

Description

Title of Invention: GIP RECEPTOR ACTIVATING PEPTIDE

Technical Field

[0001]

Related application

[0002] The present invention relates to a novel peptide compound having an activating action on GIP receptors and use of the peptide compound as a medicament.

Background of the Invention

[0003] Both glucagon-like peptide-1 (GLP-1) and glucose-dependent insulintropic polypeptide (GIP) are peptides called incretin. GLP-1 and GIP are secreted from small intestinal L cells and K cells, respectively.

[0004] GLP-1 acts via GLP-1 receptors and is known to have a glucose-dependent insulintropic action and a feeding suppressive action. On the other hand, GIP is known to have a glucose-dependent insulintropic action via GIP receptors, though an influence of GIP only on feeding is not clear.

[0005] Attempts have been made to search for peptides having GLP-1 receptor/GIP receptor coagonist or glucagon receptor/GLP-1 receptor/GIP receptor triagonist activity and modifications thereof and develop these peptides as anti-obesity drugs, therapeutic drugs for diabetes, or therapeutic drugs for neurodegenerative disorders on the basis of the structure of natural glucagon, GIP, or GLP-1 (Patent Literatures 1 to 50, Non-Patent Literatures 1 and 2). However, the peptide compound and the compound having a selective activating action on GIP receptors of the present invention are not disclosed.

Citation List

Patent Literature

[0006] [Patent Literature 1] W02010/011439
 [Patent Literature 2] WO2010/148089
 [Patent Literature 3] WO2011/119657
 [Patent Literature 4] W02012/088379
 [Patent Literature 5] W02012/167744
 [Patent Literature 6] WO2013/164483
 [Patent Literature 7] WO2013/192129
 [Patent Literature 8] WO2013/192130
 [Patent Literature 9] WO2016/084826
 [Patent Literature 10] WO2014/192284
 [Patent Literature 11] WO2017/204219

[Patent Literature 12] WO2016/066744
[Patent Literature 13] WO2006/086769
[Patent Literature 14] WO2007/109354
[Patent Literature 15] WO2008/021560
[Patent Literature 16] WO2009/042922
[Patent Literature 17] WO2010/071807
[Patent Literature 18] WO2011/094337
[Patent Literature 19] WO2012/088116
[Patent Literature 20] WO2013/003449
[Patent Literature 21] WO2006/121904
[Patent Literature 22] WO2007/028632
[Patent Literature 23] WO2005/082928
[Patent Literature 24] WO2000/069911
[Patent Literature 25] WO2016/034186
[Patent Literature 26] WO2017/075505
[Patent Literature 27] WO2017/116204
[Patent Literature 28] EP0479210
[Patent Literature 29] WO2003/082898
[Patent Literature 30] WO2007/028633
[Patent Literature 31] WO2010/016935
[Patent Literature 32] WO2010/016938
[Patent Literature 33] WO2010/016940
[Patent Literature 34] WO2010/016944
[Patent Literature 35] WO2011/014680
[Patent Literature 36] WO2012/055770
[Patent Literature 37] WO2014/096145
[Patent Literature 38] WO2014/096148
[Patent Literature 39] WO2014/096149
[Patent Literature 40] WO2014/096150
[Patent Literature 41] WO2015/022420
[Patent Literature 42] WO2015/067715
[Patent Literature 43] WO2015/067716
[Patent Literature 44] WO2015/086728
[Patent Literature 45] WO2015/086729
[Patent Literature 46] WO2015/086730
[Patent Literature 47] US2016/0015788
[Patent Literature 48] WO2016/077220
[Patent Literature 49] WO2016/111971

[Patent Literature 50] WO2016/198624

Non-Patent Literature

[0007] [Non-Patent Literature 1] Nat Med. 2013 Dec;19(12):1549. doi: 10.1038/nm1213-1549.

[Non-Patent Literature 2] Sci Transl Med. 2013 Oct 30;5(209):209ra151. doi: 10.1126/scitranslmed.3007218.

Summary of Invention

Technical Problem

[0008] It is an object of the present invention to provide a novel peptide compound which has a GIP receptor activation action and is useful as a preventive/therapeutic agent or an antiemetic agent for diabetes, obesity, and diseases accompanied by vomiting or nausea.

Solution to Problem

[0009] The present inventors have carried out extensive studies to solve the above problem and found peptide compounds comprising the sequence represented by formula (I) as novel compounds having an excellent GIP receptor activation action. Further, the inventors have found that these compounds selectively activate the GIP receptor and have an antiemetic action, leading to the completion of the present invention.

[0010] More specifically, the present invention relates to the following [1] to [26].

[1] A peptide represented by formula (I):

P¹-Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P² (SEQ ID NO: 165)

wherein

P¹ represents a group represented by formula

-R^{A1},

-CO-R^{A1},

-CO-OR^{A1},

-CO-COR^{A1},

-SO-R^{A1},

-SO₂-R^{A1},

-SO₂-OR^{A1},

-CO-NR^{A2}R^{A3},

-SO₂-NR^{A2}R^{A3}, or

-C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;
 A2 represents Aib or D-Ala;
 A6 represents Iva, Phe, or Val;
 A7 represents Ile, Lys, or Val;
 A8 represents Ser;
 A9 represents Asp, Leu, or Phe;
 A10 represents Tyr;
 A11 represents Aib or Ser;
 A12 represents Ile;
 A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;
 A14 represents Leu;
 A15 represents Asp, Glu, Lys, Ser, or Tyr;
 A16 represents Arg or Lys;
 A17 represents Aib, Gln, or Ile;
 A18 represents Ala or His;
 A19 represents Gln or Ser;
 A20 represents Aib, Ala, or Gln;
 A21 represents Asn, Asp, Glu, Leu, or Ser;
 A22 represents Phe or αMePhe;
 A23 represents Ile or Val;
 A24 represents Arg, Asn, Asp, Lys, or Lys(Ac);
 A25 represents Trp;
 A26 represents Aib, Iva, or Leu;
 A27 represents Leu;
 A28 represents Ala, Arg, Lys, or Lys(Ac);
 A29 represents Gln or Gly;
 A30 represents Arg, Gly, or a deletion;
 A31 represents Pro or a deletion;
 A32 represents Ser or a deletion;
 A33 represents Ser or a deletion;
 A34 represents Gly or a deletion;
 A35 represents Ala or a deletion;
 A36 represents Pro or a deletion;
 A37 represents Pro or a deletion;
 A38 represents Pro or a deletion;
 A39 represents Lys, Ser, or a deletion;
 A40 represents Arg, Lys, or a deletion; and
 any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and

R represents a substituent group,
provided that where all A31 to A40 represent deletions, then A2 represents Aib,
or a salt thereof.

[2] The peptide according to [1] represented by formula (II):

P¹-Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-
A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro
-Pro-Pro-A39-A40-P² (SEQ ID NO: 166)

wherein

P¹ represents a group represented by formula

-R^{A1},
-CO-R^{A1},
-CO-OR^{A1},
-CO-COR^{A1},
-SO-R^{A1},
-SO₂-R^{A1},
-SO₂-OR^{A1},
-CO-NR^{A2}R^{A3},
-SO₂-NR^{A2}R^{A3}, or
-C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;

A2 represents Aib or D-Ala;

A6 represents Iva, Phe, or Val;

A7 represents Ile, Lys, or Val;

A8 represents Ser;

A9 represents Asp, Leu, or Phe;

A10 represents Tyr;

A11 represents Aib or Ser;

A12 represents Ile;

A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;

A14 represents Leu;

A15 represents Asp, Glu, Lys, Ser, or Tyr;

A16 represents Arg or Lys;

A17 represents Aib, Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln or Ser;

A20 represents Aib, Ala, or Gln;

A21 represents Asn, Asp, Glu, Leu or Ser;

A22 represents Phe or α MePhe;

A23 represents Ile or Val;

A24 represents Arg, Asn, Asp, Lys, or Lys(Ac);

A25 represents Trp;

A26 represents Aib, Iva, or Leu;

A27 represents Leu;

A28 represents Ala, Arg, Lys, or Lys(Ac);

A29 represents Gln or Gly;

A30 represents Arg or Gly;

A39 represents Lys or Ser;

A40 represents Arg, Lys, or a deletion; and

any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and

R represents a substituent group,

or a salt thereof.

[3] The peptide according to [1] represented by formula (III):

P¹-Tyr-A2-Glu-Gly-Thr-Val-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-A39-A40-P² (SEQ ID NO: 167)

wherein

P¹ represents a group represented by formula

-R^{A1},

-CO-R^{A1},

-CO-OR^{A1},

-CO-COR^{A1},

-SO-R^{A1},

-SO₂-R^{A1},

-SO₂-OR^{A1},

-CO-NR^{A2}R^{A3},

-SO₂-NR^{A2}R^{A3}, or

-C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;

A2 represents Aib or D-Ala;

A7 represents Ile, Lys, or Val;

A8 represents Ser;

A9 represents Asp, Leu, or Phe;

A10 represents Tyr;

A11 represents Ser;

A12 represents Ile;

A13 represents Aib, Ala, Gln, Leu, or Tyr;

A14 represents Leu;

A15 represents Asp, Glu, Lys, Ser, or Tyr;

A16 represents Lys;

A17 represents Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln or Ser;

A20 represents Aib, or Gln;

A21 represents Glu, or Leu;

A22 represents Phe;

A23 represents Ile or Val;

A24 represents Lys, or Lys(Ac);

A25 represents Trp;

A26 represents Aib, or Leu;

A27 represents Leu;

A28 represents Lys, or Lys(Ac);

A29 represents Gly;

A30 represents Gly;

A39 represents Lys, or Ser;

A40 represents Lys, or a deletion; and

any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and

R represents a substituent group,

or a salt thereof.

[4] The peptide according to [1] represented by formula (IV):

P¹-Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40-P² (SEQ ID NO: 168)

wherein

P¹ represents a group represented by formula

-R^{A1},

-CO-R^{A1},

-CO-OR^{A1},

-CO-COR^{A1},

-SO-R^{A1},

-SO₂-R^{A1},

-SO₂-OR^{A1},
 -CO-NR^{A2}R^{A3},
 -SO₂-NR^{A2}R^{A3}, or
 -C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;

A6 represents Iva, Phe, or Val;

A7 represents Ile or Val;

A8 represents Ser;

A9 represents Asp or Leu;

A10 represents Tyr;

A11 represents Aib or Ser;

A12 represents Ile;

A13 represents Aib, Ala, or D-Iva;

A14 represents Leu;

A15 represents Asp;

A16 represents Arg;

A17 represents Aib, Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln;

A20 represents Aib, Ala, or Gln;

A21 represents Glu, Asn, Asp, or Ser;

A22 represents Phe or αMePhe;

A23 represents Val;

A24 represents Arg, Asp, or Asn;

A25 represents Trp;

A26 represents Leu or Iva;

A27 represents Leu;

A28 represents Ala or Arg;

A29 represents Gln or Gly;

A30 represents Arg or Gly;

A40 represents Arg or a deletion; and

any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and

R represents a substituent group,

or a salt thereof.

[5] The peptide according to [1] represented by formula (V):

P¹-Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-

A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P² (SEQ ID NO: 169)

wherein

P¹ represents a group represented by formula

-R^{A1},
 -CO-R^{A1},
 -CO-OR^{A1},
 -CO-COR^{A1},
 -SO-R^{A1},
 -SO₂-R^{A1},
 -SO₂-OR^{A1},
 -CO-NR^{A2}R^{A3},
 -SO₂-NR^{A2}R^{A3}, or
 -C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;

A6 represents Iva, Phe, or Val;

A7 represents Ile, Lys, or Val;

A8 represents Ser;

A9 represents Asp, Leu, or Phe;

A10 represents Tyr;

A11 represents Aib or Ser;

A12 represents Ile;

A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;

A14 represents Leu;

A15 represents Asp, Glu, Lys, Ser, or Tyr;

A16 represents Arg or Lys;

A17 represents Aib, Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln or Ser;

A20 represents Aib, Ala, or Gln;

A21 represents Asn, Asp, Glu, Leu, or Ser;

A22 represents Phe or α MePhe;

A23 represents Ile or Val;

A24 represents Arg, Asn, Lys, or Lys(Ac);

A25 represents Trp;

A26 represents Aib, Iva, or Leu;

A27 represents Leu;

A28 represents Ala, Arg, Lys, or Lys(Ac);

A29 represents Gln or Gly;

A30 represents Arg, Gly or a deletion;

A31 to A40 represent a deletion; and

any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and

R represents a substituent group,

or a salt thereof.

[6] The peptide according to [1] represented by formula (VI):

P¹-Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40-P² (SEQ ID NO: 170)

wherein

P¹ represents a group represented by formula

-R^{A1},

-CO-R^{A1},

-CO-OR^{A1},

-CO-COR^{A1},

-SO-R^{A1},

-SO₂-R^{A1},

-SO₂-OR^{A1},

-CO-NR^{A2}R^{A3},

-SO₂-NR^{A2}R^{A3}, or

-C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;

A6 represents Iva, Phe, or Val;

A7 represents Ile or Val;

A8 represents Ser;

A9 represents Asp or Leu;

A10 represents Tyr;

A11 represents Ser;

A12 represents Ile;

A13 represents Aib or Ala;

A14 represents Leu;

A15 represents Asp;

A16 represents Arg or Lys;

A17 represents Aib, Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln;

A20 represents Aib, or Gln;

A21 represents Asn, Glu, or Asp;

A22 represents Phe;

A23 represents Val;

A24 represents Arg, Asn, or Lys;

A25 represents Trp;

A26 represents Iva or Leu;

A27 represents Leu;

A28 represents Ala, Arg, or Lys;

A29 represents Gln or Gly;

A30 represents Arg, or Gly;

A40 represents Arg, Lys, or a deletion; and

any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and

R represents a substituent group,

or a salt thereof.

[7] The peptide according to [1] represented by formula (I):

P¹-Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P²

wherein

P¹ represents a group represented by formula

-R^{A1},

-CO-R^{A1},

-CO-OR^{A1},

-CO-COR^{A1},

-SO-R^{A1},

-SO₂-R^{A1},

-SO₂-OR^{A1},

-CO-NR^{A2}R^{A3},

-SO₂-NR^{A2}R^{A3}, or

-C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;

A2 represents Aib or D-Ala;

A6 represents Iva, Phe, or Val;
 A7 represents Ile, Lys, or Val;
 A8 represents Ser;
 A9 represents Asp, Leu, or Phe;
 A10 represents Tyr;
 A11 represents Aib or Ser;
 A12 represents Ile;
 A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;
 A14 represents Leu;
 A15 represents Asp, Glu, Lys, Ser, or Tyr;
 A16 represents Arg or Lys;
 A17 represents Aib, Gln, or Ile;
 A18 represents Ala or His;
 A19 represents Gln or Ser;
 A20 represents Aib, Ala, or Gln;
 A21 represents Asn, Asp, Glu, Leu, or Ser;
 A22 represents Phe or α MePhe;
 A23 represents Ile or Val;
 A24 represents Arg, Asn, Asp, Lys, or Lys(Ac);
 A25 represents Trp;
 A26 represents Aib, Iva, or Leu;
 A27 represents Leu;
 A28 represents Ala, Arg, Lys, or Lys(Ac);
 A29 represents Gln or Gly;
 A30 represents Arg, Gly or a deletion;
 A31 represents Pro or a deletion;
 A32 represents Ser or a deletion;
 A33 represents Ser or a deletion;
 A34 represents Gly or a deletion;
 A35 represents Ala or a deletion;
 A36 represents Pro or a deletion;
 A37 represents Pro or a deletion;
 A38 represents Pro or a deletion;
 A39 represents Lys, Ser or a deletion; and
 A40 represents Arg, Lys, or a deletion,
 or a salt thereof.

[8] The peptide according to [1] represented by formula (I):

P¹-Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-

A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P²

wherein

P¹ represents a group represented by formula

-R^{A1},
 -CO-R^{A1},
 -CO-OR^{A1},
 -CO-COR^{A1},
 -SO-R^{A1},
 -SO₂-R^{A1},
 -SO₂-OR^{A1},
 -CO-NR^{A2}R^{A3},
 -SO₂-NR^{A2}R^{A3}, or
 -C(=NR^{A1})-NR^{A2}R^{A3}

wherein R^{A1}, R^{A2}, and R^{A3} each independently represent a hydrogen atom, an optionally substituted hydrocarbon group, or an optionally substituted heterocyclic group;

P² represents -NH₂ or -OH;

A2 represents Aib or D-Ala;

A6 represents Iva, Phe, or Val;

A7 represents Ile, Lys, or Val;

A8 represents Ser;

A9 represents Asp, Leu, or Phe;

A10 represents Tyr;

A11 represents Aib or Ser;

A12 represents Ile;

A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;

A14 represents Leu;

A15 represents Asp, Glu, Lys, Ser, or Tyr;

A16 represents Arg or Lys;

A17 represents Aib, Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln or Ser;

A20 represents Aib, Ala, or Gln;

A21 represents Asn, Asp, Glu, Leu, or Ser;

A22 represents Phe or α MePhe;

A23 represents Ile or Val;

A24 represents Arg, Asn, Lys, or Lys(Ac);

A25 represents Trp;

A26 represents Aib, Iva, or Leu;

A27 represents Leu;

A28 represents Ala, Arg, Lys, or Lys(Ac);

A29 represents Gln or Gly;

A30 represents Arg, Gly or a deletion;

A31 represents Pro or a deletion;

A32 represents Ser or a deletion;

A33 represents Ser or a deletion;

A34 represents Gly or a deletion;

A35 represents Ala or a deletion;

A36 represents Pro or a deletion;

A37 represents Pro or a deletion;

A38 represents Pro or a deletion;

A39 represents Lys, Ser or a deletion;

A40 represents Arg, Lys, or a deletion, and

any one or two amino acids selected from A12, A14 and A17 optionally represent

Lys(R), and R represents a substituent group,

or a salt thereof.

[9] The peptide according to [1], wherein R represents X-L-, L represents a bivalent linker comprising PEG and/or amino acid, and X represents a substituent group, or a salt thereof.

[10] The peptide according to [1], wherein R represents X-L-, L represents a bond or a bivalent substituent group, and X represents an optionally substituted hydrocarbon group, or a salt thereof.

[11] The peptide according to [1] represented by formula: H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 12), or a salt thereof.

[12] The peptide according to [1] represented by formula: H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Gln-Ala-Gln-Aib-Glu-Phe-Val-Arg-Trp-Leu-Leu-Arg-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 36), or a salt thereof.

[13] The peptide according to [1] represented by formula: Me-

Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Ile-Ala-Gln-Gln-Asp-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 65), or a salt thereof.

[14] The peptide according to [1] represented by formula: Me-

Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-Ala-Gln-Aib

-Asn-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 110), or a salt thereof.

[15] The peptide according to [1] represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 119), or a salt thereof.

[16] The peptide according to [1] represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 123), or a salt thereof.

[17] The peptide according to [1] represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 354), wherein R represents a substituent group, or a salt thereof.

[18] The peptide according to [1] represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 362), wherein R represents a substituent group, or a salt thereof.

[19] A medicament comprising the peptide according to [1], or a salt thereof.

[20] The medicament according to [19], which is an activator of a GIP receptor.

[21] The medicament according to [19], which is a suppressant for vomiting or nausea.

[22] A method for suppressing vomiting or nausea in a mammal, comprising administering an effective amount of the peptide of [1] or a salt thereof to the mammal.

[23] A method for activating a GIP receptor in a mammal, comprising administering an effective amount of the peptide of [1] or a salt thereof to the mammal.

[24] Use of the peptide of [1] or a salt thereof for the manufacture of a suppressant for vomiting or nausea.

[25] The peptide of [1] or a salt thereof for use in suppressing vomiting or nausea.

[26] The medicament of [21], the method of [22], the use of [24], or the peptide of [25], where the vomiting or the nausea is caused by one or more conditions or causes selected from the following (1) to (6):

(1) diseases such as gastroparesis, gastrointestinal hypomotility, peritonitis, abdominal tumor, constipation, gastrointestinal obstruction, cyclic vomiting syndrome, chronic unexplained nausea and vomiting, acute and chronic pancreatitis, hyperkalemia, cerebral edema, intracranial lesion, metabolic disorder, gastritis caused by an infection, postoperative disease, myocardial infarction, migraine, intracranial hypertension, and

intracranial hypotension (e.g., altitude sickness);

(2) drugs such as (i) alkylating agents (e.g., cyclophosphamide, carmustine, lomustine, chlorambucil, streptozocin, dacarbazine, ifosfamide, temozolomide, busulfan, bendamustine, and melphalan), cytotoxic antibiotics (e.g., dactinomycin, doxorubicin, mitomycin-C, bleomycin, epirubicin, actinomycin D, amrubicin, idarubicin, daunorubicin, and pirarubicin), antimetabolic agents (e.g., cytarabine, methotrexate, 5-fluorouracil, enocitabine, and clofarabine), vinca alkaloids (e.g., etoposide, vinblastine, and vincristine), other chemotherapeutic agents such as cisplatin, procarbazine, hydroxyurea, azacytidine, irinotecan, interferon α , interleukin-2, oxaliplatin, carboplatin, nedaplatin, and miriplatin; (ii) opioid analgesics (e.g., morphine); (iii) dopamine receptor D1D2 agonists (e.g., apomorphine); (iv) cannabis and cannabinoid products including cannabis hyperemesis syndrome

(3) radiation sickness or radiation therapy for the chest, the abdomen, or the like used to treat cancers;

(4) a poisonous substance or a toxin;

(5) pregnancy including hyperemesis gravidarum; and

(6) a vestibular disorder such as motion sickness or dizziness.

This description includes all or part of the contents as disclosed in the description and/or drawings of Japanese Patent Application No. 2017-072556, from which the present application claims the priority.

All publications, patents, and patent applications cited herein are incorporated herein by reference in their entirety.

Advantageous Effects of Invention

[0011] Compound (I) selectively activates the GIP receptor and demonstrates a significant hypoglycemic action and antiemetic action in vivo.

Brief Description of Drawings

[0012] [fig.1-1]Fig. 1-1 illustrates the effect of Compound 6 on conditioned taste aversion (CTA) in mice.

[fig.1-2]Fig. 1-2 illustrates the effect of Compound 117 on conditioned taste aversion (CTA) in mice.

[fig.2-1]Fig. 2-1 illustrates the effect of Compound 6 on cisplatin-induced acute vomiting in ferrets.

[fig.2-2]Fig. 2-2 illustrates the effect of Compound 117 on cisplatin-induced acute vomiting in ferrets. Each value indicates mean $\pm$ SD (n=4).

[fig.2-3]Fig. 2-3 illustrates the effect of Compound 117 on cisplatin-induced acute vomiting in ferrets. Each value indicates mean $\pm$ SD (n=7).

[fig.3]Fig. 3 illustrates the dose-dependent effect of Compound 6 on a morphine-

induced vomiting model (ferret).

[fig.4]Fig. 4 illustrates the effects of Compounds 75, 104, and 117 (1 nmol/kg) and Compound 59 (3 nmol/kg) on morphine-induced vomiting in ferrets when subcutaneously administered.

[fig.5]Fig. 5 illustrates the effects of Compounds 59 and 113 on morphine-induced vomiting in ferrets when subcutaneously administered.

[fig.6-1]Fig. 6-1 illustrates the effects of Compounds 341, 349, 253, 268, 284, 292, and 314 on morphine-induced vomiting in ferrets when subcutaneously administered. It shows results of morphine administrations 4 hours after each compound administration. Each value indicates mean $\pm$ SD (n=4).

[fig.6-2]Fig. 6-2 illustrates the effects of Compounds 341 and 349 on morphine-induced vomiting in ferrets when subcutaneously administered. It shows results of morphine administrations 120 hours after each compound administration. Each value indicates mean $\pm$ SD (n=4).

[fig.7-1]Fig. 7-1 illustrates the suppression of PYY-1119-induced vomiting by Compound 6 administration in beagles.

[fig.7-2]Fig. 7-2 illustrates the suppression of PYY-1119-induced vomiting by Compound 117 administration in beagles.

[fig.8A]Fig. 8A illustrates an amino acid sequence of the compound according to the present invention.

[fig.8B]Fig. 8B illustrates an amino acid sequence of the compound according to the present invention.

[fig.8C]Fig. 8C illustrates an amino acid sequence of the compound according to the present invention.

[fig.8D]Fig. 8D illustrates an amino acid sequence of the compound according to the present invention.

[fig.9-1A]Figures 9-1A, B, C illustrate amino acid sequences of Compounds 158 to 230 according to the present invention. Fig. 9-1A illustrates from N-terminal to position 13 of the sequences.

[fig.9-1B]Figures 9-1A, B, C illustrate amino acid sequences of Compounds 158 to 230 according to the present invention. Fig. 9-1B illustrates from positions 14 to 22 of the sequences which are continuous from Fig. 9-1A.

[fig.9-1C]Figures 9-1A, B, C illustrate amino acid sequences of Compounds 158 to 230 according to the present invention. Fig. 9-1C illustrates from position 23 to C-terminal of the sequences which are continuous from Fig. 9-1B.

[fig.9-2A]Figures 9-2A, B, C illustrate amino acid sequences of Compounds 231 to 303 according to the present invention. Fig. 9-2A illustrates from N-terminal to position 13 of the sequences.

[fig.9-2B]Figures 9-2A, B, C illustrate amino acid sequences of Compounds 231 to 303 according to the present invention. Fig. 9-2B illustrates from positions 14 to 22 of the sequences which are continuous from Fig. 9-2A.

[fig.9-2C]Figures 9-2A, B, C illustrate amino acid sequences of Compounds 231 to 303 according to the present invention. Fig. 9-2C illustrates from position 23 to C-terminal of the sequences which are continuous from Fig. 9-2B.

[fig.9-3A]Figures 9-3A, B, C illustrate amino acid sequences of Compounds 304 to 376 according to the present invention. Fig. 9-3A illustrates from N-terminal to position 13 of the sequences.

[fig.9-3B]Figures 9-3A, B, C illustrate amino acid sequences of Compounds 304 to 376 according to the present invention. Fig. 9-3B illustrates from positions 14 to 22 of the sequences which are continuous from Fig. 9-3A.

[fig.9-3C]Figures 9-3A, B, C illustrate amino acid sequences of Compounds 304 to 376 according to the present invention. Fig. 9-3C illustrates from position 23 to C-terminal of the sequences which are continuous from Fig. 9-3B.

[fig.9-4A]Figures 9-4A, B, C illustrate amino acid sequences of Compounds 377 to 449 according to the present invention. Fig. 9-4A illustrates from N-terminal to position 13 of the sequences.

[fig.9-4B]Figures 9-4A, B, C illustrate amino acid sequences of Compounds 377 to 449 according to the present invention. Fig. 9-4B illustrates from positions 14 to 22 of the sequences which are continuous from Fig. 9-4A.

[fig.9-4C]Figures 9-4A, B, C illustrate amino acid sequences of Compounds 377 to 449 according to the present invention. Fig. 9-4C illustrates from position 23 to C-terminal of the sequences which are continuous from Fig. 9-4B.

[fig.9-5A]Figures 9-5A, B, C illustrate amino acid sequences of Compounds 450 to 522 according to the present invention. Fig. 9-5A illustrates from N-terminal to position 13 of the sequences.

[fig.9-5B]Figures 9-5A, B, C illustrate amino acid sequences of Compounds 450 to 522 according to the present invention. Fig. 9-5B illustrates from positions 14 to 22 of the sequences which are continuous from Fig. 9-5A.

[fig.9-5C]Figures 9-5A, B, C illustrate amino acid sequences of Compounds 450 to 522 according to the present invention. Fig. 9-5C illustrates from position 23 to C-terminal of the sequences which are continuous from Fig. 9-5B.

Detailed Description of the Invention

[0013] The definition of each substituent used in the present specification is described in detail in the following. Unless otherwise specified, each substituent has the following definition.

In the present specification, examples of the “halogen atom” include fluorine,

chlorine, bromine and iodine.

- [0014] In the present specification, examples of the “C₁₋₆ alkyl group” include methyl, ethyl, propyl, isopropyl, butyl, isobutyl, sec-butyl, tert-butyl, pentyl, isopentyl, neopentyl, 1-ethylpropyl, hexyl, isohexyl, 1,1-dimethylbutyl, 2,2-dimethylbutyl, 3,3-dimethylbutyl and 2-ethylbutyl.
- [0015] In the present specification, examples of the “optionally halogenated C₁₋₆ alkyl group” include a C₁₋₆ alkyl group optionally having 1 to 7, preferably 1 to 5, halogen atoms. Specific examples thereof include methyl, chloromethyl, difluoromethyl, trichloromethyl, trifluoromethyl, ethyl, 2-bromoethyl, 2,2,2-trifluoroethyl, tetrafluoroethyl, pentafluoroethyl, propyl, 2,2-difluoropropyl, 3,3,3-trifluoropropyl, isopropyl, butyl, 4,4,4-trifluorobutyl, isobutyl, sec-butyl, tert-butyl, pentyl, isopentyl, neopentyl, 5,5,5-trifluoropentyl, hexyl and 6,6,6-trifluorohexyl.
- [0016] In the present specification, examples of the “C₂₋₆ alkenyl group” include ethenyl, 1-propenyl, 2-propenyl, 2-methyl-1-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 3-methyl-2-butenyl, 1-pentenyl, 2-pentenyl, 3-pentenyl, 4-pentenyl, 4-methyl-3-pentenyl, 1-hexenyl, 3-hexenyl and 5-hexenyl.
- [0017] In the present specification, examples of the “C₂₋₆ alkynyl group” include ethynyl, 1-propynyl, 2-propynyl, 1-butyne, 2-butyne, 3-butyne, 1-pentyne, 2-pentyne, 3-pentyne, 4-pentyne, 1-hexynyl, 2-hexynyl, 3-hexynyl, 4-hexynyl, 5-hexynyl and 4-methyl-2-pentyne.
- [0018] In the present specification, examples of the “C₃₋₁₀ cycloalkyl group” include cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, bicyclo[2.2.1]heptyl, bicyclo[2.2.2]octyl, bicyclo[3.2.1]octyl and adamantyl.
- [0019] In the present specification, examples of the “optionally halogenated C₃₋₁₀ cycloalkyl group” include a C₃₋₁₀ cycloalkyl group optionally having 1 to 7, preferably 1 to 5, halogen atoms. Specific examples thereof include cyclopropyl, 2,2-difluorocyclopropyl, 2,3-difluorocyclopropyl, cyclobutyl, difluorocyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl and cyclooctyl.
- [0020] In the present specification, examples of the “C₃₋₁₀ cycloalkenyl group” include cyclopropenyl, cyclobutenyl, cyclopentenyl, cyclohexenyl, cycloheptenyl and cyclooctenyl.
- [0021] In the present specification, examples of the “C₆₋₁₄ aryl group” include phenyl, 1-naphthyl, 2-naphthyl, 1-anthryl, 2-anthryl and 9-anthryl.
- [0022] In the present specification, examples of the “C₇₋₁₆ aralkyl group” include benzyl, phenethyl, naphthylmethyl and phenylpropyl.
- [0023] In the present specification, examples of the “C₁₋₆ alkoxy group” include methoxy, ethoxy, propoxy, isopropoxy, butoxy, isobutoxy, sec-butoxy, tert-butoxy, pentyloxy and hexyloxy.

