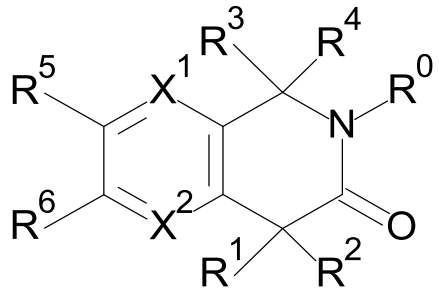
CLAIMS

1. A compound of the formula (I) or a salt thereof:



(I)

wherein,

X^1: C-R^{11} or N;

X^2: C-R^{12} or N;

R^{11}: i) H, ii) halogen, iii) –CN, or iv) -O-C_{1-6} alkyl;

R^{12}: H or halogen;

R^1: i) H, ii) C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of halogen(s), and pyrazolyl(s), iii) C_{2-6} alkenyl, or iv) -OR^0;

R^2: i) C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of -OR^0(s), halogen(s), -$COOR^0$(s), -$CONR^{21}R^{22}$(s), phenyl(s) which may be substituted with one or more substituent(s) selected from the G^1 group, and heteroaryl(s) which is selected from the group consisting of pyridyl, pyrazolyl, imidazolyl, thiazolyl, thiadiazolyl, thienyl, oxazolyl, isoxazolyl, and triazolyl, wherein, the heteroaryl may be substituted with one or more substituent(s) selected from the G^2 group, ii) C_{2-6} alkenyl, iii) C_{2-6} alkynyl, iv) -OR^0, v) -$NR^{23}R^{24}$, vi) -$COOR^0$, or vii) phenyl;

R^{21}: H or C_{1-6} alkyl;

R^{22}: i) C_{1-6} alkyl which may be substituted with one or more phenyl(s), or ii) phenyl;

R^{23}: i) H, or ii) C_{1-6} alkyl which may be substituted with one or more -OH(s);

R^{24}: i) C_{1-6} alkyl which may be substituted with one or more phenyl(s) which may be substituted with one or more halogen(s), ii) C_{3-8} cycloalkyl which may be substituted with one or more C_{1-6} alkyl(s), iii) phenyl which may be substituted with one or more halogen(s), or iv) tetrahydropyranyl; or

R^1, R^2, and a carbon atom bounded by R^1 and R^2 may interact to form a 4-tetrahydropyran ring, and the carbon atom bounded by R^1 and R^2 is a spiro atom;

R^3, R^4: the same or different each other, i) C_{1-3} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of halogen(s) and -OH(s) or ii) C_{2-6} alkenyl which may be substituted with one or more substituent(s) selected from the group consisting of -OH(s) and heteroaryl(s) which is selected from the group consisting of pyrazolyl and thienyl, wherein the heteroaryl may be substituted with one or more C_{1-6} alkyl(s), or,

R^3, R^4, and a carbon atom bounded by R^3 and R^4 may interact to form a 3-oxetane ring and the carbon atom bounded by R^3 and R^4 is a spiro atom;

R^5 : i) H, ii) C_{1-6} alkyl which may be substituted with one or more -O-(C_{1-6} alkyl)(s), iii) -O-C_{1-6} alkyl, iv) halogen, v) -COO-(C_{1-6} alkyl), or vi) C_{3-8} cycloalkyl;

R^6 : i) H, ii) C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of -O-(C_{1-6} alkyl(s) which may be substituted with one or more halogen(s)) and halogen(s), iii) -OH, iv) -O-(C_{1-6} alkyl which may be substituted with one or more halogen(s)), v) halogen, vi) -CN, vii) -S-(C_{1-6} alkyl), viii) C_{3-8} cycloalkyl, ix) -NR^0R^0, or x) C_{2-6} alkenyl;

G^1 group : i) halogen, ii) -$COOR^0$, iii) -$CONR^0R^0$, iv) -OH, v) C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of -OH(s) and halogen, or vi) -O-(C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of -OH(s) and halogen(s));

G^2 group: i) halogen, ii) C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of -OH(s) and halogen(s) or iii) -$CONR^0R^0$;

R^0: the same or different each other, H or C_{1-6} alkyl,

provided that said compound is not methyl 1,1-diallyl-3-oxo-2,4-dihydroisoquinoline-4-carboxylate or a salt thereof.

