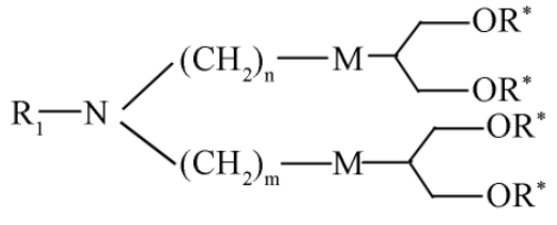
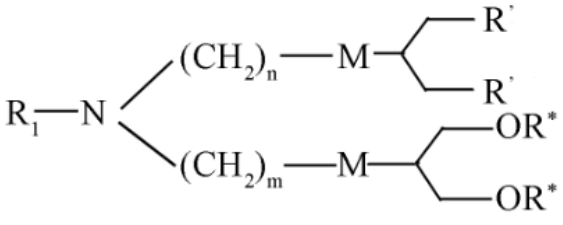
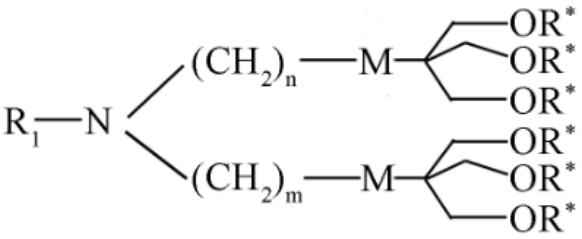
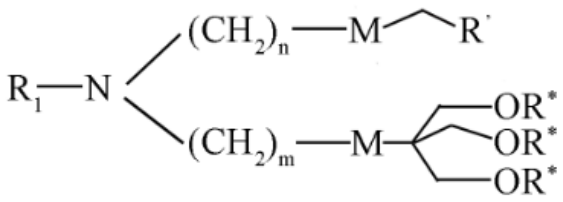
WHAT IS CLAIMED:

1. A compound which has formula (II), formula (III), formula (IV) or formula (V):


(II);

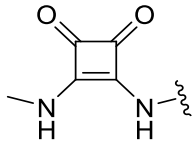

(III);


(IV);


(V);

wherein R_1 is selected from -R_1'-X,

R_1' is -$(CH_2)_{1-6}$-, X is hydroxyl, -$C(O)(CH_2)_{1-3}NR_aR_b$, -$C(O)O(CH_2)_{1-3}NR_aR_b$, -$OC(O)(CH_2)_{1-3}NR_aR_b$, -$C(O)NH(CH_2)_{1-3}NR_aR_b$, -$NHC(O)(CH_2)_{1-3}NR_aR_b$, -$NHC(O)CH(NR_aR_b)(CH_2)_{1-3}NR_aR_b$, or 5-10 membered heteroaryl, the said cycloalkyl, heterocyclic group, aryl or heteroaryl are optionally substituted by the following groups: -$(CH_2)_{1-3}OH$, -$(CH_2)_{1-3}NR_aR_b$, and -$(CH_2)_{1-3}C(O)NR_aR_b$; or X can also be: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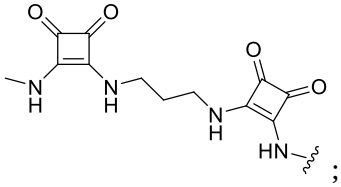

;

R_a, and R_b are independently selected from H, C_{1-3} alkyl, $-(CH_2)_{1-3}NH_2$, and $-(CH_2)_{1-3}NH(CH_2)_{1-3}NH_2$; or R_a, and R_b together with the nitrogen to which they are attached form a 5-10 membered heterocycle including 1-3 heteroatoms selected from N, O or S, by said heterocycle is optionally substituted by one or more of the following groups: C_{1-6} alkyl, C_{1-6} alkyl halides, C_{1-6} alkyl hydroxyl and C_{1-6} alkyl amino;

each M is independently selected from $-CH_2-$, -CH=CH-, -NH-, -C(O)-, -O-, -C(O)O-, -OC(O)-, -C(O)NH-, and -NHC(O)-;

each R' is independently selected from C_{1-10} alkyl or C_{3-12} alkenyl;

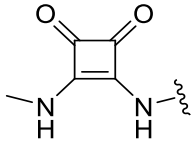
each R* is independently selected from C_{1-10} alkyl or C_{3-12} alkenyl;

n, m are independently selected from the integer range from 1-9;

or a salt.

2. The compound of claim 1, wherein:

R_1' is $-(CH_2)_{2-3}-$, X is hydroxyl, $-C(O)(CH_2)_{2-3}NR_aR_b$, $-C(O)O(CH_2)_{2-3}NR_aR_b$, $-C(O)NH(CH_2)_{2-3}NR_aR_b$, or 5-10 heteroaryl which is optionally substituted by the following groups: $-(CH_2)_{2-3}OH$, $-(CH_2)_{2-3}NR_aR_b$, $-(CH_2)_{2-3}C(O)NR_aR_b$; or X can also be: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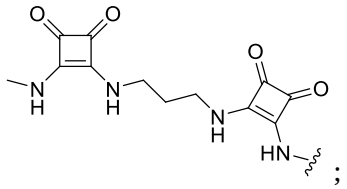

;

R_a, and R_b are independently selected from H, C_{1-3} alkyl, $-(CH_2)_{2-3}NH_2$, or $-(CH_2)_{2-3}NH(CH_2)_{2-3}NH_2$; or R_a, and R_b together with the nitrogen to which they are attached form a 5-10 membered heterocycle including 1-3 heteroatoms selected from N or O, said heterocycle is optionally substituted by the following groups: C_{1-6} alkyl, C_{1-6} alkyl halides, C_{1-6} alkyl hydroxyl groups and C_{1-6} alkyl amino groups;

or a salt thereof.