- [0024] In the present specification, examples of the “optionally halogenated C₁₋₆ alkoxy group” include a C₁₋₆ alkoxy group optionally having 1 to 7, preferably 1 to 5, halogen atoms. Specific examples thereof include methoxy, difluoromethoxy, trifluoromethoxy, ethoxy, 2,2,2-trifluoroethoxy, propoxy, isopropoxy, butoxy, 4,4,4-trifluorobutoxy, isobutoxy, sec-butoxy, pentyloxy and hexyloxy.
- [0025] In the present specification, examples of the “C₃₋₁₀ cycloalkyloxy group” include cyclopropyloxy, cyclobutyloxy, cyclopentyloxy, cyclohexyloxy, cycloheptyloxy and cyclooctyloxy.
- [0026] In the present specification, examples of the “C₁₋₆ alkylthio group” include methylthio, ethylthio, propylthio, isopropylthio, butylthio, sec-butylthio, tert-butylthio, pentylthio and hexylthio.
- [0027] In the present specification, examples of the “optionally halogenated C₁₋₆ alkylthio group” include a C₁₋₆ alkylthio group optionally having 1 to 7, preferably 1 to 5, halogen atoms. Specific examples thereof include methylthio, difluoromethylthio, trifluoromethylthio, ethylthio, propylthio, isopropylthio, butylthio, 4,4,4-trifluorobutylthio, pentylthio and hexylthio.
- [0028] In the present specification, examples of the “C₁₋₆ alkyl-carbonyl group” include acetyl, propanoyl, butanoyl, 2-methylpropanoyl, pentanoyl, 3-methylbutanoyl, 2-methylbutanoyl, 2,2-dimethylpropanoyl, hexanoyl and heptanoyl.
- [0029] In the present specification, examples of the “optionally halogenated C₁₋₆ alkyl-carbonyl group” include a C₁₋₆ alkyl-carbonyl group optionally having 1 to 7, preferably 1 to 5, halogen atoms. Specific examples thereof include acetyl, chloroacetyl, trifluoroacetyl, trichloroacetyl, propanoyl, butanoyl, pentanoyl and hexanoyl.
- [0030] In the present specification, examples of the “C₁₋₆ alkoxy-carbonyl group” include methoxycarbonyl, ethoxycarbonyl, propoxycarbonyl, isopropoxycarbonyl, butoxycarbonyl, isobutoxycarbonyl, sec-butoxycarbonyl, tert-butoxycarbonyl, pentyloxy-carbonyl and hexyloxy-carbonyl.
- [0031] In the present specification, examples of the “C₆₋₁₄ aryl-carbonyl group” include benzoyl, 1-naphthoyl and 2-naphthoyl.
- [0032] In the present specification, examples of the “C₇₋₁₆ aralkyl-carbonyl group” include phenylacetyl and phenylpropionyl.
- [0033] In the present specification, examples of the “5- to 14-membered aromatic heterocyclcarbonyl group” include nicotinoyl, isonicotinoyl, thenoyl and furoyl.
- [0034] In the present specification, examples of the “3- to 14-membered non-aromatic heterocyclcarbonyl group” include morpholinylcarbonyl, piperidinylcarbonyl and pyrrolidinylcarbonyl.
- [0035] In the present specification, examples of the “mono- or di-C₁₋₆ alkyl-carbamoyl

group” include methylcarbamoyl, ethylcarbamoyl, dimethylcarbamoyl, diethylcarbamoyl and N-ethyl-N-methylcarbamoyl.

[0036] In the present specification, examples of the “mono- or di- C_{7-16} aralkyl-carbamoyl group” include benzylcarbamoyl and phenethylcarbamoyl.

[0037] In the present specification, examples of the “ C_{1-6} alkylsulfonyl group” include methylsulfonyl, ethylsulfonyl, propylsulfonyl, isopropylsulfonyl, butylsulfonyl, sec-butylsulfonyl and tert-butylsulfonyl.

[0038] In the present specification, examples of the “optionally halogenated C_{1-6} alkylsulfonyl group” include a C_{1-6} alkylsulfonyl group optionally having 1 to 7, preferably 1 to 5, halogen atoms. Specific examples thereof include methylsulfonyl, difluoromethylsulfonyl, trifluoromethylsulfonyl, ethylsulfonyl, propylsulfonyl, isopropylsulfonyl, butylsulfonyl, 4,4,4-trifluorobutylsulfonyl, pentylsulfonyl and hexylsulfonyl.

[0039] In the present specification, examples of the “ C_{6-14} arylsulfonyl group” include phenylsulfonyl, 1-naphthylsulfonyl and 2-naphthylsulfonyl.

[0040] In the present specification, examples of the “substituent” include a halogen atom, a cyano group, a nitro group, an optionally substituted hydrocarbon group, an optionally substituted heterocyclic group, an acyl group, an optionally substituted amino group, an optionally substituted carbamoyl group, an optionally substituted thiocarbamoyl group, an optionally substituted sulfamoyl group, an optionally substituted hydroxy group, an optionally substituted sulfanyl (SH) group and an optionally substituted silyl group.

[0041] In the present specification, examples of the “hydrocarbon group” (including “hydrocarbon group” of “optionally substituted hydrocarbon group”) include a C_{1-6} alkyl group, a C_{2-6} alkenyl group, a C_{2-6} alkynyl group, a C_{3-10} cycloalkyl group, a C_{3-10} cycloalkenyl group, a C_{6-14} aryl group and a C_{7-16} aralkyl group.

[0042] In the present specification, examples of the “optionally substituted hydrocarbon group” include a hydrocarbon group optionally having substituent(s) selected from the following substituent group A.

substituent group A

- [0043] (1) a halogen atom,
 (2) a nitro group,
 (3) a cyano group,
 (4) an oxo group,
 (5) a hydroxy group,
 (6) an optionally halogenated C_{1-6} alkoxy group,
 (7) a C_{6-14} aryloxy group (e.g., phenoxy, naphthoxy),
 (8) a C_{7-16} aralkyloxy group (e.g., benzyloxy),
 (9) a 5- to 14-membered aromatic heterocyclyloxy group (e.g., pyridyloxy),

- (10) a 3- to 14-membered non-aromatic heterocyclyloxy group (e.g., morpholinyl, piperidinyl),
- (11) a C₁₋₆ alkyl-carbonyloxy group (e.g., acetoxy, propanoyloxy),
- (12) a C₆₋₁₄ aryl-carbonyloxy group (e.g., benzyloxy, 1-naphthyl, 2-naphthyl),
- (13) a C₁₋₆ alkoxy-carbonyloxy group (e.g., methoxycarbonyloxy, ethoxycarbonyloxy, propoxycarbonyloxy, butoxycarbonyloxy),
- (14) a mono- or di-C₁₋₆ alkyl-carbamoyloxy group (e.g., methylcarbamoyloxy, ethylcarbamoyloxy, dimethylcarbamoyloxy, diethylcarbamoyloxy),
- (15) a C₆₋₁₄ aryl-carbamoyloxy group (e.g., phenylcarbamoyloxy, naphthylcarbamoyloxy),
- (16) a 5- to 14-membered aromatic heterocyclylcarbonyloxy group (e.g., nicotinoyloxy),
- (17) a 3- to 14-membered non-aromatic heterocyclylcarbonyloxy group (e.g., morpholinylcarbonyloxy, piperidinylcarbonyloxy),
- (18) an optionally halogenated C₁₋₆ alkylsulfonyloxy group (e.g., methylsulfonyloxy, trifluoromethylsulfonyloxy),
- (19) a C₆₋₁₄ arylsulfonyloxy group optionally substituted by a C₁₋₆ alkyl group (e.g., phenylsulfonyloxy, toluenesulfonyloxy),
- (20) an optionally halogenated C₁₋₆ alkylthio group,
- (21) a 5- to 14-membered aromatic heterocyclic group,
- (22) a 3- to 14-membered non-aromatic heterocyclic group,
- (23) a formyl group,
- (24) a carboxy group,
- (25) an optionally halogenated C₁₋₆ alkyl-carbonyl group,
- (26) a C₆₋₁₄ aryl-carbonyl group,
- (27) a 5- to 14-membered aromatic heterocyclylcarbonyl group,
- (28) a 3- to 14-membered non-aromatic heterocyclylcarbonyl group,
- (29) a C₁₋₆ alkoxy-carbonyl group,
- (30) a C₆₋₁₄ aryloxy-carbonyl group (e.g., phenyloxycarbonyl, 1-naphthyloxycarbonyl, 2-naphthyloxycarbonyl),
- (31) a C₇₋₁₆ aralkyloxy-carbonyl group (e.g., benzyloxycarbonyl, phenethyloxycarbonyl),
- (32) a carbamoyl group,
- (33) a thiocarbamoyl group,
- (34) a mono- or di-C₁₋₆ alkyl-carbamoyl group,
- (35) a C₆₋₁₄ aryl-carbamoyl group (e.g., phenylcarbamoyl),
- (36) a 5- to 14-membered aromatic heterocyclylcarbamoyl group (e.g., pyridyl-

carbamoyl, thienylcarbamoyl),

(37) a 3- to 14-membered non-aromatic heterocyclylcarbamoyl group (e.g., morpholinylcarbamoyl, piperidinylcarbamoyl),

(38) an optionally halogenated C₁₋₆ alkylsulfonyl group,

(39) a C₆₋₁₄ arylsulfonyl group,

(40) a 5- to 14-membered aromatic heterocyclylsulfonyl group (e.g., pyridylsulfonyl, thienylsulfonyl),

(41) an optionally halogenated C₁₋₆ alkylsulfinyl group,

(42) a C₆₋₁₄ arylsulfinyl group (e.g., phenylsulfinyl, 1-naphthylsulfinyl, 2-naphthylsulfinyl),

(43) a 5- to 14-membered aromatic heterocyclylsulfinyl group (e.g., pyridylsulfinyl, thienylsulfinyl),

(44) an amino group,

(45) a mono- or di-C₁₋₆ alkylamino group (e.g., methylamino, ethylamino, propylamino, isopropylamino, butylamino, dimethylamino, diethylamino, dipropylamino, dibutylamino, N-ethyl-N-methylamino),

(46) a mono- or di-C₆₋₁₄ arylamino group (e.g., phenylamino),

(47) a 5- to 14-membered aromatic heterocyclylamino group (e.g., pyridylamino),

(48) a C₇₋₁₆ aralkylamino group (e.g., benzylamino),

(49) a formylamino group,

(50) a C₁₋₆ alkyl-carbonylamino group (e.g., acetylamino, propanoylamino, butanoylamino),

(51) a (C₁₋₆ alkyl)(C₁₋₆ alkyl-carbonyl)amino group (e.g., N-acetyl-N-methylamino),

(52) a C₆₋₁₄ aryl-carbonylamino group (e.g., phenylcarbonylamino, naphthylcarbonylamino),

(53) a C₁₋₆ alkoxy-carbonylamino group (e.g., methoxycarbonylamino, ethoxycarbonylamino, propoxycarbonylamino, butoxycarbonylamino, tert-butoxycarbonylamino),

(54) a C₇₋₁₆ aralkyloxy-carbonylamino group (e.g., benzyloxycarbonylamino),

(55) a C₁₋₆ alkylsulfonylamino group (e.g., methylsulfonylamino, ethylsulfonylamino),

(56) a C₆₋₁₄ arylsulfonylamino group optionally substituted by a C₁₋₆ alkyl group (e.g., phenylsulfonylamino, toluenesulfonylamino),

(57) an optionally halogenated C₁₋₆ alkyl group,

(58) a C₂₋₆ alkenyl group,

(59) a C₂₋₆ alkynyl group,

(60) a C₃₋₁₀ cycloalkyl group,

(61) a C₃₋₁₀ cycloalkenyl group and

(62) a C₆₋₁₄ aryl group.

- [0044] The number of the above-mentioned substituents in the “optionally substituted hydrocarbon group” is, for example, 1 to 5, preferably 1 to 3. When the number of the substituents is two or more, the respective substituents may be the same or different.
- [0045] In the present specification, examples of the “heterocyclic group” (including “heterocyclic group” of “optionally substituted heterocyclic group”) include (i) an aromatic heterocyclic group, (ii) a non-aromatic heterocyclic group and (iii) a 7- to 10-membered bridged heterocyclic group, each containing, as a ring-constituting atom besides carbon atom, 1 to 4 hetero atoms selected from a nitrogen atom, a sulfur atom and an oxygen atom.
- [0046] In the present specification, examples of the “aromatic heterocyclic group” (including “5- to 14-membered aromatic heterocyclic group”) include a 5- to 14-membered (preferably 5- to 10-membered) aromatic heterocyclic group containing, as a ring-constituting atom besides carbon atom, 1 to 4 hetero atoms selected from a nitrogen atom, a sulfur atom and an oxygen atom.
- [0047] Preferable examples of the “aromatic heterocyclic group” include 5- or 6-membered monocyclic aromatic heterocyclic groups such as thienyl, furyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, 1,2,4-oxadiazolyl, 1,3,4-oxadiazolyl, 1,2,4-thiadiazolyl, 1,3,4-thiadiazolyl, triazolyl, tetrazolyl, triazinyl and the like; and
- 8- to 14-membered fused polycyclic (preferably bi or tricyclic) aromatic heterocyclic groups such as benzothiophenyl, benzofuranyl, benzimidazolyl, benzoxazolyl, benzisoxazolyl, benzothiazolyl, benzisothiazolyl, benzotriazolyl, imidazopyridinyl, thienopyridinyl, furopyridinyl, pyrrolopyridinyl, pyrazolopyridinyl, oxazolopyridinyl, thiazolopyridinyl, imidazopyrazinyl, imidazopyrimidinyl, thienopyrimidinyl, furopyrimidinyl, pyrrolopyrimidinyl, pyrazolopyrimidinyl, oxazolopyrimidinyl, thiazolopyrimidinyl, pyrazolotriazinyl, naphtho[2,3-b]thienyl, phenoxathiinyl, indolyl, isoindolyl, 1H-indazolyl, purinyl, isoquinolyl, quinolyl, phthalazinyl, naphthyridinyl, quinoxalinyl, quinazolinyl, cinnolinyl, carbazolyl, β -carbolinyl, phenanthridinyl, acridinyl, phenazinyl, phenothiazinyl, phenoxazinyl and the like.
- [0048] In the present specification, examples of the “non-aromatic heterocyclic group” (including “3- to 14-membered non-aromatic heterocyclic group”) include a 3- to 14-membered (preferably 4- to 10-membered) non-aromatic heterocyclic group containing, as a ring-constituting atom besides carbon atom, 1 to 4 hetero atoms selected from a nitrogen atom, a sulfur atom and an oxygen atom.
- [0049] Preferable examples of the “non-aromatic heterocyclic group” include 3- to 8-membered monocyclic non-aromatic heterocyclic groups such as aziridinyl, oxiranyl, thiiranyl, azetidiny, oxetanyl, thietanyl, tetrahydrothienyl, tetrahydrofuranyl, pyrrolinyl, pyrrolidinyl, imidazoliny, imidazolidinyl, oxazoliny, oxazolidinyl,

pyrazolinyl, pyrazolidinyl, thiazolinyl, thiazolidinyl, tetrahydroisothiazolyl, tetrahydrooxazolyl, tetrahydroisooxazolyl, piperidinyl, piperazinyl, tetrahydropyridinyl, dihydropyridinyl, dihydrothiopyranyl, tetrahydropyrimidinyl, tetrahydropyridazinyl, dihydropyranyl, tetrahydropyranyl, tetrahydrothiopyranyl, morpholinyl, thiomorpholinyl, azepanyl, diazepanyl, azepinyl, oxepanyl, azocanyl, diazocanyl and the like; and 9- to 14-membered fused polycyclic (preferably bi or tricyclic) non-aromatic heterocyclic groups such as dihydrobenzofuranyl, dihydrobenzimidazolyl, dihydrobenzoxazolyl, dihydrobenzothiazolyl, dihydrobenzisothiazolyl, dihydronaphtho[2,3-b]thienyl, tetrahydroisoquinolyl, tetrahydroquinolyl, 4H-quinolizinyl, indolinyl, isoindolinyl, tetrahydrothieno[2,3-c]pyridinyl, tetrahydrobenzazepinyl, tetrahydroquinoxalinyl, tetrahydrophenanthridinyl, hexahydrophenothiazinyl, hexahydrophenoxazinyl, tetrahydrophthalazinyl, tetrahydronaphththyridinyl, tetrahydroquinazolinyl, tetrahydrocinnolinyl, tetrahydrocarbazolyl, tetrahydro- β -carbolinyl, tetrahydroacrydinyl, tetrahydrophenazinyl, tetrahydrothioxanthenyl, octahydroisoquinolyl and the like.

- [0050] In the present specification, preferable examples of the “7- to 10-membered bridged heterocyclic group” include quinuclidinyl and 7-azabicyclo[2.2.1]heptanyl.
- [0051] In the present specification, examples of the “nitrogen-containing heterocyclic group” include a “heterocyclic group” containing at least one nitrogen atom as a ring-constituting atom.
- [0052] In the present specification, examples of the “optionally substituted heterocyclic group” include a heterocyclic group optionally having substituent(s) selected from the aforementioned substituent group A.
- [0053] The number of the substituents in the “optionally substituted heterocyclic group” is, for example, 1 to 3. When the number of the substituents is two or more, the respective substituents may be the same or different.
- [0054] In the present specification, examples of the “acyl group” include a formyl group, a carboxy group, a carbamoyl group, a thiocarbamoyl group, a sulfinoyl group, a sulfo group, a sulfamoyl group and a phosphono group, each optionally having “1 or 2 substituents selected from a C₁₋₆ alkyl group, a C₂₋₆ alkenyl group, a C₃₋₁₀ cycloalkyl group, a C₃₋₁₀ cycloalkenyl group, a C₆₋₁₄ aryl group, a C₇₋₁₆ aralkyl group, a 5- to 14-membered aromatic heterocyclic group and a 3- to 14-membered non-aromatic heterocyclic group, each of which optionally has 1 to 3 substituents selected from a halogen atom, an optionally halogenated C₁₋₆ alkoxy group, a hydroxy group, a nitro group, a cyano group, an amino group and a carbamoyl group”.
- [0055] Examples of the “acyl group” also include a hydrocarbon-sulfonyl group, a heterocyclisulfonyl group, a hydrocarbon-sulfinyl group and a heterocyclisulfinyl group.
- [0056] Here, the hydrocarbon-sulfonyl group means a hydrocarbon group-bonded sulfonyl

group, the heterocyclylsulfonyl group means a heterocyclic group-bonded sulfonyl group, the hydrocarbon-sulfinyl group means a hydrocarbon group-bonded sulfinyl group and the heterocyclylsulfinyl group means a heterocyclic group-bonded sulfinyl group.

[0057] Preferable examples of the “acyl group” include a formyl group, a carboxy group, a C₁₋₆ alkyl-carbonyl group, a C₂₋₆ alkenyl-carbonyl group (e.g., crotonoyl), a C₃₋₁₀ cycloalkyl-carbonyl group (e.g., cyclobutanecarbonyl, cyclopentanecarbonyl, cyclohexanecarbonyl, cycloheptanecarbonyl), a C₃₋₁₀ cycloalkenyl-carbonyl group (e.g., 2-cyclohexenecarbonyl), a C₆₋₁₄ aryl-carbonyl group, a C₇₋₁₆ aralkyl-carbonyl group, a 5- to 14-membered aromatic heterocyclylcarbonyl group, a 3- to 14-membered non-aromatic heterocyclylcarbonyl group, a C₁₋₆ alkoxy-carbonyl group, a C₆₋₁₄ aryloxy-carbonyl group (e.g., phenyloxycarbonyl, naphthyloxycarbonyl), a C₇₋₁₆ aralkyloxy-carbonyl group (e.g., benzyloxycarbonyl, phenethylloxycarbonyl), a carbamoyl group, a mono- or di-C₁₋₆ alkyl-carbamoyl group, a mono- or di-C₂₋₆ alkenyl-carbamoyl group (e.g., diallylcarbamoyl), a mono- or di-C₃₋₁₀ cycloalkyl-carbamoyl group (e.g., cyclopropylcarbamoyl), a mono- or di-C₆₋₁₄ aryl-carbamoyl group (e.g., phenylcarbamoyl), a mono- or di-C₇₋₁₆ aralkyl-carbamoyl group, a 5- to 14-membered aromatic heterocyclylcarbamoyl group (e.g., pyridylcarbamoyl), a thiocarbamoyl group, a mono- or di-C₁₋₆ alkyl-thiocarbamoyl group (e.g., methylthiocarbamoyl, N-ethyl-N-methylthiocarbamoyl), a mono- or di-C₂₋₆ alkenyl-thiocarbamoyl group (e.g., diallylthiocarbamoyl), a mono- or di-C₃₋₁₀ cycloalkyl-thiocarbamoyl group (e.g., cyclopropylthiocarbamoyl, cyclohexylthiocarbamoyl), a mono- or di-C₆₋₁₄ aryl-thiocarbamoyl group (e.g., phenylthiocarbamoyl), a mono- or di-C₇₋₁₆ aralkyl-thiocarbamoyl group (e.g., benzylthiocarbamoyl, phenethylthiocarbamoyl), a 5- to 14-membered aromatic heterocyclylthiocarbamoyl group (e.g., pyridylthiocarbamoyl), a sulfinio group, a C₁₋₆ alkylsulfinyl group (e.g., methylsulfinyl, ethylsulfinyl), a sulfo group, a C₁₋₆ alkylsulfonyl group, a C₆₋₁₄ arylsulfonyl group, a phosphono group and a mono- or di-C₁₋₆ alkylphosphono group (e.g., dimethylphosphono, diethylphosphono, diisopropylphosphono, dibutylphosphono).

[0058] In the present specification, examples of the “optionally substituted amino group” include an amino group optionally having “1 or 2 substituents selected from a C₁₋₆ alkyl group, a C₂₋₆ alkenyl group, a C₃₋₁₀ cycloalkyl group, a C₆₋₁₄ aryl group, a C₇₋₁₆ aralkyl group, a C₁₋₆ alkyl-carbonyl group, a C₆₋₁₄ aryl-carbonyl group, a C₇₋₁₆ aralkyl-carbonyl group, a 5- to 14-membered aromatic heterocyclylcarbonyl group, a 3- to 14-membered non-aromatic heterocyclylcarbonyl group, a C₁₋₆ alkoxy-carbonyl group, a 5- to 14-membered aromatic heterocyclic group, a carbamoyl group, a mono- or di-C₁₋₆ alkyl-carbamoyl group, a mono- or di-C₇₋₁₆ aralkyl-carbamoyl group, a C₁₋₆ alkyl-sulfonyl group and a C₆₋₁₄ arylsulfonyl group, each of which optionally has 1 to 3 sub-

stituents selected from substituent group A”.

[0059] Preferable examples of the optionally substituted amino group include an amino group, a mono- or di-(optionally halogenated C₁₋₆ alkyl)amino group (e.g., methylamino, trifluoromethylamino, dimethylamino, ethylamino, diethylamino, propylamino, dibutylamino), a mono- or di-C₂₋₆ alkenylamino group (e.g., diallylamino), a mono- or di-C₃₋₁₀ cycloalkylamino group (e.g., cyclopropylamino, cyclohexylamino), a mono- or di-C₆₋₁₄ arylamino group (e.g., phenylamino), a mono- or di-C₇₋₁₆ aralkylamino group (e.g., benzylamino, dibenzylamino), a mono- or di-(optionally halogenated C₁₋₆ alkyl)-carbonylamino group (e.g., acetylamino, propionylamino), a mono- or di-C₆₋₁₄ aryl-carbonylamino group (e.g., benzoylamino), a mono- or di-C₇₋₁₆ aralkyl-carbonylamino group (e.g., benzylcarbonylamino), a mono- or di-5- to 14-membered aromatic heterocyclylcarbonylamino group (e.g., nicotinoylamino, isonicotinoylamino), a mono- or di-3- to 14-membered non-aromatic heterocyclylcarbonylamino group (e.g., piperidinylcarbonylamino), a mono- or di-C₁₋₆ alkoxy-carbonylamino group (e.g., tert-butoxycarbonylamino), a 5- to 14-membered aromatic heterocyclylamino group (e.g., pyridylamino), a carbamoylamino group, a (mono- or di-C₁₋₆ alkyl-carbamoyl)amino group (e.g., methylcarbamoylamino), a (mono- or di-C₇₋₁₆ aralkyl-carbamoyl)amino group (e.g., benzylcarbamoylamino), a C₁₋₆ alkylsulfonfylamino group (e.g., methylsulfonfylamino, ethylsulfonfylamino), a C₆₋₁₄ arylsulfonfylamino group (e.g., phenylsulfonfylamino), a (C₁₋₆ alkyl)(C₁₋₆ alkyl-carbonyl)amino group (e.g., N-acetyl-N-methylamino) and a (C₁₋₆ alkyl)(C₆₋₁₄ aryl-carbonyl)amino group (e.g., N-benzoyl-N-methylamino).

[0060] In the present specification, examples of the “optionally substituted carbamoyl group” include a carbamoyl group optionally having “1 or 2 substituents selected from a C₁₋₆ alkyl group, a C₂₋₆ alkenyl group, a C₃₋₁₀ cycloalkyl group, a C₆₋₁₄ aryl group, a C₇₋₁₆ aralkyl group, a C₁₋₆ alkyl-carbonyl group, a C₆₋₁₄ aryl-carbonyl group, a C₇₋₁₆ aralkyl-carbonyl group, a 5- to 14-membered aromatic heterocyclylcarbonyl group, a 3- to 14-membered non-aromatic heterocyclylcarbonyl group, a C₁₋₆ alkoxy-carbonyl group, a 5- to 14-membered aromatic heterocyclic group, a carbamoyl group, a mono- or di-C₁₋₆ alkyl-carbamoyl group and a mono- or di-C₇₋₁₆ aralkyl-carbamoyl group, each of which optionally has 1 to 3 substituents selected from substituent group A”.

[0061] Preferable examples of the optionally substituted carbamoyl group include a carbamoyl group, a mono- or di-C₁₋₆ alkyl-carbamoyl group, a mono- or di-C₂₋₆ alkenyl-carbamoyl group (e.g., diallylcarbamoyl), a mono- or di-C₃₋₁₀ cycloalkyl-carbamoyl group (e.g., cyclopropylcarbamoyl, cyclohexylcarbamoyl), a mono- or di-C₆₋₁₄ aryl-carbamoyl group (e.g., phenylcarbamoyl), a mono- or di-C₇₋₁₆ aralkyl-carbamoyl group, a mono- or di-C₁₋₆ alkyl-carbonyl-carbamoyl group (e.g., acetyl-carbamoyl, propionylcarbamoyl), a mono- or di-C₆₋₁₄ aryl-carbonyl-carbamoyl group

(e.g., benzoylcarbamoyl) and a 5- to 14-membered aromatic heterocyclylcarbamoyl group (e.g., pyridylcarbamoyl).

[0062] In the present specification, examples of the “optionally substituted thiocarbamoyl group” include a thiocarbamoyl group optionally having “1 or 2 substituents selected from a C₁₋₆ alkyl group, a C₂₋₆ alkenyl group, a C₃₋₁₀ cycloalkyl group, a C₆₋₁₄ aryl group, a C₇₋₁₆ aralkyl group, a C₁₋₆ alkyl-carbonyl group, a C₆₋₁₄ aryl-carbonyl group, a C₇₋₁₆ aralkyl-carbonyl group, a 5- to 14-membered aromatic heterocyclylcarbonyl group, a 3- to 14-membered non-aromatic heterocyclylcarbonyl group, a C₁₋₆ alkoxy-carbonyl group, a 5- to 14-membered aromatic heterocyclic group, a carbamoyl group, a mono- or di-C₁₋₆ alkyl-carbamoyl group and a mono- or di-C₇₋₁₆ aralkyl-carbamoyl group, each of which optionally has 1 to 3 substituents selected from substituent group A”.

[0063] Preferable examples of the optionally substituted thiocarbamoyl group include a thiocarbamoyl group, a mono- or di-C₁₋₆ alkyl-thiocarbamoyl group (e.g., methylthiocarbamoyl, ethylthiocarbamoyl, dimethylthiocarbamoyl, diethylthiocarbamoyl, N-ethyl-N-methylthiocarbamoyl), a mono- or di-C₂₋₆ alkenyl-thiocarbamoyl group (e.g., diallylthiocarbamoyl), a mono- or di-C₃₋₁₀ cycloalkyl-thiocarbamoyl group (e.g., cyclopropylthiocarbamoyl, cyclohexylthiocarbamoyl), a mono- or di-C₆₋₁₄ aryl-thiocarbamoyl group (e.g., phenylthiocarbamoyl), a mono- or di-C₇₋₁₆ aralkyl-thiocarbamoyl group (e.g., benzylthiocarbamoyl, phenethylthiocarbamoyl), a mono- or di-C₁₋₆ alkyl-carbonyl-thiocarbamoyl group (e.g., acetylthiocarbamoyl, propionylthiocarbamoyl), a mono- or di-C₆₋₁₄ aryl-carbonyl-thiocarbamoyl group (e.g., benzoylthiocarbamoyl) and a 5- to 14-membered aromatic heterocyclylthiocarbamoyl group (e.g., pyridylthiocarbamoyl).

