 2.69(d,

J=4.8Hz, 1H), 3.90~3.98(m, 1H), 4.78(dd, *J*=4.4, 7.2Hz, 1H), 7.04~7.50(m, 4H)

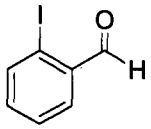
Preparation Example 62: Synthesis of 1-(2-fluorophenyl)-(R,R)-1,2-propanediol



The substantially same method as described in Preparation Example 15 was conducted, except that 1-(2-fluorophenyl)-trans-1-propene (Preparation Example 60) was used instead of 1-(2-chlorophenyl)-trans-1-propene (Preparation Example 1), to obtain the title compound (3.29g, yield 79%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, *J*=6.4Hz, 3H), 2.43(d, *J*=3.6Hz, 1H), 2.69(d, *J*=4.8Hz, 1H), 3.90~3.98(m, 1H), 4.78(dd, *J*=4.4, 7.2Hz, 1H), 7.04~7.50(m, 4H)

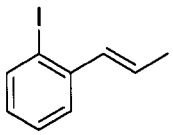
Preparation Example 63: Synthesis of 2-iodobenzenealdehyde



In a flask, 2-iodobenzyl alcohol (4g, 17.09mmol) was dissolved in dichloromethane (MC, 85ml), and then, manganese oxide (MnO_2, 14.86g, 170.92mmol) was added thereto. The obtained reaction product was stirred under the reflux condition. When the reaction was completed, the obtained reaction product was cooled to the room temperature, and then, fiteated and concentrated using celite, to obtain the title compound (3.6g, yield 91%).

^{1}H NMR(400MHz, $CDCl_3$)δ7.30~7.99(m, 4H), 10.10(s, 1H)

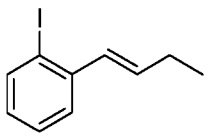
Preparation Example 64: Synthesis of 1-(2-iodophenyl)-trans-1-propene



The substantially same method as described in Preparation Example 1 was conducted, except that 2-iodobenzenealdehyde (Preparation Example 63) was used instead of 2-chlorobenzenealdehyde, to obtain the title compound (3.4g, yield 65%).

^{1}H NMR(400MHz, $CDCl_3$)δ1.95(dd, *J*=6.8Hz, 1.6Hz, 3H), 6.09~6.18(m, 1H), 6.60(dd, *J*=15.66Hz, 1.8Hz, 1H), 6.89~7.84(m, 4H)

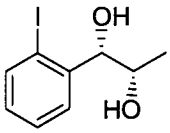
Preparation Example 65: Synthesis of 1-(2-iodophenyl)-trans-1-butene



The substantially same method as described in Preparation Example 64 was conducted, except that 3-heptanone was used instead of 3-pentanone, to obtain the title compound (8.5g, yield 75%).

^{1}H NMR(400MHz, $CDCl_3$)δ1.46(t, *J*=7.6Hz, 3H), 2.26~2.34(m, 2H), 6.17(dt, *J*=15.6Hz, 6.6Hz 1H), 6.57(d, *J*=15.6Hz, 1H), 6.89~7.85(m, 4H)

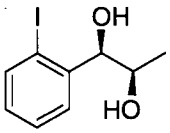
Preparation Example 66: Synthesis of 1-(2-iodophenyl)-(S,S)-1,2-propanediol



The substantially same method as described in Preparation Example 14 was conducted, except that 1-(2-iodophenyl)-trans-1-propene (Preparation Example 64) was used instead of 1-(2-chlorophenyl)-trans-1-propene (Preparation Example 1), to obtain the title compound (3.4g, yield 88%).

^{1}H NMR(400MHz, $CDCl_3$)δ1.27(d, *J*=6.4Hz, 3H), 2.26(br s, 1H), 2.74(br s, 1H), 3.99(t, *J*=6.0Hz, 1H), 4.81(d, *J*=4.0Hz, 1H), 7.01~7.87(m, 4H)

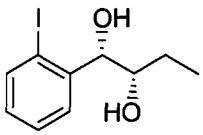
Preparation Example 67: Synthesis of 1-(2-iodorophenyl)-(R,R)-1,2-propanediol



The substantially same method as described in Preparation Example 15 was conducted was conducted, except that 1-(2-iodophenyl)-trans-1-propene (Preparation Example 64) was used instead of 1-(2-chlorophenyl)-trans-1-propene (Preparation Example 1), to obtain the title compound (7.4g, yield 84%).

^{1}H NMR(400MHz, $CDCl_3$)δ1.26(d, *J*=6.4Hz, 3H), 2.35(br s, 1H), 2.85(br d, *J*=4.0Hz, 1H), 3.98(t, *J*=6.2Hz, 1H), 4.80(dd, *J*=5.0, 4.4Hz, 1H), 7.00~7.87(m, 4H)

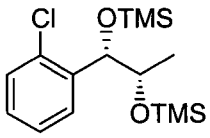
Preparation Example 68: Synthesis of 1-(2- iodophenyl)-(S,S)-1,2-butanediol



The substantially same method as described in Preparation Example 14 was conducted was conducted, except that 1-(2-iodophenyl)-trans-1-butene (Preparation Example 65) was used instead of 1-(2-chlorophenyl)-trans-1-propene (Preparation Example 1), to obtain the title compound (9.5g, yield 84%).

^{1}H NMR(400MHz, $CDCl_3$)δ1.04(t, *J*=7.6Hz, 3H), 1.60~1.71(m, 2H), 2.07(br s, 1H), 2.74(br s, 1H), 3.71~3.76(m, 1H), 4.87(d, *J*=4.8Hz, 1H), 7.01~7.87(m, 4H)

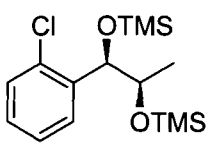
Preparation Example 69 : Preparation of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane



To a stirred solution of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14, 67g, 0.35mol) in CH_2Cl_2 (670ml) was added Et_3N (200mL, 1.43mol) and TMSCl (113.9mL, 0.89mol) at 0℃ under N_2. The reaction mixture was allowed to stir at 0℃ for 3hr. The reaction mixture was quenched with H_2O (650mL) at 0℃. The organic layer was separated and collected. The aqueous layer was extracted with CH_2Cl_2 (300mL), dried over $MgSO_4$. Concentration under vacuum provided a crude product. 104.18g (117.44%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.15(d, *J*=5.6Hz, 3H), 3.977~3.918(m, 1H), 4.973(d, *J*=6.4Hz, 1H), 7.207~7.165(m,1H), 7.321~7.245(m, 2H), 7.566~7.543(m, 1H)

Preparation Example 70 : Preparation of 1-(2-chlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy) propane

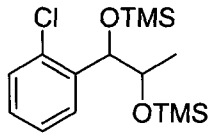


The substantially same method as described in Preparation Example 69 was conducted,

except that 1-(2-chlorophenyl)-(R,R)-1,2-propanediol(Preparation example15)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (8.5g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.15(d, *J*=5.6Hz, 3H), 3.977~3.918(m, 1H), 4.973(d, *J*=6.4Hz, 1H), 7.21~7.54(m,4H)

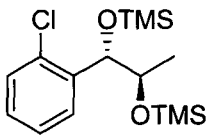
Preparation Example 71 : Preparation of 1-(2-chlorophenyl)--1,2-(Bis-trimethylsilanyloxy) propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)propane-1,2-diol(Preparation example16)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (5.2g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.15(d, *J*=5.6Hz, 3H), 3.977~3.918(m, 1H), 4.973(d, *J*6.4Hz, 1H), 7.21~7.54(m,4H)

Preparation Example 72 : Preparation of 1-(2-chlorophenyl)-(S,R)-1,2-(Bis-trimethylsilanyloxy) propane

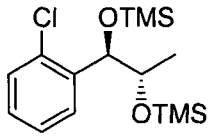


The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-(S,R)-1,2-propanediol(Preparation example56)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.4g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.15(d, *J*=5.6Hz, 3H), 3.977~3.918(m, 1H), 4.973(d, *J*=6.4Hz, 1H), 7.21~7.54(m,4H)

Preparation Example 73 : Preparation of 1-(2-chlorophenyl)-(R,S)-1,2-(Bis-

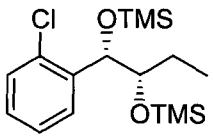
trimethylsilanyloxy) propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-(R,S)-1,2-propanediol(Preparation example55)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.2g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.15(d, *J*=5.6Hz, 3H), 3.977~3.918(m, 1H), 4.973(d, *J*=6.4Hz, 1H), 7.21~7.54(m,4H)

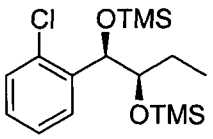
Preparation Example 74 : Preparation of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-(S,S)-1,2-butanediol(Preparation example17)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.6g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.01(t, *J*=7.4Hz, 3H), 1.52~1.65(m, 2H), 3.69~3.75(m, 1H), 5.05(t, *J*=5.0Hz, 1H), 7.23~7.54(m,4H)

Preparation Example 75 : Preparation of 1-(2-chlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy) butane

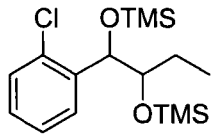


The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-(R,R)-1,2-butanediol(Preparation example18)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.5g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.01(t, *J*=7.4Hz, 3H), 1.52~1.65(m,

2H), 3.69~3.75(m, 1H), 5.05(t, *J*=5.0Hz, 1H), 7.23~7.54(m,4H)

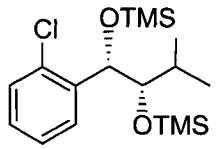
Preparation Example 76 : Preparation of 1-(2-chlorophenyl)-1,2-(Bis-trimethylsilanyloxy) butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-1,2-butanediol(Preparation example19)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.0g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.01(t, *J*=7.4Hz, 3H), 1.52~1.65(m, 2H), 3.69~3.75(m, 1H), 5.05(t, *J*=5.0Hz, 1H), 7.23~7.54(m,4H)

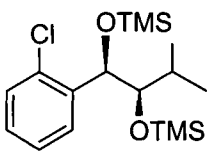
Preparation Example 77 : Preparation of 1-(2-chlorophenyl)-3-methyl-(S,S)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-3-methyl-(S,S)-1,2-butanediol(Preparation example20)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title (2.7g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.07(t, *J*=7.2Hz, 6H), 1.83~1.89(m, 1H), 3.53~3.56(m, 1H), 5.22~5.25(m, 1H), 7.23~7.55(m,4H)

Preparation Example 78 : Preparation of 1-(2-chlorophenyl)-3-methyl-(R,R)-1,2-(Bis-trimethylsilanyloxy)-butane

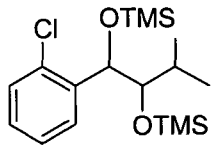


The substantially same method as described in Preparation Example 69 was conducted,

except that 1-(2-chlorophenyl)-3-methyl-(R,R)-1,2-butanediol(Preparation example21)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.4g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.07(t, J=7.2Hz, 6H), 1.83~1.89(m, 1H), 3.53~3.56(m, 1H), 5.22~5.25(m, 1H), 7.23~7.55(m,4H)

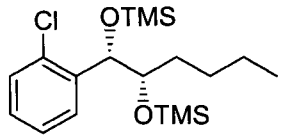
Preparation Example 79 : Preparation of 1-(2-chlorophenyl)-3-methyl-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-3-methyl-1,2-butanediol(Preparation example22)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.8g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.07(t, J=7.2Hz, 6H), 1.83~1.89(m, 1H), 3.53~3.56(m, 1H), 5.22~5.25(m, 1H), 7.23~7.55(m,4H)

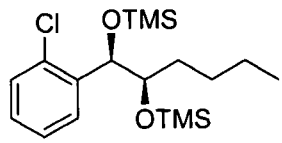
Preparation Example 80 : Preparation of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-hexane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-(S,S)-1,2-hexanediol(Preparation example23)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.1g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.90(t, J=7.2Hz, 3H), 1.35~1.65(m, 6H), 3.78~3.83(m, 1H), 5.04(t, J=5.0Hz, 1H), 7.23~7.53(m,4H)

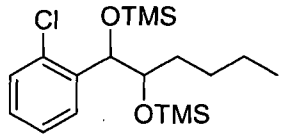
Preparation Example 81 : Preparation of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-hexane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-(R,R)-1,2-hexanediol(Preparation example24)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.3g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.90(t, *J*=7.2Hz, 3H), 1.35~1.65(m, 6H), 3.78~3.83(m, 1H), 5.04(t, *J*=5.0Hz, 1H), 7.23~7.53(m,4H)

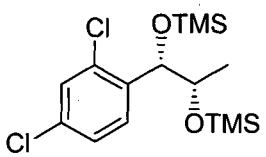
Preparation Example 82 : Preparation of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-hexane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-chlorophenyl)-1,2-hexanediol(Preparation example25)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.2g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.90(t, *J*=7.2Hz, 3H), 1.35~1.65(m, 6H), 3.78~3.83(m, 1H), 5.04(t, *J*=5.0Hz, 1H), 7.23~7.53(m,4H)

Preparation Example 83 : Preparation of 1-(2,4-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-propane

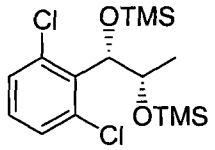


The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-propanediol(Preparation example26)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.4g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.22(d, *J*=6.4Hz, 3H), 3.90~3.95(m,

1H), 4.94(t, *J*=5.0Hz, 1H), 7.31(dd, *J*=2.0Hz, *J*=8.0Hz, 1H), 7.40(d, *J*=2.0Hz, 1H), 7.49(d, *J*=8.4Hz, 1H)

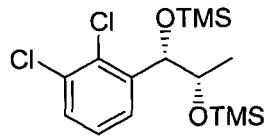
Preparation Example 84 : Preparation of 1-(2,6-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-propanediol(Preparation example38)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.4g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.10(d, *J*=6.4Hz, 3H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.13~7.36(m, 3H)

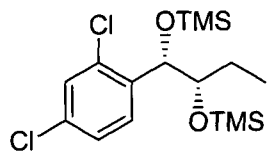
Preparation Example 85 : Preparation of 1-(2,3-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,3-dichlorophenyl)-(S,S)-1,2-propanediol(Preparation example57)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.2g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.10(d, *J*=6.4Hz, 3H,), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.22(m, 3H)

Preparation Example 86 : Preparation of 1-(2,4-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-butane

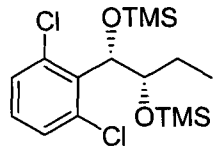


The substantially same method as described in Preparation Example 69 was conducted,

except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-butanediol(Preparation example29)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.1g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.02(t, *J*=7.4Hz, 3H), 1.54~1.61(m, 2H), 3.65~3.68(m, 1H), 5.01(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

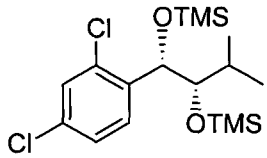
Preparation Example 87 : Preparation of 1-(2,6-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-butanediol(Preparation example41)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.8g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.97(t, *J*=7.6Hz, 3H), 1.26~1.53(m, 2H), 4.22~4.26(m, 1H), 5.26(t, *J*=8.4Hz, 1H), 7.17~7.35(m, 3H)

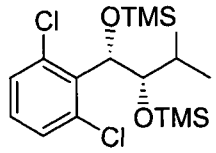
Preparation Example 88 : Preparation of 1-(2,4-dichlorophenyl)-3-methyl-(S,S)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol(Preparation example32)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.7g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.30~7.53(m, 3H)

