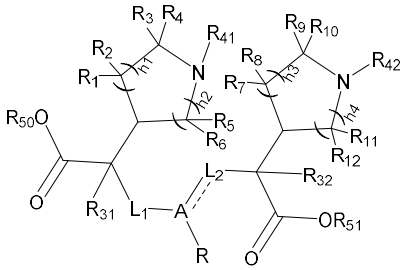
CLAIMS

1. A compound represented by the following formula (I) or a pharmaceutically acceptable salt thereof, having the following structure:

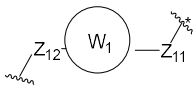

(I)

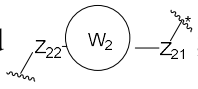
wherein ⎓ is a single bond or a double bond;

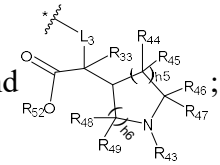
A is CR_X, P, P(O), N, C_{6-12} aryl, 5-14 membered heteroaryl, C_{3-8} carbocyclyl, or 5-18 membered heterocyclyl; the aryl, heteroaryl, carbocyclyl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy;

when ⎓is a single bond, R_X is H, -OH, or C_{1-3}alkoxy;

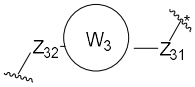
when ⎓is a double bond, R_X does not exist;

L_1 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, $-NH_2$, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A;

L_2 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, $-NH_2$, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and A;

R is selected from H, -C_{1-3}alkylene-C_{6-10} aryl, -C_{1-3}alkylene-5-12 membered heteroaryl, C_{1-6}alkyl, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents

independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, carboxyl, -CN, -OH, -NH_2, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of R and A;

L_3 is selected from -C_{1-6}alkylene-, -C_{2-6}alkenylene-, -C_{2-6}alkynylene-, -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and 

; the alkylene, alkenylene, and alkynylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of L_3 and A;

each of the rings W_1, W_2, and W_3 is independently selected from C_{6-12} aryl, 5-12 membered heteroaryl, C_{6-14}cycloalkyl, and 5-12 membered heterocyclyl; the aryl, heteroaryl, cycloalkyl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, -OH, -NH_2, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, C_{1-3}haloalkyl, C_{1-3}haloalkoxy, -N(C_{1-3}alkyl)$_2$, -NH(C_{1-3}alkyl), and -C(O)C_{1-3}alkyl;

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -O-, -S-, -NH-, -Se-, -C_{1-4}alkylene-, -C_{1-8}oxaalkylene-, -C_{1-4}thiaalkylene-, -C_{1-4}azaalkylene-, and -C_{1-4}selenaalkylene-; the alkylene, oxaalkylene, thiaalkylene, azaalkylene, and selenaalkylene are optionally substituted by one or more substituents independently selected from Z_{41}; Z_{41} is independently selected from deuterium, halogen, oxo, thio, -CN, -OH, -NH_2, C_{1-3}alkyl, C_{1-3}haloalkyl, C_{1-3}alkoxy, and C_{1-3}haloalkoxy; or any two Z_{41} together with the atom to which they are attached form C_{3-6}cycloalkyl, 3-6 membered heterocyclyl, phenyl, and 5-6 membered heteroaryl;

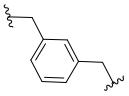
each of R_{31}, R_{32}, and R_{33} is independently selected from hydrogen, deuterium, halogen, C_{1-6}alkyl, C_{1-6}haloalkyl, C_{1-6}deuteroalkyl, C_{1-6}alkoxy, C_{1-6}haloalkoxy, and C_{1-6}deuteroalkoxy;

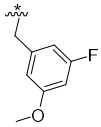
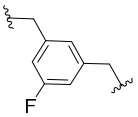
each of h1, h2, h3, h4, h5, and h6 is independently 0, 1, or 2;

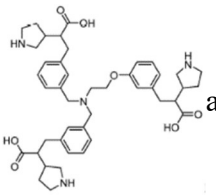
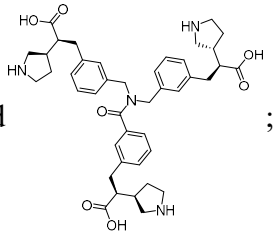
each of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{41}, R_{42}, R_{43}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, and R_{49} is independently selected from H, deuterium, -CN, -OH, -NH_2, halogen, C_{1-6}alkyl, C_{1-6}haloalkyl, C_{1-6}alkoxy, C_{1-6}haloalkoxy, -N(C_{1-3}alkyl)$_2$, and -NH(C_{1-3}alkyl);

each of R_{50}, R_{51}, R_{52} is independently selected from H, deuterium, C_{1-6}alkyl, C_{2-6}alkenyl, C_{1-6}alkoxy, -C_{1-3}alkylene-O-C_{1-6}alkyl, and -C_{1-3}alkylene-O-C(O)-C_{1-6}alkyl; the alkyl, alkenyl, alkoxy, and alkylene are optionally substituted by one or more substituents independently selected from

deuterium, halogen, -OH, -NH_2, -CN, oxo, C_{1-3}alkyl, and C_{1-3}alkoxy;

provided that when A is N, and R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{41}, R_{42}, R_{43}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, and R_{49} are all H, L_1, L_2, and L_3 are not  at the same time;

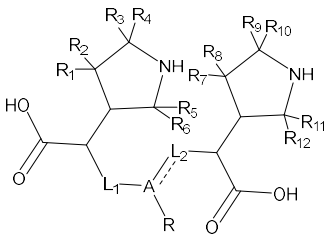
provided that when A is N, R is , and R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{41}, and R_{42} are all H, L_1 and L_2 are not  at the same time, * is the connecting end of R and A;

provided that the compound is not  and ;

the heteroatom in the heterocyclyl and heteroaryl is independently selected from O, N and S, and the heteroatom number is 1, 2, 3, or 4;

for example, R is a group containing L_3, L_1, L_2 and L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-.

2. A compound represented by the following formula (I-1-P1), formula (I-1-P2), formula (I-1-P3) or formula (I-1-P4), or a pharmaceutically acceptable salt thereof,



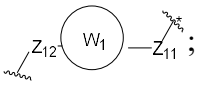
(I-1-P1)

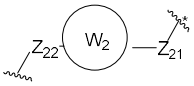
wherein ⩬ is a single bond or a double bond;

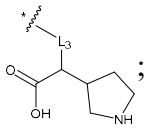
A is CR_X, P, P(O) or N;

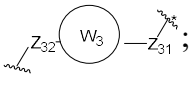
when ⎓ is a single bond, R_X is H, -OH, or C_{1-3}alkoxy;

when ⎓ is a double bond, R_X does not exist;

L_1 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A;

L_2 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and A;

R is selected from H, -C_{1-3}alkylene-C_{6-10} aryl, -C_{1-3}alkylene-5-12 membered heteroaryl, C_{1-6}alkyl, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, carboxyl, -CN, -OH, -NH_2, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of R and A;

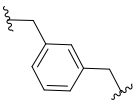
L_3 is selected from -C_{1-6}alkylene-, -C_{2-6}alkenylene-, -C_{2-6}alkynylene-, -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the alkylene, alkenylene, and alkynylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of L_3 and A;

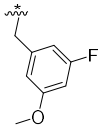
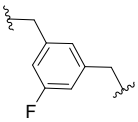
each of the rings W_1, W_2, and W_3 is independently selected from C_{6-12} aryl, 5-12 membered

heteroaryl, C_{6-14}cycloalkyl, and 5-12 membered heterocyclyl; the aryl, heteroaryl, cycloalkyl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy;

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -C_{1-4}alkylene-, and -C_{1-4}oxaalkylene-; the alkylene, and oxaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, C_{1-3}alkyl, and C_{1-3}alkoxy;

each of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} is independently selected from H, and deuterium;

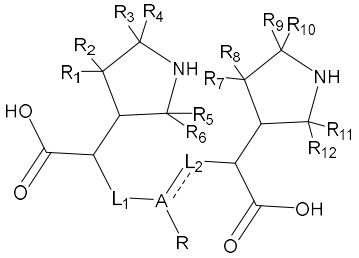
provided that when A is N, L_1, L_2, and L_3 are not  at the same time;

provided that when A is N, R is , L_1 and L_2 are not  at the same time, * is the connecting end of R and A;

the heteroatom in the heterocyclyl and heteroaryl is independently selected from O, N and S, and the heteroatom number is 1, 2, or 3;

for example, in the compound represented by formula (I-1-P1), R is a group containing L_3, L_1, L_2 and L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

or



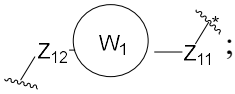
(I-1-P2)

wherein ⎓ is a single bond or a double bond;

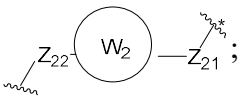
A is CR_X, P, P(O) or N;

when ⎓is a single bond, R_X is H, -OH, or C_{1-3}alkoxy;

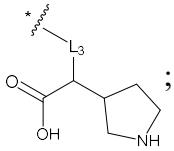
when ⎓is a double bond, R_X does not exist;

L_1 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, 

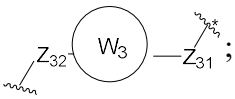
; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A;

L_2 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and 

; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and A;

R is selected from H, -C_{1-3}alkylene-C_{6-10} aryl, -C_{1-3}alkylene-5-12 membered heteroaryl, C_{1-6}alkyl, and 

; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, carboxyl, -CN, -OH, -NH_2, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of R and A;

L_3 is selected from -C_{1-6}alkylene-, -C_{2-6}alkenylene-, -C_{2-6}alkynylene-, -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and 

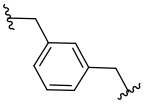
; the alkylene, alkenylene, and alkynylene are optionally substituted by one or more substituents independently

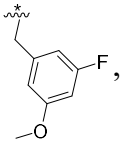
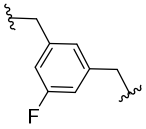
selected from deuterium, halogen, oxo, -CN, -OH, $-NH_2$, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of L_3 and A;

each of the rings W_1, W_2, and W_3 is independently selected from C_{6-12} aryl, 5-12 membered heteroaryl, C_{6-14}cycloalkyl, and 5-12 membered heterocyclyl; the aryl, heteroaryl, cycloalkyl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy;

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -C_{1-4}alkylene-, -C_{1-4}oxaalkylene-, -C_{1-4}thiaalkylene-, -C_{1-4}azaalkylene-; the alkylene, oxaalkylene, thiaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, $-NH_2$, C_{1-3}alkyl, and C_{1-3}alkoxy;

each of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} is independently selected from H, and deuterium;

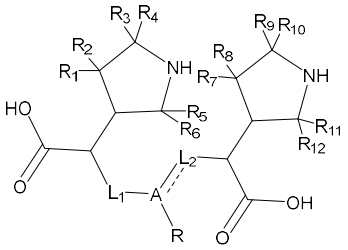
provided that when A is N, L_1, L_2, and L_3 are not  at the same time;

provided that when A is N, R is , L_1 and L_2 are not  at the same time, * is the connecting end of R and A;

the heteroatom in the heterocyclyl and heteroaryl is independently selected from O, N and S, and the heteroatom number is 1, 2, or 3;

for example, in the compound represented by formula (I-1-P2), R is a group containing L_3, L_1, L_2 and L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

or



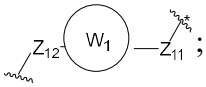
(I-1-P3)

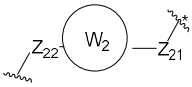
wherein ⎓ is a single bond or a double bond;

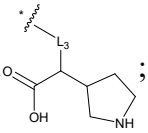
A is CR_X, P, P(O), N, C_{6-12} aryl, 5-14 membered heteroaryl, 5-18 membered heterocyclyl; the aryl, heteroaryl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy;

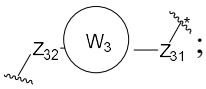
when ⎓is a single bond, R_X is H, -OH, or C_{1-3}alkoxy;

when ⎓is a double bond, R_X does not exist;

L_1 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, $-NH_2$, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A;

L_2 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, $-NH_2$, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and A;

R is selected from H, -C_{1-3}alkylene-C_{6-10} aryl, -C_{1-3}alkylene-5-12 membered heteroaryl, C_{1-6}alkyl, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, $-NH_2$, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, carboxyl, -CN, -OH, $-NH_2$, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of R and A;

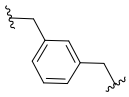
L_3 is selected from -C_{1-6}alkylene-, -C_{2-6}alkenylene-, -C_{2-6}alkynylene-, -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and 

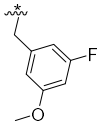
; the alkylene, alkenylene, and alkynylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of L_3 and A;

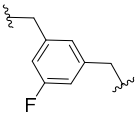
each of the rings W_1, W_2, and W_3 is independently selected from C_{6-12} aryl, 5-12 membered heteroaryl, C_{6-14}cycloalkyl, and 5-12 membered heterocyclyl; the aryl, heteroaryl, cycloalkyl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy;

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -C_{1-4}alkylene-, -C_{1-4}oxaalkylene-, -C_{1-4}thiaalkylene-, -C_{1-4}azaalkylene-; the alkylene, oxaalkylene, thiaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, C_{1-3}alkyl, C_{1-3}haloalkyl, C_{1-3}alkoxy, and C_{1-3}haloalkoxy;

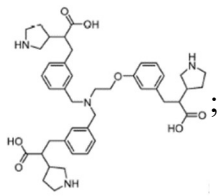
each of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} is independently selected from H, and deuterium;

provided that when A is N, and R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} are all H, L_1, L_2, and L_3 are not  at the same time;

provided that when A is N, R is 

, and R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} are all H, L_1 and L_2 are not 

at the same time, * is the connecting end of R and A;

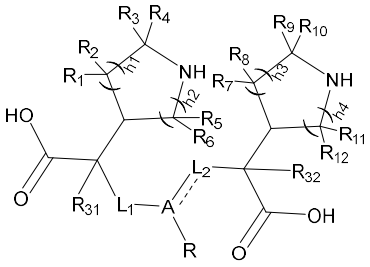
provided that the compound is not 

;

the heteroatom in the heterocyclyl and heteroaryl is independently selected from O, N and S, and the heteroatom number is 1, 2, 3, or 4;

for example, in the compound represented by formula (I-1-P3), R is a group containing L_3, L_1, L_2 and L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -$CH_2OC(O)$-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

or



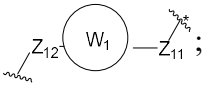
(I-1-P4)

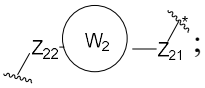
wherein ⁼⁼⁼ is a single bond or a double bond;

A is CR_X, P, P(O), N, C_{6-12} aryl, 5-14 membered heteroaryl, or 5-18 membered heterocyclyl; the aryl, heteroaryl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy;

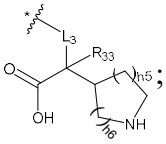
when ⁼⁼⁼is a single bond, R_X is H, -OH, or C_{1-3}alkoxy;

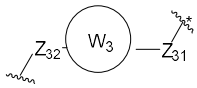
when ⁼⁼⁼is a double bond, R_X does not exist;

L_1 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A;

L_2 is selected from -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or

more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and A;

R is selected from H, -C_{1-3}alkylene-C_{6-10} aryl, -C_{1-3}alkylene-5-12 membered heteroaryl, C_{1-6}alkyl, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, carboxyl, -CN, -OH, -NH_2, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of R and A;

L_3 is selected from -C_{1-6}alkylene-, -C_{2-6}alkenylene-, -C_{2-6}alkynylene-, -C_{1-3}alkylene-C_{6-10}aryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-C_{6-10}aryl-5-12 membered heteroaryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-C_{6-10}aryl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-12 membered heteroaryl-5-12 membered heteroaryl-C_{1-3}alkylene-, and ; the alkylene, alkenylene, and alkynylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of L_3 and A;

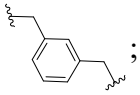
each of the rings W_1, W_2, and W_3 is independently selected from C_{6-12} aryl, 5-12 membered heteroaryl, C_{6-14}cycloalkyl, and 5-12 membered heterocyclyl; the aryl, heteroaryl, cycloalkyl, and heterocyclyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, -OH, -NH_2, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, C_{1-3}haloalkyl, C_{1-3}haloalkoxy, -N(C_{1-3}alkyl)$_2$, -NH(C_{1-3}alkyl), and -C(O)C_{1-3}alkyl;

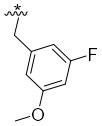
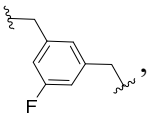
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -O-, -S-, -NH-, -Se-, -C_{1-4}alkylene-, -C_{1-8}oxaalkylene-, -C_{1-4}thiaalkylene-, -C_{1-4}azaalkylene-, -C_{1-4}selenaalkylene-; the alkylene, oxaalkylene, thiaalkylene, azaalkylene, and selenaalkylene are optionally substituted by one or more substituents independently selected from Z_{41}; Z_{41} is independently selected from deuterium, halogen, oxo, thio, -CN, -OH, -NH_2, C_{1-3}alkyl, C_{1-3}haloalkyl, C_{1-3}alkoxy, and C_{1-3}haloalkoxy; or any two Z_{41} together with the atom to which they are attached form C_{3-6}cycloalkyl, 3-6 membered heterocyclyl, phenyl, or 5-6 membered heteroaryl;

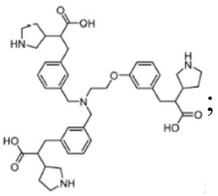
each of R_{31}, R_{32}, and R_{33} is independently selected from hydrogen, deuterium, halogen, C_{1-6}alkyl, C_{1-6}haloalkyl, C_{1-6}deuteroalkyl, C_{1-6}alkoxy, C_{1-6}haloalkoxy, and C_{1-6}deuteroalkoxy;

each of h1, h2, h3, h4, h5, and h6 is independently 0, 1, or 2;

each of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} is independently selected from H, and deuterium;

provided that when A is N, and R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} are all H, L_1, L_2, and L_3 are not at the same time ;

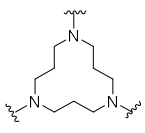
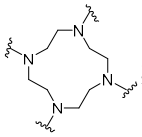
provided that when A is N, R is , and R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} are all H, L_1 and L_2 are not at the same time , * is the connecting end of R and A;

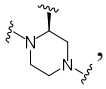
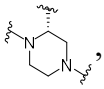
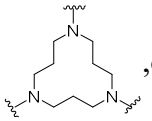
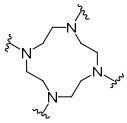
provided that the compound is not ;

the heteroatom in the heterocyclyl and heteroaryl is independently selected from O, N and S, and the heteroatom number is 1, 2, 3, or 4;

for example, in the compound represented by formula (I-1-P4), R is a group containing L_3, L_1, L_2 and L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from $-CH_2-$, $-CD_2-$, $-CH_2CH_2-$, $-CD_2CH_2-$, -C(O)-, $-CH_2C(O)-$, -NHC(O)-, -OC(O)-, $-CH_2CH_2O-$, $-OCH_2C(O)-$, $-CH_2OC(O)-$, $-CH_2CH_2CH_2O-$, and -S-C(O)-.

3. The compound according to any one of claims 1-2, or a pharmaceutically acceptable salt thereof, wherein A is CR_X, P, P(O), N, phenyl, 5-6 membered heterocyclyl, or 12 membered heterocyclyl; the heteroatom in the heterocyclyl is N, and the heteroatom number is 1, 2, 3, or 4;

preferably, A is CR_X, P, P(O), N, phenyl, piperazinyl, ,or ; or

A is CR_X, P, P(O), N, , , , , , ,or ; or

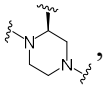
A is N, , , ,or ; or

A is N; or

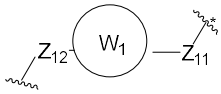
A is P(O); or

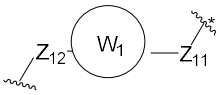
A is CR_X; R_X is H, -OH, or methoxy; or

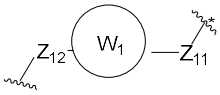
A is selected from C-OH, and C-OCH_3; or

A is 6 membered heterocyclyl; preferably, A is piperazinyl; preferably , , , or ; or

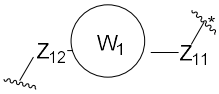
A is phenyl; for example .

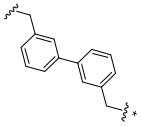
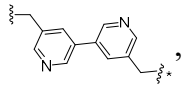
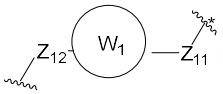
4. The compound according to any one of claims 1-3, or a pharmaceutically acceptable salt thereof, wherein L_1 is selected from -C_{1-3}alkylene-phenyl-phenyl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-6 membered heteroaryl-5-6 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A;

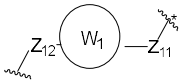
preferably, L_1 is selected from -methylene-phenyl-phenyl-methylene-, -ethylene-phenyl-phenyl-ethylene-, -methylene-5-6 membered heteroaryl-5-6 membered heteroaryl-methylene-, -ethylene-5-6 membered heteroaryl-5-6 membered heteroaryl-ethylene-, and ; the methylene, and ethylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A; or

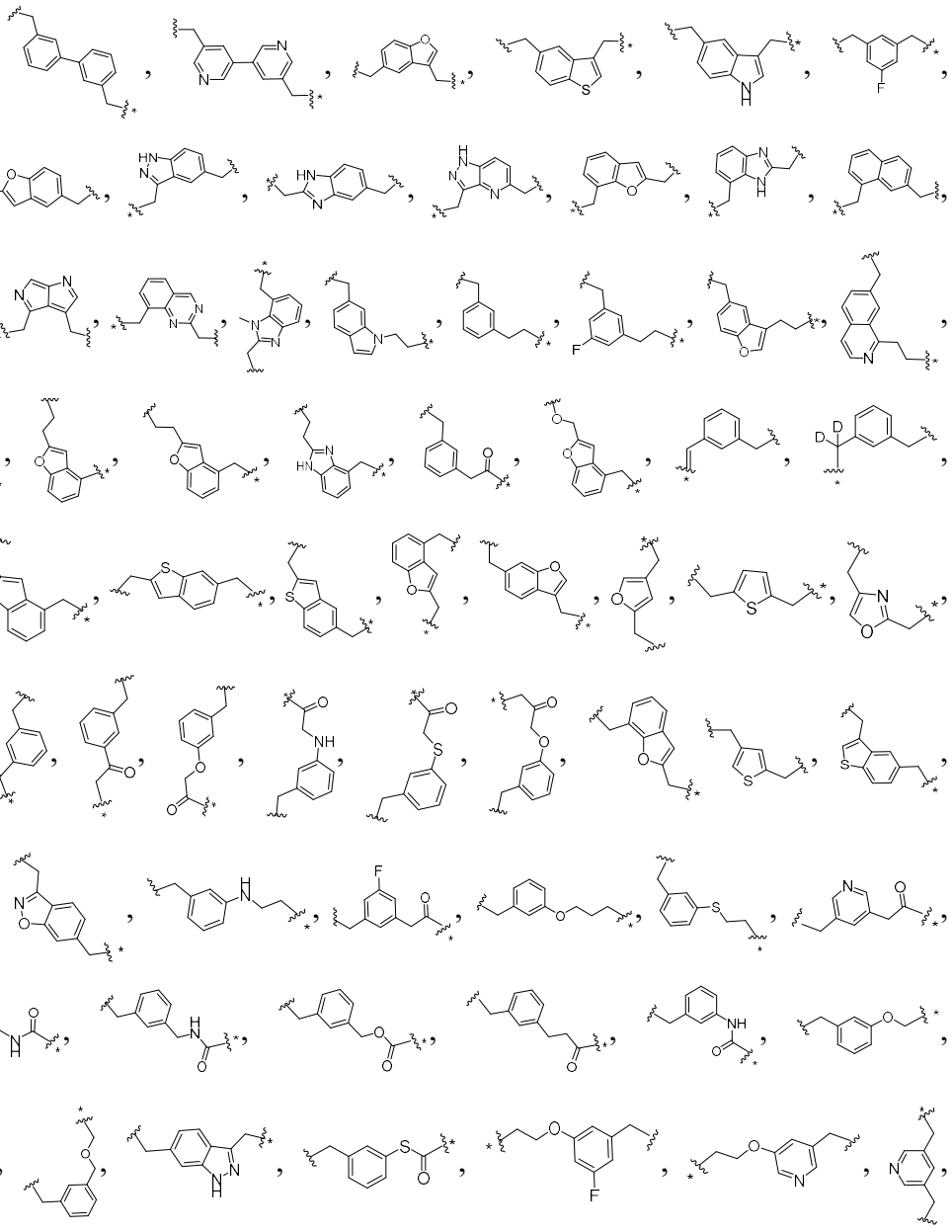
L_1 is selected from -methylene-phenyl-phenyl-methylene-, -methylene-6 membered heteroaryl-6 membered heteroaryl-methylene-, and ; the methylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the phenyl, and heteroaryl are optionally substituted by one or more

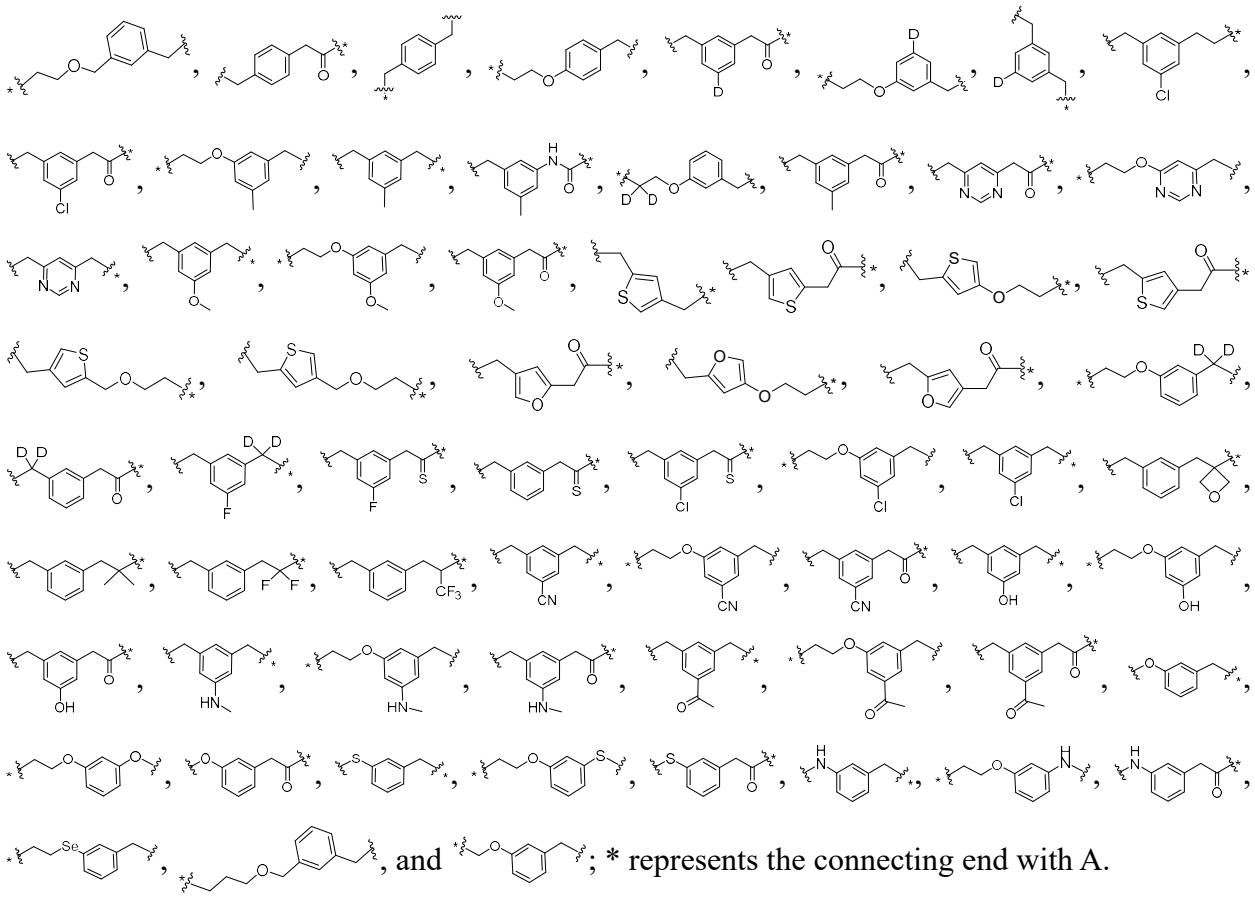
substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_1 and A; or

L_1 is selected from -methylene-phenyl-phenyl-methylene-, -methylene-pyridinyl-pyridinyl-methylene-, and ; * is the connecting end of L_1 and A; or

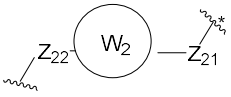
L_1 is selected from , , and ; * is the connecting end of L_1 and A; or

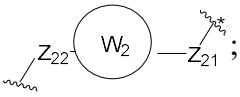
L_1 is ; * is the connecting end of L_1 and A; or

L_1 is selected from 

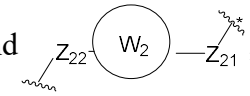


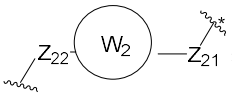
; * represents the connecting end with A.

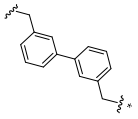
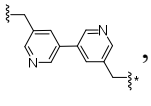
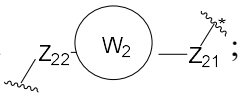
5. The compound according to any one of claims 1-4, or a pharmaceutically acceptable salt thereof, wherein L_2 is selected from -C_{1-3}alkylene-phenyl-phenyl-C_{1-3}alkylene-, -C_{1-3}alkylene-5-6 membered heteroaryl-5-6 membered heteroaryl-C_{1-3}alkylene-, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and N;

preferably, L_2 is selected from -methylene-phenyl-phenyl-methylene-, -ethylene-phenyl-phenyl-ethylene-, -methylene-5-6 membered heteroaryl-5-6 membered heteroaryl-methylene-, -ethylene-5-6 membered heteroaryl-5-6 membered heteroaryl-ethylene-, and ; the methylene, and ethylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and A; or

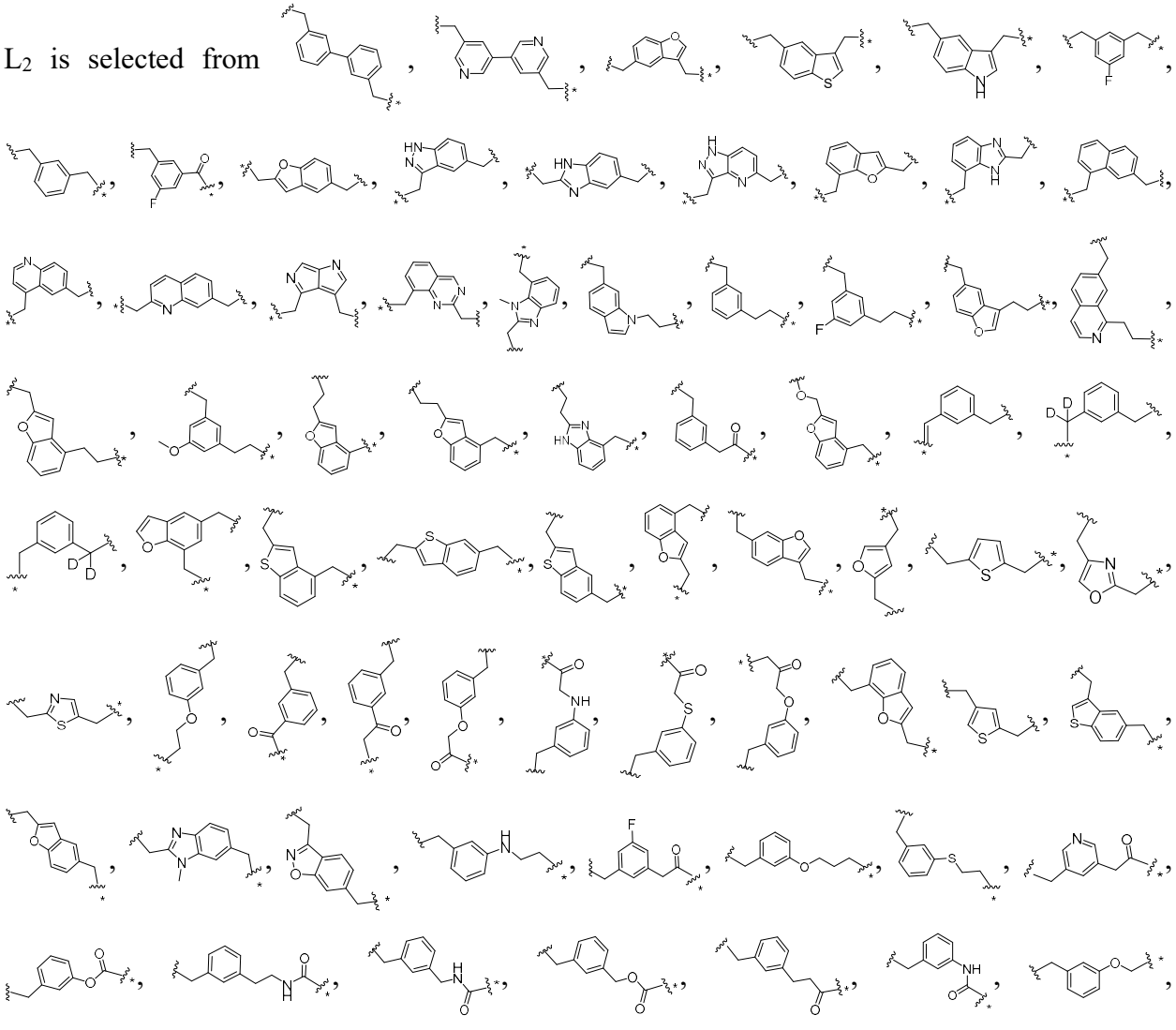
L_2 is selected from -methylene-phenyl-phenyl-methylene-, -methylene-6 membered heteroaryl-6

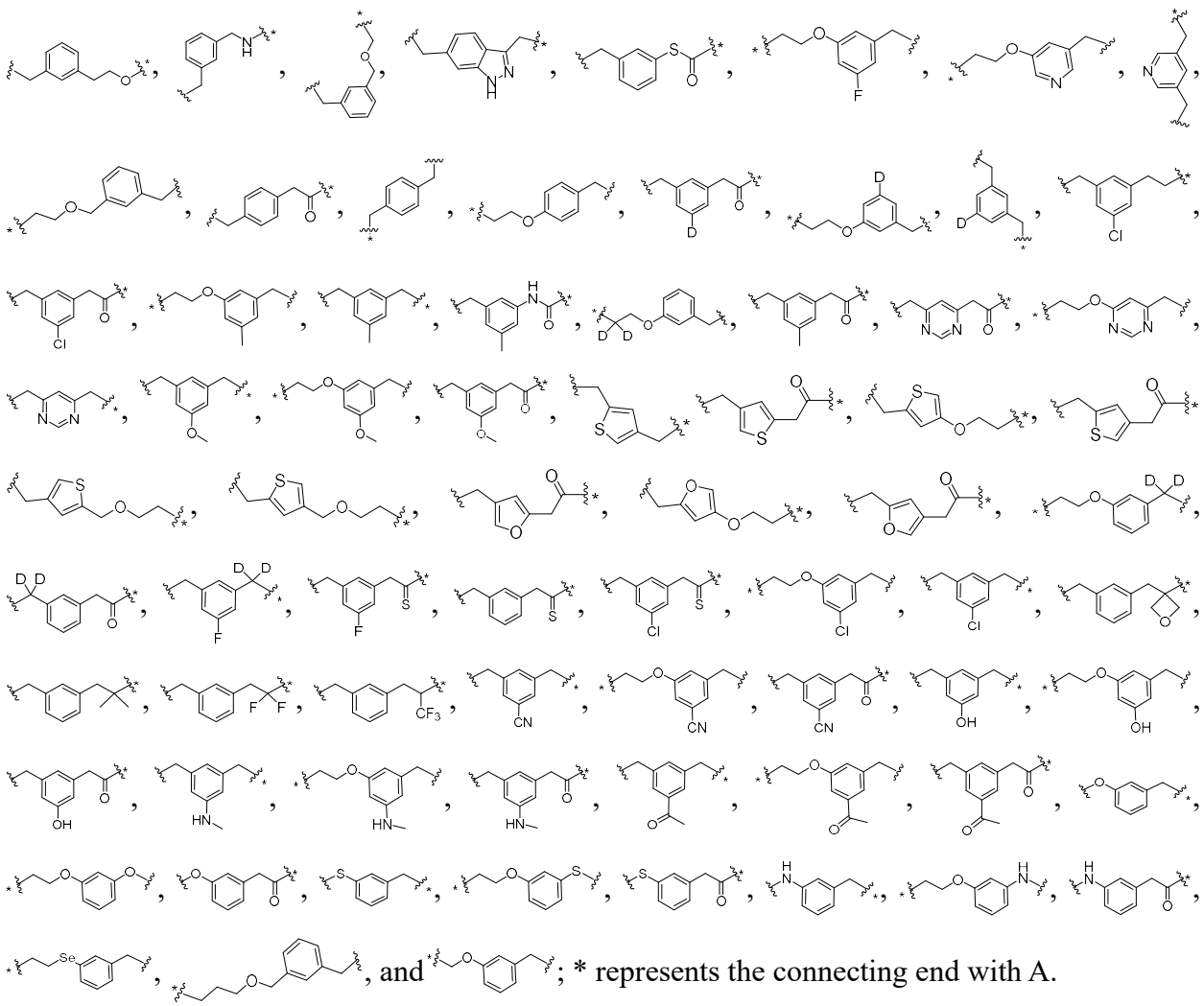
membered heteroaryl-methylene-, and ; the methylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, and C_{1-3}alkoxy; * is the connecting end of L_2 and A; or

L_2 is selected from -methylene-phenyl-phenyl-methylene-, -methylene-pyridinyl-pyridinyl-methylene-, and ; * is the connecting end of L_2 and A; or

L_2 is selected from , , and ; * is the connecting end of L_2 and A; or

L_2 is ; * is the connecting end of L_2 and A; or

L_2 is selected from 



; * represents the connecting end with A.

