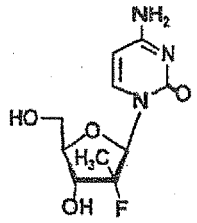
WE CLAIM:

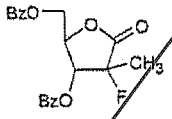
1. A method of synthesizing a 2'-deoxy-2'-fluoro-2'-C-methyl-β-D-ribofuranosyl nucleoside of the following formula:



14

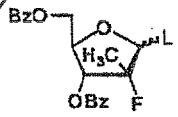
comprising the following steps:

(a) reducing the lactone of formula 49,



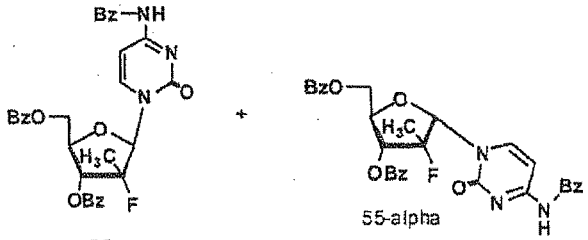
49

to the corresponding sugar followed by acetylation to yield the compound of formula 54B; wherein L is any leaving group;



54B

(b) condensation of the product of step (a), 54B, in a catalyst, with a silylated base to produce a mixture of protected nucleosides, 55 and55-α;



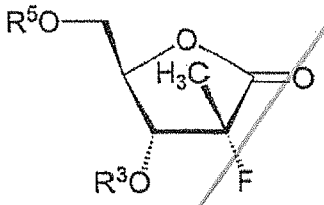
55 55-alpha

(c) separation of the anomers of step (b), 55 and 55-alpha; and

(d) deprotection of the protected nucleoside of step (c), 55, to produce the desired nucleoside.

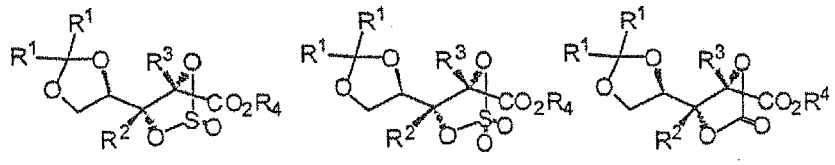
2. The method of claim 1, wherein the silylated base of step (b) is silylated N^4-benzoylcytosine andis deprotected with a metal alcoholate in alcohol.

3. A 3,5-di-O-protected-2-deoxy-2-fluoro-2-C-methyl-D-ribono-γ-lactone of the following general formula:



wherein R^3 and R^5 can be independently H, CH_3, acetyl, benzoyl, pivaloyl, or 4-nitrobenzoyl, 3-nitrobenzoyl, 2-nitrobenzoyl, 4-chlorobenzoyl, 3-chlorobenzoyl, 2-chlorobenzoyl, 4-methylbenzoyl, 3-methylbenzoyl, 2-methylbenzoyl, para-phenylbenzoyl, and other optionally substituted acyl (R^3 and R^5 are –C(O)-R, R can be independently lower alkyl of C_1-C_6, , or aryl of C_7-C_{20}), benzyl, 4-methoxybenzyl and other optionally substituted benzyl (R^3 and R^5 can be independently aryl of C_7-C_{20}), trityl, trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups; or alternatively, $R^{3'}$ and $R^{5'}$ are linked through -SiR_2-O-SiR_2- or -SiR_2-, wherein R is a lower alkyl such as CH_3, ethyl, and n-Pr or I-Pr.

4. The cyclic sulfite (**IIIa**), cyclic sulfate (**IIIb**), and cyclic carbonate (**IIIc**) of the following general formula:



IIIa **IIIb** **IIIc**

wherein

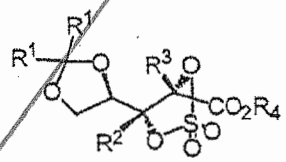
R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl;

alternatively, R^1 is a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively;

R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and

R^4 is independently hydrogen, aryl including phenyl, aryl alkyl including, benzyl, lower alkyl including methyl, ethyl, or propyl.

5. The cyclic sulfate (**IIIb**) of the following general formula:



IIIb

wherein

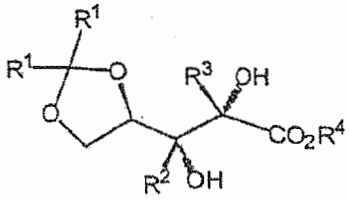
R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl;

alternatively, R^1 is a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively;

R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-), and

R^4 is independently hydrogen, aryl including phenyl, aryl alkyl including, benzyl, lower alkyl ($C_{6\text{-}10}$) including methyl, ethyl, or propyl.

6. A process for the preparation of a compound of formula IIIa of claim 4, comprising reacting a compound of formula, 42B,



42B

with a thionyl compound in presence of a base, wherein the base is a trialkylamine, in a solvent.

7. The process of claim 6, wherein the thionyl compound is thionyl chloride or thionyl diimidazole.

8. The process of claim 6, wherein the trialkylamine is selected from the group consisting of triethylamine, diisopropyl ethylamine and pyridine.

9. A process for preparation of a compound of formula IIIb of claim 5, comprising:

(a) mixing compound **IIIa** of claim 4 with one or more oxidants in one or more solvents;

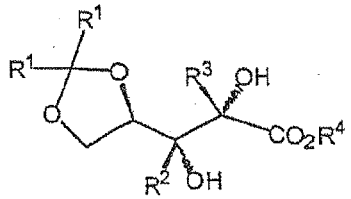
(b) alternatively, mixing a compound of the formula, **42B** of claim 6, with

sulfuryl chloride or sulfuryl diimidazole in presence of a base, in a solvent.

10. The process of claim 9, wherein the base is selected from one or more of the group consisting of trialkyl amine including triethylamine, diisopropyl ethylamine, and pyridine.

11. The process of claim 6, wherein the solvent is selected from one or more of the group consisting of chloroform, methylene chloride, 1,2-dichloroethane, diethyl ether, tetrahydrofuran, benzene, toluene, and water.

12. A process for the preparation of a compound of formula, IIIc of claim 5,



42B

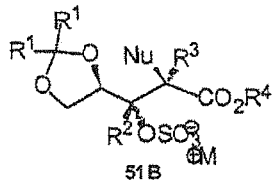
comprising mixing a compound of the formula, 42B, with carbonyl diimidazole in presence of a base, in solvent, or alternatively, with dimethyl carbonate at an elevated temperature.

13. The method of claim 9, wherein the oxidant is selected from one or more of the group consisting of $RuCl_3$, $KMnO_4$, TEMPO, $NaIO_4$, KIO_4, HIO_4, mCPBA, NaOCl, and oxone.