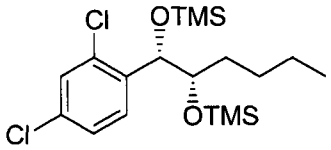
Preparation Example 89 : Preparation of 1-(2,6-dichlorophenyl)-3-methyl-(S,S)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol(Preparation example44)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.3g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

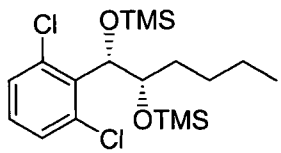
Preparation Example 90 : Preparation of 1-(2,4-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-hexane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-hexanediol(Preparation example90)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.6g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.89~0.93(m, 3H), 1.30~1.39(m, 2H), 1.49~1.52(m, 2H), 1.56~1.6(m, 2H), 3.72~3.77(m, 1H), 4.98(t, *J*=4.8Hz, 1H), 7.28~7.50(m, 3H)

Preparation Example 91 : Preparation of 1-(2,6-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-hexane

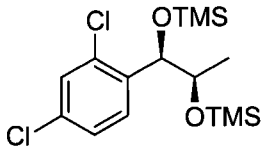


The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-hexanediol(Preparation example47)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.8g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.85(t, *J*=6.7Hz, 3H), 1.20~1.31(m, 4H),

1.45~1.53(m, 2H), 4.28~4.33(m, 1H), 5.25(t, *J*=8.4Hz, 1H), 7.18~7.35(m, 3H)

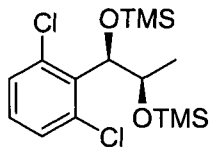
Preparation Example 92 : Preparation of 1-(2,4-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-propanediol(Preparation example27)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.2g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.22(d, *J*=6.4Hz, 3H), 3.90~3.95(m, 1H), 4.94(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

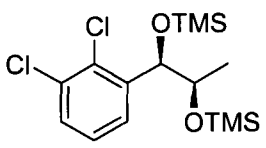
Preparation Example 93 : Preparation of 1-(2,6-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-propanediol(Preparation example39)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.6g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.10(d, *J*=6.4Hz, 3H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.36(m, 3H)

Preparation Example 94 : Preparation of 1-(2,3-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-propane

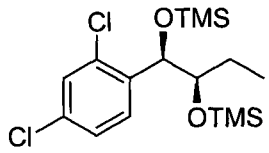


The substantially same method as described in Preparation Example 69 was conducted,

except that 1-(2,3-dichlorophenyl)-(R,R)-1,2-propanediol(Preparation example58)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.9g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.10(d, *J*=6.4Hz, 3H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.22(m, 3H)

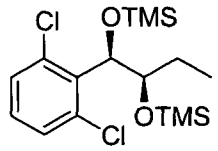
Preparation Example 95 : Preparation of 1-(2,4-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-butanediol(Preparation example30)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.6g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.02(t, *J*=7.4Hz, 3H), 1.54~1.61(m, 2H), 3.65~3.68(m, 1H), 5.01(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

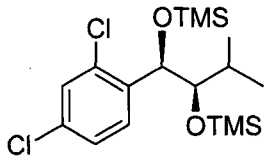
Preparation Example 96 : Preparation of 1-(2,6-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-butanediol(Preparation example42)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.3g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.97(t, *J*=7.6Hz, 3H), 1.26~1.53(m, 2H), 4.22~4.26(m, 1H), 5.26(t, *J*=8.4Hz, 1H), 7.17~7.35(m, 3H)

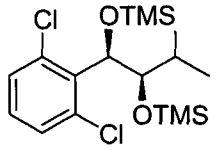
Preparation Example 97 : Preparation of 1-(2,4-dichlorophenyl)-3-methyl-(R,R)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-(R,R)-1,2-butanediol(Preparation example33)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.5g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.30~7.53(m, 3H)

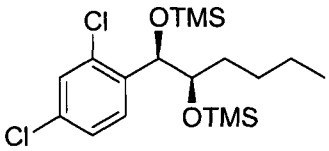
Preparation Example 98 : Preparation of 1-(2,6-dichlorophenyl)-3-methyl-(R,R)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-(R,R)-1,2-butanediol(Preparation example45)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.4g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

Preparation Example 99 : Preparation of 1-(2,4-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-hexane

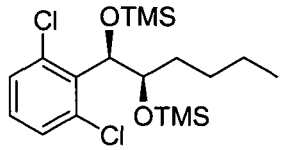


The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-hexanediol(Preparation example36)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.6g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.89~0.93(m, 3H), 1.30~1.39(m, 2H),

1.49~1.52(m, 2H), 1.56~1.62(m, 2H), 3.72~3.77(m, 1H), 4.98(t, *J*=4.8Hz, 1H), 7.28~7.50(m, 3H)

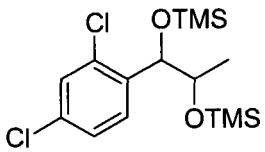
Preparation Example 100 : Preparation of 1-(2,6-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-hexane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-hexanediol(Preparation example48)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.3g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.85(t, *J*=6.7Hz, 3H), 1.20~1.31(m, 4H), 1.45~1.53(m, 2H), 4.28~4.33(m, 1H), 5.25(t, *J*=8.4Hz, 1H), 7.18~7.35(m, 3H)

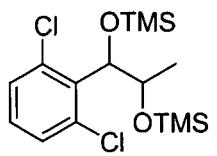
Preparation Example 101 : Preparation of 1-(2,4-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-propanediol(Preparation example28)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.6g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.22(d, *J*=6.4Hz, 3H), 3.90~3.95(m, 1H), 4.94(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

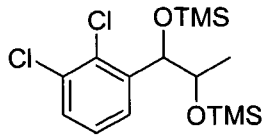
Preparation Example 102 : Preparation of 1-(2,6-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-propanediol(Preparation example40)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.1g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.10(d, *J*=6.4Hz, 3H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.36(m, 3H)

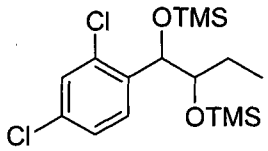
Preparation Example 103 : Preparation of 1-(2,3-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,3-dichlorophenyl)-1,2-propanediol(Preparation example59)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.7g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.10(d, *J*=6.4Hz, 3H), 4.47~4.54(m, 1H), 5.24(t, *J*=8.8Hz, 1H), 7.18~7.22(m, 3H)

Preparation Example 104 : Preparation of 1-(2,4-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)-butane

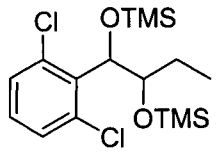


The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-butanediol(Preparation example31)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.9g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.02(t, *J*=7.4Hz, 3H), 1.54~1.61(m, 2H), 3.65~3.68(m, 1H), 5.01(t, *J*=5.0Hz, 1H), 7.31~7.49(m, 3H)

Preparation Example 105 : Preparation of 1-(2,6-dichlorophenyl)-1,2-(Bis-

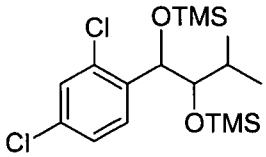
trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-butanediol(Preparation example43)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.1g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.97(t, *J*=7.6Hz, 3H), 1.26~1.53(m, 2H), 4.22~4.26(m, 1H), 5.26(t, *J*=8.4Hz, 1H), 7.17~7.35(m, 3H)

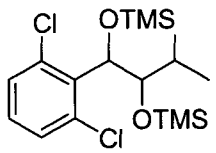
Preparation Example 106 : Preparation of 1-(2,4-dichlorophenyl)-3-methyl-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-1,2-butanediol(Preparation example34)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.7g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.30~7.53(m, 3H)

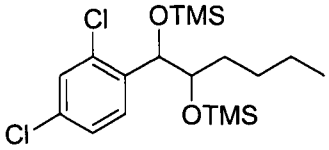
Preparation Example 107 : Preparation of 1-(2,6-dichlorophenyl)-3-methyl-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-1,2-butanediol(Preparation example46)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.6g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.00(d, *J*=6.8Hz, 6H), 1.60~1.65(m, 1H), 4.13~4.18(m, 1H), 5.36(t, *J*=7.6Hz, 1H), 7.17~7.35(m, 3H)

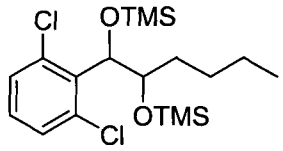
Preparation Example 108 : Preparation of 1-(2,4-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)-hexane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-hexanediol(Preparation example37)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.7g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.89~0.93(m, 3H), 1.30~1.39(m, 2H), 1.49~1.52(m, 2H), 1.56~1.62(m, 2H), 3.72~3.77(m, 1H), 4.98(t, *J*=4.8Hz, 1H), 7.28~7.50(m, 3H)

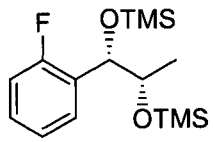
Preparation Example 109 : Preparation of 1-(2,6-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)-hexane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-hexanediol(Preparation example49)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.2g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 0.85(t, *J*=6.7Hz, 3H), 1.20~1.31(m, 4H), 1.45~1.53(m, 2H), 4.28~4.33(m, 1H), 5.25(t, *J*=8.4Hz, 1H), 7.18~7.35(m, 3H)

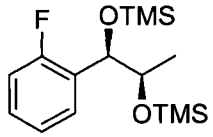
Preparation Example 110 : Preparation of 1-(2-fluoroophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-fluoroophenyl)-(S,S)-1,2-propanediol(Preparation example61)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.8g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.15(d, *J*=6.4Hz, 3H), 3.90~3.98(m, 1H), 4.78(dd, *J*=4.4, 7.2Hz, 1H), 7.04~7.50(m, 4H)

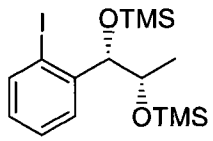
Preparation Example 111 : Preparation of 1-(2-fulorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-fluoroophenyl)-(R,R)-1,2-propanediol(Preparation example62)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.5g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.15(d, *J*=6.4Hz, 3H), 3.90~3.98(m, 1H), 4.78(dd, *J*=4.4, 7.2Hz, 1H), 7.04~7.50(m, 4H)

Preparation Example 112 : Preparation of 1-(2-iodophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-propane

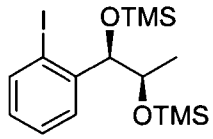


The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-iodophenyl)-(S,S)-1,2-propanediol(Preparation example66)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.1g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.27(d, *J*=6.4Hz, 3H), 3.99(t, *J*=6.0Hz,

1H), 4.81(d, *J*=4.0Hz, 1H), 7.01~7.87(m, 4H)

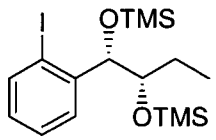
Preparation Example 113 : Preparation of 1-(2-iodophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)-propane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-iodophenyl)-(R,R)-1,2-propanediol(Preparation example67)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (2.8g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.26(d, *J*=6.4Hz, 3H), 3.98(t, *J*=6.2Hz, 1H), 4.88(d, *J*=4.4Hz, 1H), 7.00~7.87(m, 4H)

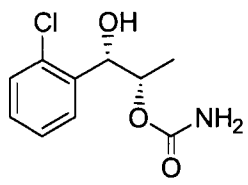
Preparation Example 114 : Preparation of 1-(2-iodophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)-butane



The substantially same method as described in Preparation Example 69 was conducted, except that 1-(2-iodophenyl)-(S,S)-1,2-butanediol(Preparation example68)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14) to obtain the title compound (3.3g, yield 90~120%).

^{1}H NMR(400MHz, $CDCl_3$)δ-0.053(s, 9H), 0.044(s, 9H), 1.04(t, *J*=7.6Hz, 3H), 1.60~1.71(m, 2H), 3.71~3.76(m, 1H), 4.87(d, *J*=4.8Hz, 1H), 7.01~7.87(m, 4H)

Example 1 : Preparation of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate(1)



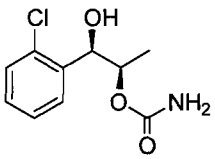
To a stirred solution of crude 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)

propane(preparation example69, 104g, 0.31mol) in toluene (670mL) was added by Chlorosulfonyl isocynate(62.5mL, 0.71mol) at 0℃. The reaction mixture was stirred for 2hr. The reaction mixture was quenched with ice water and then was stirred by additional cold H_2O (500mL) for 2hr. After separation of organic layer, the aqueous was adjusted pH2~3 with sat. $NaHCO_3$(400mL) and extracted with EtOAc (300mL x3). The EtOAc layer was washed with sat. $NaHCO_3$ (500mL) and H_2O(500mL). The organic phase was treated with Charcol for 1.5hr. The organic phase was filtered with Cellite, dreid over $MgSO_4$. Filterion and concentration under vacuum provided the title compound of white solid(yield 85%(71.1g), ee = 99.9% MP = 83~84℃, $[\alpha]_D$=+57.8(c=0.25, MeOH))

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J=6.4, 3H), 2.91(d, *J*=4.8, 1H), 4.68(br s, 2H), 5.06~5.09(m, 1H), 5.18~5.21(m, 1H), 7.23~7.39(m, 3H), 7.55(dd, *J*=1.6, *J*=7.8, 1H)

^{13}C NMR(100MHz, $CDCl_3$) δ16.4, 73.1, 75.0, 127.0, 128.4, 129.1, 129.5, 132.7, 138.0, 156.6

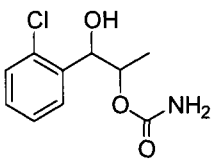
Example 2 : Preparation of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2-carbamate(2)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example70)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (5.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J=6.4, 3H), 2.91(d, *J*=4.8, 1H), 4.68(br s, 2H), 5.06~5.09(m, 1H), 5.18~5.21(m, 1H), 7.23~7.39(m, 3H), 7.55(dd, *J*=1.6, *J*=7.8, 1H)

Example 3 : Preparation of 1-(2-chlorophenyl)-1-hydroxypropyl-2-carbamate(3)

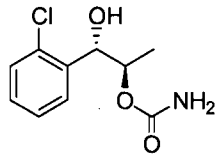


The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example71)was used

instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (3.8g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J=6.4, 3H), 2.91(d, *J*=4.8, 1H), 4.68(br s, 2H), 5.06~5.09(m, 1H), 5.18~5.21(m, 1H), 7.23~7.39(m, 3H), 7.55(dd, *J*=1.6, *J*=7.8, 1H)

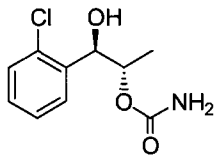
Example 4 : Preparation of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(R)-2-carbamate(4)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-(S,R)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example72)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.4g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J=6.4, 3H), 2.91(d, *J*=4.8, 1H), 4.68(br s, 2H), 5.06~5.09(m, 1H), 5.18~5.21(m, 1H), 7.23~7.39(m, 3H), 7.55(dd, *J*=1.6, *J*=7.8, 1H)

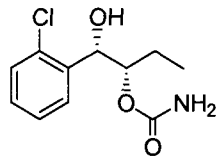
Example 5 : Preparation of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(S)-2-carbamate(5)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-(R,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example73)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.3g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J=6.4, 3H), 2.91(d, *J*=4.8, 1H), 4.68(br s, 2H), 5.06~5.09(m, 1H), 5.18~5.21(m, 1H), 7.23~7.39(m, 3H), 7.55(dd, *J*=1.6, *J*=7.8, 1H)

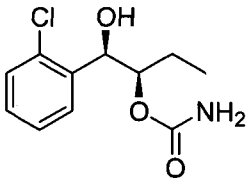
Example 6 : Preparation of 1-(2-chlorophenyl)-(S)-1-hydroxybutyl-(S)-2-carbamate(6)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation example74)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.6g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.96(t, J = 7.4Hz, 3H), 1.57~1.73(m, 2H), 3.01(d, J = 5.6Hz, 1H), 4.74(br s, 2H), 4.95(dt, J = 7.2, 8.8Hz, 1H), 5.23(t, J = 5.6Hz, 1H), 7.22~7.54(m, 4H)