3. The compound of any one of claims 1-2, wherein:

each M is independently selected from $-CH_2-$, -CH=CH-, -C(O)O-, -OC(O)-, -C(O)NH-, -NHC(O)-;

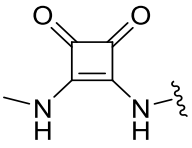
or a salt thereof.

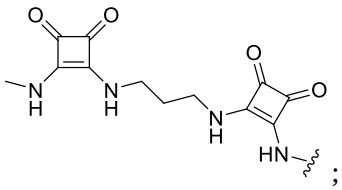
4. The compound of any one of claims 1-3, wherein in the formula (II):

each R* is independently selected from C_{2-10} alkyl, preferably C_{6-10} alkyl, preferably C_6 alkyl;

preferably, each M is independently selected from -C(O)O- or -OC(O)-, preferably -C(O)O-;

preferably, R_1 is selected from -R_1'-X, R_1' is -$(CH_2)_{1-6}$-, and X is hydroxyl; preferably, R_1 is selected from R_1'-X, R_1' is -$(CH_2)_{1-6}$-, X is 5-6 membered heteroaromatic group, preferably triazolyl, the said heteroaromatic group is optionally substituted with the following groups: -$(CH_2)_{2-3}$OH, -$(CH_2)_{2-3}NR_aR_b$, -$(CH_2)_{2-3}C(O)NR_aR_b$;R_a, and R_b are independently selected from H, C_{1-3} alkyl, -$(CH_2)_{2-3}NH_2$, -$(CH_2)_{2-3}NH(CH_2)_{2-3}NH_2$, or 5-10 membered heterocycle containing 1-3 heteroatoms selected from N or O, which is formed together by R_a, R_b and their connected nitrogen atom, preferably morpholinyl, piperazinyl or piperidinyl, the said heterocycle is optionally substituted by the following groups: C_{1-6} alkyl hydroxyl;

preferably, R_1 is selected from -R_1'-X, R_1' is -$(CH_2)_{1-6}$-, and X is 

or 

;

or a salt thereof.

5. The compound of claim 4, wherein:

each n is 7, and m is 7;

preferably, each M is independently selected from -C(O)O- or -OC(O)-, preferably -C(O)O-;

or a salt thereof.

6. The compound of any one of claims 1-3, wherein in the formula (III):

each R' is independently selected from C_{1-10} alkyl, preferably C_{2-8} alkyl;

preferably, each M is independently selected from -C(O)O- or -OC(O)-, preferably -C(O)O-;

or a salt thereof.

7. The compound of any one of claims 1-3, wherein in the formula (IV):

each R* is independently selected from C_{2-10} alkyl, preferably C_{6-10} alkyl, preferably C_6 alkyl;

preferably, each M is independently selected from -C(O)O- or -OC(O)-, preferably -C(O)O-;

or a salt thereof.

8. The compound of any one of claims 1-3, wherein in the formula (V):

each R* is independently selected from C_{2-10} alkyl, preferably C_{6-10} alkyl, preferably C_6 alkyl;

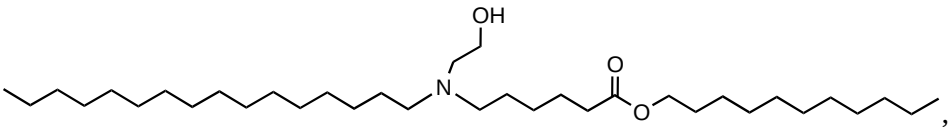
preferably, each M is independently selected from -CH=CH-, -C(O)O- or -OC(O)-, preferably -CH=CH- or -C(O)O-;

preferably, each R' is independently selected from C_{1-10} alkyl or C_{3-12} alkenyl, preferably C_{10} alkyl or C_8 alkenyl;

or a salt thereof.

9. A compound or salts or isomers thereof, wherein:

the compound is one of

A1 

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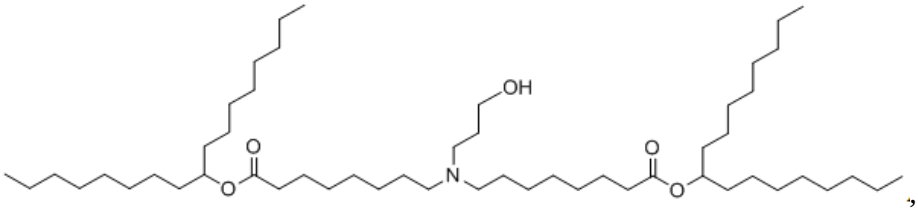
A5 

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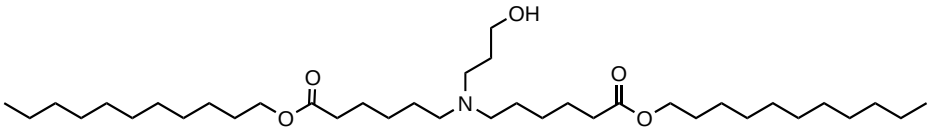
A6 