2. The compound or salt of claim 1, wherein

R^1 is i) H, or ii) C_{1-6} alkyl;

R^2 is i) C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of -OR^0(s), halogen(s), -$CONR^{21}R^{22}$(s), phenyl(s) which may be substituted with one or more substituent(s) selected from the group consisting of

halogen(s) and -$COOR^0$(s), and heteroaryl(s) which is selected from the group consisting of pyrazolyl, and triazolyl, ii) C_{2-6} alkenyl , iii) C_{2-6} alkynyl , iv) -$NR^{23}R^{24}$, or v) -$COOR^0$;

R^{21} is C_{1-6} alkyl;

R^{22} is C_{1-6} alkyl;

R^{23} is C_{1-6} alkyl; and

R^{24} is i) C_{3-8} cycloalkyl, or ii) phenyl; or

R^1, R^2, and a carbon atom bounded by R^1 and R^2 may interact to form a 4-tetrahydropyran ring, and the carbon atom bounded by R^1 and R^2 is a spiro atom.

3. The compound or salt of claim 1 or claim 2, wherein

R^3 and R^4 are the same or different each other, i) C_{1-3} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of halogen(s) and -OH(s) or ii) C_{2-6} alkenyl which may be substituted with one or more substituent(s) selected from the group consisting of -OH(s) and pyrazolyl(s) which may be substituted with one or more C_{1-6} alkyl(s), or,

R^3, R^4, and a carbon atom bounded by R^3 and R^4 may interact to form a 3- oxetane ring and the carbon atom bounded by R^3 and R^4 is a spiro atom.

4. The compound or salt of any of the preceeding claims, wherein

R^5 is i) H, ii) C_{1-6} alkyl, iii) -O-C_{1-6} alkyl, iv) halogen, or v) C_{3-8} cycloalkyl; and

R^6 is i) H, ii) C_{1-6} alkyl which may be substituted with one or more substituent(s) selected from the group consisting of -O-(C_{1-6} alkyl)(s) and halogen(s), iii) -OH, iv) -O-(C_{1-6} alkyl which may be substituted with one or more halogen(s)), v) halogen, vi) -CN, vii) -S-C_{1-6} alkyl, viii) -NR^0R^0, or ix) C_{2-6} alkenyl.

5. The compound or salt of any of the preceeding claims, wherein

X^1 is C-R^{11} or N;

X^2 is C-R^{12} or N;

$R^{11}$is i) H, ii) halogen, iii) -CN, or iv) -O-C_{1-6} alkyl; and

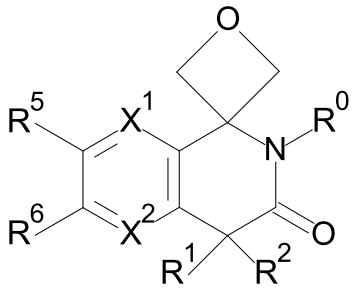
R^{12} is H.

6. The compound or salt of any of the preceeding claims, wherein

R^1 is C_{1-6} alkyl;

R^2 is C_{1-6} alkyl which may be substituted with a -OR^0;

R^3, R^4, and a carbon atom bounded by R^3 and R^4 interact to form a 3-oxetane ring and the carbon atom bounded by R^3 and R^4 is a spiro atom as represented by formula (II) below:



(II)

R^5 is H; and

R^6 is i) C_{1-6} alkyl, ii) -O-C_{1-6} alkyl which is substituted with one to three halogen(s), iii) halogen, or iv) -CN.

7. The compound or salt of any of the preceeding claims, wherein

X^1 is C-R^{11};

X^2 is C-R^{12};

R^{11} is i) H, ii) halogen, iii) -CN, or iv) -O-C_{1-6} alkyl; and

R^{12} is H.

8. The compound or salt of claim 1, which is a compound selected from the group consisting of

(-)-2-(difluoromethyl)-8-ethyl-8-(2-hydroxyethyl)-6H-spiro[1,6-naphthyridine-5,3'- oxetan]-7(8H)-one,

4,4-diethyl-1,1-dimethyl-3-oxo-1,2,3,4-tetrahydroisoquinoline-6-carbonitrile,

8,8-diethyl-5,5-dimethyl-7-oxo-5,6,7,8-tetrahydro-1,6-naphthyridine-2-carbonitrile,

(-)-6-bromo-4-ethyl-4-(2-hydroxyethyl)-1,1-dimethyl-1,4-dihydroisoquinolin-3(2H)-one,

(+)-6-bromo-4-ethyl-4-(2-hydroxyethyl)-1,1-dimethyl-1,4-dihydroisoquinolin-3(2H)-one,