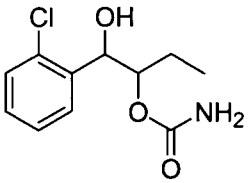
Example 7: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxybtyl-(R)-2-carbamate(7)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 75) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.5g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.94(t, J=7.4Hz, 3H), 1.53~1.73(m, 2H), 2.92(s, 1H), 4.78(br s, 2H), 4.91~4.96(m, 1H), 5.22(d, J=5.5Hz, 1H), 7.20~7.54(m, 4H)

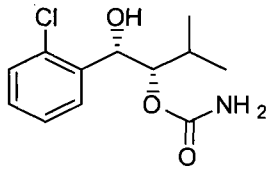
Example 8: Synthesis of 1-(2-chlorophenyl)-1-hydroxybutyl-2-carbamate(8)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 76) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.9g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.97(t, *J*=7Hz, 3H), 1.58~1.74(m, 2H), 2.94(d, *J*=6Hz, 1H), 4.69(br s, 2H), 4.94~4.99(m, 1H), 5.24(t, *J*=6Hz, 1H), 7.23~7.56(m, 4H)

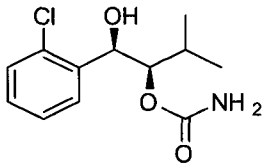
Example 9: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxy-3-methyl-butyl-(S)-2-carbamate(9)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-3-methyl-(S,S)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 77) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.01(d, J = 6.4Hz, 3H), 1.09(d, *J* = 6.8Hz, 3H), 2.06(m, 1H), 2.75(d, *J* = 6.8Hz, 1H), 4.58(br s, 2H), 4.85~4.88(m, 1H), 5.34~5.37(m, 1H), 7.22~7.33(m, 2H), 7.35~7.37(m, 1H), 7.51~7.53(m, 1H)

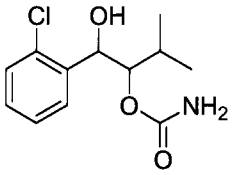
Example 10: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxy-3-methyl-butyl-(R)-2-carbamate(10)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-3-methyl-(R,R)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 78) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.6g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.01(d, *J* = 6.8Hz, 3H), 1.09(d, *J* = 6.8Hz, 3H), 2.06(m, 1H), 2.73(d, *J* = 6.8Hz, 1H), 4.57(br s, 2H), 4.85~4.88(m, 1H), 5.34~5.37(m, 1H), 7.24~7.30(m, 2H), 7.35~7.37(m, 1H), 7.51~7.53(m, 1H)

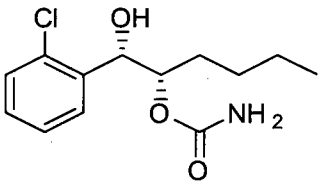
Example 11: Synthesis of 1-(2-chlorophenyl)-1-hydroxy-3-methyl-butyl-2-carbamate(11)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-3-methyl-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 79) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(d, *J*=6.4Hz, 3H), 1.09(d, *J*=6.4Hz, 3H), 2.08(m, 1H), 2.76(d, *J*=6.0Hz, 1H), 4.59(br s, 2H), 4.87(dd, *J*=7.2Hz, 4.4Hz, 1H), 5.36(t, *J*=4.6, 1H), 7.23~7.54(m, 4H)

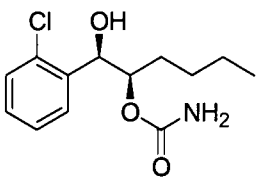
Example 12: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxyhexyl-(S)-2-carbamate(12)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 80) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.3g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.88(t, *J* = 7Hz, 3H), 1.33~1.42(m, 4H), 1.53~1.71(m, 2H), 2.89(d, *J* = 5.6Hz, 1H) 4.64(br s, 2H), 5.04(dt, *J* = 5.0, 9.0Hz, 1H), 5.20(t, *J* = 5.6Hz, 1H), 7.23~7.55(m, 4H)

Example 13: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxyhexyl-(R)-2-carbamate(13)

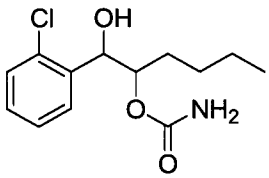


The substantially same method as described in Example 1 was conducted, except that 1-

(2-chlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 81) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.2g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.89(dd, *J*=5Hz, 3H), 1.28~1.43(m, 4H), 1.52~1.58(m, 1H), 1.65~1.72(m, 1H), 2.90(d, *J*=6Hz, 1H), 4.64(br s, 2H), 5.01~5.06(m, 1H), 5.22(t, *J*=6Hz, 1H), 7.22~7.56(m, 4H)

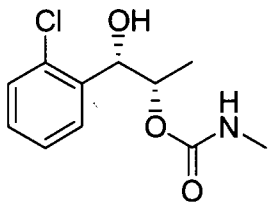
Example 14: Synthesis of 1-(2-chlorophenyl)-1-hydroxyhexyl-2-carbamate(14)



The substantially same method as described in Example 1 was conducted, except that 1-(2-chlorophenyl)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 82) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.1g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.88(dd, *J*=5Hz, 3H), 1.31~1.43(m, 4H), 1.63~1.70(m, 1H), 1.52~1.60(m, 1H), 3.06(d, *J*=6Hz, 1H), 4.75(br s, 2H), 5.00~5.05(m, 1H), 5.21(t, *J*=6Hz, 1H), 7.22~7.55(m, 4H)

Example 15: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-methylcarbamate(15)



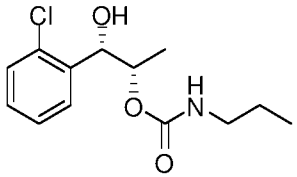
1-(2-chlorophenyl)-(S,S)-1,2-propanediol(2.4g) obtained in Preparation Example 14, tetrahydrofuran (THF, 12ml), and carbonyldiimidazole (CDI, 3.12g) were put into a flask and stirred at the room temperature. After approximately 3 hours, methylamine solution(CH_3NH_2, 4ml(33% in EtOH)) was added thereto. When the reaction was completed, the obtained product was washed with 1M HCl solution and ethylacetate (EA). The separated organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column

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chromatography, to obtain the title compound (1.6g, yield 51%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.03~1.25(m, 3H), 2.76(s, 3H), 3.34(s, 1H), 4.80(br s 1H), 5.04(t, *J*=12.5Hz, 1H), 5.14(s, 1H), 7.20~7.53(m, 4H)

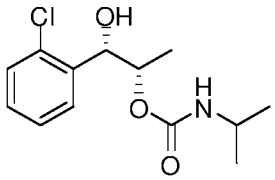
Example 16: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-propylcarbamate(16)



The substantially same method as described in Example 15 was conducted, except that propylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (0.79g, yield 25%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.90(t, *J*=6.8Hz, 3H), 1.20(d, *J*=5.96Hz, 3H), 1.49(dd, *J*=14.2Hz, 2H), 3.11(d, *J*=6.28Hz, 2H), 3.34(s, 1H), 4.84(br s, 1H), 5.05(t, *J*=5.88Hz, 1H), 5.14(s, 1H), 7.22~7.53(m, 4H)

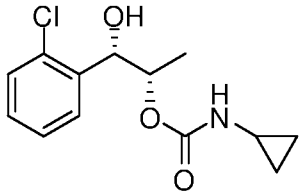
Example 17: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-isopropylcarbamate(17)



The substantially same method as described in Example 15 was conducted, except that isopropylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.5g, yield 41%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.14(dd, *J*=6.5Hz, 6H), 1.19(d, *J*=6.4Hz, 3H), 3.21(s, 1H), 3.73~3.82(m, 1H), 4.59(br s, 1H), 5.01~5.07(m, 1H), 5.14(t, *J*=5.8Hz, 1H), 7.20~7.53(m, 4H)

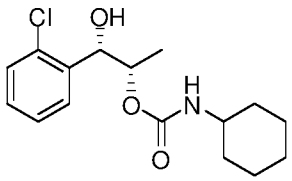
Example 18: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-cyclopropylcarbamate(18)



The substantially same method as described in Example 15 was conducted, except that cyclopropylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (2.2g, yield 43%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.50~0.56(m, 2H), 0.74(d, J=7.21Hz, 2H), 1.25(s, 3H), 2.56~2.61(m, 1H), 3.72(s, 1H), 4.98(br s, 1H), 5.05~5.11(m, 1H), 7.16(s, 1H), 7.23~7.54(m, 4H)

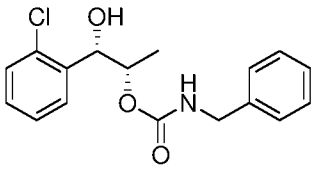
Example 19: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-cyclohexyl carbamate(19)



The substantially same method as described in Example 15 was conducted, except that cyclohexylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.1g, yield 26%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.06~1.40(m, 7H), 1.56~1.61(m, 2H), 1.69~1.71(m, 2H), 1.87~1.94(m, 2H), 3.19(d, *J*=4.32Hz, 1H), 3.45(s, 1H), 4.64(br s 1H), 5.02~5.07(m, 1H), 5.14(t, *J*=6.08Hz, 1H) 7.20~7.53(m, 4H)

Example 20: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-benzyl carbamate(20)

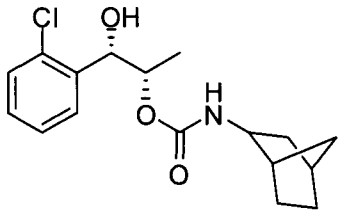


The substantially same method as described in Example 15 was conducted, except that benzylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.2g, yield 18%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.27(d, *J*=10Hz, 3H), 3.12(d, *J*=5Hz, 1H), 4.37(d, *J*=6Hz,

2H), 5.12~5.19(m, 3H), 7.15~7.56(m, 9H)

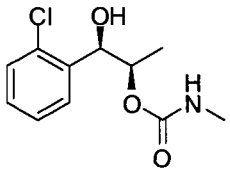
Example 21: Synthesis of 1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2- N-bicyclo[2,2,1]heptanescarbamate(21)



The substantially same method as described in Example 15 was conducted, except that 2-aminonorbornane was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.7g, yield 32%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.08~1.35(m, 9H), 1.65(br s, 1H), 1.75~1.71(m, 1H), 2.14~2.24(m, 1H), 2.27~2.30(m, 1H), 3.23~3.29(m, 1H), 3.47~3.52(m, 1H), 4.67(br s, 1H), 5.01~5.09(m, 1H), 5.12~5.18(m, 1H), 7.22~7.55(m, 4H)

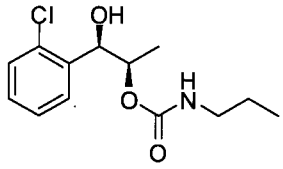
Example 22: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2- N-methylcarbamate(22)



The substantially same method as described in Example 15 was conducted, except that 1-(2-chlorophenyl)-(R,R)-1,2-propanediol(Preparation example 15) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (3.36g, yield 60%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.20(d, *J*=6.8Hz, 3H), 2.80(d, *J*=4.8Hz, 3H), 3.20(d, *J*=4.4Hz, 1H), 4.75(br s, 1H), 5.03~5.09(m, 1H), 5.14~5.17(m, 1H), 7.22~7.55(m, 4H)

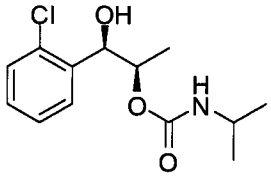
Example 23: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2- N-propylcarbamate(23)



The substantially same method as described in Example 22 was conducted, except that propylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (3.1g, yield 53%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.92(t, *J*=7.6Hz, 3H), 1.21(d, *J*=6.4Hz, 3H), 1.51(m, 2H), 3.09~3.14(m, 2H), 3.28(d, *J*=4.4Hz, 1H), 4.82(br s, 1H), 5.03~5.09(m, 1H), 5.14~5.17(m, 1H), 7.22~7.55(m. 4H)

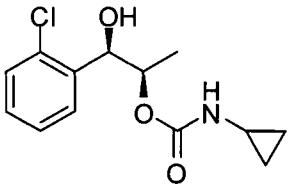
Example 24: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2- N-isopropylcarbamate(24)



The substantially same method as described in Example 22 was conducted, except that isopropylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (0.16g, yield 27%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.88~1.16(m, 6H), 1.19~1.26(m, 3H), 3.34(s, 1H), 3.71~3.78(m, 1H), 4.62(br s, 1H), 5.03(t, *J*=5.8Hz, 1H), 5.13(d, *J*=4.9Hz, 1H), 7.20~7.53(m, 4H)

Example 25: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2- N-cyclopropylcarbamate(25)

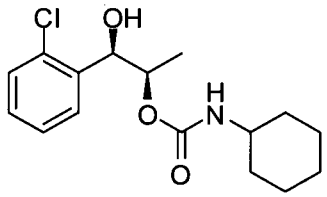


The substantially same method as described in Example 22 was conducted, except that cyclopropylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (3.7g, yield 60%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.49~0.54(m, 2H), 0.74(d, J=7.2Hz, 2H), 1.22(s, 3H),

2.55~2.60(m, 1H), 3.16(s, 1H), 5.00(s, 1H), 5.04~5.11(m, 1H), 5.16(s, 1H), 7.23~7.54(m, 4H)

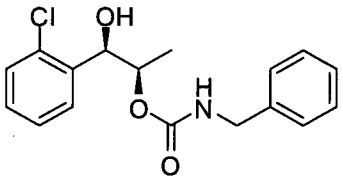
Example 26: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2- N-cyclohexyl carbamate(26)



The substantially same method as described in Example 22 was conducted, except that cyclohexylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.9g, yield 28%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.05~1.38(m, 8H), 1.58~1.70(m, 3H), 1.85~1.95(m, 2H), 3.39~3.47(m, 1H), 3.56(s, 1H), 4.79(br s, 1H), 5.01~5.07(m, 1H), 5.14(t, *J*=5.2Hz, 1H), 7.20~7.54(m, 4H)

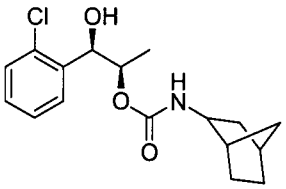
Example 27: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2- N-benzylcarbamate(27)



The substantially same method as described in Example 22 was conducted, except that benzylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (0.52g, yield 19%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.25(d, *J*=6Hz, 3H), 1.64(s, 1H), 3.13(d, *J*=4.4Hz, 1H), 4.37(d, *J*=5.6Hz, 2H), 5.12~5.19(m, 2H), 7.23~7.55(m, 9H)

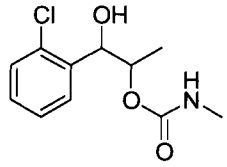
Example 28: Synthesis of 1-(2-chlorophenyl)-(R)-1-hydroxypropyl-(R)-2- N-bicyclo[2,2,1]heptanecarbamate(28)



The substantially same method as described in Example 22 was conducted, except that 2-aminonorbornane was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.7g, yield 20~50%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.08~1.35(m, 9H), 1.65(br s, 1H), 1.75~1.71(m, 1H), 2.14~2.24(m, 1H), 2.27~2.30(m, 1H), 3.23~3.29(m, 1H), 3.47~3.52(m, 1H), 4.67(br s, 1H), 5.01~5.09(m, 1H), 5.12~5.18(m, 1H), 7.22~7.55(m, 4H)