[0064] In the present specification, examples of the “optionally substituted sulfamoyl group” include a sulfamoyl group optionally having “1 or 2 substituents selected from a C₁₋₆ alkyl group, a C₂₋₆ alkenyl group, a C₃₋₁₀ cycloalkyl group, a C₆₋₁₄ aryl group, a C₇₋₁₆ aralkyl group, a C₁₋₆ alkyl-carbonyl group, a C₆₋₁₄ aryl-carbonyl group, a C₇₋₁₆ aralkyl-carbonyl group, a 5- to 14-membered aromatic heterocyclylcarbonyl group, a 3- to 14-membered non-aromatic heterocyclylcarbonyl group, a C₁₋₆ alkoxy-carbonyl group, a 5- to 14-membered aromatic heterocyclic group, a carbamoyl group, a mono- or di-C₁₋₆ alkyl-carbamoyl group and a mono- or di-C₇₋₁₆ aralkyl-carbamoyl group, each of which optionally has 1 to 3 substituents selected from substituent group A”.

[0065] Preferable examples of the optionally substituted sulfamoyl group include a sulfamoyl group, a mono- or di-C₁₋₆ alkyl-sulfamoyl group (e.g., methylsulfamoyl, ethylsulfamoyl, dimethylsulfamoyl, diethylsulfamoyl, N-ethyl-N-methylsulfamoyl), a mono- or di-C₂₋₆ alkenyl-sulfamoyl group (e.g., diallylsulfamoyl), a mono- or di-C₃₋₁₀ cycloalkyl-sulfamoyl group (e.g., cyclopropylsulfamoyl, cyclohexylsulfamoyl), a

mono- or di- C_{6-14} aryl-sulfamoyl group (e.g., phenylsulfamoyl), a mono- or di- C_{7-16} aralkyl-sulfamoyl group (e.g., benzylsulfamoyl, phenethylsulfamoyl), a mono- or di- C_{1-6} alkyl-carbonyl-sulfamoyl group (e.g., acetylsulfamoyl, propionylsulfamoyl), a mono- or di- C_{6-14} aryl-carbonyl-sulfamoyl group (e.g., benzoylsulfamoyl) and a 5- to 14-membered aromatic heterocyclisulfamoyl group (e.g., pyridylsulfamoyl).

[0066] In the present specification, examples of the “optionally substituted hydroxy group” include a hydroxyl group optionally having “a substituent selected from a C_{1-6} alkyl group, a C_{2-6} alkenyl group, a C_{3-10} cycloalkyl group, a C_{6-14} aryl group, a C_{7-16} aralkyl group, a C_{1-6} alkyl-carbonyl group, a C_{6-14} aryl-carbonyl group, a C_{7-16} aralkyl-carbonyl group, a 5- to 14-membered aromatic heterocyclylcarbonyl group, a 3- to 14-membered non-aromatic heterocyclylcarbonyl group, a C_{1-6} alkoxy-carbonyl group, a 5- to 14-membered aromatic heterocyclic group, a carbamoyl group, a mono- or di- C_{1-6} alkyl-carbamoyl group, a mono- or di- C_{7-16} aralkyl-carbamoyl group, a C_{1-6} alkyl-sulfonyl group and a C_{6-14} arylsulfonyl group, each of which optionally has 1 to 3 substituents selected from substituent group A”.

[0067] Preferable examples of the optionally substituted hydroxy group include a hydroxy group, a C_{1-6} alkoxy group, a C_{2-6} alkenyloxy group (e.g., allyloxy, 2-butenyloxy, 2-pentenyl, 3-hexenyloxy), a C_{3-10} cycloalkyloxy group (e.g., cyclohexyloxy), a C_{6-14} aryloxy group (e.g., phenoxy, naphthyloxy), a C_{7-16} aralkyloxy group (e.g., benzyloxy, phenethylxy), a C_{1-6} alkyl-carbonyloxy group (e.g., acetyloxy, propionyloxy, butyryloxy, isobutyryloxy, pivaloyloxy), a C_{6-14} aryl-carbonyloxy group (e.g., benzoyloxy), a C_{7-16} aralkyl-carbonyloxy group (e.g., benzylcarbonyloxy), a 5- to 14-membered aromatic heterocyclylcarbonyloxy group (e.g., nicotinoyloxy), a 3- to 14-membered non-aromatic heterocyclylcarbonyloxy group (e.g., piperidinylcarbonyloxy), a C_{1-6} alkoxy-carbonyloxy group (e.g., tert-butoxycarbonyloxy), a 5- to 14-membered aromatic heterocyclyloxy group (e.g., pyridyloxy), a carbamoyloxy group, a C_{1-6} alkyl-carbamoyloxy group (e.g., methylcarbamoyloxy), a C_{7-16} aralkyl-carbamoyloxy group (e.g., benzylcarbamoyloxy), a C_{1-6} alkylsulfonyloxy group (e.g., methylsulfonyloxy, ethylsulfonyloxy) and a C_{6-14} arylsulfonyloxy group (e.g., phenylsulfonyloxy).

[0068] In the present specification, examples of the “optionally substituted sulfanyl group” include a sulfanyl group optionally having “a substituent selected from a C_{1-6} alkyl group, a C_{2-6} alkenyl group, a C_{3-10} cycloalkyl group, a C_{6-14} aryl group, a C_{7-16} aralkyl group, a C_{1-6} alkyl-carbonyl group, a C_{6-14} aryl-carbonyl group and a 5- to 14-membered aromatic heterocyclic group, each of which optionally has 1 to 3 substituents selected from substituent group A” and a halogenated sulfanyl group.

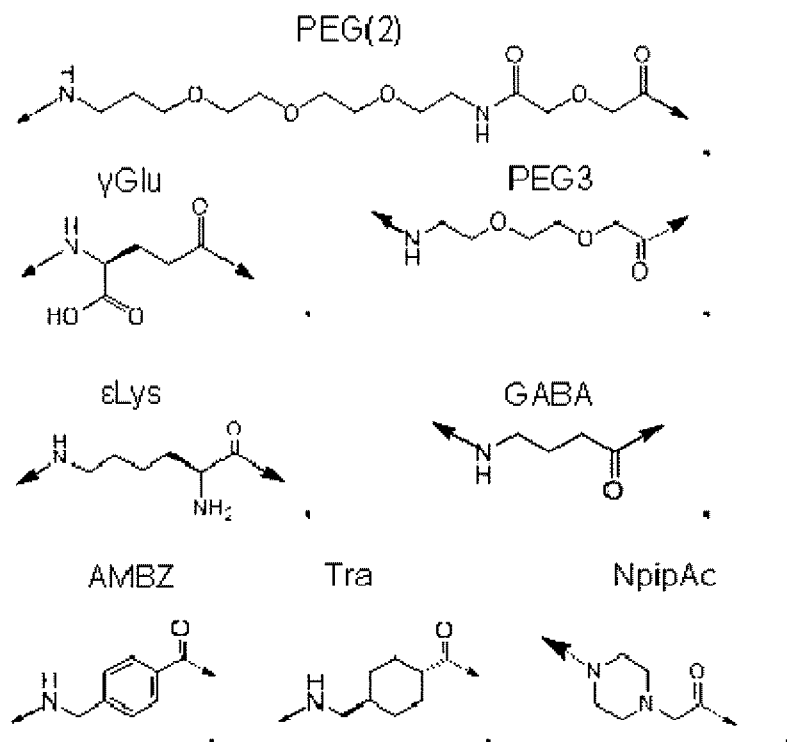
[0069] Preferable examples of the optionally substituted sulfanyl group include a sulfanyl (-SH) group, a C_{1-6} alkylthio group, a C_{2-6} alkenylthio group (e.g., allylthio,

2-butenylthio, 2-pentenylthio, 3-hexenylthio), a C₃₋₁₀ cycloalkylthio group (e.g., cyclohexylthio), a C₆₋₁₄ arylthio group (e.g., phenylthio, naphthylthio), a C₇₋₁₆ aralkylthio group (e.g., benzylthio, phenethylthio), a C₁₋₆ alkyl-carbonylthio group (e.g., acetylthio, propionylthio, butyrylthio, isobutyrylthio, pivaloylthio), a C₆₋₁₄ aryl-carbonylthio group (e.g., benzoylthio), a 5- to 14-membered aromatic heterocyclylthio group (e.g., pyridylthio) and a halogenated thio group (e.g., pentafluorothio).

- [0070] In the present specification, examples of the “optionally substituted silyl group” include a silyl group optionally having “1 to 3 substituents selected from a C₁₋₆ alkyl group, a C₂₋₆ alkenyl group, a C₃₋₁₀ cycloalkyl group, a C₆₋₁₄ aryl group and a C₇₋₁₆ aralkyl group, each of which optionally has 1 to 3 substituents selected from substituent group A”.
- [0071] Preferable examples of the optionally substituted silyl group include a tri-C₁₋₆ alkylsilyl group (e.g., trimethylsilyl, tert-butyl(dimethyl)silyl).
- [0072] Regarding compound 1, the definition of each symbol in the formula (I):P¹ - Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P² (SEQ ID NO: 165) is described in detail in the following.
- P¹ is a group represented by the formula:
- R^{A1},
 - CO-R^{A1},
 - CO-OR^{A1},
 - CO-COR^{A1},
 - SO-R^{A1},
 - SO₂-R^{A1},
 - SO₂-OR^{A1},
 - CO-NR^{A2}R^{A3},
 - SO₂-NR^{A2}R^{A3}, or
 - C(=NR^{A1})-NR^{A2}R^{A3}
- wherein R^{A1}, R^{A2} and R^{A3} are each independently a hydrogen atom, an optionally substituted hydrocarbon group, or optionally substituted heterocyclic group.
- [0073] P¹ is preferably an acetyl group, a methyl group or a hydrogen atom.
- [0074] P² represents -NH₂ or -OH.
- [0075] A2 represents Aib or D-Ala.
- [0076] A6 represents Iva, Phe or Val.
- [0077] A7 represents Ile, Lys or Val.
- [0078] A8 represents Ser.
- [0079] A9 represents Asp, Leu or Phe.
- [0080] A10 represents Tyr.

- [0081] A11 represents Aib or Ser.
- [0082] A12 represents Ile.
- [0083] A13 represents Aib, Ala, Gln, Leu, Tyr or D-Iva.
- [0084] A14 represents Leu.
- [0085] A15 represents Asp, Glu, Lys, Ser or Tyr.
- [0086] A16 represents Arg or Lys.
- [0087] A17 represents Aib, Gln or Ile.
- [0088] A18 represents Ala or His.
- [0089] A19 represents Gln or Ser.
- [0090] A20 represents Aib, Ala or Gln.
- [0091] A21 represents Asn, Asp, Glu, Leu, or Ser.
- [0092] A22 represents Phe or α MePhe.
- [0093] A23 represents Ile or Val.
- [0094] A24 represents Arg, Asn, Asp, Lys, or Lys(Ac).
- [0095] A25 represents Trp.
- [0096] A26 represents Aib, Iva, or Leu.
- [0097] A27 represents Leu.
- [0098] A28 represents Ala, Arg, Lys or Lys(Ac).
- [0099] A29 represents Gln or Gly.
- [0100] A30 represents Arg, Gly, or a deletion.
- [0101] A31 represents Pro or a deletion.
- [0102] A32 represents Ser or a deletion.
- [0103] A33 represents Ser or a deletion.
- [0104] A34 represents Gly or a deletion.
- [0105] A35 represents Ala or a deletion.
- [0106] A36 represents Pro or a deletion.
- [0107] A37 represents Pro or a deletion.
- [0108] A38 represents Pro or a deletion.
- [0109] A39 represents Lys, Ser, or a deletion.
- [0110] A40 represents Arg, Lys or a deletion.
- [0111] Provided that where all A31 to A40 represent deletions, then A2 represents Aib.
- [0112] Any one or two amino acids selected from A8 to A30 optionally represent Lys(R). R represents a substituent group.
- [0113] Preferably, R represents X-L-, wherein L represents a bivalent linker comprising PEG and/or amino acid or consisting of PEG and/or amino acid, and X represents a substituent group. A Known PEG linker, an amino acid linker or combinations thereof may be used as the bivalent linker as long as it is able to link Lys to a substituent group. Alternatively, preferably, R represents X-L-, wherein L represents a bond or a

bivalent substituent group, and X represents an optionally substituted hydrocarbon group, or a salt thereof. A Known bivalent substituent group including, but are not limited to, an alkylene group, a carbonyl group, an oxycarbonyl group, an imino group, an alkylimino group, a sulfonyl group, an oxy group, a sulfide group, an ester bond, an amide bond, a carbonate bond or combinations thereof may be used. More preferably, R represents X-L-, wherein L is one or a combination of more than one selected from



a glycine linker comprising one or two to nine-linked glycine(s) or a single bond, and X represents C₆-C₂₀ monacid or diacid, or an acetyl group.

Specifically, R represents X-L-, wherein X-L- preferably represents Trda-GGGG-(Trda:C13 diacid), Trda-GGGGG-, Trda-GGGGGG-, Teda-GGGG-(Teda:C14 diacid), Teda-GGGGG-, Teda-GGGGGG-, Peda-GGGG-(Peda:C15 diacid), Peda-GGGGG-, Peda-GGGGGG-, Heda-GGGG-(Heda:C16 diacid), Heda-GGGGG-, Heda-GGGGGG-, Hepda-GGGG-(Hepda:C17 diacid), Hepda-GGGGG-, Hepda-GGGGGG-, Oda-GGGG-(Oda:C18 diacid), Oda-GGGGG-, Oda-GGGGGG-, Eda-GGGG-(Eda:C20 diacid), Eda-GGGGG-, Eda-GGGGGG-, Eda-GGGGGGGGGG-.

Alternatively, particularly preferably, R represents X-L-, wherein L represents a glycine linker comprising five or six-linked glycines, and X represents C₁₆-C₂₀ linear saturated dicarboxylic acid.

[0114] Additionally, when any one or two amino acids selected from A8 to A30 optionally represent Lys(R), preferably one amino acid selected from A12, A14 and A17 represents Lys(R), and more preferably one amino acid selected from A14 and A17 represents Lys(R).

[0115] Preferable examples of Compound (I) include a peptide represented by the following formula (II) or a salt thereof.

formula (II):

P¹-Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-A39-A40-P² (SEQ ID NO: 166)

[0116] In the formula (II), P¹ is defined as above.

[0117] P² is defined as above.

[0118] A2 represents Aib or D-Ala.

[0119] A6 represents Iva, Phe, or Val.

[0120] A7 represents Ile, Lys or Val.

[0121] A8 represents Ser.

[0122] A9 represents Asp, Leu or Phe.

[0123] A10 represents Tyr.

[0124] A11 represents Aib or Ser.

[0125] A12 represents Ile.

[0126] A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva.

[0127] A14 represents Leu.

[0128] A15 represents Asp, Glu, Lys, Ser or Tyr.

[0129] A16 represents Arg or Lys.

[0130] A17 represents Aib, Gln or Ile.

[0131] A18 represents Ala or His.

[0132] A19 represents Gln or Ser.

[0133] A20 represents Aib, Ala, or Gln.

[0134] A21 represents Asn, Asp, Glu, Leu or Ser.

[0135] A22 represents Phe or α MePhe.

[0136] A23 represents Ile or Val.

[0137] A24 represents Arg, Asn, Asp, Lys, or Lys(Ac).

[0138] A25 represents Trp.

[0139] A26 represents Aib, Iva, or Leu.

[0140] A27 represents Leu.

[0141] A28 represents Ala, Arg, Lys, or Lys(Ac).

[0142] A29 represents Gln or Gly.

[0143] A30 represents Arg or Gly.

[0144] A39 represents Lys or Ser.

[0145] A40 represents Arg, Lys or a deletion.

[0146] Any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and R is defined as above.

[0147] Preferable other examples of Compound (I) include a peptide represented by the following formula (III) or a salt thereof.

formula (III):

P¹-Tyr-A2-Glu-Gly-Thr-Val-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-A39-A40-P² (SEQ ID NO: 167)

[0148] In the formula (III), P¹ is defined as above.

[0149] P² is defined as above.

[0150] A2 represents Aib or D-Ala.

[0151] A7 represents Ile, Lys, or Val.

[0152] A8 represents Ser.

[0153] A9 represents Asp, Leu, or Phe.

[0154] A10 represents Tyr.

[0155] A11 represents Ser.

[0156] A12 represents Ile.

[0157] A13 represents Aib, Ala, Gln, Leu, or Tyr.

[0158] A14 represents Leu.

[0159] A15 represents Asp, Glu, Lys, Ser, or Tyr.

[0160] A16 represents Lys.

[0161] A17 represents Gln or Ile.

[0162] A18 represents Ala or His.

[0163] A19 represents Gln or Ser.

[0164] A20 represents Aib or Gln.

[0165] A21 represents Glu, or Leu.

[0166] A22 represents Phe.

[0167] A23 represents Ile or Val.

[0168] A24 represents Lys, or Lys(Ac).

[0169] A25 represents Trp.

[0170] A26 represents Aib, or Leu.

[0171] A27 represents Leu.

[0172] A28 represents Lys, or Lys(Ac).

[0173] A29 represents Gly.

[0174] A30 represents Gly.

[0175] A39 represents Lys, or Ser.

[0176] A40 represents Arg or a deletion.

[0177] Any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and R is defined as above.

[0178] Furthermore, preferable other examples of Compound (I) include a peptide rep-

resented by the following formula (IV) or a salt thereof.

formula (IV):

P¹-Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40-P² (SEQ ID NO: 168)

- [0179] In the formula (IV), P¹ is defined as above.
- [0180] P² is defined as above.
- [0181] A6 represents Iva, Phe, or Val.
- [0182] A7 represents Ile or Val.
- [0183] A8 represents Ser.
- [0184] A9 represents Asp or Leu.
- [0185] A10 represents Tyr.
- [0186] A11 represents Aib or Ser.
- [0187] A12 represents Ile.
- [0188] A13 represents Aib, Ala, or D-Iva.
- [0189] A14 represents Leu.
- [0190] A15 represents Asp.
- [0191] A16 represents Arg.
- [0192] A17 represents Aib, Gln, or Ile.
- [0193] A18 represents Ala or His.
- [0194] A19 represents Gln.
- [0195] A20 represents Aib, Ala, or Gln.
- [0196] A21 represents Glu, Asn, Asp, or Ser.
- [0197] A22 represents Phe or αMePhe.
- [0198] A23 represents Val.
- [0199] A24 represents Arg, Asp or Asn.
- [0200] A25 represents Trp.
- [0201] A26 represents Leu or Iva.
- [0202] A27 represents Leu.
- [0203] A28 represents Ala or Arg.
- [0204] A29 represents Gln or Gly.
- [0205] A30 represents Arg or Gly.
- [0206] A40 represents Arg or a deletion.
- [0207] Any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and R is defined as above.
- [0208] Moreover, preferable other examples of Compound (I) include a peptide represented by the following formula (V) or a salt thereof.
formula (V):

P¹-Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P² (SEQ ID NO: 169)

- [0209] In the formula (V), P¹ is defined as above.
- [0210] P² is defined as above.
- [0211] A6 represents Iva, Phe, or Val.
- [0212] A7 represents Ile, Lys, or Val.
- [0213] A8 represents Ser.
- [0214] A9 represents Asp, Leu, or Phe.
- [0215] A10 represents Tyr.
- [0216] A11 represents Aib or Ser.
- [0217] A12 represents Ile.
- [0218] A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva.
- [0219] A14 represents Leu.
- [0220] A15 represents Asp, Glu, Lys, Ser, or Tyr.
- [0221] A16 represents Arg or Lys.
- [0222] A17 represents Aib, Gln, or Ile.
- [0223] A18 represents Ala or His.
- [0224] A19 represents Gln or Ser.
- [0225] A20 represents Aib, Ala, or Gln.
- [0226] A21 represents Asn, Asp, Glu, Leu, or Ser.
- [0227] A22 represents Phe or αMePhe.
- [0228] A23 represents Ile or Val.
- [0229] A24 represents Arg, Asn, Lys, or Lys(Ac).
- [0230] A25 represents Trp.
- [0231] A26 represents Aib, Iva, or Leu.
- [0232] A27 represents Leu.
- [0233] A28 represents Ala, Arg, Lys, or Lys(Ac).
- [0234] A29 represents Gln or Gly.
- [0235] A30 represents Arg, Gly or a deletion.
- [0236] All A31 to A40 represent a deletion.
- [0237] Any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and R is defined as above.
- [0238] Specifically preferable examples of Compound (I) include a peptide represented by the following formula (VI) or a salt thereof.

formula (VI):

P¹-Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-P

ro-Pro-Pro-Ser-A40-P² (SEQ ID NO: 170)

- [0239] In the formula (VI), P¹ is defined as above.
- [0240] P² is defined as above.
- [0241] A6 represents Iva, Phe, or Val.
- [0242] A7 represents Ile or Val.
- [0243] A8 represents Ser.
- [0244] A9 represents Asp or Leu.
- [0245] A10 represents Tyr.
- [0246] A11 represents Ser.
- [0247] A12 represents Ile.
- [0248] A13 represents Aib or Ala.
- [0249] A14 represents Leu.
- [0250] A15 represents Asp.
- [0251] A16 represents Arg or Lys.
- [0252] A17 represents Aib, Gln, or Ile.
- [0253] A18 represents Ala or His.
- [0254] A19 represents Gln.
- [0255] A20 represents Aib, or Gln.
- [0256] A21 represents Asn, Glu, or Asp.
- [0257] A22 represents Phe.
- [0258] A23 represents Val.
- [0259] A24 represents Arg, Asn, or Lys.
- [0260] A25 represents Trp.
- [0261] A26 represents Iva or Leu.
- [0262] A27 represents Leu.
- [0263] A28 represents Ala, Arg, or Lys.
- [0264] A29 represents Gln or Gly.
- [0265] A30 represents Arg, or Gly.
- [0266] A40 represents Arg, Lys, or a deletion.
- [0267] Any one or two amino acids selected from A8 to A30 optionally represent Lys(R), and R is defined as above.
- [0268] Further, preferable other examples of Compound (I) include a peptide represented by the above formula (I),
wherein P¹ is defined as above,
- [0269] P² is defined as above,
- [0270] A2 represents Aib or D-Ala,
- [0271] A6 represents Iva, Phe, or Val,
- [0272] A7 represents Ile, Lys, or Val,

- [0273] A8 represents Ser,
- [0274] A9 represents Asp, Leu, or Phe,
- [0275] A10 represents Tyr,
- [0276] A11 represents Aib or Ser,
- [0277] A12 represents Ile,
- [0278] A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva,
- [0279] A14 represents Leu,
- [0280] A15 represents Asp, Glu, Lys, Ser, or Tyr,
- [0281] A16 represents Arg or Lys,
- [0282] A17 represents Aib, Gln, or Ile,
- [0283] A18 represents Ala or His,
- [0284] A19 represents Gln or Ser,
- [0285] A20 represents Aib, Ala, or Gln,
- [0286] A21 represents Asn, Asp, Glu, Leu, or Ser,
- [0287] A22 represents Phe or α MePhe,
- [0288] A23 represents Ile or Val,
- [0289] A24 represents Arg, Asn, Asp, Lys, or Lys(Ac),
- [0290] A25 represents Trp,
- [0291] A26 represents Aib, Iva, or Leu,
- [0292] A27 represents Leu,
- [0293] A28 represents Ala, Arg, Lys, or Lys(Ac),
- [0294] A29 represents Gln or Gly,
- [0295] A30 represents Arg, Gly or a deletion,
- [0296] A31 represents Pro or a deletion,
- [0297] A32 represents Ser or a deletion,
- [0298] A33 represents Ser or a deletion,
- [0299] A34 represents Gly or a deletion,
- [0300] A35 represents Ala or a deletion,
- [0301] A36 represents Pro or a deletion,
- [0302] A37 represents Pro or a deletion,
- [0303] A38 represents Pro or a deletion,
- [0304] A39 represents Lys, Ser or a deletion, and
- [0305] A40 represents Arg, Lys, or a deletion,
or a salt thereof.
- [0306] Provided that all A31 to A40 represent deletions, then A2 represents Aib.
- [0307] Furthermore, preferable other examples of Compound (I) include a peptide represented by the above formula (I),
wherein P¹ is defined as above,

- [0308] P² is defined as above,
- [0309] A2 represents Aib or D-Ala,
- [0310] A6 represents Iva, Phe, or Val,
- [0311] A7 represents Ile, Lys, or Val,
- [0312] A8 represents Ser,
- [0313] A9 represents Asp, Leu, or Phe,
- [0314] A10 represents Tyr,
- [0315] A11 represents Aib or Ser,
- [0316] A12 represents Ile,
- [0317] A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva,
- [0318] A14 represents Leu,
- [0319] A15 represents Asp, Glu, Lys, Ser, or Tyr,
- [0320] A16 represents Arg or Lys,
- [0321] A17 represents Aib, Gln, or Ile,
- [0322] A18 represents Ala or His,
- [0323] A19 represents Gln or Ser,
- [0324] A20 represents Aib, Ala, or Gln,
- [0325] A21 represents Asn, Asp, Glu, Leu, or Ser,
- [0326] A22 represents Phe or α MePhe,
- [0327] A23 represents Ile or Val,
- [0328] A24 represents Arg, Asn, Lys, or Lys(Ac),
- [0329] A25 represents Trp,
- [0330] A26 represents Aib, Iva, or Leu,
- [0331] A27 represents Leu,
- [0332] A28 represents Ala, Arg, Lys, or Lys(Ac),
- [0333] A29 represents Gln or Gly,
- [0334] A30 represents Arg, Gly or a deletion,
- [0335] A31 represents Pro or a deletion,
- [0336] A32 represents Ser or a deletion,
- [0337] A33 represents Ser or a deletion,
- [0338] A34 represents Gly or a deletion,
- [0339] A35 represents Ala or a deletion,
- [0340] A36 represents Pro or a deletion,
- [0341] A37 represents Pro or a deletion,
- [0342] A38 represents Pro or a deletion,
- [0343] A39 represents Lys, Ser or a deletion, and
- [0344] A40 represents Arg, Lys, or a deletion,
or a salt thereof.

- [0345] Provided that all A31 to A40 represent deletions, then A2 represents Aib.
- [0346] Any one or two amino acids selected from A12, A14 and A17 optionally represent Lys(R), and R is defined as above.
- [0347] Further more preferable other examples of Compound (I) include a peptide represented by the following formula (VII) or a salt thereof.
 formula (VII):
 P^1 -Tyr-Aib-Glu-Gly-Thr-A6-A7-Ser-A9-Tyr-Ser-Ile-A13-Leu-Asp-A16-A17-A18-Gln-A20-A21-Phe-Val-A24-Trp-A26-Leu-A28-A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Ser-A40- P^2 (SEQ ID NO:567)
- [0348] In the formula (VII), P^1 is defined as above.
- [0349] P^2 is defined as above.
- [0350] A6 represents Iva, Phe, or Val.
- [0351] A7 represents Ile or Val.
- [0352] A9 represents Asp or Leu.
- [0353] A13 represents Aib or Ala.
- [0354] A16 represents Arg or Lys.
- [0355] A17 represents Aib, Gln, or Ile.
- [0356] A18 represents Ala or His.
- [0357] A20 represents Aib, or Gln.
- [0358] A21 represents Asn, Glu, or Asp.
- [0359] A24 represents Arg, Asn, or Lys.
- [0360] A26 represents Iva or Leu.
- [0361] A28 represents Ala, Arg, or Lys.
- [0362] A29 represents Gln or Gly.
- [0363] A30 represents Arg, or Gly.
- [0364] A40 represents Arg, Lys, or a deletion.
- [0365] Further more preferable other examples of Compound (I) include a peptide represented by the following formula (VIII) or a salt thereof.
 formula (VIII):
 P^1 -Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(R)-Asp-Arg-Aib-A18-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40- P^2 (SEQ ID NO:568);
- [0366] In the formula (VIII), P^1 is defined as above.
- [0367] P^2 is defined as above.
- [0368] A18 represents Ala or His.
- [0369] A40 represents Arg or a deletion.
- [0370] R represents X-L-.
- [0371] -L- represents -GGGGG- or -GGGGGG-.

[0372] X represents Heda, Hepda, Oda or Eda.

[0373] Further more preferable other examples of Compound (I) include a peptide represented by the following formula (IX) or a salt thereof.

formula (IX):

P¹-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(R)-A18-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40-P² (SEQ ID NO:569);

[0374] In the formula (IX), P¹ is defined as above.

[0375] P² is defined as above.

[0376] A18 represents Ala or His.

[0377] A40 represents Arg or a deletion.

[0378] R represents X-L-.

[0379] -L- represents -GGGGG- or -GGGGGG-.

[0380] X represents Heda, Hepda, Oda or Eda.

[0381] Specifically preferable concrete examples of Compound (I) include a peptide represented by the following formula:

H-Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 12);

H-Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Gln-Ala-Gln-Aib-Glu-Phe-Val-Arg-Trp-Leu-Leu-Arg-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 36);

Me-Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Ile-Ala-Gln-Gln-Asp-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 65);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 110);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 119);

Me-Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 123);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 458);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGGG-)-

Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 470);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 478);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 479);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 454);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 452);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 354);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 355);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:520);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:522);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:521);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:523);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:495);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:497);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:488);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:534);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:536);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:537);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:538);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:519);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:539);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:492);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:486);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:533);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:540);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Heda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:541);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-

Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:542);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hepda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:527);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:543);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:495);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:544);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGGG-)-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:535);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:545);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:507);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:546);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 508);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 362);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:509);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:547);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GG

GGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:548);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:549);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:516);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:515);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:517);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:504);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:505);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:506);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO:550);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:551);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:552);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:553);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:554);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:555);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:556);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:557);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GGGGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:558);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:559);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Heda-GGGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:560);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:561);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Hepda-GGGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:562);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:563);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:499);

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:564);

or

Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-GGGGG-)-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO:565);

or a salt thereof.

[0382] Additionally, Specifically preferable other examples of Compound (I) include a peptide represented by the following formula (X) or a salt thereof.

formula (X):

P¹-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-A14-Asp-Arg-A17-A18-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40-P² (SEQ ID NO:566)

[0383] In the formula (X), P¹ is defined as above.

[0384] P² is defined as above.

[0385] A14 represents Leu.

[0386] A17 represents Aib.

[0387] A18 represents Ala or His.

[0388] A40 represents Arg or a deletion.

[0389] Any one of amino acids selected from A14 and A17 represent Lys(R).

[0390] R represents X-L-.

[0391] L represents a glycine linker comprising five or six-linked glycines.

[0392] X represents C₁₆-C₂₀ linear saturated dicarboxylic acid.

[0393] Moreover, examples of Compound (I) include peptides represented by SEQ ID NO: 1, SEQ ID NO: 2, or SEQ ID NO: 3.

