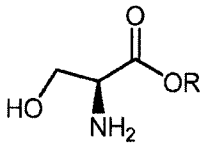
CLAIMS

1. A method for synthesizing *D-erythro*-sphingosine, comprising the steps of:

a) protecting the amino group of an *L*-serine ester having the following structure:



wherein R is a C1-5 alkyl group, or a salt thereof, with a *tert*-butoxycarbonyl group, resulting in a Boc-protected *L*-serine ester;

b) allowing the Boc-protected *L*-serine ester to react with 2,2-dimethoxypropane in the presence of benzenesulfonic acid under conditions effective to yield the corresponding C1-C5 alkyl ester of (*S*)-3-(*tert*-butoxycarbonyl)-2,2-dimethyl-4-oxazolidincarboxylic acid;

c) allowing the corresponding C1-C5 alkyl ester of (*S*)-3-(*tert*-butoxycarbonyl)-2,2-dimethyl-4-oxazolidincarboxylic acid to react with dimethyl methylphosponate in the presence of n-butyllithium under conditions effective to yield (*S*)-3-(*tert*-butoxycarbonyl)-4-(2-(dimethoxy-phosphoryl)-1-oxo-ethyl)-2,2-dimethyloxazolidine;

d) allowing (*S*)-3-(*tert*-butoxycarbonyl)-4-(2-(dimethoxy-phosphoryl)-1-oxo-ethyl)-2,2-dimethyloxazolidine to react with 1-tetradecanal under conditions effective to yield (*S*)-3-(*tert*-butoxycarbonyl)-4-(1-oxo-hexadec-2-enyl)-2,2-dimethyloxazolidine;

e) allowing (*S*)-3-(*tert*-butoxycarbonyl)-4-(1-oxo-hexadec-2-enyl)-2,2-dimethyloxazolidine to react with sodium borohydride and cerium trichloride under conditions effective to yield (2*S*,3*R*,4*E*)-3-(*tert*-butoxycarbonyl)-4-(1-hydroxy-hexadec-2-enyl)-2,2-dimethyloxazolidine; and

f) removing the *tert*-butoxycarbonyl (Boc) protecting group of (2*S*,3*R*,4*E*)-3-(*tert*-butoxycarbonyl)-4-(1-hydroxy-hexadec-2-enyl)-2,2-dimethyloxazolidine under conditions effective to yield *D-erythro*-sphingosine.

2. The method of claim 1, wherein R is a methyl group.

3. A method for synthesizing *N*-palmitoyl-*D-erythro*-sphingosine, comprising the steps of:

a) allowing (1*R*, 2*R*, 5*R*)-(+)-2-hydroxy-3-pinanone to react with ethylglycinate under conditions effective to yield (*1R, 2R, 5R*)-ethyl-((2-hydroxypinan-3-ylene)amino)acetate;

b) allowing (*1R, 2R, 5R*)-ethyl-((2-hydroxypinan-3-ylene)amino)acetate (Compound IIIb) to react with 2-(*E*)-hexadecen-1-al in the presence of chlorotitanium triisopropoxyde and triethylamine under conditions effective to yield one or both of (2*S*,3*R*,*E*)-ethyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate and (2*S*,3*R*,*E*)-isopropyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate;

c) allowing the one or both of (2*S*,3*R*,*E*)-ethyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate and (2*S*,3*R*,*E*)-isopropyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate to react with hydrochloric acid under conditions effective to yield one or both of (2*R*,3*R*,*E*)-ethyl 2-amino-3-hydroxyoctadec-4-enoate and (2*R*,3*R*,*E*)-propyl 2-amino-3-hydroxyoctadec-4-enoate;

d) allowing the one or both of (2*R*,3*R*,*E*)-ethyl 2-amino-3-hydroxyoctadec-4-enoate and (2*R*,3*R*,*E*)-propyl 2-amino-3-hydroxyoctadec-4-enoate to react with sodium borohydride under conditions effective to yield *D-erythro*-sphingosine; and

e) allowing *D-erythro*-sphingosine to react with palmitic acid under conditions effective to yield *N*-palmitoyl-*D-erythro*-sphingosine.

4. A method for synthesizing an *N*-acyl-*D-erythro*-sphingomyelin comprising the steps of:

a) allowing *D-erythro*-sphingosine to react with a fatty acid under conditions effective to yield a *D-erythro*-ceramide;

b) allowing *D-erythro*-ceramide to react with a tritylating reagent under conditions effective to yield 1-O-trityl-*D-erythro*-ceramide;

c) allowing 1-O-trityl-*D-erythro*-ceramide to react with a benzoylating reagent under conditions effective to yield 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide;

d) removing the trityl group of 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide to yield *D-erythro*-3-O-benzoyl-ceramide;

e) allowing 3-O-benzoyl-*D-erythro*-ceramide to react with with 2-chloro-2-oxo-1,3,2-dioxaphospholane (CCP) under conditions effective to yield 3-*O*-benzoyl-*D-erythro*-1-*O*-(2-oxo-1,3,2-dioxaphospholane) ceramide;

f) allowing 3-*O*-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane) ceramide to react with trimethylamine under conditions effective to yield the *N*-acyl-3-*O*-benzoyl-*D-erythro* -sphingomyelin; and

g) removing the benzoyl group of *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin under conditions effective to yield the *N*-acyl-*D-erythro*-sphingomyelin.

5. A method for synthesizing *D-erythro*-3-O-benzoyl-ceramide, comprising the steps of

a) allowing *D-erythro*-ceramide to react with a tritylating reagent under conditions effective to yield 1-O-trityl-*D-erythro*-ceramide;

b) allowing 1-O-trityl-*D-erythro*-ceramide to react with a benzoylating reagent under conditions effective to yield 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide; and

c) removing the trityl group of 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide under conditions effective to yield 3-O-benzoyl-*D-erythro*-ceramide.

6. The method of claim 4 wherein the fatty acid is palmitic acid.

7. The method of claim 5 wherein in the *D-erythro*-ceramide is *N*-palmitoyl-*D-erythro*-sphingosine.

8. The method of claim 4 wherein the trimethylamine is added as a liquid.

9. The method of claim 4 wherein step b yields less than about 5% of 1,3-O,O-dityityl-*D-erythro*-ceramide.

10. The method of claim 9 wherein step a yields less than about 5% of 1,3-O,O-dityityl-*D-erythro*-ceramide.

11. A method for synthesizing an *N*-acyl-*D-erythro*-sphingomyelin, comprising the steps of:

a) allowing 3-O-benzoyl-*D-erythro*-ceramide to react with 2-chloro-2-oxo-1,3,2-dioxaphospholane (CCP) under conditions effective to yield 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane)ceramide;

b) allowing 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane)ceramide to react with trimethylamine to yield the 3-O-benzoyl-*D-erythro*-ceramide; and

c) removing the benzoyl group of 3-O-benzoyl-*D-erythro*-ceramide under conditions effective to yield the *N*-acyl-*D-erythro*-sphingomyelin.