8,8-diethyl-7-oxo-7,8-dihydro-6H-spiro[1,6-naphthyridine-5,3'-oxetane]-2-carbonitrile,

8',8'-diethyl-7'-oxo-7',8'-dihydro-6'H-spiro[oxetane-3,5'-pyrido[3,4-b]pyrazine]-2'-carbonitrile,

4,4-diethyl-3-oxo-3,4-dihydro-2H-spiro[isoquinoline-1,3'-oxetane]-6-carbonitrile,

6-chloro-4,4-dimethyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one,

4,4-dimethyl-3-oxo-3,4-dihydro-2H-spiro[isoquinoline-1,3'-oxetane]-6-carbonitrile,

2-(difluoromethoxy)-8,8-dimethyl-6H-spiro[1,6-naphthyridine-5,3'-oxetan]-7(8H)-one,

(+)-6-chloro-4-(2-hydroxyethyl)-4-methyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one,

(-)-6-chloro-4-(2-hydroxyethyl)-4-methyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one, and

(-)-2-(difluoromethoxy)-8-ethyl-8-(2-hydroxyethyl)-6H-spiro[1,6-naphthyridine-5,3'-oxetan]-7(8H)-one,

or a salt of said compound.

9. A compound or a salt thereof, which is a compound selected from the group consisting of

4,4-diethyl-3-oxo-3,4-dihydro-2H-spiro[isoquinoline-1,3'-oxetane]-6-carbonitrile,

6-chloro-4,4-dimethyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one,

4,4-dimethyl-3-oxo-3,4-dihydro-2H-spiro[isoquinoline-1,3'-oxetane]-6-carbonitrile,

(+)-6-chloro-4-(2-hydroxyethyl)-4-methyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one, and

(-)-6-chloro-4-(2-hydroxyethyl)-4-methyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one,

or a salt of said compound.

10. The compound or salt of claim 1, which is
4,4-diethyl-3-oxo-3,4-dihydro-2H-spiro[isoquinoline-1,3'-oxetane]-6-carbonitrile,

or a salt thereof.

11. The compound or salt of claim 1, which is
6-chloro-4,4-dimethyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one,

or a salt thereof.

12. The compound or salt of claim 1, which is
4,4-dimethyl-3-oxo-3,4-dihydro-2H-spiro[isoquinoline-1,3'-oxetane]-6-carbonitrile,
or a salt thereof.

13. The compound or salt of claim 1, which is
(+)-6-chloro-4-(2-hydroxyethyl)-4-methyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one,
or a salt thereof.

14. The compound or salt of claim 1, which is
(-)-6-chloro-4-(2-hydroxyethyl)-4-methyl-2H-spiro[isoquinoline-1,3'-oxetan]-3(4H)-one,
or a salt thereof.

15. A pharmaceutical composition comprising a compound or salt of any one of the preceeding claims 1 and a pharmaceutically acceptable excipient.

16. A pharmaceutical composition for use in treating a disease or condition selected from the group consisting of stress urinary incontinence (SUI), mixed urinary incontinence (MUI) and fecal incontinence comprising a compound or salt of any one of claims 9 to 14.

17. A pharmaceutical composition for use in treating a disease or condition selected from the group consisting of frailty and sarcopenia comprising a compound or salt of any one of claims 9 to 14.

18. A pharmaceutical composition for use in treating cachexia induced muscle weakness associated with chronic obstructive pulmonary disease (COPD) comprising a compound of any one of claims 9 to 14, or a salt thereof.

19. A pharmaceutical composition for use in treating cachexia syndrome and/or muscle wasting caused by heart failure, cancer, or chronic kidney disease/dialysis comprising a compound or salt of any one of claims 9 to 14.

20. A pharmaceutical composition for use in treating a disease or condition selected from the group consisting of amyotrophic lateral sclerosis (ALS), spinal muscular atrophy (SMA), myasthenia gravis and muscular myopathies comprising a compound or salt of any one of claims 9 to 14.

21. A pharmaceutical composition for use in treating a disease or condition selected from the group consisting of post-spinal cord injury (SCI) muscle dysfunction and post- stroke muscle dysfunction comprising a compound or salt of any one of claims 9 to 14.

22. A pharmaceutical composition for use in treating muscle weakness and fatigue associated with peripheral vascular disease or peripheral artery disease-comprising a compound or salt of any one of claims 9 to 14.