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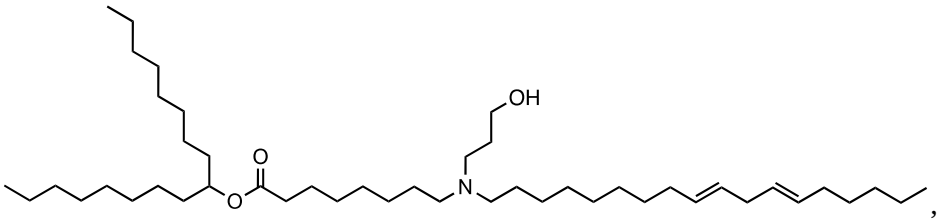
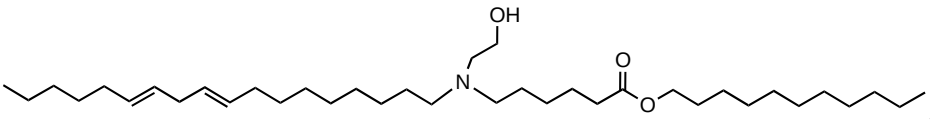
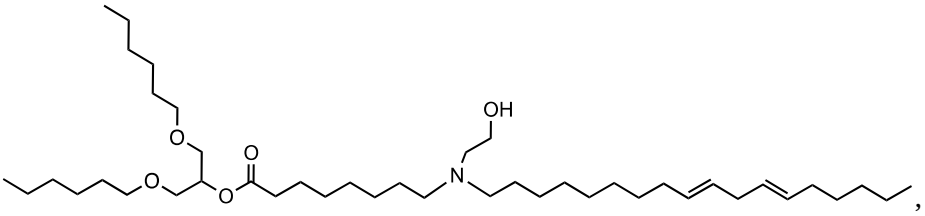
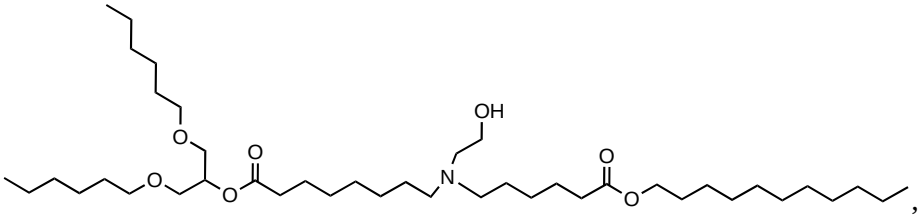
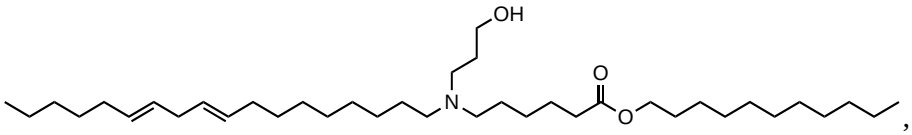
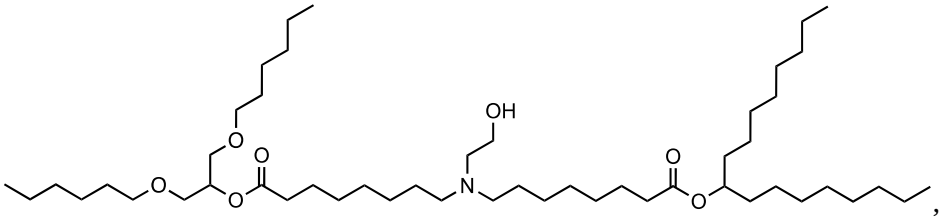
A7 ,