12. The method of claim 11 wherein in the *D-erythro*-3-O-benzoylceramide is *N*-palmitoyl-*D-erythro*-sphingosine.

13. The method of claim 11 wherein the trimethylamine is added as a liquid.

14. The method of claim 11 wherein the trimethylamine is cooled to below its boiling point prior to addition.

15. A method for synthesizing an *N*-acyl-*D-erythro*-dihydrosphingomyelin, comprising the steps of:

a) allowing a *D-erythro*-dihydrosphingosine to react with a fatty acid under conditions effective to yield a *D-erythro*-dihydroceramide;

b) allowing the *D-erythro*-dihydroceramide to react with a tritylating agent under conditions effective to yield a 1-O-trityl-*D-erythro*-dihydroceramide;

c) allowing the *D-erythro*-1-O-trityl-dihydroceramide to react with a benzoylating agent under conditions effective to yield a 1-O-trityl-3-O-benzoyl-*D-erythro*-dihydroceramide;

d) removing the trityl group of 1-O-trityl-3-O-benzoyl-*D-erythro*-dihydroceramide under conditions effective to yield a 3-O-benzoyl-*D-erythro*-ceramide;

e) allowing the 3-O-benzoyl-*D-erythro*-dihydroceramide to react with 2-chloro-2-oxo-1,3,2-dioxaphospholane (CCP) under conditions effective to yield a 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane) dihydroceramide;

f) allowing the 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane) dihydroceramide to react with trimethylamine under conditions effective to yield an *N*-acyl-3-O-benzoyl-*D-erythro*-dihydrosphingomyelin; and

g) removing the benzoyl group of the *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin under conditions effective to yield the *N*-acyl-*D-erythro*-dihydrosphingomyelin.

16. A method for synthesizing *N*-palmitoyl-*D-erythro*-sphingomyelin comprising the steps of:

a) allowing *N*-palmitoyl-*D-erythro*-sphingosine to react with ethylene halophosphite under conditions effective to yield *N*-((2S,3R,E)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadec-4-en-2-yl)palmitoylamide;

b) allowing *N*-((2S,3R,E)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadec-4-en-2-yl)palmitoylamide to react with bromine under conditions effective to yield 2-bromoethyl ((2S,3R,E)-3-hydroxy-2-palmitamidooctadec-4-en-1-yl)phosphorobromidate; and

c) allowing 2-bromoethyl ((2S,3R,E)-3-hydroxy-2-palmitamidooctadec-4-en-1-yl)phosphorobromidate to react with trimethylamine under conditions effective to yield *N*-palmitoyl-*D-erythro*-sphingomyelin.

17. The method of claim 16 wherein the ethylene halophosphite is ethylene chlorophosphite.

18. A method for synthesizing *N*-palmitoyl-D-*erythro*-dihydrosphingomyelin, comprising the steps of:

a) allowing *N*-palmitoyl-*D-erythro*-dihydrosphingosine to react with ethylene chlorophosphite under conditions effective to yield *N*-((2S,3R)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadecan-2-yl)palmitamide;

b) allowing *N*-((2S,3R)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadecan-2-yl)palmitamide to react with bromine under conditions effective to yield 2-bromoethyl ((2S,3R)-3-hydroxy-2-palmitamidooctadecyl) phosphorobromidate; and

c) allowing 2-bromoethyl ((2S,3R)-3-hydroxy-2-palmitamidooctadecyl) phosphorobromidate to react with trimethylamine under conditions effective to yield *N*-palmitoyl-*D-erythro*-dihydrosphingomyelin.

19. The method of claim 20 wherein the ethylene halophosphite is ethylene chlorophosphite.

20. A method for synthesizing an *N*-acyl-*D-erythro*-sphingomyelin, comprising the steps of:

a) allowing 3-O-benzoyl-*D-erythro*-ceramide to react with 2-chloro-2-oxo-1,3,2-dioxaphospholane (CCP) to under conditions effective to yield 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane)ceramide;

b) allowing 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane)ceramide e to react with trimethylamine under conditions effective to yield an *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin; and

c) removing the benzoyl group of the *N*-acyl-3-O-benzoyl- *D-erythro*-sphingomyelin under conditions effective to yield the *N*-acyl-*D-erythro*-sphingomyelin.

21. The method according to claim 20 wherein in the 3-O-benzoyl- *D-erythro*-ceramide is *N*-palmitoyl-3-O-benzoyl-*D-erythro*-sphingosine.

22. The method according to claim 1, further comprising, prior to step a:

1) allowing *D-erythro*-sphingosine to react with a fatty acid under conditions effective to yield *D-erythro*-ceramide;

2) allowing *D-erythro*-ceramide to react with a tritylating agent under conditions effective to yield *D-erythro*-1-O-trityl-ceramide;

3) allowing 1-O-trityl-*D-erythro*-ceramide to react with a benzoylating agent under conditions effective to yield 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide; and

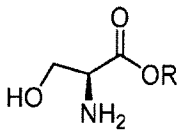
4) removing the trityl group of 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide under conditions effective to yield *D-erythro*-3-O-benzoyl-ceramide.

23. The method according to claim 23 wherein the fatty acid is palmitic acid.

24. The method according to claim 20 wherein the trimethylamine is added as a liquid.

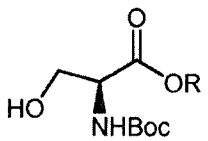
25. The method according to claim 22 wherein step 2) yields less than about 5% of 1,3-O,O-dityrityl-*D-erythro*-ceramide..