[0394] Compound (I) can be produced according to a peptide synthesis method known per se. The peptide synthesis method may be any of, for example, a solid phase synthesis process and a liquid phase synthesis process. That is, the object peptide can be produced by repeating condensation of a partial peptide or amino acid capable of constituting compound (I) and the remaining portion (which may be constituted by two or more amino acids) according to a desired sequence. When a product having the desirable sequence has a protecting group, the object peptide can be produced by eliminating a protecting group. Examples of the condensing method and eliminating method of a protecting group to be known include methods described in the following (1)-(5).

(1) M. Bodanszky and M.A. Ondetti: Peptide Synthesis, Interscience Publishers, New York (1966)

(2) Schroeder and Luebke: The Peptide, Academic Press, New York (1965)

(3) Nobuo Izumiya, et al.: Peptide Gosei-no-Kiso to Jikken (Basics and experiments of peptide synthesis), published by Maruzen Co. (1975)

(4) Haruaki Yajima and Shunpei Sakakibara: Seikagaku Jikken Koza (Biochemical Experiment) 1, Tanpakushitsu no Kagaku (Chemistry of Proteins) IV, 205 (1977)

(5) Haruaki Yajima, ed.: Zoku Iyakuhin no Kaihatsu (A sequel to Development of Pharmaceuticals), Vol. 14, Peptide Synthesis, published by Hirokawa Shoten

[0395] After the reaction, compound (I) can be purified and isolated using conventional

methods of purification, such as solvent extraction, distillation, column chromatography, liquid chromatography, recrystallization, etc., in combination thereof. When the peptide obtained by the above-mentioned method is in a free form, it can be converted to a suitable salt by a known method; conversely, when the peptide is obtained in the form of a salt, the salt can be converted to a free form or other salt by a known method.

- [0396] The starting compound may also be a salt. Examples of such salt include those exemplified as salts of compound (I) mentioned below.
- [0397] For condensation of protected amino acid or peptide, various activation reagents usable for peptide synthesis can be used, which are particularly preferably trisphosphonium salts, tetramethyluronium salts, carbodiimides and the like. Examples of the trisphosphonium salt include benzotriazol-1-yloxytris(pyrrolizino)phosphoniumhexafluorophosphate (PyBOP), bromotris(pyrrolizino)phosphoniumhexafluorophosphate (PyBroP), 7-azabenzotriazol-1-yloxytris(pyrrolizino)phosphoniumhexafluorophosphate (PyAOP), examples of the tetramethyluronium salt include 2-(1H-benzotriazol-1-yl)-1,1,3,3-tetramethyluroniumhexafluorophosphate (HBTU), 2-(7-azabenzotriazol-1-yl)-1,1,3,3-tetramethyluroniumhexafluorophosphate (HATU), 2-(1H-benzotriazol-1-yl)-1,1,3,3-tetramethyluroniumtetrafluoroborate (TBTU), 2-(5-norbornene-2,3-dicarboxyimide)-1,1,3,3-tetramethyluroniumtetrafluoroborate (TNTU), O-(N-succinimidyl)-1,1,3,3-tetramethyluroniumtetrafluoroborate (TSTU), and examples of the carbodiimide include N,N'-Dicyclohexylcarbodiimide (DCC), N,N'-diisopropylcarbodiimide (DIPCDI), N-ethyl-N'-(3-dimethylaminopropyl)carbodiimide hydrochloride (EDCI · HCl) and the like. For condensation using these, addition of a racemization inhibitor [e.g., N-hydroxy-5-norbornene-2,3-dicarboxylic imide (HONB), 1-hydroxybenzotriazole (HOBt), 1-Hydroxy-7-azabenzotriazole (HOAt), 3,4-Dihydro-3-hydroxy-4-oxo-1,2,3-benzotriazine (HOObt), ethyl 2-cyano-2-(hydroxyimino)acetate (Oxyma)etc.] is preferable. A solvent to be used for the condensation can be appropriately selected from those known to be usable for peptide condensation reaction. For example, acid amides such as anhydrous or water-containing N,N-dimethylformamide, N,N-dimethylacetamide, N-methylpyrrolidone and the like, halogenated hydrocarbons such as methylene chloride, chloroform and the like, alcohols such as trifluoroethanol, phenol and the like, sulfoxides such as dimethylsulfoxide and the like, tertiary amines such as pyridine and the like, ethers such as dioxane, tetrahydrofuran and the like, nitriles such as acetonitrile, propionitrile and the like, esters such as methyl acetate, ethyl acetate and the like, an appropriate mixture of these and the like can be used. Reaction temperature is appropriately

selected from the range known to be usable for peptide binding reactions, and is normally selected from the range of about -20°C to 90°C . An activated amino acid derivative is normally used from 1.5 to 6 times in excess. In solid phase synthesis, when a test using the ninhydrin reaction reveals that the condensation is insufficient, sufficient condensation can be conducted by repeating the condensation reaction without elimination of protecting groups. If the condensation is yet insufficient even after repeating the reaction, unreacted amino acids can be acylated with acetic anhydride, acetylimidazole or the like so that an influence on the subsequent reactions can be avoided.

- [0398] Examples of the protecting groups for the amino groups of the starting amino acid include benzyloxycarbonyl (Z), tert-butoxycarbonyl (Boc), tert-pentyloxycarbonyl, isobornyloxycarbonyl, 4-methoxybenzyloxycarbonyl, 2-chlorobenzyloxycarbonyl (Cl-Z), 2-bromobenzyloxycarbonyl (Br-Z), adamantyloxycarbonyl, trifluoroacetyl, phthaloyl, formyl, 2-nitrophenylsulphenyl, diphenylphosphinothioyl, 9-fluorenylmethyloxycarbonyl (Fmoc), trityl and the like.
- [0399] Examples of the carboxyl-protecting group for the starting amino acid include aryl, 2-adamantyl, 4-nitrobenzyl, 4-methoxybenzyl, 4-chlorobenzyl, phenacyl and benzyloxycarbonylhydrazide, tert-butoxycarbonylhydrazide, tritylhydrazide and the like, in addition to the above-mentioned C_{1-6} alkyl group, C_{3-10} cycloalkyl group, C_{7-14} aralkyl group.
- [0400] The hydroxyl group of serine or threonine can be protected, for example, by esterification or etherification. Examples of the group suitable for the esterification include lower (C_{2-4}) alkanoyl groups such as an acetyl group and the like, aroyl groups such as a benzoyl group and the like, and the like, and a group derived from an organic acid and the like. In addition, examples of the group suitable for etherification include benzyl, tetrahydropyranyl, tert-butyl (Bu^t), trityl (Trt) and the like.
- [0401] Examples of the protecting group for the phenolic hydroxyl group of tyrosine include Bzl, 2,6-dichlorobenzyl, 2-nitrobenzyl, Br-Z, tert-butyl and the like.
- [0402] Examples of the protecting group for the imidazole of histidine include p-toluenesulfonyl (Tos), 4-methoxy-2,3,6-trimethylbenzenesulfonyl (Mtr), dinitrophenyl (DNP), benzyloxymethyl (Bom), tert-butoxymethyl (Bum), Boc, Trt, Fmoc and the like.
- [0403] Examples of the protecting group for the guanidino group of arginine include Tos, Z, 4-methoxy-2,3,6-trimethylbenzenesulfonyl (Mtr), p-methoxybenzenesulfonyl (MBS), 2,2,5,7,8-pentamethylchromane-6-sulfonyl (Pmc), mesitylene-2-sulfonyl (Mts), 2,2,4,6,7-pentamethyldihydrobenzofuran-5-sulfonyl (Pbf), Boc, Z, NO_2 and the like.
- [0404] Examples of the protecting group for a side chain amino group of lysine include Z, Cl-Z, trifluoroacetyl, Boc, Fmoc, Trt, Mtr, 4,4-dimethyl-2,6-dioxocyclohexylideneyl

(Dde) and the like.

- [0405] Examples of the protecting group for indolyl of tryptophan include formyl (For), Z, Boc, Mts, Mtr and the like.
- [0406] Examples of the protecting group for asparagine and glutamine include Trt, xanthyl (Xan), 4,4'-dimethoxybenzhydryl (Mbh), 2,4,6-trimethoxybenzyl (Tmob) and the like.
- [0407] Examples of activated carboxyl groups in the starting material include corresponding acid anhydride, azide, active esters [ester with alcohol (e.g., pentachlorophenol, 2,4,5-trichlorophenol, 2,4-dinitrophenol, cyanomethylalcohol, paranitrophenol, HONB, N-hydroxysuccinimide, 1-hydroxybenzotriazole (HOBt), 1-hydroxy-7-azabenzotriazole(HOAt))] and the like. Examples of the activated amino group in the starting material include corresponding phosphorous amide.
- [0408] Examples of the method for removing (eliminating) a protecting group include a catalytic reduction in a hydrogen stream in the presence of a catalyst such as Pd-black or Pd-carbon; an acid treatment using anhydrous hydrogen fluoride, methanesulfonic acid, trifluoromethanesulfonic acid, trifluoroacetic acid (TFA), trimethylsilyl bromide (TMSBr), trimethylsilyl trifluoromethanesulfonate, tetrafluoroboric acid, tris(trifluoro)boric acid, boron tribromide, or a mixture solution thereof; a base treatment using diisopropylethylamine, triethylamine, piperidine, piperazine or the like; and reduction with sodium in liquid ammonia, and the like. The elimination reaction by the above-described acid treatment is generally carried out at a temperature of -20°C to 40°C; the acid treatment is efficiently conducted by adding a cation scavenger such as anisole, phenol, thioanisole, metacresol and paracresol; dimethylsulfide, 1,4-butanedithiol, 1,2-ethanedithiol, triisopropylsilane and the like. Also, a 2,4-dinitrophenyl group used as a protecting group of the imidazole of histidine is removed by thiophenol treatment; a formyl group used as a protecting group of the indole of tryptophan is removed by deprotection by acid treatment in the presence of 1,2-ethanedithiol, 1,4-butanedithiol, or the like, as well as by alkali treatment with dilute sodium hydroxide, dilute ammonia, or the like.

Protection of a functional group that should not be involved in the reaction of a starting material and a protecting group, elimination of the protecting group, activation of a functional group involved in the reaction and the like can be appropriately selected from known protecting groups and known means.

- [0409] In a method of preparing an amide of the peptide, it is formed by a solid phase synthesis using a resin for amide synthesis, or the α -carboxyl group of the carboxy terminal amino acid is amidated, and a peptide chain is elongated to a desired chain length toward the amino group side, thereafter a peptide wherein the protecting group for the N-terminal α -amino group of the peptide chain only removed and a peptide wherein the protecting group for the C-terminal carboxyl group only removed of the

peptide chain are prepared, and the both peptides are condensed in a mixed solvent described above. For details about the condensation reaction, the same as above applies. After the protected peptide obtained by the condensation is purified, all protecting groups can be removed by the above-described method to yield a desired crude polypeptide. By purifying this crude peptide using various publicly known means of purification, and freeze-drying the main fraction, a desired amide of the peptide can be prepared.

- [0410] When the compound (I) is present as a configurational isomer such as enantiomer, diastereomer etc., a conformer or the like, they are also encompassed in compound (I) and each can be isolated by a means known per se or the above separation and purification methods on demand. In addition, when the compound (I) is in the form of a racemate, it can be separated into S- and R-forms by conventional optical resolution.

When the compound (I) includes stereoisomers, both the isomers alone and mixtures of each isomers are also encompassed in compound (I).

- [0411] Compound (I) can be chemically modified according to a method known per se and using substituent and polyethylene glycol. For example, chemically modified compound (I) can be produced by introducing substituent and/or conjugatedly binding polyethylene glycol to Cys residue, Asp residue, Glu residue, Lys residue and the like of compound (I). Additionally, there may be a linker structure between the compound (I) and substituent and polyethylene glycol.

- [0412] Compound (I) modified by substituent and/or polyethylene glycol (PEG) produces, for example, the effects of promoting the biological activity, prolonging the blood circulation time, reducing the immunogenicity, enhancing the solubility, and enhancing the resistance to metabolism, of a therapeutically and diagnostically important peptide.

- [0413] The molecular weight of PEG is not particularly limited and is normally about 1 K to about 1000 K daltons, preferably about 10 K to about 100 K daltons, more preferably about 20 K to about 60 K daltons.

- [0414] Modifying compound (I) by substituent can be conducted by introducing the substituent based on known oxidation reaction and reduction reaction.

- [0415] A method well known in the art can be used as a method for modifying compound (I) by PEG, and, for example, the methods described below can be used.

(1) A PEGylating reagent having an active ester (e.g., SUNBRIGHT MEGC-30TS (trade name), NOF Corp.) is bound to the amino group of compound (I).

(2) A PEGylating reagent having an aldehyde (e.g., SUNBRIGHT ME-300AL (trade name), NOF Corp.) is bound to the amino group of compound (I).

(3) A divalent cross-linking reagent (e.g., GMBS (Dojindo Laboratories), EMCS (Dojindo Laboratories), KMUS (Dojindo Laboratories), SMCC (Pierce)) is bound to compound (I), to which a PEGylating reagent having a thiol group (e.g., SUNBRIGHT

ME-300-SH (trade name), NOF Corp.) is then bound.

(4) A thiol group is introduced to compound (I) through an SH-introducing agent (e.g., D-cysteine residue, L-cysteine residue, Traut's reagent), and this thiol group is reacted with a PEGylating reagent having a maleimide group (e.g., SUNBRIGHT ME-300MA (trade name), NOF Corp.).

(5) A thiol group is introduced to compound (I) through an SH-introducing agent (e.g., D-cysteine residue, L-cysteine residue, Traut's reagent), and this thiol group is reacted with a PEGylating reagent having an iodoacetamide group (e.g., SUNBRIGHT ME-300IA (trade name), NOF Corp.).

(6) A ω -aminocarboxylic acid, an α -amino acid or the like is introduced as a linker to the N-terminal amino group of compound (I), and an amino group derived from this linker is reacted with a PEGylating reagent having an active ester (e.g., SUNBRIGHT MEGC-30TS (trade name), NOF Corp.).

(7) A ω -aminocarboxylic acid, an α -amino acid or the like is introduced as a linker to the N-terminal amino group of compound (I), and an amino group derived from this linker is reacted with a PEGylating reagent having an aldehyde group (e.g., SUNBRIGHT ME-300AL (trade name), NOF Corp.).

[0416] In addition, the compound (I) may be a solvate (e.g., hydrate) or a non-solvate (e.g., non-hydrate).

[0417] The compound (I) may be labeled with an isotope (e.g., ^3H , ^{14}C , ^{35}S , ^{125}I) or the like.

[0418] Furthermore, compound (I) may be a deuterium conversion form wherein ^1H is converted to $^2\text{H}(\text{D})$.

[0419] Compound (I) labeled or substituted with an isotope can be used as, for example, a tracer (PET tracer) for use in Positron Emission Tomography (PET), and is useful in the fields of medical diagnosis and the like.

[0420] For the peptides mentioned herein, the left end is the N-terminal (amino terminal) and the right end is the C-terminal (carboxyl terminal) in accordance with the conventional peptide marking. The C-terminal of peptide may be any of an amide ($-\text{CONH}_2$), a carboxyl group ($-\text{COOH}$), a carboxylate ($-\text{COO}^-$), an alkylamide ($-\text{CONHR}^a$), and an ester ($-\text{COOR}^a$). Particularly, amide ($-\text{CONH}_2$) is preferable.

[0421] Compound (I) may be in a salt form. Examples of such salt include metal salts, ammonium salts, salts with organic base, salts with inorganic acid, salts with organic acid, salts with basic or acidic amino acid, and the like.

[0422] Preferable examples of the metal salt include alkali metal salts such as sodium salt, potassium salt and the like; alkaline earth metal salts such as calcium salt, magnesium salt, barium salt and the like; aluminum salt and the like.

[0423] Preferable examples of the salt with organic base include salts with trimethylamine, triethylamine, pyridine, picoline, 2,6-lutidine, ethanolamine, diethanolamine, tri-

ethanolamine, cyclohexylamine, dicyclohexylamine, N,N-dibenzylethylenediamine and the like.

[0424] Preferable examples of the salt with inorganic acid include salts with hydrochloric acid, hydrobromic acid, nitric acid, sulfuric acid, phosphoric acid and the like.

[0425] Preferable examples of the salt with organic acid include salts with formic acid, acetic acid, trifluoroacetic acid, phthalic acid, fumaric acid, oxalic acid, tartaric acid, maleic acid, citric acid, succinic acid, malic acid, methanesulfonic acid, benzene-sulfonic acid, p-toluenesulfonic acid and the like.

[0426] Preferable examples of the salt with basic amino acid include salts with arginine, lysine, ornithine and the like. Preferable examples of the salt with acidic amino acid include salts with aspartic acid, glutamic acid and the like.

[0427] Among the above-mentioned salts, a pharmaceutically acceptable salt is preferable. For example, when a compound has an acidic functional group, an inorganic salt such as alkali metal salt (e.g., sodium salt, potassium salt etc.), alkaline earth metal salt (e.g., calcium salt, magnesium salt, barium salt etc.) and the like, ammonium salt etc., and when a compound has a basic functional group, for example, a salt with inorganic acid such as hydrochloric acid, hydrobromic acid, nitric acid, sulfuric acid, phosphoric acid and the like, or a salt with organic acid such as acetic acid, phthalic acid, fumaric acid, oxalic acid, tartaric acid, maleic acid, citric acid, succinic acid, methanesulfonic acid, p-toluenesulfonic acid and the like are preferable.

[0428] Compound (I) may be in a prodrug form.

A prodrug means a compound which is converted to compound (I) with a reaction due to an enzyme, gastric acid, etc. under the physiological condition in the living body, that is, a compound which is converted to compound (I) with oxidation, reduction, hydrolysis, etc. according to an enzyme; a compound which is converted to compound (I) by hydrolysis etc. due to gastric acid, etc.

[0429] Examples of a prodrug of compound (I) include a compound wherein an amino of compound (I) is acylated, alkylated or phosphorylated (e.g., compound wherein amino of compound (I) is eicosanoylated, alanylated, pentylaminocarbonylated, (5-methyl-2-oxo-1,3-dioxolen-4-yl)methoxycarbonylated, tetrahydrofuranylated, pyrrolidylmethylated, pivaloyloxymethylated or tert-butylated, and the like); a compound wherein a hydroxy of compound (I) is acylated, alkylated, phosphorylated or borated (e.g., a compound wherein a hydroxy of compound (I) is acetylated, palmitoylated, propanoylated, pivaloylated, succinylated, fumarylated, alanylated or dimethylaminomethylcarbonylated); a compound wherein a carboxy of compound (I) is esterified or amidated (e.g., a compound wherein a carboxy of compound (I) is C₁₋₆ alkyl esterified, phenyl esterified, carboxymethyl esterified, dimethylaminomethyl esterified, pivaloyloxymethyl esterified, ethoxycarbonyloxyethyl esterified, phthalidyl

esterified, (5-methyl-2-oxo-1,3-dioxolen-4-yl)methyl esterified, cyclohexyloxycarbonyl ethyl esterified or methylamidated) and the like. Among others, a compound wherein carboxy of compound (I) is esterified with C₁₋₆ alkyl such as methyl, ethyl, tert-butyl or the like is preferably used. These compounds can be produced from compound (I) by a method known per se.

- [0430] A prodrug of compound (I) may also be one which is converted into compound (I) under a physiological condition, such as those described in IYAKUHIN no KAIHATSU (Development of Pharmaceuticals), Vol.7, Design of Molecules, p.163-198, Published by HIROKAWA SHOTEN (1990).
- [0431] In the present specification, the prodrug may form a salt. Examples of such a salt include those exemplified as the salt of compound (I).
- [0432] Compound (I) may be a crystal. Crystals having a singular crystal form or a mixture of plural crystal forms are also included in compound (I). Crystals can be produced by crystallizing compound (I) according to a crystallization method known per se.
- [0433] In addition, compound (I) may be a pharmaceutically acceptable cocrystal or cocrystal salt. Here, the cocrystal or cocrystal salt means a crystalline substance consisting of two or more particular substances which are solids at room temperature, each having different physical properties (e.g., structure, melting point, heat of melting, hygroscopicity, solubility, stability etc.). The cocrystal and cocrystal salt can be produced by cocrystallization known per se.
- [0434] The crystal of compound (I) is superior in physicochemical properties (e.g., melting point, solubility, stability) and biological properties (e.g., pharmacokinetics (absorption, distribution, metabolism, excretion), efficacy expression), and thus it is extremely useful as a medicament.
- [0435] Compound (I) and a prodrug thereof (hereinafter to be sometimes abbreviated as the compound of the present invention) have a GIP receptor activating action.
- [0436] The compounds of the present invention have a high GIP receptor selective activation action in vivo.
- [0437] GIP is a gastrointestinal hormone called incretin and has a promoting action on insulin secretion from the pancreas. Incretin is closely related to glucose metabolism and thus the compound having a GIP receptor activation action is useful for preventing and treating symptoms related to abnormal glucose metabolism including diabetes and obesity. Additionally, the compounds of the present invention have a GIP receptor selective activation action and suppress vomiting by activating GABAergic neurons in the area postrema.
More specifically, the compounds of the present invention have a hypoglycemic action, an antiemetic action, and the like.
- [0438] The compounds of the present invention have a high chemical stability and excellent

persistence of the effects in vivo.

[0439] The compounds of the present invention may be used as a GIP receptor activator.

[0440] In the present invention, the GIP receptor activator (GIP receptor agonist) means an agent having a GIP receptor activation action. Additionally, the GIP receptor selective activator (GIP receptor selective agonist) specifically means an agent having an EC₅₀ for the GIP receptor of 1/1000 or less, and preferably 1/10000 or less, times the EC₅₀ for the GLP-1 receptor.

[0441] The compound of the present invention is low in its toxicity (e.g., acute toxicity, chronic toxicity, genetic toxicity, reproductive toxicity, cardiac toxicity, carcinogenicity), shows a few side effects, and can be safely administered to a mammal (e.g., human, bovine, horse, dog, cat, monkey, mouse, rat) as an agent for the prophylaxis or treatment of various diseases mentioned below and the like.

[0442] The compound of the present invention can be used as an agent for the treatment or prophylaxis of various diseases including diabetes and obesity, by virtue of the above-mentioned activating action on GIP receptors. The compound of the present invention can be used as an agent for the prophylaxis or treatment of, for example, symptomatic obesity, obesity based on simple obesity, disease state or disease associated with obesity, eating disorder, diabetes (e.g., type 1 diabetes, type 2 diabetes, gestational diabetes, obese diabetes), hyperlipidemia (e.g., hypertriglyceridemia, hypercholesterolemia, high LDL-cholesterolemia, low HDL-cholesterolemia, postprandial hyperlipemia), hypertension, cardiac failure, diabetic complications [e.g., neuropathy, nephropathy, retinopathy, diabetic cardiomyopathy, cataract, macroangiopathy, osteopenia, hyperosmolar diabetic coma, infectious disease (e.g., respiratory infection, urinary tract infection, gastrointestinal infection, dermal soft tissue infections, inferior limb infection), diabetic gangrene, xerostomia, hypacusis, cerebrovascular disorder, peripheral blood circulation disorder], metabolic syndrome (disease states having 3 or more selected from hypertriglycerid(TG)emia, low HDL cholesterol(HDL-C)emia, hypertension, abdominal obesity and impaired glucose tolerance), sarcopenia and the like.

[0443] Examples of the symptomatic obesity include endocrine obesity (e.g., Cushing syndrome, hypothyroidism, insulinoma, obese type II diabetes, pseudohypoparathyroidism, hypogonadism), central obesity (e.g., hypothalamic obesity, frontal lobe syndrome, Kleine-Levin syndrome), hereditary obesity (e.g., Prader-Willi syndrome, Laurence-Moon-Biedl syndrome), drug-induced obesity (e.g., steroid, phenothiazine, insulin, sulfonylurea (SU) agent, β -blocker-induced obesity) and the like.

[0444] Examples of the disease state or disease associated with obesity include glucose tolerance disorders, diabetes (particularly type 2 diabetes, obese diabetes), lipid metabolism abnormality (synonymous with the above-mentioned hyperlipidemia), hy-

pertension, cardiac failure, hyperuricemia, gout, fatty liver (including non-alcoholic steato-hepatitis), coronary heart disease (myocardial infarction, angina pectoris), cerebral infarction (brain thrombosis, transient cerebral ischemic attack), bone/articular disease (knee osteoarthritis, hip osteoarthritis, spondylitis deformans, lumbago), sleep apnea syndrome/Pickwick syndrome, menstrual disorder (abnormal menstrual cycle, abnormality of menstrual flow and cycle, amenorrhea, abnormal catamenial symptom), metabolic syndrome and the like.

- [0445] New diagnostic criteria were reported by The Japan Diabetes Society in 1999 about the diagnostic criteria of diabetes.
- [0446] According to this report, diabetes refers to a state that meets any of a fasting blood glucose level (glucose concentration in venous plasma) of 126 mg/dl or more, a 2-hr value (glucose concentration in venous plasma) of 200 mg/dl or more in the 75 g oral glucose tolerance test (75 g OGTT), and a casual blood glucose level (glucose concentration in venous plasma) of 200 mg/dl or more. Also, a state that does not apply to the above-mentioned diabetes, and is not a state exhibiting “a fasting blood glucose level (glucose concentration in venous plasma) less than 110 mg/dl or a 2-hr value (glucose concentration in venous plasma) less than 140 mg/dl in the 75 g oral glucose tolerance test (75 g OGTT)” (normal type) is called “borderline type”.
- [0447] Moreover, new diagnostic criteria were reported by American Diabetes Association (ADA) in 1997 and by World Health Organization (WHO) in 1998 about the diagnostic criteria of diabetes.
- [0448] According to these reports, diabetes refers to a state that meets a fasting blood glucose level (glucose concentration in venous plasma) of 126 mg/dl or more and a 2-hr value (glucose concentration in venous plasma) of 200 mg/dl or more in the 75 g oral glucose tolerance test.
- [0449] According to the above-mentioned reports, impaired glucose tolerance refers to a state that meets a fasting blood glucose level (glucose concentration in venous plasma) less than 126 mg/dl and a 2-hr value (glucose concentration in venous plasma) of 140 mg/dl or more and less than 200 mg/dl in the 75 g oral glucose tolerance test. According to the report of ADA, a state exhibiting a fasting blood glucose level (glucose concentration in venous plasma) of 110 mg/dl or more and less than 126 mg/dl is called IFG (Impaired Fasting Glucose). On the other hand, according to the report of WHO, a state of the IFG (Impaired Fasting Glucose) exhibiting a 2-hr value (glucose concentration in venous plasma) less than 140 mg/dl in the 75 g oral glucose tolerance test is called IFG (Impaired Fasting Glycemia).
- [0450] The compound of the present invention is also used as an agent for the prophylaxis or treatment of diabetes determined according to the above-mentioned new diagnostic criteria, borderline type diabetes, impaired glucose tolerance, IFG (Impaired Fasting

Glucose) and IFG (Impaired Fasting Glycemia). Moreover, the compound of the present invention can prevent progress of borderline type, impaired glucose tolerance, IFG (Impaired Fasting Glucose) or IFG (Impaired Fasting Glycemia) into diabetes.

[0451] The compound of the present invention is also useful as an agent for the prophylaxis or treatment of metabolic syndrome. The incidence of cardiovascular disease is significantly high in metabolic syndrome patients, compared with patients with a single lifestyle-related disease. Thus, the prophylaxis or treatment of metabolic syndrome is exceedingly important for preventing cardiovascular disease.

[0452] The diagnostic criteria of metabolic syndrome were announced by WHO in 1999 and by NCEP in 2001. According to the diagnostic criteria of WHO, an individual having hyperinsulinemia or abnormal glucose tolerance as a requirement and two or more of visceral obesity, dyslipidemia (high TG or low HDL) and hypertension is diagnosed as having metabolic syndrome (World Health Organization: Definition, Diagnosis and Classification of Diabetes Mellitus and Its Complications. Part I: Diagnosis and Classification of Diabetes Mellitus, World Health Organization, Geneva, 1999). According to the diagnostic criteria of the Adult Treatment Panel III of the National Cholesterol Education Program (guideline of ischemic heart disease) in USA, an individual having three or more of visceral obesity, hypertriglyceridemia, low HDL-cholesterolemia, hypertension and abnormal glucose tolerance is diagnosed as having metabolic syndrome (National Cholesterol Education Program: Executive Summary of the Third Report of National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adults Treatment Panel III). The Journal of the American Medical Association, Vol. 285, 2486-2497, 2001).

[0453] The compounds of the present invention may be used as a preventive/therapeutic agent for vomiting or nausea caused, for example, by clinical pathological conditions or causes described in the following (1) to (6). Additionally, the compound of the present invention may be used as a preventive/therapeutic agent for chronic unexplained nausea and vomiting. The vomiting or nausea also includes imminent unpleasant sensations of wanting to eject the contents of the stomach through the mouth such as feeling queasy and retching, and may also be accompanied by autonomic symptoms such as facial pallor, cold sweat, salivary secretion, tachycardia, and diarrhea. The vomiting also includes acute vomiting, protracted vomiting, and anticipatory vomiting.

(1) Diseases accompanied by vomiting or nausea such as gastroparesis, gastrointestinal hypomotility, peritonitis, abdominal tumor, constipation, gastrointestinal obstruction, cyclic vomiting syndrome, chronic unexplained nausea and vomiting, acute pancreatitis, chronic pancreatitis, hyperkalemia, cerebral edema, intracranial lesion,

metabolic disorder, gastritis caused by an infection, postoperative disease, myocardial infarction, migraine, intracranial hypertension, and intracranial hypotension (e.g., altitude sickness);

(2) vomiting or nausea induced by drugs such as (i) alkylating agents (e.g., cyclophosphamide, carmustine, lomustine, chlorambucil, streptozocin, dacarbazine, ifosfamide, temozolomide, busulfan, bendamustine, and melphalan), cytotoxic antibiotics (e.g., dactinomycin, doxorubicin, mitomycin-C, bleomycin, epirubicin, actinomycin D, amrubicin, idarubicin, daunorubicin, and pirarubicin), antimetabolic agents (e.g., cytarabine, methotrexate, 5-fluorouracil, enocitabine, and clofarabine), vinca alkaloids (e.g., etoposide, vinblastine, and vincristine), other chemotherapeutic agents such as cisplatin, procarbazine, hydroxyurea, azacytidine, irinotecan, interferon α , interleukin-2, oxaliplatin, carboplatin, nedaplatin, and miriplatin; (ii) opioid analgesics (e.g., morphine); (iii) dopamine receptor D1D2 agonists (e.g., apomorphine); (iv) cannabis and cannabinoid products including cannabis hyperemesis syndrome

(3) vomiting or nausea caused by radiation sickness or radiation therapy for the chest, the abdomen, or the like used to treat cancers;

(4) vomiting or nausea caused by a poisonous substance or a toxin;

(5) vomiting and nausea caused by pregnancy including hyperemesis gravidarum; and

(6) vomiting and nausea caused by a vestibular disorder such as motion sickness or dizziness.