6. The compound according to any one of claims 1-5, or a pharmaceutically acceptable salt thereof, wherein each of rings W_1, W_2, and W_3 is independently selected from C_{6-12} aryl, 5-12 membered heteroaryl, and C_{6-14}cycloalkyl; the aryl, heteroaryl, and cycloalkyl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy;

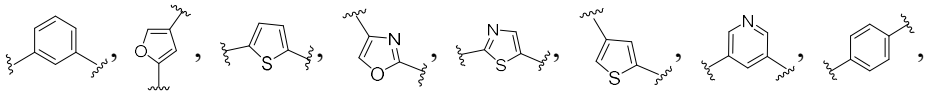
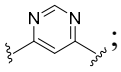
preferably, each of rings W_1, W_2, and W_3 is independently selected from C_{6-10} aryl, 5-10 membered heteroaryl, and C_{6-10}cycloalkyl; the aryl, heteroaryl, and cycloalkyl are optionally substituted by one or more substituents independently selected from F, Cl, Br, -CN, methyl, ethyl, methoxy, and ethoxy; or

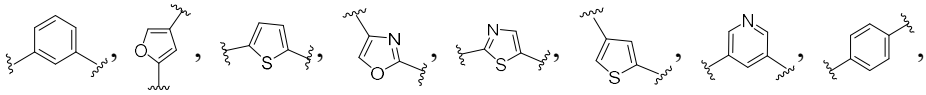
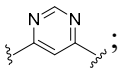
each of rings W_1, W_2, and W_3 is independently selected from phenyl, naphthyl, 8-10 membered bicyclic heteroaryl, C_{8-10} bicyclic cycloalkyl, and 5-6 membered monocyclic heteroaryl; the phenyl, naphthyl, heteroaryl, and cycloalkyl are optionally substituted by one or more substituents independently selected from halogen, -CN, C_{1-3}alkyl, and C_{1-3}alkoxy; or

each of the rings W_1, W_2, and W_3 is independently selected from phenyl, naphthyl, 5-membered/5-membered fused heteroaryl, 5-membered/6-membered fused heteroaryl, 6-membered/5-membered fused heteroaryl, 6-membered/6-membered fused heteroaryl, 4-membered/6-

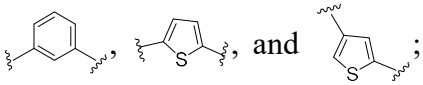
membered spirocycloalkyl, 6-membered/4-membered spirocycloalkyl, 5-membered/5-membered spirocycloalkyl, 5-membered/6-membered spirocycloalkyl, 6-membered/5-membered spirocycloalkyl, 6-membered/6-membered spirocycloalkyl, and 5-6 membered monocyclic heteroaryl; the phenyl, naphthyl, fused heteroaryl, spirocycloalkyl, and monocyclic heteroaryl are optionally substituted by one or more substituents independently selected from F, Cl, Br, -CN, methyl, ethyl, methoxy, and ethoxy; or

each of the rings W_1, W_2, and W_3 is independently selected from phenyl, 5-6 membered monocyclic heteroaryl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, -OH, $-NH_2$, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, $-N(C_{1-3}alkyl)_2$, $-NH(C_{1-3}alkyl)$, and $-C(O)C_{1-3}$alkyl; the heteroatom in the heteroaryl is O, N or S, the heteroatom number is 1 or 2; or

each of the rings W_1, W_2, and W_3 is independently selected from the following optionally substituted groups: , and ; wherein "optionally substituted" refers to unsubstituted or substituted by one or more substituents independently selected from deuterium, halogen, -CN, -OH, $-NH_2$, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, $-N(C_{1-3}alkyl)_2$, $-NH(C_{1-3}alkyl)$, and $-C(O)C_{1-3}$alkyl; or

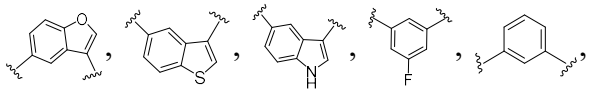
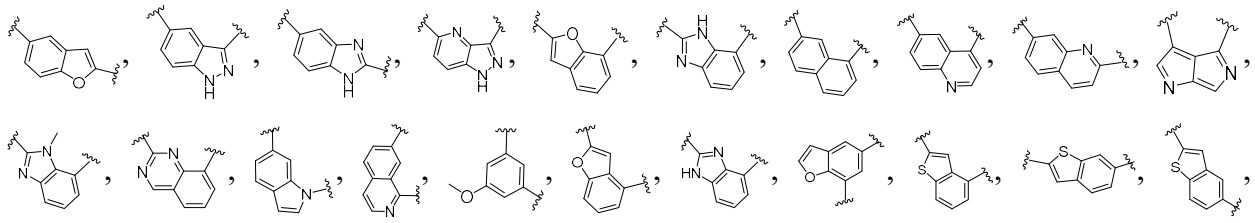
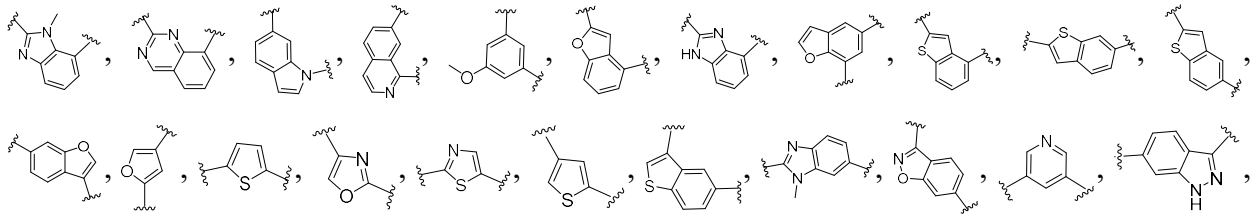
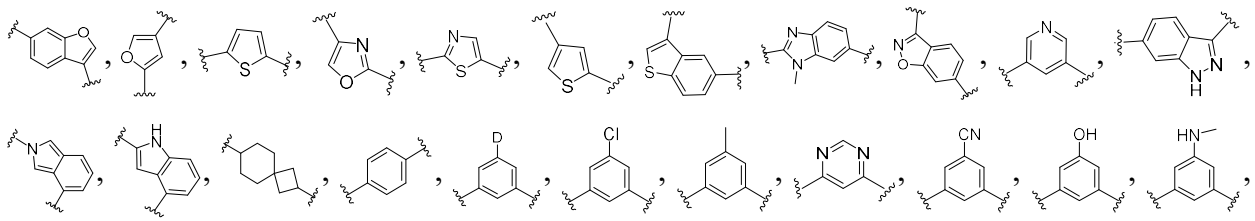
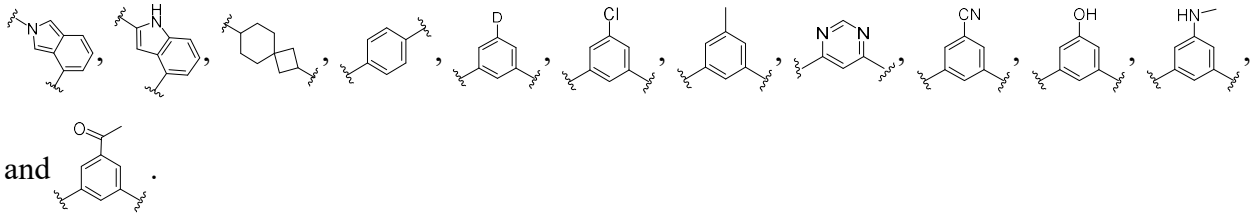
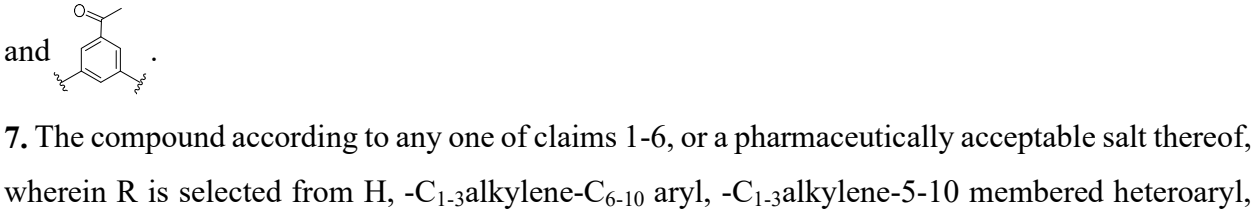
each of the rings W_1, W_2, and W_3 is independently selected from the following optionally substituted groups: , and ; wherein "optionally substituted" refers to unsubstituted or substituted by one or more substituents independently selected from deuterium, F, Cl, Br, -CN, -OH, $-NH_2$, -CHO, methyl, ethyl, methoxy, ethoxy, $-N(CH_3)_2$, $-NH(CH_3)$, and $-C(O)CH_3$; or

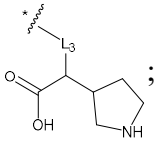
each of the rings W_1, W_2, and W_3 is independently selected from phenyl, and thienyl; the phenyl, and thienyl are optionally substituted by one or more substituents independently selected from deuterium, F, Cl, Br, -CN, -OH, $-NH_2$, -CHO, methyl, ethyl, methoxy, ethoxy, $-N(CH_3)_2$, $-NH(CH_3)$, and $-C(O)CH_3$; or

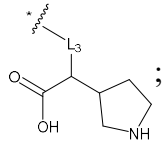
each of the rings W_1, W_2, and W_3 is independently selected from the following optionally substituted groups: ; wherein "optionally substituted" refers to unsubstituted or substituted by one or more substituents independently selected from deuterium, F, Cl, Br, -CN, -OH, $-NH_2$, -CHO, methyl, ethyl, methoxy, ethoxy, $-N(CH_3)_2$, $-NH(CH_3)$, and $-C(O)CH_3$; or

each of the rings W_1, W_2, and W_3 is independently selected from phenyl; the phenyl is optionally

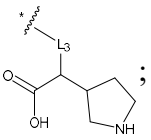
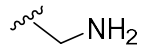
substituted by one or more substituents independently selected from F, Cl, Br, methyl, ethyl, methoxy, and ethoxy; or

each of W_1, W_2, W_3 is independently selected from , , , , , , and .

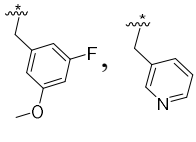
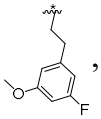
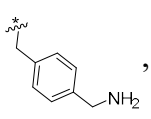
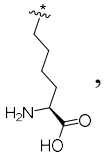
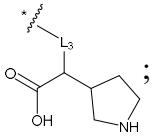
7. The compound according to any one of claims 1-6, or a pharmaceutically acceptable salt thereof, wherein R is selected from H, -C_{1-3}alkylene-C_{6-10} aryl, -C_{1-3}alkylene-5-10 membered heteroaryl, C_{1-6}alkyl, and ; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, and -NH_2; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, methoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, carboxyl, -CN, -OH, -NH_2, C_{1-3}alkyl, and C_{1-3}alkoxy; * is the connecting end of R and A;

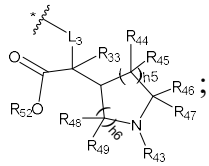
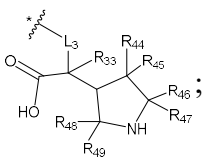
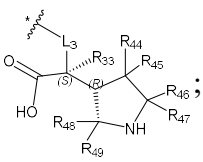
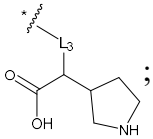
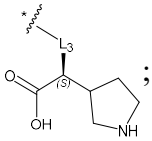
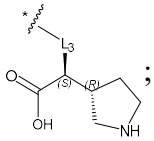
preferably, R is selected from H, -methylene-phenyl, -ethylene-phenyl, -methylene-5-6 membered heteroaryl, -ethylene-5-6 membered heteroaryl, C_{1-6}alkyl, and ; the methylene, and ethylene are optionally substituted by one or more substituents independently selected from halogen, oxo, -CN, -OH, and -NH_2; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from halogen, -CN, methoxy, and ; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from halogen, oxo, carboxyl, -CN, -OH, and -NH_2; * is the connecting end of R and A; or

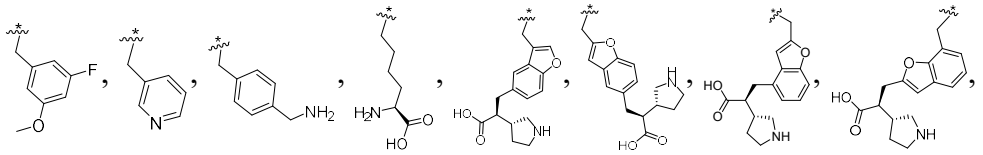
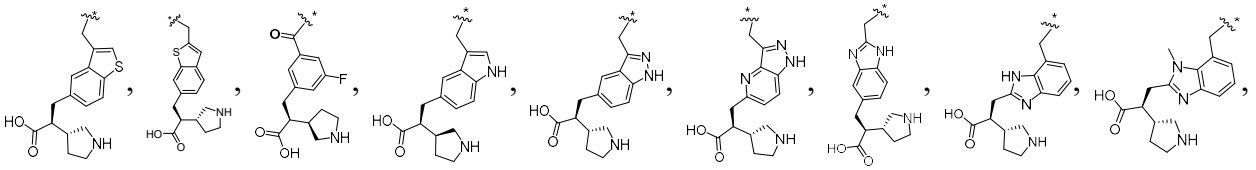
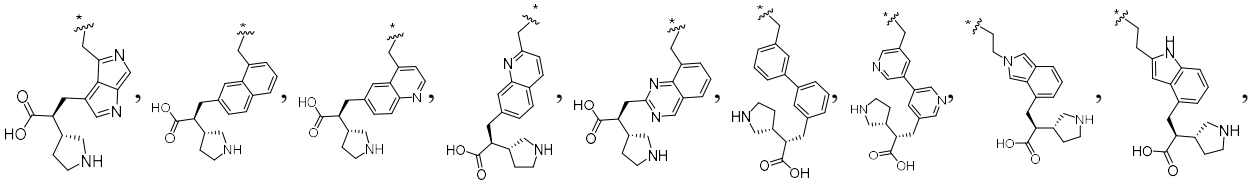
R is selected from H, -methylene-phenyl, -ethylene-phenyl, -methylene-pyridinyl, -ethylene-

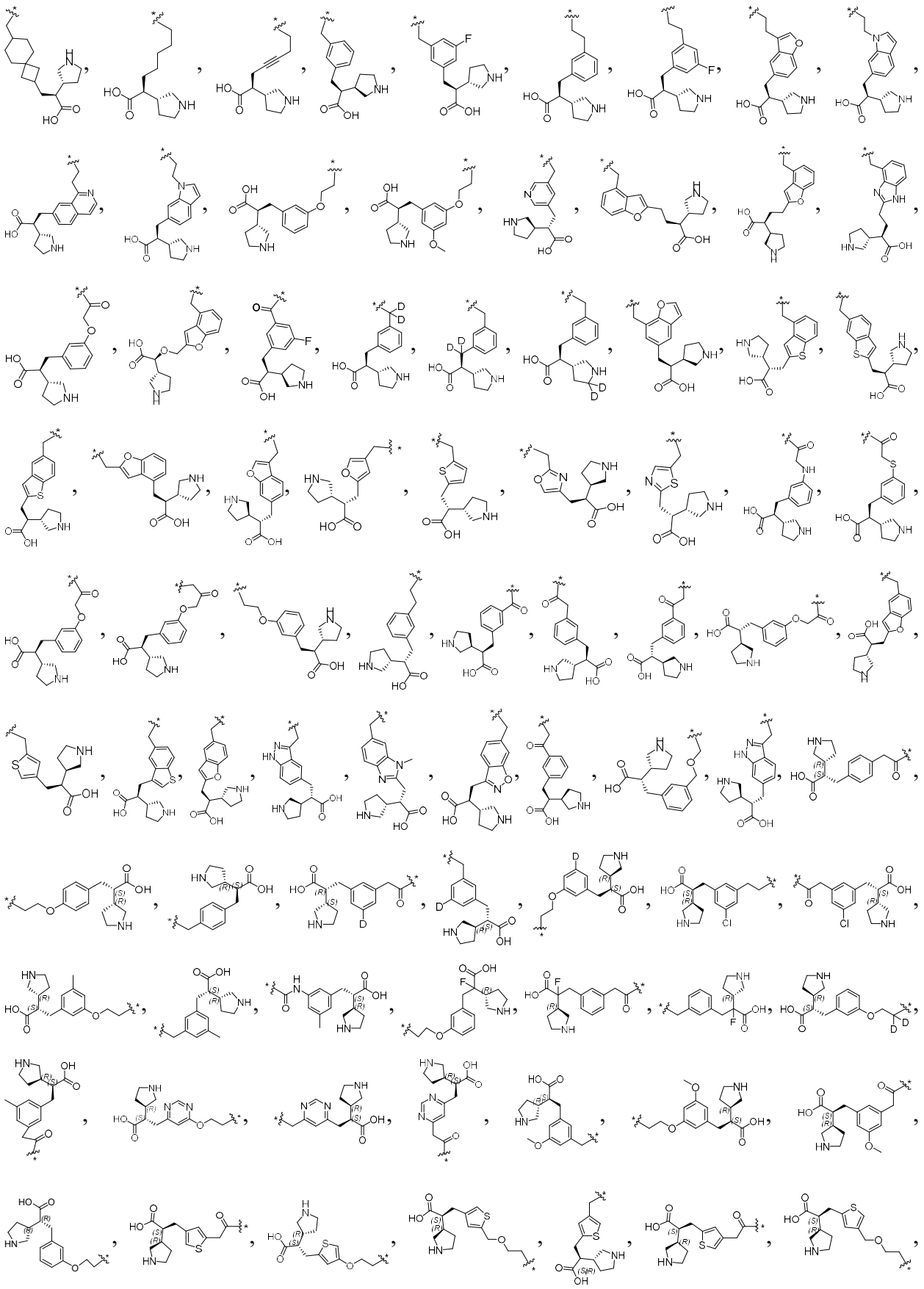
pyridinyl, methyl, ethyl, n-propyl, isopropyl, n-butyl, n-pentyl, n-hexyl, and ; the phenyl, and pyridinyl are optionally substituted by one or more substituents independently selected from halogen, methoxy, and ; the methyl, ethyl, n-propyl, isopropyl, n-butyl, n-pentyl, and n-hexyl are optionally substituted by one or more substituents independently selected from carboxyl, and -NH_2; * is the connecting end of R and A; or

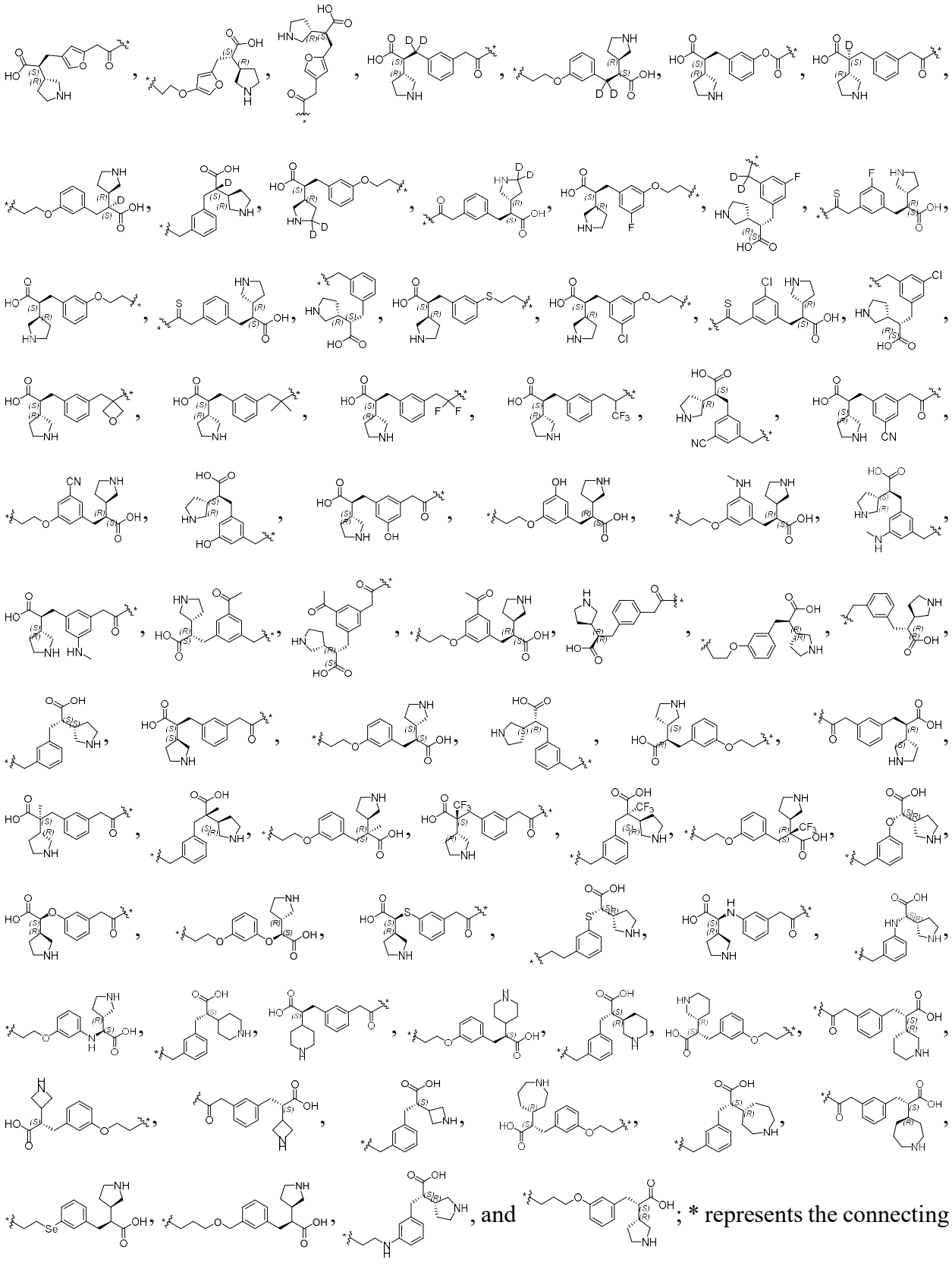
R is selected from H, -C_{1-3}alkylene-phenyl, -C_{1-3}alkylene-5-6 membered heteroaryl, C_{1-6}alkyl; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from halogen, -CN, C_{1-3}alkoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from halogen, carboxyl, -NH_2, methyl, and methoxy; or

R is selected from H, , , , , , and ; * is the connecting end of R and A; or

R is selected from H, ; or ; or ; or ; or ; or ; wherein * represents the connecting end with A; or

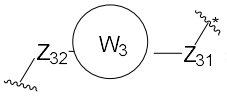
R is selected from H, , , ; or

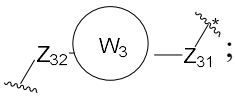


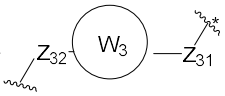


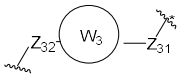
; * represents the connecting end with A.

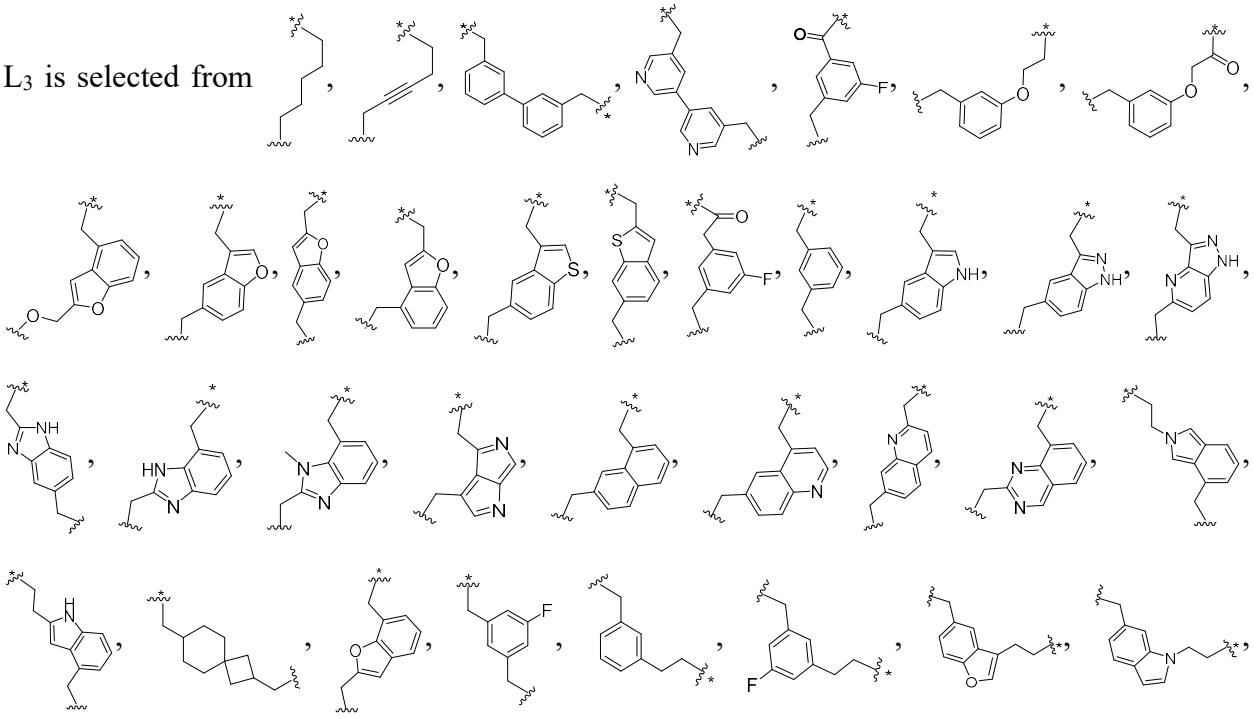
8. The compound according to any one of claims 1-7, or a pharmaceutically acceptable salt thereof, wherein L_3 is selected from -C_{1-6}alkylene-, -C_{2-6}alkynylene-, -methylene-phenyl-phenyl-methylene-, -ethylene-phenyl-phenyl-ethylene-, -methylene-5-6 membered heteroaryl-5-6 membered heteroaryl-methylene-, -ethylene-5-6 membered heteroaryl-5-6 membered heteroaryl-

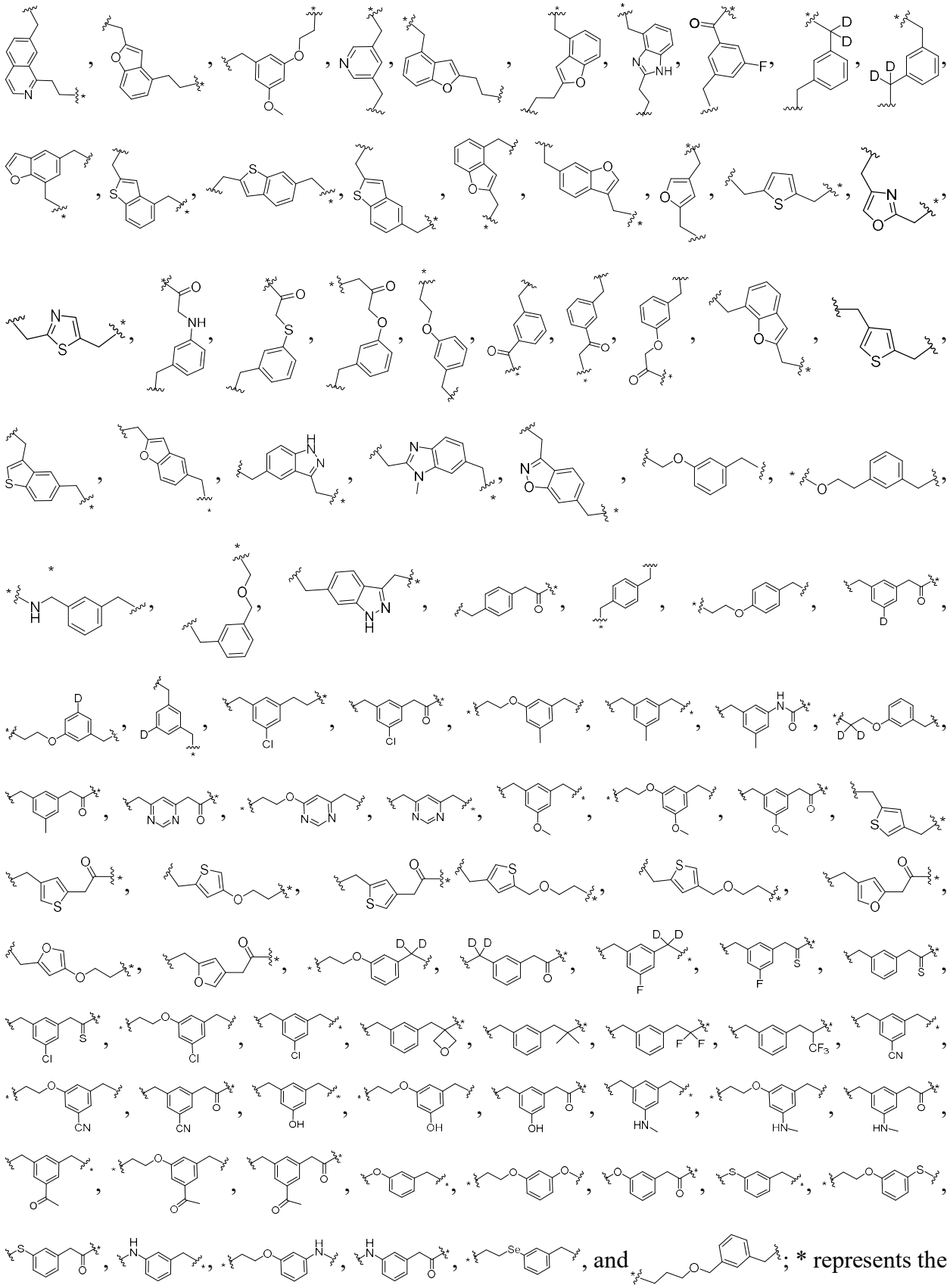
ethylene-, and, ; the alkylene methylene, ethylene, and alkynylene are optionally substituted by one or more substituents independently selected from halogen, oxo, -CN, -OH, -NH_2, methyl, and ethyl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from halogen, -CN, methyl, ethyl, methoxy, and ethoxy; * is the connecting end of L_3 and A;

preferably, L_3 is selected from -C_{1-6}alkylene-, -C_{2-6}alkynylene-, -methylene-phenyl-phenyl-methylene-, -methylene-6 membered heteroaryl-6 membered heteroaryl-methylene-, and, ; the alkylene, and methylene are optionally substituted by one or more substituents independently selected from F, Cl, Br, oxo, -CN, -OH, and -NH_2; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from F, Cl, Br, -CN, methyl, ethyl, methoxy, and ethoxy; * is the connecting end of L_3 and A; or

L_3 is selected from methylene, ethylene, n-propylene, isopropylene, n-butylene, n-pentylene, n-hexylene, n-propynylene, n-butynylene, n-pentynylene, n-hexynylene, -methylene-phenyl-phenyl-methylene-, -methylene-pyridinyl-pyridinyl-methylene-, and ; * is the connecting end of L_3 and A; or

L_3 is selected from ; * is the connecting end of L_3 and A; or

L_3 is selected from 



connecting end with A.

9. The compound according to any one of claims 1-8, or a pharmaceutically acceptable salt thereof, wherein each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -O-, -S-, -NH-, -Se-, -C_{1-4}alkylene-, -C_{1-6}oxaalkylene-, -C_{1-4}thiaalkylene-, -C_{1-4}azaalkylene-,and,-C_{1-}

$_4$selenaalkylene-; the alkylene, oxaalkylene, thiaalkylene, azaalkylene, and selenaalkylene are optionally substituted by one or more substituents independently selected from Z_{41}; Z_{41} is independently selected from deuterium, halogen (e.g. F, Cl), oxo, thio, -CN, -OH, -NH_2, C_{1-3}alkyl, C_{1-3}haloalkyl, C_{1-3}alkoxy, and C_{1-3}haloalkoxy; or any two Z_{41} together with the atom to which they are attached form C_{3-6}cycloalkyl, or 3-6 membered heterocyclyl (e.g. oxetanyl); the heteroatom in the heterocyclyl is O, N or S, the heteroatom number is 1 or 2;

preferably, each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -C_{1-3}alkylene-, -C_{1-3}oxaalkylene-, -C_{1-3}thiaalkylene-, and -C_{1-3}azaalkylene-; the alkylene, oxaalkylene, thiaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, methyl, and methoxy; preferably, the alkylene, oxaalkylene, thiaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from deuterium, and oxo; or

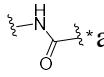
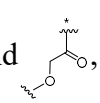
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from -C_{1-2}alkylene-, -C_{1-2}oxaalkylene-, -C_{1-2}thiaalkylene-, and -C_{1-2}azaalkylene-; the alkylene, oxaalkylene, thiaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from deuterium, and oxo; or

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -C_{1-3}alkylene-, and -C_{1-3}oxaalkylene-; the alkylene, and oxaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, methyl, and methoxy; preferably, the alkylene, and oxaalkylene are optionally substituted by one or more substituents independently selected from deuterium, and oxo; or

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from -C_{1-2}alkylene-, -C_{1-3}oxaalkylene-, and -C_{1-3}azaalkylene-; the alkylene, oxaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from and oxo; or

when Z_{11}, Z_{21}, and Z_{31} are present in the compound at the same time, in a combination of the definitions of Z_{11}, Z_{21}, and Z_{31}, at least one heteroatom or heteroatom group is present, and the heteroatom or heteroatom group is selected from -O-, -S-, -Se-, -NH-, -CO-, and -C(S)-; or

when Z_{11}, Z_{21}, and Z_{31} are present in the compound at the same time, in a combination of the definitions of Z_{11}, Z_{21}, and Z_{31}, at least one heteroatom or heteroatom group is present, and the heteroatom or heteroatom group is selected from -CO- or -C(S)-; or

when Z_{11}, Z_{21}, and Z_{31} are present in the compound at the same time, in a combination of the definitions of Z_{11}, Z_{21}, and Z_{31}, at least one group selected from , , , ,  and , or , is present; * represents the connecting end with A; or

when Z_{11}, Z_{21}, and Z_{31} are present in the compound at the same time, in a combination of the definitions of Z_{11}, Z_{21}, and Z_{31}, at least one heteroatom or heteroatom group is present, and the heteroatom or heteroatom group is selected from -O-, -NH-, and -CO-; or

when Z_{11}, Z_{21}, and Z_{31} are present in the compound at the same time, in a combination of the definitions of Z_{11}, Z_{21}, and Z_{31}, 1-4 heteroatoms or heteroatom groups are present, the heteroatom or heteroatom group is selected from -O-, -S-, -Se-, -NH-, -CO-, and -C(S)-, and the number of heteroatoms or heteroatom groups is specifically 1, 2, 3, or 4; preferably 1-3 heteroatoms or heteroatom groups are present, and the number thereof is specifically 1, 2, or 3; or preferably 2-4 heteroatoms or heteroatom groups are present, and the number thereof is 2, 3, or 4; further preferably 2 or 3 heteroatoms or heteroatom groups are present; the heteroatom or heteroatom group is preferably -O-, -S-, -NH-, or -CO-; the heteroatom or heteroatom group is more preferably -O-, or -CO-; preferably, the heteroatom or heteroatom group at least comprises -CO- or -C(S)-; or

Z_{21} contains a heteroatom or heteroatom group selected from -O-, -S-, -Se-, and -NH-; and Z_{31} contains a heteroatom or heteroatom group selected from -CO-, and -C(S)-; and in a combination of the definitions of Z_{21} and Z_{31}, the total number of the heteroatoms or heteroatom groups is 1-4; or

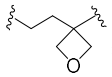
when Z_{11}, Z_{21}, and Z_{31} are present in the compound at the same time, in a combination of the definitions of Z_{11}, Z_{21}, and Z_{31}, 1-4, or 1-3, or 2-3 heteroatoms or heteroatom groups are present, and the heteroatom or heteroatom group is selected from -O-, -NH-, and -CO-; preferably, the heteroatom or heteroatom group at least comprises -CO-; or

Z_{11}, Z_{21} and Z_{31} all together contain 1-4 heteroatoms or heteroatom groups, and the heteroatom or heteroatom group is selected from -O-, -NH-, and -CO-, specifically the number of heteroatoms or heteroatom groups is 1, 2, 3, or 4; or

Z_{11}, Z_{21} and Z_{31} all together contain 1-3 heteroatoms or heteroatom groups, and the heteroatom or heteroatom group is selected from -O-, -NH-, and -CO-, specifically the number of heteroatoms or heteroatom groups is 1, 2, or 3; or

Z_{11}, Z_{21} and Z_{31} all together contain 2-3 heteroatoms or heteroatom groups, and the heteroatom or heteroatom group is selected from -O-, -NH-, and -CO-, specifically the number of heteroatoms or heteroatom groups is 2 or 3; preferably, the heteroatom or heteroatom group at least contains -CO-; or

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from -CD_2-, -C_{1-4}alkylene-, -OC_{1-3}alkylene-, -C(O)-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C_{1-3}alkylene-C(O)-, -S-C_{1-3}alkylene-C(O)-, -O-C_{1-2}alkylene-C(O)-C_{1-3}alkylene-, -C_{1-2}alkyl-O-C_{1-3}alkylene-, -NH-C_{1-3}alkylene-, -S-C_{1-3}alkylene-, -C_{1-3}alkylene-NH-C(O)-, -C_{1-3}alkylene-O-C(O)-, -NH-C(O)-, -O-

C(O)-, -S-C(O)-, -C_{1-3}alkylene-C(S)-, -Se-C_{1-3}alkylene-, , and ; the alkylene, methylene, and ethylene are optionally substituted by one or more substituents independentlyselected from deuterium, F, and Cl; or