26. A compound having the structure:

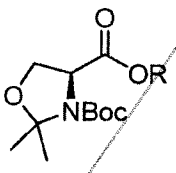


L-Serine Ester
Compound Ia

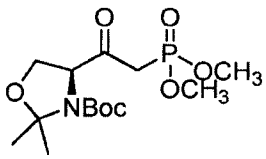
, or a salt thereof;



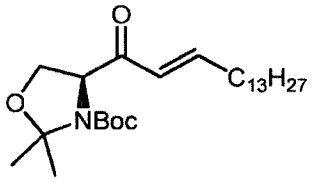
Boc-L-Ser-OR
Compound Ib ;



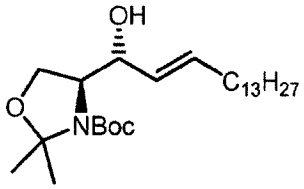
Compound Ic ;



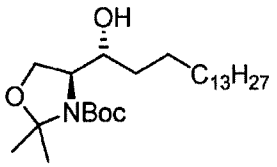
(S)-3-(tert-butoxycarbonyl)-4-(2-(dimethoxyphosphoryl)-1-oxo-ethyl)-2,2-dimethyloxazolidin
Compound Id ;



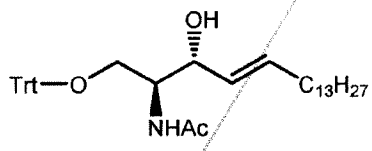
(S)-3-(tert-butoxycarbonyl)-4-(1-oxo-hexadec-2-enyl)-2,2-dimethyloxazolidin
Compound Ie ;



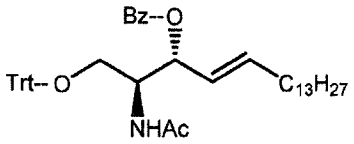
(2S,3R,4E)-3-(tert-butoxycarbonyl)-4-(1-hydroxy-hexadec-2-enyl)-2,2-dimethyloxazolidin
Compound If ;



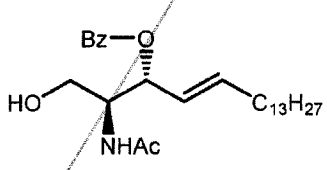
((S)-tert-butyl 4-((R)-1-hydroxyhexadecyl)-2,2-dimethyloxazolidine-3-carboxylate
Compound IIa ;



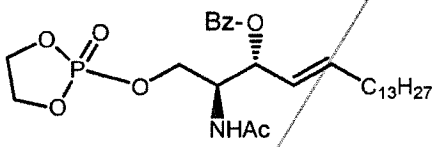
1-O-Trityl-*D-erythro*-ceramide
Compound Vc-Trt ;



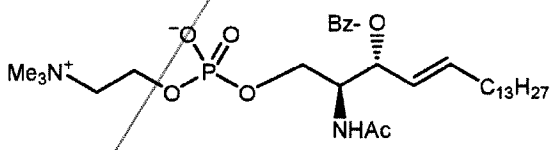
1-O-Benzoyl -3-O-Trityl-*D-erythro*-ceramide
Compound Vd-Bz-Trt ;



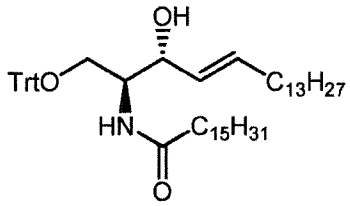
1-O-Benzoyl-*D-erythro*-ceramide
Compound Ve-Bz ;



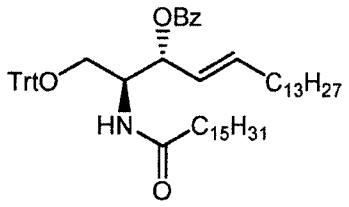
3-O-Benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholan)-ceramide
Compound Vf-Bz ;



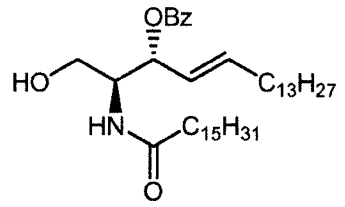
Compound Vg - Bz ;



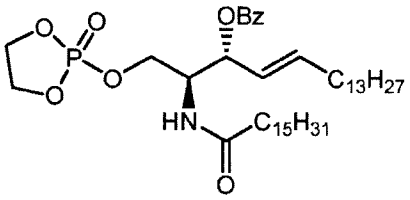
N-Palmitoyl-1-O-Trityl-D-erythro-sphingosine
Compound VIa ;



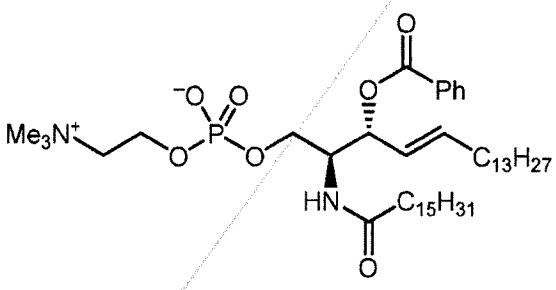
N-Palmitoyl-1-O-Trityl-3-O-Benzoyl-D-erythro-sphingosine
Compound VIb ;



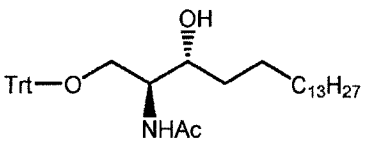
N-Palmitoyl-3-O-Benzoyl-D-erythro-sphingosine
Compound VIc ;



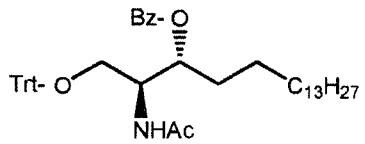
N-Palmitoyl 3-O-Benzoyl-D-erythro-1-O-(2-oxo-1,3,2-dioxaphospholan)-sphingosine
Compound VId ;



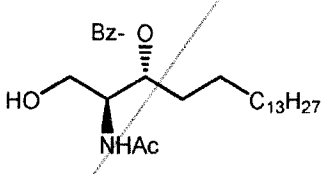
N-Palmitoyl 3-O-Benzoyl-D-erythro-Sphingomyelin
Compound VIe ;



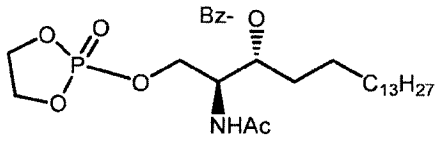
1-O-Trityl-*D-erythro*-dihydroceramide
Compound VIIc -Trt ;



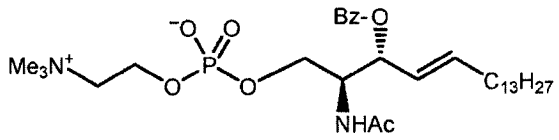
1-O-Trityl-3-O-Benzoyl-*D-erythro*-dihydroceramide
Compound VIId ;



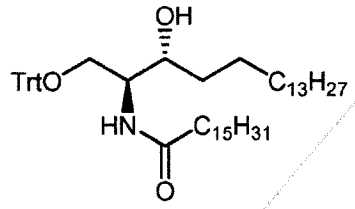
3-O-Benzoyl-*D-erythro*-dihydroceramide
Compound VIIe ;



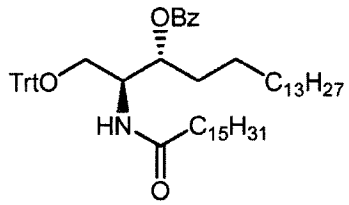
3-O-Benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholan)-dihydroceramide
Compound VIIf ;