[0454] The compound of the present invention can also be used for secondary prevention or suppression of progression of the above-mentioned various diseases (e.g., cardiovascular events such as myocardial infarction and the like). In addition, the compound of the present invention is also useful as a feeding suppressant and a weight reducing agent. The compound of the present invention can also be used in combination with a diet therapy (e.g., diet therapy for diabetes), and an exercise therapy.

[0455] A medicament containing the compound of the present invention shows low toxicity and is obtained using the compound of the present invention alone or in admixture with a pharmacologically acceptable carrier according to a method known per se (e.g., the method described in the Japanese Pharmacopoeia) generally used as production methods of pharmaceutical preparations, and safely administered orally or parenterally (e.g., topically, rectally, intravenously administered) as a pharmaceutical preparation, for example, tablets (inclusive of sugar-coated tablets, film-coated tablets, sublingual tablets, orally disintegrating tablets), powders, granules, capsules (inclusive of soft capsules, microcapsules), liquids, troches, syrups, emulsions, suspensions, injections (e.g., subcutaneous injections, intravenous injections, intramuscular injections, intraperitoneal injections etc.), external preparations (e.g., transnasal preparations,

dermal preparations, ointments), suppository (e.g., rectal suppositories, vaginal suppositories), pellets, nasal preparations, pulmonary preparations (inhalants), transfusions and the like.

These preparations may be controlled release preparations such as a rapid release preparation, a sustained release preparation and the like (e.g., a sustained release microcapsule).

The content of the compound of the present invention in a pharmaceutical preparation is about 0.01 - about 100 wt% of the whole preparation.

- [0456] The above-mentioned pharmaceutically acceptable carrier may be exemplified by various organic or inorganic carrier materials that are conventionally used as preparation materials, for example, excipient, lubricant, binding agent and disintegrant for solid preparations; or solvent, solubilizing agent, suspending agent, isotonic agent, buffering agent, soothing agent and the like for liquid preparations. Further, if necessary, general additives such as preservative, antioxidant, colorant, sweetening agent, adsorbing agent, wetting agent and the like can be also used appropriately in a suitable amount.
- [0457] Examples of the excipient include lactose, sucrose, D-mannitol, starch, corn starch, crystalline cellulose, light anhydrous silicic acid and the like.
- [0458] Examples of the lubricant include magnesium stearate, calcium stearate, talc, colloidal silica and the like.
- [0459] Examples of the binding agent include crystalline cellulose, sucrose, D-mannitol, dextrin, hydroxypropylcellulose, hydroxypropylmethylcellulose, polyvinylpyrrolidone, starch, sucrose, gelatin, methylcellulose, carboxymethylcellulose sodium and the like.
- [0460] Examples of the disintegrant include starch, carboxymethylcellulose, carboxymethylcellulose calcium, carboxymethylstarch sodium, L-hydroxypropylcellulose and the like.
- [0461] Examples of the solvent include water for injection, alcohol, propylene glycol, Macrogol, sesame oil, corn oil, olive oil and the like.
- [0462] Examples of the solubilizing agent include polyethylene glycol, propylene glycol, D-mannitol, benzyl benzoate, ethanol, trisaminomethane, cholesterol, triethanolamine, sodium carbonate, sodium citrate and the like.
- [0463] Examples of the suspending agent include surfactants such as stearyl triethanolamine, sodium lauryl sulfate, laurylaminopropionic acid, lecithin, benzalkonium chloride, benzetonium chloride, glycerin monostearate and the like; hydrophilic polymers such as polyvinyl alcohol, polyvinylpyrrolidone, carboxymethylcellulose sodium, methylcellulose, hydroxymethylcellulose, hydroxyethylcellulose, hydroxypropylcellulose and the like; and the like.
- [0464] Examples of the isotonic agent include glucose, D-sorbitol, sodium chloride,

glycerin, D-mannitol and the like.

- [0465] Examples of the buffering agent include buffer solutions such as phosphates, acetates, carbonates, citrates and the like.
- [0466] Examples of the soothing agent include benzyl alcohol and the like.
- [0467] Examples of the preservative include parahydroxybenzoic acid esters, chlorobutanol, benzyl alcohol, phenethyl alcohol, dehydroacetic acid, sorbic acid and the like.
- [0468] Examples of the antioxidant include sulfites, ascorbic acid, α -tocopherol and the like.
- [0469] Examples of the colorant include water-soluble Food coal tar dyes (e.g., Food dyes such as Food Red No. 2 and No. 3, Food Yellow No. 4 and No. 5, Food Blue No. 1 and No. 2, and the like), water-insoluble lake dyes (e.g., aluminum salts of the aforementioned water-soluble Food coal tar dyes), natural dyes (e.g., β -carotene, chlorophyll, ferric oxide red) and the like.
- [0470] Examples of the sweetening agent include saccharin sodium, dipotassium glycyrrhizinate, aspartame, stevia and the like.
- [0471] Examples of the adsorbing include porous starch, calcium silicate (trade name: Florite RE), magnesium alumino metasilicate (trade name: Neusilin) and light anhydrous silicic acid (trade name: Sylsia).
- [0472] Examples of the wetting agent include propylene glycol monostearate, sorbitan monooleate, diethylene glycol monolaurate and polyoxyethylenelauryl ether.
- [0473] During production of an oral preparation, coating may be applied as necessary for the purpose of masking of taste, enteric property or durability.
- [0474] Examples of the coating base to be used for coating include sugar coating base, aqueous film coating base, enteric film coating base and sustained-release film coating base.
- [0475] As the sugar coating base, sucrose is used. Moreover, one or more kinds selected from talc, precipitated calcium carbonate, gelatin, gum arabic, pullulan, carnauba wax and the like may be used in combination.
- [0476] Examples of the aqueous film coating base include cellulose polymers such as hydroxypropyl cellulose, hydroxypropylmethyl cellulose, hydroxyethyl cellulose, methylhydroxyethyl cellulose etc.; synthetic polymers such as polyvinylacetal diethylaminoacetate, aminoalkyl methacrylate copolymer E [Eudragit E (trade name)], polyvinylpyrrolidone etc.; and polysaccharides such as pullulan etc.
- [0477] Examples of the enteric film coating base include cellulose polymers such as hydroxypropylmethyl cellulose phthalate, hydroxypropylmethyl cellulose acetate succinate, carboxymethylethyl cellulose, cellulose acetate phthalate etc.; acrylic polymers such as methacrylic acid copolymer L [Eudragit L (trade name)], methacrylic acid copolymer LD [Eudragit L-30D55 (trade name)], methacrylic acid copolymer S [Eudragit S (trade name)] etc.; and naturally occurring substances such as shellac etc.

[0478] Examples of the sustained-release film coating base include cellulose polymers such as ethyl cellulose etc.; and acrylic polymers such as aminoalkyl methacrylate copolymer RS [Eudragit RS (trade name)], ethyl acrylate-methyl methacrylate copolymer suspension [Eudragit NE (trade name)] etc.

[0479] The above-mentioned coating bases may be used after mixing with two or more kinds thereof at appropriate ratios. For coating, for example, a light shielding agent such as titanium oxide, red ferric oxide and the like can be used.

[0480] The dosage of the compound of the present invention is appropriately determined according to the subject of administration, symptom, administration method and the like. For example, when the compound of the present invention is administered orally to an obesity or diabetes patient or a gastroparesis (body weight 60 kg), the daily dose of the compound of the present invention is about 0.1 to 100 mg, preferably about 1.0 to 50 mg, more preferably about 1.0 to 20 mg. When the compound of the present invention is administered parenterally to an obesity or diabetes patient or a gastroparesis (body weight 60 kg), the daily dose of the compound of the present invention is about 0.001 to 30 mg, preferably about 0.01 to 20 mg, more preferably about 0.1 to 10 mg. These amounts can be administered in about 1 to several portions a day.

The compound of the present invention can be administered, for example, every 2 days, every 3 days, every 4 days, every 5 days, every 6 days, every week, twice per week, every other week, every 3 weeks, every month, every 2 months, every 3 months, every 4 months, every 5 months or every 6 months.

[0481] The compound of the present invention can be used in combination with other drug that does not adversely influence the compound of the present invention, for the purpose of, for example, promoting the action (treatment of effect for obesity, diabetes, diseases accompanied by vomiting or nausea, and the like and antiemetic action) of the compound of the present invention, reducing the dose of the compound of the present invention, and the like.

Examples of a drug that can be used in combination with the compound of the present invention (hereinafter sometimes to be abbreviated as a concomitant drug) include anti-obesity agents, therapeutic agents for diabetes, therapeutic agents for diabetic complications, therapeutic agents for hyperlipidemia, antihypertensive agents, diuretics, chemotherapeutics, immunotherapeutics, anti-inflammatory drugs, antithrombotic agents, therapeutic agents for osteoporosis, vitamins, antidementia drugs, erectile dysfunction drugs, therapeutic drugs for urinary frequency or urinary incontinence, therapeutic agents for dysuria, central D₂ receptor antagonists, prokinetic agents, antihistamines, muscarine receptor antagonists, serotonin 5HT₃ receptor antagonists, somatostatin analogues, corticosteroids, benzodiazepine anxiolytics, NK-1

receptor antagonists, hypercalcemia therapeutic drug and the like. Specific examples of the concomitant drug include those mentioned below.

[0482] Examples of the anti-obesity agent include monoamine uptake inhibitors (e.g., phentermine, sibutramine, mazindol, fluoxetine, tesofensine), serotonin 2C receptor agonists (e.g., lorcaserin), serotonin 6 receptor antagonists, histamine H3 receptor modulator, GABA modulator (e.g., topiramate), neuropeptide Y antagonists (e.g., velneperit), cannabinoid receptor antagonists (e.g., rimonabant, taranabant), ghrelin antagonists, ghrelin receptor antagonists, ghrelinacylation enzyme inhibitors, opioid receptor antagonists (e.g., GSK-1521498), orexin receptor antagonists, melanocortin 4 receptor agonists, 11 β -hydroxysteroid dehydrogenase inhibitors (e.g., AZD-4017), pancreatic lipase inhibitors (e.g., orlistat, cetilistat), β 3 agonists (e.g., N-5984), diacylglycerol acyltransferase 1 (DGAT1) inhibitors, acetylCoA carboxylase (ACC) inhibitors, stearoyl-CoA desaturated enzyme inhibitors, microsomal triglyceride transfer protein inhibitors (e.g., R-256918), Na-glucose cotransporter inhibitors (e.g., JNJ-28431754, remogliflozin), NF κ inhibitory (e.g., HE-3286), PPAR agonists (e.g., GFT-505, DRF-11605), phosphotyrosine phosphatase inhibitors (e.g., sodium vanadate, Trodusquemine), GPR119 agonists (e.g., PSN-821, MBX-2982, APD597), glucokinase activators (e.g., AZD-1656), leptin, leptin derivatives (e.g., metreleptin), CNTF (ciliary neurotrophic factor), BDNF (brain-derived neurotrophic factor), cholecystokinin agonists, amylin preparations (e.g., pramlintide, AC-2307), neuropeptide Y agonists (e.g., PYY3-36, derivatives of PYY3-36, obineptide, TM-30339, TM-30335), oxyntomodulin preparations: FGF21 preparations (e.g., animal FGF21 preparations extracted from the pancreas of bovine or swine; human FGF21 preparations genetically synthesized using *Escherichia coli* or yeast; fragments or derivatives of FGF21), anorexigenic agents (e.g., P-57), GLP-1 receptor agonist, GLP-1 receptor/GIP receptor coagonist, glucagon receptor/GLP-1 receptor/GIP receptor triagonist, and the like.

[0483] Here, as the therapeutic agent for diabetes, for example, insulin preparations (e.g., animal insulin preparations extracted from the pancreas of bovine or swine; human insulin preparations genetically synthesized using *Escherichia coli* or yeast; zinc insulin; protamine zinc insulin; fragment or derivative of insulin (e.g., INS-1), oral insulin preparation), insulin sensitizers (e.g., pioglitazone or a salt thereof (preferably, hydrochloride), rosiglitazone or a salt thereof (preferably, maleate), Metaglidasen, AMG-131, Balaglitazone, MBX-2044, Rivoglitazone, Alogliptazar, Chiglitazar, Loxaglitazone, PLX-204, PN-2034, GFT-505, THR-0921, compound described in WO007/013694, WO2007/018314, WO2008/093639 or WO2008/099794), α -glucosidase inhibitors (e.g., voglibose, acarbose, miglitol, emiglitate), biguanides (e.g., metformin, buformin or a salt thereof (e.g., hydrochloride, fumarate, succinate)), insulin secretagogues (e.g., sulfonylurea (e.g., tolbutamide, glibenclamide, gliclazide,

chlorpropamide, tolazamide, acetohexamide, glyclopyramide, glimepiride, glipizide, glybuzole), repaglinide, nateglinide, mitiglinide or calcium salt hydrate thereof), dipeptidyl peptidase IV inhibitors (e.g., Alogliptin or a salt thereof (preferably, benzoate), Vildagliptin, Sitagliptin, Saxagliptin, BI1356, GRC8200, MP-513, PF-00734200, PHX1149, SK-0403, ALS2-0426, TA-6666, TS-021, KRP-104, Trelagliptin or a salt thereof (preferably succinate)), β_3 agonists (e.g., N-5984), GPR40 agonists (e.g., Fasiglifam or a hydrate thereof, compound described in WO2004/041266, WO2004/106276, WO2005/063729, WO2005/063725, WO2005/087710, WO2005/095338, WO2007/013689 or WO2008/001931), SGLT2 (sodium-glucose cotransporter 2) inhibitors (e.g., Dapagliflozin, AVE2268, TS-033, YM543, TA-7284, Remogliflozin, ASP1941), SGLT1 inhibitors, 11β -hydroxysteroid dehydrogenase inhibitors (e.g., BVT-3498, INCB-13739), adiponectin or agonist thereof, IKK inhibitors (e.g., AS-2868), leptin resistance improving drugs, somatostatin receptor agonists, glucokinase activators (e.g., Piragliatin, AZD1656, AZD6370, TTP-355, compound described in WO006/112549, WO007/028135, WO008/047821, WO008/050821, WO008/136428 or WO008/156757), GPR119 agonists (e.g., PSN821, MBX-2982, APD597), FGF21, FGF analogue, ACC2 inhibitors, GLP-1 receptor agonist, GLP-1 receptor/GIP receptor coagonist, glucagon receptor/GLP-1 receptor/GIP receptor triagonist, and the like can be mentioned.

[0484] As the therapeutic agent for diabetic complications, aldose reductase inhibitors (e.g., tolrestat, epalrestat, zopolrestat, fidarestat, CT-112, ranirestat (AS-3201), lidorestat), neurotrophic factor and increasing agents thereof (e.g., NGF, NT-3, BDNF, neurotrophic production/secretion promoting agent described in WO01/14372 (e.g., 4-(4-chlorophenyl)-2-(2-methyl-1-imidazolyl)-5-[3-(2-methylphenoxy)propyl]oxazole), compound described in WO2004/039365), PKC inhibitors (e.g., ruboxistaurin mesylate), AGE inhibitors (e.g., ALT946, N-phenacylthiazolium bromide (ALT766), EXO-226, Pyridorin, pyridoxamine), GABA receptor agonists (e.g., gabapentin, pregabalin), serotonin and noradrenalin reuptake inhibitors (e.g., duloxetine), sodium channel inhibitors (e.g., lacosamide), active oxygen scavengers (e.g., thiocetic acid), cerebral vasodilators (e.g., tiapuride, mexiletine), somatostatin receptor agonists (e.g., BIM23190), apoptosis signal regulating kinase-1 (ASK-1) inhibitors, GLP-1 receptor agonist, GLP-1 receptor/GIP receptor coagonist, glucagon receptor/GLP-1 receptor/GIP receptor triagonist, and the like can be mentioned.

[0485] As the therapeutic agent for hyperlipidemia, HMG-CoA reductase inhibitors (e.g., pravastatin, simvastatin, lovastatin, atorvastatin, fluvastatin, rosuvastatin, pitavastatin or a salt thereof (e.g., sodium salt, calcium salt)), squalene synthase inhibitors (e.g., compound described in WO97/10224, for example, N-[[[(3R,5S)-1-(3-acetoxy-2,2-dimethylpropyl)-7-chloro-5-(2,3-dimethoxyphenyl)-2-oxo-

1,2,3,5-tetrahydro-4,1-benzoxazepin-3-yl]acetyl]piperidin-4-acetic acid), fibrate compounds (e.g., bezafibrate, clofibrate, simfibrate, clinofibrate), anion exchange resin (e.g., colestyramine), probucol, nicotinic acid drugs (e.g., nicomol, niceritrol, niaspan), ethyl icosapentate, phytosterol (e.g., soysterol, gamma oryzanol (γ -oryzanol)), cholesterol absorption inhibitors (e.g., zechia), CETP inhibitors (e.g., dalcetrapib, anacetrapib), ω -3 fatty acid preparations (e.g., ω -3-fatty acid ethyl esters 90 (ω -3-acid ethyl esters 90)) and the like can be mentioned.

- [0486] Examples of the antihypertensive agent include angiotensin converting enzyme inhibitors (e.g., captopril, enalapril, delapril, etc.), angiotensin II antagonists (e.g., candesartan cilexetil, candesartan, losartan, losartan potassium, eprosartan, valsartan, telmisartan, irbesartan, tasosartan, olmesartan, olmesartan medoxomil, azilsartan, azilsartan medoxomil, etc.), calcium antagonists (e.g., manidipine, nifedipine, amlodipine, efonidipine, nicardipine, cilnidipine, etc.), β blockers (e.g., metoprolol, atenolol, propranolol, carvedilol, pindolol, etc.), clonidine and the like.
- [0487] As the diuretic, for example, xanthine derivatives (e.g., theobromine sodium salicylate, theobromine calcium salicylate and the like), thiazide preparations (e.g., ethiazide, cyclopenthiazide, trichloromethiazide, hydrochlorothiazide, hydroflumethiazide, benzylhydrochlorothiazide, penfluthiazide, poly5thiazide, methyclothiazide and the like), antialdosterone preparations (e.g., spironolactone, triamterene and the like), carbonic anhydrase inhibitors (e.g., acetazolamide and the like), chlorobenzene-sulfonamide agents (e.g., chlortalidone, mefruside, indapamide and the like), azosemide, isosorbide, ethacrynic acid, piretanide, bumetanide, furosemide and the like can be mentioned.
- [0488] Examples of the chemotherapeutic include alkylating agents (e.g., cyclophosphamide, ifosfamide), antimetabolites (e.g., methotrexate, 5-fluorouracil), anticancer antibiotics (e.g., mitomycin, adriamycin), plant-derived anticancer agents (e.g., vincristine, vindesine, Taxol), cisplatin, carboplatin, etoposide and the like. Among others, a 5-fluorouracil derivative Furtulon or Neofurtulon or the like is preferable.
- [0489] Examples of the immunotherapeutic include microbial or bacterial components (e.g., muramyl dipeptide derivative, Picibanil), polysaccharides having immunoenhancing activity (e.g., lentinan, sizofiran, Krestin), cytokines obtained by genetic engineering approaches (e.g., interferon, interleukin (IL)), colony-stimulating factors (e.g., granulocyte colony-stimulating factor, erythropoietin) and the like. Among others, interleukins such as IL-1, IL-2, IL-12 and the like are preferable.
- [0490] Examples of the anti-inflammatory drug include nonsteroidal anti-inflammatory drugs such as aspirin, acetaminophen, indomethacin and the like.
- [0491] As the antithrombotic agent, for example, heparin (e.g., heparin sodium, heparin

calcium, enoxaparin sodium, dalteparin sodium), warfarin (e.g., warfarin potassium), anti-thrombin drugs (e.g., aragatroban, dabigatran), FXa inhibitors (e.g., rivaroxaban, apixaban, edoxaban, YM150, compound described in WO02/06234, WO2004/048363, WO2005/030740, WO2005/058823 or WO2005/113504), thrombolytic agents (e.g., urokinase, tisokinase, alteplase, nateplase, monteplase, pamiteplase), platelet aggregation inhibitors (e.g., ticlopidine hydrochloride, clopidogrel, prasugrel, E5555, SHC530348, cilostazol, ethyl icosapentate, beraprost sodium, sarpogrelate hydrochloride) and the like can be mentioned.

- [0492] Examples of the therapeutic agent for osteoporosis include alfacalcidol, calcitriol, elcatonin, calcitonin salmon, estriol, ipriflavone, pamidronate disodium, alendronate sodium hydrate, incadronate disodium, risedronate disodium and the like.
- [0493] Examples of the vitamin include vitamin B₁, vitamin B₁₂ and the like.
- [0494] Examples of the antimentia drug include tacrine, donepezil, rivastigmine, galanthamine and the like.
- [0495] Examples of the erectile dysfunction drug include apomorphine, sildenafil citrate and the like.
- [0496] Examples of the therapeutic drug for urinary frequency or urinary incontinence include flavoxate hydrochloride, oxybutynin hydrochloride, propiverine hydrochloride and the like.
- [0497] Examples of the therapeutic agent for dysuria include acetylcholine esterase inhibitors (e.g., distigmine) and the like.
- [0498] Examples of the central D2 receptor antagonist include typical psychotropic drugs (prochlorperazine, haloperidol, chlorpromazine, and the like), serotonin dopamine antagonists (perospirone, risperidone, and the like), and multi-acting receptor targeted antipsychotic drugs (olanzapine and the like).
- [0499] Examples of the prokinetic agent include peripheral D2 receptor antagonists (metoclopramide, domperidone, and the like) and 5HT₄ receptor agonists (mosapride and the like).
Examples of the antihistamine include hydroxyzine, diphenhydramine, and chlorpheniramine.
- [0500] Examples of the muscarinic receptor antagonist include central muscarinic receptor antagonists (scopolamine and the like) and peripheral muscarinic receptor antagonists (butylscopolamine and the like).
- [0501] Examples of the serotonin 5HT₃ receptor antagonist include granisetron, ondansetron, azasetron, indisetron, palonosetron, and ramosetron.
- [0502] Examples of the somatostatin analogue include octreotide.
- [0503] Examples of the corticosteroid include dexamethasone, betamethasone, and methylprednisolone.

- [0504] Examples of the benzodiazepine anxiolytic include lorazepam and alprazolam, examples of the NK-1 receptor antagonist include aprepitant and fosaprepitant, and examples of the hypercalcemia therapeutic drug include bisphosphonate.
- [0505] Moreover, a drug confirmed to have a cachexia-ameliorating action either in animal models or clinically, i.e., a cyclooxygenase inhibitor (e.g., indomethacin), a progesterone derivative (e.g., megestrol acetate), glucocorticoid (e.g., dexamethasone), a metoclopramide drug, a tetrahydrocannabinol drug, an agent for improving fat metabolism (e.g., eicosapentaenoic acid), growth hormone, IGF-1, or an antibody against a cachexia-inducing factor TNF- α , LIF, IL-6 or oncostatin M or the like can also be used in combination with the compound of the present invention.
- [0506] Alternatively, a glycation inhibitor (e.g., ALT-711), a nerve regeneration-promoting drug (e.g., Y-128, VX853, prosaptide), an antidepressant (e.g., desipramine, amitriptyline, imipramine), an antiepileptic drug (e.g., lamotrigine, Trileptal, Keppra, Zonegran, Pregabalin, Harkoseride, carbamazepine), an antiarrhythmic drug (e.g., mexiletine), an acetylcholine receptor ligand (e.g., ABT-594), an endothelin receptor antagonist (e.g., ABT-627), a monoamine uptake inhibitor (e.g., tramadol), a narcotic analgesic (e.g., morphine), a GABA receptor agonist (e.g., gabapentin, MR preparation of gabapentin), an α 2 receptor agonist (e.g., clonidine), a local analgesic (e.g., capsaicin), an antianxiety drug (e.g., benzothiazepine), a phosphodiesterase inhibitor (e.g., sildenafil), a dopamine receptor agonist (e.g., apomorphine), midazolam, ketoconazole or the like may be used in combination with the compound of the present invention.
- [0507] The time of administration of the compound of the present invention and that of the concomitant drug are not limited, and they may be administered simultaneously or in a staggered manner to the administration subject.
- [0508] Examples of such administration mode include the following:
- (1) administration of a single preparation obtained by simultaneously processing the compound of the present invention and the concomitant drug, (2) simultaneous administration of two kinds of preparations of the compound of the present invention and the concomitant drug, which have been separately produced, by the same administration route, (3) administration of two kinds of preparations of the compound of the present invention and the concomitant drug, which have been separately produced, by the same administration route in a staggered manner, (4) simultaneous administration of two kinds of preparations of the compound of the present invention and the concomitant drug, which have been separately produced, by different administration routes, (5) administration of two kinds of preparations of the compound of the present invention and the concomitant drug, which have been separately produced, by different administration routes in a staggered manner (e.g., administration in the order of the

compound of the present invention and the concomitant drug, or in the reverse order) and the like.

[0509] The dose of the concomitant drug can be appropriately determined based on the dose employed in clinical situations. The mixing ratio of the compound of the present invention and a concomitant drug can be appropriately determined depending on the administration subject, symptom, administration method, target disease, combination and the like. When the subject of administration is human, for example, a concomitant drug can be used in 0.01 - 100 parts by weight relative to 1 part by weight of the compound of the present invention.

[0510] By combining the compound of the present invention and concomitant drug:

(1) the dose of the compound of the present invention or a concomitant drug can be reduced as compared to single administration of the compound of the present invention or a concomitant drug,

(2) the drug to be used in combination with the compound of the present invention can be selected depending on the condition of patients (mild, severe and the like),

(3) the period of treatment can be set longer by selecting a concomitant drug having different action and mechanism from those of the compound of the present invention,

(4) a sustained treatment effect can be designed by selecting a concomitant drug having different action and mechanism from those of the compound of the present invention,

(5) a synergistic effect can be afforded by a combined use of the compound of the present invention and a concomitant drug, and the like, can be achieved.

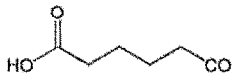
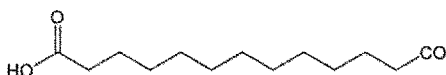
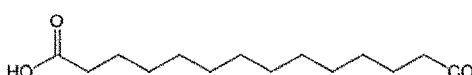
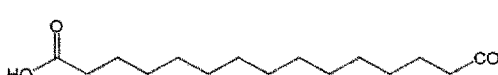
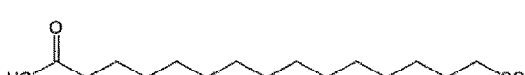
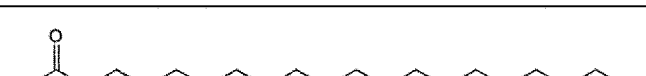
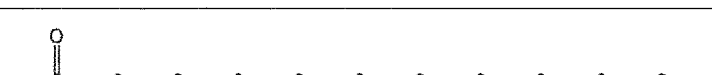
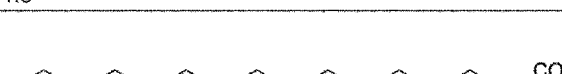
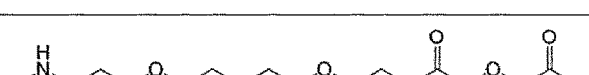
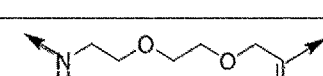
Examples

[0511] The abbreviations used in the present specification mean the following (Table 1). A hyphen in terms such as α -MePhe and the like as described herein may be omitted, and the event of omission also represents the same meaning.

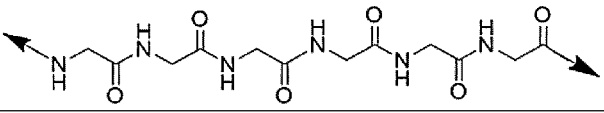
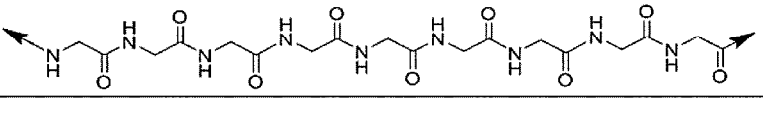
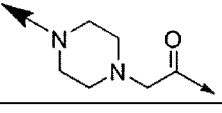
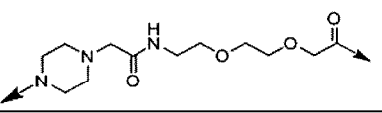
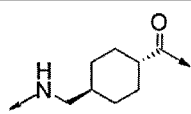
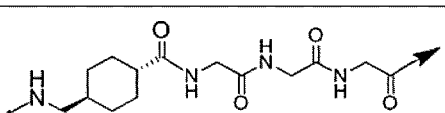
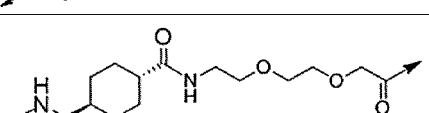
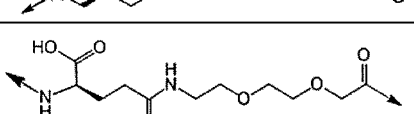
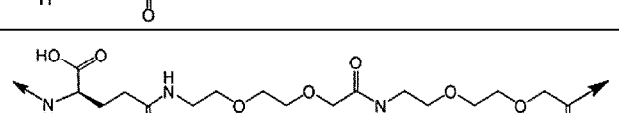
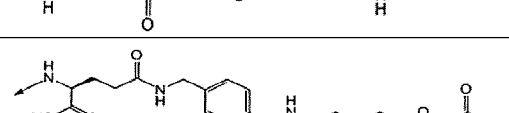
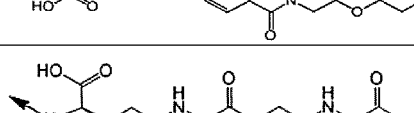
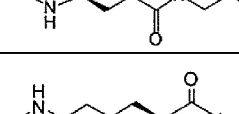
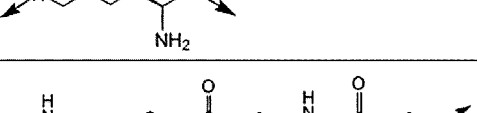
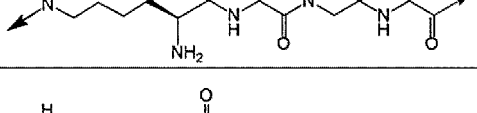
In the amino acid sequences used in the present specification, the left terminal represents N terminal and the right terminal represents C terminal.