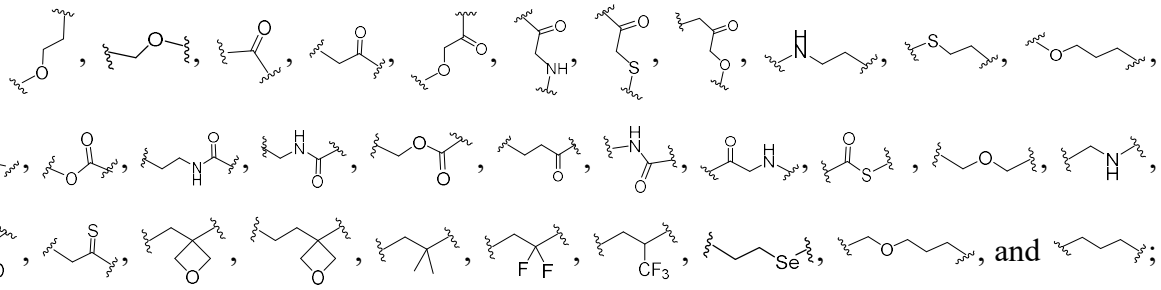
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from -CD_2-, -C_{1-3}alkylene-, -OC_{1-3}alkylene-, -C(O)-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C_{1-3}alkylene-C(O)-, -S-C_{1-3}alkylene-C(O)-, -O-C_{1-3}alkylene-C(O)-C_{1-3}alkylene-, -C_{1-3}alkylene-O-C_{1-3}alkylene-, -NH-C_{1-3}alkylene-, -S-C_{1-3}alkylene-, -C_{1-3}alkylene-NH-C(O)-, -C_{1-3}alkylene-O-C(O)-, -NH-C(O)-, -O-C(O)-, and -S-C(O)-; or

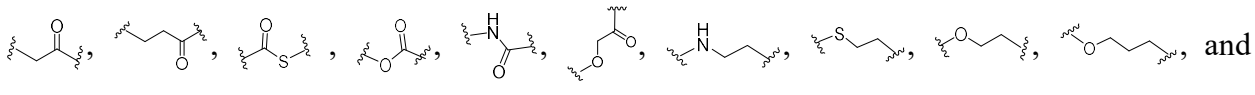
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -CD_2-, -C_{1-3}alkylene-, -OC_{1-3}alkylene-, -C(O)-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C_{1-3}alkylene-C(O)-, -S-C_{1-3}alkylene-C(O)-, and -O-C_{1-3}alkylene-C(O)-C_{1-3}alkylene-; or

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from -C_{1-3}alkylene-, -OC_{1-3}alkylene-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C(O)-, and -O-C(O)-; or

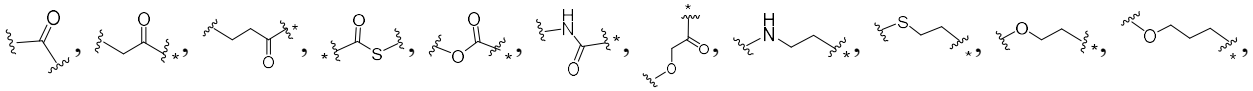
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from -CD_2-, -C_{1-2}alkylene-, -OC_{1-3}alkylene-, -C(O)-, -C_{1-2}alkylene-C(O)-, -OC_{1-2}alkylene-C(O)-, -NH-C_{1-2}alkylene-C(O)-, -S-C_{1-2}alkylene-C(O)-, -O-C_{1-2}alkylene-C(O)-C_{1-2}alkylene-, -C_{1-2}alkylene-O-C_{1-2}alkylene-, -NH-C_{1-2}alkylene-, -S-C_{1-2}alkylene-, -C_{1-2}alkylene-NH-C(O)-, -C_{1-2}alkylene-O-C(O)-, -NH-C(O)-, -O-C(O)-, and -S-C(O)-; or

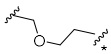
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, -CD_2-, -C_{1-2}alkylene-, -OC_{1-2}alkylene-, -C(O)-, -C_{1-2}alkylene-C(O)-, -OC_{1-2}alkylene-C(O)-, -NH-C_{1-2}alkylene-C(O)-, -S-C_{1-2}alkylene-C(O)-, and -O-C_{1-2}alkylene-C(O)-C_{1-2}alkylene-; or

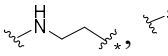
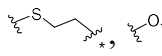
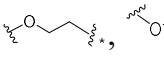
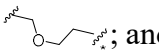
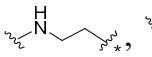
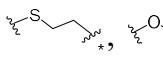
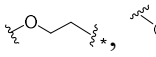
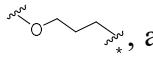
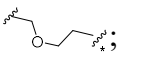
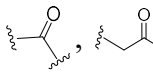
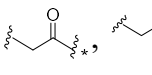
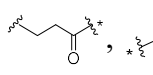
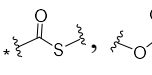
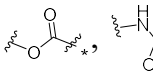
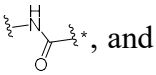
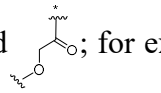
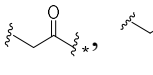
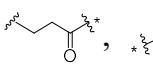
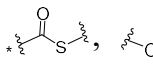
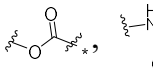
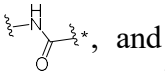
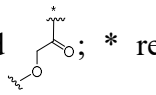
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from a bond, methylene, ethylene, -CD_2-, ; or

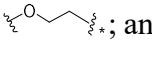
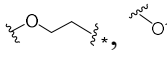
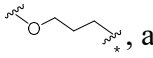
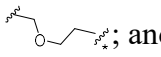
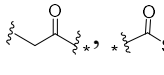
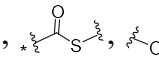
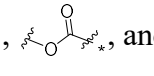
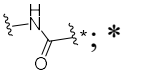
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from methylene, ethylene, , ; or

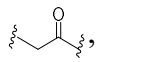
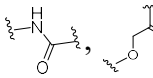
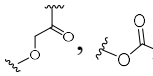
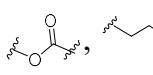
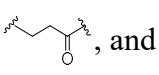
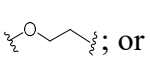
each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from methylene, ethylene, -CD_2,



and ; * represents the connecting end with A; or

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene and -CD_2-, and Z_{11} is selected from methylene, ethylene, -CD_2-, , , , and ; and Z_{21} is selected from methylene, ethylene, -CD_2-, , , , , and ; and Z_{31} is selected from , , , , , , and ; for example Z_{31} is selected from , , , , , and ; * represents the connecting end with A; or

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene and -CD_2-, and Z_{11} is selected from methylene, ethylene, -CD_2-, and ; and Z_{21} is selected from methylene, ethylene, -CD_2-, , , and ; and Z_{31} is selected from , , , and ; * represents the connecting end with A; or

each of Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, and Z_{32} is independently selected from methylene, ethylene, , , , , , and ; or

each of Z_{11}, Z_{12}, Z_{21}, and Z_{22} is independently selected from -CD_2- and methylene; or methylene; or

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from -CD_2-, methylene, and ethylene; or

Z_{12}, Z_{22}, Z_{32} are all -CD_2- or methylene; or

Z_{11} is selected from -CD_2-, -$C_{1\text{-}3}$alkylene-, and -$OC_{1\text{-}3}$alkylene-; or -$C_{1\text{-}3}$alkylene-; or -CD_2-, methylene, ethylene, methyleneoxy, and ethyleneoxy; or methylene; or

Z_{21} is selected from -$OC_{1\text{-}3}$alkylene-, -NH-$C_{1\text{-}3}$alkylene-, -S-$C_{1\text{-}3}$alkylene-, -Se-$C_{1\text{-}3}$alkylene-, and -$C_{1\text{-}2}$alkylene-O-$C_{1\text{-}3}$alkylene-; or -$OC_{1\text{-}3}$alkylene-, -NH-$C_{1\text{-}2}$alkylene-, -S-$C_{1\text{-}2}$alkylene-, and -$C_{1\text{-}2}$alkylene-O-$C_{1\text{-}3}$alkylene-; or

Z_{31} is selected from -C(O)-, -$C_{1\text{-}3}$alkylene-C(O)-, -$OC_{1\text{-}3}$alkylene-C(O)-, -NH-$C_{1\text{-}3}$alkylene-C(O)-, -S-$C_{1\text{-}3}$alkylene-C(O)-, -O-$C_{1\text{-}2}$alkylene-C(O)-$C_{1\text{-}3}$alkylene-, -$C_{1\text{-}3}$alkylene-NH-C(O)-, -$C_{1\text{-}3}$alkylene-O-C(O)-, -NH-C(O)-, -O-C(O)-, -S-C(O)-, and -$C_{1\text{-}3}$alkylene-C(S)-; or -C(O)-, -$C_{1\text{-}2}$alkylene-C(O)-, -$OC_{1\text{-}2}$alkylene-C(O)-, -NH-C(O)-, -O-C(O)-, and -S-C(O)-; or -$C_{1\text{-}2}$alkylene-C(O)-, -$OC_{1\text{-}2}$alkylene-C(O)-, -NH-C(O)-, -O-C(O)-, and -S-C(O)-; or -$CH_2C(O)$-; or

Z_{11} is independently selected from -OC_{1-3}alkyl-, -NH-C_{1-3}alkyl-, -S-C_{1-3}alkyl-, -Se-C_{1-3}alkyl-, and -C_{1-3}alkyl-O-C_{1-3}alkyl-; and Z_{21} is independently selected from -OC_{1-3}alkyl-, -NH-C_{1-3}alkyl-, -S-C_{1-3}alkyl-, -Se-C_{1-3}alkyl-, and -C_{1-3}alkyl-O-C_{1-3}alkyl-; or

Z_{21} is selected from -OC_{1-3}alkylene-, -NH-C_{1-3}alkylene-, -S-C_{1-3}alkylene-, -Se-C_{1-3}alkylene-, and -C_{1-2}alkylene-O-C_{1-3}alkylene-; and Z_{31} is selected from -C(O)-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C_{1-3}alkylene-C(O)-, -S-C_{1-3}alkylene-C(O)-, -O-C_{1-2}alkylene-C(O)-C_{1-3}alkyl-, -C_{1-3}alkylene-NH-C(O)-, -C_{1-3}alkylene-O-C(O)-, -NH-C(O)-, -O-C(O)-, -S-C(O)-, and -C_{1-3}alkylene-C(S)-; or

Z_{11} is selected from -CD_2, -C_{1-3}alkylene-, and -OC_{1-3}alkylene-; and Z_{21} is selected from -OC_{1-3}alkylene-, -NH-C_{1-3}alkylene-, -S-C_{1-3}alkylene-, -Se-C_{1-3}alkylene-, and -C_{1-2}alkylene-O-C_{1-3}alkylene-; and Z_{31} is selected from -C(O)-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C_{1-3}alkylene-C(O)-, -S-C_{1-3}alkylene-C(O)-, -O-C_{1-2}alkylene-C(O)-C_{1-3}alkylene-, -C_{1-3}alkylene-NH-C(O)-, -C_{1-3}alkylene-O-C(O)-, -NH-C(O)-, -O-C(O)-, -S-C(O)-, and -C_{1-3}alkylene-C(S)-; or

Z_{11} is -C_{1-3}alkylene-, -OC_{1-3}alkylene-; and Z_{21} is selected from -OC_{1-3}alkylene-, -NH-C_{1-3}alkylene-, -S-C_{1-3}alkylene-, -Se-C_{1-3}alkylene-, -C_{1-2}alkylene-O-C_{1-3}alkylene-; and Z_{31} is selected from -C(O)-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C_{1-3}alkylene-C(O)-, -S-C_{1-3}alkylene-C(O)-, -O-C_{1-2}alkylene-C(O)-C_{1-3}alkylene-, -C_{1-3}alkylene-NH-C(O)-, -C_{1-3}alkylene-O-C(O)-, -NH-C(O)-, -O-C(O)-, -S-C(O)-, -C_{1-3}alkylene-C(S)-; or

Z_{11} is selected from -CD_2, -C_{1-3}alkylene-, and -OC_{1-3}alkylene-*; and Z_{21} is selected from -OC_{1-3}alkylene-*, -NH-C_{1-3}alkylene-*, -S-C_{1-3}alkylene-*, -Se-C_{1-3}alkylene-*, and -C_{1-2}alkylene-O-C_{1-3}alkylene-*; and Z_{31} is selected from -C(O)-, -C_{1-3}alkylene-C(O)-*, -OC_{1-3}alkylene-C(O)-*, -NH-C_{1-3}alkylene-C(O)-*, -S-C_{1-3}alkylene-C(O)-*, -O-C_{1-2}alkylene-C(O)-C_{1-3}alkylene-*, -C_{1-3}alkylene-NH-C(O)-*, -C_{1-3}alkylene-O-C(O)-*, -NH-C(O)-*, -O-C(O)-*, -S-C(O)-*, and -C_{1-3}alkylene-C(S)-*; * represents the connecting end with A; or

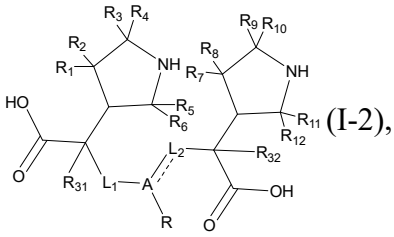
Z_{11} is selected from -C_{1-3}alkylene-, and -OC_{1-3}alkylene-*; and Z_{21} is selected from -OC_{1-3}alkylene-*, -NH-C_{1-3}alkylene-*, -S-C_{1-3}alkylene-*, -Se-C_{1-3}alkylene-*, and -C_{1-2}alkylene-O-C_{1-3}alkylene-*; and Z_{31} is selected from -C(O)-, -C_{1-3}alkylene-C(O)-*, -OC_{1-3}alkylene-C(O)-*, -NH-C_{1-3}alkylene-C(O)-*, -S-C_{1-3}alkylene-C(O)-*, -O-C_{1-2}alkylene-C(O)-C_{1-3}alkylene-*, -C_{1-3}alkylene-NH-C(O)-*, -C_{1-3}alkylene-O-C(O)-*, -NH-C(O)- *, -O-C(O)-*, -S-C(O)-*, and -C_{1-3}alkylene-C(S)-* ; * represents the connecting end with A; or

Z_{11} is selected from -CD_2, -C_{1-2}alkylene-, and -OC_{1-2}alkylene-*; and Z_{21} is selected from -OC_{1-2}alkylene-*, -NH-C_{1-2}alkylene-*, -S-C_{1-2}alkylene-*, -Se-C_{1-2}alkylene-*, and -CH_2-O-C_{1-2}alkylene-*; and Z_{31} is selected from -C(O)-, -C_{1-2}alkylene-C(O)-*, -OC_{1-2}alkylene-C(O)-*, -NH-C_{1-2}alkylene-C(O)-*, -S-C_{1-2}alkylene-C(O)-*, -C_{1-2}alkylene-NH-C(O)-*, -C_{1-2}alkylene-O-C(O)-*, -NH-C(O)-*, -O-C(O)-*, -S-C(O)-*, and -C_{1-2}alkylene-C(S)-*; for example, Z_{31} is selected from

-C_{1-2}alkylene-C(O)-*, -OC_{1-2}alkylene-C(O)-*, -NH-C_{1-2}alkylene-C(O)-*, -S-C_{1-2}alkylene-C(O)-*, -C_{1-2}alkylene-NH-C(O)-*, -C_{1-2}alkylene-O-C(O)-*, -CH_2NH-C(O)-*, -NH-C(O)-*, -O-C(O)-*, -S-C(O)-*, and -C_{1-2}alkylene-C(S)-*; for example, Z_{31} is selected from -C_{1-2}alkylene-C(O)-*, -OCH_2-C(O)-*, -CH_2-O-C(O)-*, -NH-C(O)-*, -O-C(O)-*, and -S-C(O)-*; for example, Z_{31} is selected from -CH_2C(O)-*; * represents the connecting end with A.

10. The compound according to any one of claims 1-9, or a pharmaceutically acceptable salt thereof, wherein

the compound has a structure as represented by formula (I-2):

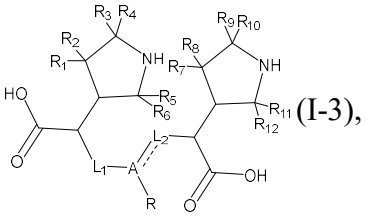

(I-2),

wherein A, ---, L_1, L_2, R, R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{31}, and R_{32} are defined as in any of claims 1-9;

for example, in the compound represented by formula (I-2), R is a group containing L_3, L_1, L_2 and L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2$O-, and -S-C(O)-;

or

the compound has a structure as represented by formula (I-3):


(I-3),

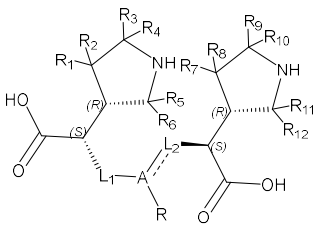
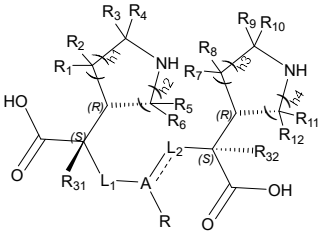
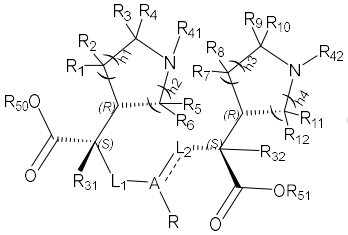
wherein A, ---, L_1, L_2, R, R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, and R_{12} are defined as in any of claims 1-9;

for example, in the compound represented by formula (I-3), R is a group containing L_3, L_1, L_2 and

L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from $-CH_2-$, $-CD_2-$, $-CH_2CH_2-$, $-CD_2CH_2-$, -C(O)-, $-CH_2C(O)-$, -NHC(O)-, -OC(O)-, $-CH_2CH_2O-$, $-OCH_2C(O)-$, $-CH_2OC(O)-$, $-CH_2CH_2CH_2O-$, and -S-C(O)-;

or

the compound has a structure as represented by formula (I'-1), formula (I'-2), or formula (I'-3):

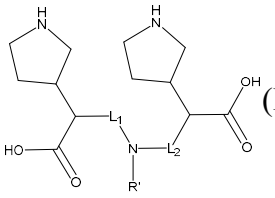

(I'-1),

(I'-2),

(I'-3),

wherein A, L_1, L_2, R, R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{31}, R_{32}, R_{41}, R_{42}, R_{50}, R_{51}, h1, h2, h3, h4 are defined as in any of claims 1-9;

for example, in the compound represented by formula (I'-1), (I'-2), or (I'-3), R is a group containing L_3, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from $-CH_2-$, $-CD_2-$, $-CH_2CH_2-$, $-CD_2CH_2-$, -C(O)-, $-CH_2C(O)-$, -NHC(O)-, -OC(O)-, $-CH_2CH_2O-$, $-OCH_2C(O)-$, $-CH_2OC(O)-$, $-CH_2CH_2CH_2O-$, and -S-C(O)-;

or

the compound has a structure as represented by formula (II):

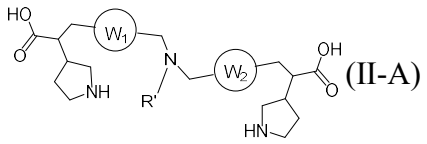

(II),

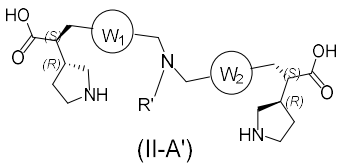
wherein L_1, L_2 are defined as in any of claims 1-9, R' is selected from H, $-C_{1-3}$alkylene-C_{6-10} aryl,

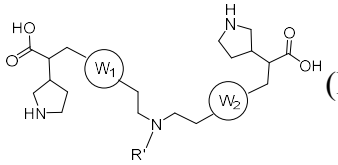
-C_{1-3}alkylene-5-12 membered heteroaryl, and C_{1-6}alkyl; the C_{1-3}alkylene is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, and C_{1-3}alkyl; the aryl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, C_{1-3}alkoxy, and C_{1-3}aminoalkyl; the C_{1-6}alkyl is optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, carboxyl, -CN, -OH, -NH_2, C_{1-3}alkyl, and C_{1-3}alkoxy;

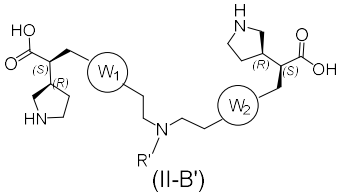
or

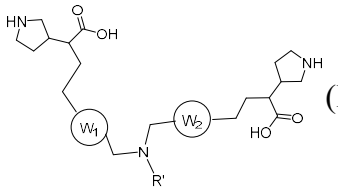
the compound has a structure as represented by formula (II-A), formula (II-B), formula (II-C), formula (II-A'), formula (II-B'), or formula (II-C'):

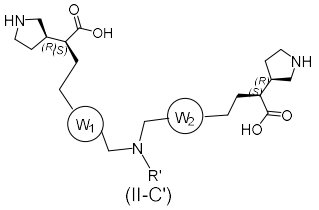

(II-A)


(II-A')


(II-B)


(II-B')

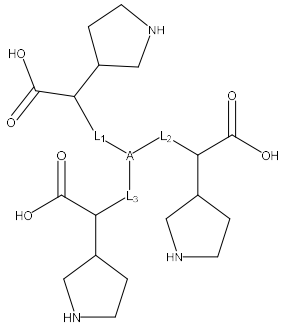

(II-C)


(II-C')

wherein W_1, W_2, R' are defined as in any of claims 1-9;

or

the compound has a structure as represented by formula (III):


(III),

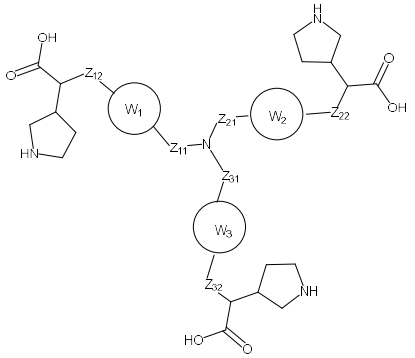
wherein A, L_1, L_2, L_3 are defined as in any of claims 1-9;

for example, in the compound represented by formula (III), L_1, L_2 and L_3 are groups containing Z_{11}, Z_{21} and Z_{31} respectively, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each

independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

or

the compound has a structure as represented by formula (III-1):



(III-1),

wherein W_1, W_2, W_3, Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, Z_{32} are defined as in any of claims 1-9;

preferably, each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and ethylene;

each of Z_{11}, Z_{21}, Z_{31} is independently selected from a bond, -C_{1-4}alkylene-, -C_{1-6}oxaalkylene- (e.g. -C_{1-4}oxaalkylene-), -C_{1-4}thiaalkylene-, -C_{1-4}azaalkylene-, and -C_{1-4}selenaalkylene-; the alkylene, oxaalkylene, thiaalkylene, azaalkylene, and selenaalkylene are optionally substituted by one or more substituents independently selected from Z_{41}; Z_{41} is independently selected from deuterium, halogen (e.g. F, Cl), oxo, thio, -CN, -OH, -NH_2, C_{1-3}alkyl, C_{1-3}haloalkyl, C_{1-3}alkoxy, and C_{1-3}haloalkoxy; or any two Z_{41} together with the atom to which they are attached form C_{3-6}cycloalkyl, or 3-6 membered heterocyclyl (e.g. oxetanyl); the heteroatom in the heterocyclyl is O, N or S, the heteroatom number is 1;

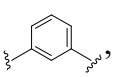
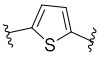
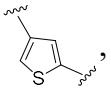
each of the rings W_1, W_2, and W_3 is independently selected from phenyl, and 5-6 membered monocyclic heteroaryl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, -OH, -NH_2, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, -N(C_{1-3}alkyl)$_2$, -NH(C_{1-3}alkyl), and -C(O)C_{1-3}alkyl; the heteroatom in the heteroaryl is O, N or S, the heteroatom number is 1 or 2; or

Z_{12}, Z_{22}, Z_{32} are all methylene; or

when Z_{11}, Z_{21}, and Z_{31} are present in the compound at the same time, in a combination of the definitions of Z_{11}, Z_{21}, and Z_{31} 2 or 3 heteroatoms or heteroatom groups are present, and the heteroatom or heteroatom group is selected from -O-, -S-, -NH-, and -CO-;

each of the rings W_1, W_2, and W_3 is independently selected from phenyl, and thienyl; the phenyl, and thienyl are optionally substituted by one or more substituents independently selected from

deuterium, halogen, -CN, -OH, $-NH_2$, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, $-N(C_{1-3}alkyl)_2$, $-NH(C_{1-3}alkyl)$, and $-C(O)C_{1-3}$alkyl; or

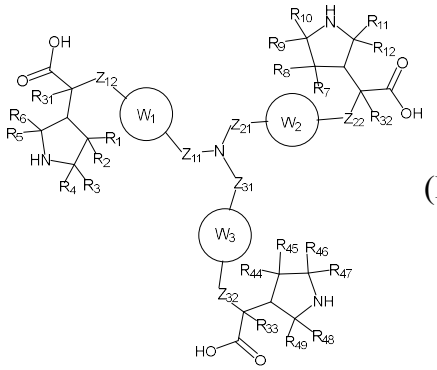
each of the rings W_1, W_2, and W_3 is independently selected from , , and ,

which are optionally substituted by one or more substituents independently selected from deuterium, F, Cl, Br, methyl, ethyl, methoxy, and ethoxy;

for example, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from $-CH_2-$, $-CD_2-$, $-CH_2CH_2-$, $-CD_2CH_2-$, -C(O)-, $-CH_2C(O)-$, -NHC(O)-, -OC(O)-, $-CH_2CH_2O-$, $-OCH_2C(O)-$, $-CH_2OC(O)-$, $-CH_2CH_2CH_2O-$, and -S-C(O)-;

or

the compound has a structure as represented by formula (III-2):



(III-2),

wherein W_1, W_2, W_3, Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, Z_{32}, R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, R_{49}, R_{31}, R_{32}, and R_{33} are defined as in any of claims 1-9;

preferably, the heteroatom or heteroatom group in Z_{31} comprises -CO- or -C(S)-; or

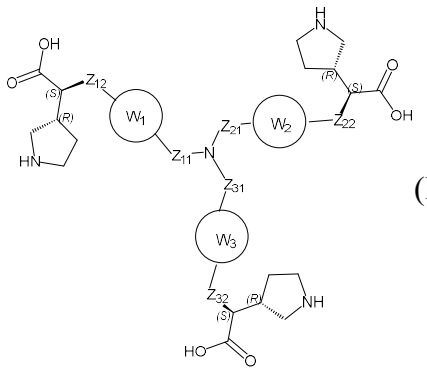
R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, R_{49}, R_{31}, R_{32}, and R_{33} are selected from hydrogen or deuterium;

for example, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28,

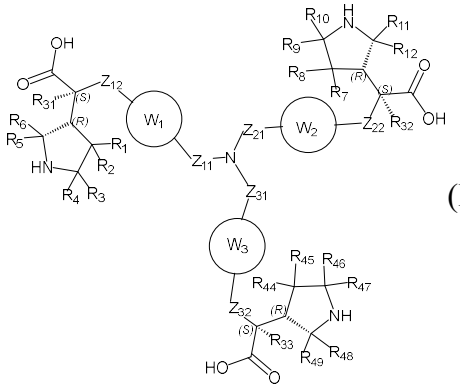
about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

or

the compound has a structure as represented by formula (III-1-1), or formula (III-2-1):



(III-1-1),



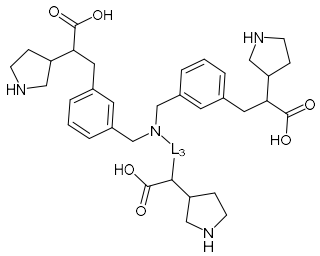
(III-2-1),

wherein W_1, W_2, W_3, Z_{11}, Z_{12}, Z_{21}, Z_{22}, Z_{31}, Z_{32}, R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, R_{49}, R_{31}, R_{32}, and R_{33} are defined as in any of claims 1-9;

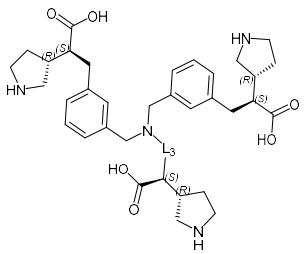
for example, one and only one of Z_{11}, Z_{21} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11}, Z_{21} and Z_{31} are different from each other, or two groups not containing the double bond in Z_{11}, Z_{21} and Z_{31} are the same, and the two same groups contain -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11}, Z_{21} and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

or

the compound has a structure as represented by formula (III-A), or formula (III-A'):



(III-A),

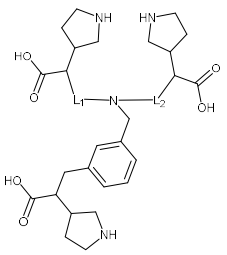
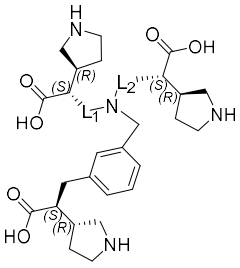


(III-A'),

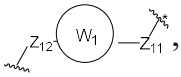
wherein L_3 are defined as in any of claims 1-9;

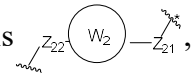
or

the compound has a structure as represented by formula (III-B), or formula (III-B'-1):


(III-B), 
(III-B'-1),

wherein L_1, L_2 are defined as in any of claims 1-9;

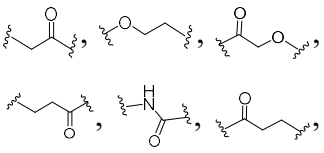
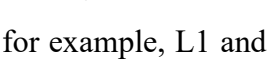
preferably, L_1为 , *represents the connecting end with A; or

L_2 is , * represents the connecting end with A; or

each of Z_{11}, Z_{12}, Z_{21}, and Z_{22} is independently selected from -C_{1-3}alkylene-, -C_{1-3}oxaalkylene-, -C_{1-3}thiaalkylene-, and -C_{1-3}azaalkylene-; the alkylene, oxaalkylene, thiaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, methyl, and methoxy; or

each of Z_{11}, Z_{12}, Z_{21}, and Z_{22} is independently selected from -C_{1-3}alkylene-, and -C_{1-3}oxaalkylene-; the alkylene, and oxaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, methyl, and methoxy; or

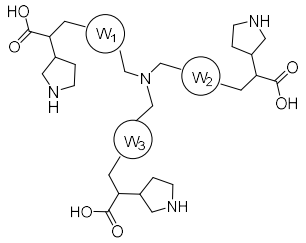
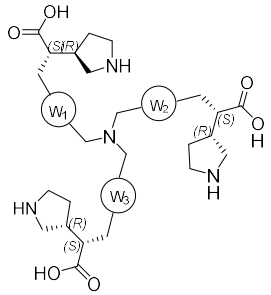
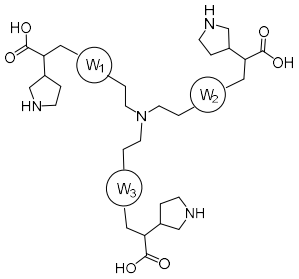
each of Z_{11}, Z_{12}, Z_{21}, and Z_{22} is independently selected from -C_{1-2}alkylene-, -C_{1-2}oxaalkylene-, -C_{1-2}thiaalkylene-, and -C_{1-2}azaalkylene-; the alkylene, oxaalkylene, thiaalkylene, and azaalkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, oxo, -CN, -OH, -NH_2, methyl, and methoxy; or

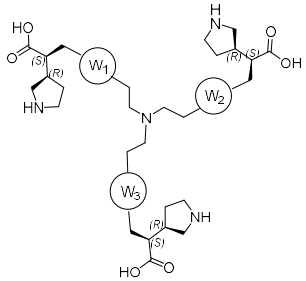
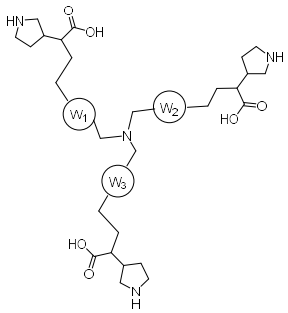
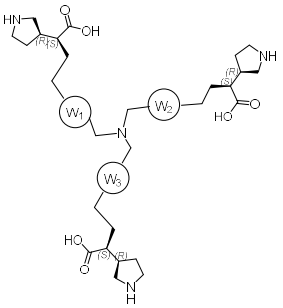
each of Z_{11}, Z_{12}, Z_{21}, and Z_{22} is independently selected from methylene, , and  ;

for example, L1 and L2 are groups containing Z_{11} and Z_{21} respectively, one and only one of Z_{11} and Z_{21} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; preferably, the double bond is for example a double bond between C and O in -C(O)-; further preferably, neither Z_{11} nor Z_{21} is methylene, or a group not containing the double bond of Z_{11} and Z_{21} contains -O-, -NH-, -S-, or -Se-, preferably, -O-; still further preferably, Z_{11} and Z_{21} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

or

the compound has a structure as represented by formula (III-C), formula (III-C'), formula (III-D), formula (III-D'), formula (III-E), or formula (III-E'):

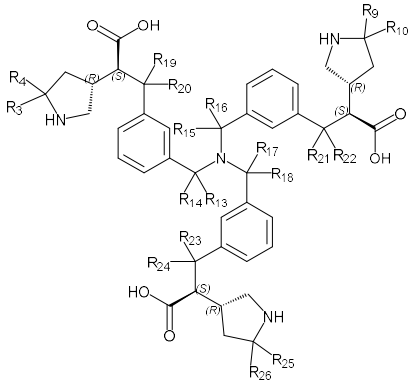

(III-C),

(III-C'),

(III-D),


(III-D'),

(III-E),

(III-E'),

wherein W_1, W_2, W_3 are defined as in any of claims 1-9;

or

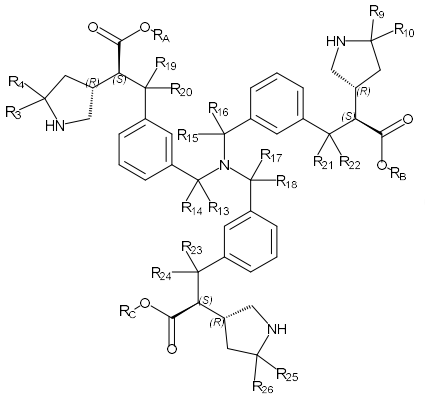
the compound has a structure as represented by formula (IV):


(IV),

wherein R_3, R_4, R_9, R_{10}, R_{13}, R_{14}, R_{15}, R_{16}, R_{17}, R_{18}, R_{19}, R_{20}, R_{21}, R_{22}, R_{23}, R_{24}, R_{25}, and R_{26} are each independently selected from H, deuterium, and at least one of R_3, R_4, R_9, R_{10}, and R_{13}-R_{26} is deuterium;

or

the compound has a structure as represented by formula (A):



(A),

wherein R_3, R_4, R_9, R_{10}, R_{13}, R_{14}, R_{15}, R_{16}, R_{17}, R_{18}, R_{19}, R_{20}, R_{21}, R_{22}, R_{23}, R_{24}, R_{25}, and R_{26} are each independently selected from H, and deuterium, and at least one of R_3, R_4, R_9, R_{10}, and R_{13}-R_{26} is deuterium; R_A, R_B, R_C are each independently selected from hydrogen, C_{1-6}alkyl, C_{2-6}alkenyl, C_{1-6}alkoxy, -C_{1-3}alkyleneO-C_{1-6}alkyl, and -C_{1-3}alkylene-O-C(O)-C_{1-6}alkyl, the alkyl, alkenyl, alkoxy, and alkylene are optionally substituted by one or more substituents independently selected from deuterium, halogen, -OH, -NH_2, -CN, oxo, C_{1-3}alkyl, and C_{1-3}alkoxy;

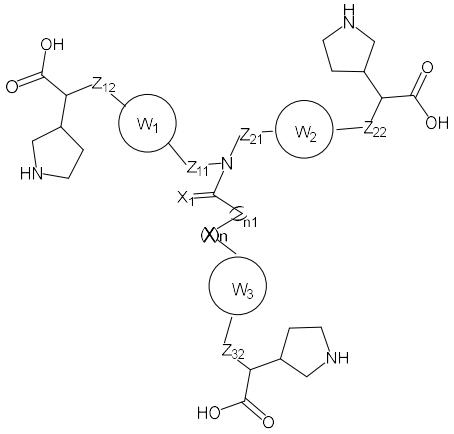
preferably, R_A, R_B, R_C are each independently selected from C_{1-6}alkyl, C_{1-6}alkoxy, -C_{1-2}alkylene-O-C_{1-4}alkyl, and -C_{1-2}alkylene-O-C(O)-C_{1-4}alkyl, the alkyl, C_{1-6}alkoxy, and alkylene are optionally substituted by one or more substituents independently selected from deuterium, F, Cl, Br, -OH, -NH_2, -CN, oxo, methyl, ethyl, n-propyl, isopropyl, methoxy, ethoxy, n-propyloxy, and isopropyloxy; or

R_A, R_B, R_C are each independently selected from C_{1-3}alkyl, -methylene-O-C_{1-4}alkyl, and -methylene-O-C(O)-C_{1-3}alkyl, the methylene and alkyl are optionally substituted by one or more substituents independently selected from methyl, ethyl, n-propyl, and isopropyl; or

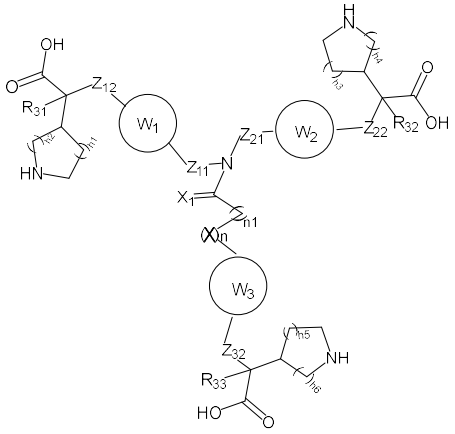
R_A, R_B, R_C are each independently selected from methyl, ethyl, and -CH_2-OC(O)-$CH(CH_3)_2$;

or

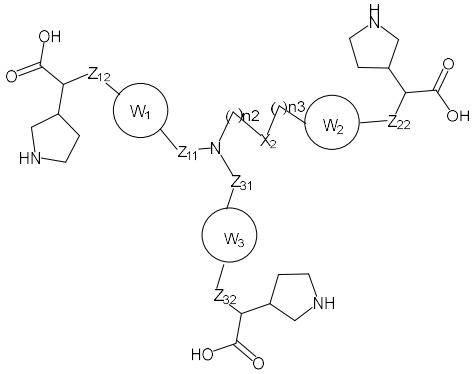
the compound has a structure as represented by formula (B), formula (B-1), formula (C), formula (C-1), formula (D), formula (D-1), formula (B-2), formula (B-3), formula (C-2), formula (C-3), formula (D-2), or formula (D-3):