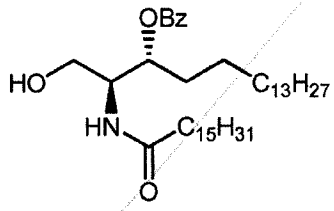
Compound VIIg ;



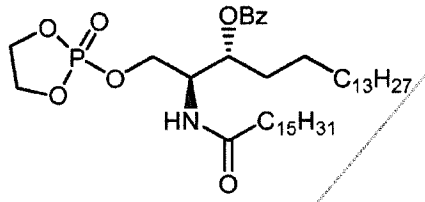
N-palmitoyl 1-O-Trityl-
D-erythro-dihydrosphingosine
Compound VIIIa ;



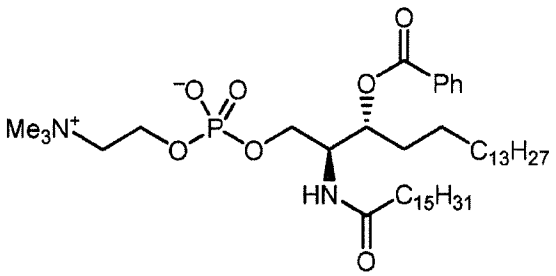
N-palmitoyl-1-O-Trityl-3-O-Benzoyl-
D-erythro-dihydrosphingosine
Compound VIIIb ;



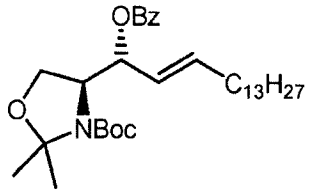
N-palmitoyl 3-O-Benzoyl-
D-erythro-dihydrosphingosine
Compound VIIIc ;



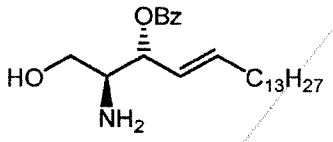
N-palmitoyl 3-O-Benzoyl-
1-O-(2-oxo-1,3,2-dioxaphospholan)
D-erythro-dihydrosphingosine
Compound VIIId ;



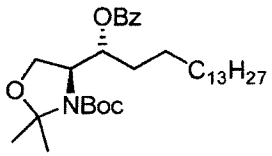
N-Palmitoyl-3-O-Benzoyl-D-erythro-
dihydrosphingomyelin
Compound VIIIe ;



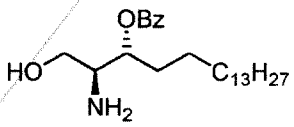
(2S,3R,4E)-3-(tert.-Butoxycarbonyl)-4-(1-benzoyl-hexadec-2-enyl)-2,2-dimethyloxazolidine
Compound IXa ;



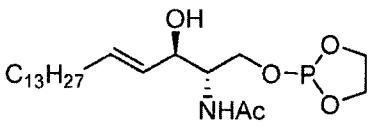
D-erythro-3-O-Benzoyl-Sphingosine
Compound IXb ;



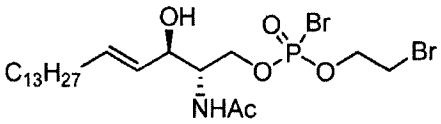
(S)-tert-butyl 4-((R)-1-(benzoyloxy)hexadecyl)-2,2-dimethyloxazolidine-3-carboxylate
Compound XIIa ;



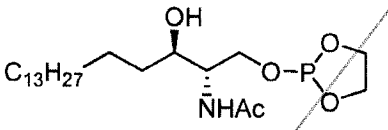
3-O-Benzoyl-
D-erythro-dihydrosphingosine
Compound XIIb



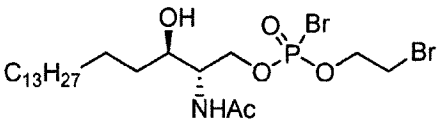
; Compound XIIIa ;



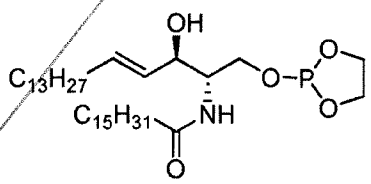
Compound XIIIb ;



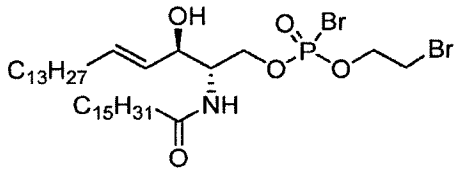
Compound XIVa ;



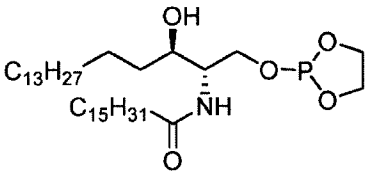
Compound XIVb ;



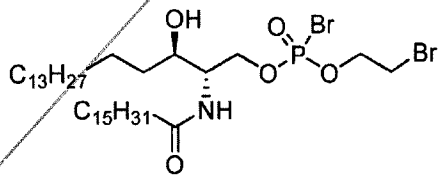
N-((2S,3R,E)-1-((1,3,2-dioxaphospholan-2-yl) oxy)-3-hydroxyoctadec-4-en-2-yl)palmitamide ;



2-bromoethyl ((2S,3R,E)-3-hydroxy-2-palmitamidooctadec-4-en-1-yl) phosphorobromidate ;



N-((2S,3R)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadecan-2-yl)palmitamide ; or



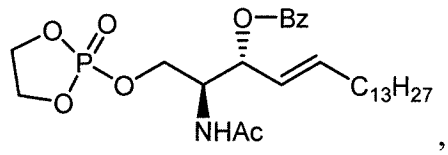
2-bromoethyl ((2S,3R)-3-hydroxy-2-palmitamidooctadecyl) phosphorobromidate ;

where Ac is a fatty acid residue having 3 to 36 carbons and zero to six carbon-carbon double bonds; and

R is a C1-5 alkyl group.

CLAIMS

1. A compound having the formula:



,

wherein Ac is a fatty acid residue having 3 to 36 carbons and zero to six carbon-carbon double bonds.

2. The compound of claim 1, wherein the fatty acid is palmitic acid.

3. A method for synthesizing the compound of claim 1, comprising allowing an *N*-acyl-3-O-benzoyl-*D-erythro*-ceramide to react with 2-chloro-2-oxo-1,3,2-dioxaphospholane under conditions suitable to yield the compound, wherein the acyl is Ac.

4. The method of claim 3, further comprising allowing 3-O-benzoyl-*D-erythro*-sphingosine to react with HOAc under conditions suitable to yield the *N*-acyl-3-O-benzoyl-*D-erythro*-ceramide.

