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(54) Production of optically active sphingoid compound

Herstellung von einer optisch-aktiven Sphingoid-Verbindung

Préparation d'un composé sphingoide optiquement actif

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(56) References cited:
EP-A- 0 146 810
EP-A- 0 189 878
EP-A- 0 472 336
EP-A- 0 845 534
WO-A-95/34525

- **ABE, AKIRA ET AL: "A novel enzyme that catalyzes the esterification of N-acetylsphingosine. Metabolism of C2-ceramides" J. BIOL. CHEM. (1996), 271(24), 14383-14389 , XP002116086**

EP 0 869 185 B9

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method for producing an optically active sphingoid compound.

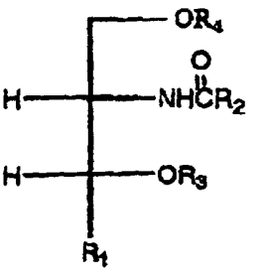
Description of the Related Art

[0002] Optically active sphingoid compounds having optically active erythro amino alcohol moiety have been used in cosmetics and medical supplies for treatment of hair and skin or production intermediates thereof.

[0003] Conventionally, these compounds are extracted and separated mainly from epidermis tissue of animals such as cows and pigs, alternatively obtained by several synthetic steps.However, they are expensive and a stable supply thereof is difficult since the production amount is limited. Therefore, a a further provision of a convenient method for producing the said compound has been desired. EP0189878, EP 0765857 and EP 0845534 disclose the preparation of optically active compounds by means of stereoselective enzymes. However, none of these compounds are structurally related to sphingoid derivatives.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide: a method for producing an optically active erythro sphingoid ester of the formula I:

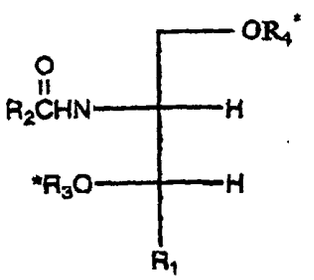


wherein R_1 and R_2 may be the same or different and represent an aliphatic hydrocarbon having 7 to 31 carbon atoms which may be substituted by one or more hydroxyl groups, and

R_3 and R_4 may be the same or different and represent an acyl group having 1 to 7 carbon atoms,

which comprises:

allowing a racemic mixture comprising the optically active erythro sphingoid ester of the formula I as defined above and its enantiomer to contact with an esterase having the ability to selectively hydrolyze the said enantiomer of the optically active erythro sphingoid ester of the formula I to produce an optically active erythro sphingoid alcohol compound of the formula II:



wherein R_1 and R_2 have the same meaning as defined above, and

R_3 and R_4 represent a hydrogen atom and an acyl group having 1 to 7 carbon atoms provided that R_3* and R_4*

do not simultaneously represent an acyl group having 1 to 7 carbon atoms; and
recovering the optically active erythro sphingoid ester of the formula I.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0005] Next, a description will be made to the racemic mixture comprising the optically active erythro sphingoid ester compound of the formula I as defined above and its enantiomer represented by the formula II as defined above.

[0006] Examples of the aliphatic hydrocarbon having 7 to 31 carbon atoms which may be substituted by one or more hydroxyl groups, represented by R_1 and R_2, for example, include:

a liner or branched alkyl group having 7 to 31 carbon atoms which may be substituted by one or more hydroxyl groups,
a liner or branched alkenyl group having 7 to 31 carbon atoms which has one or more double bonds and may be substituted by one or more hydroxyl groups,

[0007] A liner or branched alkyl group having 7 to 31 carbon atoms which may be substituted by one to three hydroxyl groups, a liner or branched alkenyl group having 7 to 31 carbon atoms which has one to three double bonds and may be substituted by one to three hydroxyl groups, are preferred.

[0008] Among the aliphatic hydrocarbon having 7 to 31 carbon atoms which may be substituted by one or more hydroxyl groups, for R_1 and R_2, the aliphatic hydrocarbon having 7 to 26 carbon atoms which may be substituted by one or more hydroxyl groups are preferred.

[0009] Specific examples of the above-described preferred alkyl or alkenyl groups include:

a heptyl group, tridecyl group, tetradecyl group, pentadecenyl group, hexadecyl group, heptadecyl group, octadecyl group, nonadecyl group, eicosyl group, heneicosyl group, docosyl group, tricosyl group, tetracosyl group, pentacosyl group, hexacosyl group, heptacosyl group, octacosyl group, nonacosyl group, tracontyl group, hentriacontyl group, 1-tridecenyl group, 1-tetradecenyl group, 1-pentadecenyl group, 1-hexadecenyl group, 1-heptadecenyl group, 1-octadecenyl group, 1-nonadecenyl group, 1-eicosenyl group, 1-hydroxytetradecyl group, 1-hydroxypentadecyl group, 1-hydroxthexadecyl group, 1-hydroxtheptadecyl group, 1-hydroxyoctadecyl group, 1-hydroxynondecyl group, 1-hydroxyeicosyl group, 1-hydroxtheneicosyl group, 1-hydroxydocosyl group, 1-hydroxytricosyl group, 1-hydroxytetracosyl group, 1-hydroxypentacosyl group, 1-hydroxyhexacosyl group, 1-hydroxyheptacosyl group, 12-methyl-tridecyl group, 14-methy-1-pentadecenyl group, 14-methyl-heptadecyl group and the like.

[0010] Examples of the acyl group having 1 to 7 carbon atoms for R_3 and R_4 include an alkylcarbonyl group having 2 to 7 carbon atoms.

[0011] Specific examples of the acyl group include an acetyl group, propionyl group, butyryl group.

[0012] An acetyl group is more preferred.

[0013] Specific examples of the racemic erythro sphingoid ester include:

N-heptadecanoyl-1,3-O,O-diacetyl-2-amino-4-hexadecene-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-aminohexadecane-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecene-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-aminooctadecane-1,3,4-triol,
N-heptadecanoyl-1, 3-O,O-diacetyl-2-aminoeicosane-1, 3-diol,
N-heptadecanoyl-1,3-O,O-dibutyryl-2-aminoeicosane-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-aminoheptacosane-1 ,3-diol,
N-octadecanoyl-1,3-O,O-diacetyl-2-amino-15-methylhexadecane-1,3-diol,
N-octadecanoyl-1,3-O,O-diacetyl-2-aminohexadecane-1,3-diol,
N-octadecanoyl-1, 3.-O,O-dibutyryl-2-aminohexadecane-1 , 3-diol,
N-octadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecene-1,3-diol,
N-octadecanoyl-1,3-O,O-diacetyl-2-aminooctadecane-1,3,4-triol,
N-octadecanoyl-1,3-O,O-diacetyl-2-aminoeicosane-1,3-diol,
N-octadecanoyl-1,3-O,O-dibutyryl-2-aminoheptacosane-1,3-diol,
N-2'-hydroxyoctadecanoyl-1 ,3-O,O-diacetyl-2-amino-15 methylhexadecane-1,3-diol,
N-2'-hydroxyhexadecanoyl-1,3-O,O-diacetyl-2-aminohexadecane-1,3-diol,
N-2'-hydroxyhexadecanoyl-1,3-O,O-dibutyryl-2-aminohexadecane-1,3-diol,
N-2 '-hydroxyeicosanoyl-1, 3-O,O-diacetyl-2-amino-4-octadecene-1,3-diol,
N-2'-hydroxyeicosanoyl-1,3-O,O-diacetyl-2-aminooctadecane-1,3,4-triol,