[0512]

[Table 1]

Ac	acetyl
Aib	α -aminoisobutyric acid
Ambz (4)	4-aminomethylbenzoyl
GABA	γ -aminobutyric acid
Iva	isovaline
Lys (Ac)	N ϵ -acetyllysine
α -MePhe	α -methylphenylalanine
MeTyr	N-Methyltyrosine
Hda	
Doda	
Trda	
Teda	
Peda	
Heda	
Hepda	
Oda	
Eda	
Dda	
Pal	
PEG (2)	
PEG3	

(PEG3) 2	
(PEG3) 3	
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PEG (4)	
γ Glu	
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(γ Glu) 3	
(γ Glu) 2-PEG3	
AMBZ-PEG3	
GABA-(PEG3) 2	
GABA-GGG	
GG	
GGG	
GGGG	
GGGGG	

GGGGGG	
G9	
NpipAc	
NpipAc-PEG3	
Tra	
Tra-GGG	
Tra-PEG3	
γGlu-PEG3	
γGlu-(PEG3)2	
γGlu-AMBZ-PEG3	
γGlu-GGG	
εLys	
εLys-GGG	
εLys-PEG3	

[0513] In the specification, where bases, amino acids, etc. are denoted by their codes, they are based on conventional codes in accordance with the IUPAC-IUB Commission on

Biochemical Nomenclature or by the common codes in the art, examples of which are shown below. For amino acids that may have an optical isomer, L-form is presented unless otherwise indicated (e.g., “Ala” is L-form of Ala). In addition, “D-” means a D-form (e.g., “D-Ala” is D-form of Ala), and “DL-” means a racemate of a D-form and an L-form (e.g., “DL-Ala” is DL racemate of Ala).

TFA : trifluoroacetic acid

Gly or G : glycine

Ala or A : alanine

Val or V : valine

Leu or L : leucine

Ile or I : isoleucine

Ser or S : serine

Thr or T : threonine

Cys or C : cysteine

Met or M : methionine

Glu or E : glutamic acid

Asp or D : aspartic acid

Lys or K : lysine

Arg or R : arginine

His or H : histidine

Phe or F : phenylalanine

Tyr or Y : tyrosine

Trp or W : tryptophan

Pro or P : proline

Asn or N : asparagine

Gln or Q : glutamine

[0514] The present invention is explained in detail in the following by referring to the following Reference Examples, Examples, Test Examples and Formulation Examples, which are mere embodiments and not to be construed as limitative. In addition, the present invention may be modified without departing from the scope of invention.

The term “room temperature” in the following Examples indicates the range of generally from about 10°C to about 35°C. As for “%”, the yield is in mol/mol%, the solvent used for chromatography is in % by volume and other “%” is in % by weight.

[0515] NMP: methylpyrrolidone

THF: tetrahydrofuran

DMF: N,N-dimethylformamide

WSC: 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride

DCC: N,N'-Dicyclohexylcarbodiimide

DIPCDI: N,N'-diisopropylcarbodiimide

HOBt: 1-hydroxybenzotriazole monohydrate

Oxyma: ethyl 2-cyano-2-(hydroxyimino)acetate

[0516] Reference Example 1

Synthesis of H-

Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin (SEQ ID NO: 4)

Sieber amide resin (0.61 meq/g, 410 mg) was added to a reaction tube, which was then loaded in a peptide synthesizer (ABI 433A). Amino acids were successively condensed according to the Fmoc/DCC/HOBt protocol. In the final step, the N-terminal Fmoc group was removed. After the termination of condensation, the resin was washed with MeOH, and dried under reduced pressure. As a result, 1137 mg (0.220 meq/g) of the protected peptide resin of interest was obtained.

[0517] Reference Example 2

Synthesis of H-

Aib-Leu-Asp(OtBu)-Lys(Boc)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Aib-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin (SEQ ID NO: 5)

Sieber amide resin (0.71 meq/g, 71 mg) was added to a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. The condensation of Gln(Trt) at position 19 and Ala at position 18 was carried out by double coupling. The N-terminal Fmoc group was removed at the final step. After completion of the condensation, the resin was washed with MeOH and dried under reduced pressure. As a result, 264 mg (0.189 meq/g) of the protected peptide resin of interest was obtained.

[0518] Reference Example 3

Synthesis of H-

Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin (SEQ ID NO: 6)

Sieber amide resin (0.71 mmol/g, 141 mg) was added to 5 reaction tubes, which were then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. After elongation, the resins in the respective reaction tubes were mixed, washed with MeOH, and dried under reduced pressure to thereby obtain 1282 mg of the protected peptide resin of interest H-

Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin (0.394 mmol/g).

[0519] Reference Example A

Synthesis of H-

Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin (SEQ ID NO: 481)

Sieber amide resin (0.71 meq/g, 1.40 g, 1.0 mmol) was added to a reaction tube, which was then set in a peptide synthesizer, and amino acids were sequentially extended according to the protocol using 20% piperidine/NMP [reacted at room temperature for 15 minutes] to deprotect the Fmoc group and 8 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at room temperature for 150 minutes] to condense the Fmoc-amino acids. After elongation, the obtained resin was washed with MeOH, and dried under reduced pressure to thereby obtain 5.2064 g of the protected peptide resin of interest.

[0520] Reference Example B

Synthesis of Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Sieber amide resin (SEQ ID NO: 482)

Sieber amide resin (0.71 meq/g, 140.8 mg, 0.1 mmol) was added to a reaction tube, which was then set in a peptide synthesizer, and amino acids were sequentially extended according to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at 50°C for 15 minutes] to condense the Fmoc-amino acids. In this case, the condensation reaction of Boc-MeTyr(tBu) at position 1, Thr(tBu) at position 5, Ile at position 12, Arg(Pbf) at position 16, Gln(Trt) at position 19, and Trp(Boc) at position 25 was carried out at 50°C for 30 minutes. The operation wherein the obtained Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Sieber amide resin was suspended in a 2% hydrazine/NMP solution, the resulting suspension was stirred at 50°C for 10 minutes, and then the solution was removed by filtration was repeated 8 times to deprotect the ivDde group of Lys at position 14. The obtained resin was washed with MeOH, and dried under reduced pressure to thereby obtain 762.1 mg of Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(T

rt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Sieber amide resin.

[0521] Reference Example C

Synthesis of Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Ser(tBu)-Alko resin (SEQ ID NO: 483)

Fmoc-Ser(tBu)-Alko resin (0.68 meq/g, 147.1 mg, 0.1 mmol) was added to a reaction tube, which was then set in a peptide synthesizer, and amino acids were sequentially extended according to the protocol using 20% piperidine/NMP [reacted at room temperature for 15 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at 50°C for 15 minutes] to condense the Fmoc-amino acids. The operation wherein the obtained Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(ivDde)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Alko resin was suspended in a 2% hydrazine/NMP solution, the resulting suspension was stirred at 50°C for 10 minutes, and then the solution was removed by filtration was repeated 8 times to deprotect the ivDde group of Lys at position 14. Subsequently, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 664.0 mg of the protected peptide resin of interest.

[0522] Example 1

Synthesis of H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 12) (Compound 6)

H-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin (0.220 meq/g, 46 mg) prepared in Reference Example 1 was weighed into a reaction tube, and swollen with DMF. After removal of DMF by filtration, Fmoc-Aib-OH (32.5 mg), 0.5 M Oxyma in DMF (200 µL) and diisopropylcarbodiimide (15.9 µL) were successively added to the resin, and then the mixture was shaken for 2 hours. The reaction solution was filtered off, and the resin was then washed with DMF 6 times. After confirmation of negativity in the Ninhydrin test, a DMF solution of 20% piperidine was added thereto, and the mixture was shaken for 1 minute. The solution was filtered off, and a DMF solution of 20% piperidine was then added thereto again, and the mixture was shaken for 20 minutes. The solution was filtered off, and the resin was then washed with DMF 10 times. This Fmoc amino acid condensation-Fmoc deprotection cycle was

repeated to successively condense Gln(Trt), Ala, Gln(Trt), Lys(Boc), Asp(OtBu), Leu, Aib, Ile*, Ser(tBu), Tyr(tBu), Leu, Ser(tBu), Val, Val, Thr(tBu), Gly, Glu(OtBu), Aib and Tyr(tBu) (*: overnight reaction). The resin was washed with MeOH, and then dried under reduced pressure to give 64 mg of H-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Val-Val-Ser(tBu)-Leu-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Lys(Boc)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin.

- [0523] To 64 mg of the obtained resin was added 1 mL of TFA: m-cresol: thioanisole: ethanedithiol: H₂O: triisopropylsilane (80:5:5:5:2.5:2.5), and the mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated three times and thereby washed the precipitate. The residue was extracted with 50% aqueous acetic acid solution, and the resin was removed by filtration, followed by preparative HPLC using Daisopak SP-100-5-ODS-P column (250 × 20 mm I.D.) [Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, flow rate 8 mL/min, A/B: 63/37-53/47 linear concentration gradient elution (60 min)]. The fractions containing the object product were collected and freeze-dried to give 16.0 mg of a white powder.

Mass spectrometry, (M+H)⁺ 4231.2 (Calculated: 4231.3)

HPLC elution time: 7.4 min

elution condition:

column: Merck Chromolith Performance RP-18e (100 × 4.6 mm I.D.)

eluent: using Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 - 35/65 linear concentration gradient elution (10 min)

flow rate: 3.0 mL/min

- [0524] Example 2

Synthesis of H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (Acetate of Compound 6)

A powder (1084.2 mg) prepared in the same manner as in Example 1 was dissolved in a small amount of acetonitrile-water, an ion exchange resin (AG1 X8 resin (acetate form), 1.2 meq/mL, 2.1 mL) was added thereto, and the resulting mixture was allowed to stand for 1 hour while occasionally shaken. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 929.6 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4231.3 (calculated 4231.3)

HPLC elution time: 7.5 minutes

Elution conditions:

Column Chromolith Performance RP-18e (100 x 4.6 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 to 35/65. Linear concentration gradient elution (10 minutes).

Flow rate: 3.0 mL/minute

[0525] Example 3

Synthesis of H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (Hydrochloride of Compound 6)

The powder prepared in Example 2 (73.0 mg) was dissolved in a small amount of acetonitrile-water and 1N hydrochloric acid (172 µL) was added thereto while ice cooled. After stirring at 0°C for 2 hours, the resulting mixture was allowed to stand at 4°C overnight. The obtained solution was freeze-dried to thereby obtain 71 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4231.6 (calculated 4231.3)

HPLC elution time: 7.4 minutes

Elution conditions:

Column Chromolith Performance RP-18e (100 x 4.6 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 to 35/65. Linear concentration gradient elution (10 minutes).

Flow rate: 3.0 mL/minute

[0526] Example 4

Synthesis of H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Phe-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 13) (Compound 7)

H-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin (0.220 meq/g, 46 mg) prepared in Reference Example 1 was weighed into a reaction tube, and swollen with DMF. After removal of DMF by filtration, Fmoc-Aib-OH (32.5 mg), 0.5 M Oxyma in DMF (200 µL) and diisopropylcarbodiimide (15.9 µL) were successively added to the resin, and then the mixture was shaken for 2 hours. The reaction solution was filtered off, and the resin was then washed with DMF 6 times. After confirmation of negativity in the Ninhydrin test, a DMF solution of 20% piperidine was added thereto, and the mixture was shaken for 1 minute. The solution was filtered off, and a DMF solution of 20% piperidine was then added thereto again, and the mixture was shaken for 20 minutes. The solution was filtered off, and the resin was then washed

with DMF 10 times. This Fmoc amino acid condensation-Fmoc deprotection cycle was repeated to successively condense Gln(Trt), Ala, Gln(Trt), Lys(Boc), Asp(OtBu), Leu, Aib, Ile*, Ser(tBu), Tyr(tBu), Phe, Ser(tBu), Val, Val, Thr(tBu), Gly, Glu(OtBu), Aib and Tyr(tBu) (*: overnight reaction). The resin was washed with MeOH, and then dried under reduced pressure to give 74 mg of H-

Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Val-Val-Ser(tBu)-Phe-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Lys(Boc)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin.

- [0527] To 74 mg of the obtained resin was added 1 mL of TFA: m-cresol: thioanisole: ethanedithiol: H₂O: triisopropylsilane (80:5:5:5:2.5:2.5), and the mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated three times and thereby washed the precipitate. The residue was extracted with 50% aqueous acetic acid solution, and the resin was removed by filtration, followed by preparative HPLC using Daisopak SP-100-5-ODS-P column (250 × 20 mm I.D.) [Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, flow rate 8 mL/min, A/B: 63/37-53/47 linear concentration gradient elution (60 min)]. The fractions containing the object product were collected and freeze-dried to give 17.0 mg of a white powder.

Mass spectrometry, (M+H)⁺ 4265.1 (Calculated: 4265.3)

HPLC elution time: 7.3 min

elution condition:

column: Merck Chromolith Performance RP-18e (100 × 4.6 mm I.D.)

eluent: using Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 - 35/65 linear concentration gradient elution (10 min)

flow rate: 3.0 mL/min

- [0528] Example 5

Synthesis of H-

Tyr-Aib-Glu-Gly-Thr-Val-Lys-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 14) (Compound 8)

H-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin (0.220 meq/g, 46.0 mg) prepared in Reference Example 1 was weighed into a reaction tube, and swollen with DMF. After removal of DMF by filtration, Fmoc-Aib-OH (32.5 mg), 0.5 M Oxyma in DMF (200 μL) and diisopropylcarbodiimide (15.9 μL) were successively added to the resin, and then the mixture was shaken for 2 hours. The reaction solution

was filtered off, and the resin was then washed with DMF 6 times. After confirmation of negativity in the Ninhydrin test, a DMF solution of 20% piperidine was added thereto, and the mixture was shaken for 1 minute. The solution was filtered off, and a DMF solution of 20% piperidine was then added thereto again, and the mixture was shaken for 20 minutes. The solution was filtered off, and the resin was then washed with DMF 10 times. This Fmoc amino acid condensation-Fmoc deprotection cycle was repeated to successively condense Gln(Trt), Ala, Gln(Trt), Lys(Boc), Asp(OtBu), Leu, Aib, Ile*, Ser(tBu), Tyr(tBu), Asp(OtBu), Ser(tBu), Lys(Boc), Val, Thr(tBu), Gly, Glu(OtBu), Aib and Tyr(tBu) (*: overnight reaction). The resin was washed with MeOH, and then dried under reduced pressure to give 73 mg of H-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Val-Lys(Boc)-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Lys(Boc)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin.

[0529] To 73 mg of the obtained resin was added 1 mL of TFA: m-cresol: thioanisole: ethanedithiol: H₂O: triisopropylsilane (80:5:5:5:2.5:2.5), and the mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated three times and thereby washed the precipitate. The residue was extracted with 50% aqueous acetic acid solution, and the resin was removed by filtration, followed by preparative HPLC using Daisopak SP-100-5-ODS-P column (250 × 20 mm I.D.) [Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, flow rate 8 mL/min, A/B: 68/32-58/42 linear concentration gradient elution (60 min)]. The fractions containing the object product were collected and freeze-dried to give 15.7 mg of a white powder.

Mass spectrometry, (M+H)⁺ 4262.3 (Calculated: 4262.3)

HPLC elution time: 6.6 min

elution condition:

column: Merck Chromolith Performance RP-18e (100 × 4.6 mm I.D.)

eluent: using Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 - 35/65 linear concentration gradient elution (10 min)

flow rate: 3.0 mL/min

[0530] Example 6

H-Tyr-Aib-Glu-Gly-Thr-Val-Lys-Ser-Asp-Tyr-Ser-Ile-Leu-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 15) (Compound 10)

H-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin (0.220 meq/g,

46 mg) prepared in Reference Example 1 was weighed into a reaction tube, and swollen with DMF. After removal of DMF by filtration, Fmoc-Aib-OH (32.5 mg), 0.5 M Oxyma in DMF (200 μ L) and diisopropylcarbodiimide (15.9 μ L) were successively added to the resin, and then the mixture was shaken for 2 hours. The reaction solution was filtered off, and the resin was then washed with DMF 6 times. After confirmation of negativity in the Ninhydrin test, a DMF solution of 20% piperidine was added thereto, and the mixture was shaken for 1 minute. The solution was filtered off, and a DMF solution of 20% piperidine was then added thereto again, and the mixture was shaken for 20 minutes. The solution was filtered off, and the resin was then washed with DMF 10 times. This Fmoc amino acid condensation-Fmoc deprotection cycle was repeated to successively condense Gln(Trt), Ala, Gln(Trt), Lys(Boc), Asp(OtBu), Leu, Leu, Ile*, Ser(tBu), Tyr(tBu), Asp(OtBu), Ser(tBu), Lys(Boc), Val, Thr(tBu), Gly, Glu(OtBu), Aib and Tyr(tBu) (*: overnight reaction). The resin was washed with MeOH, and then dried under reduced pressure to give 85 mg of H-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Val-Lys(Boc)-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Leu-Leu-Asp(OtBu)-Lys(Boc)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Leu-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin.

- [0531] To 85 mg of the obtained resin was added 1 mL of TFA: m-cresol: thioanisole: ethanedithiol: H₂O: triisopropylsilane (80:5:5:5:2.5:2.5), and the mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated three times and thereby washed the precipitate. The residue was extracted with 50% aqueous acetic acid solution, and the resin was removed by filtration, followed by preparative HPLC using Daisopak SP-100-5-ODS-P column (250 $\times$ 20 mm I.D.) [Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, flow rate 8 mL/min, A/B: 67/33-57/43 linear concentration gradient elution (60 min)]. The fractions containing the object product were collected and freeze-dried to give 19.0 mg of a white powder.

Mass spectrometry, (M+H)⁺ 4290.5 (Calculated: 4290.3)

HPLC elution time: 6.7 min

elution condition:

column: Merck Chromolith Performance RP-18e (100 $\times$ 4.6 mm I.D.)

eluent: using Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 - 35/65 linear concentration gradient elution (10 min)

flow rate: 3.0 mL/min

- [0532] Example 7
Synthesis of H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-Aib-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 50) (Compound 42)

- [0533] H-Aib-Leu-Asp(OtBu)-Lys(Boc)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Aib-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin (0.189 meq/g, 132 mg) prepared in Reference Example 2 was weighed into a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. After completion of the condensation, the resin was washed with MeOH and dried under reduced pressure to thereby obtain 171 mg of H-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Val-Val-Ser(tBu)-Leu-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Lys(Boc)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Lys(Boc)-Trp(Boc)-Aib-Leu-Lys(Boc)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Lys(Boc)-Sieber amide resin.

- [0534] To 171 mg of the obtained resin was added 1 mL of TFA: m-cresol: thioanisole: ethanedithiol: H₂O: triisopropylsilane (80:5:5:5:2.5:2.5), and the mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated three times and thereby washed the precipitate. The residue was extracted with 50% aqueous acetic acid solution, and the resin was removed by filtration, followed by preparative HPLC using Daisopak SP-100-5-ODS-P column (250 × 20 mm I.D.) [Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, flow rate 8 mL/min, A/B: 65/35-55/45 linear concentration gradient elution (60 min)]. The fractions containing the object product were collected and freeze-dried to give 29.1 mg of a white powder.

Mass spectrometry, (M+H)⁺ 4202.4 (Calculated: 4203.3)

HPLC elution time: 7.3 min

elution condition:

column: Merck Chromolith Performance RP-18e (100 × 4.6 mm I.D.)

eluent: using Solution A: 0.1% TFA-water, Solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 - 35/65 linear concentration gradient elution (10 min)

flow rate: 3.0 mL/min

- [0535] Example 8

Synthesis of H-

Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Gln-Ala-Gln-Aib-Glu-Phe-Val-Arg-Trp-Leu-Leu-Arg-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-

Arg-NH₂ (SEQ ID NO: 36) (Compound 30)

Sieber amide resin (0.7 mmol/g, 149 mg) was added to 2 reaction tubes, which were then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. After elongation, the resins were washed with MeOH and dried under reduced pressure to thereby obtain 1308 mg of the protected peptide resin of interest H-

Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Val-Val-Ser(tBu)-Leu-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Arg(Pbf)-Gln(Trt)-Ala-Gln(Trt)-Aib-Glu(OtBu)-Phe-Val-Arg(Pbf)-Trp(Boc)-Leu-Leu-Arg(Pbf)-Gly-Gly-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-sieber amide resin. To the total amount of the obtained resins, 15 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated twice and thereby washed the precipitate. The residue was extracted with a 50% acetic acid aqueous solution and after removal of the resin by filtration, the purification was carried out several times by preparative HPLC using a daisopak SP-100-5-ODS-P column (250 x 20 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 62/38 to 52/48, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 190.1 mg of a white powder.

[0536] The obtained powder (190.1 mg) was dissolved in a small amount of an acetonitrile aqueous solution. An ion exchange resin (AG1 X8 resin (acetate form), 1.2 meq/mL, 365 µL) was added to the solution, which was then allowed to stand for 1 hour while occasionally shaken. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 159.2 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4343.3 (calculated 4343.3)

HPLC elution time: 7.5 minutes

Elution conditions:

Column Merck Chromolith Performance RP-18e (4.6 x 100 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 to 35/65. Linear concentration gradient elution (10 minutes).

Flow rate: 3.0 mL/minute

[0537] Example 9

Synthesis of Methyl-

Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Ile-Ala-Gln-Gln

-Asp-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 65) (Compound 59)

H-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin (0.394 mmol/g, 127 mg) prepared in Reference Example 3 was added to a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. After elongation, the resin was washed with MeOH and dried under reduced pressure to thereby obtain the protected peptide resin of interest Boc-

Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Phe-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Ala-Leu-Asp(OtBu)-Arg(Pbf)-Ile-Ala-Gln(Trt)-Gln(Trt)-Asp(OtBu)-Phe-Val-Asn(Trt)-Trp(Boc)-Leu-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin. To the total amount of the obtained resin, 3.5 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated twice and thereby washed the precipitate. The residue was extracted with a 50% acetic acid aqueous solution and after removal of the resin by filtration, the purification was carried out by preparative HPLC using a daisopak SP-100-5-ODS-P column (250 x 20 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 60/40 to 50/50, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 71.4 mg of a white powder.

[0538] The total amount of the obtained powder was dissolved in a small amount of an acetonitrile aqueous solution. An ion exchange resin (AG1 X8 resin (acetate form), 1.2 meq/mL, 67 µL) was added to the solution, which was then allowed to stand for 1 hour while occasionally shaken. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 59.0 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4464.8 (calculated 4464.3)

HPLC elution time: 7.8 minutes

Elution conditions:

Column Merck Chromolith Performance RP-18e (4.6 x 100 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 to 35/65. Linear concentration gradient elution (10 minutes).

Flow rate: 3.0 mL/minutes

[0539] Example 10

Synthesis of Methyl-

Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 110) (Compound 104)

H-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin (0.394 mmol/g, 127 mg) prepared in Reference Example 3 was added to a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. After elongation, the resin was washed with MeOH and dried under reduced pressure to thereby obtain the protected peptide resin of interest Boc-

Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Ala-Leu-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Leu-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin. To the total amount of the obtained resin, 4 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated twice and thereby washed the precipitate. The residue was extracted with a 50% acetic acid aqueous solution and after removal of the resin by filtration, the purification was carried out by preparative HPLC using a daisopak SP-100-5-ODS-P column (250 x 20 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 62/38 to 52/48, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 81 mg of a white powder.

[0540] The total amount of the obtained powder was dissolved in a small amount of an acetonitrile aqueous solution. An ion exchange resin (AG1 X8 resin (acetate form), 1.2 meq/mL, 78 µL) was added to the solution, which was then allowed to stand for 1 hour while occasionally shaken. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 53.2 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4345.1 (calculated 4344.3)

HPLC elution time: 7.7 minutes

Elution conditions:

Column Merck Chromolith Performance RP-18e (4.6 x 100 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 to 35/65. Linear concentration gradient elution (10 minutes).

Flow rate: 3.0 mL/minutes

[0541] Example 11

Synthesis of Methyl-

Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 119) (Compound 113)

H-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin (0.394 mmol/g, 127 mg) prepared in Reference Example 3 was added to a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. After elongation, the resin was washed with MeOH and dried under reduced pressure to thereby obtain the protected peptide resin of interest Boc-

Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin. To the total amount of the obtained resin, 4 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated twice and thereby washed the precipitate. The residue was extracted with a 50% acetic acid aqueous solution and after removal of the resin by filtration, the purification was carried out by preparative HPLC using a daisopak SP-100-5-ODS-P column (250 x 20 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 61/39 to 51/49, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 71.1 mg of a white powder.

[0542] The total amount of the obtained powder was dissolved in a small amount of an acetonitrile aqueous solution. An ion exchange resin (AG1 X8 resin (acetate form), 1.2 meq/mL, 68 µL) was added to the solution, which was then allowed to stand for 1 hour while occasionally shaken. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 62.8 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4345.0 (calculated 4344.3)

HPLC elution time: 7.6 minutes

Elution conditions:

Column Merck Chromolith Performance RP-18e (4.6 x 100 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 to 35/65. Linear concentration gradient elution (10 minutes).

Flow rate: 3.0 mL/minutes

[0543] Example 12

Synthesis of Methyl-

Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 123) (Compound 117)

Sieber amide resin (0.71 mmol/g, 352 mg) was added to a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially condensed according to the protocol using 20% piperidine/NMP [50°C, 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids. After elongation, the resin was washed with MeOH and dried under reduced pressure to thereby obtain the protected peptide resin of interest Boc-

Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Phe-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Ala-Leu-Asp(OtBu)-Arg(Pbf)-Aib-His(Trt)-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Arg(Pbf)-Sieber amide resin. To the total amount of the obtained resin, 4 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours at room temperature. The operation wherein diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed was repeated twice and thereby washed the precipitate. The residue was extracted with a 50% acetic acid aqueous solution and after removal of the resin by filtration, the purification was carried out by preparative HPLC using a daisopak SP-100-5-ODS-P column (250 x 20 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 69/31 to 59/41, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 190.8 mg of a white powder.

[0544] The total amount of the obtained powder was dissolved in a small amount of an acetonitrile aqueous solution. An ion exchange resin (AG1 X8 resin (acetate form), 1.2 meq/mL, 179 µL) was added to the solution, which was then allowed to stand for 1 hour while occasionally shaken. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 170.0 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4443.3 (calculated 4444.3)

HPLC elution time: 6.5 minutes

Elution conditions:

Column Merck Chromolith Performance RP-18e (4.6 x 100 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 95/5 to 35/65. Linear concentration gradient elution (10 minutes).

Flow rate: 3.0 mL/minutes

[0545] Example 13

Synthesis of H-

MeTyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGG-)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 354) (Compound 341)

H-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin (SEQ ID NO: 481) (260.4 mg, 0.05 mmol) synthesized in Reference Example A was weighed into a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially extended according to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at 50°C for 15 minutes] to condense the Fmoc-amino acids. In this case, the condensation reaction of Boc-MeTyr(tBu) at position 1, Thr(tBu) at position 5, Ile at position 12, Arg(Pbf) at position 16, Gln(Trt) at position 19, and Trp(Boc) at position 25 was carried out at 50°C for 30 minutes. The operation wherein the obtained Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(ivDde)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin was suspended in a 2% hydrazine/NMP solution, the resulting suspension was stirred at 50°C for 10 minutes, and then the solution was removed by filtration was repeated 8 times to deprotect the ivDde group of Lys at position 14. Subsequently, Fmoc-Gly-Gly-Gly-OH was introduced using the peptide synthesizer and then Gly, Gly, and eicosanedioic acid were sequentially introduced. In this case, 20% piperidine/NMP was used [reacted at 50°C for 5 minutes] to deprotect the Fmoc group, and the condensation reaction was carried out using the double coupling method in which after all the reactions at 50°C for 15 minutes, the solution was removed by filtration, and the same condensation reaction was repeated. After completion of solid-phase synthesis, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 421.5 mg of the protected peptide resin of interest, Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(Eda-GGGGG-)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)

-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin. To the total amount of the obtained resin, 4.6 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. Diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed. This operation was repeated twice and the precipitate was washed. The residue was extracted with a 90% acetic acid aqueous solution and the resin was removed by filtration, and then the purification was carried out by preparative HPLC using Phenomenex Kinetex 5 μ m XB-C18 (250 $\times$ 30.0 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 15 mL/minute from A/B: 40/60 to 50/50, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 70.1 mg of a white powder.

[0546] Subsequently, the total amount of the obtained powder was dissolved in 50% acetonitrile-water, an ion exchange resin [AG1X8 resin (acetate form), 1.2 meq/mL, 182 μ L] was added to the solution, and the resulting mixture was shaken for 1 hour. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 58.8 mg of the acetate of the product of interest.

Mass spectrometry result: (M+H)⁺ 4811.57 (calculated 4812.54)

HPLC elution time: 6.19 minutes

Elution conditions:

Column: Kinetex 1.7 μ m C8 100A, (100 $\times$ 2.1 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 80/20 to 30/70. Linear concentration gradient elution (10 minutes).