5. The method of claim 4, further comprising allowing (2S,3R,4E)-3-(tert-butoxycarbonyl)-4-(1-benzoyl-hexadec-2-enyl)-2,2-dimethyloxazolidine to react with hydrochloric acid under conditions suitable to yield the 3-O-benzoyl-D-*erythro*-sphingosine.

6. The method of claim 5, further comprising allowing (2S,3R,4E)-3-(tert-butoxycarbonyl)-4-(1-hydroxy-hexadec-2-enyl)-2,2-dimethyloxazolidine to react with a benzoylating reagent under conditions effective to yield the (2S,3R,4E)-3-(tert-butoxycarbonyl)-4-(1-benzoyl-hexadec-2-enyl)-2,2-dimethyloxazolidine.

7. A method for synthesizing an *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin, comprising allowing the compound of claim 1 to react with trimethylamine under conditions effective to yield the *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin.

8. A method for synthesizing an *N*-acyl-*D-erythro*-sphingomyelin, comprising performing the method of claim 7 and allowing the *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin to react with

a debenzoylating reagent under conditions that are effective to yield the *N*-acyl-*D-erythro*-sphingomyelin.

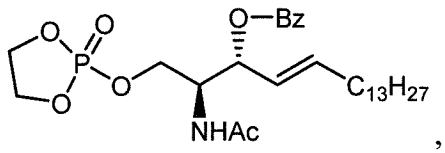
9. The method of claim 3, wherein the *N*-acyl-3-O-benzoyl-*D-erythro*-ceramide is *N*-palmitoyl-3-O-benzoyl-*D-erythro*-sphingosine.

10. The method of claim 4 wherein the fatty acid is palmitic acid and the *N*-acyl-3-O-benzoyl-*D-erythro*-ceramide is *N*-palmitoyl-3-O-benzoyl-*D-erythro*-sphingosine.

11. The method of claim 7, wherein the *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin is *N*-palmitoyl-3-O-benzoyl-*D-erythro*-sphingomyelin and the fatty acid is palmitic acid.

12. The method of claim 8, wherein the *N*-acyl-D-*erythro*-sphingomyelin is *N*-palmitoyl-*D-erythro*-sphingomyelin and the *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin is *N*-palmitoyl-3-O-benzoyl-D-*erythro*-sphingomyelin.

13. A compound having the formula:



,

wherein Ac is palmitoyl.

14. A method for synthesizing the compound of claim 13, comprising allowing *N*-acyl-3-O-benzoyl-*D-erythro*-ceramide to react with 2-chloro-2-oxo-1,3,2-dioxaphospholane under conditions suitable to yield the compound, wherein acyl is palmitoyl.

15. A method for synthesizing *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin, comprising allowing the compound of claim 13 to react with trimethylamine under conditions effective to yield *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin, wherein acyl is palmitoyl.

16. A method for synthesizing *N*-acyl-*D-erythro*-sphingomyelin, comprising performing the method of claim 15 and allowing *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin to react with a debenzoylating reagent under conditions that are effective to yield *N*-acyl-*D-erythro*-sphingomyelin, wherein acyl is palmitoyl.

17. The method of claim 15, wherein the trimethylamine is added as a liquid.

18. The method of claim 15, wherein the trimethylamine is added in a gaseous form.

19. A method for synthesizing *N*-palmitoyl-D-*erythro*-sphingomyelin, comprising:

allowing the compound of claim 13 to react with trimethylamine under conditions effective to yield *N*-palmitoyl-D-*erythro*-3-O-benzoyl-sphingosine; and

allowing *N*-palmitoyl-D-*erythro*-3-O-benzoyl-sphingosine to react with sodium methoxide under conditions effective to yield *N*-palmitoyl-D-*erythro*-sphingomyelin.

20. A method for synthesizing *N*-palmitoyl-D-*erythro*-sphingomyelin, comprising:

allowing *N*-palmitoyl-3-O-benzoyl-D-*erythro*-sphingosine to react with 2-chloro-2-oxo-1,3,2-dioxaphospholane under conditions effective to yield the compound of claim 13;

allowing the compound of claim 13 to react with trimethylamine under conditions effective to yield *N*-palmitoyl-D-*erythro*-3-O-benzoyl-sphingosine; and

allowing *N*-palmitoyl-D-*erythro*-3-O-benzoyl-sphingosine to react with sodium methoxide under conditions effective to yield *N*-palmitoyl-D-erythro-sphingomyelin.

21. The method of claim 19, wherein the trimethylamine is added as a liquid.

22. The method of claim 19, wherein the trimethylamine is added in a gaseous form.

23. The method of claim 20, wherein the trimethylamine is added as a liquid.

24. The method of claim 20, wherein the trimethylamine is added in a gaseous form.

25. The method of claim 14, wherein the method is performed on a kilogram scale.

26. The method of claim 15, wherein the method is performed on a kilogram scale.

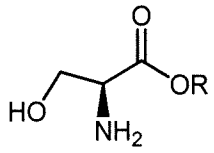
27. The method of claim 16, wherein the method is performed on a kilogram scale.

28. The method of claim 19, wherein the method is performed on a kilogram scale.

29. The method of claim 20, wherein the method is performed on a kilogram scale.

30. A method for synthesizing *D-erythro*-sphingosine, comprising the steps of:

a) protecting the amino group of an *L*-serine ester having the following structure:



wherein R is a C1-5 alkyl group, or a salt thereof, with a *tert*-butoxycarbonyl group, resulting in a Boc-protected *L*-serine ester;

b) allowing the Boc-protected *L*-serine ester to react with 2,2-dimethoxypropane in the presence of benzenesulfonic acid under conditions effective to yield the corresponding C1-C5 alkyl ester of (*S*)-3-(*tert*-butoxycarbonyl)-2,2-dimethyl-4-oxazolidincarboxylic acid;

c) allowing the corresponding C1-C5 alkyl ester of (*S*)-3-(*tert*-butoxycarbonyl)-2,2-dimethyl-4-oxazolidincarboxylic acid to react with dimethyl methylphosponate in the presence of n-butyllithium under conditions effective to yield (*S*)-3-(*tert*-butoxycarbonyl)-4-(2-(dimethoxy-phosphoryl)-1-oxo-ethyl)-2,2-dimethyloxazolidine;

d) allowing (*S*)-3-(*tert*-butoxycarbonyl)-4-(2-(dimethoxy-phosphoryl)-1-oxo-ethyl)-2,2-dimethyloxazolidine to react with 1-tetradecanal under conditions effective to yield (*S*)-3-(*tert*-butoxycarbonyl)-4-(1-oxo-hexadec-2-enyl)-2,2-dimethyloxazolidine;

e) allowing (*S*)-3-(*tert*-butoxycarbonyl)-4-(1-oxo-hexadec-2-enyl)-2,2-dimethyloxazolidine to react with sodium borohydride and cerium trichloride under conditions effective to yield (2*S*,3*R*,4*E*)-3-(*tert*-butoxycarbonyl)-4-(1-hydroxy-hexadec-2-enyl)-2,2-dimethyloxazolidine; and

f) removing the *tert*-butoxycarbonyl (Boc) protecting group of (2*S*,3*R*,4*E*)-3-(*tert*-butoxycarbonyl)-4-(1-hydroxy-hexadec-2-enyl)-2,2-dimethyloxazolidine under conditions effective to yield *D-erythro*-sphingosine.