14. The process of claim 12, wherein the base is a trialkyl amine or pyridine.

15. The process of claim 12, wherein the solvent is selected from one or more of the group consisting of: chloroform, methylene chloride, 1,2-dichloroethane, diethyl ether, and tetrahydrofuran.

16. A compound of the following general formula 51B:



51B

wherein,

R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl; alternatively, R^1 is a part of

cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl, respectively; R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

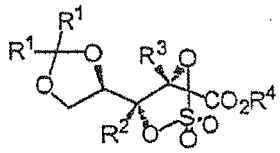
R^4 is independently hydrogen, aryl including phenyl, aryl alkyl including benzyl, lower alkyl ($C_{6\text{-}10}$) including methyl, ethyl, propyl;

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR where R is acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl including methyl, ethyl, or propyl; and

M^+ is tetraalkylammonium including tetrabutylammonium, tetraethylammonium, tetramethylammonium, or metal cation including sodium, potassium, cesium, rubidium, and silver cations.

17. A process for the preparation of compounds of the general formula **51B** of claim 16, comprising:

mixing a compound of the following formula, IIIb



IIIb

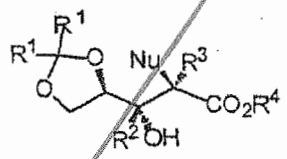
with at least one fluoride source and a phase transfer catalyst in an appropriate solvent,

with $NaBH_4$, tetraalkylammonium chloride, tetraalkylammonium bromide, NaN_3 or LiN_3,NH_4SCN, CF_3I-tetrakis(dimethylamino)-ethylene (TDAE), tetraalkylammonium nitrate, KCN, NH_4OR, HNR where R is lower alkyl or acyl, $LiCu(R)_2$ where R is methyl, ethyl, ethylenyl, or ethnyl.

18. The method of claim 17, wherein the fluoride source is selected from the group consisting of tetramethylammonium fluoride (TMAF), tetraethylammonium fluoride (TEAF), tetrabutylammonium fluoride (TBAF),tris(dimehtylamino)sulfur (trimethylsilyl)difluoride (TAS-F), silver fluroide (AgF), potassium fluoride (KF), cesium fluoride (CsF), and rubidium fluoride (RbF).

19. The method of claim 17, wherein the solvent is selected from one or more of the group consisting of *N,N*-dimethylformamide, tetrahydrofuran, acetone, diethyl ether, diglyme, polyethylene glycol, DMSO, MeCN, and dioxane.

20. A compound of the following general formula **52B**:



52B

wherein,

R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl; or R^1 is a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-);

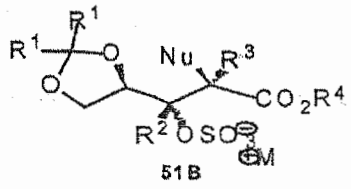
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

R^4 is independently hydrogen, aryl including phenyl, aryl alkyl including benzyl, lower alkyl including methyl, ethyl, propyl;

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR_2 where R is acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl including methyl,ethyl, propyl, CH_2R where R is methyl, halomethyl (fluoromethyl), ethyl, ethylenyl, or ethnyl; and

R^3 is hydrogen, a lower alkyl including, but limited to, methyl, halomethyl (fluoromethyl), ethyl, ethylenyl, or ethnyl.

21. A method for the preparation of a compound of formula 52B of claim 20 comprising mixing a compound of formula, 51B, wherein R^1, R^2, R^3, R^4 and M^+ are as defined in claim 20,



51B

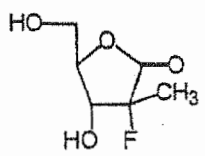
with a catalytic amount of acid and water in an appropriate solvent with or without a cosolvent.

22. The method of claim 21, wherein the acid is selected from one or more of the group consisting of HCl, H_2PO_3, H_2SO_4, TsOH, CH_3CO_2H, CF_3CO_2H, HCO_2H and RSO_3H, wherein R is 4-methyl phenyl, phenyl, methyl, and ethyl.

23. The method of claim 21, wherein the solvent is selected from one or more of the group consisting of diethyl ether, tetrahydrofuran, dioxane, diglyme, toluene, MeCN, ethanol, benzene, and methanol.

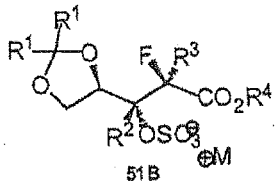
24. The method of claim 17, wherein the phase-transfer catalyst is selected from one or more of the group consisting of crown-ether, diglyme, and polyethylene glycol.

25. A process for the preparation of a compound of formula 53 comprising:

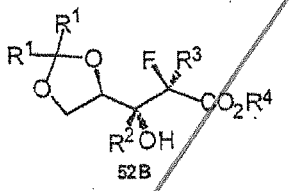


53

(a) treating a compound of the formula 51B or 52B:



51B



52B

with an acid in at least one solvent,

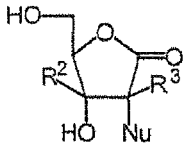
(b) optionally, followed by azeotropic distillation in benzene or toluene in

presence of acid.

26. The process of claim 25, wherein the acid from either step (a) or step (b) is selected from one or more of the group consisting of HCl, H_2PO_3, H_2SO_4, TsOH, CH_3CO_2H, CF_3CO_2H and HCO_2H.

27. The process of claim 25, wherein the solvent from step (a) is selected from one or more of the group consisting of MeOH, EtOH, I-PrOH, CH_3CN, THF and water.

28. A compound of the following general formula **53B**:



53B

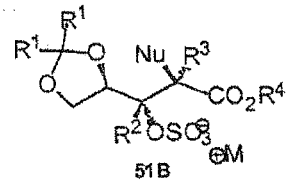
wherein,

R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including, fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including, haloallyl (FHC=CH-CH_2-); and

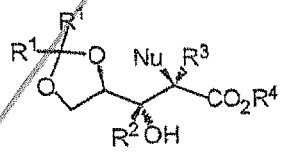
Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR where R is acyl including, acetyl, benzoyl, arylalkyl including benzyl, lower alkyl including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl including methyl, ethyl, or propyl.

29. A process for the preparation of a compound of the formula 53B comprising:

(a) heating a compound of the formula 51B or 52B:



51B



52B

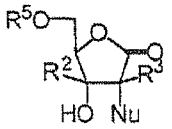
with an acid with a solvent; wherein the solvent is selected from one or more of the group consisting of MeOH, EtOH, i-PrOH, CH_3CN, THF, and water;

(b) optionally, followed by azeotropic distillation in benzene or toluene in presence of an acid.