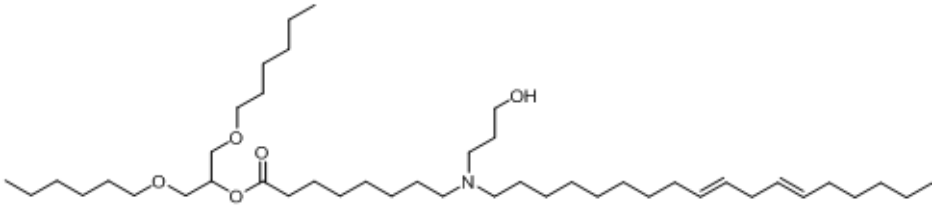
A9 ,

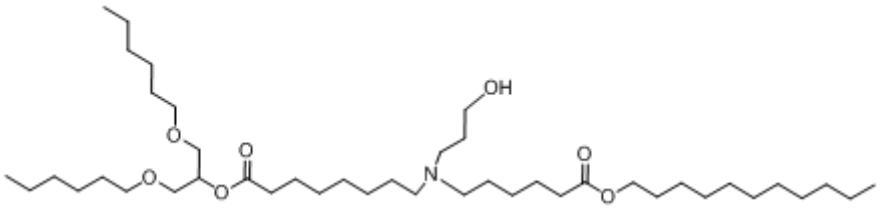
A10 ,

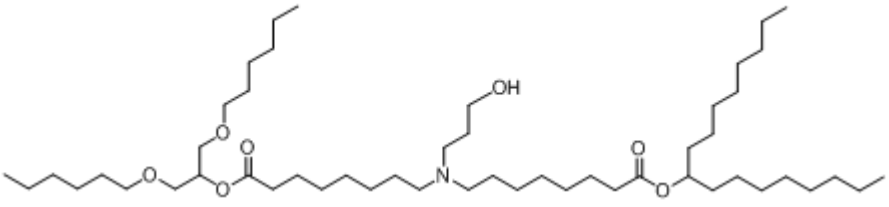
A11 ,

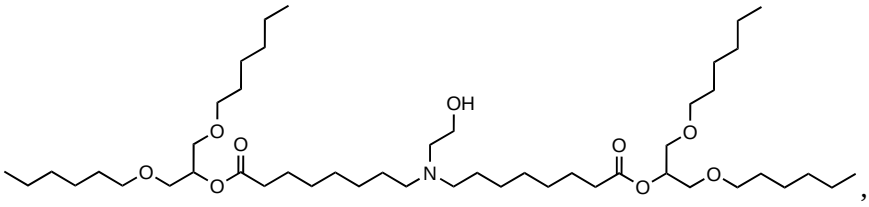
A12 ,

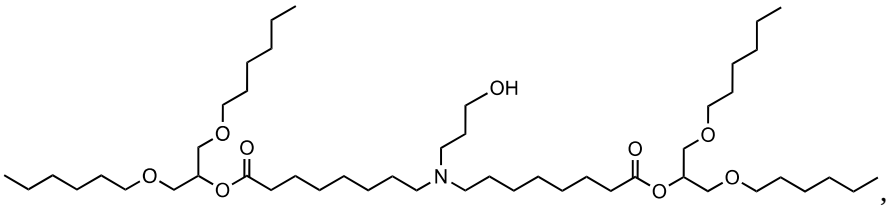
A13 ,

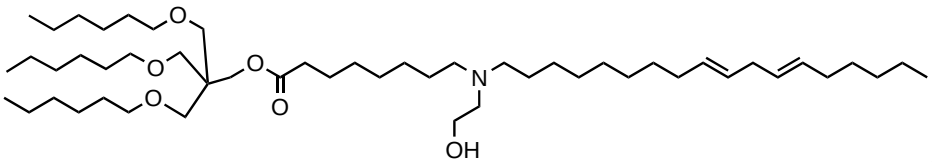
A15 ,

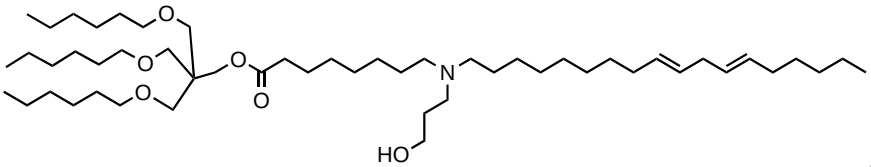
A16 ,

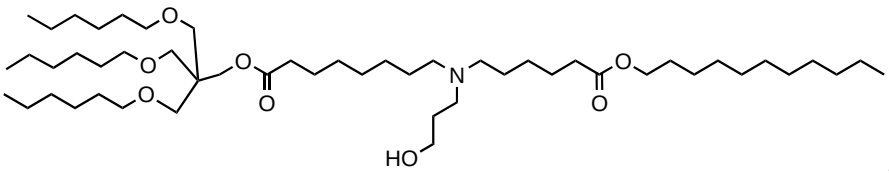
A17 ,

