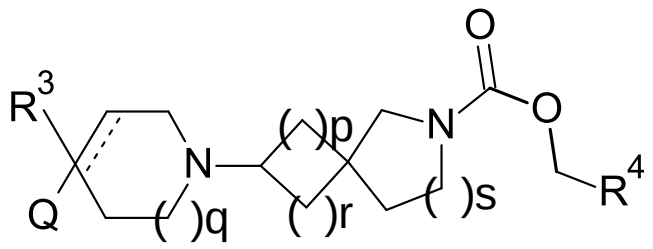
CLAIMS

1. A compound of the formula (1a):



(1a)

or a salt thereof, wherein

p is 1 or 2;

q is 0, 1 or 2;

r is 1 or 2;

s is 0 or 1, where the total of r and s is 1 or 2;

Q is $CR^1R^2NR^5R^6$, NR^5R^6, OR^7 or SR^7;

R^1 is selected from hydrogen and a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof;

R^2 is selected from hydrogen and a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof;

R^3 is selected from hydrogen; fluorine; cyano; hydroxy; amino; and a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one, two or three, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof;

R^4 is a hydrogen or a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon

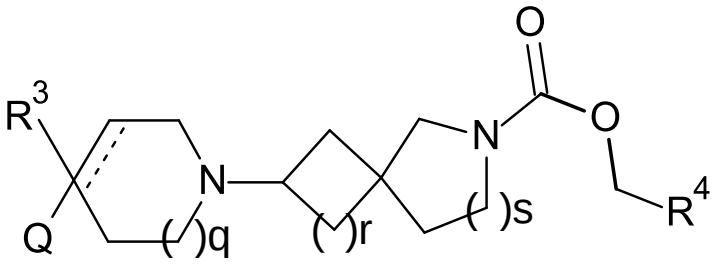
atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidised forms thereof;

R^5 is selected from hydroxy; OR^7; COR^7; $COOR^7$; CH_2COR^7; CH_2COOR^7; a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof; and a group W or CH_2W where W is an optionally substituted 5- or 6-membered ring containing 0, 1, 2 or 3 heteroatoms selected from O, N and S and oxidized forms thereof;

R^6 is selected from hydroxy; OR^7; COR^7; $COOR^7$; CH_2COR^7; CH_2COOR^7; a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof; and a group W or CH_2W where W is an optionally substituted 5- or 6-membered ring containing 0, 1, 2 or 3 heteroatoms selected from O, N and S and oxidized forms thereof;

R^7 is selected from hydrogen; a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof; and a group W or CH_2W or C_{1-4} hydrocarbon group-W where W is an optionally substituted 5- or 6-membered ring containing 0, 1, 2 or 3 heteroatoms selected from O, N and S and oxidized forms thereof; and the dotted line indicates an optional second carbon-carbon bond, provided that when a second carbon-carbon bond is present, then R^3 is absent.

2. The compound according to claim 1 of the formula (1):



(1)

or a salt thereof, wherein

q is 0, 1 or 2;

r is 1 or 2;

s is 0 or 1, where the total of r and s is 1 or 2;

Q is $CR^1R^2NR^5R^6$, NR^5R^6, OR^7 or SR^7;

R^1 is selected from hydrogen and a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof;

R^2 is selected from hydrogen and a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof;

R^3 is selected from hydrogen; fluorine; cyano; hydroxy; amino; and a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one, two or three, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof;

R^4 is a hydrogen or a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidised forms thereof;

R^5 is selected from hydroxy; OR^7; COR^7; $COOR^7$; CH_2COR^7; CH_2COOR^7; a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine

atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof; and a group W or CH_2W where W is an optionally substituted 5- or 6-membered ring containing 0, 1, 2 or 3 heteroatoms selected from O, N and S and oxidized forms thereof;

R^6 is selected from hydroxy; OR^7; COR^7; $COOR^7$; CH_2COR^7; CH_2COOR^7; a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof; and a group W or CH_2W where W is an optionally substituted 5- or 6-membered ring containing 0, 1, 2 or 3 heteroatoms selected from O, N and S and oxidized forms thereof;

R^7 is selected from hydrogen; a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof; and a group W or CH_2W where W is an optionally substituted 5- or 6-membered ring containing 0, 1, 2 or 3 heteroatoms selected from O, N and S and oxidized forms thereof;

and the dotted line indicates an optional second carbon-carbon bond, provided that when a second carbon-carbon bond is present, then R^3 is absent.