30. The process of claim 29, wherein the acid from either step (a) or step (b) is selected from one or more of the group consisting of HC1, H_2PO_3, H_2SO_4, TsOH, CH_3CO_2H, CF_3CO_2H and HCO_2H.

31. The process of claim 29, wherein the solvent is selected from one or more of the group consisting of MeOH, EtOH, I-PrOH, CH_3CN, THF and water.

32. A compound of the following general formula, **53C**:



53C

wherein,

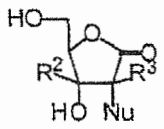
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

R^5 includes trityl, t-butyldimethylsilyl, t-butyldiphenylsilyl, benzyloxymethyl, benzoyl, toluoyl, 4-phenyl benzoyl, 2-, 3-, or 4-nitrobenzoyl, 2-, 3-, or 4-chlorobenzoyl, other substituted benzoyl; and acyl with $C_{1\text{-}20}$ including benzoyl and pivaloyl; and

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR where R is acyl including, acetyl, benzoyl, arylalkyl including benzyl, lower alkyl ($C_{1\text{-}10}$) including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl ($C_{1\text{-}10}$) including methyl, ethyl, or propyl.

33. A process for the preparation of a compound of formula **53C** comprising

selective protection of the 5-hydroxy of the formula 53B:



53B

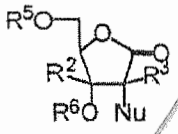
with a protecting agent, and a base in a solvent.

34. The process of claim 33, wherein the protecting agent is selected from one or more of the group consisting of trityl chloride, t-butyldimethylsilyl chloride, t-butyldiphenylsilyl chloride, benzyloxymethyl chloride, acyl halide or acyl anhydride including but not limited to benzoyl chloride, toluoyl chloride, 4-phenyl benzoyl chloride, and benzoyl anhydride.

35. The process of claim 33, wherein the base is selected from one or more of the group consisting of imidazole, pyridine, 4-(dimethylamino)pyridine, triethytlamine, diisopropylethylamine, and 1,4- diazabicyclo[2,2,2]octane.

36. The process of claim 33, wherein the solvent is selected from one or more of the group consisting of pyridine, dichloromethane, chloroform, 1,2-dichloroethane, and tetrahydrofuran.

37. A compound of the following general formula, 49B:



49B

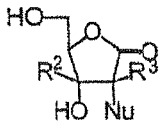
wherein

R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

R^5 are independently methyl, benzyl, optionally substituted benzyl, trityl, triethylsilyl, t-butyldimethylsilyl, t-butyldiphenylsilyl, methoxymethyl (MOM), methoxyethyl (MEM), benzyloxymethyl (BOM), acetyl, benzoyl, 2-, 3-, or 4-nitrobenzoyl, 2-, 3-, or 4-chlorobenzoyl, toluoyl, or other substituted benzoyl; and acyl with C_{1-20} including benzoyl and pivaloyl; and

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR_2 where R is independently acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl (C_{1-10}) including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl (C_{1-10}) including methyl, ethyl, or propyl.

38. A process for the preparation of a compound of formula, 49B of claim 35, comprising treating a compound 53B:



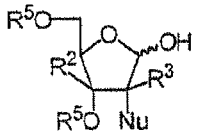
53B

with a protecting agent selected from one or more of the group consisting of methoxymethyl chloride, methoxyethyl chloride, benzyloxymethyl chloride, ethoxymethyl chloride, trityl chloride, triethylsilyl chloride, t-butyldimethylsilyl chloride, t-butyldiphenylsilyl chloride, acetyl chloride, acetic, anhyride, benzoic anhydride, benzoyl chloride, toluoyl chloride, 4-phenyl, benzoyl chloride, 4-nitrobenzoyl chloride, and 4-chlorobenzoyl chloride; and a base in a solvent.

39. The process of claim 36, wherein the base is selected from one or more of the group consisting of imidazole, pyridine, 4-(dimethylamino)pyridine, triethytlamine, diisopropylethylamine, and 1,4- diazabicyclo[2,2,2]octane.

40. The process of claim 36, wherein the solvent is selected from one or more of the group consisting of pyridine, dichloromethane, chloroform, and 1,2-dichloroethane, and tetrahydrofuran and the like.

41. A compound of the following general formula, 56:



56

wherein

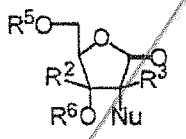
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

R^5 is methyl, benzyl, optionally substituted benzyl, trityl, triethylsilyl, t-butyldimethylsilyl, t-butyldiphenylsilyl, methoxymethyl (MOM),

methoxyethyl (MEM), benzyloxymethyl (BOM), acetyl, benzoyl, 2-, 3-, or 4-nitrobenzoyl, 2-, 3-, or 4-chlorobenzoyl, toluoyl, or other substituted benzoyl; and acyl with C_{1-20} including benzoyl and pivaloyl; and

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR_2 where R is acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl including methyl, ethyl, or propyl.

42. A process for the preparation of a compound of formula 56 of claim 41 comprising treating a compound of the formula, 49B:



49B

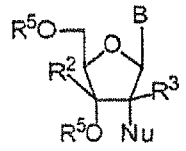
with a reducing agent in a solvent.

43. The process of claim 42, wherein the reducing agent is a metal hydride.

44. The process of claim 43, wherein the metal hydride is selected from one or more of the group consisting of DIBAL-H and lithium tri-*tert*-butoxyaluminum hydride.

45. The process of claim 42, wherein the solvent selected from one or more of the group consisting of dichloromethane, chloroform, benzene, toluene, and 1,2-dichloroethane.

46. A compound of the formula, 57:



57

wherein

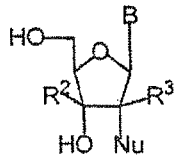
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

R^5 are independently methyl, benzyl, optionally substituted benzyl, trityl, triethylsilyl, t-butyldimethylsilyl, t-butyldiphenylsilyl, methoxymethyl (MOM), methoxyethyl (MEM), benzyloxymethyl (BOM), carbamate, carbonate, acetyl, benzoyl, 2-, 3-, or 4-nitrobenzoyl, 2-, 3-, or 4-chlorobenzoyl, toluoyl, or other substituted benzoyl; and acyl with C_{1-20} including benzoyl and pivaloyl;

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR where R is acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl (C_{1-10}) including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl (C_{1-10}) including methyl, ethyl, or propyl; and

B is a natural or modified nucleic base .