23. A pharmaceutical composition for use in treating post-surgical muscle weakness comprising a compound or salt of any one of claims 9 to 14.

24. A pharmaceutical composition for use in treating muscle weakness associated with metabolic syndrome or obesity comprising a compound or salt of any one of claims 9 to 14.

25. A pharmaceutical composition for use in treating ventilator-induced muscle weakness and chronic fatigue syndrome comprising a compound or salt of any one of claims 9 to 14.

26. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating a disease or condition selected from the group consisting of stress urinary incontinence (SUI), mixed urinary incontinence (MUI) and fecal incontinence.

27. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating a disease or condition selected from the group consisting of frailty and sarcopenia.

28. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating cachexia induced muscle weakness associated with chronic obstructive pulmonary disease (COPD).

29. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating cachexia syndrome and/or muscle wasting caused by heart failure, cancer, or chronic kidney disease/dialysis.

30. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating a disease or condition selected from the group consisting of amyotrophic lateral sclerosis (ALS), spinal muscular atrophy (SMA) and myasthenia gravis, muscular myopathies.

31. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating a disease or condition selected from the group consisting of post-spinal cord injury (SCI) muscle dysfunction and post-stroke muscle dysfunction.

32. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating muscle weakness and fatigue associated with peripheral vascular disease or peripheral artery disease.

33. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating post-surgical muscle weakness.

34. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating muscle weakness associated with metabolic syndrome or obesity.

35. Use of a compound or salt of any one of claims 9 to 14 in the manufacture of a medicament for treating ventilator-induced muscle weakness and chronic fatigue syndrome.

36. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of a disease or

condition selected from the group consisting of stress urinary incontinence (SUI), mixed urinary incontinence (MUI) and fecal incontinence.

37. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of a disease or condition selected from the group consisting of frailty and sarcopenia.

38. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of cachexia induced muscle weakness associated with chronic obstructive pulmonary disease (COPD).

39. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of cachexia syndrome and/or muscle wasting caused by heart failure, cancer, or chronic kidney disease/dialysis.

40. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of a disease or condition selected from the group consisting of amyotrophic lateral sclerosis (ALS), spinal muscular atrophy (SMA), myasthenia gravis and muscular myopathies.

41. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of a disease or condition selected from the group consisting of post-spinal cord injury (SCI) muscle dysfunction and post-stroke muscle dysfunction.

42. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of muscle weakness and fatigue associated with peripheral vascular disease or peripheral artery disease .

43. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of post-surgical muscle weakness.

44. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of muscle weakness associated with metabolic syndrome or obesity.

45. Use of a pharmaceutical composition comprising a compound of any one of claims 9 to 14 or salt thereof in the manufacture of a medicament for the treatment of ventilator-induced muscle weakness and chronic fatigue syndrome.

46. A compound or salt of any one of claims 9 to 14 for use in the treatment of a disease or condition selected from the group consisting of stress urinary incontinence (SUI), mixed urinary incontinence (MUI) and fecal incontinence.

47. A compound or salt of any one of claims 9 to 14 for use in the treatment of a disease or condition selected from the group consisting of frailty and sarcopenia.

48. A compound or salt of any one of claims 9 to 14 for use in the treatment of cachexia induced muscle weakness associated with chronic obstructive pulmonary disease (COPD).

49. A compound or salt of any one of claims 9 to 14 for use in the treatment of cachexia syndrome and/or muscle wasting caused by heart failure, cancer, or chronic kidney disease/dialysis.

50. A compound or salt of any one of claims 9 to 14 for use in the treatment of a disease or condition selected from the group consisting of amyotrophic lateral sclerosis (ALS), spinal muscular atrophy (SMA), myasthenia gravis and muscular myopathies.

51. A compound or salt of any one of claims 9 to 14 for use in the treatment of a disease or condition selected from the group consisting of post-spinal cord injury (SCI) muscle dysfunction and post-stroke muscle dysfunction.

52. A compound or salt of any one of claims 9 to 14 for use in the treatment of muscle weakness and fatigue associated with peripheral vascular disease or peripheral artery disease.

53. A compound or salt of any one of claims 9 to 14 for use in the treatment of post-surgical muscle weakness.

54. A compound or salt of any one of claims 9 to 14 for use in the treatment of muscle weakness associated with metabolic syndrome or obesity.

55. A compound or salt of any one of claims 9 to 14 for use in the treatment of ventilator-induced muscle weakness and chronic fatigue syndrome.