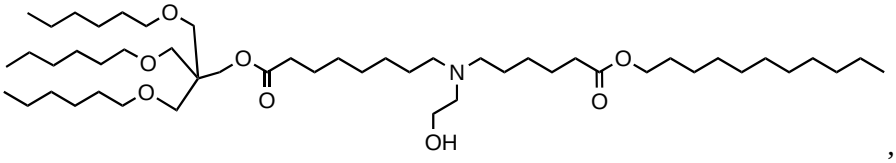
A18 ,

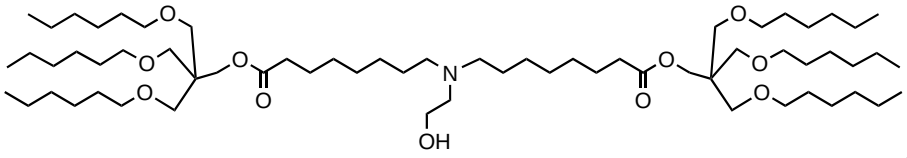
A19 ,

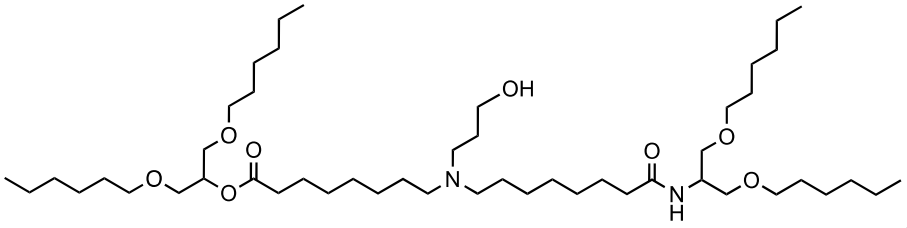
A20 ,

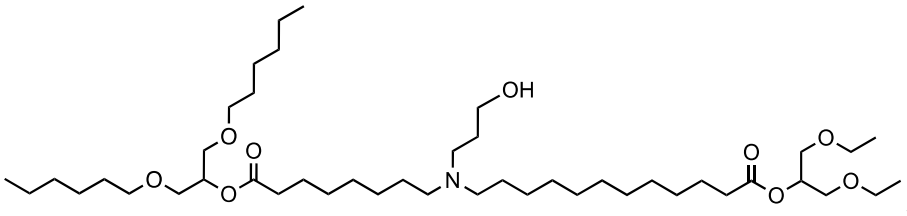
A21 ,

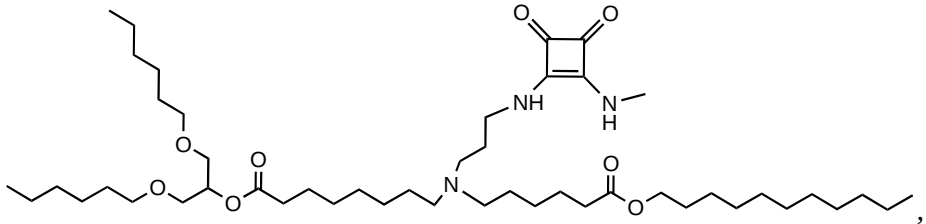
A22 ,

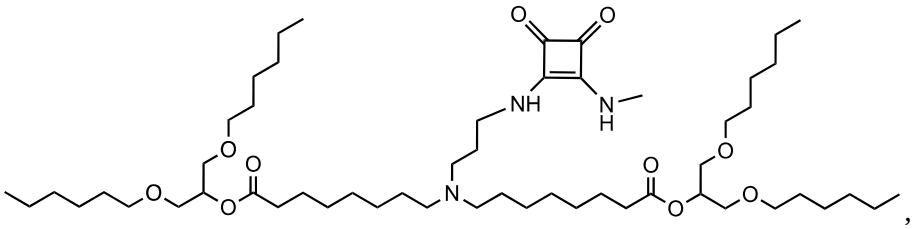
A23 ,

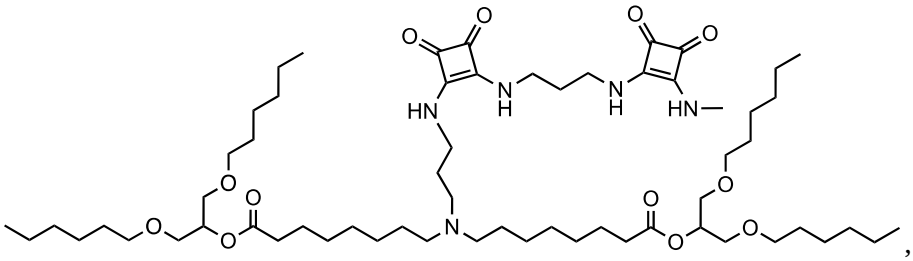
A24 ,

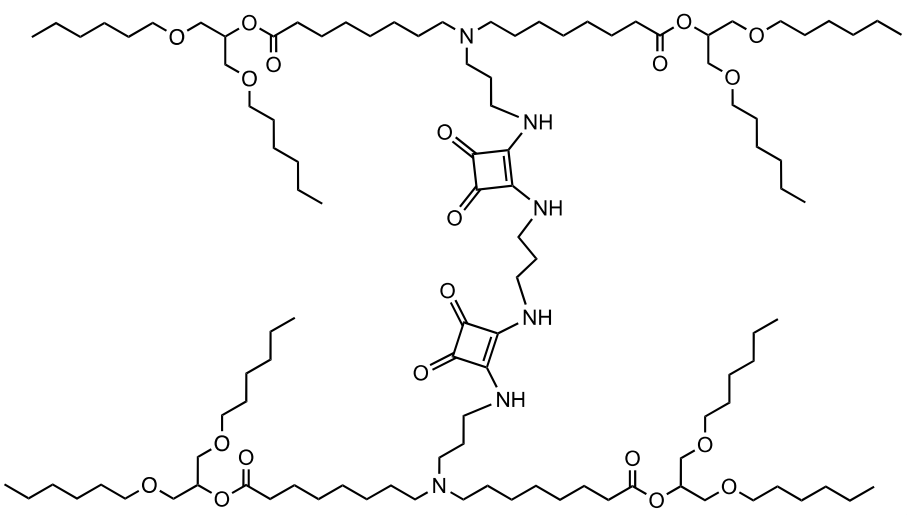
A25 ,