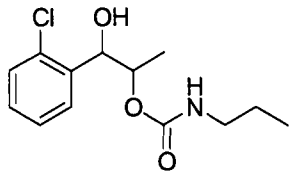
Example 29: Synthesis of 1-(2-chlorophenyl)-1-hydroxypropyl-2- N-methylcarbamate(29)



The substantially same method as described in Example 15 was conducted, except that 1-(2-chlorophenyl)-1,2-propanediol(Preparation example 16) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (2.6g, yield 45%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.21(d, *J*=6Hz, 3H), 2.81(d, *J*=5Hz, 3H), 3.14(d, *J*=4Hz, 1H), 4.72(br s, 1H), 5.07(dd, *J*=6Hz, 1H), 5.16(t, *J*=6Hz, 1H), 7.22~7.56(m, 4H)

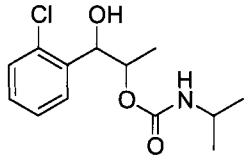
Example 30: Synthesis of 1-(2-chlorophenyl)-1-hydroxypropyl-2- N-propylcarbamate(30)



The substantially same method as described in Example 29 was conducted, except that propylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.0g, yield 17%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.92(t, *J*=7Hz, 3H), 1.21(d, *J*=6Hz, 3H), 1.53(dd, *J*=7Hz, 2H), 3.13(dd, *J*=7Hz, 2H), 3.28(d, 1H), 4.82(S, 1H), 5.06(dd, *J*=7Hz, 1H), 5.16(t, *J*=5Hz, 1H), 7.21~7.56(m, 4H)

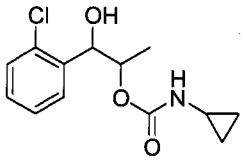
Example 31: Synthesis of 1-(2-chlorophenyl)-1-hydroxypropyl-2- N-isopropylcarbamate(31)



The substantially same method as described in Example 29 was conducted, except that isopropylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (0.54g, yield 16%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.16(dd, *J*=6Hz, 6H), 1.21(d, *J*=6Hz, 3H), 3.23(d, *J*=6Hz, 1H), 3.75~3.84(m, 1H), 4.61(br s, 1H), 5.06(t, *J*=6Hz, 1H), 5.16(t, *J*=6Hz, 1H), 7.22~7.56(m, 4H)

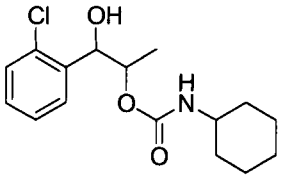
Example 32: Synthesis of 1-(2-chlorophenyl)-1-hydroxypropyl-2- N-cyclopropylcarbamate(32)



The substantially same method as described in Example 29 was conducted, except that cyclopropylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.0g, yield 17%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.50(t, *J*=6Hz, 2H), 0.77(t, *J*=3Hz, 2H), 1.12(d, *J*=7Hz, 3H), 2.53~2.59(m, 1H), 3.22(d, *J*=4Hz, 1H), 5.08(dd, *J*=6Hz, 1H), 5.15(S, 1H), 7.22~7.55(m, 4H)

Example 33: Synthesis of 1-(2-chlorophenyl)-1-hydroxypropyl-2- N-cyclohexylcarbamate(33)

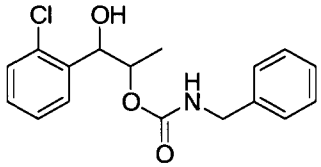


The substantially same method as described in Example 29 was conducted, except that cyclohexylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title

compound (2.2g, yield 33%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.07~1.17(m, 3H), 1.21(d, *J*=6Hz, 3H), 1.29~1.42(m, 3H), 1.72(dd, *J*=6Hz, 2H), 1.92(dd, *J*=6Hz, 2H), 3.26(d, *J*=4Hz, 1H), 3.46(t, *J*=4Hz, 1H), 4.68(d, *J*=6Hz, 1H), 5.07(dd, *J*=6Hz, 1H), 5.16(t, *J*=6Hz, 1H), 7.22~7.55(m, 4H)

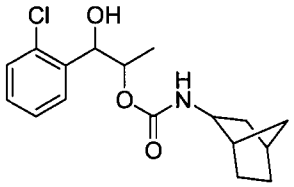
Example 34: Synthesis of 1-(2-chlorophenyl)-1-hydroxypropyl-2- N-benzylcarbamate(34)



The substantially same method as described in Example 29 was conducted, except that benzylamine was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.3g, yield 19%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.25(d, *J*=6Hz, 3H), 3.16(d, *J*=4Hz, 1H), 4.36(d, *J*=6Hz, 2H), 5.14(dd, *J*=6Hz, 3H), 7.23~7.56(m, 9H), yield:19%(1.3g)

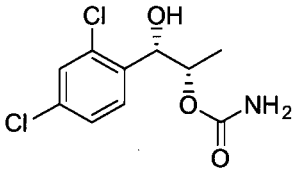
Example 35: Synthesis of 1-(2-chlorophenyl)-1-hydroxypropyl-2- N-bicyclo[2,2,1]heptanecarbamate(35)



The substantially same method as described in Example 29 was conducted, except that 2-aminonorbornane was used instead of methylamine solution(CH_3NH_2 in EtOH), to obtain the title compound (1.7g, yield 20~50%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.08~1.35(m, 9H), 1.65(br s, 1H), 1.75~1.71(m, 1H), 2.14~2.24(m, 1H), 2.27~2.30(m, 1H), 3.23~3.29(m, 1H), 3.47~3.52(m, 1H), 4.67(br s, 1H), 5.01~5.09(m, 1H), 5.12~5.18(m, 1H), 7.22~7.55(m, 4H)

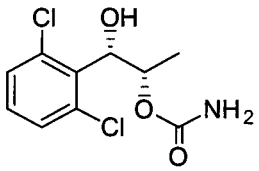
Example 36: Synthesis of 1-(2,4-dichlorophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate(36)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 83) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.8g, yield 60~90%).

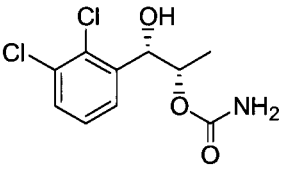
^{1}H NMR(400MHz, $CDCl_3$) δ1.22(d, J = 6.4Hz, 3H), 4.16(br t, 1H) 4.96(br t, 3H), 5.07(t, J = 4.8Hz, 1H), 7.23~7.52(m, 3H)

Example 37: Synthesis of 1-(2,6-dichlorophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate(37)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 84) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.6g, yield 60~90%)

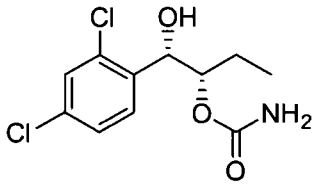
Example 38 : Synthesis of 1-(2,3-dichlorophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate(38)



The substantially same method as described in Example 1 was conducted, except that 1-(2,3-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 85) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.4g, yield 60~90%)

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, J = 6.4Hz, 3H), 3.66(d, J = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, J = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

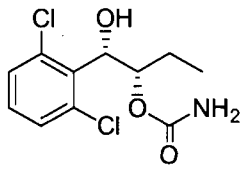
Example 39: Synthesis of 1-(2,4-dichlorophenyl)-(S)-1-hydroxybutyl-(S)-2-carbamate(39)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 86) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.3g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.96(t, J = 7.4Hz, 3H), 1.58~1.74(m, 2H), 2.98(d, J = 5.6Hz, 1H) 4.68(br s, 2H), 5.59(dt, J = 5.2, 8.8Hz, 1H), 5.19(t, J = 5.4Hz, 1H), 7.30~7.50(m, 3H)

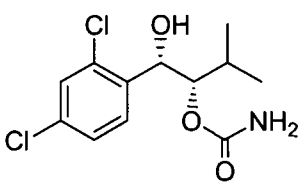
Example 40: Synthesis of 1-(2,6-dichlorophenyl)-(S)-1-hydroxybutyl-(S)-2-carbamate(40)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 87) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.92(t, J = 7.4Hz, 3H), 1.30~1.38(m, 1H), 1.57~1.64(m, 1H), 3.74(d, J = 9.2Hz, 1H), 4.80(br s, 2H), 5.40~5.50(m, 2H), 7.17~7.34(m, 3H)

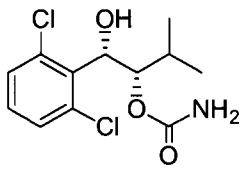
Example 41: Synthesis of 1-(2,4-dichlorophenyl)-(S)-1-hydroxy-3-methyl-butyl-(S)-2-carbamate(41)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-(S,S)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 88) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.9g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.85(br s, 2H), 5.40~5.43(m, 1H), 5.49~5.54(m, 1H), 7.30~7.50(m, 3H)

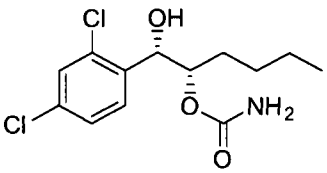
Example 42: Synthesis of 1-(2,6-dichlorophenyl)-(S)-1-hydroxy-3-methyl-butyl-(S)-2-carbamate(42)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-(S,S)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 89) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.4g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.85(br s, 2H), 5.40~5.43(m, 1H), 5.49~5.54(m, 1H), 7.16~7.33(m, 3H)

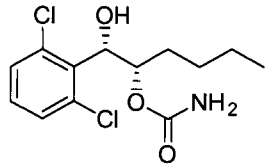
Example 43: Synthesis of 1-(2,4-dichlorophenyl)-(S)-1-hydroxyhexyl-(S)-2-carbamate(43)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 90) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.2g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.89(t, J = 3.6Hz, 3H), 1.28~1.42(m, 4H), 1.52~1.59(m, 1H), 1.64~1.71(m, 1H), 2.98(d, J = 5.6Hz, 1H), 4.67(br s, 2H), 4.96~5.00(m, 1H), 5.17(t, J = 5.6Hz, 1H), 7.30~7.49(m 3H)

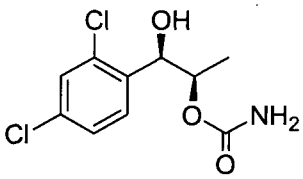
Example 44: Synthesis of 1-(2,6-dichlorophenyl)-(S)-1-hydroxyhexyl-(S)-2-carbamate(44)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 91) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.1g, yield 60~90%)

^{1}H NMR(400MHz, $CDCl_3$) δ0.84(t, J = 7.0Hz, 3H), 1.20~1.35(m, 4H), 1.36~1.41(m, 1H), 1.59~1.63(m, 1H), 3.71(d, J = 10.0Hz, 1H), 4.74(br s, 2H), 5.40~5.44(m, 1H), 5.52~5.57(m, 1H), 7.17~7.35(m, 3H)

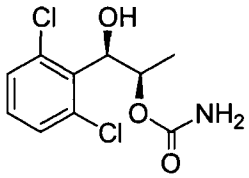
Example 45: Synthesis of 1-(2,4-dichlorophenyl)-(R)-1-hydroxypropyl-(R)-2-carbamate(45)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 92) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.2g, yield 60~90%),

^{1}H NMR(400MHz, $CDCl_3$) δ1.22(d, J = 6.4Hz, 3H), 4.16(br t, 1H) 4.96(br t, 3H), 5.07(t, J = 4.8Hz, 1H), 7.23~7.52(m, 3H)

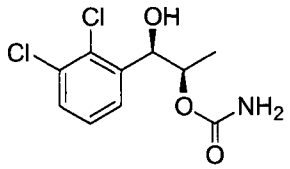
Example 46: Synthesis of 1-(2,6-dichlorophenyl)-(R)-1-hydroxypropyl-(R)-2-carbamate(46)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 93) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%),

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, J = 6.4Hz, 3H), 3.66(d, J = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, J = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

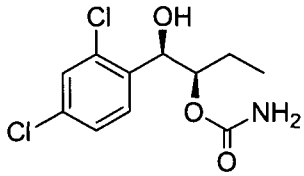
Example 47: Synthesis of 1-(2,3-dichlorophenyl)-(R)-1-hydroxypropyl-(R)-2-carbamate(47)



The substantially same method as described in Example 1 was conducted, except that 1-(2,3-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 94) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.0g, yield 60~90%)

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, J = 6.4Hz, 3H), 3.66(d, J = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, J = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

Example 48: Synthesis of 1-(2,4-dichlorophenyl)-(R)-1-hydroxybutyl-(R)-2-carbamate(48)

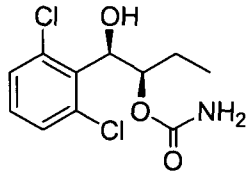


The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 95) was

used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.3g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.96(t, J = 7.4Hz, 3H), 1.58~1.74(m, 2H), 2.98(d, J = 5.6Hz, 1H) 4.68(br s, 2H), 5.59(dt, J = 5.2, 8.8Hz, 1H), 5.19(t, J = 5.4Hz, 1H), 7.30~7.50(m, 3H)

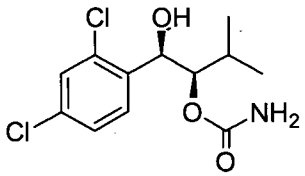
Example 49: Synthesis of 1-(2,6-dichlorophenyl)-(R)-1-hydroxybutyl-(R)-2-carbamate(49)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 96) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.5g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.92(t, J = 7.4Hz, 3H), 1.30~1.38(m, 1H), 1.57~1.64(m, 1H), 3.74(d, J = 9.2Hz, 1H), 4.80(br s, 2H), 5.40~5.50(m, 2H), 7.17~7.34(m, 3H)

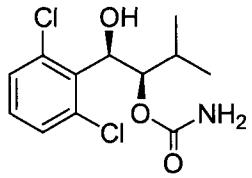
Example 50: Synthesis of 1-(2,4-dichlorophenyl)-(R)-1-hydroxy-3-methyl-butyl-(R)-2-carbamate(50)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-(R,R)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 97) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.8g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.85(br s, 2H), 5.40~5.43(m, 1H), 5.49~5.54(m, 1H), 7.30~7.50(m, 3H)

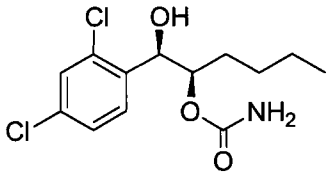
Example 51: Synthesis of 1-(2,6-dichlorophenyl)-(R)-1-hydroxy-3-methyl-butyl-(R)-2-carbamate(51)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-(R,R)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 98) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.6g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.85(br s, 2H), 5.40~5.43(m, 1H), 5.49~5.54(m, 1H), 7.16~7.33(m, 3H)

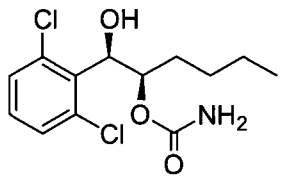
Example 52: Synthesis of 1-(2,4-dichlorophenyl)-(R)-1-hydroxyhexyl-(R)-2-carbamate(52)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 99) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.5g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.89(t, J = 3.6Hz, 3H), 1.28~1.42(m, 4H), 1.52~1.59(m, 1H), 1.64~1.71(m, 1H), 2.98(d, J = 5.6Hz, 1H), 4.67(br s, 2H), 4.96~5.00(m, 1H), 5.17(t, J = 5.6Hz, 1H), 7.30~7.49(m, 3H)

Example 53: Synthesis of 1-(2,6-dichlorophenyl)-(R)-1-hydroxyhexyl-(R)-2-carbamate(53)

