CLAIMS

1. A peptide comprising the following amino acid sequence:

X1-X2-X3-X4-X5-X6-X7-X8-X9-X10-X11-X12-X13-X14-X15 (SEQ ID NO: 2);

or a pharmaceutically acceptable salt thereof,

wherein

X1 is any amino acid or peptoid;

X2 is any amino acid;

X3 is an amino acid having an optionally substituted aromatic ring in a side chain;

X4 is an amino acid having an optionally substituted aromatic ring in a side chain;

X5 is an amino acid having an optionally substituted aromatic ring or optionally substituted cycloalkyl in a side chain;

X6 is an amino acid having an alkyl group in a side chain;

X7 is any secondary amino acid, N-alkylamino acid, or peptoid;

X8 is any amino acid;

X9 is an amino acid having an optionally substituted aromatic ring or an optionally substituted alkyl group or cycloalkyl group in a side chain;

X10 is R;

X11 is an amino acid having an optionally substituted aromatic ring or an optionally substituted alkyl group or cycloalkyl group in a side chain;

X12 is an optionally substituted aliphatic amino acid or an amino acid having an optionally substituted alkyl chain in a side chain;

X13 is any secondary amino acid, N-alkylamino acid, or peptoid;

X14 is an amino acid having an optionally substituted aromatic ring in a side chain; and

X15 is any amino acid.

2. The peptide or pharmaceutically acceptable salt thereof according to claim 1, wherein the following one or two or more requirements are satisfied:

X1 is an amino acid having an optionally substituted alkyl group in a side chain or a peptoid having an optionally substituted alkyl group in a side chain attached to amide nitrogen;

X3 is optionally substituted F or W;

X4 is optionally substituted F or Y, or naphthylalanine;

X5 is optionally substituted F, Y, or naphthylalanine, or optionally substituted cyclohexylalanine;

X6 is an amino acid having a branched alkyl group, or an amino acid having a cycloalkyl group, wherein a carbon atom contained therein is optionally replaced by an oxygen atom;

X8 is an amino acid having an optionally substituted aromatic ring or an optionally substituted alkyl group or cycloalkyl in a side chain;

X9 is optionally substituted F or Y, or an amino acid containing an optionally substituted heterocycloalkyl group in a side chain, or alanine;

X12 is an aliphatic amino acid containing three or more carbon atoms in a side chain, or an amino acid having an optionally substituted alkyl chain in a side chain;

X13 is an N-alkylamino acid;

X14 is optionally substituted F or Y; and

X15 is an amino acid having a sulfur (S) element at a side chain terminus.

3. The peptide or pharmaceutically acceptable salt thereof according to claim 1, wherein the following one or two or more requirements are satisfied:

X1 is an amino acid having an optionally substituted alkyl group in a side chain or a peptoid having an optionally substituted alkyl group in a side chain attached to amide nitrogen;

X3 is optionally substituted F or W;

X4 is optionally substituted F or Y, or naphthylalanine;

X5 is optionally substituted F, Y, or naphthylalanine, or optionally substituted cyclohexylalanine;

X6 is an amino acid having a branched alkyl group, or an amino acid having a cycloalkyl group, wherein a carbon atom contained therein is optionally replaced by an oxygen atom;

X8 is an amino acid having an optionally substituted aromatic ring or an optionally substituted alkyl group or cycloalkyl in a side chain;

X9 is optionally substituted F or Y, or an amino acid containing an optionally substituted heterocycloalkyl group in a side chain, or alanine;

X12 is an aliphatic amino acid containing three or more carbon atoms in a side chain, or an amino acid having an optionally substituted alkyl chain in a side chain;

X13 is an N-alkylamino acid;

X14 is optionally substituted F or Y; and

X15 is an aliphatic amino acid, and is further attached to an aliphatic amino acid or proline as X16.

4. The peptide or pharmaceutically acceptable salt thereof according to claim 1, wherein the following one or two or more requirements are satisfied:

X1 is A, MeA, Dap, ApG, CrpG, CmG, MeD, N, CrmG, MeopG, MeeG, AcapG, A4paa, KCOpipzaa, CeG, CrbG, K, KMe, Hly, E, Hgl, Orn, Dab, MeE, D, or MeHgl;

X2 is R, Dap, K, E, A, da, S, G, de, dkCOpipzaa, ddab, or dorn;

X3 is W, W7N, F44Py, Bph, W6N, F41dMeCmm4Pyz, W1Bn, W6H, W1Ph, Bph4ms, W1aa, W7Ph3C, W1Ph4OMe, W1Ph4COO, F42Py, or W6H1Ph4COO;

X4 is Y, 3Py6NH2, YBn, Yae, Nal1, Yph, or mBph;

X5 is MeF, MeY, MeF3Me, F, MeCha, MeYap, MeA1Ac4pip, MemBph, MeNal1, MeNal2, MeF4OMe, or MeF4C;

X6 is I, Gcpe, or TMe;

X7 is MeG, MeA, Meda, dp, EtG, or PrG;

X8 is Y, F4COO, K, 4Py, F, F3aao, F3OMe, A4paa, KCOpipzaa, Bph2C, Bph2OMe, or pBph2aao;

X9 is Y, F4COO, 3Py, 4Py, F4aao, F4CON, F3CON, F4F, or F4OMe;

X11 is MeF, Me4Py, Me3Py, F, Cha, MeCha, MeK, MeKMe, MeF4am, MeD, MeE, MeF4COO, or F4am;

X12 is L, Ahp, Ano, Ado, Ade, Aoc, SPent, HseBu, AhpOMe, HsePr, or Aun;

X13 is MeA, MeE, MeKCOpipzaa, MeK, MeDap, or MeDab;

X14 is MeF, MeF3Et, Me4Py, Me3Py, or MemBph; and

X15 is C, MeC, dc, Medc, dhcy, Hcy, or de.