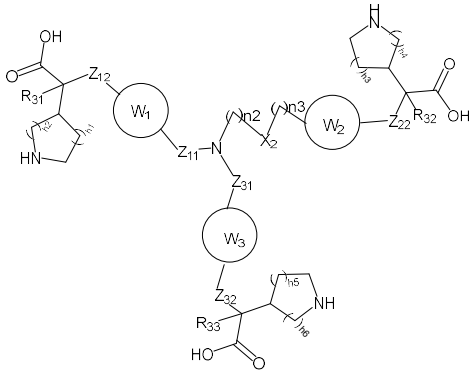
formula (B)



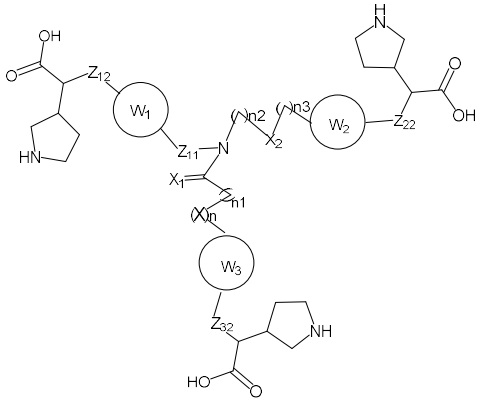
formula (B-1)



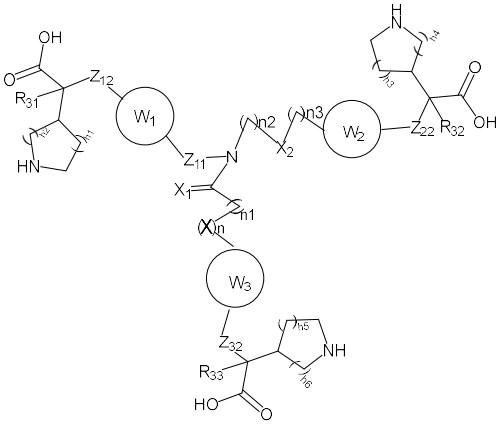
formula (C)



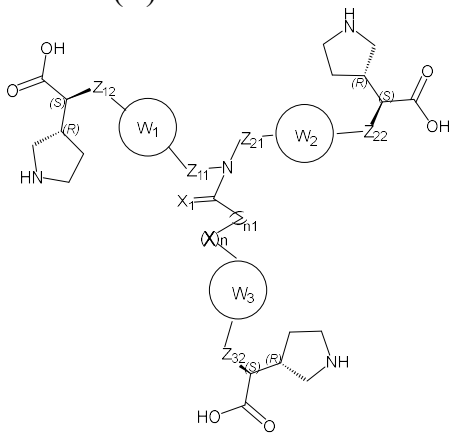
formula (C-1)



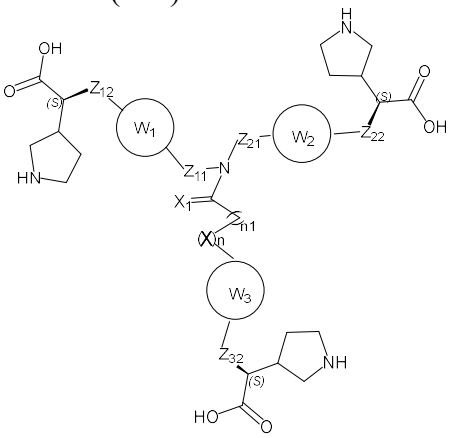
formula (D)



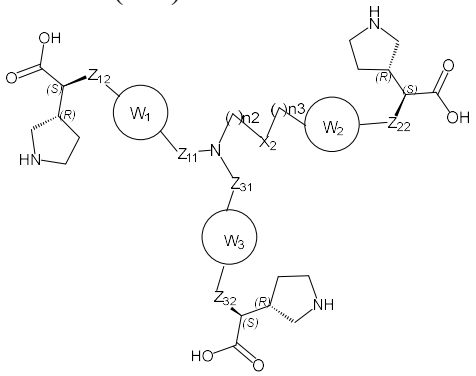
formula (D-1)



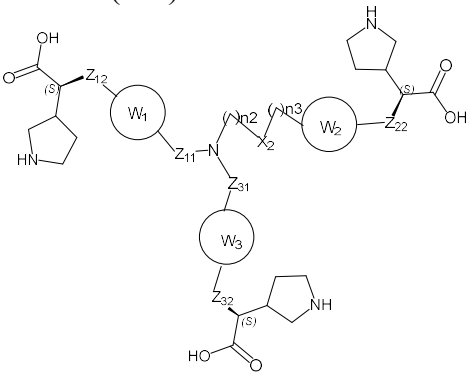
formula (B-2)



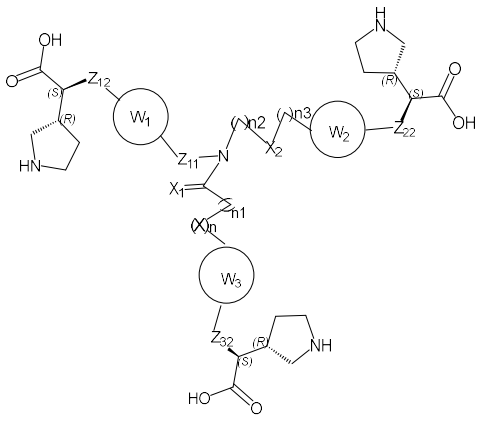
formula (B-3)



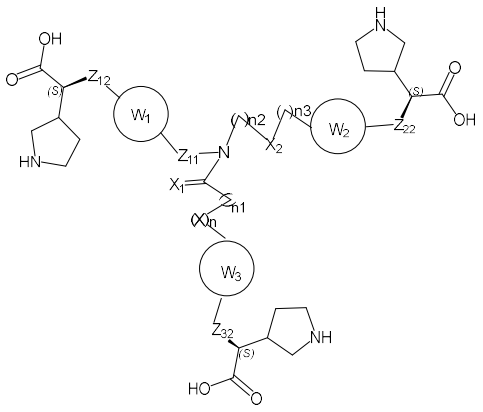
formula (C-2)



formula (C-3)



formula (D-2)



formula (D-3)

wherein

Z_{11}, Z_{21}, Z_{31}, R_{31}, R_{32}, R_{33}, h1, h2, h3, h4, h5, h6 are defined as in any of claims 1-9,

X is selected from O, CH_2, NH, S, and Se, or X is selected from O, CH_2, NH, and S; or X is CH_2;

X_2 is selected from O, CH_2, NH, S, and Se, or X_2 is selected from O, NH, and S; or X_2 is O;

X_1 is independently selected from O, and S, or X_1 is O;

n, n1, and n3 are each independently 0 or 1,

n2 is independently 0, 1, 2 or 3;

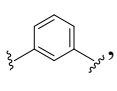
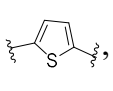
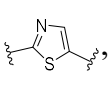
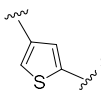
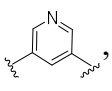
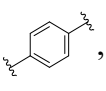
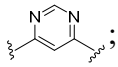
each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, ethylene, and -CD_2-;

or each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-;

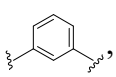
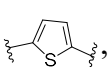
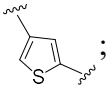
or Z_{12}, Z_{22}, Z_{32} are all methylene;

each of the rings W_1, W_2, and W_3 is independently selected from phenyl, and 5-6 membered monocyclic heteroaryl; the phenyl, and heteroaryl are optionally substituted by one or more substituents independently selected from deuterium, halogen, -CN, -OH, -NH_2, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, -N(C_{1-3}alkyl)$_2$, -NH(C_{1-3}alkyl), and -C(O)C_{1-3}alkyl; the heteroatom in the heteroaryl is O, N or S, the heteroatom number is 1 or 2;

or

each of the rings W_1, W_2, and W_3 is independently selected from the following optionally substituted groups: , , , , , , , , and ; wherein "optionally substituted" refers to unsubstituted or substituted by one or more substituents independently selected from deuterium, halogen, -CN, -OH, -NH_2, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, -N(C_{1-3}alkyl)$_2$, -NH(C_{1-3}alkyl), and -C(O)C_{1-3}alkyl;

or

each of the rings W_1, W_2, and W_3 is independently selected from the following optionally substituted groups: , , and ; wherein "optionally substituted" refers to unsubstituted or substituted by one or more substituents independently selected from deuterium,

F, Cl, Br, methyl, ethyl, methoxy, and ethoxy;

preferably,

the sum of n2 and n3 is not greater than 3 (e.g. 0, 1, 2, 3); for example the sum of n2 and n3 is not greater than 2 (e.g. 0, 1, 2); for example the sum of n2 and n3 is 1 or 2 (e.g. n2 is 2, n3 is 0; or n2 is 1, n3 is 1; or n2 is 0, n3 is 2); or

the sum of n and n1 is 0, 1, or 2; for example the sum of n and n1 is 1 or 2 (i.e. n is 1, n1 is 0; or n is 0, n1 is 1; or n is 1, n1 is 1; or n is 0, n1 is 2; or n is 2, n1 is 0); or

the sum of n and n1 is 1 (i.e. n is 1, n1 is 0; or n is 0, n1 is 1);

for example:

n2 is 0 or 1, n3 is 0, X_2 is CH_2; or

n2 is 2 or 3, n3 is 0, X_2 is O, NH, or S; or

n2 is 1 or 2, n3 is 1, X_2 is O, NH, or S; or

n2 is 2 or 3, n3 is 0, X_2 is O; or

n2 is 2, n3 is 1, X_2 is O; or

n2 is 2, n3 is 0, X_2 is O, NH, or S; or

n2 is 2, n3 is 0, X_2 is O;

and/or for example:

X is selected from O, CH_2, NH, and S, n is 1, n1 is 0; or

X is O or CH_2, n is 1, n1 is 1; or

X_1 is O, X is selected from O, CH_2, NH, and S, n is 1, n1 is 0; or

X_1 is O, X is O or CH_2, n is 1, n1 is 1; or

X_1 is O, X is O or CH_2, n is 1, n1 is 0; or

X_1 is O, X is O or CH_2, n is 1, n1 is 1; or

X_1 is O, X is CH_2, n is 1, n1 is 0;

and/or, preferably:

Z_{11} is $-CD_2-$; or

Z_{11} is independently selected from $-C_{1-3}$alkylene-, $-OC_{1-3}$alkylene-, $-NH-C_{1-3}$alkylene-, $-S-C_{1-3}$alkylene-, $-Se-C_{1-3}$alkylene-, and $-C_{1-2}$alkylene-$O-C_{1-3}$alkylene-; or, Z_{11} is independently selected from $-C_{1-3}$alkylene-, $-OC_{1-3}$alkylene-; or, Z_{11} is independently selected from methylene, ethylene, methyleneoxy, ethyleneoxy; or, Z_{11} is independently selected from methylene, and $-CD_2-$; preferably, Z_{11} is independently selected from methylene; and/or

Z_{21} is $-CD_2-$; or

Z_{21} is independently selected from $-C_{1-3}$alkylene-, $-OC_{1-3}$alkylene-, $-NH-C_{1-3}$alkylene-, $-S-C_{1-3}$alkylene-, $-Se-C_{1-3}$alkylene-, and $-C_{1-2}$alkylene-$O-C_{1-3}$alkylene-; or, Z_{21} is $-OC_{1-3}$alkylene-, $-NH-C_{1-2}$alkylene-, $-S-C_{1-2}$alkylene-, and $-C_{1-2}$alkylene-$O-C_{1-3}$alkylene-;

and/or, preferably:

Z_{31} is independently selected from -C(O)-, -C_{1-3}alkylene-C(O)-, -OC_{1-3}alkylene-C(O)-, -NH-C_{1-3}alkylene-C(O)-, -S-C_{1-3}alkylene-C(O)-, -O-C_{1-2}alkylene-C(O)-C_{1-3}alkylene-, -C_{1-3}alkylene-NH-C(O)-, -C_{1-3}alkylene-O-C(O)-, -NH-C(O)-, -O-C(O)-, -S-C(O)-, and -C_{1-3}alkylene-C(S)-; or, Z_{31} is -C(O)-, -C_{1-2}alkylene-C(O)-, -OC_{1-2}alkylene-C(O)-, -NH-C(O)-, -O-C(O)-, and -S-C(O)-;

for example, in the above-mentioned formula (B) and formula (B-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-;

each of Z_{11} and Z_{21} is independently selected from -CD_2-, -C_{1-3}alkylene- (for example -C_{1-2}alkylene-), -OC_{1-3}alkylene-* (for example -OC_{1-2}alkylene-*), -SC_{1-3}alkylene-*, -NHC_{1-3}alkylene-*, -Se-C_{1-3}alkylene-*, and -CH_2-O-C_{1-2}alkylene-*, * represents the connecting end with N;

X_1 is O or S, X is selected from O, CH_2, NH, and S, n is 1, n1 is 0; or X_1 is O or S, X is O or CH_2, n is 1, n1 is 1; or X_1 is O or S, n is 0, n1 is 0; or

again for example, in the above-mentioned formula (B) and formula (B-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-;

Z_{11} is independently selected from -CD_2-, -CH_2-, -CH_2CH_2-, -OCH_2-*, and -OCH_2CH_2-*, * represents the connecting end with N;

Z_{21} is independently selected from -OCH_2CH_2-*, -CH_2OCH_2CH_2-*, and -O$CH_2CH_2CH_2$-*, * represents the connecting end with N;

X_1 is O, X is selected from O, CH_2, NH, and S, n is 1, n1 is 0; or X_1 is O, X is O or CH_2, n is 1, n1 is 1; or

again for example, in the above-mentioned formula (B) and formula (B-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-;

each of Z_{11} and Z_{21} is independently selected from -CD_2-, -C_{1-3}alkylene- (for example -C_{1-2}alkylene-), -OC_{1-3}alkylene-* (for example -OC_{1-2}alkylene-*), -SC_{1-3}alkylene-*, -NHC_{1-3}alkylene-*, -Se-C_{1-3}alkylene-*, and -CH_2-O-C_{1-2}alkylene-*, * represents the connecting end with N,

X_1 is O or S,

X is selected from O, CH_2, NH, and S,

the sum of n and n1 is 0, 1, or 2;

further for example,

Z_{21} is independently selected from -OCH_2CH_2-*, -CH_2OCH_2CH_2-*, and -O$CH_2CH_2CH_2$-*, * represents the connecting end with N;

X_1 is O, X is selected from O, CH_2, NH, and S,

the sum of n and n1 is 1, or 2;

further for example, in any of the above-mentioned formula (B), formula (B-1), formula (B-2), and formula (B-3), each of Z_{11} and Z_{21} is a group not containing a double bond; the double bond

is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11} and Z_{21} are identical or different, and at least one of Z_{11} and Z_{21} is a group containing -O-, -NH-, -S-, or -Se-, preferably, a group containing -O-, e.g. *-CH_2O-, *-CH_2CH_2O-, * represents the connecting end with N; still further preferably, Z_{11}, Z_{21} and *-$C(X_1)$-$(CH_2)_{n1}$-$(X)_n$- each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

for example, in the above-mentioned formula (C) and formula (C-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-; and/or

Z_{11} is independently selected from -CD_2-, -C_{1-3}alkylene- (for example -C_{1-2}alkylene-), -OC_{1-3}alkylene-* (for example -OC_{1-2}alkylene-*), -SC_{1-2}alkylene-*, -NHC_{1-2}alkylene-*, -Se-C_{1-2}alkylene-*, and -CH_2-O-C_{1-2}alkylene-*, * represents the connecting end with N; and/or

Z_{31} is independently selected from -C(O)-, -C_{1-3}alkylene-C(O)-*, -OC_{1-2}alkylene-C(O)-*, -$NHCH_2$-C(O)-*, -SCH_2-C(O)-*, -CH_2-NHC(O)-*, -C_{1-2}alkylene-O-C(O)-*, -NH-C(O)-*, -O-C(O)-*, -S-C(O)-*, and -C_{1-2}alkylene-C(S)-*, * represents the connecting end with N; and/or

n2 is 2 or 3, n3 is 0, X_2 is O, NH, and S; or

n2 is 1 or 2, n3 is 1, X_2 is O, NH, and S; or

n2 is 0 or 1, n3 is 0, X_2 is CH_2;

again for example, in the above-mentioned formula (C) and formula (C-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-; and/or

Z_{11} is independently selected from -CD_2-, -CH_2-, -CH_2CH_2-, -OCH_2-*, and -OCH_2CH_2-*, * represents the connecting end with N; and/or

Z_{31} is independently selected from -C(O)-, -CH_2CH_2C(O)-*, -CH_2C(O)-*, -OCH_2C(O)-*, -NHC(O)-*, -OC(O)-*, and -SC(O)-*, * represents the connecting end with N; and/or

n2 is 2 or 3, n3 is 0, X_2 is O; or

n2 is 1 or 2, n3 is 1, X_2 is O; or

n2 is 0 or 1, n3 is 0, X_2 is CH_2;

again for example, in the above-mentioned formula (C) and formula (C-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-; Z_{11} is independently selected from -CD_2-, -C_{1-3}alkylene- (for example -C_{1-2}alkylene-), -OC_{1-3}alkylene-* (for example -OC_{1-2}alkylene-*), -SC_{1-2}alkylene-*, -NHC_{1-2}alkylene-*, -Se-C_{1-2}alkylene-*, and -CH_2-O-C_{1-2}alkylene-*, and/or

Z_{31} is independently selected from -C(O)-, -C_{1-3}alkylene-C(O)-*, -OC_{1-2}alkylene-C(O)-*, -

$NHCH_2$-C(O)-*, -SCH_2-C(O)-*, -CH_2-NHC(O)-*, -C_{1-2}alkylene-O-C(O)-*, -NH-C(O)-*, -O-C(O)-*, -S-C(O)-*, and -C_{1-2}alkylene-C(S)-*, * represents the connecting end with N; further for example, Z_{31} is independently selected from -CH_2CH_2C(O)-*, -CH_2C(O)-*, -OCH_2C(O)-*, -NHC(O)-*, -OC(O)-*, and -SC(O)-*, * represents the connecting end with N; and/or

Z_{11} is independently selected from -CD_2-, -CH_2-, -CH_2CH_2-, and -OCH_2CH_2-*, * represents the connecting end with N; and/or

X_2 is O, NH, S, or Se, the sum of n2 and n3 is 1, 2, or3; further for example, X_2 is O, the sum of n2 and n3 is 2, or 3;

further for example, in any of the above-mentioned formula (C), formula (C-1), formula (C-2), and formula (C-3), one and only one of Z_{11} and Z_{31} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, the group not containing a double bond of Z_{11} and Z_{31} is identical to or different from *-$(CH_2)_{n2}$-X_2-$(CH_2)_{n3}$- (*represents the connecting end with N); still further preferably, Z_{11}, -$(CH_2)_{n2}$-X_2-$(CH_2)_{n3}$- and Z_{31} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2$O-, and -S-C(O)-;

for example, in the above-mentioned formula (D), and formula (D-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-; and/or

Z_{11} is independently selected from -CD_2-, -C_{1-2}alkylene-, -OC_{1-2}alkylene-*, -SC_{1-2}alkylene-*, -NHC_{1-2}alkylene-*, -Se-C_{1-2}alkylene-*, and -CH_2-O-C_{1-2}alkylene-*, * represents the connecting end with N; and/or

n2 is 2 or 3, n3 is 0, X_2 is O, NH, or S; or

n2 is 1 or 2, n3 is 1, X_2 is O, NH, or S; or

n2 is 0 or 1, n3 is 0, X_2 is CH_2; and/or

X_1 is O or S, X is selected from O, CH_2, NH, and S, n is 1, n1 is 0; or

X_1 is O or S, X is O or CH_2, n is 1, n1 is 1;

alternatively for example, in the above-mentioned formula (D) and formula (D-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-; and/or

Z_{11} is independently selected from -CD_2-, -CH_2-, -CH_2CH_2-, -OCH_2-*, and -OCH_2CH_2-*, * represents the connecting end with N; and/or

n2 is 2 or 3, n3 is 0, X_2 is O; or

n2 is 1 or 2, n3 is 1, X_2 is O; or

n2 is 0 or 1, n3 is 0, X_2 is CH_2; and/or

X_1 is O, X is selected from O, CH_2, NH, and S, n is 1, n1 is 0; or

X_1 is O, X is O or CH_2, n is 1, n1 is 1;

alternatively for example, in the above-mentioned formula (D) and formula (D-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-; and/or

Z_{11} is independently selected from -CD_2-, -CH_2-, -CH_2CH_2-, and -OCH_2CH_2-*, * represents the connecting end with N; and/or

n2 is 2 or 3, n3 is 0, X_2 is O; or

n2 is 2, n3 is 1, X_2 is O; and/or

X_1 is O, X is selected from O, CH_2, NH, and S, n is 1, n1 is 0;

alternatively for example, in the above-mentioned formula (D) and formula (D-1),

each of Z_{12}, Z_{22}, and Z_{32} is independently selected from methylene, and -CD_2-;

Z_{11} is independently selected from -CD_2-, -$C_{1\text{-}2}$alkylene-, -$OC_{1\text{-}2}$alkylene-*, -$SC_{1\text{-}2}$alkylene-*, -$NHC_{1\text{-}2}$alkylene-*, -Se-$C_{1\text{-}2}$alkylene-*, and -CH_2-O-$C_{1\text{-}2}$alkylene-*, * represents the connecting end with N; or, Z_{11} is independently selected from -CD_2-, -CH_2-, -CH_2CH_2-, and -OCH_2CH_2-*, * represents the connecting end with N; and/or

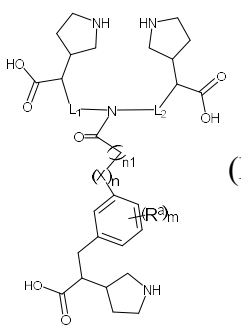
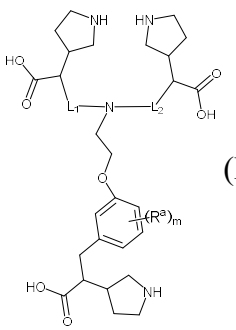
X_2 is O, NH, S, or Se, the sum of n2 and n3 is 1, 2, or 3;or, X_2 is O, the sum of n2 and n3 is 2, or 3; and/or

X_1 is O or S, X is selected from O, CH_2, NH, and S, the sum of n and n1 is 0, 1, or 2;or, X_1 is O, X is selected from O, CH_2, NH, and S, the sum of n and n1 is 1, or 2; and/or

further for example, in any of the above-mentioned formula (D), formula (D-1), formula (D-2), and formula (D-3), Z_{11} is a group not containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11} is identical to or different from *-$(CH_2)_{n2}$-X_2-$(CH_2)_{n3}$- (* represents the connecting end with N); still further preferably, Z_{11}, -C(X_1)-$(CH_2)_{n1}$-$(X)_n$- and -$(CH_2)_{n2}$-X_2-$(CH_2)_{n3}$- each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2$O-, and -S-C(O)-;

or

the compound has a structure as represented by formula (E), formula (F), formula (E-1), formula (E-2), formula (E-3), formula (E-4), formula (F-1), or formula (F-2):


(E),

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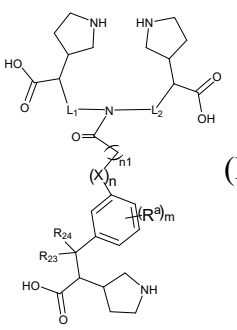
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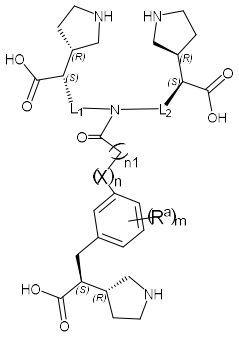
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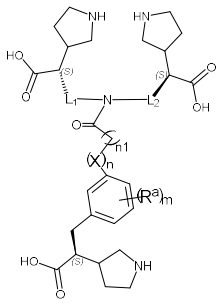
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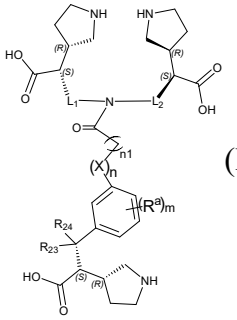
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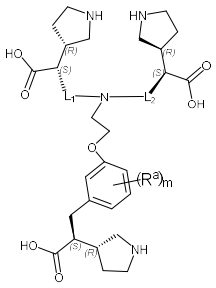
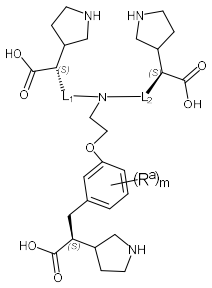
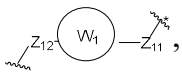
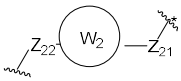

(F-1),

(F-2),

wherein

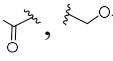
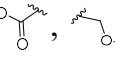
L_1, L_2 are defined as in any of claims 1-9, X is O, CH_2, or NH, R^a is deuterium, halogen, -CN, -OH, $-NH_2$, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, $-N(C_{1-3}alkyl)_2$, $-NH(C_{1-3}alkyl)$, or $-C(O)C_{1-3}$alkyl, n1 is 0 or 1, m is 0 or 1, n is 0 or 1; R_{23} and R_{24} are each independently selected from H, and deuterium;

for example,

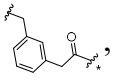
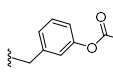
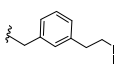
L_1 is , L_2 is , * represents the connecting end with N; wherein

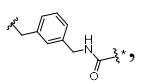
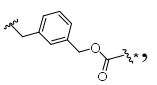
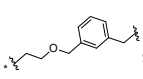
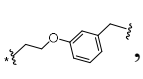
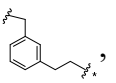
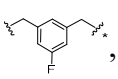
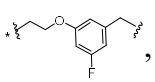
each of rings W_1 and W_2 is independently selected from , which is optionally substituted by one or more substituents independently selected from halogen, and C_{1-3}alkoxy (preferably F, methoxy);

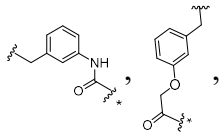
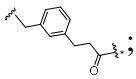
each of Z_{11}, Z_{12}, Z_{21}, and Z_{22} is independently selected from $-C_{1-2}$alkylene-, $-OC_{1-3}$alkylene-, $-NH-C_{1-2}$alkylene-, $-S-C_{1-2}$alkylene-, $-C_{1-2}$alkylene-O-C_{1-2}alkylene-, $-C_{1-2}$alkylene-C(O)-, $-OC_{1-2}$alkylene-C(O)-, $-C_{1-2}$alkylene-NH-C(O)-, $-C_{1-2}$alkylene-O-C(O)-, -NH-C(O)-, $-NH-C_{1-2}$alkylene-C(O)-, -O-C(O)-, and -S-C(O)-; or

each of Z_{11}, Z_{12}, Z_{21}, and Z_{22} is independently selected from methylene, ethylene, , , , , , , , , , , and ;

or , for example

each of L1 and L2 is independently selected from , , ,

, , , , , , , ,

, , and ; * represents the connecting end withN;

X is selected from O, CH_2, NH, and S, for example X is O, CH_2, or NH, e.g. X is CH_2; and/or

R^a is deuterium, halogen, -CN, -OH, $-NH_2$, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, $-N(C_{1-3}alkyl)_2$, $-NH(C_{1-3}alkyl)$, or $-C(O)C_{1-3}$alkyl, for example, R^a is F, Cl, methyl, ethyl, methoxy, or ethoxy; for example, R^a is F; and/or

n1 is 0 or 1, and/or

m is 0 or 1, for example m is 1, and/or

n is 0 or 1; for example, the sum of n and n1 is 0, 1, or 2; for example, the sum of n and n1 is 1 or 2 (i.e. n is 1, n1 is 0; or n is 0, n1 is 1; or n is 1, n1 is 1; or n is 0, n1 is 2; or n is 2, n1 is 0); for example, the sum of n and n1 is 1(i.e. n is 1, n1 is 0; or n is 0, n1 is 1);

preferably,

X is selected from O, CH_2, NH, and S, n is 1, and n1 is 0; or

X is O or CH_2, n is 1, n1 is 1;

alternatively preferably,

R^a is F, Cl, methyl, ethyl, methoxy, or ethoxy,

m is 1,

X is selected from O, CH_2, NH, and S,

the sum of n and n1 is 0, 1, or 2;

alternatively preferably,

R^a is F or methoxy,

m is 1,

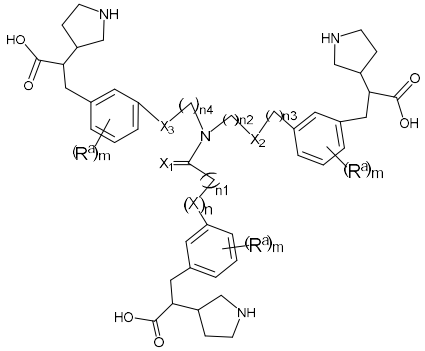
X is selected from O, CH_2, NH, and S,

the sum of n and n1 is 1 or 2;

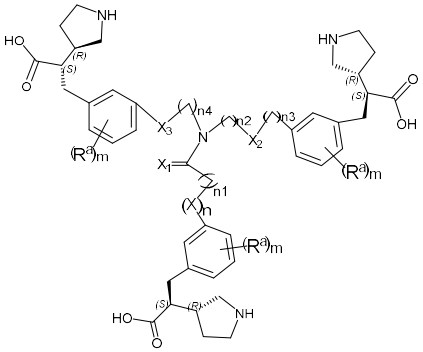
for example, in any of the above-mentioned formula (E), formula (E-1), formula (E-2), formula (E-3) and formula (E-4), L_1 and L_2 are groups containing Z_{11} and Z_{21} respectively, and each of Z_{11} and Z_{21} is a group not containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, Z_{11} and Z_{21} are identical or different; still further preferably, Z_{11}, Z_{21} and $-C(O)-(CH_2)_{n1}-(X)_n-$ each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from $-CH_2-$, $-CD_2-$, $-CH_2CH_2-$, $-CD_2CH_2-$, -C(O)-, $-CH_2C(O)-$, -NHC(O)-, -OC(O)-, $-CH_2CH_2O-$, $-OCH_2C(O)-$, $-CH_2OC(O)-$, $-CH_2CH_2CH_2O-$, and -S-C(O)-; or

in any of the above-mentioned formula (F), formula (F-1) and formula (F-2), L_1 and L_2 are groups containing Z_{11} and Z_{21} respectively, one and only one of Z_{11} and Z_{21} is a group containing a double bond; the double bond is, for example, a double bond between C and O in -C(O)-, or a double bond between C and S in -C(S)-; further preferably, the group not containing a double bond of Z_{11} and Z_{21} is identical to or different from *-$(CH_2)_2$-O- (*represents the connecting end with N); still further preferably, Z_{11} and Z_{21} each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2O$-, and -S-C(O)-;

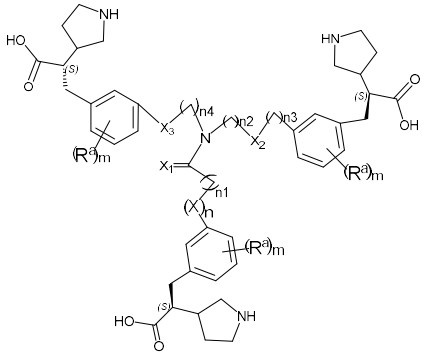
or, the compound has a structure as represented by formula (G), formula (G-1), formula (G-2), formula (G-3), or formula (G-4):



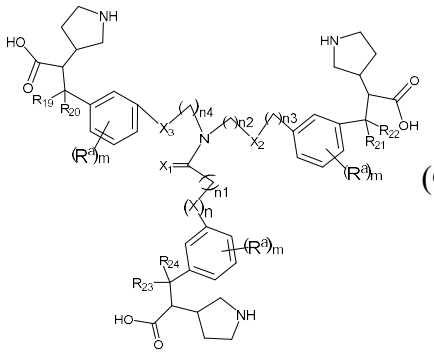
(G),



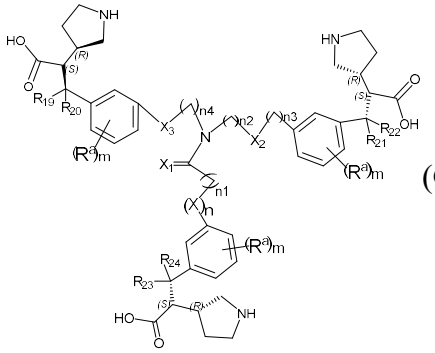
(G-1),



(G-2),



(G-3),



(G-4),

wherein

X, X_1, X_2, n, n1, n2, and n3 are defined as in any of formula (B), formula (C) and formula (D),

m is independently 0 or 1, for example m is 1;

n4 is 0, 1, 2 or 3, or , n4 is 0, 1 or 2, or n4 is 0 or 1, or n4 is 0;

X_3 is O, S, CH_2, or NH; or X_3 is O, S, CH_2, NH, or CD_2; or X_3 is O or CH_2; or X_3 is O, CH_2, or CD_2;

R^a is deuterium, halogen, -CN, -OH, $-NH_2$, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, $-N(C_{1-3}alkyl)_2$, $-NH(C_{1-3}alkyl)$, or $-C(O)C_{1-3}$alkyl; for example, R^a is F, Cl, methyl, ethyl, methoxy, or ethoxy; for example, R^a is F, or methoxy;

R_{19}, R_{20}, R_{21}, R_{22}, R_{23}, and R_{24} are each independently selected from H and deuterium;

preferably,

X_3 is O, and n4 is 2; or

X_3 is CH_2, and n4 is 0 or 1; or

X_3 is CH_2 or CD_2, and n4 is 0 or 1; or

X_3 is CH_2 or CD_2, and n4 is 0; or

alternatively preferably

R^a is F, Cl, methyl, ethyl, methoxy, or ethoxy;

m is 1;

X_2 is O, NH, S, or Se,

the sum of n2 and n3 is 1, 2, or 3;

X_1 is O or S,

X is selected from O, CH_2, NH, and S,

the sum of n and n1 is 0, 1, or 2; and

X_3 is O, and n4 is 2; or

X_3 is CH_2 or CD_2, and n4 is 0 or 1;

alternatively preferably

R^a is F, Cl, or methoxy;

m is 1;

X_2 is O,

the sum of n2 and n3 is 2 or 3;

X_1 is O,

X is selected from O, CH_2, NH, and S,

the sum of n and n1 is 1, or 2; and

X_3 is O, and n4 is 2; or

X_3 is CH_2, or CD_2, and n4 is 0 or 1;

alternatively preferably

R^a is F, Cl, methyl, ethyl, methoxy, or ethoxy;

m is 1;

X_3 is O, and n4 is 2; or

X_3 is CH_2 or CD_2, and n4 is 0 or 1;

n2 is 2 or 3, and n3 is 0, and X_2 is O, NH, or S; or

n2 is 1 or 2, and n3 is 1, and X_2 is O, NH, or S; or

n2 is 0 or 1, and n3 is 0, and X_2 is CH_2; and

X_1 is O or S, X is selected from O, CH_2, NH, and S, n is 1, and n1 is 0; or

X_1 is O or S, X is O or CH_2, n is 1, and n1 is 1;

alternatively preferably

R^a is F, Cl, or methoxy;

m is 1;

X_3 is O, and n4 is 2; or

X_3 is CH_2 or CD_2, and n4 is 0 or 1;

n2 is 2 or 3, n3 is 0, and X_2 is O; or

n2 is 1 or 2, n3 is 1, and X_2 is O; or

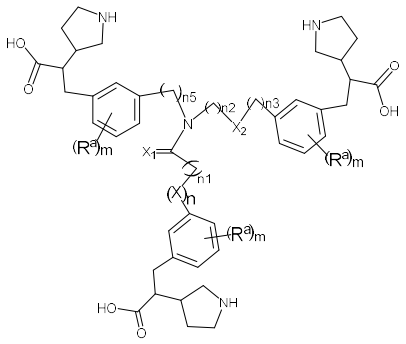
n2 is 0 or 1, n3 is 0, and X_2 is CH_2; and

X_1 is O, X is selected from O, CH_2, NH, and S, n is 1, and n1 is 0; or

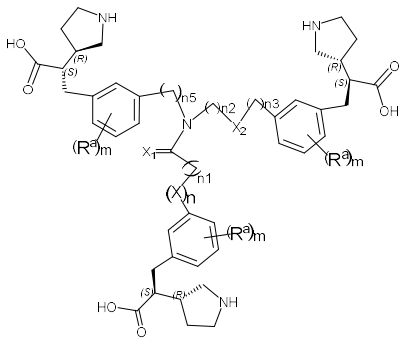
X_1 is O, X is O or CH_2, n is 1, and n1 is 1;

in any of the above-mentioned formula (G), formula (G-1), formula (G-2), formula (G-3), and formula (G-4), *-$(CH_2)_{n4}$-X_3-, *-$(CH_2)_{n2}$-X_2-$(CH_2)_{n3}$-, and *-C(X_1)-$(CH_2)_{n1}$-$(X)_n$- (* represents the connecting end with N) are identical to or different from each other, and they each independently have a molecular weight of 14.0-107.1, preferably 14.0-60; preferably about 14, about 16, about 28, about 30, about 42, about 43, about 44, about 46, about 58, or about 60; still more preferably, Z_{11}, Z_{21} and Z_{31} are selected from -CH_2-, -CD_2-, -CH_2CH_2-, -CD_2CH_2-, -C(O)-, -CH_2C(O)-, -NHC(O)-, -OC(O)-, -CH_2CH_2O-, -OCH_2C(O)-, -CH_2OC(O)-, -$CH_2CH_2CH_2$O-, and -S-C(O)-;

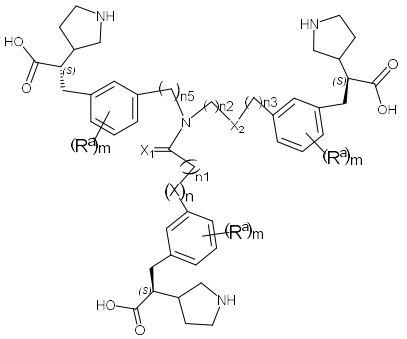
or, the compound has a structure as represented by formula (H), formula (H-1), formula (H-2), formula (H-3), or formula (H-4):