47. A process for the preparation of a compound of the formula I:



I

wherein

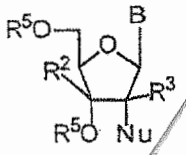
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C),

optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR or NR where R is acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl (C_{6-10}) including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl (C_{6-10}) including methyl, ethyl, or propyl; and

B is a natural or modified nucleic base;

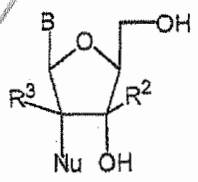
comprising treatment of a compound of the formula, **57**



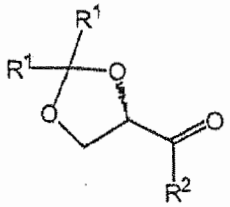
57

with alkyl ammonium fluoride, or, ammonium fluoride when R^5 is silyl; or acid when R^5 is trityl or alkoxymethyl; followed by sodium methoxide, or base, when R^5 is acyl.

48. A process for the preparation of the L-enantiomers, IB-L



IB-L



(S)-glyceraldehyde

wherein,

R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl, or R^1 is a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively;

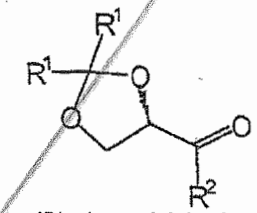
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl,

propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, OR or NR_2 where R is acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl including methyl, ethyl, propyl, CH_2R where R is hydrogen, lower alkyl including methyl, ethyl, propyl; and

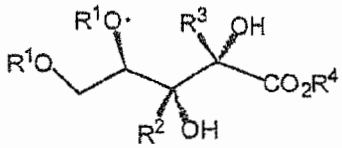
B is a natural or modified nucleic base,

comprising using the (S)-glyceraldehyde as the starting material.



(S)-glyceraldehyde

49. A process for the preparation of compounds of the formula I from claim 47 from the following intermediate:



42B

wherein

R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl; or R^1 is a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively;

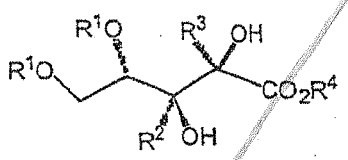
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C),

optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and

R^4 is independently hydrogen, aryl including phenyl, aryl alkyl including benzyl, lower alkyl (C_{1-10}) including methyl, ethyl, and propyl.

using the methods of any of the previous claims.

50. A process for the preparation of compounds of the formula, IB-L from claim 48 from the following intermediate:



42B-L

wherein

R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl; or R^1 is a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively;

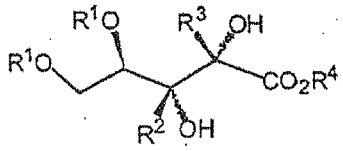
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and

R^4 is independently hydrogen, aryl including phenyl, aryl alkyl including benzyl, lower alkyl (C_{6-10}) including methyl, ethyl, and propyl.

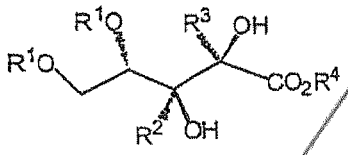
using the methods of any of the previous claims.

51. An intermediate of the formula 42B, 42B-L, 42C, 42D:

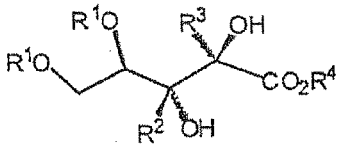
wherein



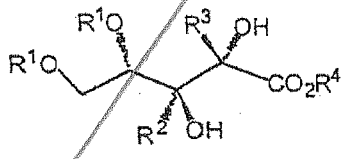
42B



42B-L



42C



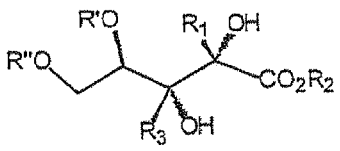
42D

R^1 is independently a lower alkyl (C_1-C_6) including methyl, ethyl, optionally substituted phenyl, optionally substituted benzyl; or R^1 is a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively;

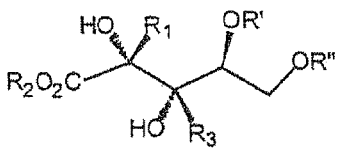
R^2, R^3 are independently hydrogen, a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and

R^4 is independently hydrogen, aryl including phenyl, aryl alkyl including benzyl, lower alkyl ($C_{1\text{-}10}$) including methyl, ethyl, and propyl.

52. A 2-alkyl-4,5-di-O-protected-2,3-dihydroxy-pentanoic-acid ester of the following general formula (42B) and its isomer (42B-L):



42B



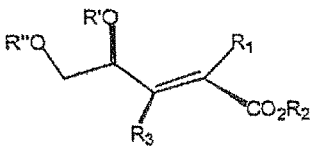
42B-L

wherein R',R" = isopropylidene, benzylidene, cyclohexylidene or a like, or a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-

$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively; R' and R" can be independently lower alkyl of C_1-C_6, or aryl of C_6-C_{20}, benzyl and other optionally substituted benzyl, trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups; or H, acetyl, benzoyl and other optionally substituted acyl (R' and R" are –C(O)-R, wherein R can be lower alkyl of C_1-C_6, , or aryl of C_6-C_{20}, benzyl and other optionally substituted benzyl);

R_1, R_2 are independently hydrogen, aryl (C_6-C_{20}) and a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethynyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and R_3 is independently hydrogen, aryl including phenyl, aryl alkyl including, but not limited to benzyl, lower alkyl (C_{1-6}) including methyl, ethyl, or propyl.

53. A process for the stereoselective preparation of a compound of formula **42B** of claim 51, mixing a compound of formula, 41,



wherein R',R" = isopropylidene, benzylidene, cyclohexylidene or a like, or a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively; R' and R" can be independently lower alkyl of C_1-C_6, , or aryl of C_6-C_{20}, benzyl and other optionally substituted benzyl), trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups or H, acetyl, benzoyl and other optionally substituted acyl (R' and R" are –C(O)-R, wherein R can be independently lower alkyl of C_1-C_6, or aryl of C_6-C_{20},benzyl and other optionally substituted benzyl); R' and R" can be independently lower alkyl of C_1-C_6, , or aryl of C_6-C_{20});

R_1, R_2 are independently hydrogen, aryl (C_6-C_{20}) and a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including

fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and R_3 is independently hydrogen, aryl including phenyl, aryl alkyl including, benzyl, lower alkyl (C_{1-6}) including methyl, ethyl, or propyl,

with a catalytic or stoichiometric amount of an osmium agent, without any chiral catalysts in a solvent.

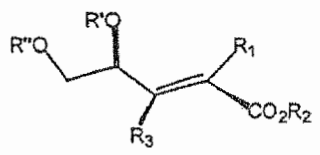
54. The process of claim 53, wherein the osmium agent is OsO_4, or osmate.