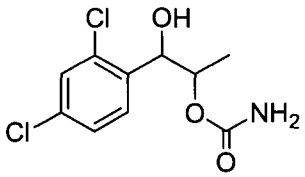


The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 100) was

used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.4g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.84(t, J = 7.0Hz, 3H), 1.20~1.35(m, 4H), 1.36~1.41(m, 1H), 1.59~1.63(m, 1H), 3.71(d, J = 10.0Hz, 1H), 4.74(br s, 2H), 5.40~5.44(m, 1H), 5.52~5.57(m, 1H), 7.17~7.35(m, 3H)

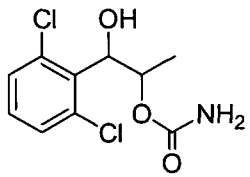
Example 54: Synthesis of 1-(2,4-dichlorophenyl)-1-hydroxypropyl-2-carbamate(54)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 101) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.22(d, J = 6.4Hz, 3H), 4.16(br t, 1H) 4.96(br t, 3H), 5.07(t, J = 4.8Hz, 1H), 7.23~7.52(m, 3H)

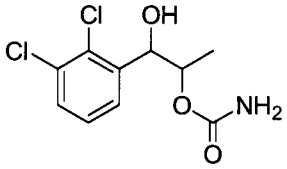
Example 55: Synthesis of 1-(2,6-dichlorophenyl)-1-hydroxypropyl-2-carbamate(55)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 102) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.4g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, J = 6.4Hz, 3H), 3.66(d, J = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, J = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

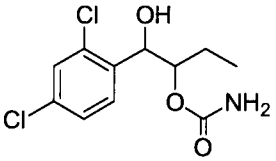
Example 56: Synthesis of 1-(2,3-dichlorophenyl)-1-hydroxypropyl-2-carbamate(56)



The substantially same method as described in Example 1 was conducted, except that 1-(2,3-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 103) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.6g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, J = 6.4Hz, 3H), 3.66(d, J = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, J = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

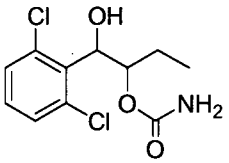
Example 57: Synthesis of 1-(2,4-dichlorophenyl)-1-hydroxybutyl-2-carbamate(57)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 104) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.96(t, J = 7.4Hz, 3H), 1.58~1.74(m, 2H), 2.98(d, J = 5.6Hz, 1H) 4.68(br s, 2H), 5.59(dt, J = 5.2, 8.8Hz, 1H), 5.19(t, J = 5.4Hz, 1H), 7.30~7.50(m, 3H)

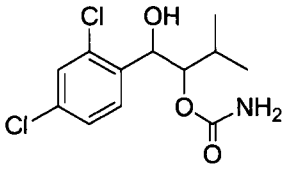
Example 58: Synthesis of 1-(2,6-dichlorophenyl)-1-hydroxybutyl-2-carbamate(58)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 105) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.4g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.92(t, J = 7.4Hz, 3H), 1.30~1.38(m, 1H), 1.57~1.64(m, 1H), 3.74(d, J = 9.2Hz, 1H), 4.80(br s, 2H), 5.40~5.50(m, 2H), 7.17~7.34(m, 3H)

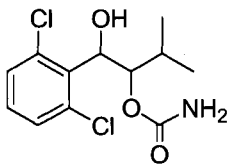
Example 59: Synthesis of 1-(2,4-dichlorophenyl)-1-hydroxy-3-methyl-butyl-2-carbamate(59)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 106) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.9g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.85(br s, 2H), 5.40~5.43(m, 1H), 5.49~5.54(m, 1H), 7.30~7.50(m, 3H)

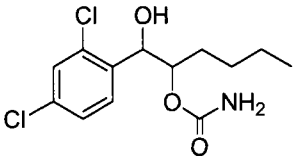
Example 60: Synthesis of 1-(2,6-dichlorophenyl)-1-hydroxy-3-methyl-butyl-2-carbamate(60)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 107) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.85(br s, 2H), 5.40~5.43(m, 1H), 5.49~5.54(m, 1H), 7.16~7.33(m, 3H)

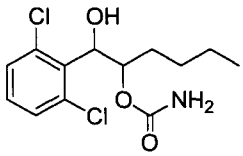
Example 61: Synthesis of 1-(2,4-dichlorophenyl)-1-hydroxyhexyl-2-carbamate(61)



The substantially same method as described in Example 1 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 108) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.6g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.89(t, J = 3.6Hz, 3H), 1.28~1.42(m, 4H), 1.52~1.59(m, 1H), 1.64~1.71(m, 1H), 2.98(d, J = 5.6Hz, 1H), 4.67(br s, 2H), 4.96~5.00(m, 1H), 5.17(t, J = 5.6Hz, 1H), 7.30~7.49(m, 3H)

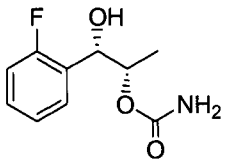
Example 62: Synthesis of 1-(2,6-dichlorophenyl)-1-hydroxyhexyl-2-carbamate(62)



The substantially same method as described in Example 1 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-(Bis-trimethylsilanyloxy)hexane (Preparation Example 109) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.5g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.84(t, J = 7.0Hz, 3H), 1.20~1.35(m, 4H), 1.36~1.41(m, 1H), 1.59~1.63(m, 1H), 3.71(d, J = 10.0Hz, 1H), 4.74(br s, 2H), 5.40~5.44(m, 1H), 5.52~5.57(m, 1H), 7.17~7.35(m, 3H)

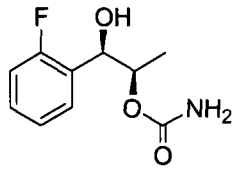
Example 63: Synthesis of 1-(2-fluorophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate(63)



The substantially same method as described in Example 1 was conducted, except that 1-(2-fluorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 110) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.8g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.19(d, J=5.2Hz, 3H), 2.93(d, J=4.4Hz, 1H), 4.71(br s, 2H), 4.99~5.06(m, H), 7.04~7.48(m, 4H)

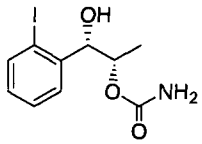
Example 64: Synthesis of 1-(2-fluorophenyl)-(R)-1-hydroxypropyl-(R)-2-carbamate(64)



The substantially same method as described in Example 1 was conducted, except that 1-(2-fluorophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 111) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.6g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.19(d, *J*=5.2Hz, 3H), 2.93(d, *J*=4.4Hz, 1H), 4.71(br s, 2H), 4.99~5.06(m, H), 7.04~7.48(m, 4H)

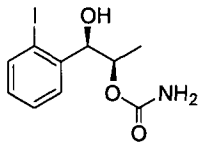
Example 65: Synthesis of 1-(2-iodophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate(65)



The substantially same method as described in Example 1 was conducted, except that 1-(2-iodophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 112) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.2g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.27(d, *J*=6.4Hz, 3H), 3.09(br s, 1H), 4.83(br s, 2H), 5.00~5.10(m, 2H), 7.00~7.76(m, 4H)

Example 66: Synthesis of 1-(2-iodophenyl)-(R)-1-hydroxypropyl-(R)-2-carbamate(66)

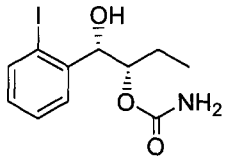


The substantially same method as described in Example 1 was conducted, except that 1-(2-iodophenyl)-(R,R)-1,2-(Bis-trimethylsilanyloxy)propane (Preparation Example 113) was used

instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (1.7g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.27(d, *J*=6.4Hz, 3H), 2.95(d, *J*=3.6Hz, 1H), 4.73(br s, 2H), 5.01~5.11(m, 2H), 7.01~7.86(m, 4H)

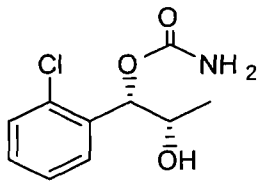
Example 67: Synthesis of 1-(2-iodophenyl)-(S)-1-hydroxybutyl-(S)-2-carbamate(67)



The substantially same method as described in Example 1 was conducted, except that 1-(2-iodophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy)butane (Preparation Example 114) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-(Bis-trimethylsilanyloxy) propane (Preparation example69) to obtain the title compound (2.1g, yield 60~90%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.27(d, *J*=6.4Hz, 3H), 3.09(br s, 1H), 4.83(br s, 2H), 5.00~5.10(m, 2H), 7.00~7.76(m, 4H)

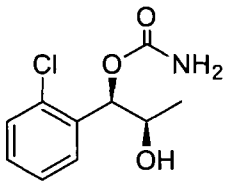
Example 68: Synthesis of 1-(2-chlorophenyl)-(S)-2-hydroxypropyl-(S)-1-carbamate(68)



1-(2-chlorophenyl)-(S,S)-1,2-propanediol(2.33g, Preparation example 14) obtained in Preparation Example 14, tetrahydrofuran (THF, 12ml), and carbonyldiimidazole (CDI, 3.04g) were put into a flask and stirred at the room temperature. After approximately 3 hours, ammonia solution (NH_4OH, 4ml) was added thereto. When the reaction was completed, the obtained product was washed with 1M HCl solution and ethylacetate (EA). The separated organic layer was dehydrated with anhydrous magnesium sulfate ($MgSO_4$), filtrated, and concented under reduced pressure. The concentrated residue was purified by a silica gel column chromatography, to obtain the title compound (0.28g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J = 6.8Hz, 3H), 2.13(d, J = 4.4Hz, 1H), 4.12~4.16(m, 1H), 4.85(br s, 2H), 5.98(d, J = 5.6Hz, 1H), 7.24~7.43(m, 4H)

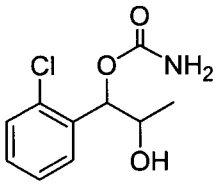
Example 69: Synthesis of 1-(2-chlorophenyl)-(R)-2-hydroxypropyl-(R)-1-carbamate(69)



The substantially same method as described in Example 68 was conducted, except that 1-(2-chlorophenyl)-(R,R)-1,2-propanediol (Preparation Example 15) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol (Preparation example 14) to obtain the title compound (0.77g, yield 16%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J = 6.4Hz, 3H), 2.04(d, J = 4.8Hz, 1H), 4.11~4.18(m, 1H), 4.74(br s, 2H), 6.00(d, J = 5.6Hz, 1H), 7.24~7.43(m, 4H)

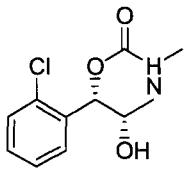
Example 70: Synthesis of 1-(2-chlorophenyl)-2-hydroxypropyl-1-carbamate(70)



The substantially same method as described in Example 68 was conducted, except that 1-(2-chlorophenyl)-(R,R)-1,2-propanediol (Preparation Example 16) was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol (Preparation example 14) to obtain the title compound (0.16g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.24(d, J = 6.4Hz, 3H), 2.04(d, J = 4.8Hz, 1H), 4.11~4.18(m, 1H), 4.74(br s, 2H), 6.00(d, J = 5.6Hz, 1H), 7.24~7.43(m, 4H)

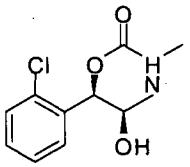
Example 71: Synthesis of 1-(2-chlorophenyl)-(S)-2-hydroxypropyl-(S)-1- N-methylcarbamate(71)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 15, to obtain the title compound (0.70g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.21(d, *J*=6.4Hz, 3H), 2.80(d, *J*=4.8Hz, 3H), 3.12(s, 1H), 4.09~4.16(m, 1H), 4.86(br s, 1H), 5.99(d, *J*= 6.0Hz, 1H), 7.23~7.40(m, 4H)

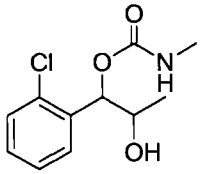
Example 72: Synthesis of 1-(2-chlorophenyl)-(R)-2-hydroxypropyl-(R)-1- N-methylcarbamate(72)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 22, to obtain the title compound (0.69g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.21(d, *J*=6.4Hz, 3H), 2.80(d, *J*=4.8Hz, 3H), 3.12(s, 1H), 4.09~4.16(m, 1H), 4.86(br s, 1H), 5.99(d, *J*= 6.0Hz, 1H), 7.23~7.40(m, 4H)

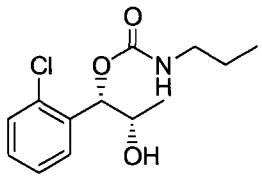
Example 73: Synthesis of 1-(2-chlorophenyl)-2-hydroxypropyl-1- N-methylcarbamate(73)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 29, to obtain the title compound (0.73g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.22(d, *J*=6Hz, 3H), 2.15(d, *J*=4Hz, 1H), 2.81(d, *J*=5Hz, 3H), 4.12(dd, *J*=6Hz, 1H), 4.83(br s, 1H), 6.00(d, *J*=6Hz, 1H), 7.23~7.41(m, 4H)

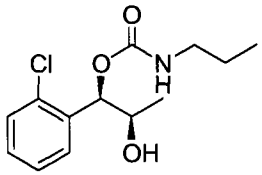
Example 74: Synthesis of 1-(2-chlorophenyl)-(S)-2-hydroxypropyl-(S)-1- N-propylcarbamate(74)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 16, to obtain the title compound (0.15g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.91(t, *J*=7Hz, 3H), 1.22(d, *J*=6Hz, 3H), 1.52(dd, *J*=7Hz, 2H), 2.23(d, *J*=4Hz, 1H), 3.09~3.21(m, 2H), 4.09~4.17(m, 1H), 4.93(s, 1H), 5.99(d, *J*=6Hz, 1H), 7.23~7.47(m, 4H)

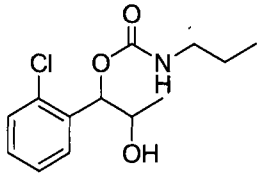
Example 75: Synthesis of 1-(2-chlorophenyl)-(R)-2-hydroxypropyl-(R)-1- N-propylcarbamate(75)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 23, to obtain the title compound (0.04g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.91(t, *J*=7Hz, 3H), 1.22(d, *J*=6Hz, 3H), 1.52(dd, *J*=7Hz, 2H), 2.23(d, *J*=4Hz, 1H), 3.09~3.21(m, 2H), 4.09~4.17(m, 1H), 4.93(s, 1H), 5.99(d, *J*=6Hz, 1H), 7.23~7.47(m, 4H)

Example 76: Synthesis of 1-(2-chlorophenyl)-2-hydroxypropyl-1- N-propylcarbamate(76)

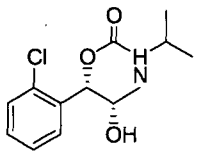


A regioisomer of monocarbamate was separated and purified by conducting the silica gel

column chromatography as described in Example 30, to obtain the title compound (0.15g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.91(t, *J*=7Hz, 3H), 1.22(d, *J*=6Hz, 3H), 1.52(dd, *J*=7Hz, 2H), 2.23(d, *J*=4Hz, 1H), 3.09~3.21(m, 2H), 4.09~4.17(m, 1H), 4.93(s, 1H), 5.99(d, *J*=6Hz, 1H), 7.23~7.47(m, 4H)

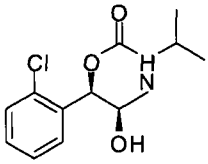
Example 77: Synthesis of 1-(2-chlorophenyl)-(S)-2-hydroxypropyl-(S)-1- N-isopropylcarbamate(77)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 17, to obtain the title compound (0.42g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10(d, *J*=6.0Hz, 3H), 1.15~1.19(m, 6H), 2.41(s, 1H), 3.76~4.08(m, 1H), 4.34(s, 1H), 4.83(br s 1H), 5.95(d, *J*=5.3Hz, 1H), 7.19~7.39(m, 4H)