N-2'-hydroxytetracosanoyl-1,3-O,O-diacetyl-2-aminoeicosane-1,3-diol,
N-2'-hydroxyhexacosanoyl-1,3-O,O-dibutyryl-2-aminoheptacosane-1,3-diol,
N-docosanoyl-1,3-O,O-dibutyryl-2-amino-15-methyhexadecane-1,3-diol,
N-tetracosanoyl-1,3-O,O-diacetyl-2-aminohexadecane-1,3-diol,
N-hexacasanoyl-1,3-O,O-dibutyryl-2-aminohexadecane-1,3-diol,
N-methyloctadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecene-1,3-diol,
N-pentacosanoyl-1,3-O,O-diacetyl-2-amino-4-docosene-1,3-diol,
N-pentacosanoyl-1, 3-O,O-diacetyl-2-amino-4-octadeaeme-1,3-diol,
N-pentacosanoyl-1,3-O,O-diacetyl-2-aminoeicosane-1,3-diol. These sphingoid esters can be obtained, for example, by a method disclosed by T. Kolter et al.

(Tetrahedron, 50, p.13425 (1994)).

[0014] The esterase includes an esterase, protease and the like in addition to a narrowly-defined lipase, and may be derived from animals such as hogs, human and the like, derived from plants such as ricinus, or derived from microorganisms belonging *to Aspergillus, Candida*, *Fusarium, Geotrichum, Mucor, Nocardia, Penicillium, Rhizopus, Saccharomyces, Acromobacter, Acinetobacter, Alcaligenes, Chromobacterium, Escherichia, Pseudomonas, Sphingomonas, Bacillus, Burkholderia, Moraxella, Lactobacillus, Staphylococcus, Serratia, Yarrowia* .

[0015] An esterase produced by a transformed host organism, into which an isolated gene of the esterase is introduced by using recombinant DNA technology, can be used in the present invention.

[0016] As the host organism, an organism belonging to the same genus or a host organism belonging to the different genus can be used.

[0017] As a more specific example of the esterase, a protein having an amino acid sequence represented by SEQUENCE ID NO: 1 or a sequence in which one or more amino acids in the amino acid sequence are added, deleted or substituted, is listed..

[0018] A microorganism (*E. coli* JM 109/pAL 612 strain) producing the protein having the amino acid sequence represented by SEQUENCE ID NO: 1 has been deposited as FERM-BP5740 (accepted date: November 7, 1996) under the Budapest Treaty at the Ministry of International Trade and Industry, Agency of Industrial Science and Technology, National Institute of Biochemical and Human-Technology.

[0019] The esterase may be used in the form of a microorganism containing the same or a cell culture, however, it may also be separated from the culture or tissue containing the esterase and utilized in the form of a crude enzyme, purified enzyme, if necessary.

[0020] These crude enzyme, purified enzyme and the like can be prepared by a conventional method such as, for example,

(1) ultrasonic treatment,
(2) grinding treatment using glass beads or alumina,
(3) French press treatment,
(4) treatment with an enzyme such as lysozyme and the like,
(5) bacteria, cell, tissue or the like is ground by Waring blender treatment and the like,
(6) the resulted ground material is salted out using ammonium sulfate,
(7) precipitation by an organic solvent or an organic polymer such as polyethylene glycol,
(8) various chromatographies such as ion exchange chromatography, hydrophobic chromatography, gel filtration chromatography, affinity chromatography, and
(9) electrophoresis and the like.

[0021] The esterase may be insolubilized by a immobilization such as a carrier binding method in which the esterase is bound to a carrier by a covalent bond, ion bond, adsorption and the like, an entrapment method in which the esterase is confined in gel structure.

[0022] The reaction is usually carried out from about 20°C to about 70°C, preferably from about 25°C to about 40°C. The reaction is preferably conducted in a two-layer system comprising an organic solvent which dissolves the sphingoid ester compound of the formula I as defined above and its enantiomer and a buffer solution which dissolves the above-described esterase.

[0023] Examples of the organic solvent include, for example, decane.

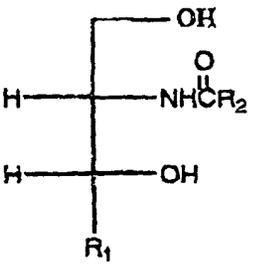
[0024] Examples of the buffer solution include a usual buffer solution having pH of 5 to 8.

[0025] The reaction time can be optionally set, for example, from about 1 hour to 1 week.

[0026] For recovery of the optically active erythro sphingoid ester of the formula I from the reaction solution, conventional methods such as, for example, solvent extraction, fractional distillation, column chromatography and the like

may be used, and optionally, these methods may also be appropriately combined for use, if necessary.

[0027] The optically active erythro sphingoid ester of the formula I as defined above can be allowed to react with either an acid or a base to effect a hydrolysis reaction by a conventional method to obtain an optically active erythro sphingoid alcohol of the formula I':



wherein R_1 and R_2 are the same as defined for the formula I above.

[0028] Examples of thus obtained optically active erythro sphingoid alcohols includes optically active erythro isomers of the following compounds such as:

N-heptadecanoyl-2-amino-4-hexadecene-1,3-diol,
N-heptadecanoyl-2-aminohexadecane-1,3-diol,
N-heptadecanoyl-2-amino-4-octadecene-1, 3-diol,
N-heptadecanoyl-2-aminooctadecane-1,3,4-triol,
N-heptadecanoyl-2-aminoeicosane-1,3-diol,
N-heptadecanoyl-2-aminoeicosane-1, 3-diol,
N-heptadecanoyl-2-aminoheptacosane-1,3-diol,
N-octadecanoyl-2-amino-15-methylhexadecane-1,3-diol,
N-octadecanoyl-2-aminohexadecane-1,3-diol,
N-octadecanoyl-2-amino-4-octadecene-1,3-diol,
N-octadecanoyl-2-aminooctadecane-1,3,4-triol,
N-octadecanoyl-2-aminaeicoBane-1,3-diol,
N-octadecanoyl-2-aminoheptacosane-1,3-diol,
N-2'-hydroxyoctadecanoyl-2-amino-15-methylhexadecane-1,3-diol,
N-2'-hydroxyhexadecanoyl-2-aminohexadecane-1,3-diol,
N-2'-hydroxyeicosanoyl-2-amino-4-octadecene-1,3-diol,
N-2'-hydroxyeicosanoyl-2-aminooctadecane-1,3,4-triol,
N-2'-hydroxytetracosanoyl-2-aminoeicosane-1,3-diol,
N-2 '-hydroxyhexaconoyl-2-aminoheptacosane-1, 3-diol
N-docosanoyl-2-amino-15-methyhexadecane-1,3-diol,
N-tetracosanoyl-2-aminohexadecane-1,3-diol,
N-hexacosanoyl-2-aminohexadecane-1,3-diol,
N-methyloctadecanoyl-2-amino-4-octadecene-1,3-diol,
N-pentacosanoyl-2-amino-4-docosene-1,3-diol,
N-pentacosanoyl-2-amino-4-octadecene-1,3-diol,
N-pentacosanoyl-2-aminoeicosane-1,3-diol.