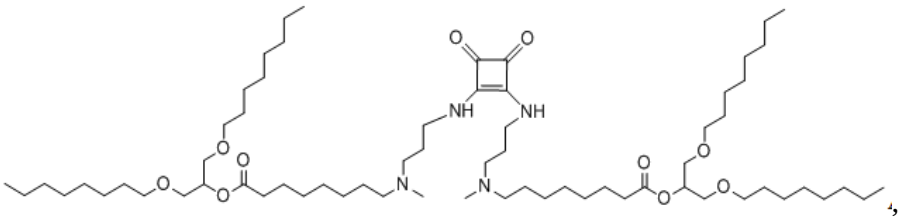
A26 ,

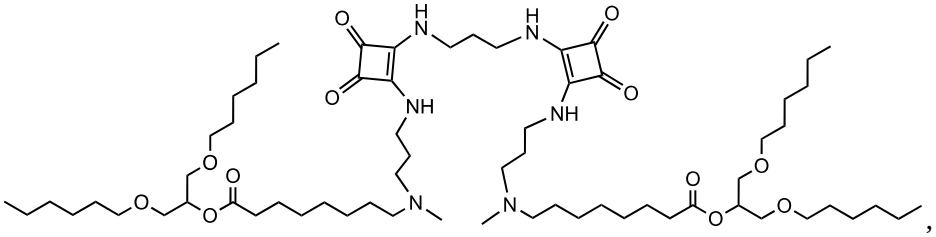
A27 ,

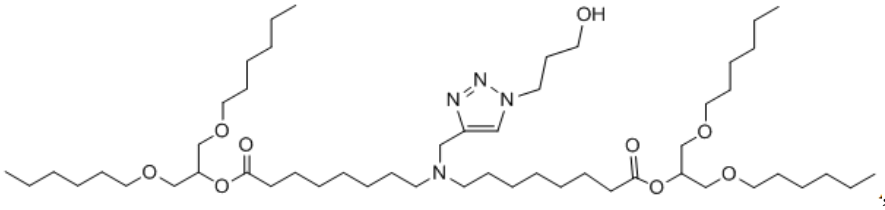
A28 ,

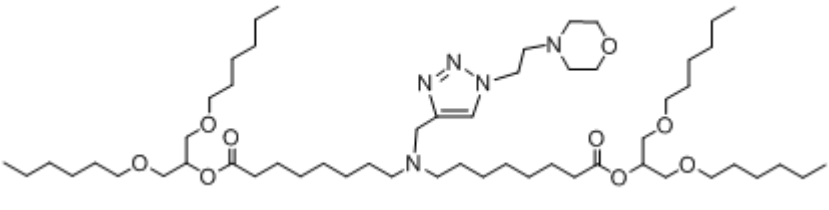
A29 ,

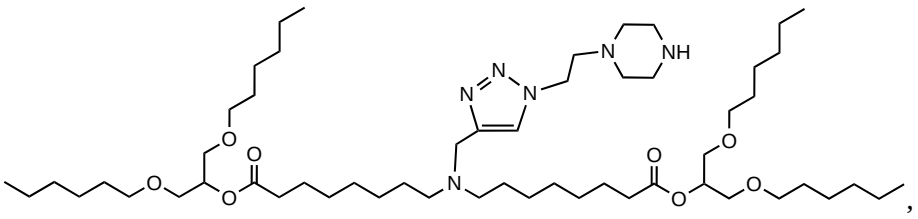
A30 ,

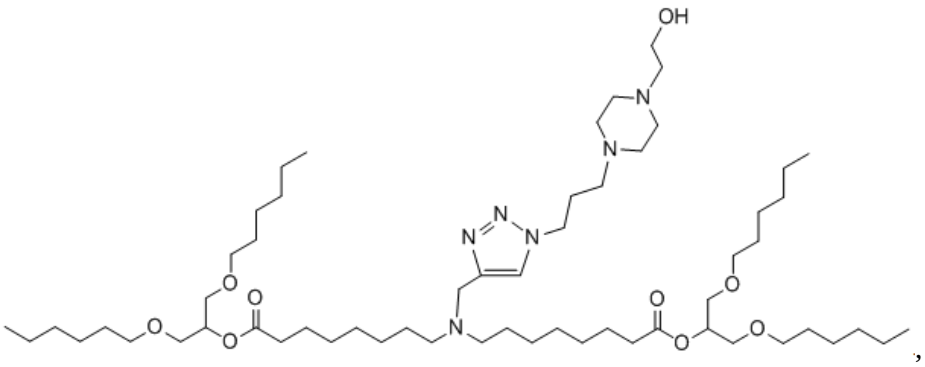
A31 ,

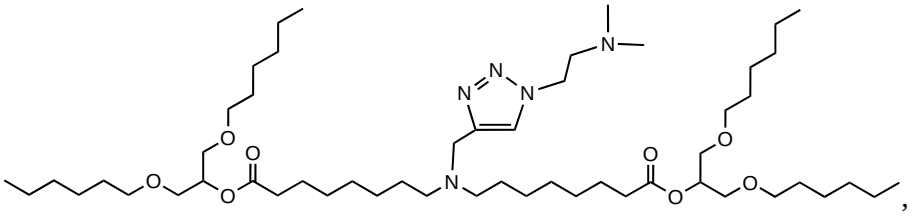
A32 ,

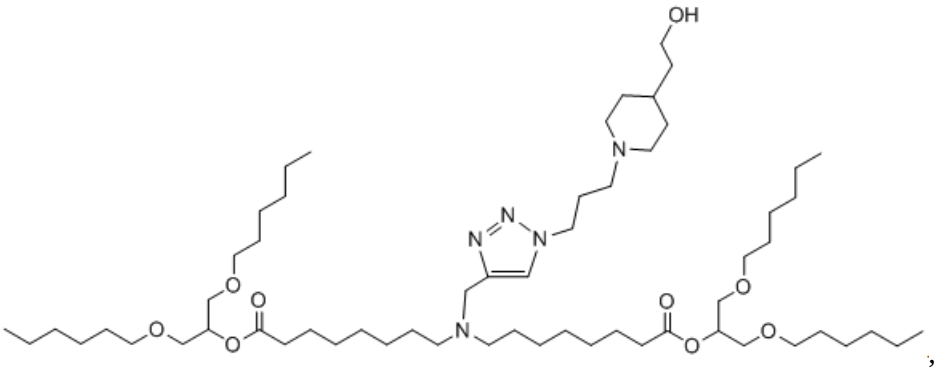
A34 ,

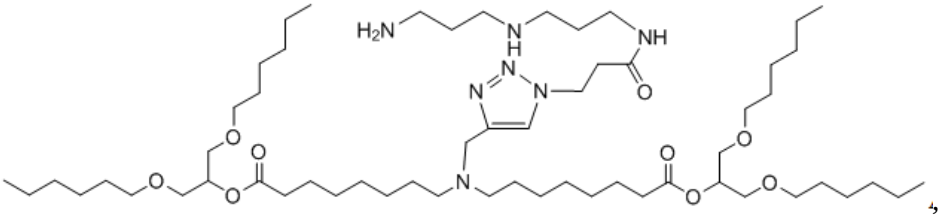