55. The process of claim 53, wherein the oxidant is selected from one or more of the group consisting of 4-N-methylmorpholine-N-oxide, pyridine-N-oxide trialkyamine-N-oxide, potassium fericyanide, hydrogen peroxide, chlorite, an alkyl peroxide an acyl peroxide, and a substituted or unsubstituted perbenzoic acid.

56. The process of claim 53, wherein the solvent is selected from one or more of the groups consisting of halogenated hydrocarbon including methylene chloride, chloroform, carbon tetrachloride, ethylene dichloride, dimethyl formamide, dimethyl acetamide, hexamethyl phosphoramide, water, tert-butanol, i-PrOH, THF, and pyridine.

57. A process for the stereoselective preparation of a compound of formula **42B** of claim 51, comprising:

mixing a compound of formula **41**



with an oxidant, in the presence of a catalytic or stoichiometric amount of an osmium agent, or potassium ruthenate, with a catalyst, and an inert solvent.

58. The process of claim 57, wherein the oxidant is selected from one or more of the group consisting of 4-N-methylmorpholine-N-oxide, trialkylamine-N-oxide, potassium ferricyanide, hydrogen peroxide, chlorite, an alkyl peroxide, an acyl and a substituted or unsubstituted perbenzoic acid.

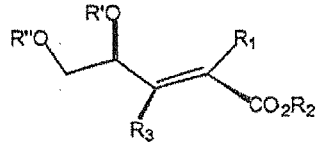
59. The process of claim 57, wherein the osmium agent is OsO_4 or osmate.

60. The process of claim 57, wherein the catatyst is selected from one or more of the group consisting of such as dihydroquinidine (DHQD) and its derivatives, dihydroquinine (DHQ) and its derivatives, quinuclidine, quinidine, DABCO, N,N'-dialkyl-2,2'-bipyrrolidine ligands, and N,N,N',N'-tetramethylethylenediamine.

61. The process of claim 57, wherein the solvent is selected from one or more of the group consisting of a halogenated hydrocarbon, dimethyl acetamide, hexamethyl phosphoramide, water, tert-butanol, i-PrOH, THF, and pyridine.

62. A process for the stereoselective preparation of a compound of formula **42B** of claim 51, comprising:

mixing a compound of formula **41**



with a permanganate compound, in suitable solvent, optionally with a base.

63. The process of claim 62, wherein the permanganate is selected from one or more of the group consisting of $KMnO_4$ tetradecyltrimethylammoium permanganate (TDTAP), cetyltrimethylammoium permanganate (CTAP) and other quaternary ammonium permanganate such as $R_1R_2R_3\ R_4N^+\ MnO_4^-$, wherein R_1,R_2,R_3,R_4, can be independently alkyl of C_1-C_{20}.

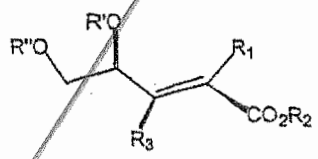
64. The process of claim 62, wherein the solvent is selected from one or more of the group consisting of a halogenated hydrocarbon, dimethyl acetamide, hexamethyl phosphoramide, water, tert-butanol, i-PrOH, THF, and pyridine.

65. The process of claim 64, wherein the halogenerated hydrocarbon is selected from one or more of the group consisting of methylene chloride, chloroform, carbon tetrachloride, ethylene dichloride.

66. The process of claim 63, wherein the base comprises KOH, NaOH, pyridine, and trialkylammonia.

67. A process for the stereoselective preparation of a compound of formula **42B** of claim 51, comprising:

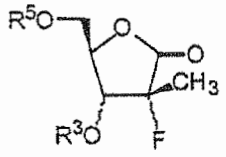
mixing a compound of formula **41**



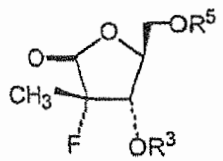
with a ruthenium system, optionally with a chiral or achiral catalyst in a solvent.

68. The process of claim 67, wherein the ruthenium system comprises $RuCl_3/CeCl_3/NaIO_4$.

69. A 3,5-di-O-protected-2-deoxy-2-fluoro-2-C-methyl-D-ribono-γ-lactone of the following general formula (49B) and its L-isomer (49B-L):



49B



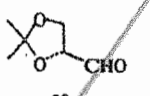
49B-L

wherein R^3 and R^5 can be independently H, CH_3, acetyl, benzoyl,, pivaloyl, or 4-nitrobenzoyl, 3-nitrobenzoyl, 2-nitrobenzoyl, 4-chlorobenzoyl, 3-

chlorobenzoyl, 2-chlorobenzoyl, 4-methylbenzoyl, 3-methylbenzoyl, 2-methylbenzoyl, para-phenylbenzoyl, and other optionally substituted acyl, –C(O)-R, where R can be independently lower alkyl of C_1-C_{10}, , or aryl of C_6-C_{20}, benzyl, 4-methoxybenzyl and other optionally substituted benzyl, trityl, trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups; alternatively, R^3 and R^5 are linked through -SiR_2-O-SiR_2- or -SiR_2-, wherein R is a lower alkyl such as CH_3, ethyl, and n-Pr or i-Pr.

70. A process for the preparation of the lactone of claim 69, comprising:

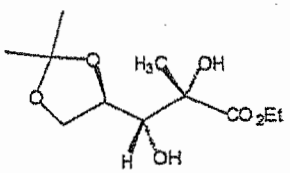
(a) reacting of a compound of the formula 39.



39

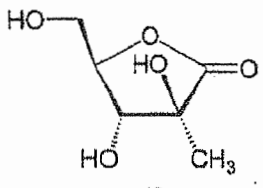
with (1-alkoxycarbonylethylidene) triphenylphosphorane under the Wittig condition in a solvent;

(b) stereoselective dihydroxylation of the olefin intermediate **41** to provide the diol **42** optionally or with chiral catalyst;



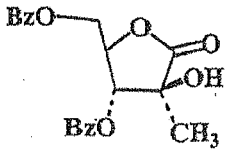
42

(c) treatment of the compound **42** with an acid in an alcohol to provide **46**;



46

(d) selective O-protection of primary and secondary OH groups to yield 3,5- di-O-protected derivative 47; and

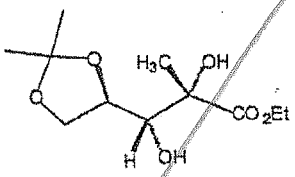


47

(e) fluorination of compound 47 to provide the desired lactone.