3. The compound according to claim 1 wherein Q is NR^5R^6.

4. The compound according to claim 1 wherein Q is $CR^1R^2NR^5R^6$.

5. The compound according to claim 1 wherein R^1 is selected from hydrogen, methyl and ethyl.

6. The compound according to claim 1 wherein R^2 is selected from hydrogen, methyl and ethyl.

7. The compound according to claim 1 wherein R^5 is selected from a C_{1-4} alkyl group which is optionally substituted with one to four fluorine atoms; and a group W or CH_2W where W is an optionally substituted 5- or 6-membered aromatic ring containing 0, 1, 2 or 3 heteroatoms selected from O, N and S.

8. The compound according to claim 7 wherein R^5 is selected from methyl, ethyl, propyl, isopropyl, cyclopropyl, fluoroethyl, difluoroethyl, butyl and cyclobutyl.

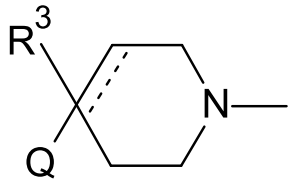
9. The compound according to claim 7 wherein R^5 is a group W or CH_2W where W is an optionally substituted phenyl, pyridyl or isoxazole ring.

10. The compound according to claim 1 wherein R^6 is selected from; COR^7; $COOR^7$; CH_2COR^7; CH_2COOR^7 and a C_{1-6} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidized forms thereof.

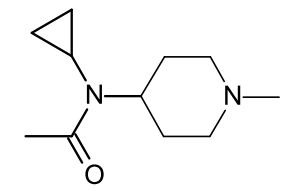
11. The compound according to claim 10 wherein R^6 is selected from methyl, ethyl, trifluoroethyl, hydroxyethyl and methoxyethyl.

12. The compound according claim 10 wherein R^6 is selected from; COR^7; $COOR^7$; CH_2COR^7; and CH_2COOR^7, wherein R^7 is selected from H, methyl, fluoromethyl, difluoromethyl, trifluoromethyl, ethyl, fluoroethyl, difluoroethyl and trifluoroethyl.

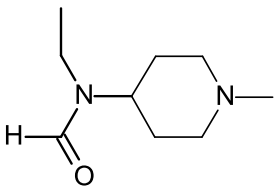
13. The compound according to claim 1 wherein the moiety:



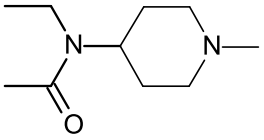
is selected from groups A to KKK as follows:



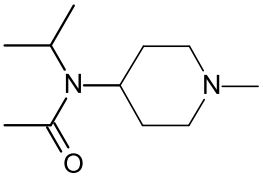
A



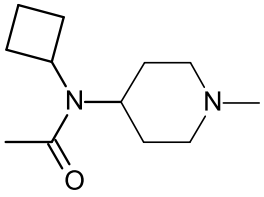
B



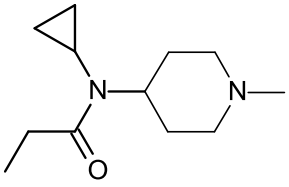
C



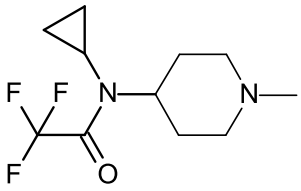
D



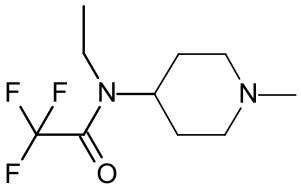
E



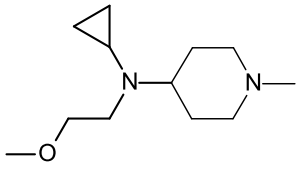
F



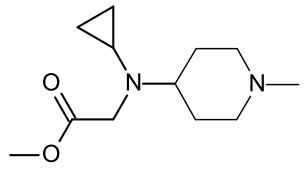
G



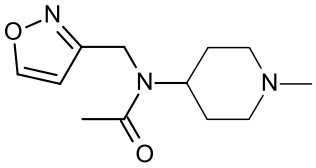
H



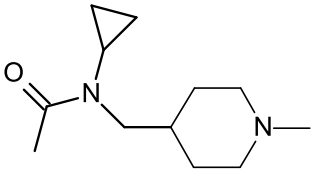
I



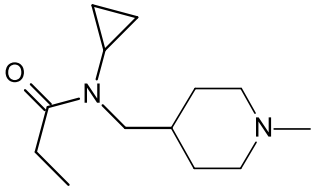
J



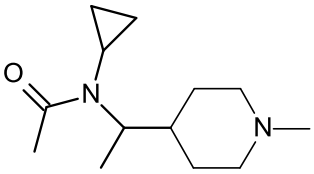
K



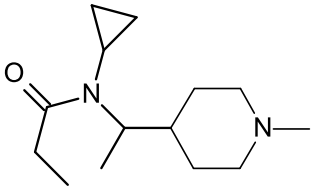
L



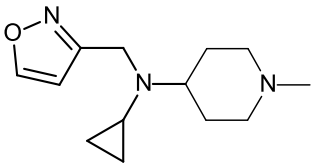
M



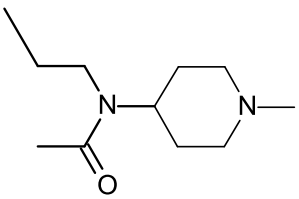
N



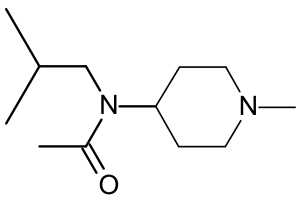
O



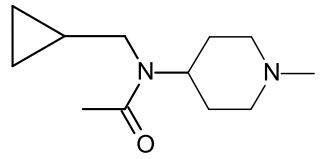
P



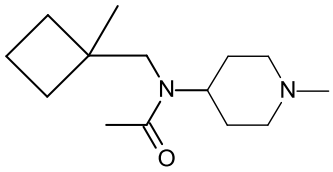
Q



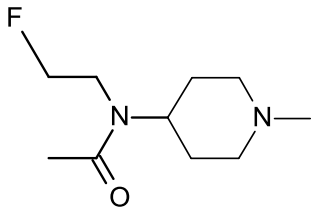
R



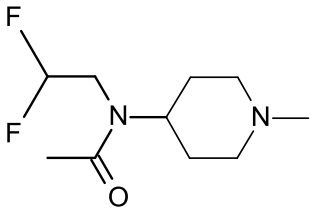
S



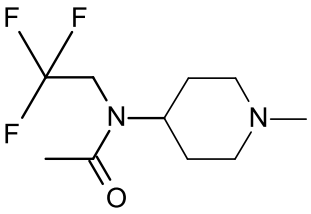
T



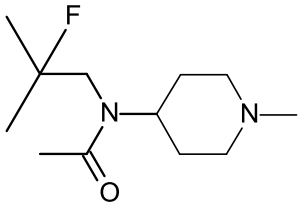
U



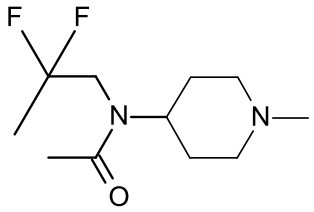
V



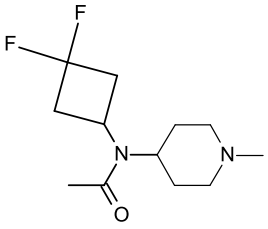
W



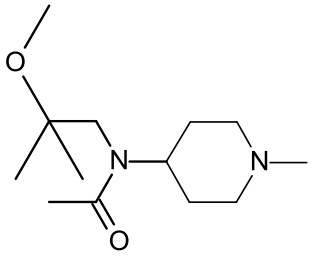
X



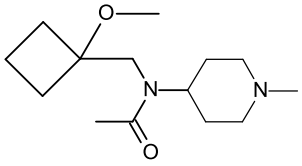
Y



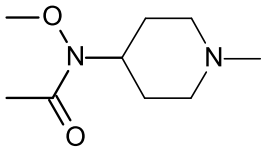
Z



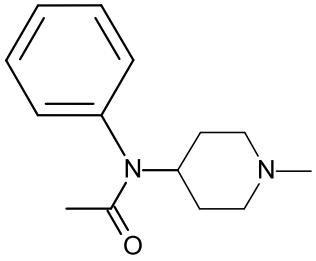
AA



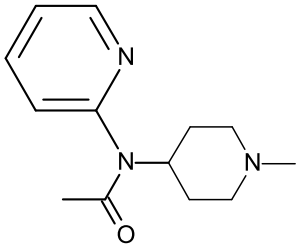
BB



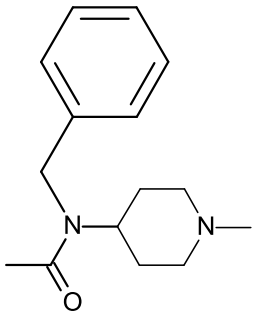
CC



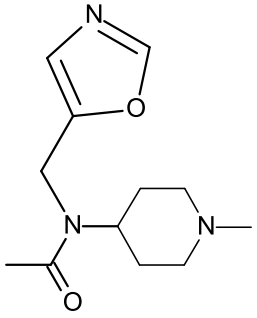
DD



EE

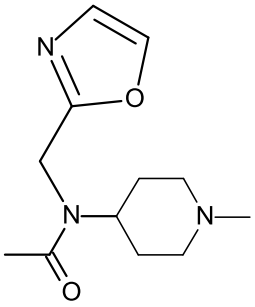


FF

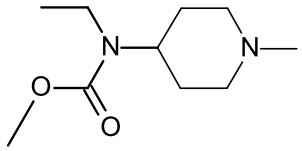


GG

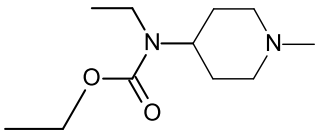
FF



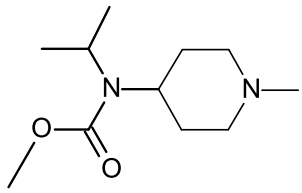
HH



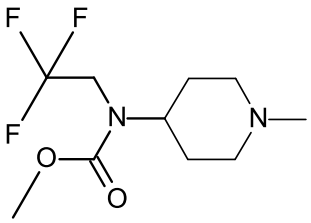
II



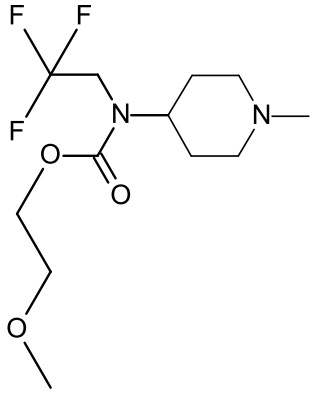
JJ



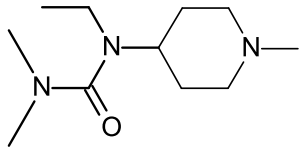
KK



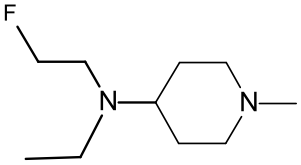
LL



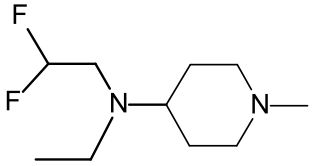
MM



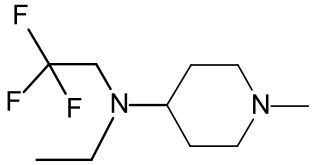
NN



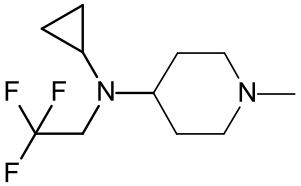
OO



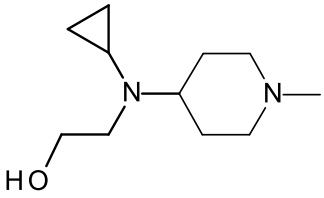
PP



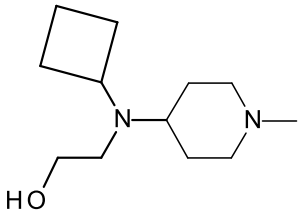
QQ



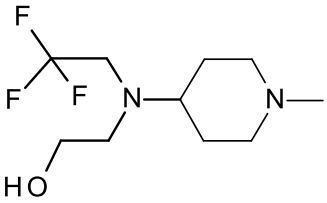
RR



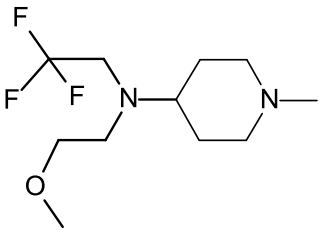
SS



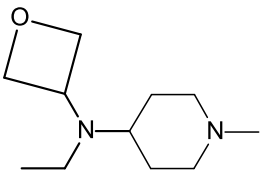
TT



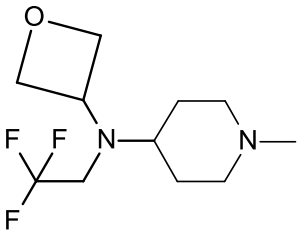
UU



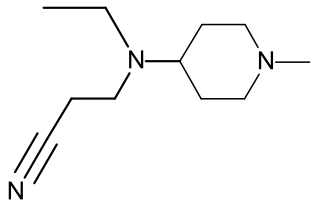
VV



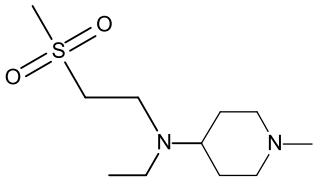