A35 ,

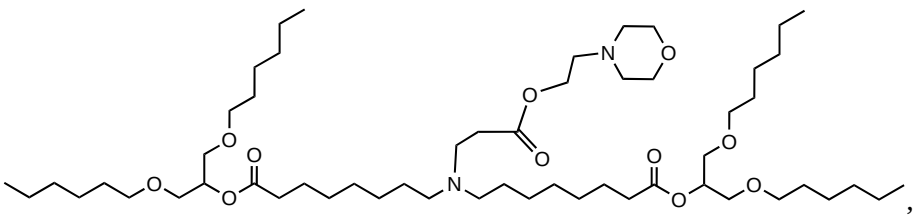
A36 ,

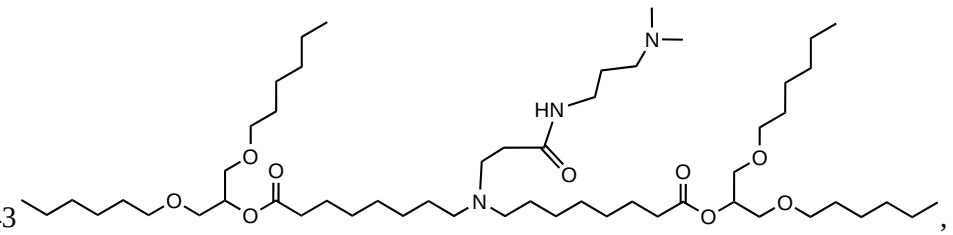
A37 ,

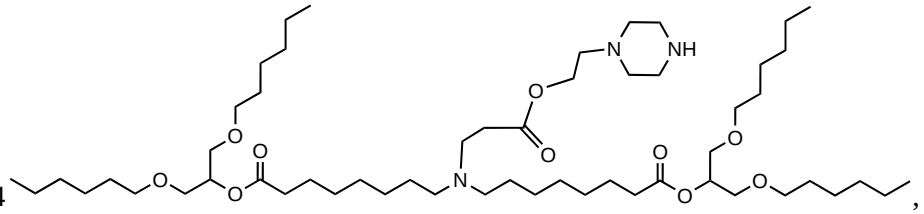
A38 ,

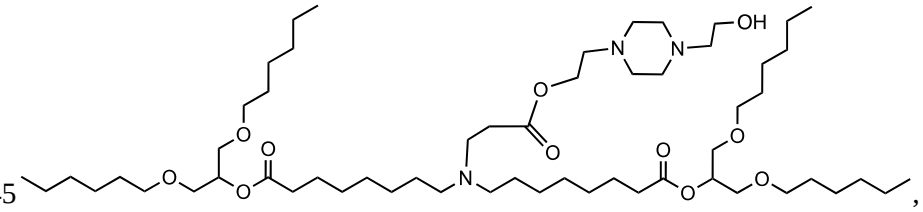
A39 ,

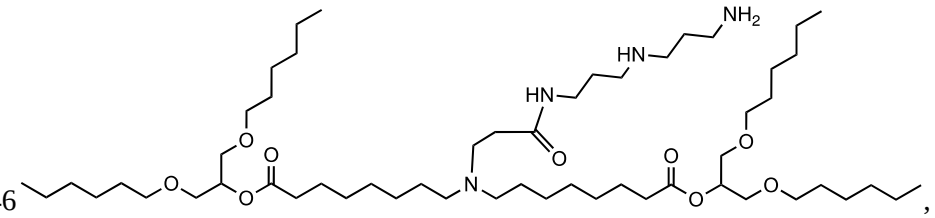
A40 ,

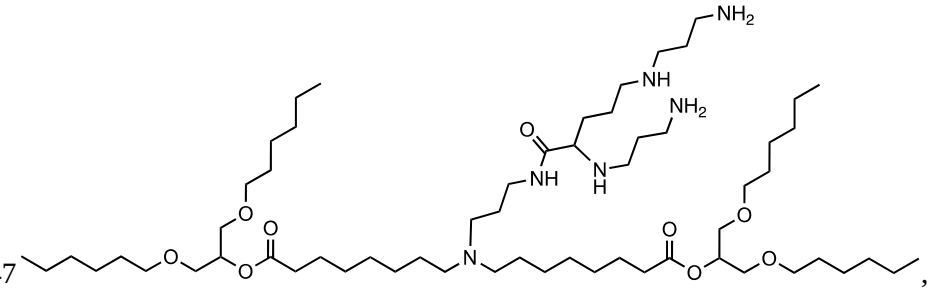
A42 ,

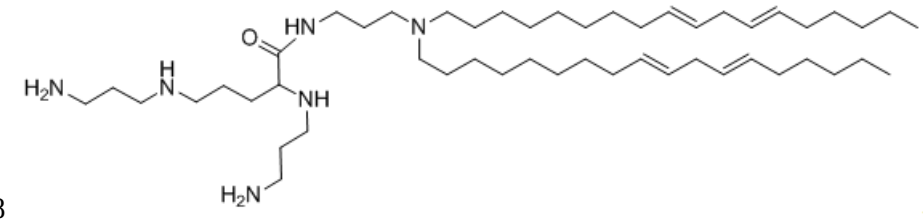
A43 ,

A44 ,

A45 ,

A46 ,

A47 ,

A48 ..