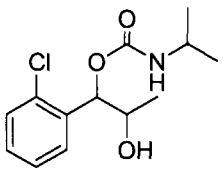
Example 78: Synthesis of 1-(2-chlorophenyl)-(R)-2-hydroxypropyl-(R)-1- N-isopropylcarbamate(78)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 24, to obtain the title compound (0.5g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.13(d, J=6Hz, 3H), 1.20(dd, J=9.2Hz, 6H), 2.23(s, 1H), 3.77~3.82(m, 1H), 4.10(s, 1H), 4.76(br s, 1H), 5.98(d, J=5.6Hz, 1H), 7.23~7.41(m, 4H)

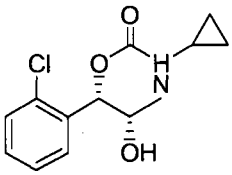
Example 79: Synthesis of 1-(2-chlorophenyl)-2-hydroxypropyl-1- N-isopropylcarbamate(79)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 31, to obtain the title compound (0.09g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.14(d, *J*=6Hz, 3H), 1.21(dd, *J*=6Hz, 6H), 2.16(d, *J*=5Hz, 1H), 3.81(t, *J*=6Hz, 1H), 4.11(d, *J*=5Hz, 1H), 4.73(br s, 1H), 5.98(d, *J*=5Hz, 1H), 7.24~741(m, 4H)

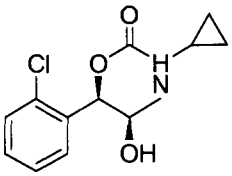
Example 80: Synthesis of 1-(2-chlorophenyl)-(S)-2-hydroxypropyl-(S)-1- N-cyclopropylcarbamate(80)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 18, to obtain the title compound (0.53g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.53~0.60(m, 2H), 0.74(s, 2H), 1.21(d, J=6.0Hz, 3H), 2.19(s, 1H), 2.59(s, 1H), 4.11~4.15(m, 1H), 5.13(br s, 1H), 5.99(d, J=5.20Hz, 1H), 7.23~7.40(m, 4H)

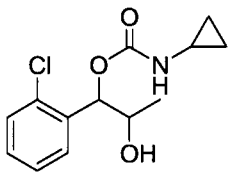
Example 81: Synthesis of 1-(2-chlorophenyl)-(R)-2-hydroxypropyl-(R)-1- N-cyclopropylcarbamate(81)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 25, to obtain the title compound (0.58g, yield 10%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.53~0.60(m, 2H), 0.74(s, 2H), 1.21(d, J=6.0Hz, 3H), 2.19(s, 1H), 2.59(s, 1H), 4.11~4.15(m, 1H), 5.13(br s, 1H), 5.99(d, J=5.20Hz, 1H), 7.23~7.40(m, 4H)

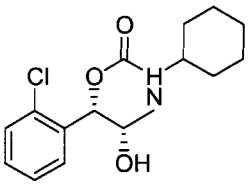
Example 82: Synthesis of 1-(2-chlorophenyl)-2-hydroxypropyl-1- N-cyclopropylcarbamate(82)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 32, to obtain the title compound (0.38g, yield 14%).

^{1}H NMR(400MHz, $CDCl_3$) δ 0.71(s, 2H), 1.19(d, *J*=6Hz, 3H), 2.45(S, 1H), 2.57(S, 1H), 4.08~4.12(m, 1H), 5.26(s, 1H), 5.97(d, *J*=4Hz, 1H), 7.22~7.54(m, 4H)

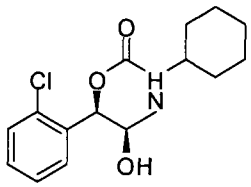
Example 83: Synthesis of 1-(2-chlorophenyl)-(S)-2-hydroxypropyl-(S)-1- N-cyclohexylcarbamate(83)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 19, to obtain the title compound (0.24g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10~1.39(m, 7H), 1.61(s, 3H), 1.71~1.74(m, 2H), 1.87(d, *J*=11.2Hz, 1H), 2.48(d, *J*=10.8Hz, 1H), 3.46(t, *J*=4Hz, 1H), 4.10~4.11(m, 1H), 4.80(br s 1H), 5.97(d, *J*=5.6Hz, 1H), 7.23~7.41(m, 4H)

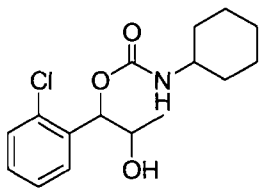
Example 84: Synthesis of 1-(2-chlorophenyl)-(R)-2-hydroxypropyl-(R)-1- N-cyclohexylcarbamate(84)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 26, to obtain the title compound (0.35g, yield 10%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.10~1.39(m, 7H), 1.61(s, 3H), 1.71~1.74(m, 2H), 1.87(d, *J*=11.2Hz, 1H), 2.48(d, *J*=10.8Hz, 1H), 3.46(t, *J*=4Hz, 1H), 4.10~4.11(m, 1H), 4.80(br s 1H), 5.97(d, *J*=5.6Hz, 1H), 7.23~7.41(m, 4H)

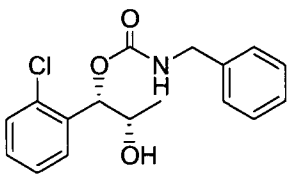
Example 85: Synthesis of 1-(2-chlorophenyl)-2-hydroxypropyl-1- N-cyclohexylcarbamate(85)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 33, to obtain the title compound (0.26g, yield 10%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.12~1.19(m, 3H), 1.22(d, *J*=6Hz, 3H), 1.27~1.37(m, 1H), 1.71(t, J=6Hz, 2H), 1.86~1.88(m, 1H), 1.97~2.00(m, 1H), 2.18(d, *J*=4Hz, 1H), 3.47(S, 1H), 4.12(t, *J*=6Hz, 1H), 4.78(S, 1H), 5.97(d, *J*=6Hz, 1H), 7.23~7.40(m, 4H)

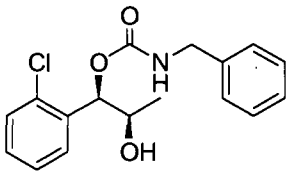
Example 86: Synthesis of 1-(2-chlorophenyl)-(S)-2-hydroxypropyl-(S)-1- N-benzylcarbamate(86)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 20, to obtain the title compound (0.19g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.23(d, *J*=6Hz, 3H), 2.16(d, *J*=4Hz, 1H), 4.12(t, *J*=6Hz, 1H), 4.31~4.44(m, 2H), 5.22(br S, 1H), 6.04(d, *J*=6Hz, 1H), 7.27~7.42(m, 9H)

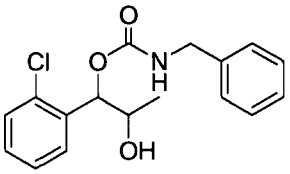
Example 87: Synthesis of 1-(2-chlorophenyl)-(R)-2-hydroxypropyl-(R)-1- N-benzylcarbamate(87)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 27, to obtain the title compound (0.07g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.23(d, *J*=6Hz, 3H), 2.16(d, *J*=4Hz, 1H), 4.12(t, *J*=6Hz, 1H), 4.31~4.44(m, 2H), 5.22(br S, 1H), 6.04(d, *J*=6Hz, 1H), 7.27~7.42(m, 9H)

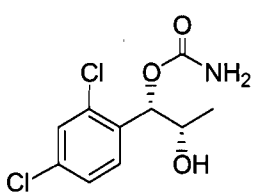
Example 88: Synthesis of 1-(2-chlorophenyl)-2-hydroxypropyl-1- N-benzylcarbamate(88)



A regioisomer of monocarbamate was separated and purified by conducting the silica gel column chromatography as described in Example 34, to obtain the title compound (0.21g, yield 14%).

^{1}H NMR(400MHz, $CDCl_3$) δ 1.23(d, *J*=6Hz, 3H), 2.16(d, *J*=4Hz, 1H), 4.12(t, *J*=6Hz, 1H), 4.31~4.44(m, 2H), 5.22(br S, 1H), 6.04(d, *J*=6Hz, 1H), 7.27~7.42(m, 9H)

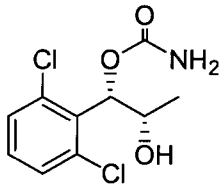
Example 89: Synthesis of 1-(2,4-dichlorophenyl)-(S)-2-hydroxypropyl-(S)-1-carbamate(89)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-propanediol(Preparation example 26)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.05g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.13(d, J = 6.8Hz, 3H), 2.49(d, J = 4.0Hz, 1H), 4.66~4.74(m, 1H), 4.76(br s, 2H), 6.20(d, J = 8.8Hz, 1H), 7.30(d, J=8.4Hz, 1H), 7.39(d, J=2.0Hz, 2H), 7.50(dd, J=8.4Hz, 2.0Hz, 1H)

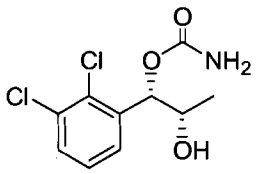
Example 90: Synthesis of 1-(2,6-dichlorophenyl)-(S)-2-hydroxypropyl-(S)-1-carbamate(90)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-propanediol(Preparation example 38)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.07g, yield 24%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.13(d, J = 6.8Hz, 3H), 2.49(d, J = 4.0Hz, 1H), 4.66~4.74(m, 1H), 4.76(br s, 2H), 6.20(d, J = 8.8Hz, 1H), 7.25~7.40(m, 3H)

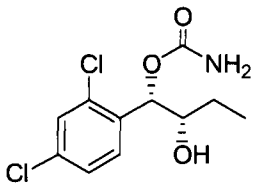
Example 91: Synthesis of 1-(2,3-dichlorophenyl)-(S)-2-hydroxypropyl-(S)-1-carbamate(91)



The substantially same method as described in Example 68 was conducted, except that 1-(2,3-dichlorophenyl)-(S,S)-1,2-propanediol(Preparation example 57)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.08g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, J = 6.4Hz, 3H), 3.66(d, J = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, J = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

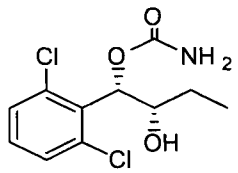
Example 92: Synthesis of 1-(2,4-dichlorophenyl)-(S)-2-hydroxybutyl-(S)-1-carbamate(92)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-butanediol(Preparation example 29)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.07g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.77(t, J = 7.4Hz, 3H), 0.92~1.01(m, 1H), 1.18~1.28(m, 1H), 4.06~4.13(m, 1H), 4.96(d, J = 6.0Hz, 1H), 5.91(d, J = 8.8Hz, 1H), 6.4(br s, 2H), 7.30~7.50(m, 3H)

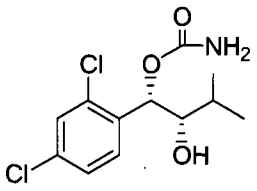
Example 93: Synthesis of 1-(2,6-dichlorophenyl)-(S)-2-hydroxybutyl-(S)-1-carbamate(93)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-butanediol(Preparation example 41)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.11g, yield 29%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.77(t, J = 7.4Hz, 3H), 0.92~1.01(m, 1H), 1.18~1.28(m, 1H), 4.06~4.13(m, 1H), 4.96(d, J=6.0Hz, 1H), 5.91(d, J=8.8Hz, 1H), 6.4(br s, 2H), 7.25~7.40(m, 3H)

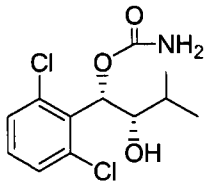
Example 94: Synthesis of 1-(2,4-dichlorophenyl)-(S)-2-hydroxy-3-methyl-butyl-(S)-1-carbamate(94)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol(Preparation example 32)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.01g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.96(d, J=6.0Hz, 1H), 5.91(d, J=8.8Hz, 1H), 6.42(br s, 2H), 7.30~7.50(m, 3H)

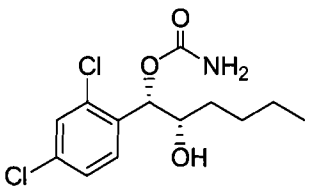
Example 95: Synthesis of 1-(2,6-dichlorophenyl)-(S)-2-hydroxy-3-methyl-butyl-(S)-1-carbamate(95)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-(S,S)-1,2-butanediol(Preparation example 44)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.03g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.96(d, J=6.0Hz, 1H), 5.91(d, J=8.8Hz, 1H), 6.42(br s, 2H), 7.25~7.40(m, 3H)

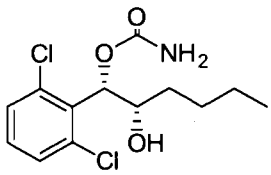
Example 96: Synthesis of 1-(2,4-dichlorophenyl)-(S)-2-hydroxyhexyl-(S)-1-carbamate(96)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-(S,S)-1,2-hexanediol(Preparation example 35)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.21g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, *J*=7.2Hz, 3H), 1.18~1.33(m, 4H), 1.48~1.55(m, 2H), 2.35(d, *J*=4.4Hz, 1H), 4.45~4.50(m, 1H), 4.76(br s, 2H), 6.21(d, *J*=8.4Hz, 1H), 7.30~7.50(m, 3H)

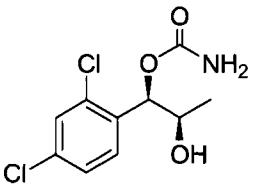
Example 97: Synthesis of 1-(2,6-dichlorophenyl)-(S)-2-hydroxyhexyl-(S)-1-carbamate(97)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-(S,S)-1,2-hexanediol(Preparation example 47)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.06g, yield 29%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, *J* = 7.2Hz, 3H), 1.18~1.33(m, 4H), 1.48~1.55(m, 2H), 2.35(d, *J* = 4.4Hz, 1H), 4.45~4.50(m, 1H), 4.76(br s, 2H), 6.21(d, *J*=8.4Hz, 1H), 7.16~7.34(m, 3H)

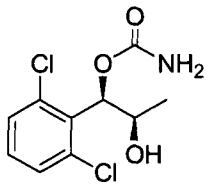
Example 98: Synthesis of 1-(2,4-dichlorophenyl)-(R)-2-hydroxypropyl-(R)-1-carbamate(98)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-propanediol(Preparation example 27)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.04g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.13(d, *J*=6.8Hz, 3H), 2.49(d, *J*=4.0Hz, 1H), 4.66~4.74(m, 1H), 4.76(br s, 2H), 6.20(d, *J*=8.8Hz, 1H), 7.30~7.50(m, 3H)

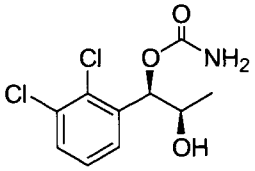
Example 99: Synthesis of 1-(2,6-dichlorophenyl)-(R)-2-hydroxypropyl-(R)-1-carbamate(99)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-propanediol(Preparation example 39)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.09g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.13(d, *J* = 6.8Hz, 3H), 2.49(d, *J* = 4.0Hz, 1H), 4.66~4.74(m, 1H), 4.76(br s, 2H), 6.20(d, *J* = 8.8Hz, 1H), 7.25~7.40(m, 3H)

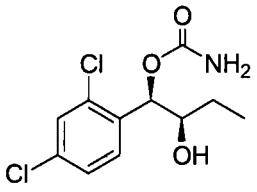
Example 100: Synthesis of 1-(2,3-dichlorophenyl)-(R)-2-hydroxypropyl-(R)-1-carbamate(100)



The substantially same method as described in Example 68 was conducted, except that 1-(2,3-dichlorophenyl)-(R,R)-1,2-propanediol(Preparation example 58)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.25g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, *J* = 6.4Hz, 3H), 3.66(d, *J* = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, *J* = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

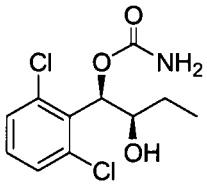
Example 101: Synthesis of 1-(2,4-dichlorophenyl)-(R)-2-hydroxybutyl-(R)-1-carbamate(101)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-butanediol(Preparation example 30)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14), to obtain the title compound (0.08g, yield 10~30%).