Flow rate: 0.5 mL/minutes

Temperature: 40°C

[0547] Example 14

Synthesis of H-

MeTyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Oda-GGG-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 362) (Compound 349)

H-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin (SEQ ID NO: 481) (520.0 mg, 0.1 mmol) synthesized in Reference Example A was weighed into a reaction tube, which was then set in a peptide synthesizer. Amino acids were sequentially extended according to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at 50°C for 15 minutes] to condense the Fmoc-amino

acids. In this case, the condensation reaction of Boc-MeTyr(tBu) at position 1, Thr(tBu) at position 5, Ile at position 12, Gln(Trt) at position 19, and Trp(Boc) at position 25 was carried out at 50°C for 30 minutes. The operation wherein the obtained Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Arg(Pbf)-Lys(ivDde)-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin was suspended in a 2% hydrazine/NMP solution, the resulting suspension was stirred at 50°C for 10 minutes, and then the solution was removed by filtration was repeated 8 times to deprotect the ivDde group of Lys at position 17. Subsequently, Fmoc-Gly-Gly-Gly-OH was introduced using the peptide synthesizer and then Gly, Gly, and octadecanedioic acid were sequentially introduced. In this case, 20% piperidine/NMP was used [reacted at 50°C for 5 minutes] to deprotect the Fmoc group, and the condensation reaction was carried out using the double coupling method in which after all the reactions at 50°C for 15 minutes, the solution was removed by filtration, and the same condensation reaction was repeated. After completion of solid-phase synthesis, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 817.0 mg of the protected peptide resin of interest, Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Arg(Pbf)-Lys(Oda-GGGGG-)-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin. To the total amount of the obtained resin, 8 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. Diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed. This operation was repeated twice and the precipitate was washed. The residue was extracted with a 90% acetic acid aqueous solution and the resin was removed by filtration, and then the purification was carried out by preparative HPLC using Phenomenex Kinetex 5 μ m XB-C18 (250 $\times$ 30.0 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 15 mL/minute from A/B: 40/60 to 50/50, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 109.2 mg of a white powder.

[0548] Subsequently, the total amount of the obtained powder was dissolved in 50% acetonitrile-water, an ion exchange resin [AG1X8 resin (acetate form), 1.2 meq/mL, 285 μ L] was added to the solution, and the resulting mixture was shaken for 1 hour. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 93.1 mg of the acetate of the product of interest.

Mass spectrometry result: (M+H)⁺ 4810.655 (calculated 4812.54)

HPLC elution time: 6.09 minutes

Elution conditions:

Column: Kinetex 1.7 μ m C8 100A, (100 $\times$ 2.1 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 80/20 to 30/70. Linear concentration gradient elution (10 minutes).

Flow rate: 0.5 mL/minutes

Temperature: 40°C

[0549] Example 15

Synthesis of Ac-

Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Eda-GGGGG)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Ser-NH₂ (SEQ ID NO: 448) (Compound 435)

Sieber amide resin (0.71 meq/g, 70.4 mg, 0.05 mmol) was added to a reaction tube, and amino acids were sequentially extended to the N-terminal according to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at 50°C for 15 minutes] to condense the Fmoc-amino acids. In this case, the condensation reaction of Boc-MeTyr(tBu) at position 1, Thr(tBu) at position 5, Ile at position 12, Arg(Pbf) at position 16, Gln(Trt) at position 19, and Trp(Boc) at position 25 was carried out at 50°C for 30 minutes. To the obtained H-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(ivDde)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Ser(tBu)-Sieber amide resin, 0.625 ml of a mixed solution in which 0.5 M acetic anhydride, 0.5 M pyridine and 0.05 M Oxyma were dissolved in NMP was added, and the resulting mixture was reacted at 50°C for 2 minutes. After the resin was washed with NMP, the operation wherein the resin was suspended in a 2% hydrazine/NMP solution, the resulting suspension was stirred at 50°C for 10 minutes, and then the solution was removed by filtration was repeated 8 times to deprotect the ivDde group of Lys at position 14. Subsequently, Gly, Gly, Fmoc-Gly-Gly-Gly-OH, and eicosanedioic acid were sequentially introduced using the peptide synthesizer. In this case, 20% piperidine/NMP was used [reacted at 50°C for 5 minutes] to deprotect the Fmoc group, and the condensation reaction was carried out using the double coupling method in which after all the reactions at 50°C for 15 minutes, the solution was removed by filtration, and the same condensation reaction was repeated. After completion of solid-phase synthesis, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 470.7 mg of the protected peptide resin of

interest, Ac-

Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(Eda-GGGGG)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin. To the total amount of the obtained resin, 4.8 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours.

Diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed. This operation was repeated twice and the precipitate was washed. The residue was extracted with a 90% acetic acid aqueous solution and the resin was removed by filtration, and then the purification was carried out by preparative HPLC using Phenomenex Kinetex 5 μ m XB-C18 (250 $\times$ 30.0 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 15 mL/minute from A/B: 57/43 to 47/53, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 58.8 mg of a white powder.

[0550] Subsequently, the total amount of the obtained powder was dissolved in 50% acetonitrile-water, an ion exchange resin [AG1X8 resin (acetate form), 1.2 meq/mL, 152 μ L] was added to the solution, and the resulting mixture was shaken for 1 hour. After removal of the resin by filtration, the filtrate was freeze-dried to thereby obtain 53.6 mg of the acetate of the product of interest.

Mass spectrometry result: (M+H)⁺ 4841.26 (calculated 4840.53)

HPLC elution time: 7.12 minutes

Elution conditions:

Column: Kinetex 1.7 μ m C8 100A, (100 $\times$ 2.1 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 80/20 to 30/70. Linear concentration gradient elution (10 minutes).

Flow rate: 0.5 mL/minutes

Temperature: 40°C

[0551] Example 16

Synthesis of H-

MeTyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGG)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-NH₂ (SEQ ID NO: 428) (Compound 415)

Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Sieber amide resin (SEQ ID NO: 482) (38.1 mg, 0.005 mmol) synthesized in Reference Example B was weighed into a

reaction tube, which was then set in a peptide synthesizer. Gly, Gly, Fmoc-Gly-Gly-Gly-OH, and octadecanedioic acid were introduced according to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at 50°C for 15 minutes] to condense the Fmoc-amino acids. In this case, 20% piperidine/NMP was used [reacted at 50°C for 5 minutes] to deprotect the Fmoc group, and the condensation reaction was carried out using the double coupling method in which after the reactions at 50°C for 15 minutes, the solution was removed by filtration, and the same condensation reaction was repeated. After completion of solid-phase synthesis, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 45.3 mg of the protected peptide resin of interest, Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(Oda-GGGGG)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Sieber amide resin. To the total amount of the obtained resin, 0.5 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. Diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed. This operation was repeated and the precipitate was washed. The residue was extracted with a 90% acetic acid aqueous solution and the resin was removed by filtration, and then the purification was carried out by preparative HPLC using Phenomenex Kinetex 5 µm XB-C18 (250 × 20.0 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 59/41 to 49/51, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 3.7 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4006.32 (calculated 4007.14)

HPLC elution time: 5.97 minutes

Elution conditions:

Column: Kinetex 1.7 µm C8 100A, (100 × 2.1 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 80/20 to 30/70. Linear concentration gradient elution (10 minutes).

Flow rate: 0.5 mL/minutes

Temperature: 40°C

[0552] Example 17

Synthesis of H-

MeTyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Oda-GGGGG)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-OH (SEQ ID NO: 454) (Compound 441)

Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Ser(tBu)-Alko resin (SEQ ID NO: 483) (166.0 mg, 0.025 mmol) synthesized in Reference Example C was weighed into a reaction tube, which was then set in a peptide synthesizer. 20% piperidine/NMP [reacted at 50°C for 5 minutes] was used to deprotect the Fmoc group, subsequently Fmoc-Gly-Gly-Gly-OH was introduced using the peptide synthesizer, and then Gly, Gly, and octadecanedioic acid were sequentially introduced. In this case, 20% piperidine/NMP was used [reacted at 50°C for 5 minutes] to deprotect the Fmoc group, and the condensation reaction was carried out using the double coupling method was used in which after the reactions at 50°C for 15 minutes, the solution was removed by filtration, and the same condensation reaction was repeated. After completion of solid-phase synthesis, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain the protected peptide resin of interest, Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(Oda-GGGGG)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Alko resin. Subsequently, to the total amount of the obtained resin, 2.5 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. Diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed. This operation was repeated twice and the precipitate was washed. The residue was extracted with a 50% acetic acid aqueous solution and the resin was removed by filtration, and then the purification was carried out by preparative HPLC using YMC-Triart C8-S-10 µm, 20 nm column (250 x 30 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 15 mL/minute from A/B: 40/60 to 50/50, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 3.4 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4784.51 (calculated 4785.49)

HPLC elution time: 5.88 minutes

Elution conditions:

Column: Kinetex 1.7 µm C8 100A, (100 x 2.1 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 80/20 to 30/70. Linear concentration gradient elution (10 minutes).

Flow rate: 0.5 mL/minutes

Temperature: 40°C

[0553] Example 18

Synthesis of H-

MeTyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys(Eda-PEG (3)-PEG(3)-)-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 320) (Compound 307)

Sieber amide resin (0.71 meq/g, 70.4 mg, 0.05 mmol) was added to a reaction tube, which was then set in a peptide synthesizer, and amino acids were sequentially extended according to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at 50°C for 15 minutes] to condense the Fmoc-amino acids. The operation wherein the obtained Boc-

MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Arg(Pbf)-Lys(ivDde)-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin was suspended in a 2% hydrazine/NMP solution, the resulting suspension was stirred at room temperature for 3 hours, and then the solution was removed by filtration. After the filtration, the resin was suspended in a 2% hydrazine/NMP solution and reacted at room temperature overnight to deprotect the ivDde group of Lys at position 14. Subsequently, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 388.8 mg of Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Arg(Pbf)-Lys-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin.

38.9 mg (0.01 mmol) of the obtained resin was weighed into a reaction tube, which was then set in a peptide synthesizer. According to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group, and using 5 equivalents of acid agent (Fmoc-amino acids or eicosanedioic acid mono-tert-butyl ester) and DIPCDI/Oxyma to condense, PEG(3), PEG(3), eicosanedioic acid mono-tert-butyl ester were sequentially introduced using the peptide synthesizer. The condensation reaction was carried out using the double coupling method was used in which after the reactions at 50°C for 15 minutes, the solution was removed by filtration, and the same condensation reaction was repeated. After completion of solid-phase synthesis, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 39.3 mg of the protected peptide resin of interest, Boc-MeTyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Leu-Asp(OtBu)-Arg(Pbf)-Lys(19-tert-butoxycarbonyl-nonanedanoyl)-PEG

(3)-PEG(3)-)-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin.

Subsequently, to the total amount of the obtained resin, 0.5 mL of TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. Diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed. This operation was repeated twice and the precipitate was washed. The residue was extracted with a 90% acetic acid aqueous solution and the resin was removed by filtration, and then the purification was carried out by preparative HPLC using YMC-Triart C8-S-10 μ m, 20 nm column (250 x 20 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 52/48 to 42/58, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 7.5 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4846.10 (calculated 4845.61)

HPLC elution time: 7.11 minutes

Elution conditions:

Column: Kinetex 1.7 μ m C8 100A, (100 x 2.1 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 80/20 to 30/70. Linear concentration gradient elution (10 minutes).

Flow rate: 0.5 mL/minutes

Temperature: 40°C

[0554] Example 19

Synthesis of Me-

Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys(Hda-GGGGG)-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 472) (Compound 459)

Sieber amide resin (0.71 meq/g, 352 mg, 0.25 mmol) was added to a reaction tube, which was then set in a peptide synthesizer, and amino acids were sequentially extended according to the protocol using 20% piperidine/NMP [reacted at room temperature for 15 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [reacted at room temperature for 150 minutes] to condense the Fmoc-amino acids.

The operation wherein the obtained Boc-

Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(ivDde)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-P

ro-Pro-Pro-Ser(tBu)-Sieber amide resin was suspended in a 2% hydrazine/NMP solution, the resulting suspension was stirred at room temperature for 3 hours, and then the solution was removed by filtration was repeated twice to deprotect the ivDde group of Lys at position 14.

Subsequently, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 1.87 g of Boc-

Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin.

37.3 mg (0.005 mmol) of the obtained resin was weighed into a reaction tube, which was then set in a peptide synthesizer. Subsequently, Fmoc-Gly-Gly-OH and Fmoc-Gly-Gly-Gly-OH was introduced using the peptide synthesizer, according to the protocol using 20% piperidine/NMP [reacted at 50°C for 5 minutes] to deprotect the Fmoc group and 5 equivalents of Fmoc-amino acids/DIPCDI/Oxyma [50°C, 15 minutes] to condense the Fmoc-amino acids, and then Boc-

Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(H-Gly-Gly-Gly-Gly-Gly-Gly-)-Asp(OtBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin was obtained. In this case, the condensation reaction was carried out using the double coupling method in which after all the reactions at 50°C for 15 minutes, the solution was removed by filtration, and the same condensation reaction was repeated. To the obtained resin, 6.4 mg of adipic anhydride, 6.4 mg of DIPEA, and NMP (0.1 ml) were added, and then the solution was stirred at room temperature for 2 hours. After removal of the reaction solution by filtration, the resin was washed with MeOH, and dried under reduced pressure to thereby obtain 36.9 mg of the protected peptide resin of interest, Boc-Me-Tyr(tBu)-Aib-Glu(OtBu)-Gly-Thr(tBu)-Iva-Ile-Ser(tBu)-Asp(OtBu)-Tyr(tBu)-Ser(tBu)-Ile-Aib-Lys(Hda-GGGGG-)-Asp(tBu)-Arg(Pbf)-Aib-Ala-Gln(Trt)-Aib-Asn(Trt)-Phe-Val-Asn(Trt)-Trp(Boc)-Iva-Leu-Ala-Gln(Trt)-Arg(Pbf)-Pro-Ser(tBu)-Ser(tBu)-Gly-Ala-Pro-Pro-Pro-Ser(tBu)-Sieber amide resin.

Subsequently, to the total amount of the obtained resin, 0.5 mL of

TFA:m-cresol:thioanisole:ethanedithiol:H₂O:triisopropylsilane (80:5:5:5:2.5:2.5) was added and the resulting mixture was stirred for 1.5 hours. Diethyl ether was added to the reaction solution to obtain a precipitate and after centrifugation the supernatant was removed. This operation was repeated twice and the precipitate was washed. The residue was extracted with a 90% acetic acid aqueous solution and the resin was removed by filtration, and then the purification was carried out by preparative HPLC

using Phenomenex Kinetex 5 μ m XB-C18 (250x20.0 mm I.D.) by the linear concentration gradient elution (60 minutes) with solution A: 0.1% TFA-water and solution B: 0.1% TFA-containing acetonitrile at a flow rate of 8 mL/minute from A/B: 66/34 to 56/44, and fractions containing the product of interest were collected and freeze-dried to thereby obtain 2.9 mg of a white powder.

Mass spectrometry result: (M+H)⁺ 4616.573 (calculated 4616.32)

HPLC elution time: 4.09 minutes

Elution conditions:

Column: Kinetex 1.7 μ m C8 100A, (100 $\times$ 2.1 mm I.D.)

Eluents: Using solution A: 0.1% TFA-water, solution B: 0.1% TFA-containing acetonitrile, A/B: 80/20 to 30/70. Linear concentration gradient elution (10 minutes).

Flow rate: 0.5 mL/minutes

Temperature: 40°C

[0555] The compounds not described in Examples disclosed in Figures 8A-D and Figures 9-1A,B,C to 9-5A,B,C were synthesized in accordance with Examples 1 to 19.

[0556] Test Example 1

(A) Evaluation of agonist activity on human GIPR and human GLP-1R with increase in intracellular cAMP concentration as indicator

(1) Construction of expression plasmid of human GIPR gene

The human GIPR gene having an identical sequence to Genebank Accession No. U39231 was cloned into a pMSR α -neo vector to prepare hGIPR/pMSR α -neo.

[0557] (2) Construction of reporter plasmid expressing cell

Luciferase reporter gene with a cAMP-responsive sequence located upstream was transferred to a CHO-K1 cell to construct a CRE-LUC/CHO-K1 cell.

[0558] (3) Construction of reporter plasmid

4 Copies of a cAMP responsive sequence and a Zeocin resistance gene were transferred to pGL3(R2.2)-Basic Vector (Promega) to construct a Cre-luc(Zeo) reporter plasmid.

[0559] (4) Transfer of human GIPR gene to CRE-LUC/CHO-K1 cell and obtaining of expressing cell

The plasmid hGIPR/pMSR α -neo obtained in (1) was transferred to the CRE-LUC/CHO-K1 cell obtained in (2) to obtain a transformant. Subsequently, the cell line inducing the luciferase expression, hGIPR/CRE-LUC/CHO-K1 cell, was selected from the obtained transformant by adding GIP.

[0560] (5) Construction of expression plasmid of human GLP-1R gene

The human GLP-1R gene having an identical sequence to Genebank Accession No. NM_002062 was cloned into a pIRESneo3 vector to prepare hGLP-1/pIRESneo3.

[0561] (6) Transfer of human GLP-1R gene and reporter plasmid to CHO-K1 cell and

obtaining of expressing cell

The Cre-luc (Zeo) obtained in (3) and the plasmid hGLP-1/pIRESneo3 obtained in (5) were transferred to the CHO-K1 cell to obtain a transformant. Subsequently, the cell line inducing the luciferase expression, hGLP-1R/CRE-luc/CHO-K1 cell, was selected from the obtained transformant by adding GLP-1.

[0562] (7) Reporter assay

25 μ L each of the hGIPR/CRE-LUC/CHO-K1 cell was inoculated in a 384-well white plate (Corning) in such a way as to provide 5×10^3 cells/well and cultured in a HamF12 medium containing 10% fetal bovine serum, 100 U/mL penicillin, and 100 μ g/mL streptomycin in a CO₂ incubator at 37°C overnight. 5 μ L of a medium containing a test compound was added to the cells and incubated for 4 hours at the indicated concentration in a CO₂ incubator at 37°C. Steady-Glo (Promega) was added in amounts of 30 μ L and shaken under light shielding. 20 Minutes later, luciferase activity was measured using a plate reader Envision (PerkinElmer). The GIPR agonist activity was calculated with increase in intracellular cAMP concentration as the indicator when the luciferase activity in the presence of 10 nM of GIP was 100% and the luciferase activity in the case of adding DMSO instead of the test compound was 0%.

[0563] The GLP-1R agonist activity was assayed in the same manner as above using the hGLP-1R/CRE-luc/CHO-K1 cell. The GLP-1R agonist activity was calculated with increase in intracellular cAMP concentration as the indicator when the luciferase activity in the presence of 10 nM of GLP-1 was 100% and the luciferase activity in the case of adding DMSO instead of the test compound was 0%.

[0564] As shown in Table 2-1, the compounds of the present invention have an excellent GIP receptor selective activation action.

[0565]

[Table 2-1]

Compound #	Agonist activity (EC ₅₀ , M)		SEQ ID NO.
	GLP-1R	GIPR	
1	1.6E-07	3.7E-12	SEQ ID NO.7
2	3.5E-07	7.2E-13	SEQ ID NO.8
3	1.4E-07	4.5E-12	SEQ ID NO.9
4	4.3E-07	1.4E-12	SEQ ID NO.10
5	>1.0E-06	3.9E-12	SEQ ID NO.11
6	>1.0E-06	6.8E-12	SEQ ID NO.12
7	>1.0E-06	2.1E-11	SEQ ID NO.13
8	>1.0E-06	7.9E-11	SEQ ID NO.14
9	>1.0E-06	1.0E-09	SEQ ID NO.15
10	>1.0E-06	1.6E-11	SEQ ID NO.16
11	2.7E-08	1.1E-11	SEQ ID NO.17
12	2.0E-07	1.1E-10	SEQ ID NO.18
13	4.7E-08	7.4E-12	SEQ ID NO.19
14	>1.0E-06	2.2E-11	SEQ ID NO.20
15	>1.0E-06	1.7E-10	SEQ ID NO.21
16	5.3E-07	5.0E-10	SEQ ID NO.22
17	>1.0E-06	3.1E-09	SEQ ID NO.23
18	>1.0E-06	1.3E-09	SEQ ID NO.24
19	>1.0E-06	2.7E-10	SEQ ID NO.25
20	1.9E-07	2.6E-10	SEQ ID NO.26
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22	>1.0E-06	1.5E-09	SEQ ID NO.28
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26	>1.0E-06	1.2E-08	SEQ ID NO.32
27	>1.0E-06	4.1E-11	SEQ ID NO.33
28	>1.0E-06	3.4E-11	SEQ ID NO.34
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41	>1.0E-06	4.8E-12	SEQ ID NO.47

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96	>1.0E-06	8.9E-13	SEQ ID NO.102
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115	>1.0E-06	1.1E-12	SEQ ID NO.121
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117	>1.0E-06	1.7E-12	SEQ ID NO.123
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121	4.3E-07	1.1E-12	SEQ ID NO.127
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135	>1.0E-06	1.8E-12	SEQ ID NO.141
136	2.1E-07	2.2E-12	SEQ ID NO.142
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164	>1.0E-06	1.2E-09	SEQ ID NO.177
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184	3.0E-08	3.6E-12	SEQ ID NO.197
185	2.6E-08	7.0E-12	SEQ ID NO.198
186	1.3E-08	6.4E-12	SEQ ID NO.199
187	1.1E-08	1.2E-11	SEQ ID NO.200
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193	7.7E-08	3.6E-12	SEQ ID NO.206
194	2.5E-08	3.5E-12	SEQ ID NO.207
195	1.0E-07	4.8E-12	SEQ ID NO.208
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204	9.5E-09	8.1E-12	SEQ ID NO.217
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211	2.6E-08	3.4E-12	SEQ ID NO.224
212	1.4E-07	4.7E-12	SEQ ID NO.225
213	5.4E-08	3.1E-12	SEQ ID NO.226
214	1.3E-08	4.2E-12	SEQ ID NO.227
215	1.5E-07	2.8E-12	SEQ ID NO.228
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226	1.2E-08	3.0E-12	SEQ ID NO.239
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255	>1.0E-06	4.4E-11	SEQ ID NO.268
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374	>1.0E-06	5.4E-11	SEQ ID NO.387
375	>1.0E-06	6.5E-11	SEQ ID NO.388
376	>1.0E-06	5.0E-11	SEQ ID NO.389
377	6.2E-07	3.5E-11	SEQ ID NO.390
378	>1.0E-06	4.8E-11	SEQ ID NO.391
379	>1.0E-06	3.1E-11	SEQ ID NO.392
380	>1.0E-06	5.1E-11	SEQ ID NO.393
381	>1.0E-06	4.4E-11	SEQ ID NO.394
382	>1.0E-06	1.0E-10	SEQ ID NO.395
383	>1.0E-06	4.3E-11	SEQ ID NO.396
384	>1.0E-06	5.7E-11	SEQ ID NO.397
385	>1.0E-06	8.3E-11	SEQ ID NO.398
386	>1.0E-06	7.5E-11	SEQ ID NO.399
387	>1.0E-06	5.9E-11	SEQ ID NO.400
388	>1.0E-06	9.0E-11	SEQ ID NO.401
389	>1.0E-06	8.0E-11	SEQ ID NO.402
390	>1.0E-06	6.4E-11	SEQ ID NO.403
391	>1.0E-06	1.1E-10	SEQ ID NO.404
392	>1.0E-06	1.6E-10	SEQ ID NO.405
393	>1.0E-06	8.0E-11	SEQ ID NO.406
394	>1.0E-06	6.1E-11	SEQ ID NO.407
395	>1.0E-06	4.4E-11	SEQ ID NO.408
396	>1.0E-06	3.8E-11	SEQ ID NO.409
397	>1.0E-06	1.1E-10	SEQ ID NO.410
398	>1.0E-06	2.4E-10	SEQ ID NO.411
399	>1.0E-06	1.2E-10	SEQ ID NO.412
400	>1.0E-06	8.2E-11	SEQ ID NO.413
401	>1.0E-06	1.1E-10	SEQ ID NO.414
402	>1.0E-06	7.8E-11	SEQ ID NO.415
403	>1.0E-06	1.1E-10	SEQ ID NO.416
404	>1.0E-06	1.1E-10	SEQ ID NO.417
405	>1.0E-06	4.3E-10	SEQ ID NO.418
406	>1.0E-06	3.2E-10	SEQ ID NO.419
407	>1.0E-06	3.6E-10	SEQ ID NO.420
408	>1.0E-06	4.8E-10	SEQ ID NO.421
409	>1.0E-06	8.3E-11	SEQ ID NO.422
410	>1.0E-06	1.0E-10	SEQ ID NO.423
411	>1.0E-06	1.1E-10	SEQ ID NO.424
412	>1.0E-06	7.1E-11	SEQ ID NO.425
413	>1.0E-06	1.0E-10	SEQ ID NO.426
414	>1.0E-06	2.2E-11	SEQ ID NO.427
415	>1.0E-06	2.4E-11	SEQ ID NO.428

416	>1.0E-06	3.7E-10	SEQ ID NO.429
417	>1.0E-06	3.1E-10	SEQ ID NO.430
418	>1.0E-06	6.1E-10	SEQ ID NO.431
419	>1.0E-06	4.9E-10	SEQ ID NO.432
420	>1.0E-06	7.0E-11	SEQ ID NO.433
421	>1.0E-06	1.9E-11	SEQ ID NO.434
422	>1.0E-06	1.9E-10	SEQ ID NO.435
423	>1.0E-06	2.4E-10	SEQ ID NO.436
424	>1.0E-06	1.1E-10	SEQ ID NO.437
425	>1.0E-06	8.0E-11	SEQ ID NO.438
426	>1.0E-06	8.6E-11	SEQ ID NO.439
427	>1.0E-06	7.8E-11	SEQ ID NO.440
428	>1.0E-06	2.3E-10	SEQ ID NO.441
429	>1.0E-06	1.2E-10	SEQ ID NO.442
430	>1.0E-06	5.9E-10	SEQ ID NO.443
431	>1.0E-06	1.7E-10	SEQ ID NO.444
432	>1.0E-06	5.9E-11	SEQ ID NO.445
433	>1.0E-06	4.2E-11	SEQ ID NO.446
434	>1.0E-06	3.9E-11	SEQ ID NO.447
435	>1.0E-06	5.1E-11	SEQ ID NO.448
436	>1.0E-06	5.3E-11	SEQ ID NO.449
437	>1.0E-06	5.8E-11	SEQ ID NO.450
438	>1.0E-06	6.6E-11	SEQ ID NO.451
439	>1.0E-06	1.6E-11	SEQ ID NO.452
440	>1.0E-06	4.7E-11	SEQ ID NO.453
441	>1.0E-06	3.1E-11	SEQ ID NO.454
442	>1.0E-06	8.3E-11	SEQ ID NO.455
443	>1.0E-06	3.1E-11	SEQ ID NO.456
444	>1.0E-06	5.1E-11	SEQ ID NO.457
445	>1.0E-06	5.6E-12	SEQ ID NO.458
446	>1.0E-06	2.8E-12	SEQ ID NO.459
447	>1.0E-06	1.8E-12	SEQ ID NO.460
448	>1.0E-06	1.9E-12	SEQ ID NO.461
449	>1.0E-06	2.0E-12	SEQ ID NO.462
450	>1.0E-06	1.9E-12	SEQ ID NO.463
451	>1.0E-06	2.0E-12	SEQ ID NO.464
452	>1.0E-06	2.3E-12	SEQ ID NO.465
453	>1.0E-06	3.5E-12	SEQ ID NO.466
454	>1.0E-06	3.4E-12	SEQ ID NO.467
455	>1.0E-06	3.3E-12	SEQ ID NO.468
456	>1.0E-06	4.9E-12	SEQ ID NO.469
457	>1.0E-06	2.6E-12	SEQ ID NO.470
458	>1.0E-06	1.4E-11	SEQ ID NO.471
459	>1.0E-06	2.7E-12	SEQ ID NO.472
460	>1.0E-06	9.7E-13	SEQ ID NO.473

461	>1.0E-06	1.1E-12	SEQ ID NO.474
462	>1.0E-06	3.1E-12	SEQ ID NO.475
463	>1.0E-06	6.6E-12	SEQ ID NO.476
464	>1.0E-06	5.2E-12	SEQ ID NO.477
465	>1.0E-06	5.6E-12	SEQ ID NO.478
466	>1.0E-06	6.1E-12	SEQ ID NO.479
467	>1.0E-06	2.0E-12	SEQ ID NO.480
471	>1.00E-06	5.8E-11	SEQ ID NO.484
472	>1.00E-06	3.8E-12	SEQ ID NO.485
473	>1.00E-06	3.2E-11	SEQ ID NO.486
474	>1.00E-06	2.0E-12	SEQ ID NO.487
475	>1.00E-06	4.2E-11	SEQ ID NO.488
476	>1.00E-06	3.2E-12	SEQ ID NO.489
477	>1.00E-06	4.8E-12	SEQ ID NO.490
478	>1.00E-06	4.5E-12	SEQ ID NO.491
479	>1.00E-06	1.4E-11	SEQ ID NO.492
480	>1.00E-06	1.6E-11	SEQ ID NO.493
481	>1.00E-06	3.3E-11	SEQ ID NO.494
482	>1.00E-06	3.9E-11	SEQ ID NO.495
483	>1.00E-06	2.5E-11	SEQ ID NO.496
484	>1.00E-06	2.6E-11	SEQ ID NO.497
485	>1.00E-06	2.1E-11	SEQ ID NO.498
486	>1.00E-06	2.5E-11	SEQ ID NO.499
487	>1.00E-06	5.8E-11	SEQ ID NO.500
488	>1.00E-06	1.7E-11	SEQ ID NO.501
489	>1.00E-06	1.4E-11	SEQ ID NO.502
490	>1.00E-06	3.5E-11	SEQ ID NO.503
491	>1.00E-06	1.7E-11	SEQ ID NO.504
492	>1.00E-06	1.8E-11	SEQ ID NO.505
493	>1.00E-06	4.6E-11	SEQ ID NO.506
494	>1.00E-06	4.4E-12	SEQ ID NO.507
495	>1.00E-06	5.8E-12	SEQ ID NO.508
496	>1.00E-06	1.3E-11	SEQ ID NO.509
497	>1.00E-06	1.3E-11	SEQ ID NO.510
498	>1.00E-06	7.3E-12	SEQ ID NO.511
499	>1.00E-06	1.2E-11	SEQ ID NO.512
500	>1.00E-06	5.9E-12	SEQ ID NO.513
501	>1.00E-06	6.0E-12	SEQ ID NO.514
502	>1.00E-06	8.4E-12	SEQ ID NO.515
503	>1.00E-06	5.1E-12	SEQ ID NO.516
504	>1.00E-06	8.9E-12	SEQ ID NO.517
505	>1.00E-06	8.2E-12	SEQ ID NO.518
506	>1.00E-06	1.2E-11	SEQ ID NO.519
507	>1.00E-06	6.8E-12	SEQ ID NO.520
508	>1.00E-06	1.8E-11	SEQ ID NO.521

509	>1.00E-06	1.1E-11	SEQ ID NO.522
510	>1.00E-06	1.8E-11	SEQ ID NO.523
511	>1.00E-06	1.4E-11	SEQ ID NO.524
512	>1.00E-06	1.7E-11	SEQ ID NO.525
513	>1.00E-06	1.0E-11	SEQ ID NO.526
514	>1.00E-06	2.4E-11	SEQ ID NO.527
515	>1.00E-06	6.3E-12	SEQ ID NO.528
516	>1.00E-06	6.3E-12	SEQ ID NO.529
517	>1.00E-06	6.6E-12	SEQ ID NO.530
518	>1.00E-06	8.1E-12	SEQ ID NO.531
519	>1.00E-06	1.2E-11	SEQ ID NO.532
520	>1.00E-06	5.6E-11	SEQ ID NO.533
521	>1.00E-06	5.4E-11	SEQ ID NO.534
522	>1.00E-06	1.2E-10	SEQ ID NO.535

[0566] (B) Evaluation of binding activity to human GIPR using [¹²⁵I]-GIP

(1) Construction of expression plasmid of human GIPR gene

The human GIPR gene having an identical sequence to Genebank Accession No. U39231 was cloned into a pcDNA3.3 vector to prepare hGIPR/pcDNA3.3.