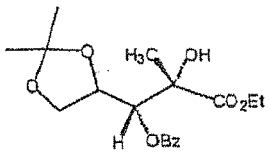
71. A process for the preparation of the lactone of claim 69, comprising:

(a) selective O-protected of secondary OH group of compound 42



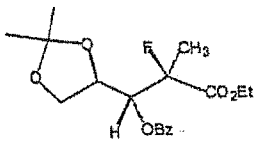
42

to yield the mono-O-protected derivative 43;



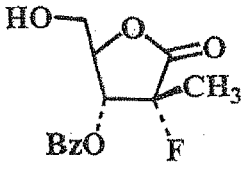
43

(b) fluorination of compound 43 to provide the fluorinated product 44;



44

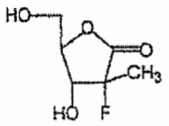
(c) lactonization of 44 with acid to give the γ lactone 45; and



45

(d) protection of the primary OH to provide the desired lactone.

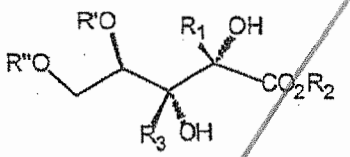
72. A method for the synthesis of an intermediate in the synthesis of a lactone **53**,



53

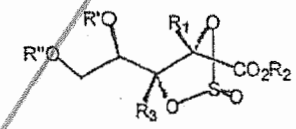
comprising:

(a) mixing a compound of formula, **42B**,



42B

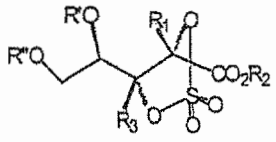
with thionyl chloride or thionyl diimidazole in presence of a base in a solvent to yield the intermediate **50A**;



50A

73. A process for preparation of a compound of formula **50B**

comprising,



50B

wherein R',R" = isopropylidene or cyclohexylidene or a like, or a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively; R' and R" can be independently trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups or H, acetyl, benzoyl and other optionally substituted acyl (R' and R" are –C(O)-R,

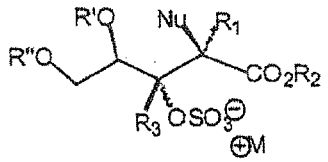
wherein R can be lower alkyl of C_1-C_6, , or aryl of C_6-C_{20},benzyl and other optionally substituted benzyl); R' and R" can be independently lower alkyl of C_1-C_6, , or aryl of C_6-C_{20});

R_1, R_2 are independently hydrogen, aryl (C_6-C_{20}) and a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and R_3 is independently hydrogen, aryl including phenyl, aryl alkyl including, but not limited to benzyl, lower alkyl (C_{1-6}) including methyl, ethyl, or propyl; comprising mixing the product **50A** from claim 70 with an oxidant in a solvent or a combination of solvents; or

alternatively, mixing a compound of the formula, **42B** of claim 51, with sulfuryl chloride or sulfuryl diimidazole in presence of a base, in a solvent.

74. The process of claim 73, whrein the oxidant is selected from one or more of group consisting of $RuCl_3$, $KMnO_4$, TEMPO, $NaIO_4$, KIO_4, HIO_4, mCPBA, NaOC1 and oxone.

75. A compound of the following general formula **51B**:



51B

wherein R',R" is isopropylidene or cyclohexylidene or a like, or a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively; R' and R" can be independently trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups or H, acetyl, benzoyl and other optionally substituted acyl (R' and R" are –C(O)-R, wherein R can be lower alkyl

of C_1-C_6, , or aryl of C_6-C_{20},benzyl and other optionally substituted benzyl); R' and R" can be independently lower alkyl of C_1-C_6, , or aryl of C_6-C_{20});

R_1, R_2 are independently hydrogen, aryl (C_6-C_{20}) and a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

R_3 is independently hydrogen, aryl including phenyl, aryl alkyl including, to benzyl, lower alkyl (C_{1-6}) including methyl, ethyl, or propyl; d

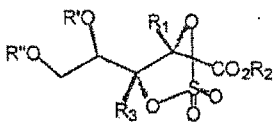
Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR, NR'", NHR'", or NR'"$_2$ wherein R'" is H or acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl

(C_{6-10}) including methyl, ethyl, propyl, CH_2R wherein R is hydrogen, lower alkyl (C_{1-10}) including methyl, ethyl, or propyl; and

M^+ is tetraalkylammonium including tetrabutylammonium, tetraethylammonium, tetramethylammonium, or metal cation including sodium, potassium, cesium, rubidium, and silver cations.

76. A process for the preparation of compounds of the general formula **51B** of claim 75, comprising:

(a) mixing a compound of the following formula, **50B**



50B

wherein R',R" = isopropylidene or cyclohexylidene or a like, or a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively; R' and R" can be independently trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups or H, acetyl, benzoyl and other optionally substituted acyl (R' and R" are –C(O)-R,

wherein R can be lower alkyl of C_1-$C_{6,}$, or aryl of C_6-C_{20},benzyl and other optionally substituted benzyl); R' and R" can be independently lower alkyl of C_1-$C_{6,}$, or aryl of C_6-C_{20});

R_1, R_2 are independently hydrogen, aryl (C_6-C_{20}) and a lower alkyl (C_1-C_6); including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-); and R_3 is independently hydrogen, aryl including phenyl, aryl alkyl including, *o*-benzyl, lower alkyl (C_{1-6}) including methyl, ethyl, or propyl;

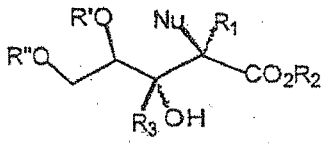
with one fluoride source or in combination with phase transfer catalyst in a solvent; or

(b) alternatively mixing a compound of the formula, **50B** with a base.

77. The process of claim 76, wherein the base is selected from one or more of the group consisting of $NaBH_4$, tetraalkylammonium chloride, tetraalkylammonium bromide, NaN_3 or LiN_3,NH_4SCN, CF_3I-tetrakis (dimethylamino)-ethylene (TDAE), tetraalkylammonium nitrate, KCN, NH_4OR, HNR where R is lower alkyl or acyl, $LiCu(R)_2$ where R is methyl, ethyl, ethylenyl, or ethnyl.

78. The method of claim 75, wherein the fluoride source is selected from the group consisting of tetramethylammonium fluoride (TMAF), tetraethylammonium fluoride (TEAF), tetrabutylammonium fluoride (TBAF),tris(dimehtylamino)sulfur (trimethylsilyl)difluoride (TAS-F), alone or in combination with a fluoride source selected from one or more of the group consisting of silver fluroide (AgF), potassium fluoride (KF), cesium fluoride (CsF), and rubidium fluoride (RbF); optionally in combination with crown-ether, diglyme, polyethylene glycol or other phase transfer catalyst.