31. The method of claim 30, wherein R is a methyl group.

32. A method for synthesizing *N*-palmitoyl-*D-erythro*-sphingosine, comprising the steps of:

a) allowing (1*R*, 2*R*, 5*R*)-(+)-2-hydroxy-3-pinanone to react with ethylglycinate under conditions effective to yield (*1R*, *2R*, *5R*)-ethyl-((2-hydroxypinan-3-ylene)amino)acetate;

b) allowing (*1R*, *2R*, *5R*)-ethyl-((2-hydroxypinan-3-ylene)amino)acetate (Compound IIIb) to react with 2-(*E*)-hexadecen-1-al in the presence of chlorotitanium triisopropoxyde and triethylamine under conditions effective to yield one or both of (2*S*,3*R*,*E*)-ethyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate and (2*S*,3*R*,*E*)-isopropyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate;

c) allowing the one or both of (2*S*,3*R*,*E*)-ethyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate and (2*S*,3*R*,*E*)-isopropyl 3-hydroxy-2-((*E*)-((1*S*,2*S*,5*S*)-2-hydroxy-2,6,6-trimethylbicyclo[3.1.1]heptan-3-ylidene)amino)octadec-4-enoate to react with hydrochloric acid under conditions effective to yield one or both of (2*R*,3*R*,*E*)-ethyl 2-amino-3-hydroxyoctadec-4-enoate and (2*R*,3*R*,*E*)-propyl 2-amino-3-hydroxyoctadec-4-enoate;

d) allowing the one or both of (2*R*,3*R*,*E*)-ethyl 2-amino-3-hydroxyoctadec-4-enoate and (2*R*,3*R*,*E*)-propyl 2-amino-3-hydroxyoctadec-4-enoate to react with sodium borohydride under conditions effective to yield *D-erythro*-sphingosine; and

e) allowing *D-erythro*-sphingosine to react with palmitic acid under conditions effective to yield *N*-palmitoyl-*D-erythro*-sphingosine.

33. A method for synthesizing an *N*-acyl-*D-erythro*-sphingomyelin comprising the steps of:

a) allowing *D-erythro*-sphingosine to react with a fatty acid under conditions effective to yield a *D-erythro*-ceramide;

b) allowing *D-erythro*-ceramide to react with a tritylating reagent under conditions effective to yield 1-O-trityl-*D-erythro*-ceramide;

c) allowing 1-O-trityl-*D-erythro*-ceramide to react with a benzoylating reagent under conditions effective to yield 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide;

d) removing the trityl group of 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide to yield *D-erythro*-3-O-benzoyl-ceramide;

e) allowing 3-O-benzoyl-*D-erythro*-ceramide to react with with 2-chloro-2-oxo-1,3,2-dioxaphospholane (CCP) under conditions effective to yield 3-*O*-benzoyl-*D-erythro*-1-*O*-(2-oxo-1,3,2-dioxaphospholane) ceramide;

f) allowing 3-*O*-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane) ceramide to react with trimethylamine under conditions effective to yield the *N*-acyl-3-*O*-benzoyl-*D-erythro* - sphingomyelin; and

g) removing the benzoyl group of *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin under conditions effective to yield the *N*-acyl-*D-erythro*-sphingomyelin.

34. A method for synthesizing *D-erythro*-3-O-benzoyl-ceramide, comprising the steps of

a) allowing *D-erythro*-ceramide to react with a tritylating reagent under conditions effective to yield 1-O-trityl-*D-erythro*-ceramide;

b) allowing 1-O-trityl-*D-erythro*-ceramide to react with a benzoylating reagent under conditions effective to yield 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide; and

c) removing the trityl group of 1-O-trityl-3-O-benzoyl-*D-erythro*-ceramide under conditions effective to yield 3-O-benzoyl-*D-erythro*-ceramide.

35. The method of claim 33, wherein the fatty acid is palmitic acid.

36. The method of claim 34, wherein in the *D-erythro*-ceramide is *N*-palmitoyl-*D-erythro*-sphingosine.

37. The method of claim 33, wherein the trimethylamine is added as a liquid.

38. The method of claim 33, wherein step b yields less than about 5% of 1,3-O,O-ditrityl-*D-erythro*-ceramide.

39. The method of claim 38, wherein step a yields less than about 5% of 1,3-O,O-ditrityl-*D-erythro*-ceramide.

40. A method for synthesizing an *N*-acyl-*D-erythro*-dihydrosphingomyelin, comprising the steps of:

a) allowing a *D-erythro*-dihydrosphingosine to react with a fatty acid under conditions effective to yield a *D-erythro*-dihydroceramide;

b) allowing the *D-erythro*-dihydroceramide to react with a tritylating agent under conditions effective to yield a 1-O-trityl-*D-erythro*-dihydroceramide;

c) allowing the *D-erythro*-1-O-trityl-dihydroceramide to react with a benzoylating agent under conditions effective to yield a 1-O-trityl-3-O-benzoyl-*D-erythro*-dihydroceramide;

d) removing the trityl group of 1-O-trityl-3-O-benzoyl-*D-erythro*-dihydroceramide under conditions effective to yield a 3-O-benzoyl-*D-erythro*-ceramide;

e) allowing the 3-O-benzoyl-*D-erythro*-dihydroceramide to react with 2-chloro-2-oxo-1,3,2-dioxaphospholane (CCP) under conditions effective to yield a 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane) dihydroceramide;

f) allowing the 3-O-benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholane) dihydroceramide to react with trimethylamine under conditions effective to yield an *N*-acyl-3-O-benzoyl-*D-erythro*-dihydrosphingomyelin; and

g) removing the benzoyl group of the *N*-acyl-3-O-benzoyl-*D-erythro*-sphingomyelin under conditions effective to yield the *N*-acyl-*D-erythro*-dihydrosphingomyelin.