EXAMPLE

[0029] The following examples further illustrate the present invention in detail, but they are not to be construed to limit the scope thereof.

Example 1

[0030] To a mixed solution of 10 ml decane and 100 ml of **a** phosphate buffer solution were added 1.03 g of racemic erythro-3-acetoxy-2-stearoylaminohexadecyl acetate and 50 mg of an esterase prepared in Reference Example 1 below, and the resulted mixture was reacted by stirring at 30°C. The reaction was traced by TLC [silica gel, hexane : ethyl acetate (2:1), chloroform : methanol (15:1)].

[0031] The reaction was continued for 2 days, and then, the reaction solution was diluted with ethyl acetate, and then extracted with chloroform. The recovered organic solvent layer was washed with salt water, then, dried over anhydrous sodium sulfate, and the filtered solution was concentrated under reduced pressure to obtain a residue. The resulted residue was separated by silica gel column chromatography using hexane : ethyl acetate (5:1) and chloroform : methanol (30:1) as eluent. A sample of the eluted (+)- (2S , 3R) erythro-3-acetoxy-2-stearoylaminohexadecyl acetate (264.9 mg) was hydrolyzed, then converted to (4R, 5S)-erythro-2,2-dimethyl-5-stearoylamino-4-tridecyl-1,3-dioxane in the presence of p-toluenesulfonic acid, 2,2-dimethoxypropane and acetone, and the optical purity was analyzed by ^{1}H-NMR to find it was >95%e.e.

[0032] Then, a sample of the eluted (-)-(2R,3S)-3-acetoxy 2-stearoylaminohexadecane-1-ol (481.8 mg) was hydrolyzed, and compared with angle of rotation of (-)-(2R,3S)-erythro-2-stearoylamino-113-hexadecanediol, to find a optical purity of 16%e-e.

[0033] Then, a part of the eluted (-)-(2R,3s)-erythro-2-stearoylamino-1,3-hexanediol (214.8 mg) was converted to (4S,5R)-erythro-2,2-dimethyl-5-stearoylamino-4-tridecyl-1,3-dioxane according to the method as described above. The optical purity was analyzed by^{1}H-NMR to find it was >95%e.e.

Example 2

[0034] To a mixed solution of 10 ml decane and 100 ml of a phosphate buffer solution were added 10.2 mg of racemic erythro-3-acetoxy-2-stearoylaminohexadecyl acetate and 10.8 mg of an immobolized esterase prepared in Reference Example 2 below, and the resulted mixture reacted under stirring at 30°C. The reaction was traced by TLC [silica gel, hexane : ethyl acetate (2:1), chloroform : methanol (15:1)].

[0035] The reaction was continued for 2 days, and then, the product (+)-(2S,3R)-erythro-3-acetoxy-2-stearoylaminohexadecyl acetate was separated according to the method described in Example 1.

[0036] Then a sample of the separated product was hydrolyzed, then reacted with α-methoxy-α-trifluoromethylphenyl acetate (hereinafter, referred to as MTPA), converted to a bis-MTPA ester, then, optical purity was analyzed by ^{1}H-NMR.

[0037] (+)- (2S, 3R)-erythro-2-acetoxy-2-stearoylaminohexadecyl acetate was obtained in a yield of 50%, and the optical purity was >95%e.e.

Reference Example 1 : Preparation of esterase

[0038] Recombinant E. coli JM109/pAL612 strain (FREM-BP 5740) was incubated in 100 ml of a LB medium (manufactured by Difco) containing 50 mg/L of ampicillin and 1 mM of isopropyl thio-β-D-galactoside, at 37°C for 16 hours, then the culture was subjected to centrifuged (6000 rpm, 10 minutes) to recover microorganism. The recovered microorganism was suspended in a 10 ml of 100 mM phosphate buffer solution (pH 7.0), then was broken by ultrasonic wave, and the broken material was centrifuged to obtain a crude enzyme extract solution. Then, the resulted crude enzyme extract solution was freeze-dried to obtain a crude enzyme powder.

Reference Example 2: Immobilization of esterase

[0039] To a 10 ml of 0.1 M phosphate buffer solution (pH 7.0) into which Triton X-100 (TRM of Union Carbide Chemicals and Plastics) (300 mg) was dissolved was added 1 g of the enzyme powder obtained in Reference Example 1, then, Florysil (TRM of U.S. Silica Company, purchased from Aldrich Japan) (8.7 mg) was added in ice water. The resulted mixture was frozen at -78°C, then freeze-dried to obtain 1.4 g of an immobilized powdery enzyme.

SEQUENCE LISTING

INFORMATION FOR SEQ ID NO:1:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 363 amino acids

(B) TYPE: amino acid

(C) TOPOLOGY: linear

(ii) MOLECULAR TYPE: protein

(iii) SEQUENCE DESCRIPTION: SEQ ID NO: 1

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Met Ser Arg Ser Ile Arg Ala Lys Ala Val Ala Thr Val Val Ala Ile
 1               5                  10                  15
Ala Met Asn Ala Ala Pro Ala Ala Ser Val Gly Thr Val Leu Ser Leu
            20                  25                  30
Ala Gly Ala Gln Ala Ala Ser Ala Ala Thr Thr Ala Val Asp Asp Tyr
        35                  40                  45
Ala Ala Thr Arg Tyr Pro Ile Ile Leu Val His Gly Leu Thr Gly Thr
    50                  55                  60
Asp Lys Tyr Gly Gly Val Val Glu Tyr Trp Tyr Arg Ile Pro Glu Asp
65                  70                  75                  80
Leu Arg Ala His Gly Ala Ala Val Tyr Val Ala Asn Leu Ser Gly Phe
                85                  90                  95
Gln Ser Asp Asp Gly Pro Asn Gly Arg Gly Glu Gln Leu Leu Ala Phe
            100                 105                 110
Val Lys Gln Val Leu Ala Ala Thr Gly Ala Gln Lys Val Asn Leu Ile
        115                 120                 125
Gly His Ser Gln Gly Gly Leu Thr Ser Arg Tyr Val Ala Ser Val Ala
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130 135 140

Pro Glu Leu Val Ala Ser Val Thr Thr Ile Ser Thr Pro His Trp Gly

145 150 155 160

Ser Gln Phe Ala Asp Phe Val Gln Gln Leu Leu Gln Thr Asp Pro Thr

165 170 175

Gly Leu Ser Ser Thr Val Leu Gly Ala Phe Ala Asn Ala Leu Gly Thr

180 185 190

Leu Thr Ser Ser Asn Phe Asn Thr Asn Gln Asn Ala Ile Gln Ala Leu

195 200 205

Ser Val Leu Thr Thr Ala Lys Ala Ala Ala Tyr Asn Gln Lys Phe Pro

210 215 220

Ser Ala Gly Leu Gly Ala Pro Gly Ser Cys Gln Thr Gly Ala Pro Thr

225 230 235 240

Glu Thr Val Gly Gly Asn Thr His Leu Leu Tyr Ser Trp Gly Gly Thr

245 250 255

Ala Ile Gln Pro Thr Ala Thr Val Ala Gly Val Thr Gly Ala Val Asp

260 265 270

Thr Ser Val Ser Gly Val Thr Asp Pro Ala Asn Ala Leu Asp Pro Ser

275 280 285

Thr Leu Ala Leu Leu Gly Ser Gly Thr Val Met Ile Asn Arg Ser Ala

290 295 300

Gly Pro Asn Asp Gly Val Val Ser Gln Cys Ser Ala Arg Phe Gly Gln

305 310 315 320

Val Leu Gly Thr Tyr His Trp Asn His Thr Asp Ala Ile Asn Gln Ile

325 330 335

Leu Gly Val Leu Gly Ala Asn Val Glu Asp Pro Val Ala Val Ile Arg

340 345 350

Thr Asp Ala Asn Arg Leu Lys Leu Ala Gly Val

355 360 363

INFORMATION FOR SEQ ID NO:2:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 1089