79. A compound of the following general formula **52B**:



52B

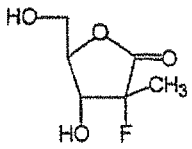
wherein R',R" = isopropylidene, benzylidene, cyclohexylidene or a like, or a part of cyclic group including ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) forming cyclopentyl or cyclohexanyl group, respectively; R' and R" can be independently trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups or H, acetyl, benzoyl and other optionally substituted acyl (R' and R" are –C(O)-R, wherein R can be independently lower alkyl of C_1-C_6, , or aryl of C_7-C_{20},benzyl and other optionally substituted benzyl); R' and R" can be independently lower alkyl of C_1-C_6,, or aryl of C_7-C_{20});

R_1, R_2 are independently hydrogen, aryl (C_7-C_{20}) and a lower alkyl (C_1-C_6) including methyl, hydroxymethyl, methoxymethyl, halomethyl including fluoromethyl, ethyl, propyl, optionally substituted ethenyl including vinyl, halovinyl (F-CH=C), optionally substituted ethnyl including haloethnyl (F-C≡C), optionally substituted allyl including haloallyl (FHC=CH-CH_2-);

R_3 is independently hydrogen, aryl including phenyl, aryl alkyl including, benzyl, lower alkyl (C_{1-6}) including methyl, ethyl, or propyl; and

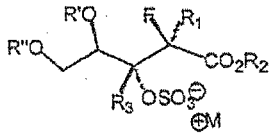
Nu is halogen (F, Cl, Br), N_3, CN, NO_3, CF_3, SCN, OR, NR'", NHR'", or NR'"$_2$ where R'" is H or acyl including acetyl, benzoyl, arylalkyl including benzyl, lower alkyl (C_{6-10}) including methyl,ethyl, propyl, CH_2R where R is methyl, halomethyl (fluoromethyl), ethyl, ethylenyl, or ethnyl.

80. A process for the preparation of a compound of formula **53** comprising:

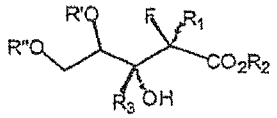


53

(a) heating a compound of the formula **51B** or **52B**:



51B



52B

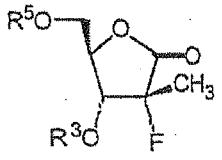
with an acid in a solvent or a combination of solvents;

(b) optionally, followed by azeotropic distillation in benzene or toluene in presence of an acid.

81. The process of claim 80, wherein the acid is selected from one or more of the group consisting of acidic polymer resins, HCl, H_2PO_3, H_2SO_4, TsOH, CH_3CO_2H, CF_3CO_2H, and HCO_2H.

82. The process of claim 80, wherein the solvent is selected from one or more of the group consisting of MeOH, EtOH, i-PrOH, CH_3CN, THF, and water.

83. A process for the preparation of a compound of the formula **49B**:



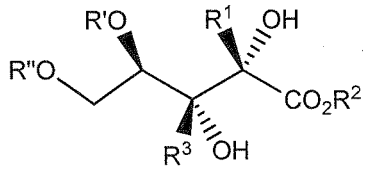
49B

wherein R^3 and R^5 can be independently H, CH_3, acetyl, benzoyl, pivaloyl or 4-nitrobenzoyl, 3-nitrobenzoyl, 2-nitrobenzoyl, 4-chlorobenzoyl, 3-chlorobenzoyl, 2-chlorobenzoyl, 4-methylbenzoyl, 3-methylbenzoyl, 2-methylbenzoyl, para-phenylbenzoyl, and other optionally substituted acyl (R^3 and R^5 are –C(O)-R, wherein R can be lower alkyl of C_1-C_{10}, , or aryl of C_6-C_{20}, benzyl, 4-methoxybenzyl and other optionally substituted benzyl; R^3 and R^5 can be independently aryl of C_6-C_{20}, trityl, trialkylsilyl, *t*-butyl-dialkylsyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM and other optionally ether protecting groups; and alternatively, $R^{3'}$ and $R^{5'}$ are linked through -SiR_2-O-SiR_2- or -SiR_2-, wherein R is a lower alkyl such as CH_3, ethyl, and n-Pr or I-Pr;

comprising protection of the hydroxy groups of the formula 53 with a protecting agent selected from one or more of the group consisting of trityl chloride, t-butyldimethylsilyl chloride, t-butyldiphenylsilyl chloride, benzyloxymethyl chloride, acyl halide or acyl anhydride including benzoyl chloride, toluoyl chloride, 4-phenyl benzoyl chloride, benzoyl anhydride, with a base in a solvent.

We claim:

1. A compound of the formula



wherein

R' and R" are independently H, lower alkyl (C_1-C_6), aryl (C_6-C_{20}), optionally substituted benzyl, trialkylsilyl, *t*-butyl-dialkylsilyl, *t*-butyldiphenylsilyl, TIPDS, THP, MOM, MEM, acetyl, benzoyl, or optionally substituted acyl; or R' and R" form a cyclopentyl or cyclohexanyl group;

R^1 and R^2 are independently H, lower alkyl (C_1-C_6), aryl (C_6-C_{20}), hydroxymethyl, methoxymethyl, halomethyl, optionally substituted ethenyl, halovinyl, optionally substituted ethynyl, or optionally substituted allyl; and

R^3 is H, aryl, arylalkyl, or lower alkyl (C_1-C_6).

2. The compound of claim 1,

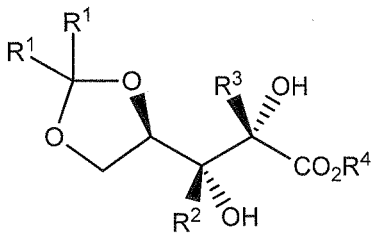
wherein

R' and R" are independently H or lower alkyl (C_1-C_6);

R^1 and R^2 are independently H, or lower alkyl (C_1-C_6); and

R^3 is H or lower alkyl (C_1-C_6).

3. A compound of the formula



wherein

each R^1 is independently lower alkyl (C_1-C_6), optionally substituted phenyl, or optionally substituted benzyl; or R^1 forms a cyclopentyl or cyclohexanyl group;

R^2 and R^3 are independently hydrogen, lower alkyl (C_1-C_6), hydroxymethyl, methoxymethyl, halomethyl, optionally substituted ethenyl, halovinyl, optionally substituted ethynyl, or optionally substituted allyl; and

R^4 is independently arylalkyl, or lower alkyl (C_1-C_{10}).