41. A method for synthesizing *N*-palmitoyl-*D-erythro*-sphingomyelin comprising the steps of:

a) allowing *N*-palmitoyl-*D-erythro*-sphingosine to react with ethylene halophosphite under conditions effective to yield *N*-((2S,3R,E)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadec-4-en-2-yl)palmitoylamide;

b) allowing *N*-((2S,3R,E)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadec-4-en-2-yl)palmitoylamide to react with bromine under conditions effective to yield 2-bromoethyl ((2S,3R,E)-3-hydroxy-2-palmitamidooctadec-4-en-1-yl)phosphorobromidate; and

c) allowing 2-bromoethyl ((2S,3R,E)-3-hydroxy-2-palmitamidooctadec-4-en-1-yl)phosphorobromidate to react with trimethylamine under conditions effective to yield *N*-palmitoyl-*D-erythro*-sphingomyelin.

42. The method of claim 41, wherein the ethylene halophosphite is ethylene chlorophosphite.

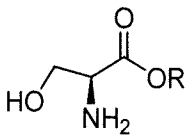
43. A method for synthesizing *N*-palmitoyl-D-*erythro*-dihydrosphingomyelin, comprising the steps of:

a) allowing *N*-palmitoyl-*D-erythro*-dihydrosphingosine to react with ethylene chlorophosphite under conditions effective to yield *N*-((2S,3R)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadecan-2-yl)palmitamide;

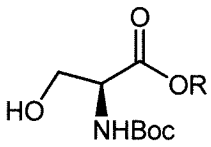
b) allowing *N*-((2S,3R)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadecan-2-yl)palmitamide to react with bromine under conditions effective to yield 2-bromoethyl ((2S,3R)-3-hydroxy-2-palmitamidooctadecyl) phosphorobromidate; and

c) allowing 2-bromoethyl ((2S,3R)-3-hydroxy-2-palmitamidooctadecyl) phosphorobromidate to react with trimethylamine under conditions effective to yield *N*-palmitoyl-*D-erythro*-dihydrosphingomyelin.

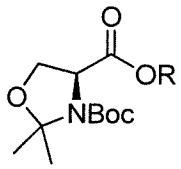
44. A compound having the structure:



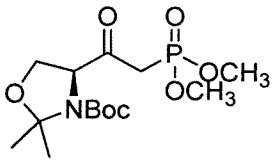
L-Serine Ester
Compound Ia , or a salt thereof;



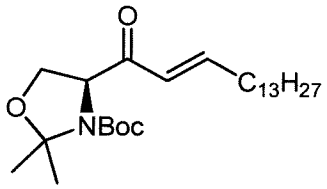
Boc-L-Ser-OR
Compound Ib ;



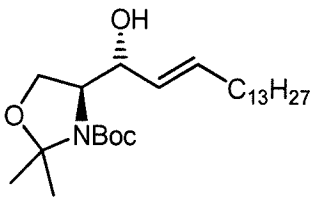
Compound Ic ;



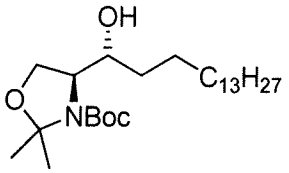
(S)-3-(tert-butoxycarbonyl)-4-(2-(dimethoxyphosphoryl)-1-oxo-ethyl)-2,2-dimethyloxazolidin
Compound Id ;



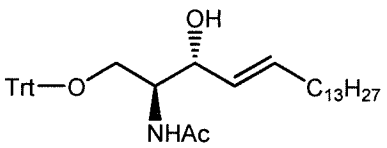
(S)-3-(tert-butoxycarbonyl)-4-(1-oxo-hexadec-2-enyl)-2,2-dimethyloxazolidin
Compound Ie ;



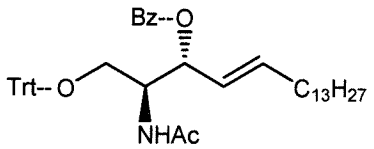
(2S,3R,4E)-3-(tert-butoxycarbonyl)-4-(1-hydroxy-hexadec-2-enyl)-2,2-dimethyloxazolidin
Compound If ;



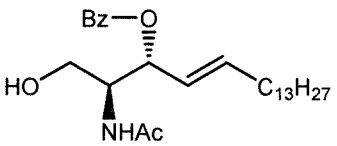
((S)-tert-butyl 4-((R)-1-hydroxyhexadecyl)-2,2-dimethyloxazolidine-3-carboxylate
Compound IIa ; ;



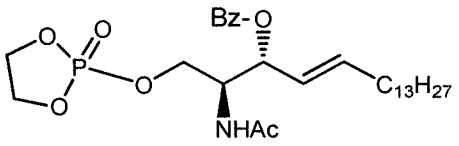
1-O-Trityl-*D-erythro*-ceramide
Compound Vc-Trt ;



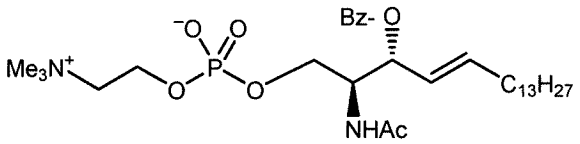
1-O-Benzoyl -3-O-Trityl-*D-erythro*-ceramide
Compound Vd-Bz-Trt ;



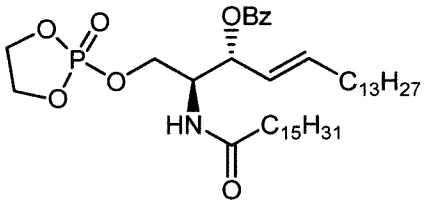
1-O-Benzoyl-*D-erythro*-ceramide
Compound Ve-Bz ;



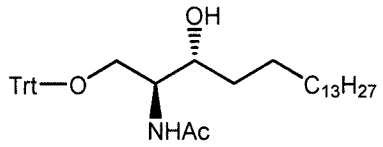
3-O-Benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholan)-ceramide
Compound Vf-Bz ;



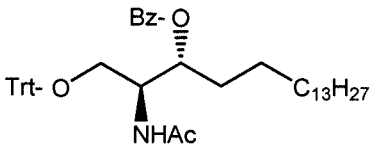
Compound Vg - Bz ;



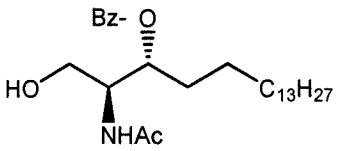
N-Palmitoyl 3-O-Benzoyl-D-erythro-1-O-(2-oxo-1,3,2-dioxaphospholan)-sphingosine
Compound VId ;