5. The peptide or pharmaceutically acceptable salt thereof according to claim 1, wherein the following one or two or more requirements are satisfied:

X1 is A, MeA, Dap, ApG, CrpG, CmG, MeD, N, CrmG, MeopG, MeeG, AcapG, A4paa, KCOpipzaa, CeG, CrbG, K, KMe, Hly, E, Hgl, Orn, Dab, MeE, D, or MeHgl;

X2 is R, Dap, K, E, A, da, S, G, de, dkCOpipzaa, ddab, or dorn;

X3 is W, W7N, F44Py, Bph, W6N, F41dMeCmm4Pyz, W1Bn, W6H, W1Ph, Bph4ms, W1aa, W7Ph3C, W1Ph4OMe, F42Py, W1Ph4COO, or W6H1Ph4COO;

X4 is Y, 3Py6NH2, YBn, Yae, Nal1, Yph, or mBph;

X5 is MeF, MeY, MeF3Me, F, MeCha, MeYap, MeA1Ac4pip, MemBph, MeNal1, MeNal2, MeF4OMe, or MeF4C;

X6 is I, Gcpe, or TMe;

X7 is MeG, MeA, Meda, dp, EtG, or PrG;

X8 is Y, F4COO, K, 4Py, F, F3aao, F3OMe, A4paa, KCOpipzaa, Bph2C, Bph2OMe, or pBph2aao;

X9 is Y, F4COO, 3Py, 4Py, F4aao, F4CON, F3CON, F4F, or F4OMe;

X11 is MeF, Me4Py, Me3Py, F, Cha, MeCha, MeK, MeKMe, MeF4am, MeD, MeE, MeF4COO, or F4am;

X12 is L, Ahp, Ano, Ado, Ade, Aoc, SPent, HseBu, AhpOMe, HsePr, or Aun;

X13 is MeA, MeE, MeKCOpipzaa, MeK, MeDap, or MeDab;

X14 is MeF, MeF3Et, Me4Py, Me3Py, or MemBph; and

X15 is Aeoac, Ape, dhgl, Hgl, MeHgl, Medhgl, MeAeoac, or MeApe, or X15 is G, da, A, or de and is attached to MeA, Meda, G, da, MeG, P, or A as X16.

6. The peptide or pharmaceutically acceptable salt thereof according to claim 1, wherein the following one or two requirements are satisfied:

X1 is A, MeA, Dap, ApG, CrpG, CmG, MeD, N, CrmG, MeopG, MeeG, AcapG, A4paa, KCOpipzaa, CeG, CrbG, K, KMe, Hly, E, Hgl, Orn, Dab, MeE, D, or MeHgl; and

X15 is Aeoac, Ape, dhgl, Hgl, MeHgl, Medhgl, MeAeoac, or MeApe, or X15 is G, da, A, or de and is attached to MeA, Meda, G, da, MeG, P, or A as X16.

7. The peptide or pharmaceutically acceptable salt thereof according to claim 1, the peptide comprising or consisting of an amino acid sequence set forth in any one of SEQ ID NOs: 2 to 368.

8. The peptide or pharmaceutically acceptable salt thereof according to any one of claims 1 to 7, wherein the peptide is a cyclic peptide.

9. The peptide or pharmaceutically acceptable salt thereof according to any one of claims 1, 2, 4, 6, and 7, which has a cyclic structure in which a chloroacetylated amino acid is bonded to a cysteine residue included in the peptide.

10. The peptide or pharmaceutically acceptable salt thereof according to any one of claims 1, 3, 5, 6, and 7, which has a cyclic structure in which an amino group of an amino acid residue at position 1 included in the peptide is bonded to a carboxy group of an amino acid residue at position 15 or at position 16.

11. The peptide or pharmaceutically acceptable salt thereof according to claim 8, wherein the peptide further comprises a crosslinking structure.

12. The peptide or pharmaceutically acceptable salt thereof according to claim 8, which has a crosslinking structure between any of X1, X2, or X3 and X11 or X13.

13. The peptide or pharmaceutically acceptable salt thereof according to claim 10, the peptide comprising or consisting of an amino acid sequence set forth in any one of SEQ ID NOs: 238-290, 326-329, 334-338, 348-354, 358-360, 362-366, and 368.

14. The peptide or pharmaceutically acceptable salt thereof according to any one of claims 1 to 7, further comprising an additional amino acid residue.

15. The peptide or pharmaceutically acceptable salt thereof according to any one of claims 1 to 7, comprising a linker at a C-terminus thereof.

16. A pharmaceutical composition comprising the peptide or pharmaceutically acceptable salt thereof according to any one of claims 1 to 7.

17. Use of the peptide or pharmaceutically acceptable salt thereof according to any one of claims 1 to 7 for the manufacture of a pharmaceutical composition for preventing or treating a myostatin-related disease or a disease or symptom associated with reduced muscle function.

18. Use of the peptide or pharmaceutically acceptable salt thereof according to any one of claims 1 to 7, for the manufacture of a diagnostic composition for diagnosing a myostatin-related disease or a disease or symptom associated with reduced muscle function.