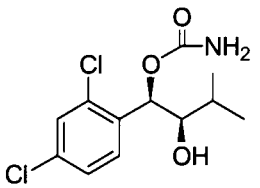
^{1}H NMR(400MHz, $CDCl_3$) δ0.77(t, J = 7.4Hz, 3H), 0.92~1.01(m, 1H), 1.18~1.28(m, 1H), 4.06~4.13(m, 1H), 4.96(d, J = 6.0Hz, 1H), 5.91(d, J = 8.8Hz, 1H), 6.4(br s, 2H), 7.30~7.50(m, 3H)

Example 102: Synthesis of 1-(2,6-dichlorophenyl)-(R)-2-hydroxybutyl-(R)-1-carbamate(102)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-butanediol(Preparation example 42)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.09g, yield 10~30%). ^{1}H NMR(400MHz, $CDCl_3$) δ0.77(t, J = 7.4Hz, 3H), 0.92~1.01(m, 1H), 1.18~1.28(m, 1H), 4.06~4.13(m, 1H), 4.96(d, J = 6.0Hz, 1H), 5.91(d, J = 8.8Hz, 1H), 6.4(br s, 2H), 7.25~7.40(m, 3H)

Example 103: Synthesis of 1-(2,4-dichlorophenyl)-(R)-2-hydroxy-3-methyl-butyl-(R)-1-carbamate(103)

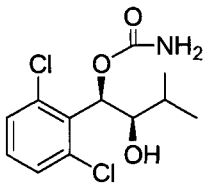


The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-(R,R)-1,2-propanediol(Preparation example 33)was used

instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14), to obtain the title compound (0.01g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, *J* = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.96(d, *J*=6.0Hz, 1H), 5.91(d, *J*=8.8Hz, 1H), 6.42(br s, 2H), 7.30~7.50(m, 3H)

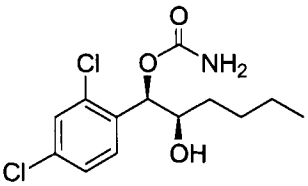
Example 104: Synthesis of 1-(2,6-dichlorophenyl)-(R)-2-hydroxy-3-methyl-butyl-(R)-1-carbamate(104)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-(R,R)-1,2-propanediol(Preparation example 45)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14), to obtain the title compound (0.01g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, *J* = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.96(d, *J*=6.0Hz, 1H), 5.91(d, *J*=8.8Hz, 1H), 6.42(br s, 2H), 7.25~7.40(m, 3H)

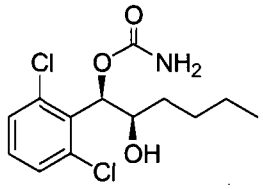
Example 105: Synthesis of 1-(2,4-dichlorophenyl)-(R)-2-hydroxyhexyl-(R)-1-carbamate(105)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-(R,R)-1,2-hexanediol(Preparation example 36)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.21g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, *J*=7.2Hz, 3H), 1.18~1.33(m, 4H), 1.48~1.55(m, 2H), 2.35(d, *J*=4.4Hz, 1H), 4.45~4.50(m, 1H), 4.76(br s, 2H), 6.21(d, *J*=8.4Hz, 1H), 7.30~7.50(m, 3H)

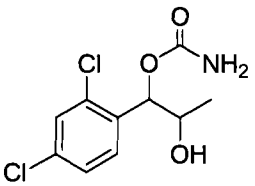
Example 106: Synthesis of 1-(2,6-dichlorophenyl)-(R)-2-hydroxyhexyl-(R)-1-carbamate(106)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-(R,R)-1,2-hexanediol(Preparation example 48)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.12g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, J = 7.2Hz, 3H), 1.18~1.33(m, 4H), 1.48~1.55(m, 2H), 2.35(d, J = 4.4Hz, 1H), 4.45~4.50(m, 1H), 4.76(br s, 2H), 6.21(d, J = 8.4Hz, 1H), 7.16~7.34(m, 3H)

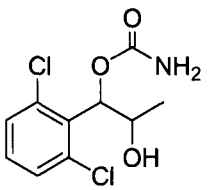
Example 107: Synthesis of 1-(2,4-dichlorophenyl)-2-hydroxypropyl-1-carbamate(107)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-propanediol(Preparation example 28)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.05g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.13(d, J=6.8Hz, 3H), 2.49(d, J=4.0Hz, 1H), 4.66~4.74(m, 1H), 4.76(br s, 2H), 6.20(d, J=8.8Hz, 1H), 7.30~7.50(m, 3H)

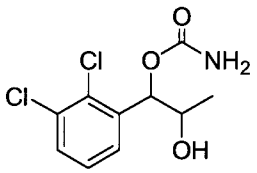
Example 108: Synthesis of 1-(2,6-dichlorophenyl)-2-hydroxypropyl-1-carbamate(108)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-propanediol(Preparation example 40)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.06g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.13(d, J = 6.8Hz, 3H), 2.49(d, J = 4.0Hz, 1H), 4.66~4.74(m, 1H), 4.76(br s, 2H), 6.20(d, J = 8.8Hz, 1H), 7.25~7.40(m, 3H)

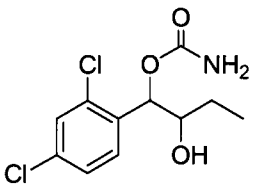
Example 109: Synthesis of 1-(2,3-dichlorophenyl)-(R)-2-hydroxypropyl-(R)-1-carbamate(109)



The substantially same method as described in Example 68 was conducted, except that 1-(2,3-dichlorophenyl)-1,2-propanediol(Preparation example 59)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.02g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.15(d, J = 6.4Hz, 3H), 3.66(d, J = 9.2Hz, 1H), 4.73(br s, 2H), 5.43(t, J = 9.0Hz, 1H), 5.62~5.69(m, 1H), 7.18~7.22(m, 3H),

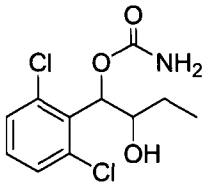
Example 110: Synthesis of 1-(2,4-dichlorophenyl)-2-hydroxybutyl-1-carbamate(110)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-butanediol(Preparation example 31)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.07g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.77(t, J=7.4Hz, 3H), 0.92~1.01(m, 1H), 1.18~1.28(m, 1H), 4.06~4.13(m, 1H), 4.96(d, J=6.0Hz, 1H), 5.91(d, J=8.8Hz, 1H), 6.4(br s, 2H), 7.30~7.50(m, 3H)

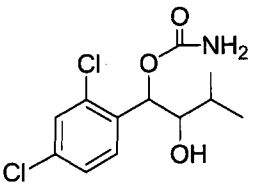
Example 111: Synthesis of 1-(2,6-dichlorophenyl)-2-hydroxybutyl-1-carbamate(111)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-butanediol(Preparation example 43)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.10g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.77(t, J = 7.4Hz, 3H), 0.92~1.01(m, 1H), 1.18~1.28(m, 1H), 4.06~4.13(m, 1H), 4.96(d, J = 6.0Hz, 1H), 5.91(d, J = 8.8Hz, 1H), 6.4(br s, 2H), 7.25~7.40(m, 3H)

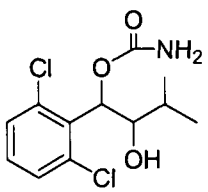
Example 112: Synthesis of 1-(2,4-dichlorophenyl)-2-hydroxy-3-methyl-butyl-1-carbamate(112)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-3-methyl-1,2-propanediol(Preparation example 34)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.04g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.96(d, J=6.0Hz, 1H), 5.91(d, J=8.8Hz, 1H), 6.42(br s, 2H), 7.30~7.50(m, 3H)

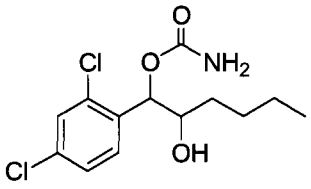
Example 113: Synthesis of 1-(2,6-dichlorophenyl)-2-hydroxy-3-methyl-butyl-1-carbamate(113)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-3-methyl-1,2-propanediol(Preparation example 46)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example14), to obtain the title compound (0.01g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ1.00(t, J = 7.2Hz, 6H), 1.73~1.79(m, 1H), 3.67~3.69(m, 1H), 4.96(d, J=6.0Hz, 1H), 5.91(d, J=8.8Hz, 1H), 6.42(br s, 2H), 7.25~7.40(m, 3H)

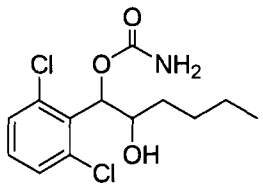
Example 114: Synthesis of 1-(2,4-dichlorophenyl)-2-hydroxyhexyl-1-carbamate(114)



The substantially same method as described in Example 68 was conducted, except that 1-(2,4-dichlorophenyl)-1,2-hexanediol(Preparation example 37)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.21g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, J=7.2Hz, 3H), 1.18~1.33(m, 4H), 1.48~1.55(m, 2H), 2.35(d, J=4.4Hz, 1H), 4.45~4.50(m, 1H), 4.76(br s, 2H), 6.21(d, J=8.4Hz, 1H), 7.30~7.50(m, 3H)

Example 115: Synthesis of 1-(2,6-dichlorophenyl)-2-hydroxyhexyl-1-carbamate(115)



The substantially same method as described in Example 68 was conducted, except that 1-(2,6-dichlorophenyl)-1,2-hexanediol(Preparation example 49)was used instead of 1-(2-chlorophenyl)-(S,S)-1,2-propanediol(Preparation example 14), to obtain the title compound (0.12g, yield 10~30%).

^{1}H NMR(400MHz, $CDCl_3$) δ0.85(t, J = 7.2Hz, 3H), 1.18~1.33(m, 4H), 1.48~1.55(m, 2H), 2.35(d, J = 4.4Hz, 1H), 4.45~4.50(m, 1H), 4.76(br s, 2H), 6.21(d, J = 8.4Hz, 1H), 7.16~7.34(m, 3H)

Compounds 1 to 115 produced in Examples 1 to 115 were summarized in following Tables 1 and 2.

(Table 1) Compounds 1 to 67 having the structure of Chemical Formula 1 where 'A' is a carbamoyl derivative and 'B' is H

No.	X	n (position)	1st Chiral	2nd Chiral	R^1	A	B
						A = carbamoyl derivative R^2 =	B = H
1	Cl	1(2-)	S	S	Me	H	H
2	Cl	1(2-)	R	R	Me	H	H
3	Cl	1(2-)	Rac.	Rac.	Me	H	H
4	Cl	1(2-)	S	R	Me	H	H
5	Cl	1(2-)	R	S	Me	H	H
6	Cl	1(2-)	S	S	Et	H	H
7	Cl	1(2-)	R	R	Et	H	H
8	Cl	1(2-)	Rac.	Rac.	Et	H	H
9	Cl	1(2-)	S	S	Isopropyl	H	H
10	Cl	1(2-)	R	R	Isopropyl	H	H
11	Cl	1(2-)	Rac.	Rac.	Isopropyl	H	H
12	Cl	1(2-)	S	S	butyl	H	H
13	Cl	1(2-)	R	R	butyl	H	H
14	Cl	1(2-)	Rac.	Rac.	butyl	H	H
15	Cl	1(2-)	S	S	Me	Me	H
16	Cl	1(2-)	S	S	Me	Propyl	H
17	Cl	1(2-)	S	S	Me	Isopropyl	H
18	Cl	1(2-)	S	S	Me	Cyclopropyl	H
19	Cl	1(2-)	S	S	Me	Cyclohexyl	H
20	Cl	1(2-)	S	S	Me	Benzyl	H
21	Cl	1(2-)	S	S	Me	Bicyclo[2.2.1]heptane	H
22	Cl	1(2-)	R	R	Me	Me	H
23	Cl	1(2-)	R	R	Me	Propyl	H
24	Cl	1(2-)	R	R	Me	Isopropyl	H
25	Cl	1(2-)	R	R	Me	Cyclopropyl	H
26	Cl	1(2-)	R	R	Me	Cyclohexyl	H
27	Cl	1(2-)	R	R	Me	Benzyl	H
28	Cl	1(2-)	R	R	Me	Bicyclo[2.2.1]heptane	H
29	Cl	1(2-)	Rac.	Rac.	Me	Me	H
30	Cl	1(2-)	Rac.	Rac.	Me	Propyl	H
31	Cl	1(2-)	Rac.	Rac.	Me	Isopropyl	H
32	Cl	1(2-)	Rac.	Rac.	Me	Cyclopropyl	H
33	Cl	1(2-)	Rac.	Rac.	Me	Cyclohexyl	H
34	Cl	1(2-)	Rac.	Rac.	Me	Benzyl	H
35	Cl	1(2-)	Rac,	Rac.	Me	Bicyclo[2.2.1]heptane	H
36	Cl	2(2,4-)	S	S	Me	H	H
37	Cl	2(2,6-)	S	S	Me	H	H

38	Cl	2(2,3-)	S	S	Me	H	H
39	Cl	2(2,4-)	S	S	Et	H	H
40	Cl	2(2,6-)	S	S	Et	H	H
41	Cl	2(2,4-)	S	S	Isopropyl	H	H
42	Cl	2(2,6-)	S	S	Isopropyl	H	H
43	Cl	2(2,4-)	S	S	butyl	H	H
44	Cl	2(2,6-)	S	S	butyl	H	H
45	Cl	2(2,4-)	R	R	Me	H	H
46	Cl	2(2,6-)	R	R	Me	H	H
47	Cl	2(2,3-)	R	R	Me	H	H
48	Cl	2(2,4-)	R	R	Et	H	H
49	Cl	2(2,6-)	R	R	Et	H	H
50	Cl	2(2,4-)	R	R	Isopropyl	H	H
51	Cl	2(2,6-)	R	R	Isopropyl	H	H
52	Cl	2(2,4-)	R	R	butyl	H	H
53	Cl	2(2,6-)	R	R	butyl	H	H
54	Cl	2(2,4-)	Rac,	Rac.	Me	H	H
55	Cl	2(2,6-)	Rac,	Rac.	Me	H	H
56	Cl	2(2,3-)	Rac,	Rac.	Me	H	H
57	Cl	2(2,4-)	Rac,	Rac.	Et	H	H
58	Cl	2(2,6-)	Rac,	Rac.	Et	H	H
59	Cl	2(2,4-)	Rac,	Rac.	Isopropyl	H	H
60	Cl	2(2,6-)	Rac,	Rac.	Isopropyl	H	H
61	Cl	2(2,4-)	Rac,	Rac.	butyl	H	H
62	Cl	2(2,6-)	Rac,	Rac.	butyl	H	H
63	F	1(2-)	S	S	Me	H	H
64	F	1(2-)	R	R	Me	H	H
65	I	1(2-)	S	S	Me	H	H
66	I	1(2-)	R	R	Me	H	H
67	I	1(2-)	S	S	Et	H	H

(Table 2) Compounds 68 to 115 having the structure of Chemical Formula 1 where 'A' is H and 'B' is a carbamoyl derivative