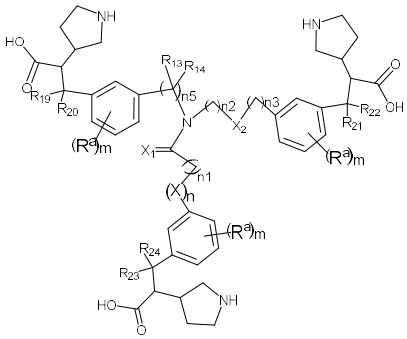
(H),



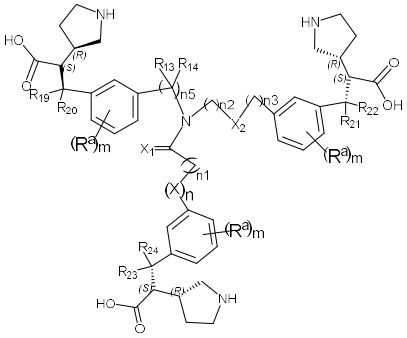
(H-1),



(H-2),



(H-3),



(H-4),

wherein

X, X_1, X_2, n, n1, n2, and n3 are defined as in formula (B), formula (C), formula (D) or formula (G),

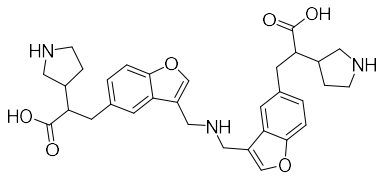
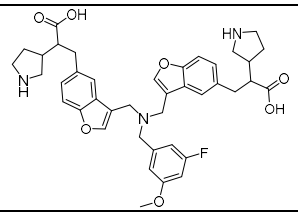
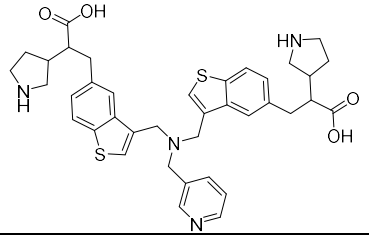
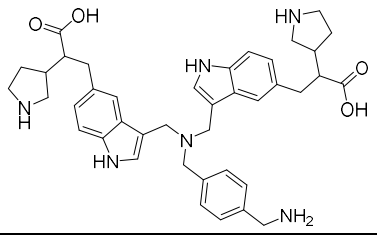
m is independently 0 or 1, or m is 1;

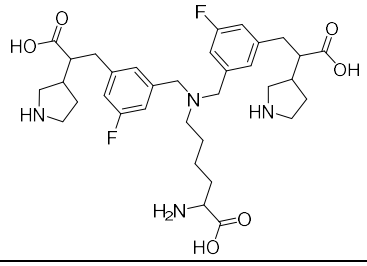
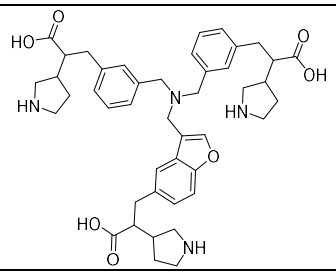
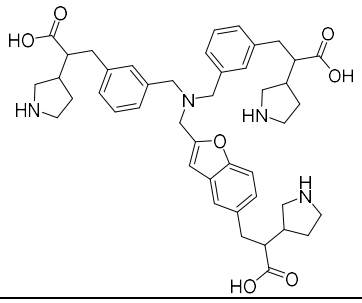
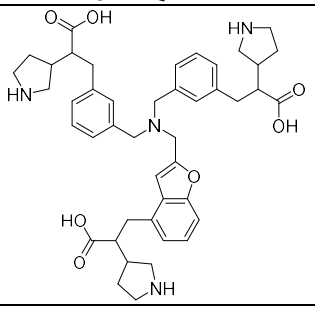
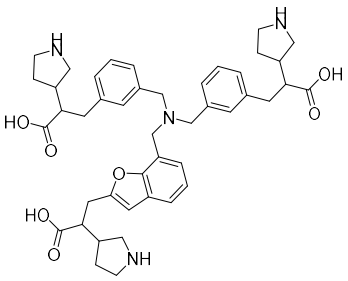
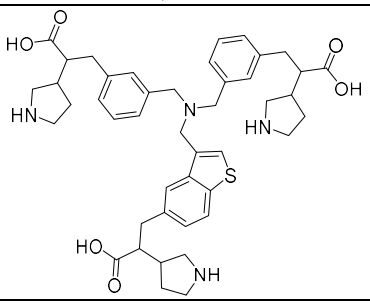
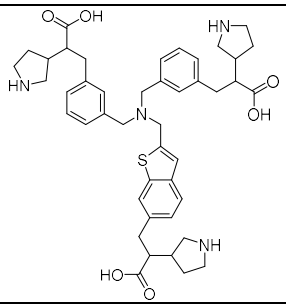
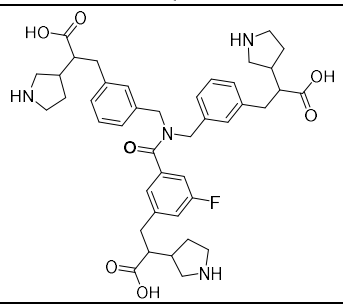
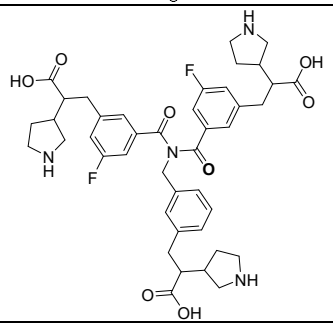
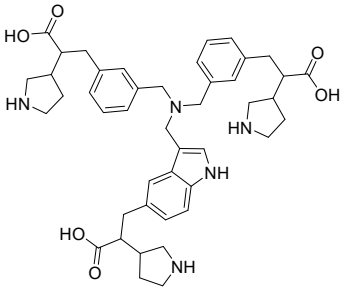
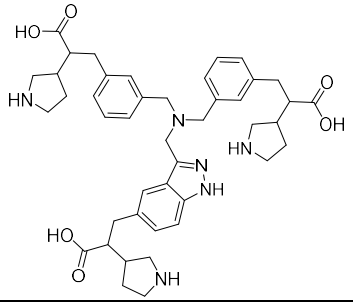
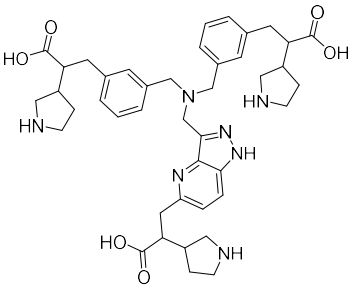
n5 is 1, 2, 3 or 4, or n5 is 1, 2, or 3, or n5 is 1 or 2, or n5 is 1;

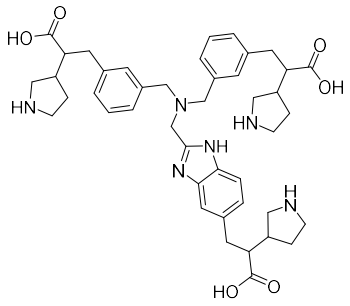
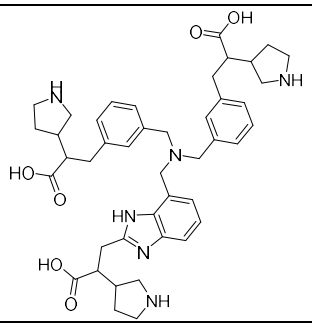
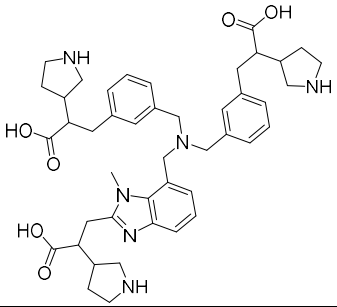
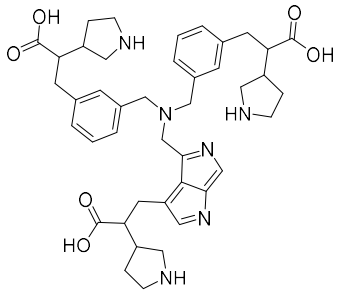
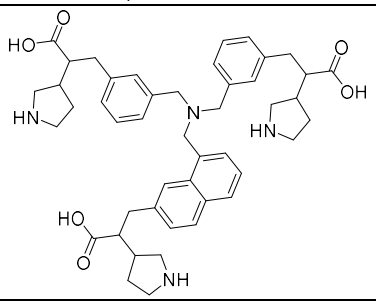
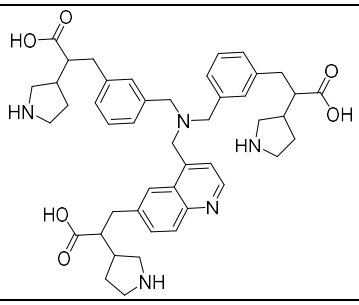
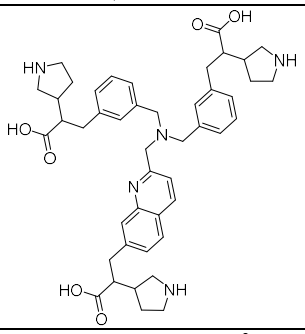
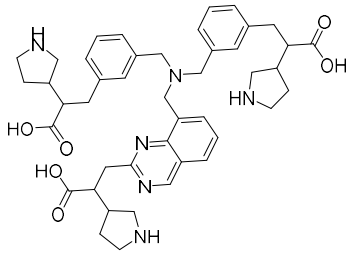
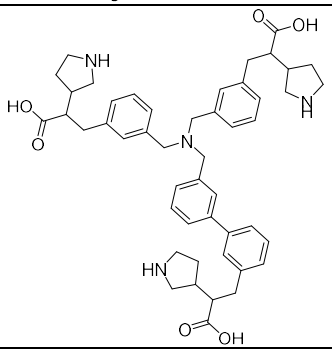
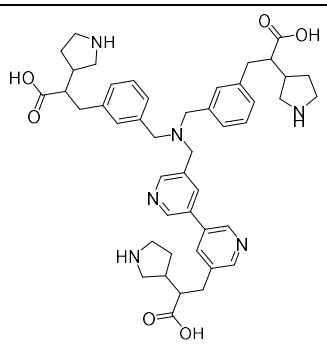
R^a is deuterium, halogen, -CN, -OH, $-NH_2$, -CHO, C_{1-3}alkyl, C_{1-3}alkoxy, $-N(C_{1-3}alkyl)_2$, $-NH(C_{1-3}alkyl)$, or $-C(O)C_{1-3}$alkyl; or R^a is F, Cl, methyl, ethyl, methoxy, or ethoxy; or R^a is F, or methoxy;

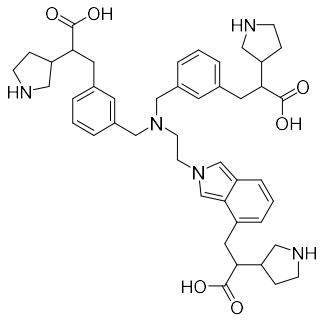
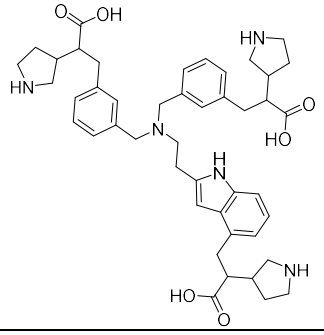
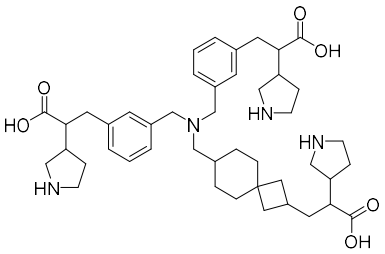
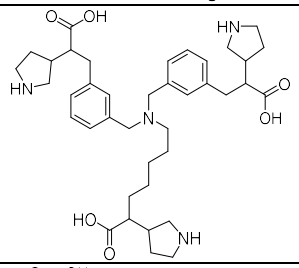
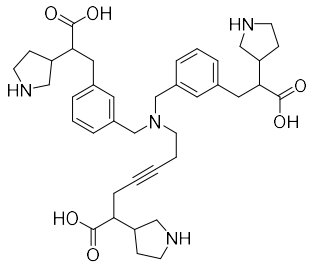
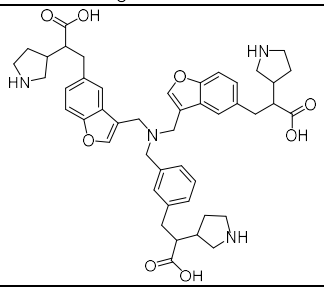
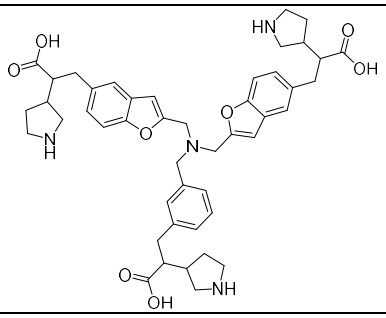
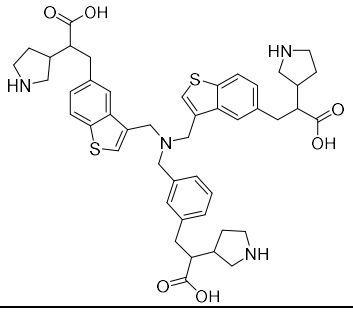
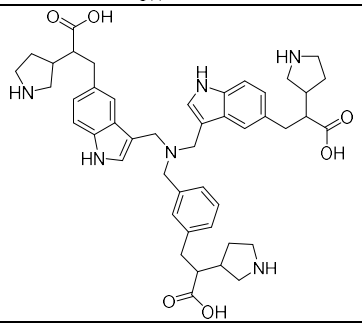
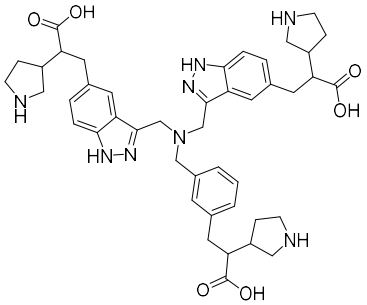
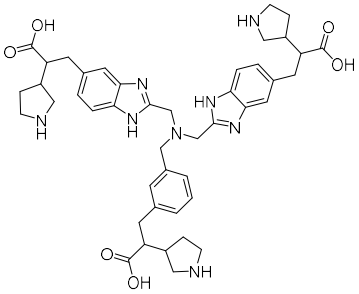
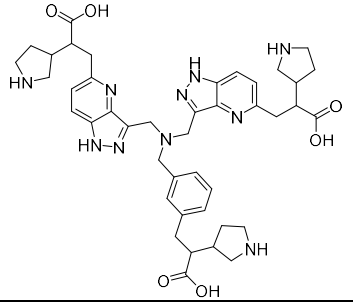
each of R_{13}, R_{14}, R_{19}, R_{20}, R_{21}, R_{22}, R_{23}, and R_{24} is independently selected from H and deuterium.

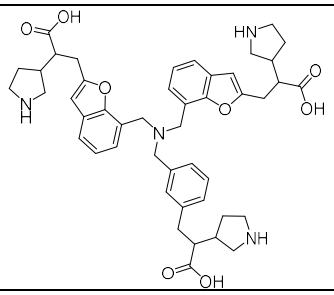
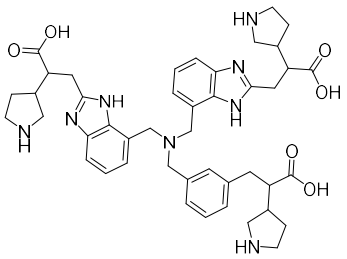
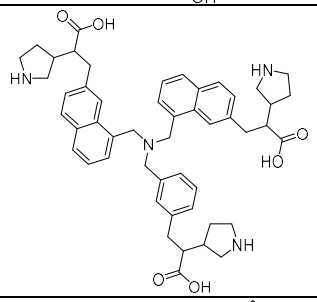
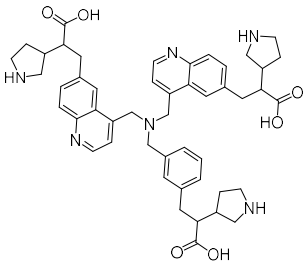
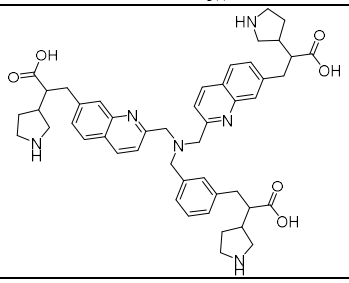
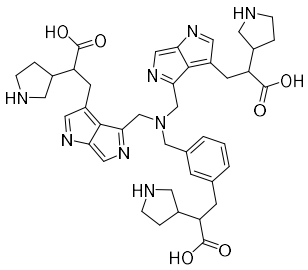
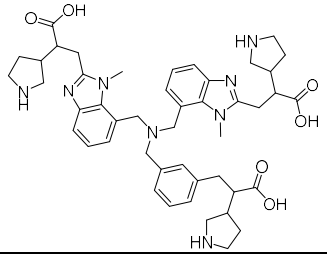
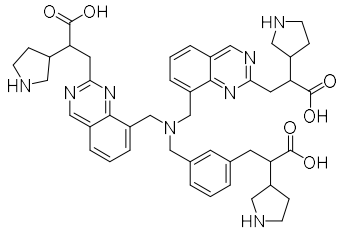
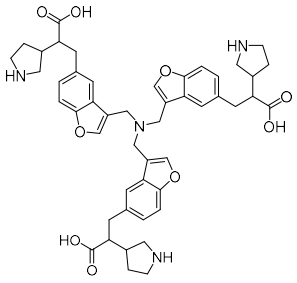
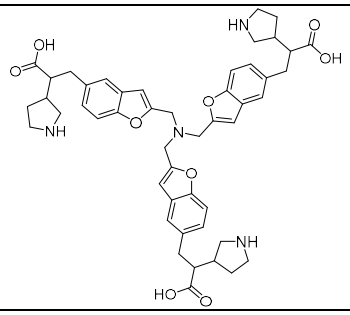
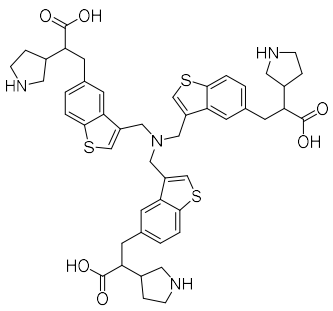
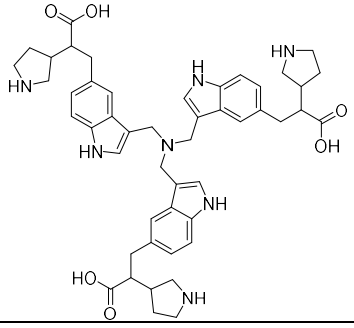
11. A compound, or a pharmaceutically acceptable salt thereof, wherein the compound is selected from:

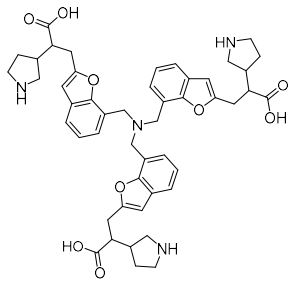
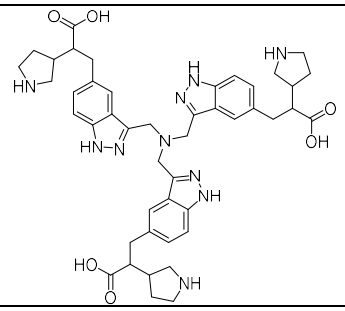
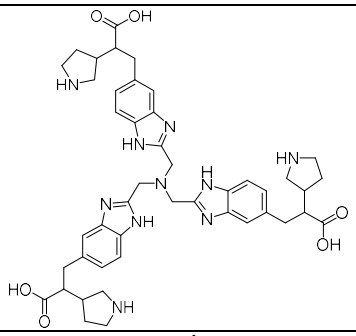
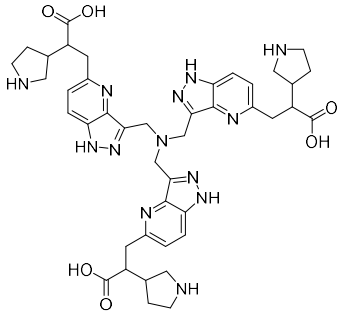
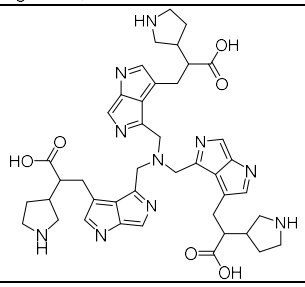
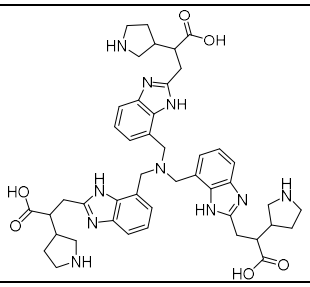
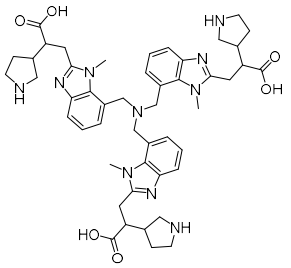
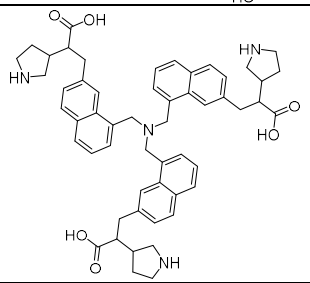
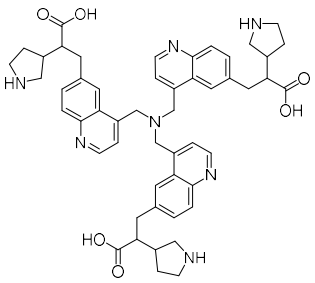
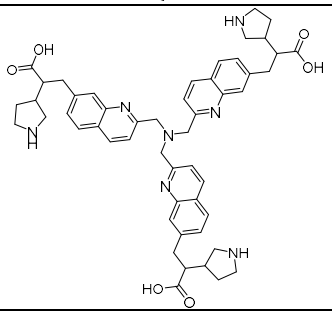
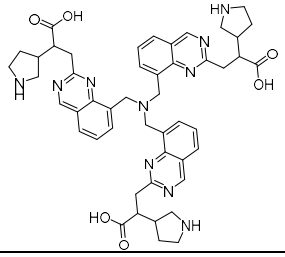
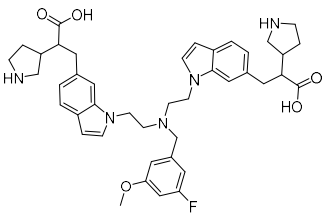
Compound No.	Structure	Compound No.	Structure
1-a		2-a	
3-a		4-a	

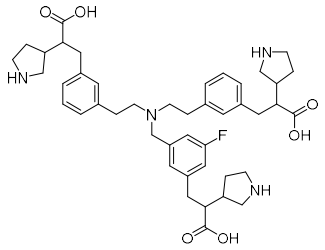
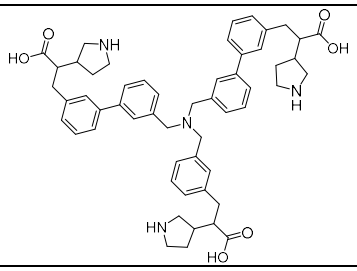
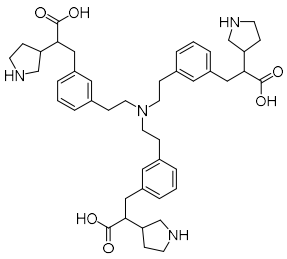
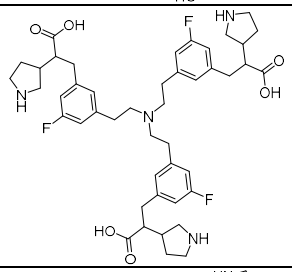
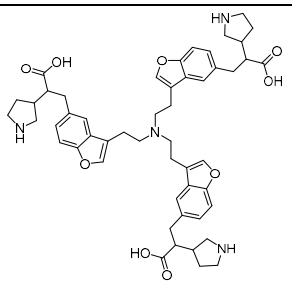
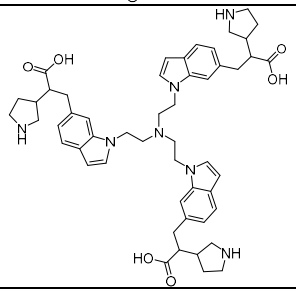
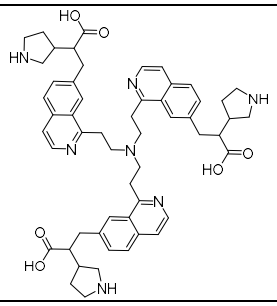
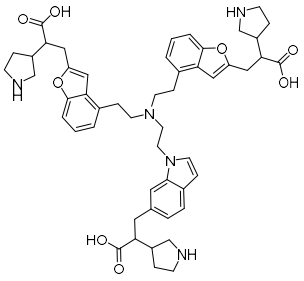
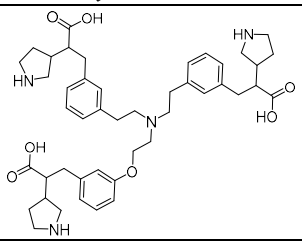
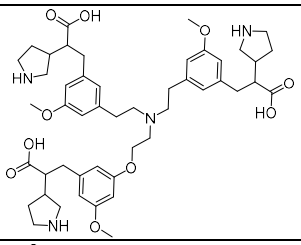
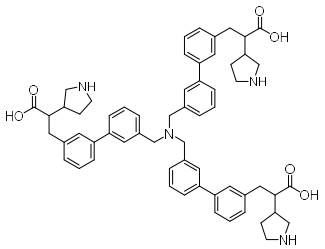
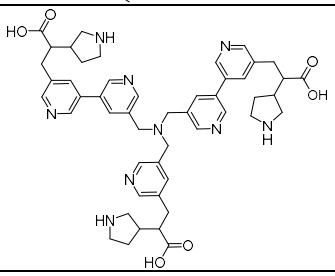
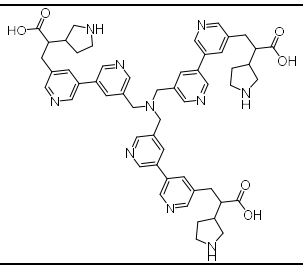
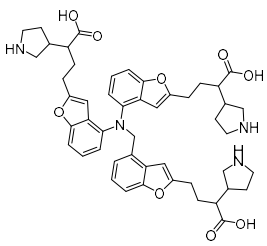
Compound No.	Structure	Compound No.	Structure
5-a		6-a	
7-a		8-a	
9-a		10-a	
11-a		12-a	
13-a		14-a	
15-a		16-a	

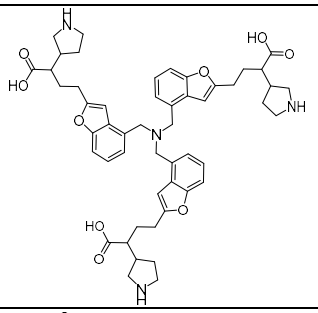
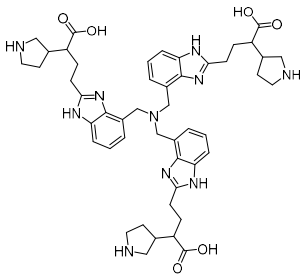
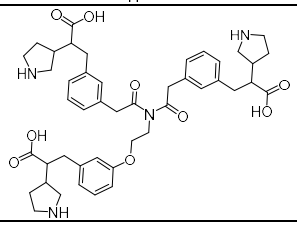
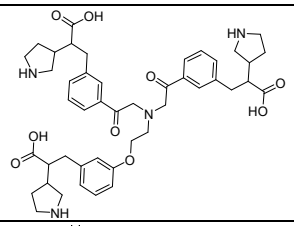
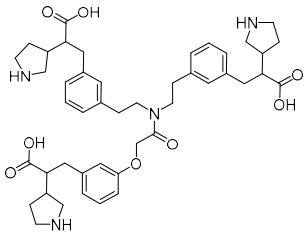
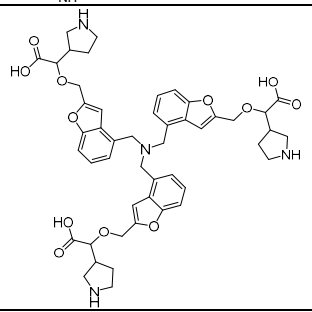
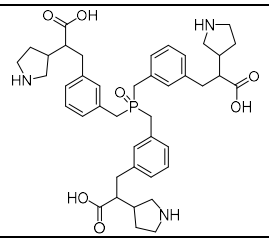
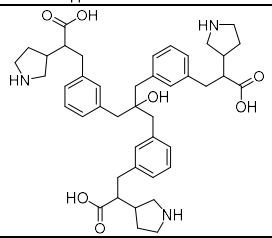
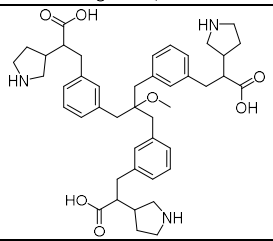
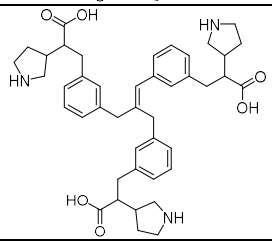
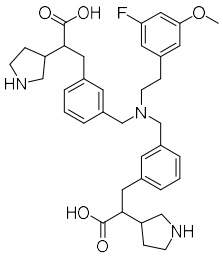
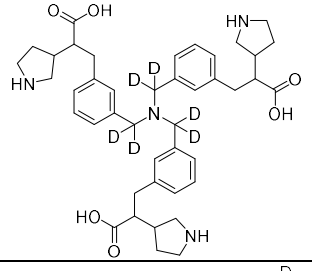
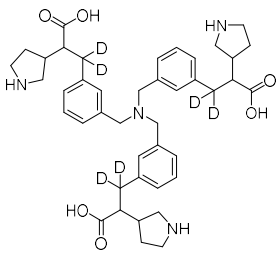
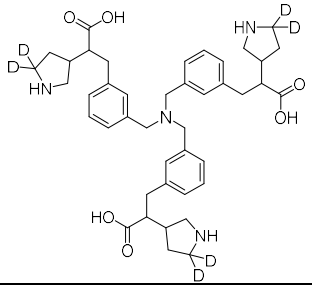
Compound No.	Structure	Compound No.	Structure
17-a		18-a	
19-a		20-a	
21-a		22-a	
23-a		24-a	
25-a		26-a	

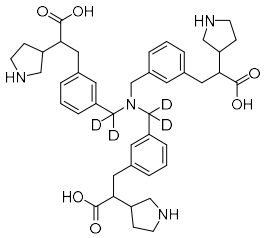
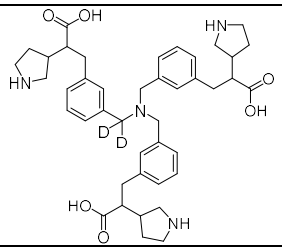
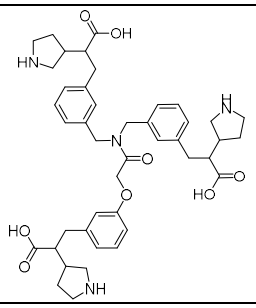
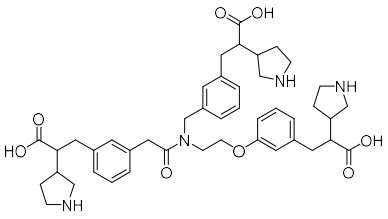
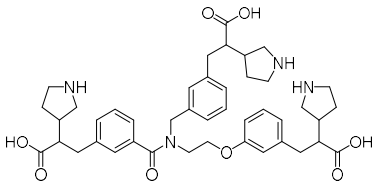
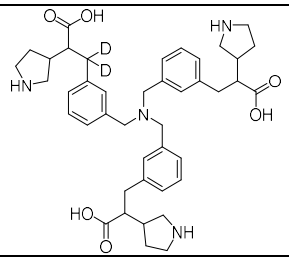
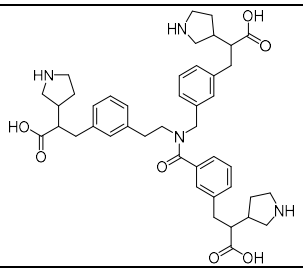
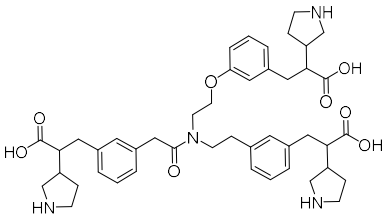
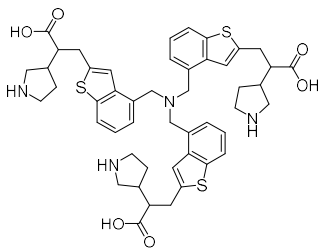
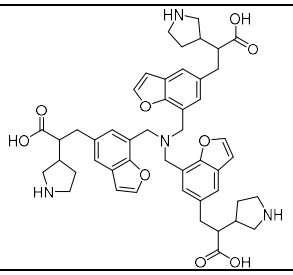
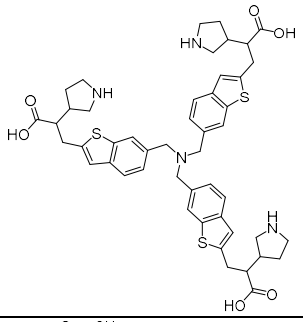
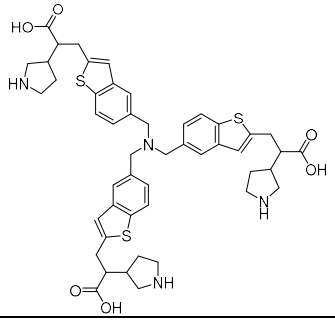
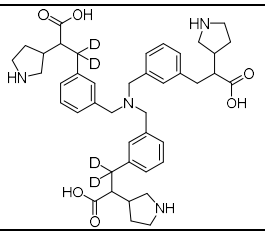
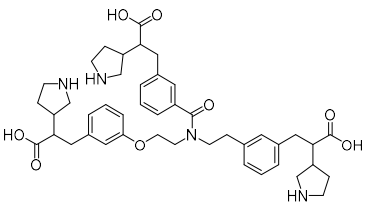
Compound No.	Structure	Compound No.	Structure
27-a		28-a	
29-a		30-a	
31-a		32-a	
33-a		34-a	
35-a		36-a	
37-a		38-a	

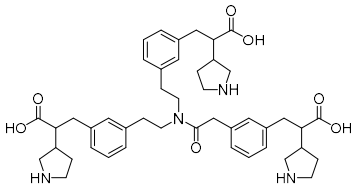
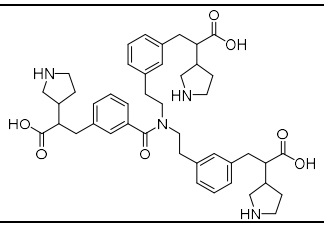
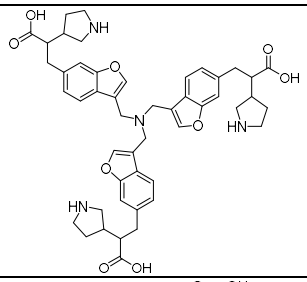
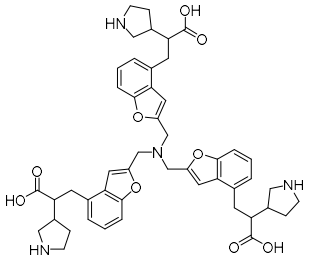
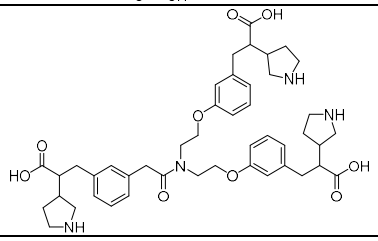
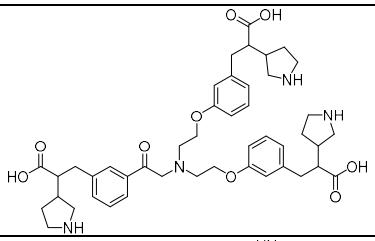
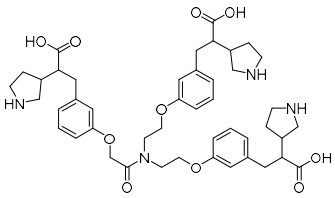
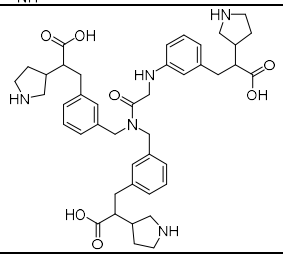
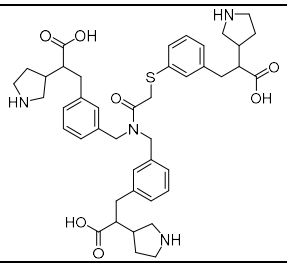
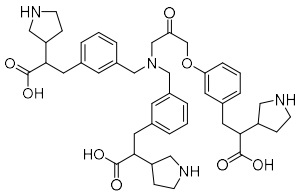
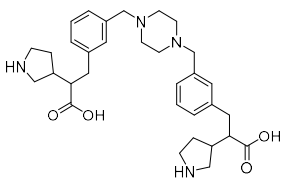
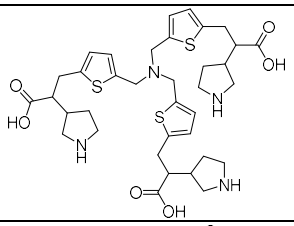
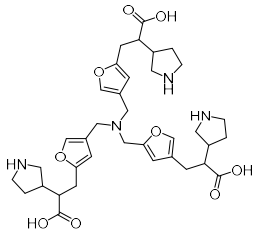
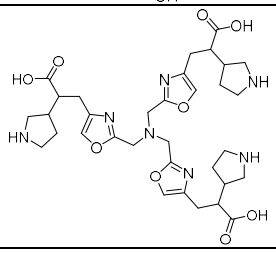
Compound No.	Structure	Compound No.	Structure
39-a		40-a	
41-a		42-a	
43-a		44-a	
45-a		46-a	
47-a		48-a	
49-a		50-a	