10. A composition comprising a compound according to any one of the claim 1-8 as an ionizable lipid compound.
11. The composition of claim 10, further comprising a phospholipid, preferably,the phospholipid is selected from 1,2-dilinoleoyl-sn-glycero-3-phosphocholine (DLPC),

1,2-dimyristoyl-sn-glycero-phosphocholine (DMPC), 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC), l,2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC), l,2-distearoyl-sn-glycero-3 -phosphocholine (DSPC), 1 ,2-diundecanoyl-sn-glycero-phosphocholine (DUPC), l-palmitoyl-2-oleoyl-sn-glycero-3 -phosphocholine (POPC), l,2-di-0-octadecenyl-5«-glycero-3 -phosphocholine (18:0 Diether PC), l-oleoyl-2-cholesterylhemisuccinoyl-5«-glycero-3-phosphocholine (OChemsPC), l-hexadecyl-sn-glycero-3 -phosphocholine (C16 Lyso PC), 1 ,2-dilinolenoyl-sn-glycero-3 -phosphocholine, l,2-diarachidonoyl-sn-glycero-3 -phosphocholine, l,2-didocosahexaenoyl-sn-glycero-3-phosphocholine, l,2-dioleoyl-sn-glycero-3-phosphoethanol amine (DOPE), l,2-diphytanoyl-sn-glycero-3-phosphoethanolamine (ME 16.0 PE), l,2-distearoyl-sn-glycero-3-phosphoethanolamine, 1 ,2-dilinoleoyl-sn-glycero-3 -phosphoethanolamine, l,2-dilinolenoyl-sn-glycero-3-phosphoethanolamine, l,2-diarachidonoyl-sn-glycero-3 -phosphoethanolamine, l,2-didocosahexaenoyl-sn-glycero-3-phosphoethanolamine, l,2-dioleoyl-sn-glycero-3-phospho-rac-(l -glycerol) sodium salt (DOPG), dipalmitoylphosphatidylglycerol (DPPG), palmitoyloleoylphosphatidylethanolamine (POPE), distearoyl-phosphatidyl-ethanolamine (DSPE), dipalmitoyl phosphatidyl ethanolamine (DPPE), dimyristoylphosphoethanolamine (DMPE), 1 -stearoyl-2-oleoyl-phosphatidyethanolamine (SOPE), l-stearoyl-2-oleoyl-phosphatidylcholine (SOPC), sphingomyelin, phosphatidylcholine, phosphatidylethanolamine, phosphatidylserine, phosphatidylinositol, phosphatidic acid, palmitoyloleoyl phosphatidylcholine, lysophosphatidylcholine, lysophosphatidylethanolamine (LPE), or a combination thereof.

12. The composition of claim 10 or 11, further comprising a PEG lipid, preferably, the PEG lipid is selected from PEG-modified phosphatidylethanolamine, PEG- modified phosphatidic acid, PEG-modified ceramide, PEG-modified dialkylamine, PEG- modified diacylglycerol, PEG-modified dialkylglycerol, or a combination thereof.

13. The composition of any one of claims 10-12, further comprising a structural lipid, preferably, the structural lipid is selected from: cholesterol, fecosterol, sitosterol, ergosterol, campesterol, stigmasterol, brassicasterol, tomatidine, ursolic acid, alpha-tocopherol, or a combination thereof.

14. The composition of any one of claims 10-13, further comprising an active ingredient, which is selected from at least any one of: DNA, RNA, protein, or an active pharmaceutical molecule,

preferably, the ionizable lipid compound is from 20% to 80%, the PEG lipid is from 1% to 10%, the structural lipid is from 10% to 50% and the phospholipid is from 5% to 30%, each of these percentages being calculated based on mole percentage of all lipids in the composition;

preferably, the ionizable lipid compound is from 20% to 80%, the PEG lipid is from 1% to 5%, the structural lipid is from 10% to 50% and the phospholipid is from 5% to 30%, each of these percentages being calculated based on mole percentage of all lipids in the composition;

preferably, the active agent is RNA and the RNA is selected from at least any one of: mRNA, siRNA, aiRNA, miRNA, dsRNA, aRNA, or lncRNA;

preferably, the active agent is a protein which is is selected from at least any one of: antibody, enzyme, recombinant protein, polypeptide and short chain polypeptide.

15. The composition of any one of claims 10-14, wherein:

the composition is in the form of a lipid nanoparticle.

16. A method of producing lipid nanoparticle, comprising:

mixing an ionizable compound of claim 1 with a PEG lipid, a structural lipid and a phospholipid to form a lipid mixture.

17. The method of claim 16, further comprising:

mixing an active ingredient with the lipid mixture to form lipid nanoparticle by mixer.

18. The compound of any one of claims 1-8, for use in the production of lipid nanoparticle.

19. The compound of claim 18, wherein:

the said lipid nanoparticle is neutral and uncharged in a neutral medium, and is positively charged after being protonated in an acidic medium;

preferably, the compound is dissolved and mixed with a PEG lipid, a structural lipid and a phospholipid to form a lipid mixture, then mixing an active ingredient with the lipid mixture by mixer to form a lipid nanoparticle.

20. A pharmaceutical composition comprising the lipid nanoparticle of claim 15 and pharmaceutically acceptable carrier.

21. The lipid nanoparticle of claim 15 or pharmaceutical composition of claim 20, for use in the production of medicine;

preferably, the medicine further comprises an active ingredient, the active ingredient selected from at least any one of DNA, RNA, protein, or an active pharmaceutical molecule;

preferably, the active ingredient is RNA that is selected from at least any one of: mRNA, siRNA, aiRNA, miRNA, dsRNA, aRNA, or lncRNA;

preferably, the active ingredient is a protein is selected from at least any one of: antibody, enzyme, recombinant protein, polypeptide and short chain polypeptide;

preferably, the said medicine can be administered to a human by intravenous injection, intramuscular injection, subcutaneous injection, microneedle patch, oral administration, or oral and nasal spray.