(B) TYPE: nucleic acid

(C) STRANDEDNESS: double

(D) TOPOLOGY: linear

(ii) MOLECULAR TYPE: genomic DNA

(iii) SEQUENCE DESCRIPTION: SEQ ID NO: 2

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GCG GCG ACC CGG TAC CCG ATC ATT CTC GTG CAC GGG CTG ACC GGC ACC	192
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CAG AGC GAC GAT GGC CCG AAC GGG CGT GGC GAG CAA TTG CTT GCA TTC	336
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GGC CAT AGC CAG GGC GGC CTG ACA TCG CGT TAT GTT GCG TCC GTT GCA	432
CCG GAA CTG GTC GCA TCG GTG ACG ACG ATC AGT ACG CCG CAC TGG GGC	480
TCG CAA TTC GCG GAC TTC GTC CAG CAA CTG TTG CAG ACG GAC CCG ACC	528
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TCG GTG CTG ACG ACG GCA AAG GCC GCC GCA TAC AAC CAG AAA TTC CCG	672
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ACG CTG GCA CTC CTC GGC AGC GGC ACG GTG ATG ATC AAT CGC AGC GCC   912

GGT CCG AAC GAT GGC GTC GTG TCG CAA TGC AGC GCG CGG TTT GGC CAG   960

GTG CTC GGC ACG TAT CAC TGG AAT CAC ACC GAT GCG ATC AAC CAG ATC  1008

CTC GGC GTG CTC GGC GCG AAT GTG GAG GAT CCG GTT GCG GTA ATC CGC  1056

ACG GAC GCG AAC CGG TTG AAG CTC GCA GGC GTG                      1089
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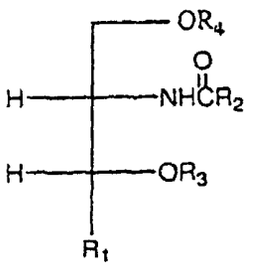
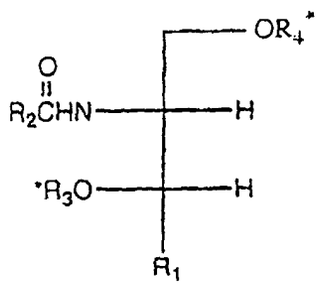
Claims

1. A method for producing an optically- active erythro sphingoid ester of the formula I:



wherein R_1 and R_2, are the same or different, represent an aliphatic hydrocarbon having 7 to 31 carbon atoms which may be substituted by one or more hydroxyl groups, and
R_3 and R_4, may be the same or different and represent an acyl group having 1 to 7 carbon atoms,
which comprises:
allowing a racemic mixture comprising the optically active sphingoid ester of the formula I as defined above and its enantiomer to contact with an esterase having an ability to selectively hydrolyze said enantiomer of the optically active sphingoid ester of the formula I to produce an optically active sphingoid alcohol compound of the formula II:



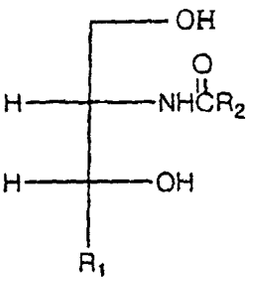
wherein R_1 and R_2 have the same meaning as defined above, and R_3^* and R_4^*. represent a hydrogen atom or an acyl group having 1 to 7 carbon atoms provided that R_3^* and R_4^*, do not simultaneously represent an acyl group having 1 to 7 carbon atoms; and recovering the optically active erythro sphingoid ester of the formula I,
wherein said enzyme is an enzyme

(a) comprising an amino acid sequence of SEQUENCE ID NO: 1: or
(b) comprising an amino acid sequence of SEQUENCE ID NO: 1 with addition, deletion or substitution of one or more amino acids: or
(c) obtainable from:

1) an animal,
2) plant, or
3) a microorganism belonging to Aspergillus, Candida, Fusarium, Geotrichum, Mucor, Nocardia, Penicillium, Rhizopus, Saccharomyces, Acromobacter, Acinetobacter, Alcaligenes, Chromobacterium, Escherichia, Pseudomonas, Sphingomonas, Bacillus, Burkholderia, Moraxella, Lactobacillus, Staphylococcus, Serratia, or Yarrowia, or

(d) obtainable from FERM-BP 5740.

2. A method for producing an optically active erythro sphingoid alcohol of the formula I':

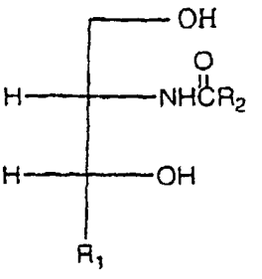


wherein R_1 and R_2 are the same as defined in claim 1, which comprises: allowing the recovered optically active erythro sphingoid ester of the formula I as defined in claim 1 to a hydrolysis reaction.

3. The method according to Claim 1, wherein the esterase is a protein having an amino acid sequence of SEQUENCE ID NO: 1, or an amino acid sequence of SEQUENCE ID NO: I with addition, deletion or substitution of an amino acid.

4. The method according to Claim 2, wherein the esterase is a protein having an amino acid sequence of SEQUENCE ID NO: 1, or an amino acid sequence of SEQUENCE ID NO : 1 with addition, deletion or substitution of an amino acid.

5. The method according to claim 1, which further comprises the step of reacting the recovered optically active erythro sphingoid ester of the formula I to a hydrolysis reaction to produce an optically active erythro sphingoid alcohol of the formula I':



wherein R_1 and R_2 are the same or different, represent an aliphatic hydrocarbon having 7 to 31 carbon atoms which may be substituted by one or more hydroxyl groups.