WW



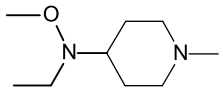
XX



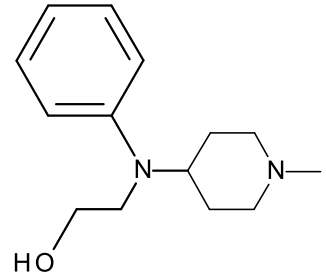
YY



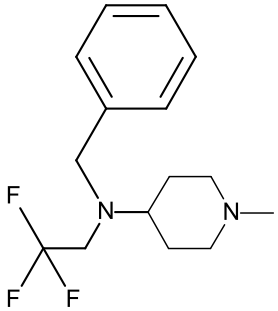
ZZ



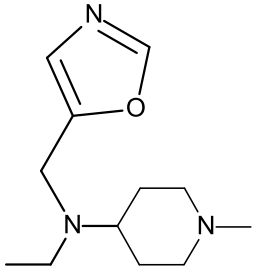
AAA



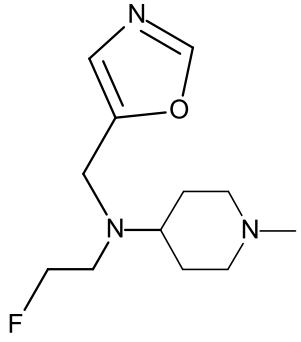
BBB



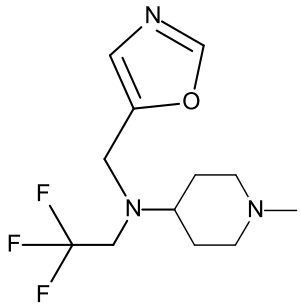
CCC



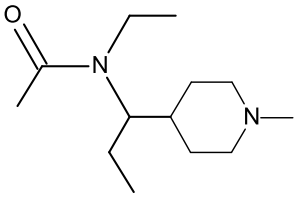
DDD



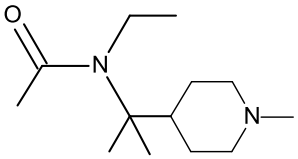
EEE



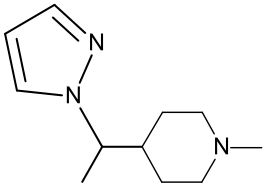
FFF



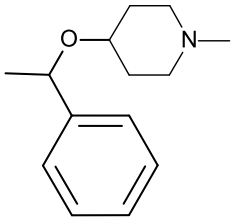
GGG



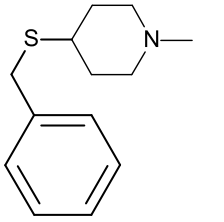
HHH



III



JJJ



KKK

14. The compound according to claim 1 wherein R^3 is present and the optional second carbon-carbon bond is absent.

15. The compound according to claim 14 wherein R^3 is selected from hydrogen; fluorine; hydroxyl, methoxy and cyano.

16. The compound according to claim 15 wherein R^3 is hydrogen.

17. The compound according to claim 1 wherein R^4 is selected from hydrogen and methyl.

18. The compound according to claim 1 which is
Ethyl 6-{4-[acetyl(cyclopropyl)amino]piperidin-1-yl}-2-azaspiro[3.3]heptane-2-carboxylate;
Ethyl 6-{4-[acetyl(ethyl)amino]piperidin-1-yl}-2-azaspiro[3.3]heptane-2-carboxylate;
Ethyl 2-{4-[acetyl(ethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[acetyl(propan-2-yl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(cyclopropyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[cyclopropyl(trifluoroacetyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[cyclopropyl(propanoyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(cyclobutyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[ethyl(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[cyclopropyl(2-methoxyethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[cyclopropyl(2-methoxy-2-oxoethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[cyclopropyl(1,2-oxazol-3-ylmethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{[acetyl(cyclopropyl)amino]methyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{[cyclopropyl(propanoyl)amino]methyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{1-[acetyl(cyclopropyl)amino]ethyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{1-[cyclopropyl(propanoyl)amino]ethyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Methyl 