No.	X	n (position)	1st Chiral	2nd Chiral	R^1	A	B
						A=H	B= carbamoyl derivative R^3=
68	Cl	1(2-)	S	S	Me	H	H
69	Cl	1(2-)	R	R	Me	H	H
70	Cl	1(2-)	Rac.	Rac.	Me	H	H
71	Cl	1(2-)	S	S	Me	H	Me
72	Cl	1(2-)	R	R	Me	H	Me
73	Cl	1(2-)	Rac.	Rac.	Me	H	Me
74	Cl	1(2-)	S	S	Me	H	Propyl
75	Cl	1(2-)	R	R	Me	H	Propyl
76	Cl	1(2-)	Rac.	Rac.	Me	H	Propyl
77	Cl	1(2-)	S	S	Me	H	Isopropyl
78	Cl	1(2-)	R	R	Me	H	Isopropyl
79	Cl	1(2-)	Rac.	Rac.	Me	H	Isopropyl
80	Cl	1(2-)	S	S	Me	H	Cyclopropyl
81	Cl	1(2-)	R	R	Me	H	Cyclopropyl
82	Cl	1(2-)	Rac.	Rac.	Me	H	Cyclopropyl
83	Cl	1(2-)	S	S	Me	H	Cyclohexyl

84	Cl	1(2-)	R	R	Me	H	Cyclohexyl
85	Cl	1(2-)	Rac.	Rac.	Me	H	Cyclohexyl
86	Cl	1(2-)	S	S	Me	H	Benzyl
87	Cl	1(2-)	R	R	Me	H	Benzyl
88	Cl	1(2-)	Rac.	Rac.	Me	H	Benzyl
89	Cl	2(2,4-)	S	S	Me	H	H
90	Cl	2(2,6-)	S	S	Me	H	H
91	Cl	2(2,3-)	S	S	Me	H	H
92	Cl	2(2,4-)	S	S	Et	H	H
93	Cl	2(2,6-)	S	S	Et	H	H
94	Cl	2(2,4-)	S	S	Isopropyl	H	H
95	Cl	2(2,6-)	S	S	Isopropyl	H	H
96	Cl	2(2,4-)	S	S	Butyl	H	H
97	Cl	2(2,6-)	S	S	Butyl	H	H
98	Cl	2(2,4-)	R	R	Me	H	H
99	Cl	2(2,6-)	R	R	Me	H	H
100	Cl	2(2,3-)	R	R	Me	H	H
101	Cl	2(2,4-)	R	R	Et	H	H
102	Cl	2(2,6-)	R	R	Et	H	H
103	Cl	2(2,4-)	R	R	Isopropyl	H	H
104	Cl	2(2,6-)	R	R	Isopropyl	H	H
105	Cl	2(2,4-)	R	R	Butyl	H	H
106	Cl	2(2,6-)	R	R	Butyl	H	H
107	Cl	2(2,4-)	Rac.	Rac.	Me	H	H
108	Cl	2(2,6-)	Rac.	Rac.	Me	H	H
109	Cl	2(2,3-)	Rac.	Rac.	Me	H	H
110	Cl	2(2,4-)	Rac.	Rac.	Et	H	H
111	Cl	2(2,6-)	Rac.	Rac.	Et	H	H
112	Cl	2(2,4-)	Rac.	Rac.	Isopropyl	H	H
113	Cl	2(2,6-)	Rac.	Rac.	Isopropyl	H	H
114	Cl	2(2,4-)	Rac.	Rac.	Butyl	H	H
115	Cl	2(2,6-)	Rac.	Rac.	Butyl	H	H

Biological Experimental Example I : Measurement of Anti-epilepsy activity

In the MES test(Ref., G. Villetti et al. Neuropharmacology 40(2001) 866-878), an electrical stimulus(mice; 50mA, 60Hz, 0.2sec and rats; 150mA 60Hz, 0.2sec in the test animal) supplied by 11A Shocker(IITC Life Science Company) was delivered through corneal electrodes. All mice or rats assigned to any electroshock at peak time were treated with each test compound sample which was dissolved in 30% PEG400 prepared by saline solvent applied to oral before the test. If the test animal stretching their hind limb in a straight line weren't observed in the MES test, the results indicate that the test sample had an anti-epilepsy activity. Three doses of the test sample were administered orally to over 18 mice (6 mice per dose) for evaluating the respective doses at which 50% of the animals are protected from seizure (ED50). The value of ED50 (median effective dose) is calculated by Litchfield and Wicoxon log-probit method which is a dose-response relationship. Then, the test results are shown in following Table 3.

Experimental animal, male ICR mice and male SD rats, were purchased from OrientBio or Nara biotech, Korea, and housed 4-5 mice per a cage for 4-5 days. The range of mice body weight was used between 19 and 26 grams and range of rats body weight was used between 100 and 130 grams.

Biological Experimental Example II: Measurement of Anti-epilepsy activity through scPTZ

In this experiment, each test compound sample was formulated as described in Biological Experimental Example I, and administered intraperitoneally to test animals (mice; ICR or Rat; SD); Experimental animal, male ICR mice and male SD rats, were purchased from OrientBio or Nara biotech, Korea, and housed 4-5 mice per a cage for 4-5 days. The range of mice body weight was used between 19 and 26 grams and range of rats body weight was used between 100 and 130 grams. After Peak time (0.5, 1, 2 and 4hr) from the administration, PTZ(Pentylenetetrazol) was administered subcutaneously in the concentration capable of inducing 97% intermittent convulsions (mice: 100~110mg/kg•bw, 10㎕/g, or rats: 90~110 mg/kg•bw, 2㎕/g). If clonic seizure was not observed for at least 3 seconds in the PTZ administered animal, it can be considered that the test compound has anti-epilepsy activity. The median effective dose (ED50) is determined using 6 animals per a concentration (total three different concentrations), and calculated by Litchfield and Wicoxon log-probit method which is a dose-response relationship. The obtained results are shown in following Table 3.

Biological Experimental Example III: Measurement of Neurotoxicity

The measurement of neurotoxicity of the test compounds was conducted by the method of Dunham and Miya [Dunham, N.W. and Miya, T.S. 1957. A note on a simple apparatus for detecting neurological deficit in rats and mice. J.Am.Pharm.Assoc. (Baltimore) 46: 208-209]. In the method, motor abilities of the test animals can be determined by observing whether the test animals can walk without falling from a rotator, thereby determining the value of neurotoxicity of each compound. Term "TD50" means the respective dose of the test compound at which 50% of the test animal exhibit neurotoxicity. They were pre-trained on the rotarod (Rotarod; Columbus instrument, rota-max, USA) at 6 rpm for 5 min 24 hr prior to the test. The peak time was determined by administration test material's random dose for 0.5, 1, 2, 4 hour. To evaluate the minimal neurotoxicity of the compound, the mice were placed on the

Rotarod (rod circle; 3Cm) at 6rpm and the test animal fails to maintain walking once or more during 1 minute, it can be regarded that the test animal exhibits neurotoxicity. The ratio of TD50 to ED50 (TD50/ED50) is called as a protective index, and useful as a parameter for comparison of pharmaceutical efficacy and neurotoxicity. The obtained results are shown in following Table 3.

[Statistical Analysis]

The obtained results are shown as mean±sem. The difference between the groups was statistically analyzed by ANOVA, and then, further examined by Dunnett's test or Bonferroni test. If p is less than 0.05, it was determined that the difference between the groups had statistical significance.

(Table 3) Measurement results of anti-epilepsy activity of compounds in the test animals (Mice and Rats)

Compound No.	MES test(po)		ScPTZ test(ip)		TD50 (mg/kg po)	PI(TD50/ ED50 in MES)
	ED50(mg/kg)	Peak Time(h)	ED50(mg/kg)	Peak Time(h)		
1	13.0	2	15.8	2	218.1	16.8
2	51.0	0.25	38.8	0.5	372.0	7.3
3	31.4	2	15.3	0.5	378.3	12.0
4	82.4	0.5				
5	84.1	0.5	15.0	0.5	275.2	3.3
6	22.2	1	17.9	0.5		
8	100 [a](100%)					
9	67.1	0.5				
12	100 [a](75%)					
13	200 [a](75%)					
14	200 [a](100%)					
15	100 [a](75%)					
16	200 [a](25%)					
18	200 [a](100%)					
23	200 [a](25%)					
25	200 [a](25%)					
29	200 [a](75%)					
30	200 [a](25%)					
31	200 [a](25%)					
32	200 [a](100%)					
36	82.8					
37	25.8	0.25	25.7	0.25	131.6	5.1
38	91.4	2				
39	41.2	1	24.3	0.5		
40	46.9					
42	35.2	0.5				
43	100 [a](25%)					
44	100 [a](75%)					
45	200 [a](0%)					

46	35.2	1				
63	50[a](100%)					
65	50[a](100%)					
67	100[a](100%)					

a: Injection amount(mg/kg), Protection%(4 mice);

b: Injection amount(mg/kg), Protection%(6 Rats);

Biological Experimental Example IV: Measurement of pharmaceutical efficacy duration time through MES

The ED50 values according to time were measured in the test animals (mice and rats) after oral administration of test compound 1 as described in Biological Experimental Example I. The obtained results are shown in following Table 4 and Fig. 1.

(Table 4) Duration of MES test ED50(mg/kg), (po)

No	species	Time								
		0.25h	0.5h	1h	2h	3h	4h	6h	8h	12h
1	Mouse	21.2	22.5	13.3	13.0	14.7	18.7	30.0	49.4	118.8
	Rat	-	5.9	3.3	1.4	-	6.9	-	14.4	36.1

As shown in Table 4 and Fig. 1, the test compound 1 exhibits the efficacy duration time of at least 12 hours in both of the tested rats and mice.

Biological Experimental Example V: Measurement of pharmaceutical efficacy duration time through scPTZ

The ED50 values according to time were measured in the test animals (mice and rats) after intraperitoneal administration of test compound 1 as described in Biological Experimental Example II. The obtained results are shown in following Table 5 and Fig. 2.

(Table 5) Duration of scPTZ test ED50(mg/kg), (ip)

No	species	Time						
		0.5h	1h	2h	4h	6h	8h	12h
1	Mouse	17.3	16.9	15.8	27.4	52.2	80.7	201.1
	Rat	18.9	14.5	21.0	31.0	-	41.3	76.7

As shown in Table 5 and Fig. 2, the test compound 1 exhibits the efficacy duration time of at least 12 hours in both of the tested rats and mice.

As the pharmaceutical efficacy duration time of a drug is longer, the administration number of the drug becomes decreased, thereby increasing the administration convenience of a patient. Such advantages may be particularly preferable for a patient suffered from a disease

that requires long term administration of a drug, such as epilepsy. In addition, the decrease of the administration number may be profitable in economic aspect and helpful to increase the quality of life of the patient.

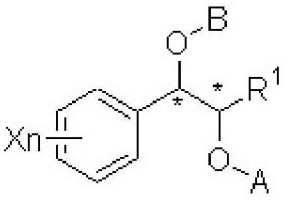
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The claims defining the invention are as follows:

1. A use of a phenyl carbamate compound represented by Chemical Formula 1 or a pharmaceutically acceptable salt thereof in manufacturing a medicament for treating epilepsy:

[Chemical formula 1]

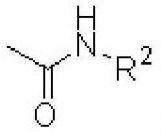


wherein the relative configuration at the carbon atoms bearing an asterisk (*) is (S);

X is a chlorine, fluorine or iodine;

n is 1 or 2;

R^1 is a methyl group;

A is a carbamoyl derivative represented by ;

B is hydrogen;

and

R^2 is selected from the group consisting of hydrogen, a linear or branched alkyl group of C_1-C_4, a cycloalkyl group of C_3-C_8, and benzyl group.

2. The use according to Claim 1, wherein the compound is selected from the group consisting of:

1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate,

1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-methylcarbamate,

1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-propylcarbamate,

1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-isopropylcarbamate,

1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-cyclopropylcarbamate,

1-(2-chlorophenyl)-(S)-1-hydroxypropyl-(S)-2-N-cyclohexylcarbamate,

1-(2-fluorophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate, and

1-(2-iodophenyl)-(S)-1-hydroxypropyl-(S)-2-carbamate.

Fig. 1

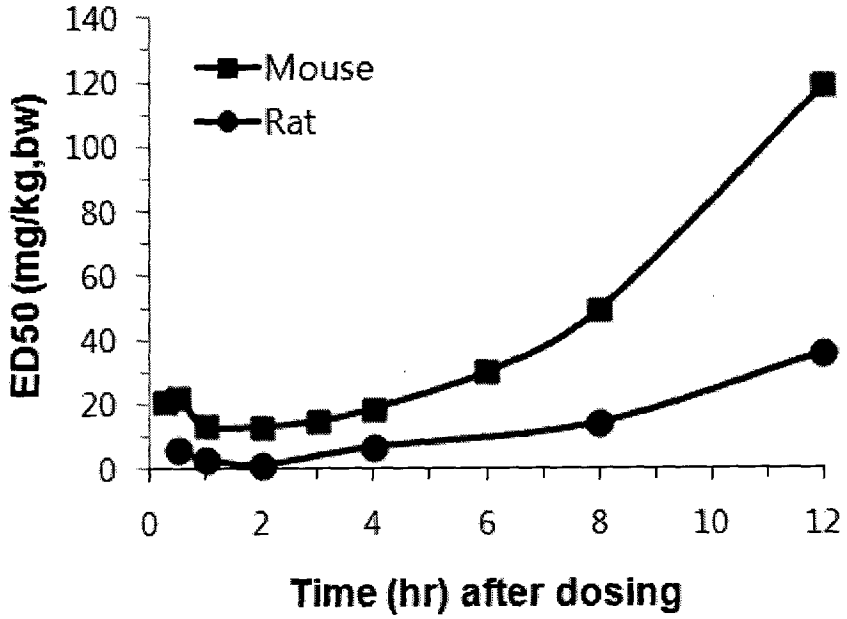
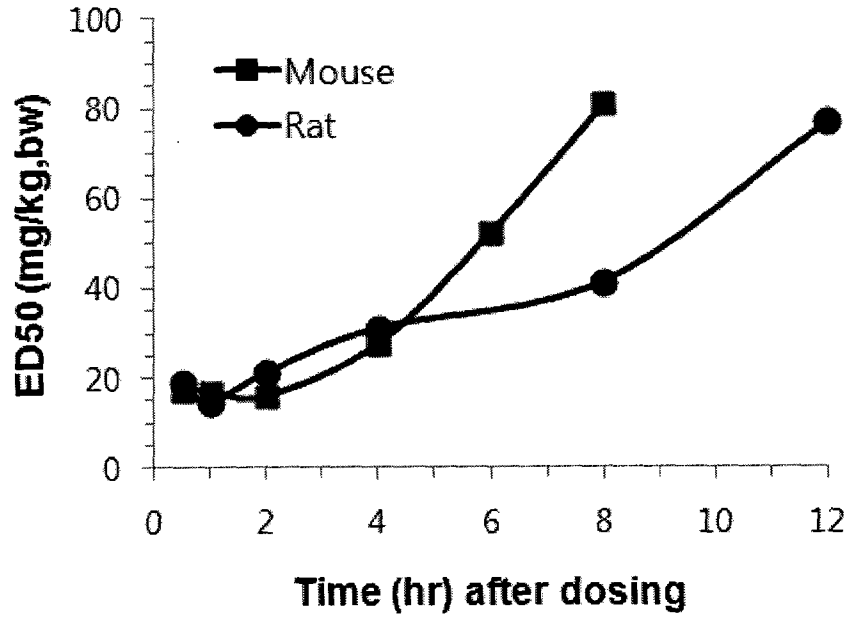

140
120
100
80
60
40
20
0
ED50 (mg/kg,bw)
Mouse
Rat
0
2
4
6
8
10
12
Time (hr) after dosing

Fig. 2


100
80
60
40
20
0
ED50 (mg/kg,bw)
Mouse
Rat
0
2
4
6
8
10
12
Time (hr) after dosing