6. The method according to claim 1 or 5, wherein the racemic sphingoid ester is:

N-heptadecanoyl-1,3-O,O-diacetyl-2-amino-4-hexadecene-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-aminohexadecane-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecene-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-aminooctadecane-1,3,4-triol,
N-heptadecanoyl-1,3-O, O-diacetyl-2-aminoeicosane-1, 3-diol,
N-heptadecanoyl-1,3-O,O-dibutyryl-2-aminoeicosane-1,3-diol,
N-heptadecanoyl-1,3-O,O-diacetyl-2-aminoheptacosane-1.3-diol,
N-octadecanoyl-1,3-O,O-diacetyl-2-amino-15-methylhexadecane-1, 3 -diol,
N-octadecanoyl-1,3-O,O-diacetyl-2-aminohexadecane-1,3-diol,
N-octadecanoyl-1, 3-O,O-dibutyryl-2-aminohexadecane-1,3-diol.
N-octadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecene-1-3-diol,
N-octadecanoyl-1,3-O,O-diacetyl-2-aminooctadecane-1,3,4-triol,
N-octadecanoyl-1, 3-O,O-diacetyl-2-aminoeicosane-1, 3-diol,
N-octadecanoyl-1, 3-O,O-dibutyryl-2-aminoheptacosane-1,3-diol,
N-2'-hydroxyhexadecanoyl-1,3-O,O-diacetyl-2-amino-15-methylhex adecane-1-3-diol,
N-2'-hydroxyhexadecanoyl-1,3-O,O-diacetyl-2-aminohexadecane-1, 3-diol,
N-2'-hydroxyhexadecanoyl-1,3-O,O-dibutyryl-2-aminohexadecane-1 ,3-diol,
N-2'-hydroxyeicosanoyl-1, 3-O, O-diacetyl-2-amino-4-octadecene-1 , ,3-diol,
N-2'-hydroxyeicosanoyl-1,3-O,O-diacetyl-2-aminooctadecane-1, 3, 4-triol,
N-2'-hydroxytetracosanoyl-1,3-O,O-diacetyl-2-aminoeicosane-1, 3 -diol,
N-2' -hydraxyhexadecanayl-1,3-O,O-dibutyryl-2-aminoheptacosane-1, 3-diol,
N-docosanoyl-1,3 -O, O-dibutyryl-2-amino-15-methyhexadecane-1,3-diol,
N-tetracosanoyl-1. 3-O,O-diacetyl-2-aminohexadecane-l, 3-diol,
N-hexacosanoyl-1,3-O,O-dibutyryi-2-aminohexadecane-1,3-diol,
N-methyloctadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecene-1,3 -diol,
N-pentacosanoyl-1,3-O,O-diacetyl-2-amino-4-docosene-1,3-diol,
N-pentacosanoyl-1,3-O,O-diacetyl-2-amino-4-octadecene-1,3-diol, or
N-pentacosanoyl-1,3-O,O-diacetyl-2-aminoeicosane-1,3-diol.

7. The method according to claim 1 or 5, wherein the acyl group represented by R3, R4, R3*, or R4* is an acetyl group.

8. The method according to claim 2 or 5, wherein the optically active erythro sphingoid alcohol of the formula I' is an optically active erythro isomer of:

N-heptadecanoyl-2-amino-4-hexadecene-1,3-diol,
N-heptadecanoyl-2-aminohexadecane-1,3-diol,
N-heptadecanoyl-2-amino-4-octadecene-1,3-diol,
N-heptadecanoyl-2-aminooctadecane-1,3,4-triol,
N-heptadecanoyl-2-aminoeicosane-1,3-diol,
N-heptadecanoyl-2-aminoeicosane-1,3-diol,
N-heptadecanoyl-2-aminoheptacosane-1,3-diol,
N-octadecanoyl-2-amino-15-methylhexadecane-1,3-diol,
N-octadecanoyl-2-aminohexadecane-1,3-diol,
N-octadecanoyl-2-amino-4-octadecene-1,3-diol,
N-octadecanoyl-2-aminooctadecane-1,3,4-triol,
N-octadecanoyl-2-aminoeicosane-1,3-diol,
N-octadecanoyl-2-aminoheptacosane-1,3-diol,
N-2' -hydroxyoctadecanoyl-2-amino-15-methylhexadecane-1,3-diol, N-2'-hydroxyhexadecanoyl-2-aminohexadecane-1,3-diol,
N-2'-hydroxyeicosanoyl-2-amino-4-octadecene-1,3-diol,
N-2'-hydroxyeicosanoyl-2-aminooctadecane-1,3,4-triol,
N-2'-hydroxytetracosanoyl-2-aminoeicosane-1,3-diol,
N-2'-hydroxyhexaconoyl-2-aminoheptacosane-1,3-diol,
N-docosanoyl - 2 - amino-15 -methyhexadecane-1, 3-diol,
N-tetracosanoyl-2-aminohexadecane-1,3-diol,
N-hexacosanoyl-2-aminohexadecane-1,3-diol,
N-methyloctadecanoyl-2-amino-4-octadecene-1,3-diol,
N-pentacosanoyl-2-amino-4-docosene-1,3-diol,

N-pentacosanoyl-2-amino-4-octadecene-1,3-diol, or
N-pentacosanoyl-2-aminoeicosane-1,3-diol.

9. The method according to claim 1 or 5, wherein said enzyme is an enzyme comprising an amino acid sequence of SEQUENCE ID NO: 1.

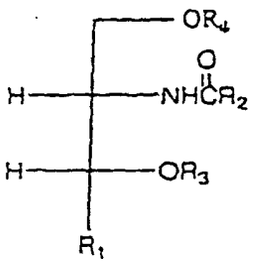
10. The method according to claim 1 or 5, wherein said enzyme is an enzyme comprising the amino acid sequence of SEQUENCE ID NO: 1 with addition, deletion or substitution of an amino acid.

11. The method according to claim 1 or 5, wherein said enzyme is an enzyme obtainable from a microorganism belonging to Aspergillus, Candida, Fusarium, Geotrichum, Mucor, Nocardia, Penicillium, Rhizopus, Saccharomyces, Acromobacter, Acinetobacter, Alcaligenes, Chromobacterium, Escherichia, Pseudomonas, Sphingomonas, Bacillus, Burkholderia, Moraxella, Lactobacillus, Staphylococcus, Serratia, or Yarrowia.

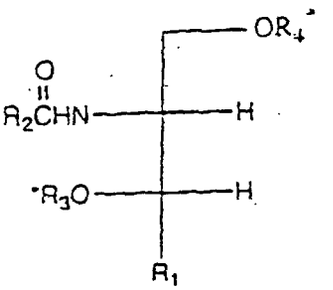
12. The method according to claim 1 or 5, wherein said enzyme is an enzyme obtainable from FERM-BP 5740.

Patentansprüche

1. Ein Verfahren zum Herstellen eines optisch aktiven Erythrosphingoidesters der Formel I:



wobei R_1 und R_2 gleich oder unterschiedlich sind und einen aliphatischen Kohlenwasserstoff mit von 7 bis 31 Kohlenstoffatomen darstellen, welcher durch eine oder mehrere Hydroxylgruppen substituiert sein kann, und R_3 und R_4 können gleich oder unterschiedlich sein und stellen eine Acylgruppe mit von 1 bis 7 Kohlenstoffatomen dar, welches umfaßt:
Erlauben, daß eine racemische Mischung umfassend den optisch aktiven Sphingoidester der Formel I, wie oben definiert, und seinen Enantiomer, mit einer Esterase in Kontakt kommt, die die Fähigkeit hat, den Enatiomer des optisch aktiven Sphingoidester der Formel I selektiv zu hydrolysieren, um eine optisch aktive Sphingoidalkoholverbindung der Formel II herzustellen:



wobei R_1 und R_2 die gleiche Bedeutung, wie oben definiert, haben, und R_3^* und R_4^* ein Wasserstoffatom oder eine Acylgruppe mit von 1-7 Kohlenstoffatomen darstellen, vorausgesetzt daß R_3^* und R_4^* nicht gleichzeitig eine Acylgruppe mit von 1-7 Kohlenstoffatomen darstellen; und Rückgewinnen des optisch aktiven Erythrosphingoidesters der Formel I,