2-{4-[acetyl(cyclobutyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[ethyl(formyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Methyl 2-{4-[acetyl(ethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(propyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[acetyl(2-methylpropyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(cyclopropylmethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{acetyl[(1-methylcyclobutyl)methyl]amino}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(1-methylcyclobutyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{acetyl[(3-methyloxetan-3-yl)methyl]amino}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(2,2-difluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(2-fluoro-2-methylpropyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(2,2-difluoropropyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(3,3-difluorocyclobutyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(2-methoxy-2-methylpropyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{acetyl[(1-methoxycyclobutyl)methyl]amino}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{acetyl[(1-hydroxycyclobutyl)methyl]amino}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(methoxy)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(phenyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(pyridin-2-yl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[acetyl(benzyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[acetyl(1,3-oxazol-5-ylmethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[acetyl(1,3-oxazol-2-ylmethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

(1,1-2H2)-Ethyl 2-{4-[acetyl(ethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[ethyl(methoxycarbonyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[(ethoxycarbonyl)(ethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[(methoxycarbonyl)(propan-2-yl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[(methoxycarbonyl)(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-(4-{[(2-methoxyethoxy)carbonyl](2,2,2-trifluoroethyl)amino}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[(dimethylcarbamoyl)(ethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[ethyl(2-fluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