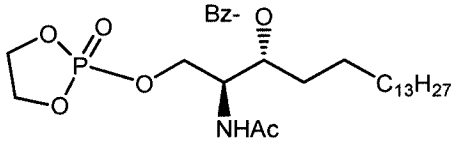
1-O-Trityl-*D-erythro*-dihydroceramide
Compound VIIc -Trt ;



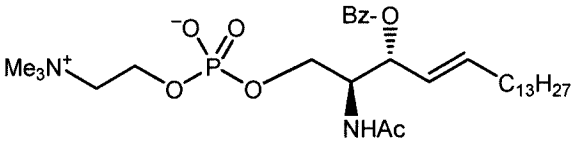
1-O-Trityl-3-O-Benzoyl-*D-erythro*-dihydroceramide
Compound VIId ;



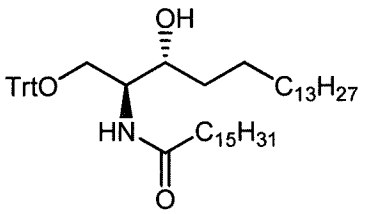
3-O-Benzoyl-*D-erythro*-dihydroceramide
Compound VIIe ;



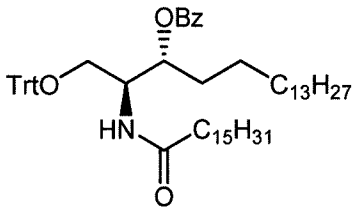
3-O-Benzoyl-*D-erythro*-1-O-(2-oxo-1,3,2-dioxaphospholan)-dihydroceramide
Compound VIIf ;



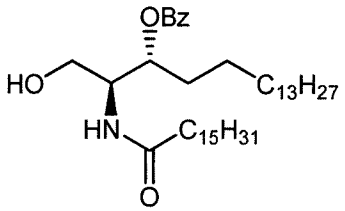
Compound VIIg ;



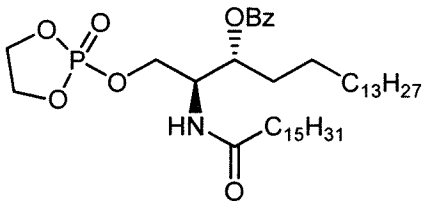
N-palmitoyl 1-O-Trityl-D-erythro-dihydrosphingosine
Compound VIIIa ;



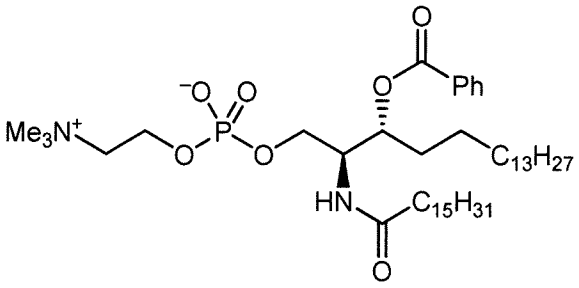
N-palmitoyl-1-O-Trityl-3-O-Benzoyl-D-erythro-dihydrosphingosine
Compound VIIIb ;



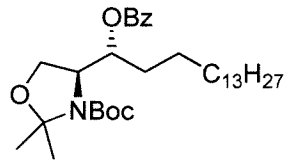
N-palmitoyl 3-O-Benzoyl-
D-erythro-dihydrosphingosine
Compound VIIIc ;



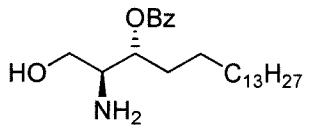
N-palmitoyl 3-O-Benzoyl-
1-O-(2-oxo-1,3,2-dioxaphospholan)
D-erythro-dihydrosphingosine
Compound VIIId ;



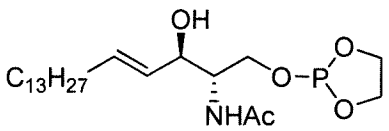
N-Palmitoyl-3-O-Benzoyl-D-erythro-
dihydrosphingomyelin
Compound VIIIe ;



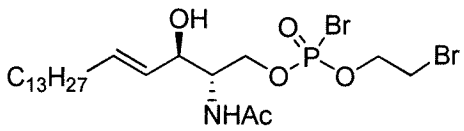
(S)-tert-butyl 4-((R)-1-(benzoyloxy)hexadecyl)-2,2-
dimethyloxazolidine-3-carboxylate
Compound XIIa ;



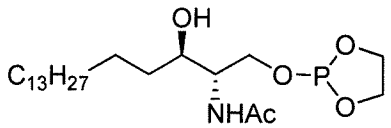
3-O-Benzoyl-
D-erythro-dihydrosphingosine
Compound XIIb



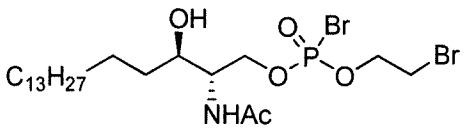
; Compound XIIIa ;



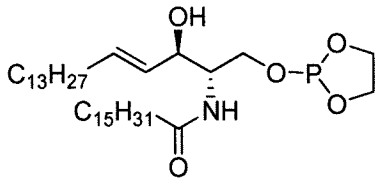
Compound XIIIb ;



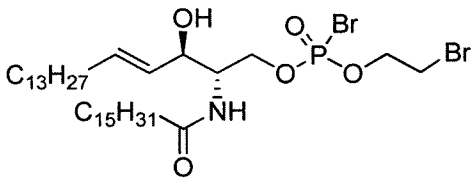
Compound XIVa ;



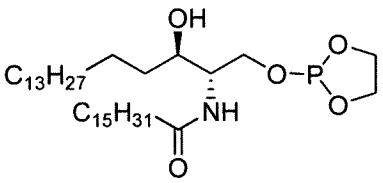
Compound XIVb ;



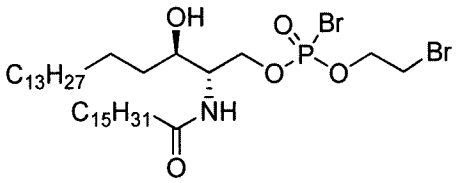
N-((2S,3R,E)-1-((1,3,2-dioxaphospholan-2-yl) oxy)-3-hydroxyoctadec-4-en-2-yl)palmitamide ;



2-bromoethyl ((2S,3R,E)-3-hydroxy-2-palmitamidooctadec-4-en-1-yl) phosphorobromidate ;



N-((2S,3R)-1-((1,3,2-dioxaphospholan-2-yl)oxy)-3-hydroxyoctadecan-2-yl)palmitamide ; or



2-bromoethyl ((2S,3R)-3-hydroxy-2-palmitamidooctadecyl) phosphorobromidate ;

where Ac is a fatty acid residue having 3 to 36 carbons and zero to six carbon-carbon double bonds; and

R is a C1-5 alkyl group.