4. A compound of claim 3,

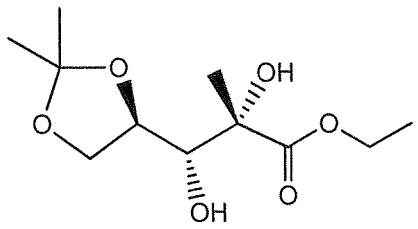
wherein

each R^1 is independently lower alkyl (C_1-C_6);

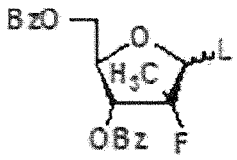
R^2 and R^3 are independently hydrogen, or lower alkyl (C_1-C_6); and

R^4 is independently lower alkyl (C_1-C_{10}).

5. The compound of claim 3, having the formula



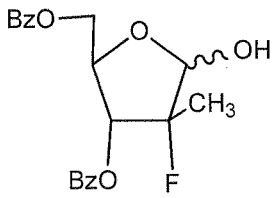
6. A compound of the formula



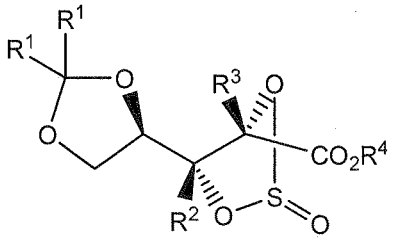
548

wherein L is a leaving group.

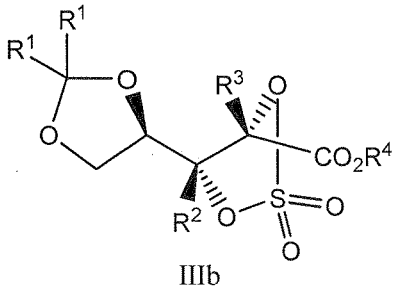
7. The compound of the formula



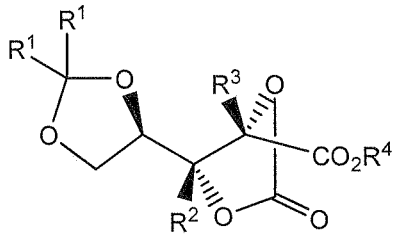
8. A compound of formulae IIIa, IIIb or IIIc



IIIa



IIIb



IIIc

wherein

each R^1 is independently lower alkyl (C_1-C_6), optionally substituted phenyl, or optionally substituted benzyl;

R^2 and R^3 are independently hydrogen, lower alkyl (C_1-C_6), hydroxymethyl, methoxymethyl, halomethyl, optionally substituted ethenyl, optionally substituted ethynyl, or optionally substituted allyl; and

R^4 is independently hydrogen, aryl, arylalkyl, and lower alkyl (C_1-C_{10}).

9. A compound of claim 8,

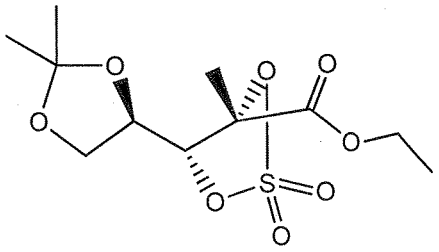
wherein

each R^1 is lower alkyl (C_1-C_6);

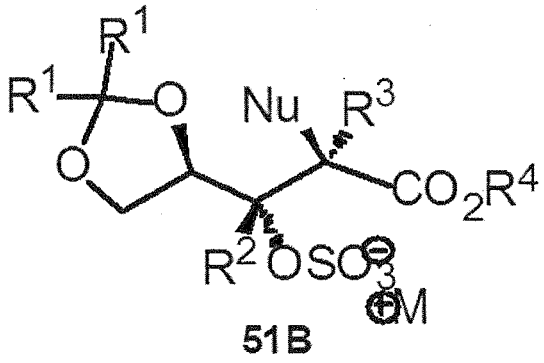
R^2 and R^3 are independently hydrogen, or lower alkyl (C_1-C_6); and

R^4 is lower alkyl (C_1-C_{10}).

10. The compound of claim 8 or 9, having the formula



11. A compound of the following general formula **51B**:



51B

wherein

R^1 is independently a (C_1-C_6) alkyl, phenyl or benzyl; alternatively, R^1 is a part of cyclic group forming a cyclopentyl or cyclohexanyl group;

R^2 is independently hydrogen, a (C_1-C_6) alkyl, hydroxymethyl, methoxymethyl, halomethyl, vinyl, halovinyl, ethynyl, haloethnyl, allyl or haloallyl;

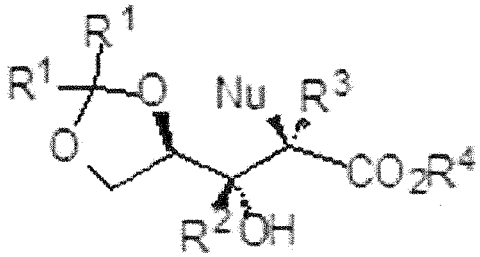
R^3 is independently a (C_1-C_6) alkyl, hydroxymethyl, methoxymethyl, halomethyl, vinyl, halovinyl, ethynyl, haloethynyl, allyl or haloallyl;

R^4 is independently hydrogen, aryl, arylalkyl or a (C_1-C_6) alkyl;

Nu is F, Cl, N_3, CN, NO_3, CF_3, SCN, OR or NR where R is acyl, arylalkyl, a (C_1-C_6) alkyl, CH_2R where R is hydrogen or a (C_1-C_6) alkyl; and

M^+ is tetrabutylammonium, tetraethylammonium, tetramethylammonium, sodium, potassium, cesium, rubidium, or silver.

12. A compound of the following general formula **52B**:



52B

wherein:

R^1 is independently a (C_1-C_6) alkyl, phenyl, or benzyl; alternatively, R^1 is an ethylene (-CH_2CH_2-), or trimethylene (-$CH_2CH_2CH_2$-) which forms a cyclopentyl or a cyclohexyl;

R^2 is independently hydrogen, a (C_1-C_6) alkyl, hydroxymethyl, methoxymethyl, halomethyl, vinyl, halovinyl, ethynyl, haloethnyl, allyl or haloallyl;

R^3 is independently a (C_1-C_6) alkyl, hydroxymethyl, methoxymethyl, halomethyl, vinyl, halovinyl, ethynyl, haloethnyl, allyl or haloallyl;

R^4 is independently hydrogen, aryl, aryl or a alkyl a (C_1-C_6) alkyl;

Nu is F, Cl, N_3, CN, NO_3, CF_3, SCN, OR or NR^2 where R is acyl, arylalkyl, a (C_1-C_6) alkyl, CH_2R where R is methyl, halomethyl, ethyl, ethylenyl, or ethnyl.