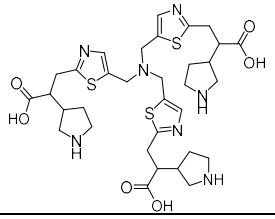
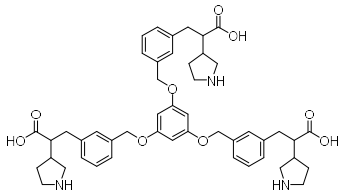
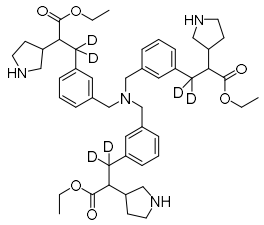
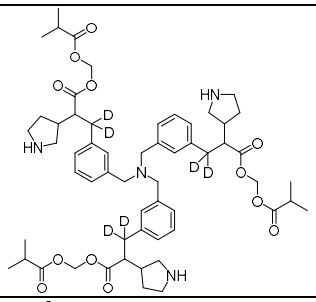
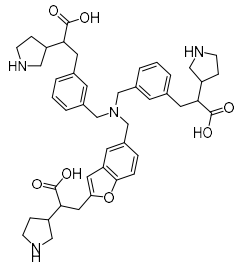
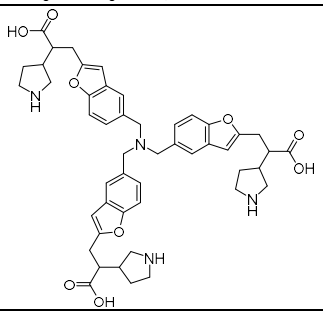
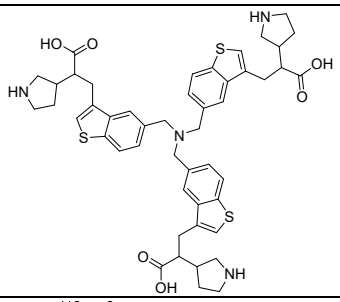
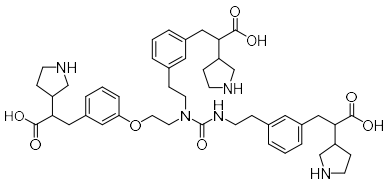
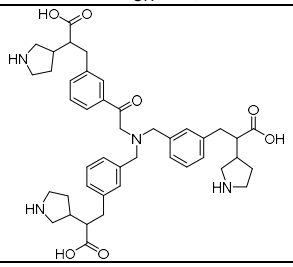
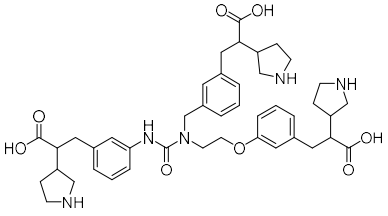
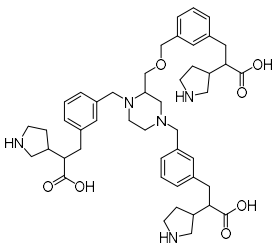
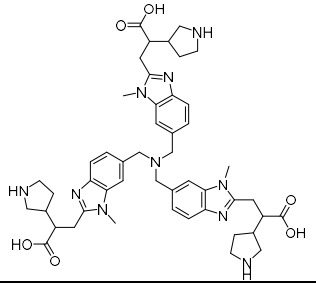
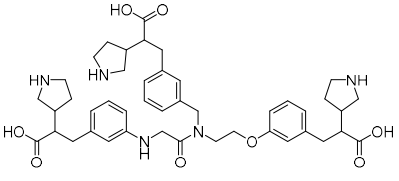
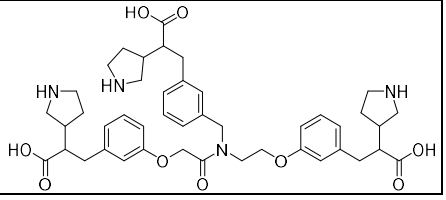
Compound No.	Structure	Compound No.	Structure
51-a		52-a	
53-a		54-a	
55-a		56-a	
57-a		58-a	
59-a		60-a	
61-a		62-a	

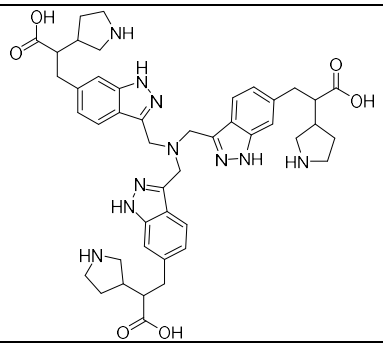
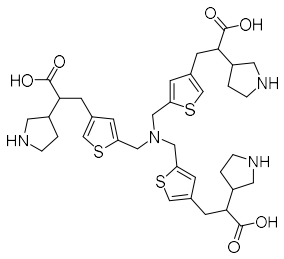
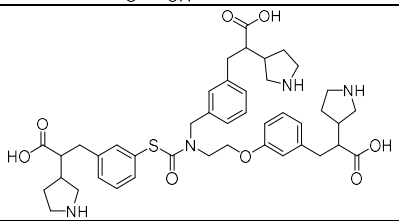
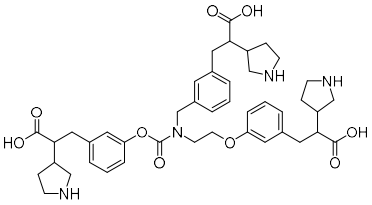
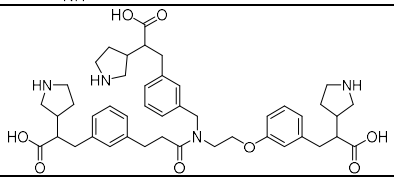
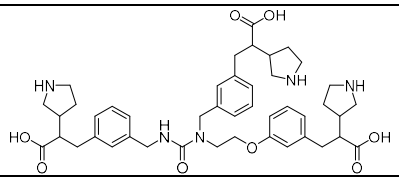
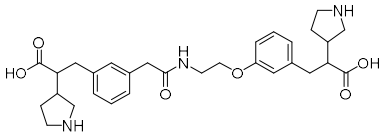
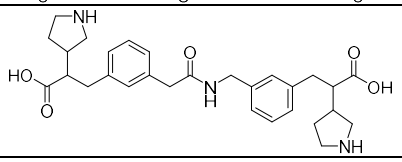
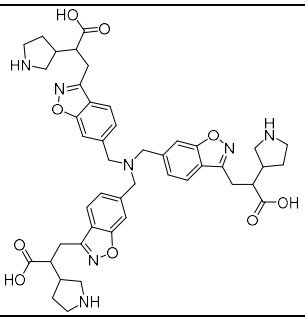
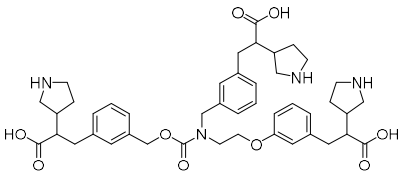
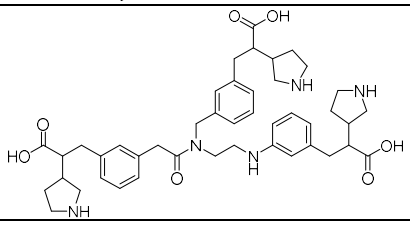
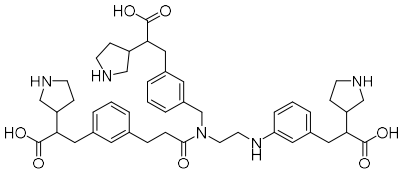
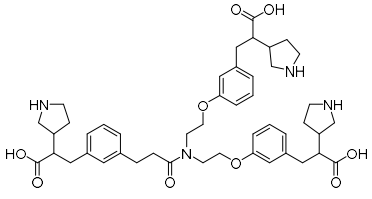
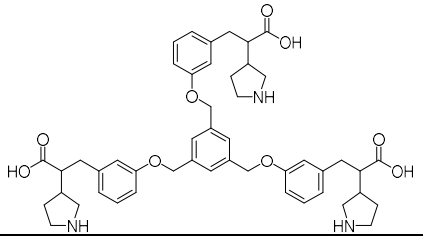
Compound No.	Structure	Compound No.	Structure
63-a		64-a	
65-a		66-a	
67-a		68-a	
69-a		70-a	
71-a		72-a	
73-a		74-a	
75-a		76-a	

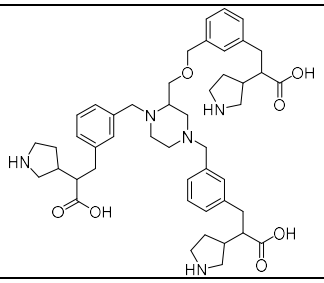
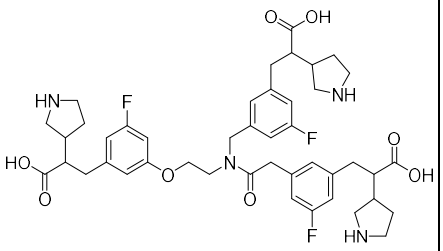
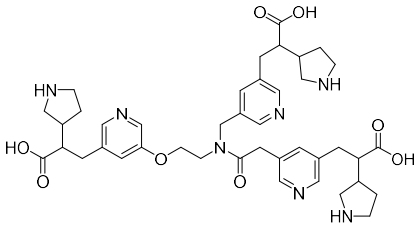
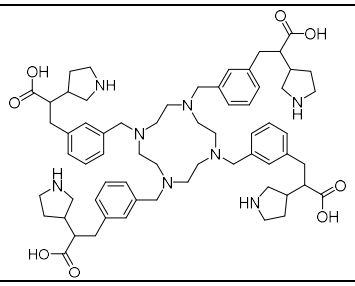
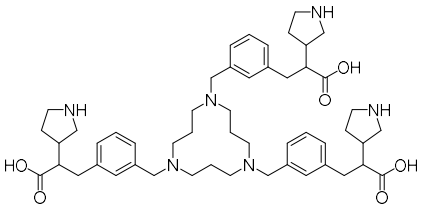
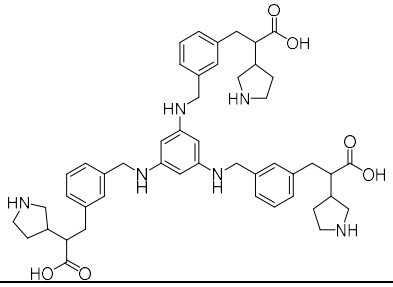
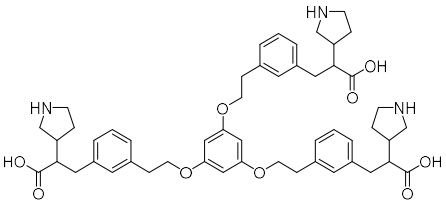
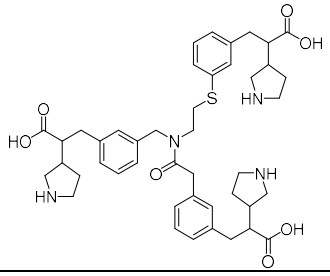
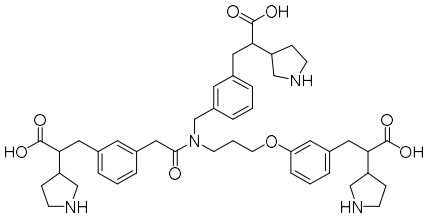
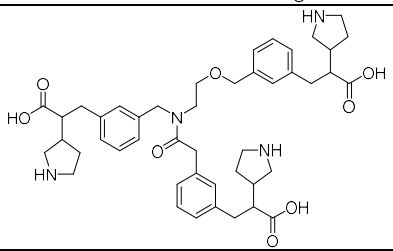
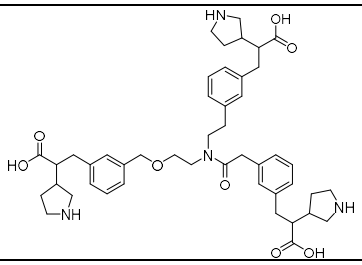
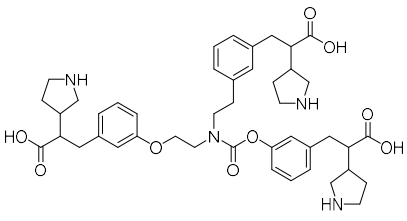
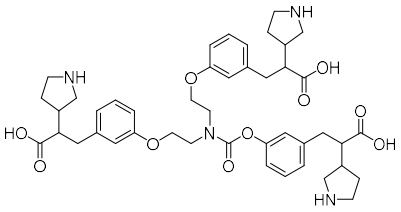
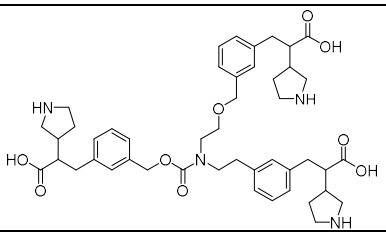
Compound No.	Structure	Compound No.	Structure
77-a		78-a	
79-a		80-a	
81-a		82-a	
85-a		86-a	
87-a		88-a	
89-a		90-a	
91-a		92-a	

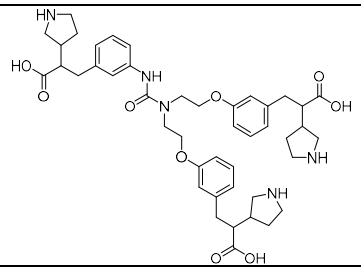
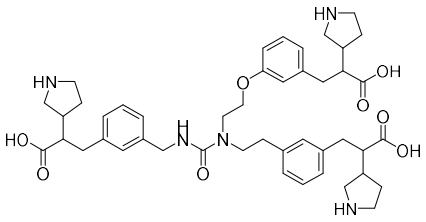
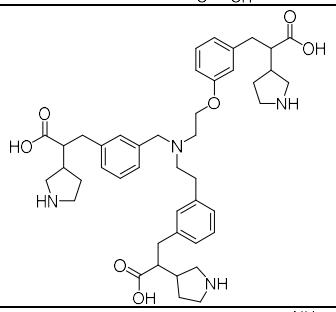
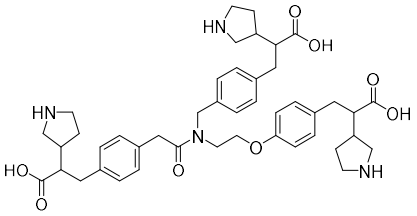
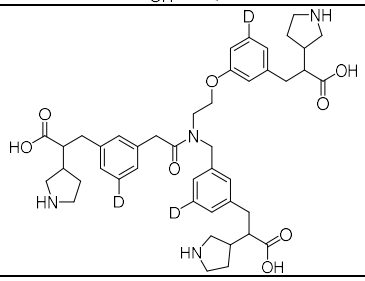
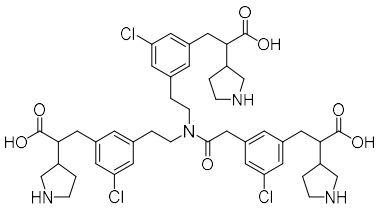
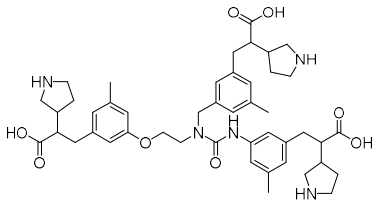
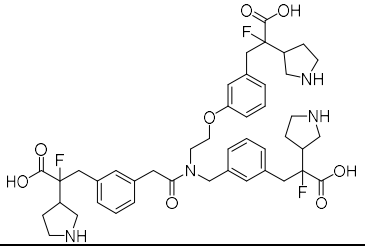
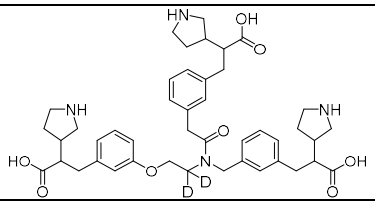
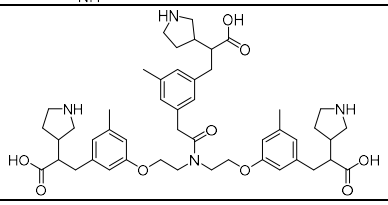
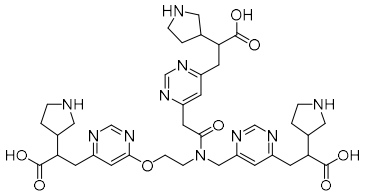
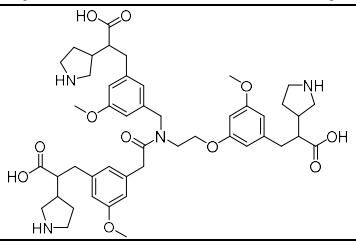
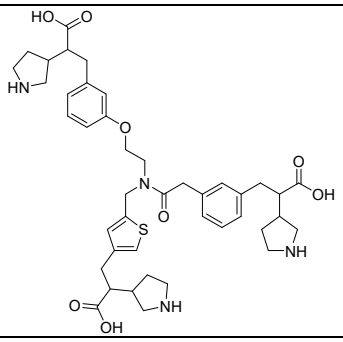
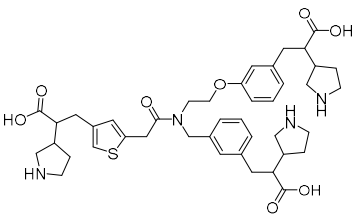
Compound No.	Structure	Compound No.	Structure
93-a		94-a	
95-a		96-a	
97-a		98-a	
99-a		100-a	
101-a		102-a	
103-a		104-a	
105-a		106-a	

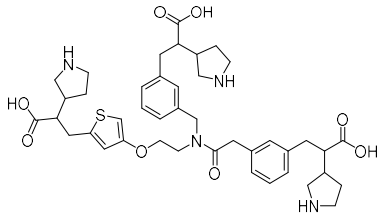
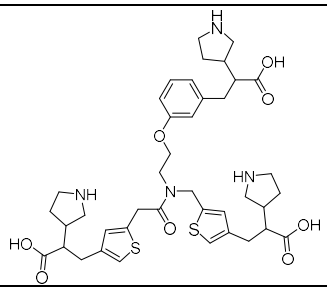
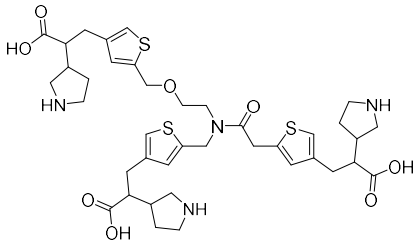
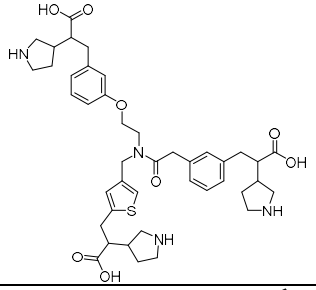
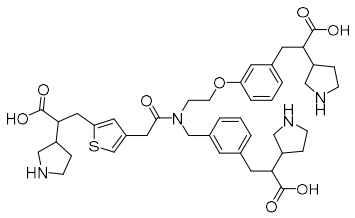
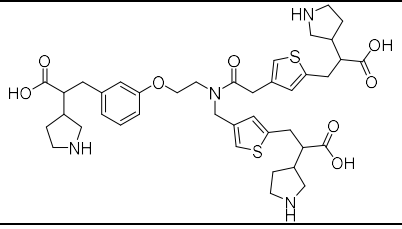
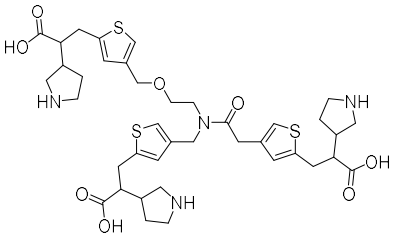
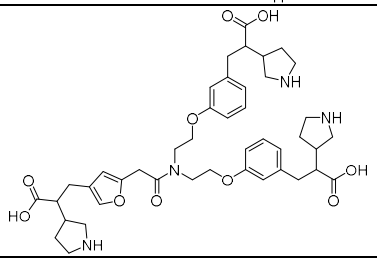
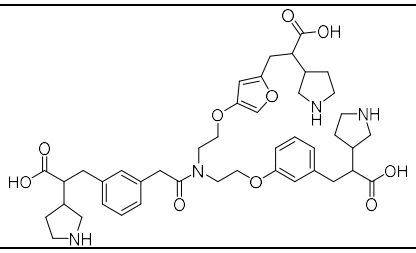
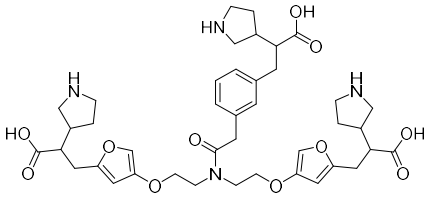
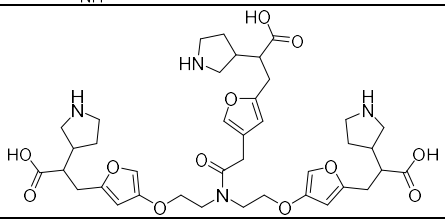
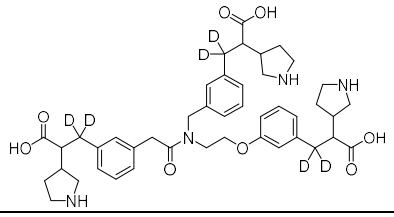
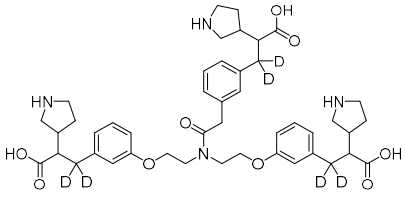
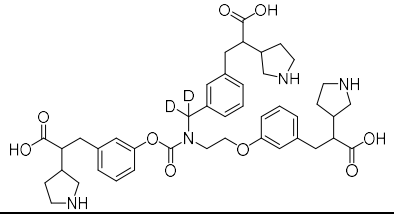
Compound No.	Structure	Compound No.	Structure
107-a		108-a	
109-a		110-a	
111-a		112-a	
113-a		114-a	
115-a		116-a	
117-a		118-a	
119-a		120-a	

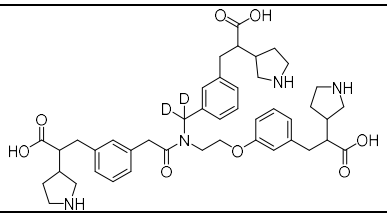
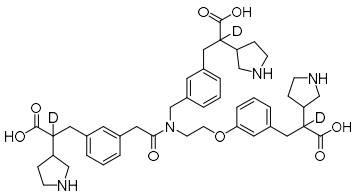
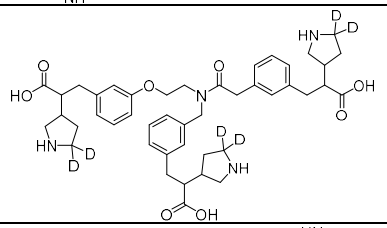
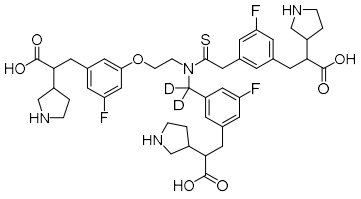
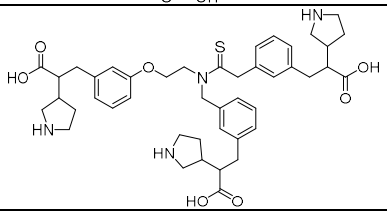
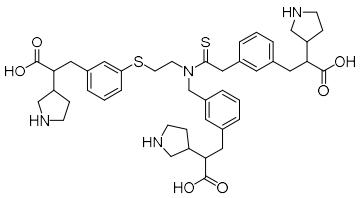
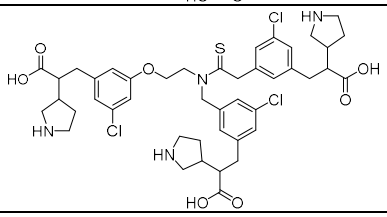
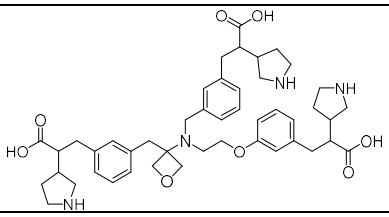
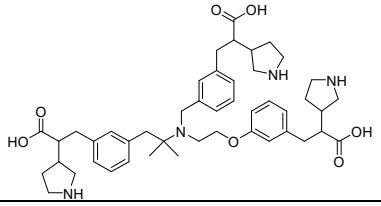
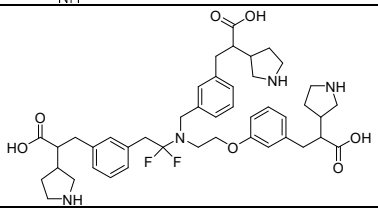
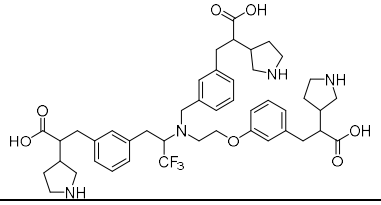
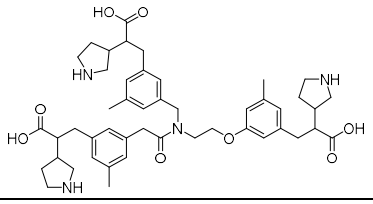
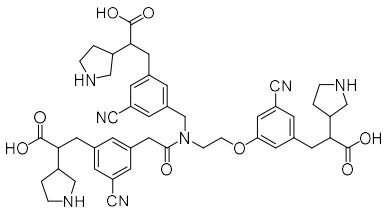
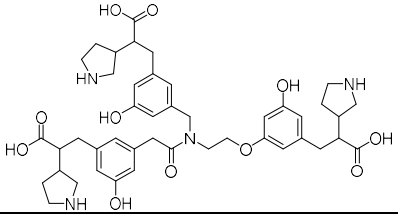
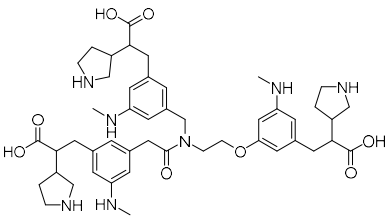
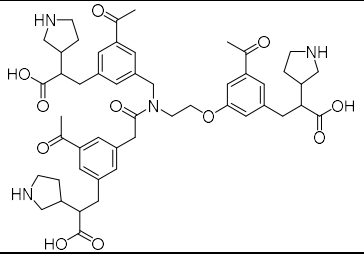
Compound No.	Structure	Compound No.	Structure
121-a		122-a	
123-a		124-a	
126-a		127-a	
128-a		129-a	
130-a		131-a	
132-a		133-a	
134-a		135-a	

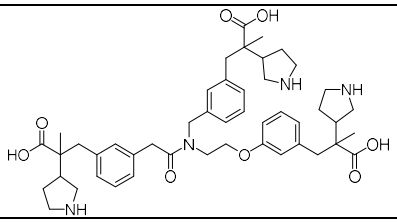
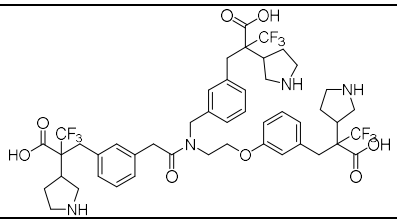
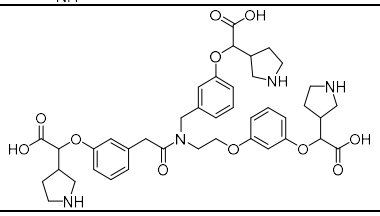
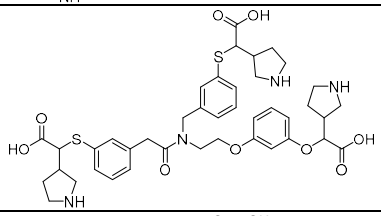
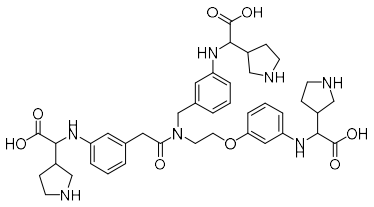
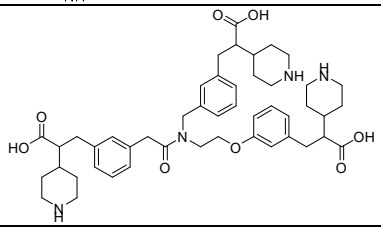
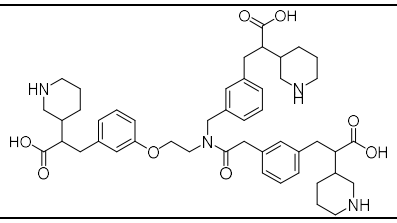
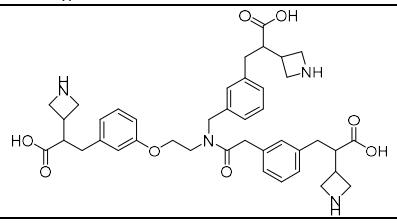
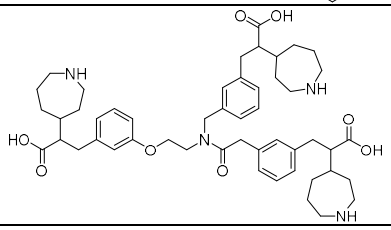
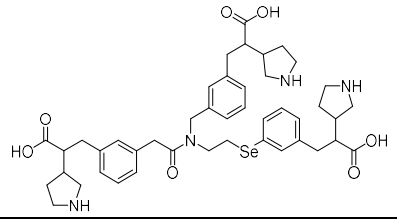
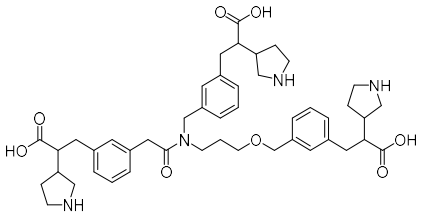
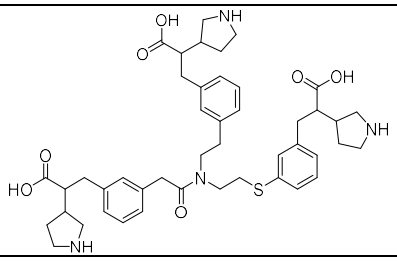
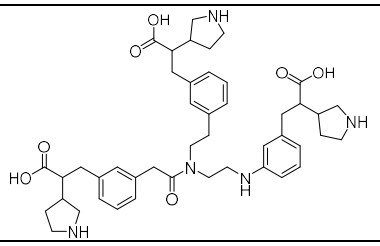
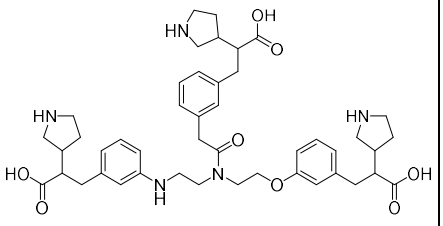
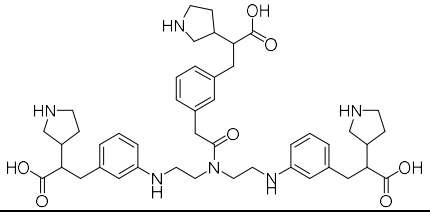
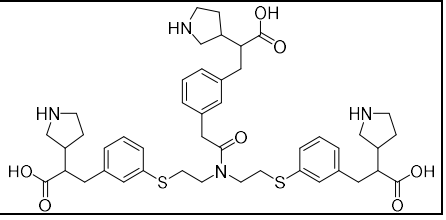
Compound No.	Structure	Compound No.	Structure
136-a		137-a	
138-a		139-a	
140-a		141-a	
142-a		143-a	
144-a		145	
146-a		147-a	
148-a		149-a	

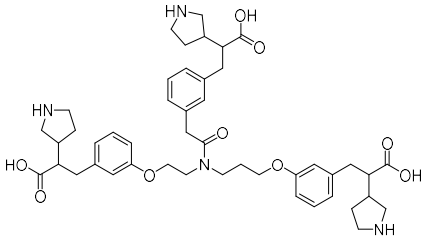
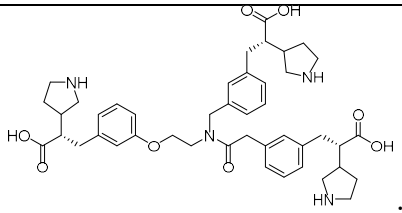
Compound No.	Structure	Compound No.	Structure
150-a		152-a	
153-a		154-a	
155-a		156-a	
157-a		158-a	
159-a		160-a	
161-a		162-a	
163-a		164-a	

Compound No.	Structure	Compound No.	Structure
165-a		166-a	
167-a		168-a	
169-a		170-a	
171-a		172-a	
173-a		174-a	
175-a		176-a	
177-a		178-a	

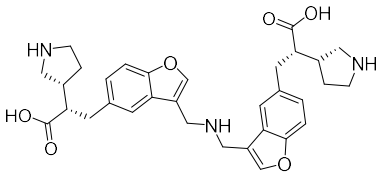
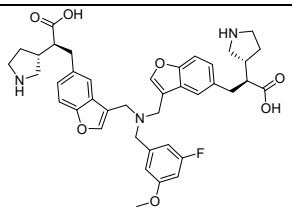
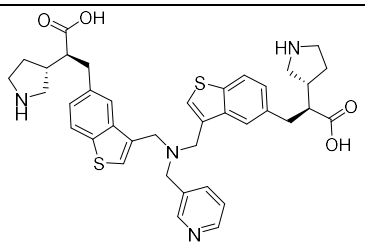
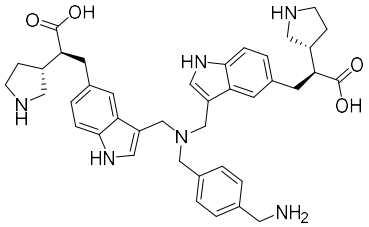
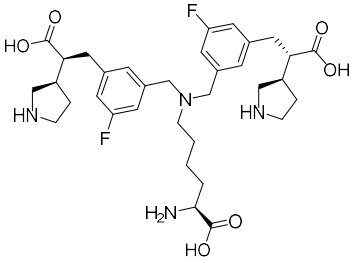
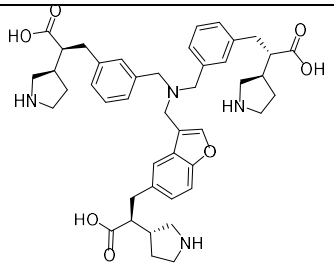
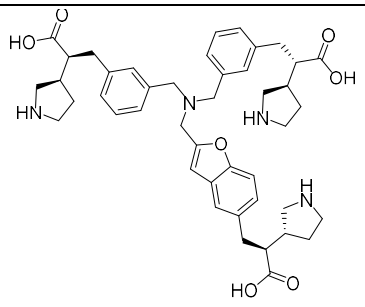
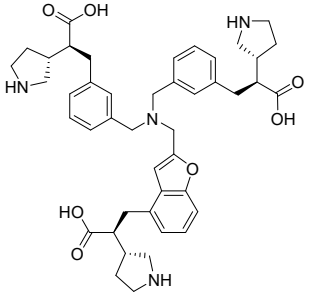
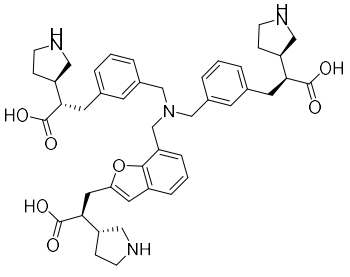
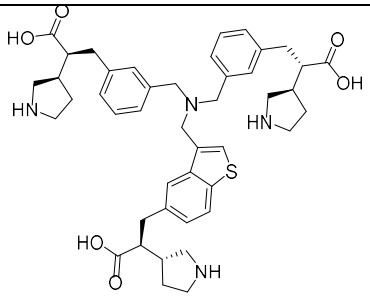
Compound No.	Structure	Compound No.	Structure
179-a		180-a	
181-a		182-a	
183-a		184-a	
185-a		186-a	
187-a		188-a	
189-a		190-a	
191-a		192-a	

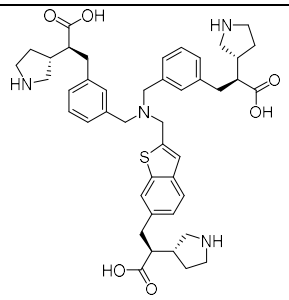
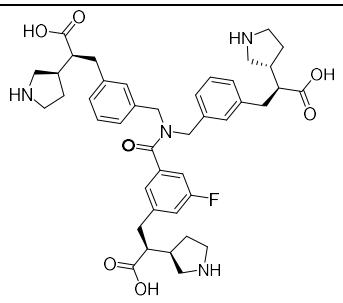
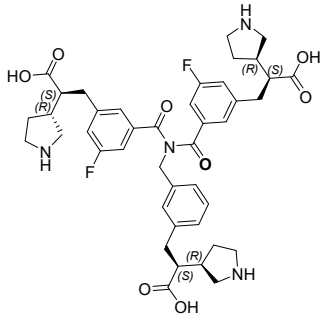
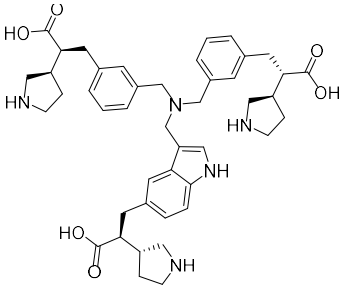
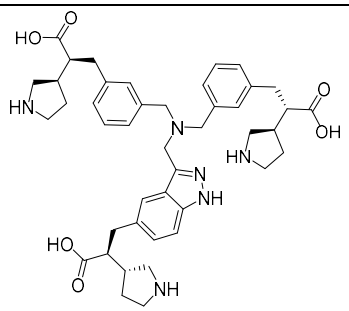
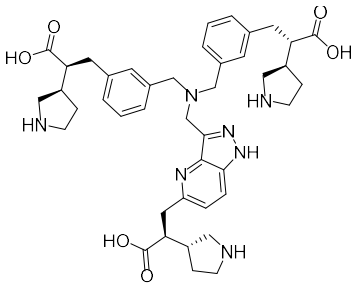
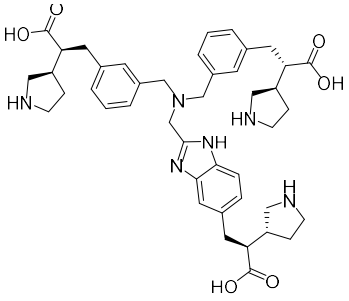
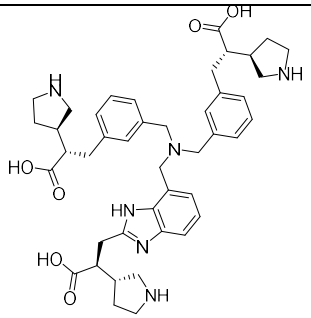
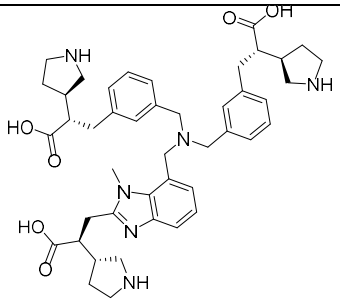
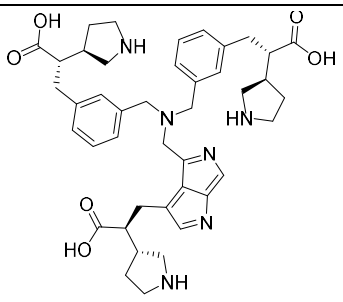
Compound No.	Structure	Compound No.	Structure
193-a		194-a	
195-a		196-a	
197-a		198-a	
199-a		200-a	
201-a		202-a	
203-a		204-a	
205-a		206-a	
207-a		208-a	