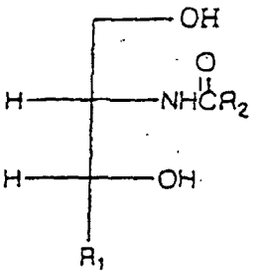
wobei das Enzym ein Enzym ist,

(a) umfassend eine Aminosäuresequenz von SEQUENZ ID NO : 1: oder
(b) umfassend eine Aminosäuresequenz von SEQUENZ ID NO: 1 unter Hinzufügung, Auslassung oder Substitution von einer oder mehreren Aminosäuren: oder
(c) das erhältlich ist aus:

1) einem Tier,
2) einer Pflanze, oder
3) einem Mikroorganismus gehörend zu Aspergillus, Candida, Fusarium, Geotrichum, Mucor, Nocardia, Penicillium, Rhizopus, Saccharomyces, Acromobacter, Acinetobacter, Alcaligenes, Chromobacterium, Escherichia, Pseudomonas, Sphingomonas, Bacillus, Burkholderia, Moraxella, Lactobacillus, Staphylococcus, Serratia, oder Yarrowia, oder

(d) erhältlich ist aus FERM-BP 5740.

2. Ein Verfahren zum Herstellen eines optisch aktiven Erythrosphingoidalkohols der Formel I':

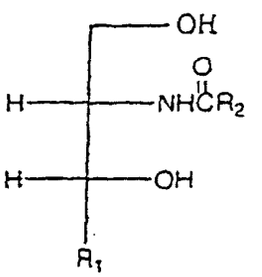


wobei R_1 und R_2 so sind, wie in Anspruch 1 definiert, welches umfaßt: Erlauben, daß der zurückgewonnene optisch aktive Erythrosphingoidester der Formula I, wie definiert in Anspruch 1, eine Hydrolyse-Umsetzung ausführt.

3. Das Verfahren gemäß Anspruch 1, wobei die Esterase ein Protein ist mit
einer. Aminosäuresequenz von SEQUENZ ID NO : 1, oder einer Aminosäuresequenz von SEQUENZ ID NO: I mit Hinzufügung, Auslassung oder Substitution einer Aminosäure.

4. Das Verfahren gemäß Anspruch 2, wobei die Esterase ein Protein ist, mit
einer Aminosäuresequenz von SEQUENZ ID NO: 1, oder
einer Aminosäuresequenz von SEQUENZ ID NO: 1 mit Hinzufügung, Auslassung oder Substitution einer Aminosäure.

5. Das Verfahren gemäß Anspruch 1, welches weiterhin den Schritt des Umsetzens des zurückgewonnenen optisch aktiven Erythrosphingoidesters der Formel I in einer Hydrolyse-Umsetzung umfaßt, um einen optisch aktiven Erythrosphingoidalkohol der Formel I' herzustellen:



wobei R_1 und R_2 gleich oder unterschiedlich sind und einen aliphatischen Kohlenwasserstoff mit von 7 bis zu 31 Kohlenstoffatomen darstellen, welcher durch eine oder mehrere Hydroxylgruppen substituiert sein kann.

6. Das Verfahren gemäß Anspruch 1 oder 5, wobei der racemische Sphingoidester

N-Heptadecanoyl-1,3-O,O-diacetyl-2-amino-4-hexadecen-1,3-diol,
N-Heptadecanoyl-1,3-O,O-diacetyl-2-aminohexadecan-1,3-diol,
N-Heptadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecen-1,3-diol,
N-Heptadecanoyl-1,3-O,O-diacetyl-2-aminooctadecan-1,3,4-triol,
N-Heptadecanoyl-1,3-O,O-diacetyl-2-aminoeicosan-1,3-diol,
N-Heptadecanoyl-1, 3-O,O-dibutyryl-2-aminoeicosan-1, 3-diol,
N-Heptadecanoyl-1,3-O, O-diacetyl-2-aminoheptacosan-1,3-diol,
N-Octadecanoyl-1,3-O,O-diacetyl-2-amino-15-methylhexadecan-1, 3-diol,
N-Octadecanoyl-1, 3-O,O-diacetyl-2-aminohexadecan-1,3-diol.
N-Octadecanoyl-1,3-O,O-dibutyryl-2-aminohexadecan-1,3-diol.
N-Octadecanoyl-1,3-O,O-diacetyl-2-amíno-4-octadecen-1,3-diol,
N-Octadecanoyl-1,3-O,O-diacetyl-2-aminooctadecan-1,3,4-triol,
N-Octadecanoyl-1,3-O,O-diacetyl-2-aminoeicosan-1,3-diol,
N-Octadecanoyl-1,3-O,O-dibutyryl-2-aminoheptacosan-1,3-diol,
N-2-Hydroxyhexadecanoyl-1,3-O,O-diacetyl-2-amino-15-methylhexadecan-1, 3 -diol,
N-2'-Hydroxyhexadecanoyl-1,3-O,O-diacetyl-2-aminohexadecan-1, 3-diol,
N-2'-Hydroxyhexadecanoyl-1,3-O,O-dibutyryl-2-aminohexadecan-1 ,3-diol,
N-2'-Hydroxyeicosanoyl-1,3-O,O-diacetyl-2-amino-4-octadecen-1 ,3-diol,
N-2'-Hydroxyeicosanoyl-1,3-O,O-diacetyl-2-aminooctadecan-1,3, 4-triol,
N-2'-Hydroxytetracosanoyl-1,3-O,O-diacetyl-2-aminoeicosan-1,3 -diol,
N-2'-Hydroxyhexadecanoyl-1,3-O,O-dibutyryl-2-aminoheptacosan-1,3-diol,
N-Docosanoyl-1, 3-O,O-dibutyryl-2-amino-1s-methyhexadecan-1,3-diol,
N-Tetracosanoyl-1,3-O,O-diacetyl-2-aminohexadecan-1,3-diol,
N-Hexacosanoyl-1,3-O,O-dibutyryi-2-aminohexadecan-1,3-diol,
N-Methyloctadecanoyl-1,3-O,O-diacetyl-2-amino-4-octadecen-1,3 -diol,
N-Pentacosanoyl-1,3-O,O-diacetyl-2-amino-4-docosen-1,3-diol,
N-Pentacosanoyl-1,3-O,O-diacetyl-2-amino-4-octadecen-1,3-diol, oder
N-Pentacosanoyl-1,3-O,O-diacetyl-2-aminoeicosan-1, 3-diol ist.

7. Das Verfahren gemäß Anspruch 1 oder 5, wobei die Acylgruppe dargestellt durch R3, R4, R3*, oder R4* eine Acetylgruppe ist.