[(2,2-difluoroethyl)(ethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[(methoxycarbonyl)(oxetan-3-yl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[cyclopropyl(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[cyclopropyl(2-hydroxyethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[cyclobutyl(2-hydroxyethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 2-{4-[(2-hydroxyethyl)(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[(2-methoxyethyl)(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[ethyl(oxetan-3-yl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[oxetan-3-yl(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[(2-cyanoethyl)(ethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{ethyl[2-(methylsulfonyl)ethyl]amino}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[ethyl(methoxy)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[(2-hydroxyethyl)(phenyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[benzyl(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[ethyl(1,3-oxazol-5-ylmethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[(2-fluoroethyl)(1,3-oxazol-5-ylmethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[(1,3-oxazol-5-ylmethyl)(2,2,2-trifluoroethyl)amino]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{1-[acetyl(ethyl)amino]propyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-(4-{2-[acetyl(ethyl)amino]propan-2-yl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-{4-[1-(1H-pyrazol-1-yl)ethyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-[4-(1-phenylethoxy)piperidin-1-yl]-6-azaspiro[3.4]octane-6-carboxylate;
Ethyl 2-[4-(benzylsulfanyl)piperidin-1-yl]-6-azaspiro[3.4]octane-6-carboxylate;

Ethyl 6-{4-[acetyl(cyclopropyl)amino]piperidin-1-yl}-2-azaspiro[3.4]octane-2-carboxylate;
Methyl 6-{4-[acetyl(ethyl)amino]piperidin-1-yl}-2-azaspiro[3.4]octane-2-carboxylate or
Ethyl 6-{4-[acetyl(ethyl)amino]piperidin-1-yl}-2-azaspiro[3.4]octane-2-carboxylate,
or a salt of any of the foregoing.

19. A pharmaceutical composition comprising a compound as defined in claim 1 and a pharmaceutically acceptable excipient.

20. The compound according to claim 1 wherein the compound has a muscarinic M_1 receptor and/or M_4 receptor agonist activity.