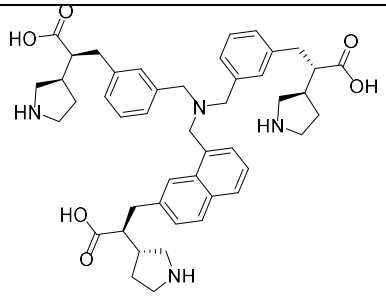
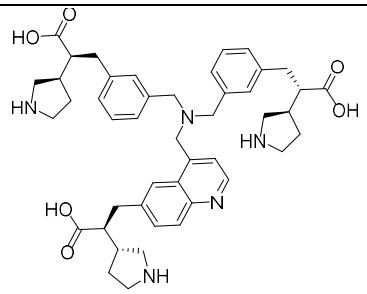
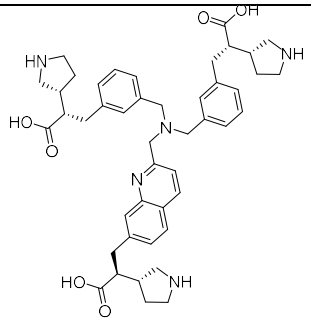
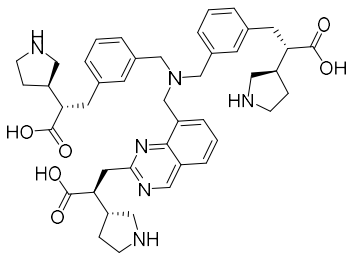
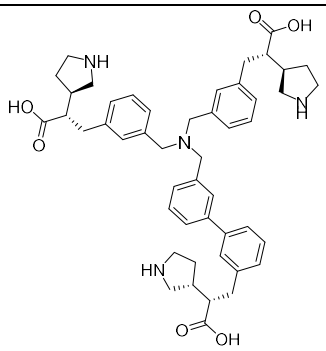
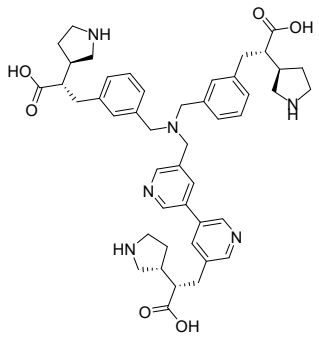
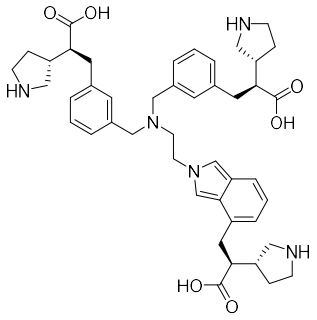
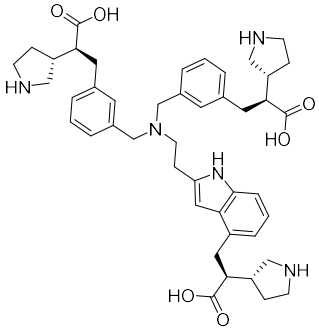
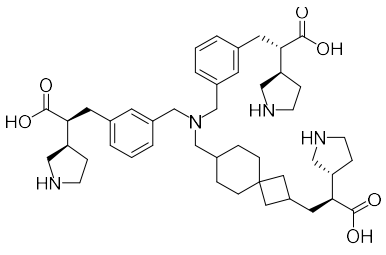
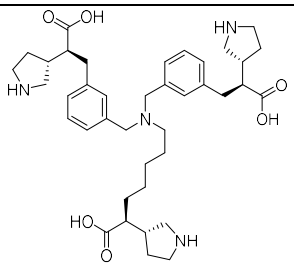
Compound No.	Structure	Compound No.	Structure
212-a		213-a	
214-a		215-a	
216-a		217-a	
218-a		219-a	
220-a		221-a	
222-a		223-a	
224-a		225-a	
226-a		227-a	

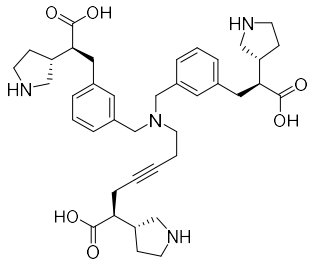
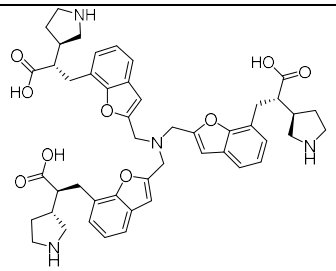
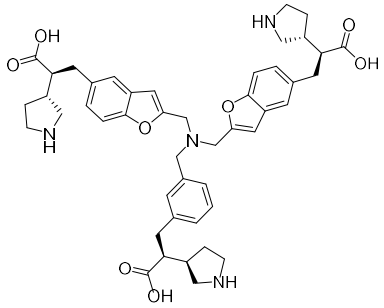
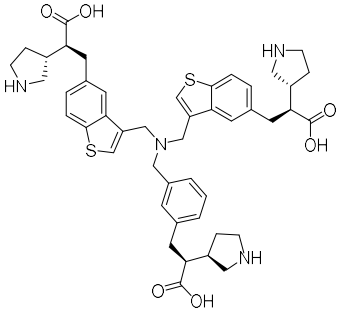
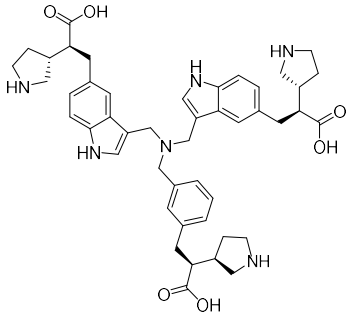
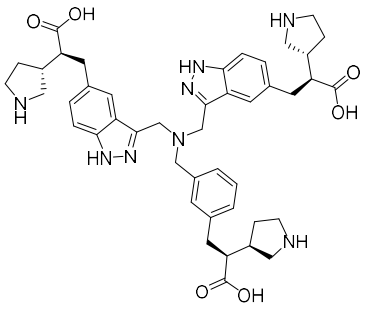
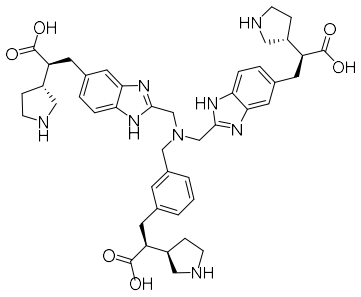
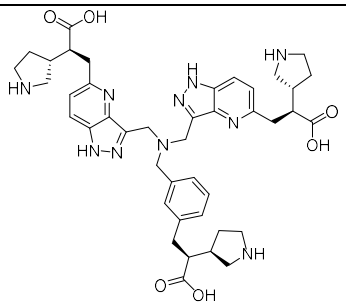
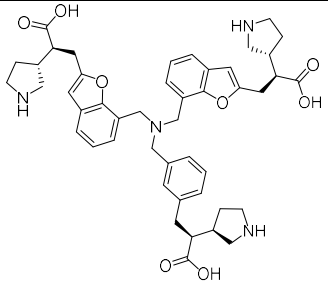
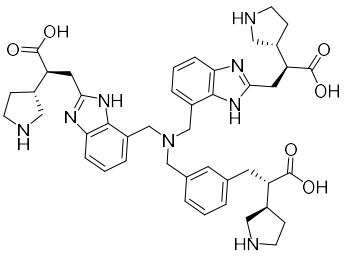
Compound No.	Structure	Compound No.	Structure
228-a		96-b	

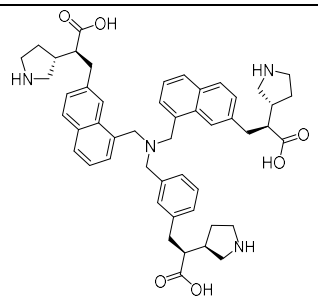
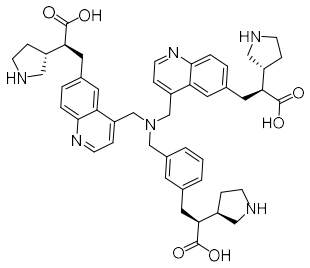
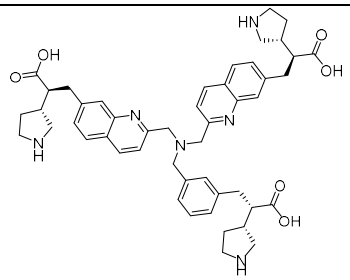
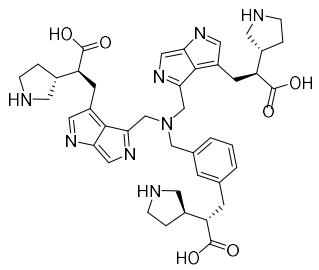
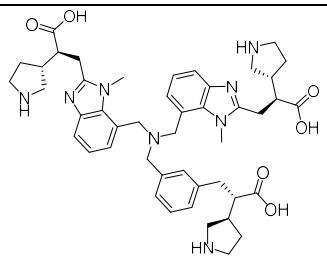
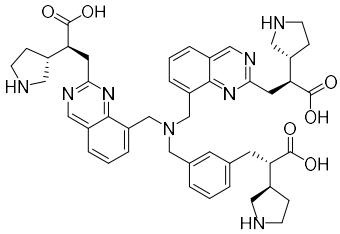
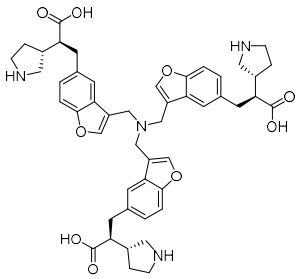
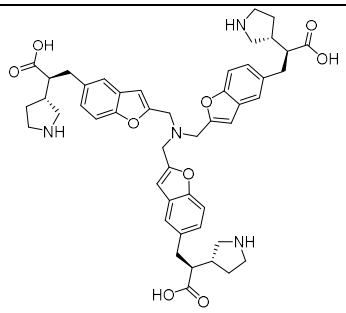
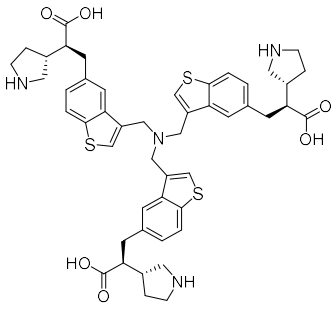
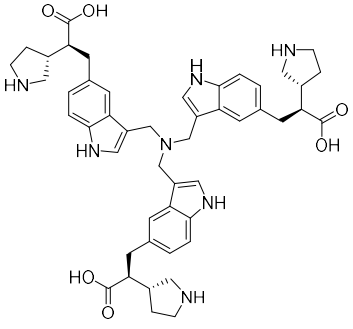
12. A compound, or a pharmaceutically acceptable salt thereof, wherein the compound is selected from:

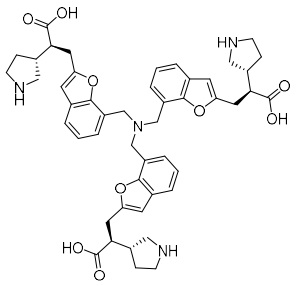
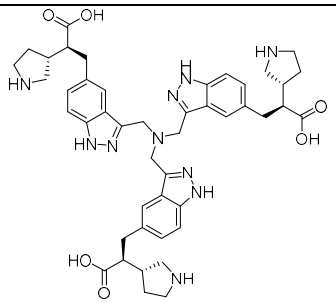
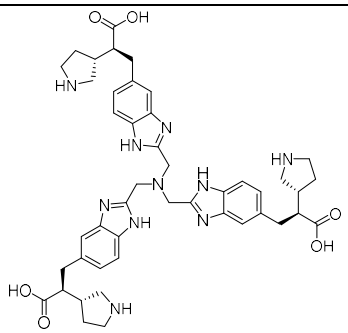
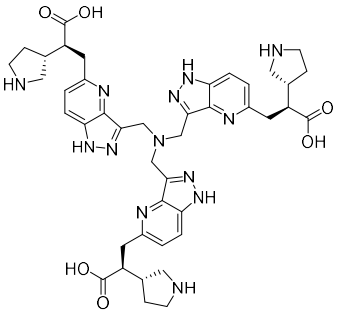
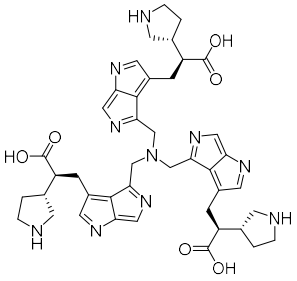
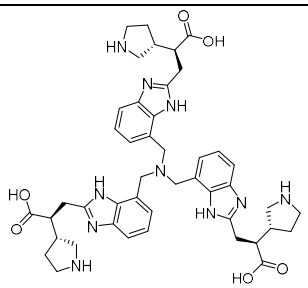
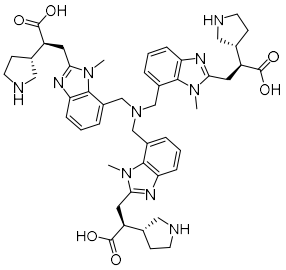
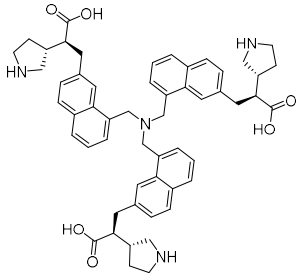
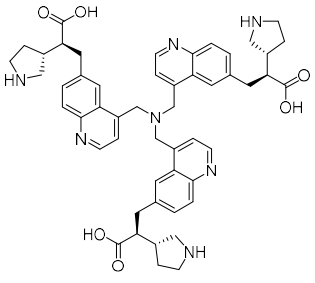
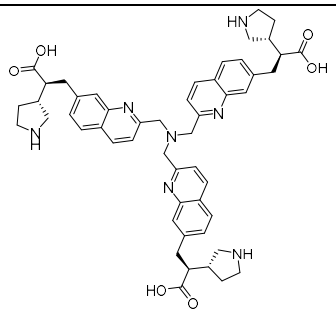
Compound No.	Structure	Compound No.	Structure
1		2	
3		4	
5		6	
7		8	
9		10	

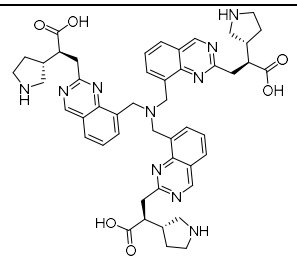
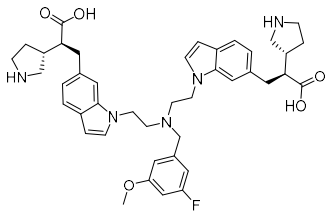
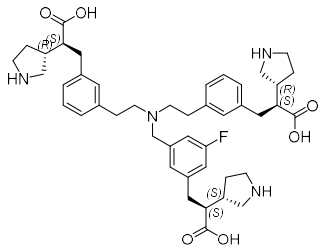
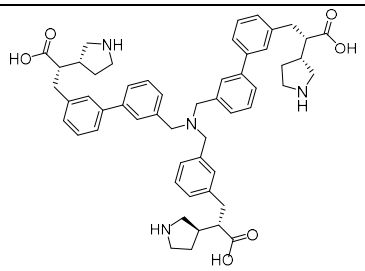
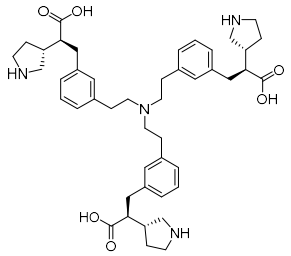
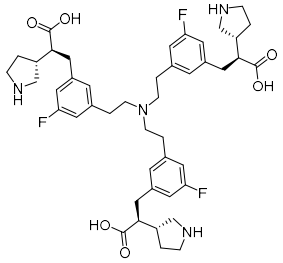
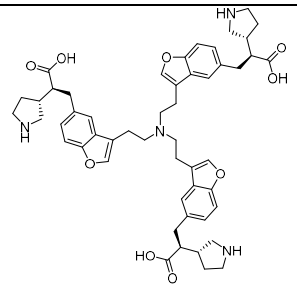
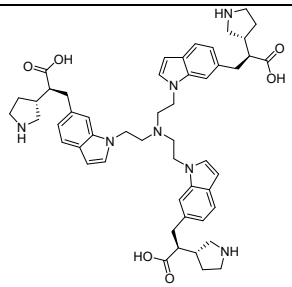
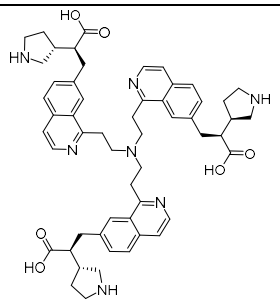
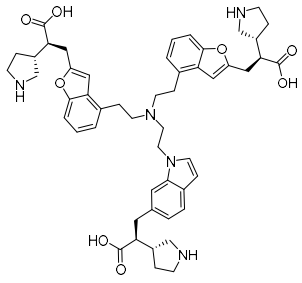
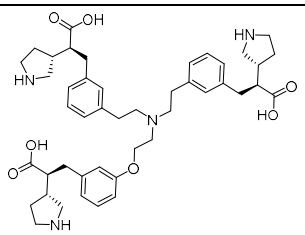
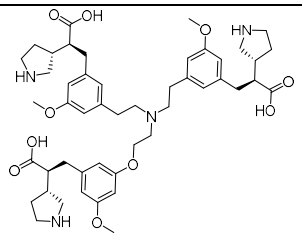
Compound No.	Structure	Compound No.	Structure
11		12	
13		14	
15		16	
17		18	
19		20	

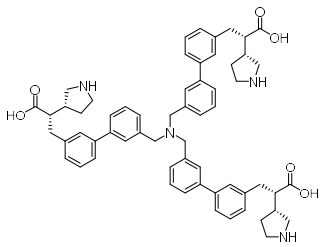
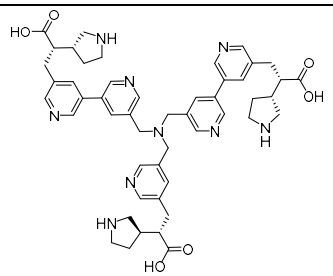
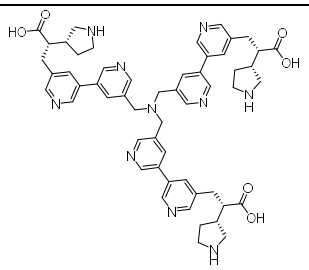
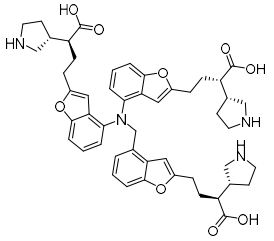
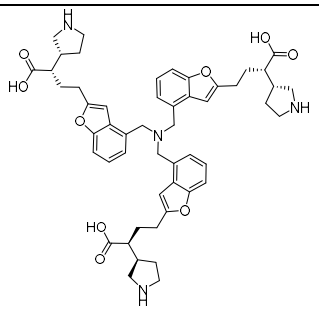
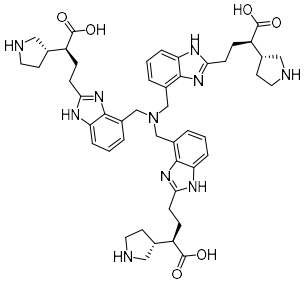
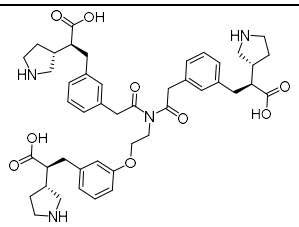
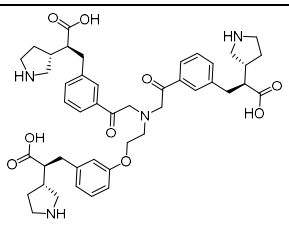
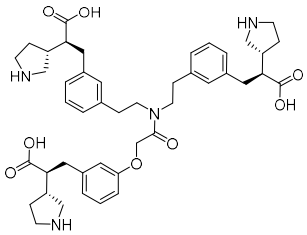
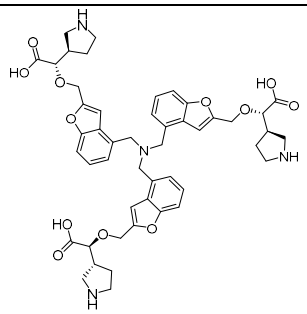
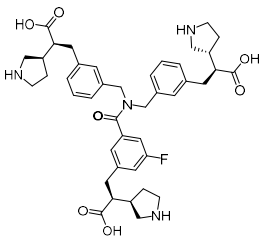
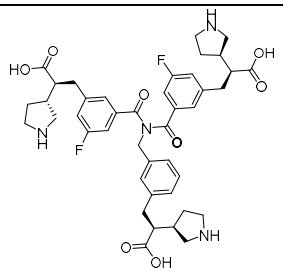
Compound No.	Structure	Compound No.	Structure
21		22	
23		24	
25		26	
27		28	
29		30	

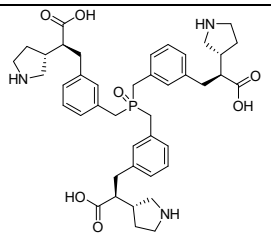
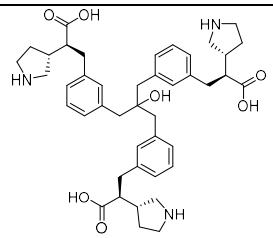
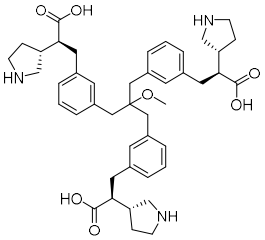
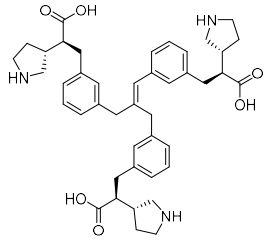
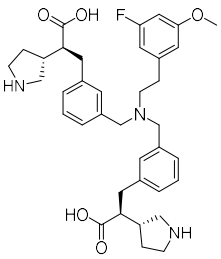
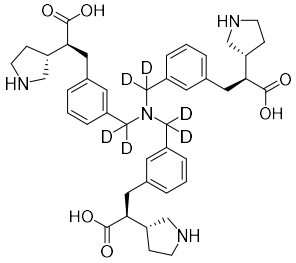
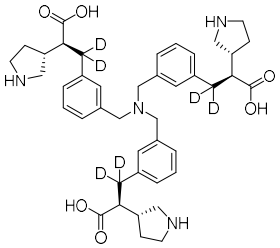
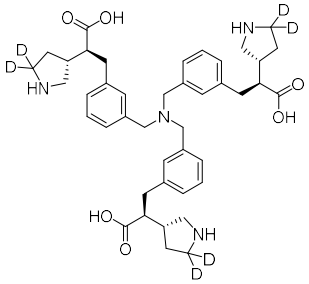
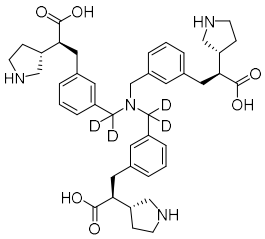
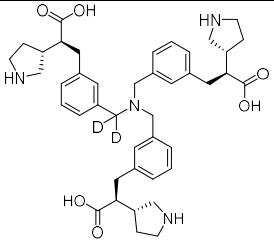
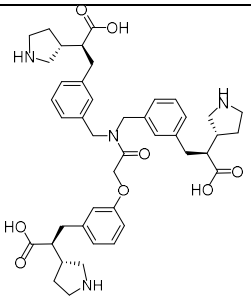
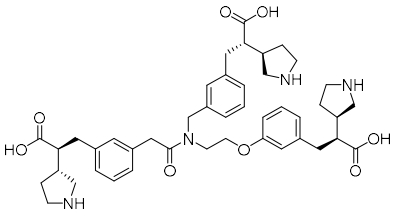
Compound No.	Structure	Compound No.	Structure
31		32	
33		34	
35		36	
37		38	
39		40	

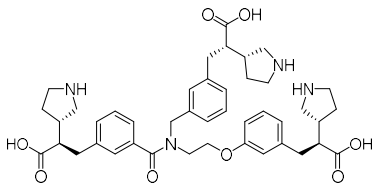
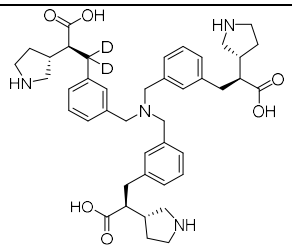
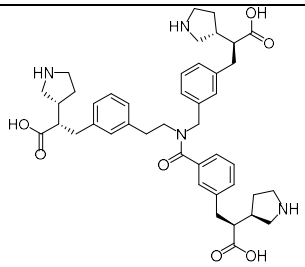
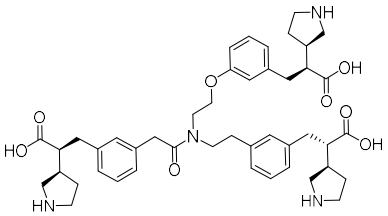
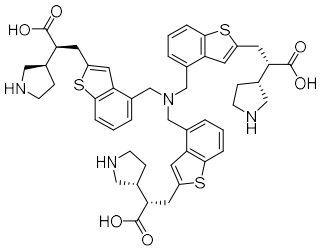
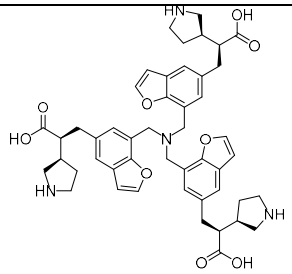
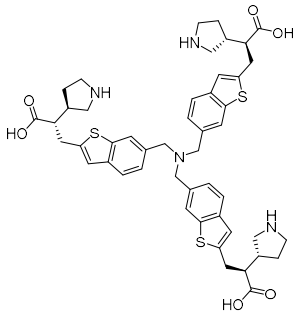
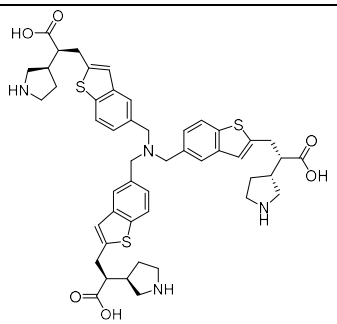
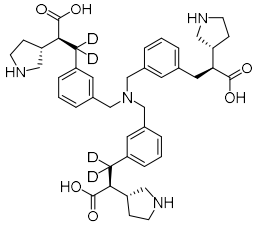
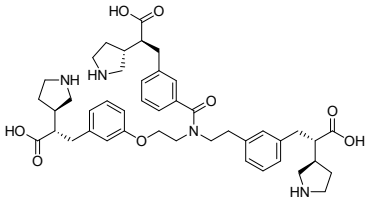
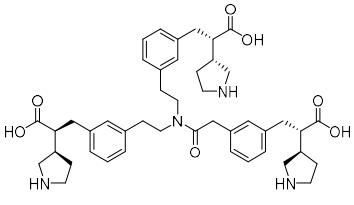
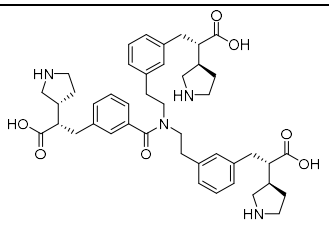
Compound No.	Structure	Compound No.	Structure
41		42	
43		44	
45		46	
47		48	
49		50	

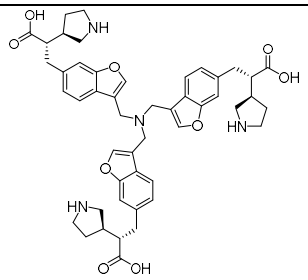
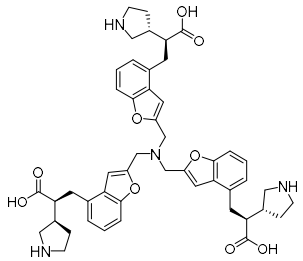
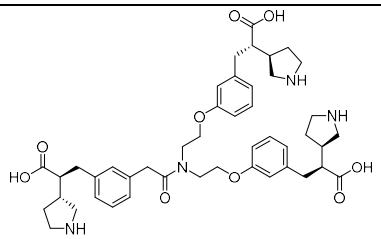
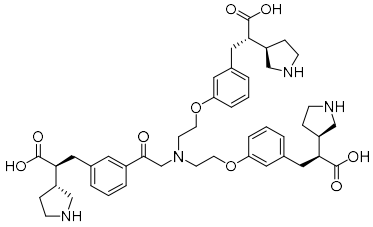
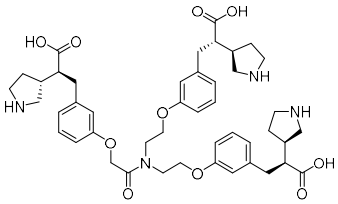
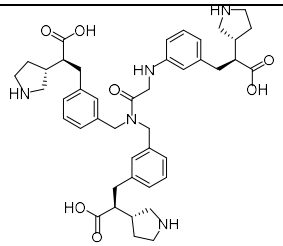
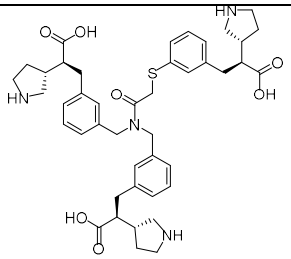
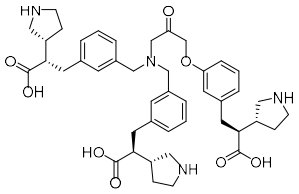
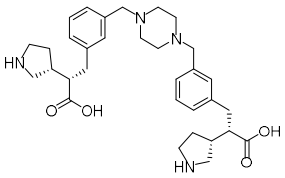
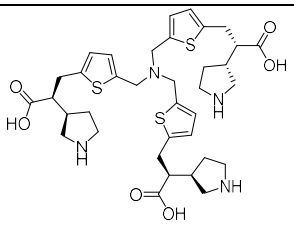
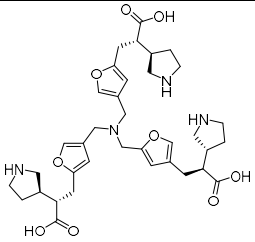
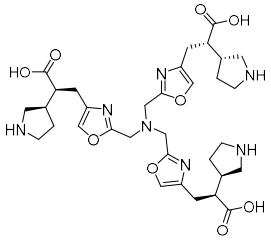
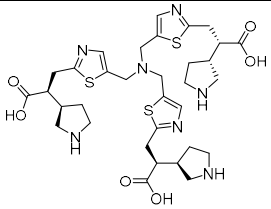
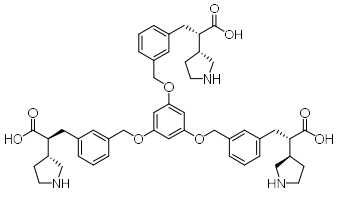
Compound No.	Structure	Compound No.	Structure
51		52	
53		54	
55		56	
57		58	
59		60	

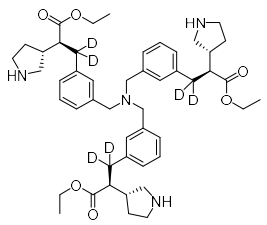
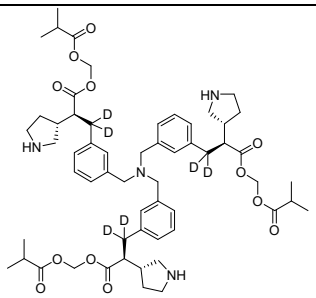
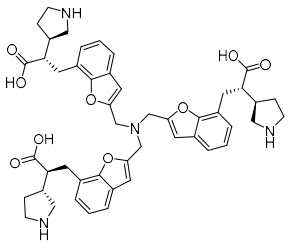
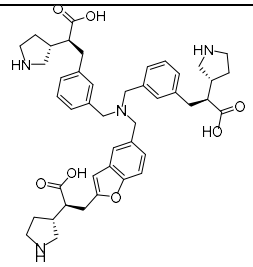
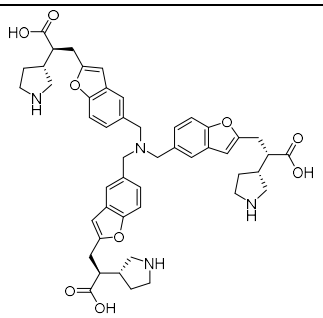
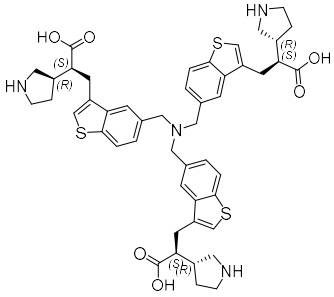
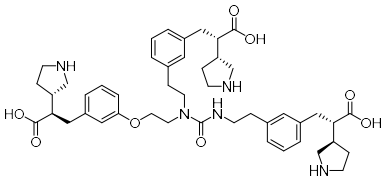
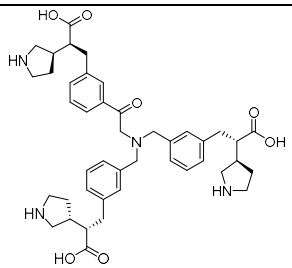
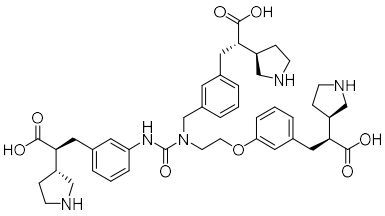
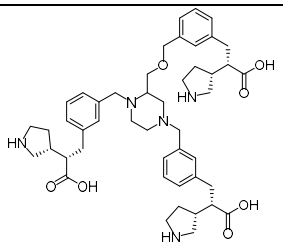
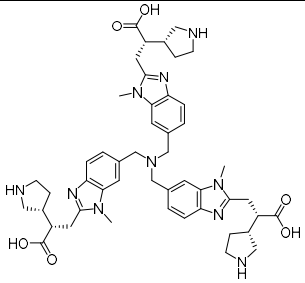
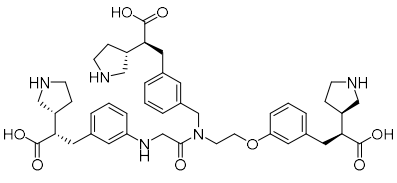
Compound No.	Structure	Compound No.	Structure
61		62	
63		64	
65		66	
67		68	
69		70	
71		72	

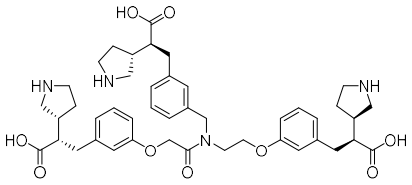
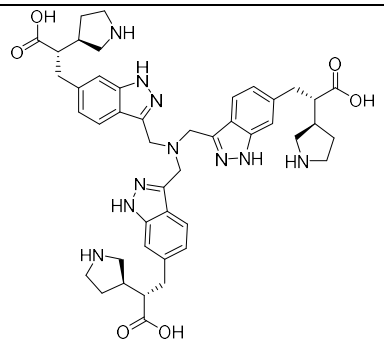
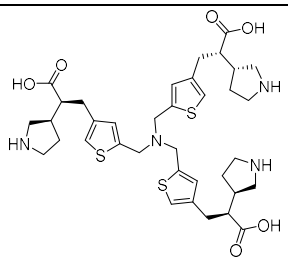
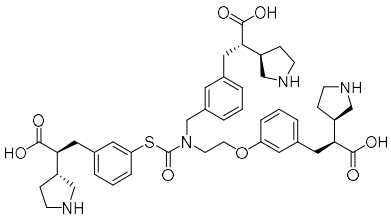
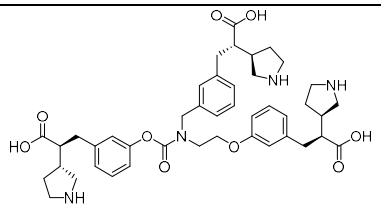
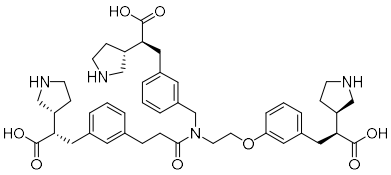
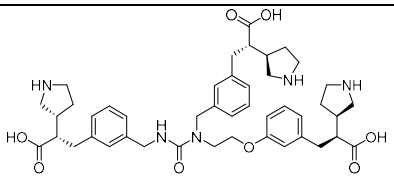
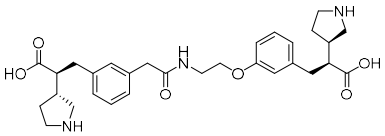
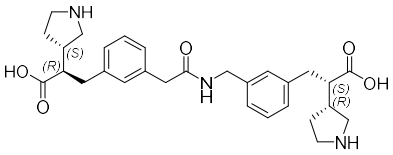
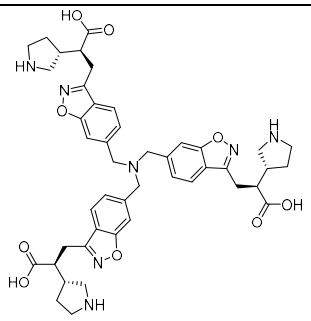
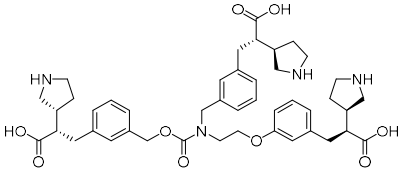
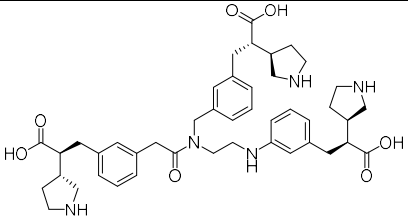
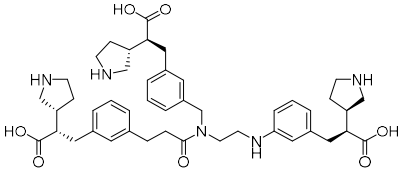
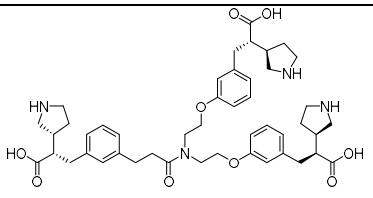
Compound No.	Structure	Compound No.	Structure
73		74	
75		76	
77		78	
79		80	
81		82	
83		84	