8. Das Verfahren gemäß Anspruch 2 oder 5, wobei der optisch aktive Erythrosphingoidalkohol der Formel I' ein optisch aktiver Erythroisomer von

N-Heptadecanoyl-2-amino-4-hexadecen-1,3-diol,
N-Heptadecanoyl-2-aminohexadecan-1,3-diol,
N-Heptadecanoyl-2-amino-4-octadecen-1,3-diol,
N-Heptadecanoyl-2-aminooctadecan-1,3,4-triol,
N-Heptadecanoyl-2-aminoeicosan-1, 3-diol,
N-Heptadecanoyl-2-aminoeicosan-1,3-diol,
N-Heptadecanoyl-2-aminoheptacosan-1,3-diol,
N-Octadecanoyl-2-amino-15-methylhexadecan-1,3-diol,
N-Octadecanoyl-2-aminohexadecan-1, 3 -diol,
N-Octadecanoyl-2-amino-4-octadecen-1,3-diol,
N-Octadecanoyl-2-aminooctadecan-1,3,4-triol,
N-Octadecanoyl-2-aminoeicosan-1, 3-diol,
N-Octadecanoyl-2-aminoheptacosan-1,3-diol,
N-2'-Hydroxyoctadecanoyl-2-amino-15-methylhexadecan-1,3-diol,
N-2'-Hydroxyhexadecanoyl-2-aminohexadecan-1,3-diol,
N-2' -Hydroxyeicosanoyl-2-amino-4-octadecen-1, 3-diol,
N-2 -Hydroxyeicosanoyl-2-aminooctadecan-1, 3, 4-triol,
N-2 -Hydroxytetracosanoyl-2-aminoeicosan-1, 3-diol,
N-2'-Hydroxyhexaconoyl-2-aminoheptacosan-1,3-diol,
N-Docosanoyl-2-amino-15-methyhexadecan-1,3-diol,
N-Tetracosanoyl-2-aminohexadecan-1,3-diol,

N-Hexacosanoyl-2-aminohexadecan-1,3-diol,
N-Methyloctadecanoyl-2-amino-4-octadecen-1,3-diol,
N-Pentacosanoyl-2-amino-4-docosen-1,3-diol,
N-Pentacosanoyl-2-amino-4-octadecen-1,3-diol, oder
N-Pentacosanoyl-2-aminoeicosan-1,3-diol ist.

9. Das Verfahren gemäß Anspruch 1 oder 5, wobei das Enzym ein Enzym ist, umfassend eine Aminosäuresequenz von *SEQUENZ ID NO:* 1.

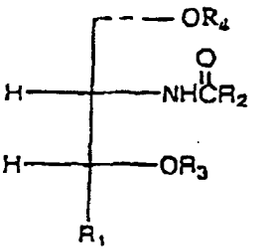
10. Das Verfahren gemäß Anspruch 1 oder 5, wobei das Enzym ein Enzym ist, umfassend die Aminosäuresequenz von SEQUENZ ID NO: 1 mit Hinzufügung, Auslassung oder Substitution einer Aminosäure.

11. Das Verfahren gemäß Anspruch 1 oder 5, wobei das Enzym ein Enzym ist, erhältlich aus einem Mikroorganismus gehörend zu Aspergillus, Candida, Fusarium, Geotrichum, Mucor, Nocardia, Penicillium, Rhizopus, Saccharomyces, Acromobacter, Acinetobacter, Alcaligenes, Chromobacterium, Escherichia, Pseudomonas, Sphingomonas, Bacillus, Burkholderia, Moraxella, Lactobacillus, Staphylococcus, Serratia, oder Yarrowia.

12. Das Verfahren gemäß Anspruch 1 oder 5, wobei das Enzym ein Enzym ist, erhältlich aus FERM-BP 5740.

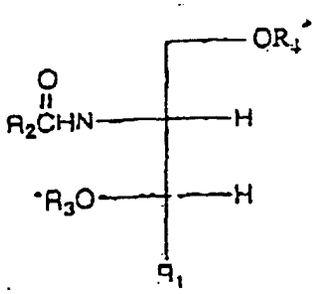
Revendications

1. Procédé afin de produire un ester sphingoïde érythro optiquement actif de la formule I :



I

dans laquelle R_1 et R_2, sont les mêmes ou différents, et représentent un hydrocarbure aliphatique ayant 7 à 31 atomes de carbone qui peuvent être substitués par un ou plusieurs groupes hydroxyles, et
R_3 et R_4, peuvent être les mêmes ou différents et représentent un groupe acyle ayant 1 à 7 atomes de carbone, qui comprend :
de permettre à un mélange racémique comprenant l'ester sphingoïde optiquement actif de la formule I comme défini plus haut et à ses énantiomères d'être mis en contact avec une estérase ayant une capacité d'hydrolyser sélectivement ledit énantiomère de l'ester sphingoïde optiquement actif de la formule I afin de produire un composé alcool sphingoïde optiquement actif de la formule II:



II

dans laquelle R_1 et R_2 ont la même signification que défini plus haut, et R_3^* et R_4^* représentent un atome d'hydrogène ou un groupe acyle ayant 1 à 7 atomes de carbone pourvu que R_3^* et R_4^*, ne représentent pas simultanément un groupe acyle ayant 1 à 7 atomes de carbone ; et récupérer l'ester sphingoide érythro optiquement actif de la formule I,

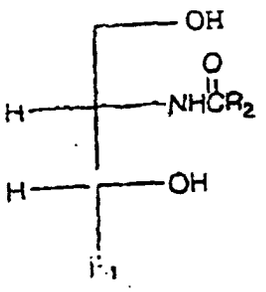
où ladite enzyme est une enzyme

(a) comprenant une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1 ; ou
(b) comprenant une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1 avec addition, suppression ou substitution d'un ou plusieurs acides aminés ; ou
(c) pouvant être obtenu à partir :

1) d'un animal
2) de plante, ou
3) d'un microorganisme appartenant à un Aspergillus, un Candida, un Fusarium, un Géotrichum, un Mucor, un Nocardia, un Pénicillium, un Rhizopus, des Saccharomyces, un Achromobacter, un Acinétobacter, des Alcaligènes, un Chromobactérium, un Eschérichia, un Pseudomonas, un Sphingomonas, un Bacille, un Burkholderia, un Moraxella, un Lactobacille, un Staphylocoque, un Serratia ou un Yarrowia,

ou .
d) pouvant être obtenu à partir de FERM-BP 5740.

2. Procédé afin de produire un alcool sphingoide érythro optiquement actif de la formule I' :



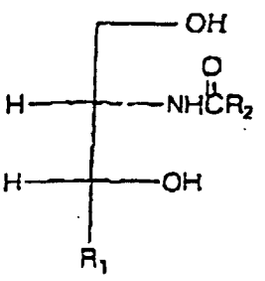
I'

dans laquelle R_1 et R_2 sont les mêmes que définis dans la revendication 1,
qui comprend : de permettre à l'ester sphingoïde érythro optiquement actif de la formule I récupéré comme défini dans la revendication 1 de subir une réaction d'hydrolyse.

3. Procédé selon la revendication 1, dans lequel l'estérase est une protéine ayant une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1, ou
une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1 avec addition, suppression ou substitution d'un acide aminé.

4. Procédé selon la revendication 2, dans lequel l'estérase est une protéine ayant une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1, ou
une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1 avec addition, suppression ou substitution d'un acide aminé.

5. Procédé selon la revendication 1, qui comprend en outre l'étape de faire réagir l'ester sphingoïde érythro optiquement actif de la formule I récupéré selon une réaction d'hydrolyse afin de produire un alcool sphingoïde érytro optiquement actif de la formule I':



I'

dans laquelle R_1 et R_2, sont les mêmes ou différents, représentent un hydrocarbure aliphatique ayant 7 à 31 atomes de carbone qui peuvent être substitués par un ou plusieurs groupes hydroxyles.

6. Procédé selon la revendication 1 ou 5, dans lequel l'ester sphingoïde racémique est :

un N-heptadécanoyl-1, 3-O, O-diacétyl-2-amino-4 -hexadécèné-1,3-diol,
un N-heptadécanoyl-1, 3-O, O-diacétyl-2-aminohexadécane-1, 3-diol,
un N-heptadécanoyl-1,3-O,O-diacétyl-2-amino-4-octadécène-1,3-diol,
un N-heptadécanoyl-1,3-O,O-diacétyl-2-aminooctadécane-1,3,4-triol,
un N-heptadécanoyl-1,3-O,O-diacétyl-2-aminoéicosane-1,3-diol,
un N-heptadécanoyl-1,3-O, O-dibutyryl-2-aminoéicosane-1,3-diol,
un N-heptadécanoyl-1, 3-O,O-diacétyl-2-aminoheptacosane-1, 3-diol,
un N-octadécanoyl-1, 3-O, O-diacétyl-2-amino-15-méthylhexadécane-1,3-diol,
un N-octadécanoyl-1,3-O, O-diacétyl-2-aminohexadécane-1, 3-diol,
un N-octadécanoyl-1,3-O, O-dibutyryl-2-aminohexadécane-1,3-diol,
un N-octadécanoyl-1,3-O,O-diacétyl-2-amino-4-octadécène-1,3-diol,
un N-octadécanoyl-1,3-O,O-diacétyl-2-aminooctadécane-1, 3,4-triol,
un N-octadécanoyl-1,3-O, O-diacétyl-2-aminoéicosane-1,3-diol,
un N-octadécanoyl-1,3-O,O-dibutyryl-2-aminoheptacosane-1,3-diol,
un N-2'-hydroxyoctadécanoyl-1,3-O,O-diacétyl-2-amino-15-méthylhexadécane-1,3-diol,
un N-2'-hydroxyhexadécanoyl-1, 3-O,O-diacétyl-2-aminohexadécane-1,3-diol,
un N-2'-hydroxyhexadécanoyl-1,3-O,O-dibutyryl-2-aminohexadécane-1,3-diol,
un N-2'-hydroxyéicosanoyl-1,3-O, O-diacétyl-2-amino-4-octadécène-1,3-diol,
un-N-2'-hydroxyéicosanoyl-1,3-O, O-diacétyl-2-aminooctadécane-1,3,4-triol,
un N-2'-hydroxytétracosanoyl-1,3-O,O-diacétyl-2-aminoéicosane-1,3-diol,
un N-2'-hydroxyhexacosanoyl-1,3-O, O-dibutyryl-2-aminoheptacosane-1,3-diol,
un N-docosanoyl-1,3-O,O-dibutyryl-2-amino-15-méthyhexadécane-1,3-diol,
un N-tétracosanoyl-1,3-O,O-diacétyl-2-aminohexadécane-1,3-diol,
un N-hexacosanoyl-1,3-O,O-dibutyryl-2-aminohexadécane-1,3-diol,
un N-méthyloctadécanoyl-1,3-O, O-diacétyl-2-amino-4-octadécène-1,3-diol,
un N-pentacosanoyl-1,3-O,O-diacétyl-2-amino-4-docosène-1,3-diol,
un N-pentacosanoyl-1,3-O,O-diacétyl-2-amino-4-octadécène-1,3-diol, ou
un N-pentacosanoyl-1,3-O,O-diacétyl-2-aminoéicosane-1,3-diol.

7. Procédé selon la revendication 1 ou 5, dans lequel le groupe acyle représenté par R3, R4, R3*, ou R4* est un groupe acétyle.

8. Procédé selon la revendication 2 ou 5, dans lequel l'alcool sphingoïde érythro optiquement actif de la formule I' est un isomère érythro optiquement actif d' :

un N-heptadécanoyl-2-amino-4-hexadécène-1, 3-diol,
un N-heptadécanoyl-2-aminohexadécane-1, 3-diol,
un N-heptadécanoyl-2-amino-4-octadécène-1,3-diol,
un N-heptadécanoyl-2-aminooctadécane-1,3,4-triol,
un N-heptadécanoyl-2-aminoéicosane-1,3-diol,
un N-heptadécanoyl-2-aminoéicosane-1,3-diol,
un N-heptadécanoyl-2-aminoheptacosane-1,3-diol,
un N-octadécanoyl-2-amino-15-méthylhexadécane-1,3-diol,
un N-octadécanoyl-2-aminohexadécane-1,3-diol,
un N-octadécanoyl-2-amino-4-octadécène-1,3-diol,
un N-octadécanoyl-2-aminooctadécane-1,3,4-triol,
un N-octadécanoyl-2-aminoéicosane-1,3-diol,
un N-octadécanoyl-2-aminoheptacosane-1,3-diol,
un N-2'-hydroxyoctadécanoyl-2-amino-15-méthylhexadécane-1,3-diol,
un N-2'-hydroxyhexadécanoyl-2-aminohexadécane-1,3-diol,
un N-2'-hydroxyéicosanoyl-2-amino-4-octadécène-1, 3-diol,
un N-2'-hydroxyéicosanoyl-2-aminooctadécane-1, 3,4-triol,
un N-2'-hydroxytétracosanoyl-2-aminoéicosane-1, 3-diol,

un N-2'-hydroxyhexaconoyl-2-aminoheptacosane-1,3-diol,
un N-docosanoyl-2-amino-15-méthyhexadécane-1, 3-diol,
un N-tétracosanoyl-2-aminohexadécane-1,3-diol,
un N-hexacosanoyl-2-aminohexadécane-1, 3-diol,
un N-méthyloctadécanoyl-2-amino-4-octadécène-1, 3-diol,
un N-pentacosanoyl-2-amino-4-docosène-1,3-diol,
un N-pentacosanoyl-2-amino-4-octadécène-1,3-diol, ou
un N-pentacosanoyl-2-aminoéicosane-1,3-diol.

9. Procédé selon la revendication 1 ou 5, dans lequel ladite enzyme est une enzyme comprenant une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1.

10. Procédé selon la revendication 1 ou 5, dans lequel ladite enzyme est une enzyme comprenant une séquence d'acides aminés de numéro d'identification de SEQUENCE : 1 avec addition, suppression ou substitution d'un acide aminé.

11. Procédé selon la revendication 1 ou 5, dans lequel ladite enzyme est une enzyme pouvant être obtenue à partir d'un microorganisme appartenant à un Aspergillus, un Candida, un Fusarium, un Géotrichum, un Mucor, un Nocardia, un Penicillium, un Rhizopus, des Saccharomyces, un Achromobacter, un Acinétobacter, des Alcaligènes, un Chromobactérium, un Eschérichia, un Pseudomonas, un Sphingomonas, un Bacille, un Burkholderia, un Moraxella, un Lactobacille, un Staphylocoque, un Serratia ou un Yarrowia.

12. Procédé selon la revendication 1 ou 5, dans lequel ladite enzyme est une enzyme pouvant être obtenue à partir de FERM-BP 5740.