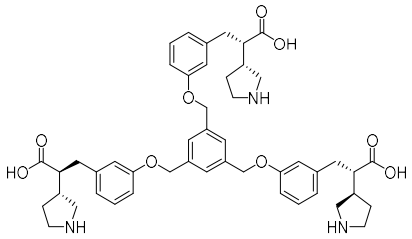
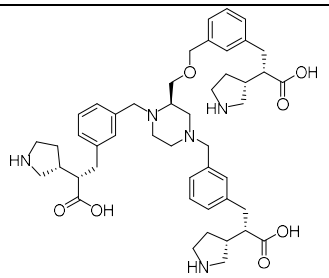
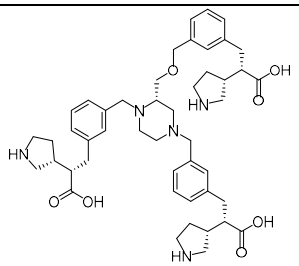
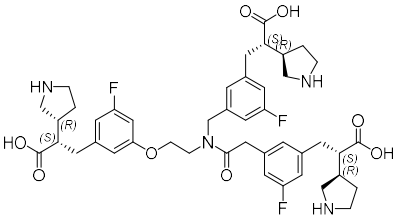
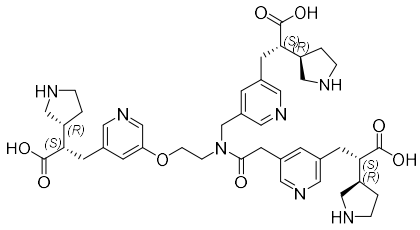
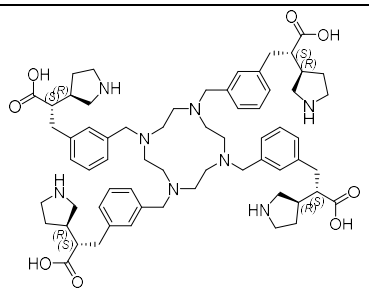
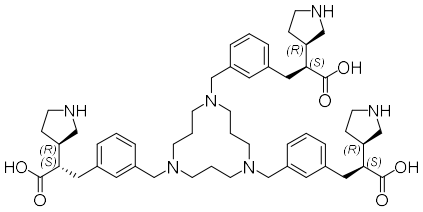
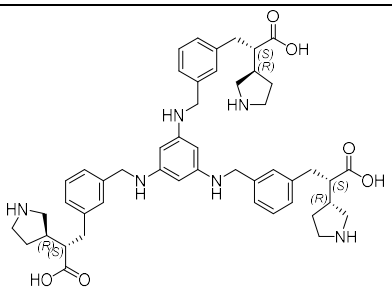
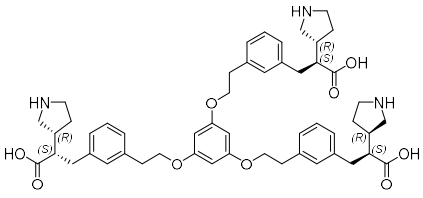
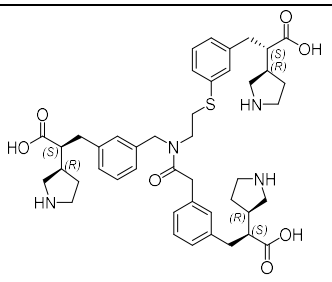
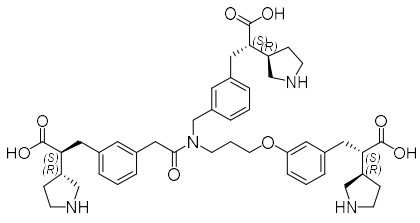
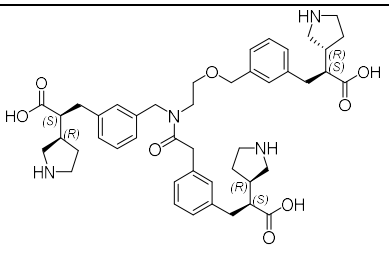
Compound No.	Structure	Compound No.	Structure
85		86	
87		88	
89		90	
91		92	
93		94	
95		96	

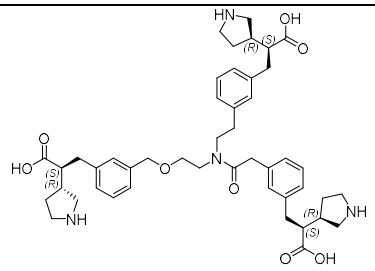
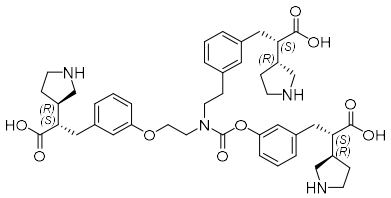
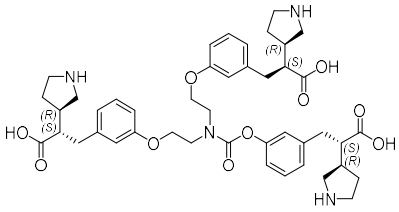
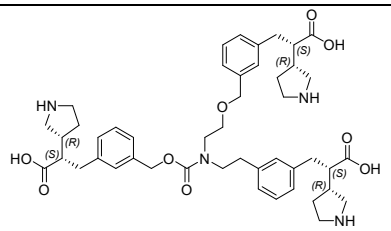
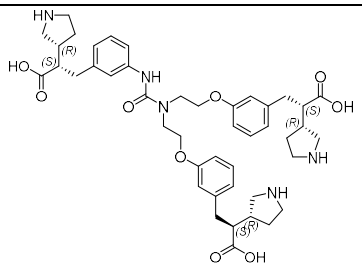
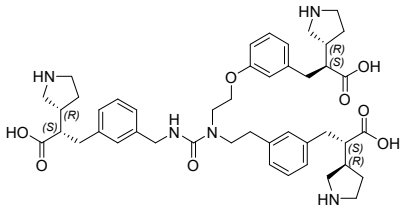
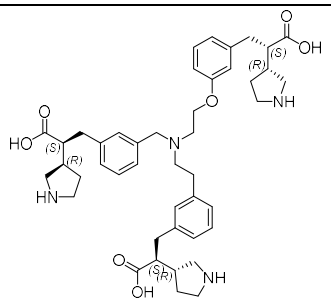
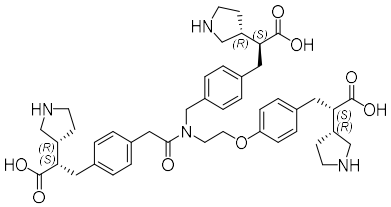
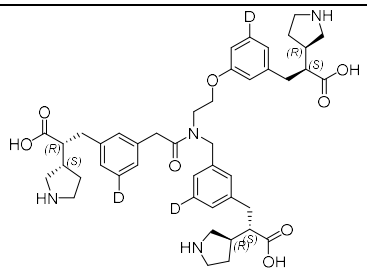
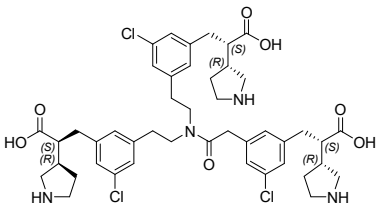
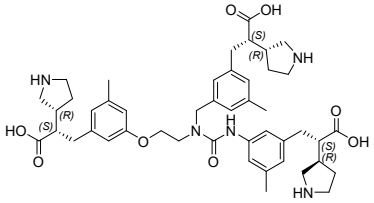
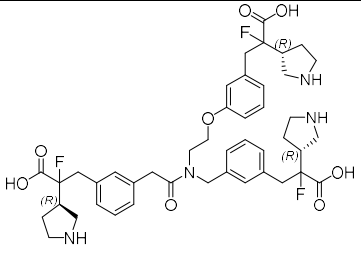
Compound No.	Structure	Compound No.	Structure
97		98	
99		100	
101		102	
103		104	
105		106	
107		108	

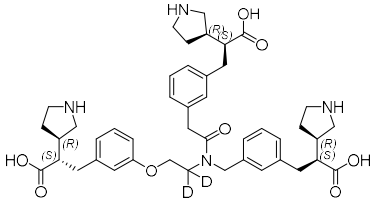
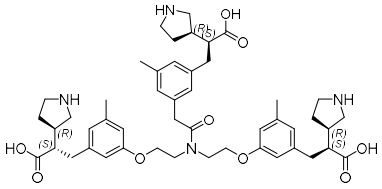
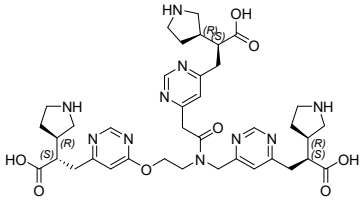
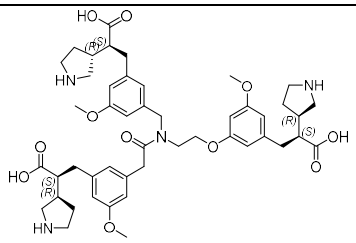
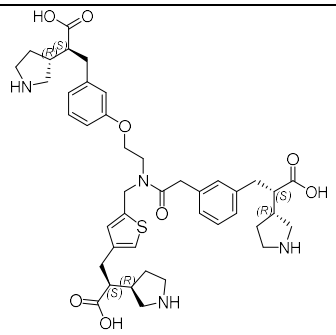
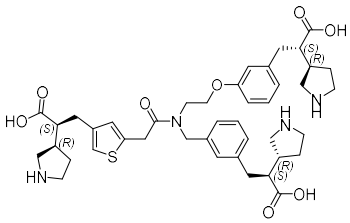
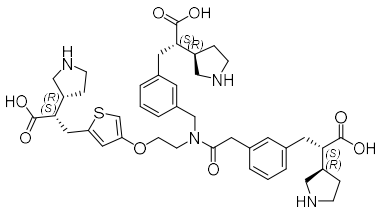
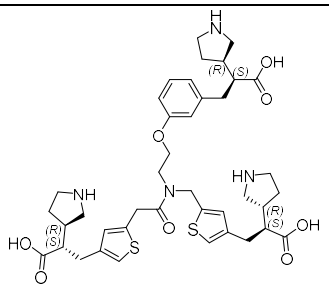
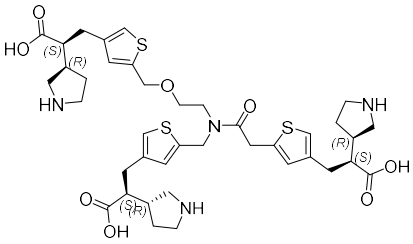
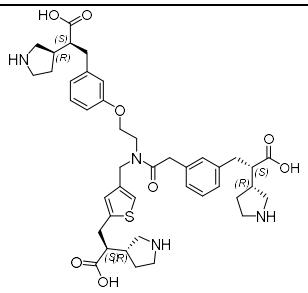
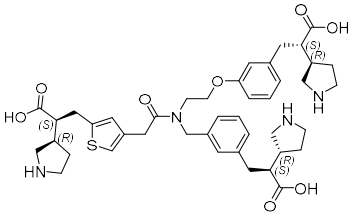
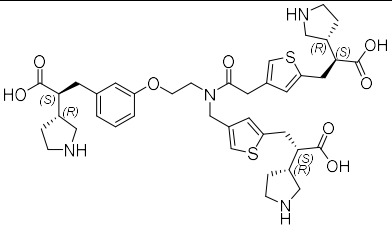
Compound No.	Structure	Compound No.	Structure
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	
121		122	

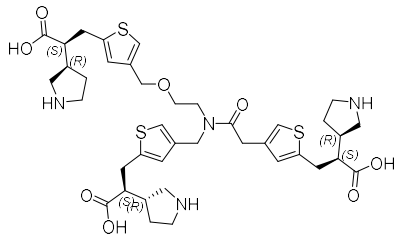
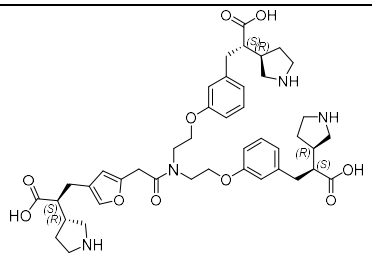
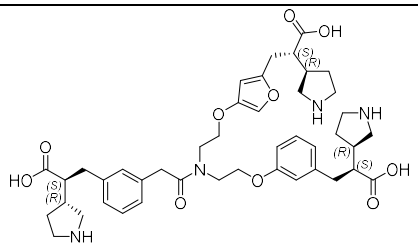
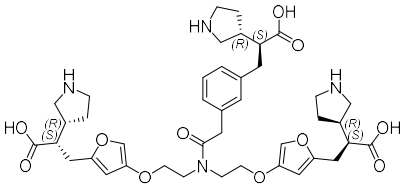
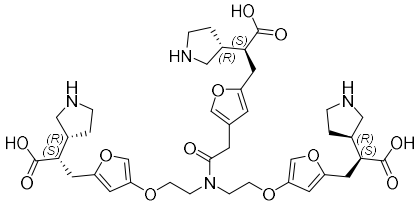
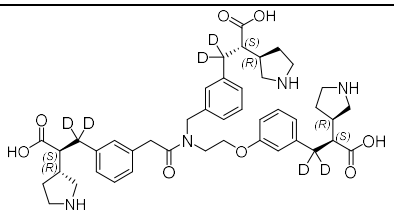
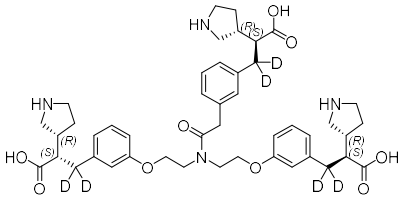
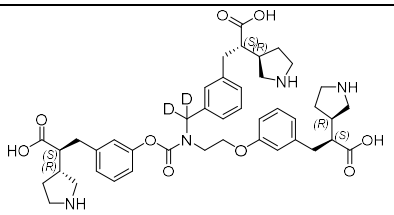
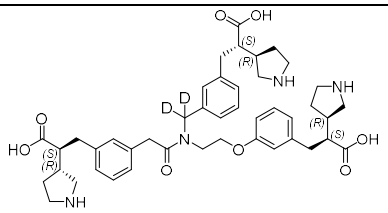
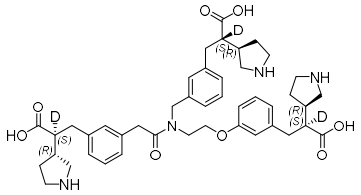
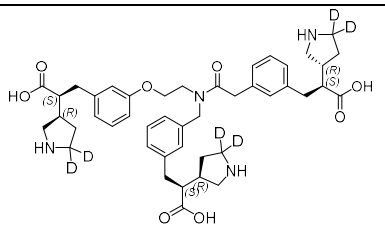
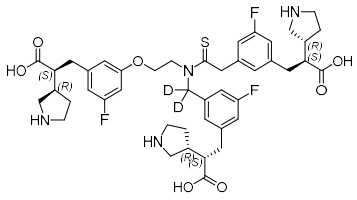
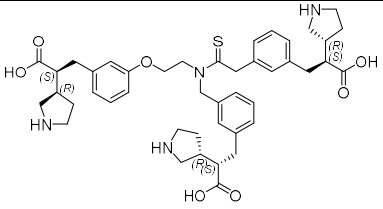
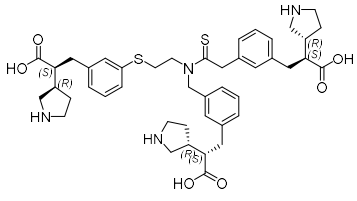
Compound No.	Structure	Compound No.	Structure
123		124	
125		126	
127		128	
129		130	
131		132	
133		134	

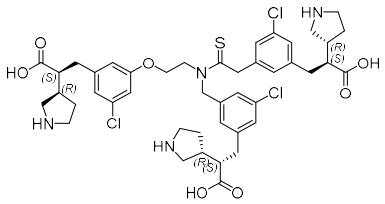
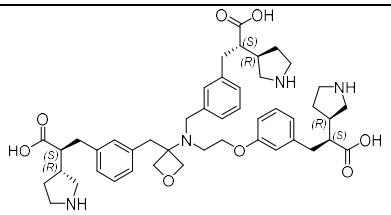
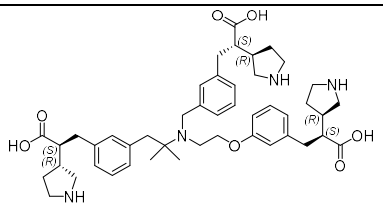
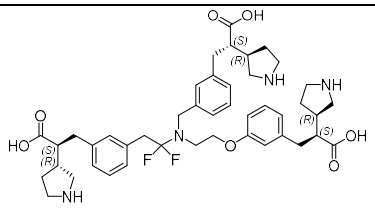
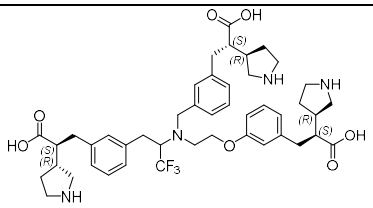
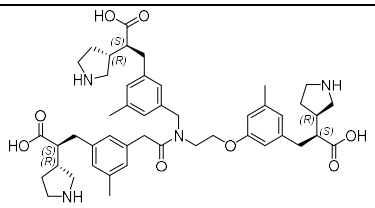
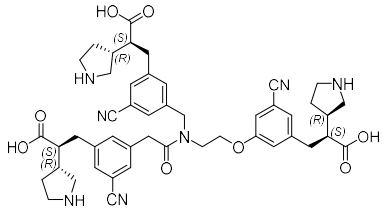
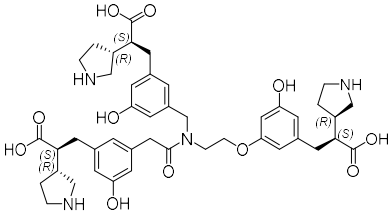
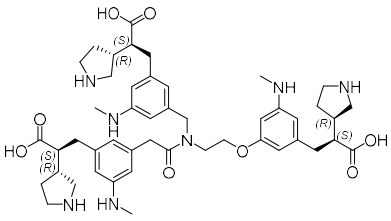
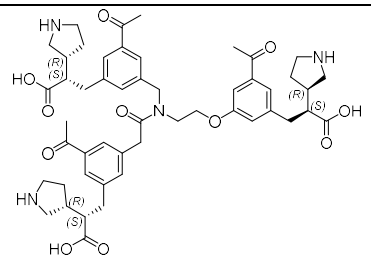
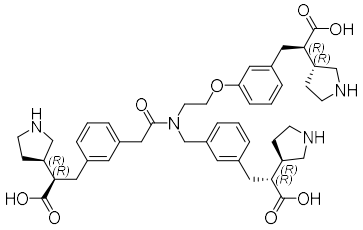
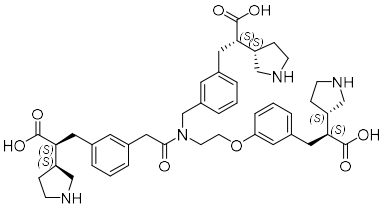
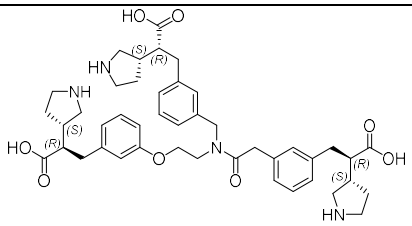
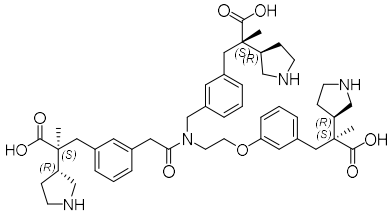
Compound No.	Structure	Compound No.	Structure
135		136	
137		138	
139		140	
141		142	
143		144	
145		146	
147		148	

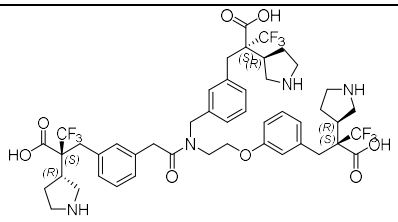
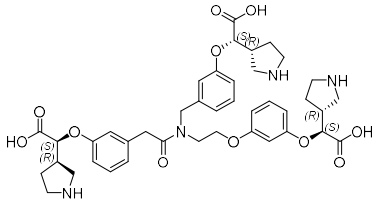
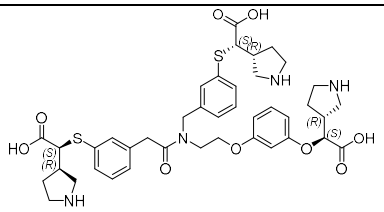
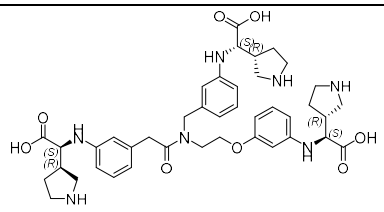
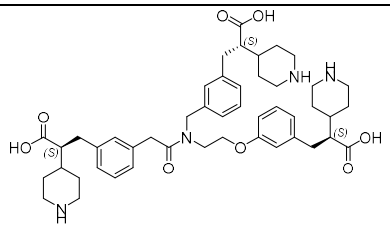
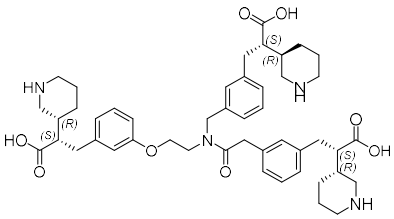
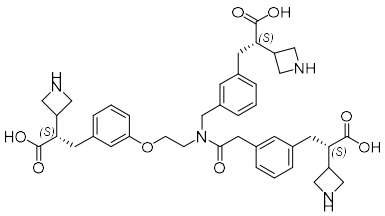
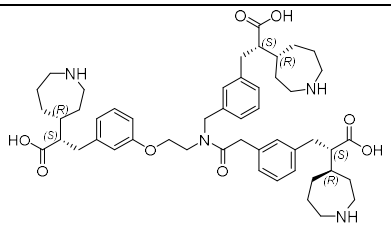
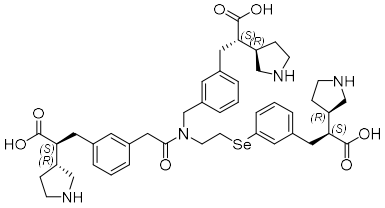
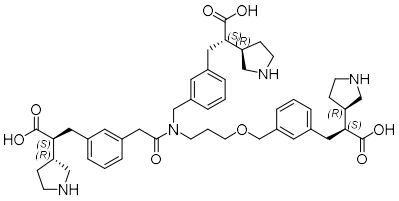
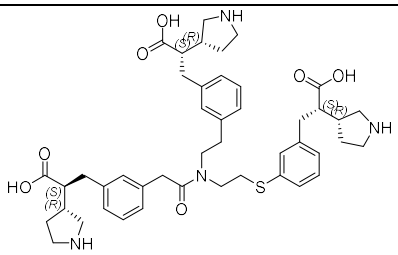
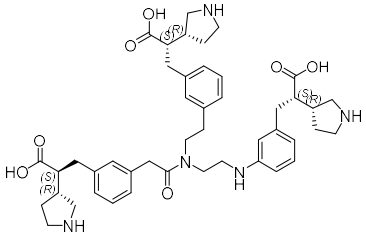
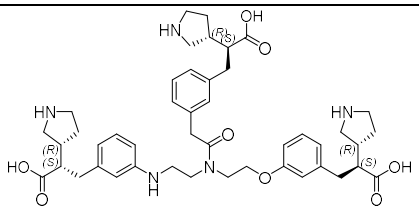
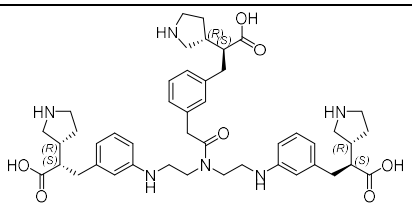
Compound No.	Structure	Compound No.	Structure
149		150	
151		152	
153		154	
155		156	
157		158	
159		160	

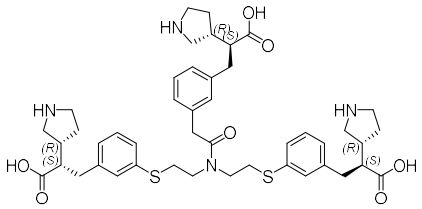
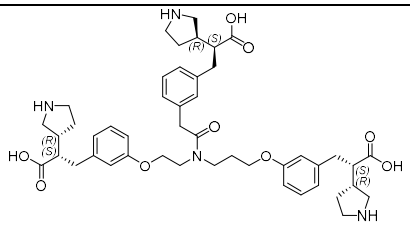
Compound No.	Structure	Compound No.	Structure
161		162	
163		164	
165		166	
167		168	
169		170	
171		172	

Compound No.	Structure	Compound No.	Structure
173		174	
175		176	
177		178	
179		180	
181		182	
183		184	

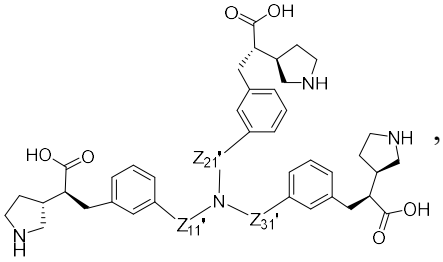
Compound No.	Structure	Compound No.	Structure
185		186	
187		188	
189		190	
191		192	
193		194	
195		196	
197		198	

Compound No.	Structure	Compound No.	Structure
199		200	
201		202	
203		204	
205		206	
207		208	
209		210	
211		212	

Compound No.	Structure	Compound No.	Structure
213		214	
215		216	
217		218	
219		220	
221		222	
223		224	
225		226	

Compound No.	Structure	Compound No.	Structure
227		228	

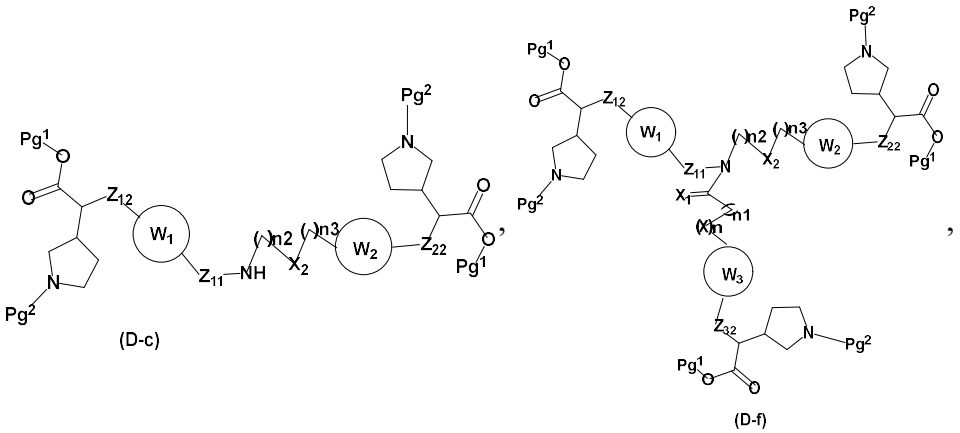
alternatively said compound is selected from:

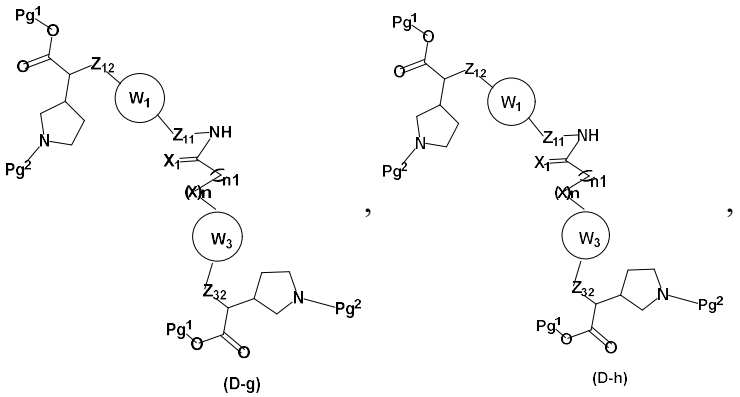
 , wherein * represents the connecting end with N,

Compound No.	Z_{31}'	Z_{11}'	Z_{21}'
229	C(O)	CH_2	$CH_2CH_2CH_2$
230	C(O)	CH_2	*CH_2CH_2S
231	C(O)	CH_2	*CH_2CH_2NH
232	C(O)	CH_2	*$CH_2CH_2CH_2O$
233	C(O)	CH_2	*$CH_2CH_2C(O)$
234	C(O)	CH_2	*$CH_2CH_2C(S)$
235	C(O)	CH_2	*$CH_2CH_2C(O)O$
236	C(O)	CH_2	*$CH_2CH_2C(O)NH$
237	C(O)	CH_2	*$CH_2CH_2C(O)NCH_2$
238	C(O)	CH_2	*$CH_2CH_2NHC(O)$
239	C(O)	CH_2CH_2	$CH_2CH_2CH_2$
240	C(O)	CH_2CH_2	*CH_2CH_2S
241	C(O)	CH_2CH_2	*$CH_2CH_2CH_2O$
242	C(O)	*CH_2CH_2O	*CH_2CH_2O
243	C(O)	*CH_2CH_2O	*CH_2CH_2S
244	C(O)	*CH_2CH_2O	*CH_2CH_2NH
245	C(O)	*CH_2CH_2O	*$CH_2CH_2C(O)$
246	C(O)	*CH_2CH_2O	*$CH_2CH_2C(O)NH$
247	*$C(O)CH_2$	CH_2	CH_2
248	*$C(O)CH_2$	CH_2	CH_2CH_2
249	*$C(O)CH_2$	CH_2CH_2	$CH_2CH_2CH_2$
250	*$C(O)CH_2$	*CH_2CH_2O	$CH_2CH_2CH_2$
251	*$C(O)CH_2$	*CH_2CH_2O	*CH_2CH_2S
252	*$C(O)CH_2CH_2$	*CH_2CH_2O	*$CH_2CH_2CH_2S$
253	*$C(O)CH_2CH_2$	*CH_2CH_2O	*$CH_2CH_2C(O)$
254	*$C(O)CH_2CH_2$	*CH_2CH_2O	CH_2CH_2
255	*$C(O)CH_2CH_2$	CH_2	*$CH_2CH_2CH_2O$
256	*$C(O)CH_2CH_2$	CH_2	*$CH_2CH_2C(O)$
257	*$C(O)CH_2CH_2$	CH_2	*$CH_2CH_2C(O)O$
258	*$C(O)CH_2CH_2$	CH_2	*$CH_2CH_2C(O)NH$

Compound No.	Z_{31}'	Z_{11}'	Z_{21}'
259	*$CH_2C(O)$	CH_2	CH_2CH_2
260	*$CH_2C(O)$	CH_2	*CH_2CH_2O
261	*$CH_2C(O)$	CH_2	*CH_2CH_2NH
262	*$CH_2CH_2C(O)$	CH_2	CH_2
263	*$CH_2CH_2C(O)$	CH_2	CH_2CH_2
264	*$CH_2CH_2C(O)$	CH_2	*CH_2CH_2O
265	*$CH_2CH_2C(O)$	CH_2	*CH_2CH_2S
266	*CH_2CH_2O	*CH_2CH_2O	*CH_2CH_2O
267	*CH_2CH_2O	*CH_2CH_2O	*$CH_2CH_2C(O)$
268	*CH_2CH_2O	*CH_2CH_2O	*$CH_2CH_2C(O)NH$
269	*CH_2CH_2NH	CH_2	*$CH_2CH_2C(O)NCH_2$
270	*CH_2CH_2NH	CH_2	*$CH_2CH_2NHC(O)$
271	*CH_2CH_2NH	*CH_2CH_2NH	*CH_2CH_2O
272	*CH_2CH_2NH	*$CH_2CH_2NCH_2$	*$CH_2CH_2C(O)$
273	*CH_2CH_2NH	*CH_2CH_2O	*$CH_2CH_2C(O)NH$
274	*$C(O)OCH_2$	CH_2	*CH_2CH_2NH
275	*$C(O)OCH_2$	CH_2	*CH_2CH_2S
276	*$C(O)OCH_2$	CH_2CH_2	*CH_2CH_2O
277	*$C(O)OCH_2$	CH_2CH_2	*CH_2CH_2S
278	*$C(O)OCH_2$	*CH_2CH_2NH	*CH_2CH_2O
279	*$C(O)OCH_2$	*CH_2CH_2NH	*$CH_2CH_2CH_2O$
280	*$C(O)OCH_2$	CH_2	CH_2
281	*$C(O)OCH_2$	CH_2CH_2	CH_2
282	*$C(O)NHCH_2$	CH_2	*CH_2CH_2NH
283	*$C(O)NHCH_2$	CH_2CH_2	*CH_2CH_2NH
284	*$C(O)NHCH_2$	*CH_2CH_2NH	*CH_2CH_2O
285	*C(O)NH	CH_2	*CH_2CH_2S
286	*C(O)NH	CH_2CH_2	*CH_2CH_2NH
287	*C(O)NH	CH_2CH_2	*CH_2CH_2O
288	*C(O)NH	CH_2CH_2	*CH_2CH_2S
289	*C(O)NH	*CH_2CH_2NH	*CH_2CH_2O
290	*C(O)O	CH_2	*CH_2CH_2S
291	*C(O)O	CH_2CH_2	*CH_2CH_2S
292	*$C(O)CH_2O$	CH_2	*CH_2CH_2NH
293	*$C(O)CH_2O$	CH_2CH_2	*$CH_2CH_2C(O)NH$
294	*$C(O)CH_2O$	CH_2CH_2	*CH_2CH_2O
295	*$C(O)CH_2O$	CH_2CH_2	*CH_2CH_2NH
296	*$C(O)CH_2NH$	*CH_2CH_2O	*CH_2CH_2S
297	*$C(O)CH_2NH$	*CH_2CH_2O	*CH_2CH_2O
298	*$C(O)CH_2NH$	CH_2CH_2	*CH_2CH_2NH
299	CH_2	*CH_2CH_2O	*CH_2CH_2O.

13. A compound as represented by formula (D-c), formula (D-f), formula (D-g), or formula (D-h), or a pharmaceutically acceptable salt thereof:



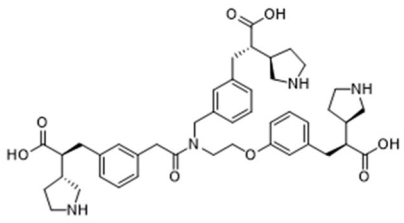


wherein Pg^1 and Pg^2 are protecting groups respectively; Z_{11}, Z_{12}, Z_{22}, Z_{32}, X, X_1, X_2, n, n1, n2, n3, and rings W_1, W_2, and W_3 are as defined in any one of claims 1 to 12;

for example, Pg^1 is independently selected from tert-butyl, methyl, and benzyl, Pg^2 is independently selected from tert-butyloxycarbonyl (Boc), 9-fluorenylmethoxycarbonyl (FMOC), and benzyloxycarbonyl (Cbz); or

Pg^2 is Boc.

14. A compound, or a pharmaceutically acceptable salt thereof, which is the compound:



or a pharmaceutically acceptable salt thereof.

15. A pharmaceutical composition comprising the compound according to any one of claims 1 to 14, or a pharmaceutically acceptable salt thereof; optionally the pharmaceutical composition further comprises a pharmaceutically acceptable excipient thereof.

16. Use of the compound according to any one of claims 1 to 14 or a pharmaceutically acceptable salt thereof, or the pharmaceutical composition according to claim 15 in the preparation of a medicament for preventing and/or treating diseases or conditions associated with elevated blood plasma Lp(a) levels; preferably, the disease or condition associated with elevated blood plasma

Lp(a) levels is a cardiovascular disease (CVD); preferably, the cardiovascular disease (CVD) including, but not limited to atherosclerotic cardiovascular disease (ASCVD), coronary artery stenosis, aortic valve stenosis, heart failure, and atrial fibrillation; said ASCVD includes peripheral vascular disease, coronary heart disease, and ischemic stroke.

17. The compound according to any one of claims 1 to 14 or a pharmaceutically acceptable salt thereof, or the pharmaceutical composition according to claim 15 for use in medicament.

18. Use of the compound according to any one of claims 1 to 14 or a pharmaceutically acceptable salt thereof, or the pharmaceutical composition according to claim 15 in the preparation of a medicament for preventing and/or treating cardiovascular diseases in combination with another compound;

preferably, the another compound is for preventing and/or treating cardiovascular diseases;

preferably, the cardiovascular diseases are diseases or conditions associated with elevated blood plasma Lp(a) levels;

preferably, the disease or condition associated with elevated blood plasma Lp(a) levels is including, but not limited to atherosclerotic cardiovascular disease (ASCVD), coronary artery stenosis, aortic valve stenosis, heart failure, and atrial fibrillation; said ASCVD includes peripheral vascular disease, coronary heart disease, and ischemic stroke.