[0567] (2) Preparation of human GIPR_Virus-like particle (VLP) using Expi293F cell

On the day before transfection, 850 mL of Expi293F cells were inoculated in a concentration of 1.8×10^6 cells/mL in a 3-L flask (Corning Incorporated) and cultured under conditions of 37°C, 8% CO₂, 85 rpm for 24 hours. The transfection was carried out using Expi293 Expression System Kit (Thermo Fisher Scientific). More specifically, 0.67 mg of pcDNA3.3/hGIPR and 0.33 mg of pcDNA3.3/GAG plasmid for VLP preparation were added to 50 mL of opti-MEM (Thermo Fisher Scientific) to prepare a DNA mixture. Subsequently, 2.7 mL of Expifectamine was added to 50 mL of opti-MEM and allowed to stand for 5 minutes, then the DNA mixture was mixed thereinto and the resulting mixture was allowed to stand for 20 minutes and then further added to the culture medium. 20 hours after transfection, 5 mL of Enhancers 1 and 50 mL of Enhancers 2 were added thereto. 96 hours after transfection, the culture medium was centrifuged at 850 x g for 15 minutes to thereby obtain a supernatant. The obtained supernatant was ultra-centrifuged at 54000 x g for 1 hour to thereby obtain a GIPR_VLP fraction. The precipitate was washed once with PBS and then suspended in a small amount of PBS to thereby obtain GIPR_VLP. The obtained GIPR_VLP was stored at -80°C until used. Protein quantification was carried out using GelCode Blue Safe Protein Stain (Thermo Fisher Scientific) with BSA as the standard.

[0568] (3) Measurement of binding activity of test compounds to human GIPR

For the measurement of the binding activity to GIPR, [¹²⁵I]GIP (PerkinElmer, Inc.) in a final concentration of 100 pM and a test compound in a specified concentration were

mixed to GIPR_VLP in an assay buffer (50 mM HEPES (pH 7.4, WAKO 342-01375), 5 mM EGTA (WAKO 346-01312), 5 mM MgCl₂ (WAKO 136-03995), 0.1% BSA (Merckmillipore 81-066-04) and 0.005% Tween 20 (BioRad 170-6531)) and reacted at room temperature for 2 hours. VLP to which [¹²⁵I]GIP was bound was trapped in a GF/C glass fiber filter 96-well plate (PerkinElmer 6005274) using a cell harvester and washed with an assay buffer. The GF/C glass fiber filter 96-well plate in which VLP was trapped was dried at 42°C overnight. Thereafter, MicroScint-O (PerkinElmer 6013611) was added to the GF/C glass fiber filter 96-well plate sealed using a backseal and the plate was sealed using a topseal. The radioactivity of each well was eventually measured using Topcount (PerkinElmer) and the binding activity of the test compound to GIPR was calculated when the [¹²⁵I]GIP binding activity in the presence of GIP in a final concentration of 1 μM was 100% and the [¹²⁵I]GIP binding activity of the wells to which DMSO was added was 0%.

[0569] As shown in Table 2-2, the compounds of the present invention have excellent binding activity to the GIP receptor.

[0570]

[Table 2-2]

compound #	Binding Activity (IC ₅₀ , M)	SEQ ID NO.
	GIPR	
1	8.8E-09	SEQ ID NO.7
2	1.4E-09	SEQ ID NO.8
3	6.0E-09	SEQ ID NO.9
4	1.5E-09	SEQ ID NO.10
5	2.6E-09	SEQ ID NO.11
6	2.5E-09	SEQ ID NO.12
7	5.9E-09	SEQ ID NO.13
8	1.7E-08	SEQ ID NO.14
9	1.1E-07	SEQ ID NO.15
10	5.8E-09	SEQ ID NO.16
11	1.7E-09	SEQ ID NO.17
12	9.4E-09	SEQ ID NO.18
13	2.5E-09	SEQ ID NO.19
14	7.0E-09	SEQ ID NO.20
15	7.0E-08	SEQ ID NO.21
16	1.3E-07	SEQ ID NO.22
17	1.3E-07	SEQ ID NO.23
18	1.4E-07	SEQ ID NO.24
19	2.6E-07	SEQ ID NO.25
20	2.1E-07	SEQ ID NO.26
21	3.9E-07	SEQ ID NO.27
22	9.4E-08	SEQ ID NO.28
23	2.1E-07	SEQ ID NO.29
24	3.7E-07	SEQ ID NO.30
25	5.2E-07	SEQ ID NO.31
26	4.2E-07	SEQ ID NO.32
27	6.3E-08	SEQ ID NO.33
28	4.8E-08	SEQ ID NO.34
29	4.6E-08	SEQ ID NO.35
30	1.3E-09	SEQ ID NO.36
31	1.4E-09	SEQ ID NO.37
32	2.0E-09	SEQ ID NO.38
33	2.0E-09	SEQ ID NO.39
34	1.8E-09	SEQ ID NO.40
35	2.2E-09	SEQ ID NO.41
36	1.5E-09	SEQ ID NO.42
37	1.7E-09	SEQ ID NO.43
38	2.0E-09	SEQ ID NO.44
39	1.6E-09	SEQ ID NO.45
40	1.6E-09	SEQ ID NO.46
41	1.0E-09	SEQ ID NO.47
42	1.1E-09	SEQ ID NO.48
43	3.3E-09	SEQ ID NO.49
44	1.4E-09	SEQ ID NO.50
45	1.3E-08	SEQ ID NO.51
46	2.0E-07	SEQ ID NO.52
47	2.5E-08	SEQ ID NO.53
48	1.2E-08	SEQ ID NO.54
49	2.1E-08	SEQ ID NO.55

50	8.7E-09	SEQ ID NO.56
51	2.5E-08	SEQ ID NO.57
52	1.9E-09	SEQ ID NO.58
53	1.5E-09	SEQ ID NO.59
54	1.6E-09	SEQ ID NO.60
55	1.8E-09	SEQ ID NO.61
56	2.3E-09	SEQ ID NO.62
57	1.9E-09	SEQ ID NO.63
58	2.1E-09	SEQ ID NO.64
59	1.1E-09	SEQ ID NO.65
60	1.4E-09	SEQ ID NO.66
61	1.5E-09	SEQ ID NO.67
62	1.1E-09	SEQ ID NO.68
63	1.8E-09	SEQ ID NO.69
64	2.4E-09	SEQ ID NO.70
65	1.6E-09	SEQ ID NO.71
66	1.3E-09	SEQ ID NO.72
67	2.0E-09	SEQ ID NO.73
68	2.4E-09	SEQ ID NO.74
69	1.3E-09	SEQ ID NO.75
70	1.8E-09	SEQ ID NO.76
71	2.1E-09	SEQ ID NO.77
72	2.7E-09	SEQ ID NO.78
73	1.3E-09	SEQ ID NO.79
74	1.9E-09	SEQ ID NO.80
75	1.3E-09	SEQ ID NO.81
76	1.7E-09	SEQ ID NO.82
77	1.1E-09	SEQ ID NO.83
78	2.5E-09	SEQ ID NO.84
79	1.2E-09	SEQ ID NO.85
80	1.8E-09	SEQ ID NO.86
81	1.1E-09	SEQ ID NO.87
82	1.5E-09	SEQ ID NO.88
83	3.1E-09	SEQ ID NO.89
84	1.2E-09	SEQ ID NO.90
85	1.4E-09	SEQ ID NO.91
86	1.3E-09	SEQ ID NO.92
87	1.5E-09	SEQ ID NO.93
88	1.0E-09	SEQ ID NO.94
89	9.5E-10	SEQ ID NO.95
90	2.0E-09	SEQ ID NO.96
91	1.2E-09	SEQ ID NO.97
92	2.3E-09	SEQ ID NO.98
93	1.0E-09	SEQ ID NO.99
94	1.5E-09	SEQ ID NO.100
95	1.1E-09	SEQ ID NO.101
96	1.8E-09	SEQ ID NO.102
97	1.1E-09	SEQ ID NO.103
98	1.3E-09	SEQ ID NO.104
99	2.1E-09	SEQ ID NO.105
100	1.4E-09	SEQ ID NO.106
101	9.4E-10	SEQ ID NO.107
102	1.4E-09	SEQ ID NO.108

103	2.0E-09	SEQ ID NO.109
104	1.5E-09	SEQ ID NO.110
105	1.3E-09	SEQ ID NO.111
106	1.6E-09	SEQ ID NO.112
107	1.3E-09	SEQ ID NO.113
108	2.2E-09	SEQ ID NO.114
109	1.1E-09	SEQ ID NO.115
110	1.7E-09	SEQ ID NO.116
111	2.5E-09	SEQ ID NO.117
112	1.1E-09	SEQ ID NO.118
113	1.9E-09	SEQ ID NO.119
114	1.1E-09	SEQ ID NO.120
115	1.0E-09	SEQ ID NO.121
116	9.7E-10	SEQ ID NO.122
117	5.2E-09	SEQ ID NO.123
118	1.2E-09	SEQ ID NO.124
119	1.5E-09	SEQ ID NO.125
120	1.1E-09	SEQ ID NO.126
121	1.0E-09	SEQ ID NO.127
122	9.0E-10	SEQ ID NO.128
123	1.5E-09	SEQ ID NO.129
124	1.6E-09	SEQ ID NO.130
125	1.8E-09	SEQ ID NO.131
126	1.1E-09	SEQ ID NO.132
127	1.0E-09	SEQ ID NO.133
128	9.2E-10	SEQ ID NO.134
129	1.1E-09	SEQ ID NO.135
130	1.1E-09	SEQ ID NO.136
131	1.9E-09	SEQ ID NO.137
132	1.8E-09	SEQ ID NO.138
133	1.8E-09	SEQ ID NO.139
134	1.2E-09	SEQ ID NO.140
135	2.0E-09	SEQ ID NO.141
136	2.1E-09	SEQ ID NO.142
137	9.8E-10	SEQ ID NO.143
138	1.5E-09	SEQ ID NO.144
139	9.9E-10	SEQ ID NO.145
140	1.2E-09	SEQ ID NO.146
141	1.1E-09	SEQ ID NO.147
142	1.1E-09	SEQ ID NO.148
143	1.3E-09	SEQ ID NO.149
144	1.1E-09	SEQ ID NO.150
145	1.1E-09	SEQ ID NO.151
146	2.3E-09	SEQ ID NO.152
147	1.3E-09	SEQ ID NO.153
148	1.3E-09	SEQ ID NO.154
149	1.2E-09	SEQ ID NO.155
150	1.6E-09	SEQ ID NO.156
151	1.5E-09	SEQ ID NO.157
152	2.1E-09	SEQ ID NO.158
153	1.1E-09	SEQ ID NO.159
154	1.2E-09	SEQ ID NO.160
155	1.9E-09	SEQ ID NO.161
156	1.9E-09	SEQ ID NO.162

157	1.6E-09	SEQ ID NO.163
158	3.4E-09	SEQ ID NO.171
159	8.1E-09	SEQ ID NO.172
160	4.1E-09	SEQ ID NO.173
161	2.4E-08	SEQ ID NO.174
162	5.4E-09	SEQ ID NO.175
163	5.0E-08	SEQ ID NO.176
164	4.2E-09	SEQ ID NO.177
165	2.0E-08	SEQ ID NO.178
166	2.9E-09	SEQ ID NO.179
167	7.0E-09	SEQ ID NO.180
168	3.7E-09	SEQ ID NO.181
169	1.6E-08	SEQ ID NO.182
170	3.5E-09	SEQ ID NO.183
171	3.2E-09	SEQ ID NO.184
172	3.1E-09	SEQ ID NO.185
173	7.1E-09	SEQ ID NO.186
174	3.8E-09	SEQ ID NO.187
175	2.0E-09	SEQ ID NO.188
176	3.4E-09	SEQ ID NO.189
177	2.4E-09	SEQ ID NO.190
178	3.0E-09	SEQ ID NO.191
179	2.1E-09	SEQ ID NO.192
180	1.2E-09	SEQ ID NO.193
181	2.6E-09	SEQ ID NO.194
182	1.3E-09	SEQ ID NO.195
183	2.0E-09	SEQ ID NO.196
184	2.1E-09	SEQ ID NO.197
185	1.9E-08	SEQ ID NO.198
186	1.8E-08	SEQ ID NO.199
187	1.1E-08	SEQ ID NO.200
188	2.7E-09	SEQ ID NO.201
189	1.3E-08	SEQ ID NO.202
190	5.8E-09	SEQ ID NO.203
191	2.7E-09	SEQ ID NO.204
192	2.5E-09	SEQ ID NO.205
193	2.5E-09	SEQ ID NO.206
194	2.3E-09	SEQ ID NO.207
195	2.3E-09	SEQ ID NO.208
196	2.4E-09	SEQ ID NO.209
197	2.6E-09	SEQ ID NO.210
198	1.8E-09	SEQ ID NO.211
199	2.4E-09	SEQ ID NO.212
200	2.0E-09	SEQ ID NO.213
201	1.6E-09	SEQ ID NO.214
202	1.7E-09	SEQ ID NO.215
203	2.1E-09	SEQ ID NO.216
204	2.6E-09	SEQ ID NO.217
205	1.6E-09	SEQ ID NO.218
206	2.2E-09	SEQ ID NO.219
207	1.8E-09	SEQ ID NO.220
208	1.3E-09	SEQ ID NO.221
209	1.9E-09	SEQ ID NO.222
210	1.1E-09	SEQ ID NO.223

211	3.5E-09	SEQ ID NO.224
212	3.5E-09	SEQ ID NO.225
213	3.1E-09	SEQ ID NO.226
214	3.3E-09	SEQ ID NO.227
215	2.8E-09	SEQ ID NO.228
216	3.5E-09	SEQ ID NO.229
217	2.5E-09	SEQ ID NO.230
218	2.9E-09	SEQ ID NO.231
219	2.8E-09	SEQ ID NO.232
220	2.9E-09	SEQ ID NO.233
221	3.0E-09	SEQ ID NO.234
222	2.9E-09	SEQ ID NO.235
223	3.0E-09	SEQ ID NO.236
224	2.5E-09	SEQ ID NO.237
226	2.8E-09	SEQ ID NO.239
227	3.1E-09	SEQ ID NO.240
228	6.1E-09	SEQ ID NO.241
229	2.6E-09	SEQ ID NO.242
230	2.6E-09	SEQ ID NO.243
231	8.8E-09	SEQ ID NO.244
232	2.1E-09	SEQ ID NO.245
233	2.2E-09	SEQ ID NO.246
234	8.2E-08	SEQ ID NO.247
235	1.8E-08	SEQ ID NO.248
236	1.2E-08	SEQ ID NO.249
237	1.1E-07	SEQ ID NO.250
238	4.3E-08	SEQ ID NO.251
239	2.2E-09	SEQ ID NO.252
240	2.4E-09	SEQ ID NO.253
241	1.3E-08	SEQ ID NO.254
242	1.8E-08	SEQ ID NO.255
243	1.7E-09	SEQ ID NO.256
244	1.0E-08	SEQ ID NO.257
245	1.3E-08	SEQ ID NO.258
246	7.2E-09	SEQ ID NO.259
247	5.9E-09	SEQ ID NO.260
248	1.5E-08	SEQ ID NO.261
249	6.4E-09	SEQ ID NO.262
250	6.9E-09	SEQ ID NO.263
251	3.2E-09	SEQ ID NO.264
252	1.4E-08	SEQ ID NO.265
253	7.0E-09	SEQ ID NO.266
254	2.7E-09	SEQ ID NO.267
255	1.1E-08	SEQ ID NO.268
256	1.4E-08	SEQ ID NO.269
257	1.5E-08	SEQ ID NO.270
258	1.5E-08	SEQ ID NO.271
259	2.2E-08	SEQ ID NO.272
260	1.5E-08	SEQ ID NO.273
261	1.7E-08	SEQ ID NO.274
262	8.6E-09	SEQ ID NO.275
263	2.0E-08	SEQ ID NO.276
264	4.8E-09	SEQ ID NO.277
265	1.0E-08	SEQ ID NO.278

266	1.0E-08	SEQ ID NO.279
280	4.0E-08	SEQ ID NO.293
281	3.3E-08	SEQ ID NO.294
282	1.9E-08	SEQ ID NO.295
283	7.8E-09	SEQ ID NO.296
284	6.5E-09	SEQ ID NO.297
285	8.6E-09	SEQ ID NO.298
286	1.5E-08	SEQ ID NO.299
287	1.5E-08	SEQ ID NO.300
288	3.6E-09	SEQ ID NO.301
289	5.8E-09	SEQ ID NO.302
290	6.6E-09	SEQ ID NO.303
291	7.4E-09	SEQ ID NO.304
292	7.3E-09	SEQ ID NO.305
293	9.4E-09	SEQ ID NO.306
294	1.1E-08	SEQ ID NO.307
295	6.2E-09	SEQ ID NO.308
296	6.5E-09	SEQ ID NO.309
297	1.5E-08	SEQ ID NO.310
298	7.1E-09	SEQ ID NO.311
299	>1.00E-06	SEQ ID NO.312
300	>1.00E-06	SEQ ID NO.313
301	9.4E-09	SEQ ID NO.314
302	4.0E-08	SEQ ID NO.315
303	6.7E-08	SEQ ID NO.316
304	2.5E-07	SEQ ID NO.317
305	7.6E-08	SEQ ID NO.318
306	7.1E-09	SEQ ID NO.319
307	5.0E-09	SEQ ID NO.320
308	4.2E-09	SEQ ID NO.321
309	4.0E-09	SEQ ID NO.322
310	3.5E-09	SEQ ID NO.323
311	1.2E-07	SEQ ID NO.324
312	5.4E-08	SEQ ID NO.325
313	5.7E-08	SEQ ID NO.326
314	4.8E-08	SEQ ID NO.327
315	1.0E-07	SEQ ID NO.328
316	4.5E-08	SEQ ID NO.329
317	5.8E-08	SEQ ID NO.330
318	8.3E-08	SEQ ID NO.331
319	1.0E-07	SEQ ID NO.332
320	6.9E-08	SEQ ID NO.333
321	5.1E-08	SEQ ID NO.334
322	4.0E-08	SEQ ID NO.335
323	1.1E-08	SEQ ID NO.336
324	7.8E-09	SEQ ID NO.337
325	1.6E-08	SEQ ID NO.338
326	1.5E-08	SEQ ID NO.339
327	1.3E-08	SEQ ID NO.340
328	2.8E-08	SEQ ID NO.341
329	2.5E-08	SEQ ID NO.342
330	1.1E-08	SEQ ID NO.343
331	1.5E-08	SEQ ID NO.344
332	8.3E-09	SEQ ID NO.345

333	7.3E-09	SEQ ID NO.346
334	1.5E-08	SEQ ID NO.347
335	7.2E-09	SEQ ID NO.348
336	1.3E-08	SEQ ID NO.349
337	1.7E-08	SEQ ID NO.350
338	1.4E-08	SEQ ID NO.351
339	1.4E-08	SEQ ID NO.352
340	1.4E-08	SEQ ID NO.353
341	1.6E-08	SEQ ID NO.354
342	1.3E-08	SEQ ID NO.355
343	3.6E-09	SEQ ID NO.356
344	3.8E-09	SEQ ID NO.357
345	5.2E-09	SEQ ID NO.358
346	3.5E-09	SEQ ID NO.359
347	1.1E-08	SEQ ID NO.360
348	4.5E-09	SEQ ID NO.361
349	4.2E-09	SEQ ID NO.362
350	1.4E-08	SEQ ID NO.363
351	3.2E-09	SEQ ID NO.364
352	1.3E-08	SEQ ID NO.365
353	2.3E-08	SEQ ID NO.366
354	1.4E-08	SEQ ID NO.367
355	2.0E-08	SEQ ID NO.368
356	1.0E-08	SEQ ID NO.369
357	2.6E-08	SEQ ID NO.370
358	1.6E-08	SEQ ID NO.371
359	9.4E-09	SEQ ID NO.372
360	2.6E-08	SEQ ID NO.373
361	1.8E-08	SEQ ID NO.374
362	9.6E-09	SEQ ID NO.375
363	1.2E-08	SEQ ID NO.376
364	9.6E-09	SEQ ID NO.377
365	8.7E-09	SEQ ID NO.378
366	8.7E-09	SEQ ID NO.379
367	1.4E-08	SEQ ID NO.380
368	1.4E-08	SEQ ID NO.381
369	1.5E-08	SEQ ID NO.382
370	1.2E-08	SEQ ID NO.383
371	8.3E-09	SEQ ID NO.384
372	3.3E-08	SEQ ID NO.385
373	9.7E-09	SEQ ID NO.386
374	1.7E-08	SEQ ID NO.387
375	1.7E-08	SEQ ID NO.388
376	1.3E-08	SEQ ID NO.389
377	8.7E-09	SEQ ID NO.390
378	2.7E-08	SEQ ID NO.391
379	6.7E-09	SEQ ID NO.392
380	1.4E-08	SEQ ID NO.393
381	8.7E-09	SEQ ID NO.394
382	1.2E-08	SEQ ID NO.395
383	1.0E-08	SEQ ID NO.396
384	1.7E-08	SEQ ID NO.397
385	1.5E-08	SEQ ID NO.398
386	2.1E-08	SEQ ID NO.399

387	8.2E-09	SEQ ID NO.400
388	9.4E-09	SEQ ID NO.401
389	1.9E-08	SEQ ID NO.402
390	1.4E-08	SEQ ID NO.403
391	3.4E-08	SEQ ID NO.404
392	2.7E-08	SEQ ID NO.405
393	1.2E-08	SEQ ID NO.406
394	1.0E-08	SEQ ID NO.407
395	1.5E-08	SEQ ID NO.408
396	9.4E-09	SEQ ID NO.409
397	1.7E-08	SEQ ID NO.410
398	2.0E-08	SEQ ID NO.411
399	3.0E-08	SEQ ID NO.412
400	2.0E-08	SEQ ID NO.413
401	2.3E-08	SEQ ID NO.414
402	1.8E-08	SEQ ID NO.415
403	3.1E-08	SEQ ID NO.416
404	2.4E-08	SEQ ID NO.417
405	3.6E-08	SEQ ID NO.418
406	2.9E-08	SEQ ID NO.419
407	5.3E-08	SEQ ID NO.420
408	8.4E-08	SEQ ID NO.421
409	1.7E-08	SEQ ID NO.422
410	4.4E-08	SEQ ID NO.423
411	2.4E-08	SEQ ID NO.424
412	1.6E-08	SEQ ID NO.425
413	2.4E-08	SEQ ID NO.426
414	4.0E-09	SEQ ID NO.427
415	4.3E-09	SEQ ID NO.428
416	1.6E-07	SEQ ID NO.429
417	3.9E-07	SEQ ID NO.430
418	3.8E-07	SEQ ID NO.431
419	5.0E-07	SEQ ID NO.432
420	1.2E-08	SEQ ID NO.433
421	3.2E-09	SEQ ID NO.434
422	2.3E-08	SEQ ID NO.435
423	2.5E-07	SEQ ID NO.436
424	5.0E-08	SEQ ID NO.437
425	2.6E-08	SEQ ID NO.438
426	2.2E-08	SEQ ID NO.439
427	1.5E-08	SEQ ID NO.440
428	7.2E-08	SEQ ID NO.441
429	5.7E-08	SEQ ID NO.442
430	3.1E-07	SEQ ID NO.443
431	2.8E-08	SEQ ID NO.444
432	9.2E-09	SEQ ID NO.445
433	8.7E-09	SEQ ID NO.446
434	1.0E-08	SEQ ID NO.447
435	1.8E-08	SEQ ID NO.448
436	2.2E-08	SEQ ID NO.449
437	3.0E-08	SEQ ID NO.450
438	2.5E-08	SEQ ID NO.451
439	3.1E-09	SEQ ID NO.452
440	8.0E-09	SEQ ID NO.453

441	3.8E-09	SEQ ID NO.454
442	9.8E-09	SEQ ID NO.455
443	4.5E-09	SEQ ID NO.456
444	1.2E-08	SEQ ID NO.457
445	9.2E-10	SEQ ID NO.458
446	7.4E-10	SEQ ID NO.459
447	7.9E-10	SEQ ID NO.460
448	1.0E-09	SEQ ID NO.461
449	1.2E-09	SEQ ID NO.462
450	1.1E-09	SEQ ID NO.463
451	9.9E-10	SEQ ID NO.464
452	1.0E-09	SEQ ID NO.465
453	1.5E-09	SEQ ID NO.466
454	1.1E-09	SEQ ID NO.467
455	1.1E-09	SEQ ID NO.468
456	1.6E-09	SEQ ID NO.469
457	1.4E-09	SEQ ID NO.470
458	3.2E-09	SEQ ID NO.471
459	1.7E-09	SEQ ID NO.472
460	1.3E-09	SEQ ID NO.473
461	1.3E-09	SEQ ID NO.474
462	2.0E-09	SEQ ID NO.475
463	2.1E-09	SEQ ID NO.476
464	1.9E-09	SEQ ID NO.477
465	2.2E-09	SEQ ID NO.478
466	1.8E-09	SEQ ID NO.479
467	1.4E-09	SEQ ID NO.480
471	9.6E-09	SEQ ID NO.484
472	1.8E-09	SEQ ID NO.485
473	6.8E-09	SEQ ID NO.486
474	1.1E-09	SEQ ID NO.487
475	8.9E-09	SEQ ID NO.488
476	1.8E-09	SEQ ID NO.489
477	2.8E-09	SEQ ID NO.490
478	2.3E-09	SEQ ID NO.491
479	4.6E-09	SEQ ID NO.492
480	5.8E-09	SEQ ID NO.493
481	1.4E-08	SEQ ID NO.494
482	1.8E-08	SEQ ID NO.495
483	8.5E-09	SEQ ID NO.496
484	1.0E-08	SEQ ID NO.497
485	1.2E-08	SEQ ID NO.498
486	1.7E-08	SEQ ID NO.499
487	2.1E-08	SEQ ID NO.500
488	6.4E-09	SEQ ID NO.501
489	9.4E-09	SEQ ID NO.502
490	2.1E-08	SEQ ID NO.503
491	1.3E-08	SEQ ID NO.504
492	1.3E-08	SEQ ID NO.505
493	2.5E-08	SEQ ID NO.506
494	3.2E-09	SEQ ID NO.507
495	4.6E-09	SEQ ID NO.508
496	1.0E-08	SEQ ID NO.509
497	8.4E-09	SEQ ID NO.510

498	7.7E-09	SEQ ID NO.511
499	9.6E-09	SEQ ID NO.512
500	6.6E-09	SEQ ID NO.513
501	6.3E-09	SEQ ID NO.514
502	1.4E-08	SEQ ID NO.515
503	8.0E-09	SEQ ID NO.516
504	9.1E-09	SEQ ID NO.517
505	4.0E-09	SEQ ID NO.518
506	5.3E-09	SEQ ID NO.519
507	5.4E-09	SEQ ID NO.520
508	9.1E-09	SEQ ID NO.521
509	7.3E-09	SEQ ID NO.522
510	1.2E-08	SEQ ID NO.523
511	8.3E-09	SEQ ID NO.524
512	1.3E-08	SEQ ID NO.525
513	8.4E-09	SEQ ID NO.526
514	1.2E-08	SEQ ID NO.527
515	5.7E-09	SEQ ID NO.528
516	4.1E-09	SEQ ID NO.529
517	8.7E-09	SEQ ID NO.530
518	5.8E-09	SEQ ID NO.531
519	1.4E-08	SEQ ID NO.532
520	1.8E-08	SEQ ID NO.533
521	2.0E-08	SEQ ID NO.534
522	2.8E-08	SEQ ID NO.535

[0571] Test Example 2

Oral glucose tolerance test (1)

An oral glucose tolerance test (OGTT) was carried out using C57BL/6J mice with a glucose load of 0.03 nmol/kg. Each peptide or a solvent (control group) was subcutaneously administered 30 minutes before glucose loading and the glucose levels 30 minutes and 60 minutes after oral glucose administration were measured to evaluate the action of the compound. The action of the compound was calculated by the calculation formula below and expressed as the rate of increase in blood glucose level (%).

Rate of increase in blood glucose level (%) = (blood glucose level after glucose loading - blood glucose level before glucose loading of compound administered group) / (blood glucose level after glucose loading - blood glucose level before glucose loading of control group) x 100

Results are shown in Table 3-1. As shown in Table 3-1, it is verified that the compounds of the present invention suppress increase in blood glucose level caused by

oral glucose loading.

[0572]

[Table 3-1]

Compound #	Rate of increase in blood glucose level (%)	
	30 min	60min
4	83	55
6	56	31
13	61	35
30	96	85
41	55	31
42	70	43
52	74	42
54	85	92
59	41	23
60	40	34
61	58	31
62	59	22
63	54	25
64	45	20
65	38	36
66	51	32
67	42	16
68	42	11
69	47	23
71	52	27
72	46	17
73	44	29
74	46	34
75	45	16
76	52	37
77	98	92
78	40	16
79	51	32
81	56	29
82	41	16
83	48	25
84	44	16
85	46	29
86	48	27
87	40	21
88	45	30
89	52	26
90	40	17
91	56	31
92	44	17
93	43	31
94	45	22
95	49	23
96	40	16
97	47	30

98	94	85
99	91	73
100	89	52
101	88	66
102	34	16
103	35	15
104	31	8
105	50	19
106	42	13
107	36	8
108	42	9
109	53	34
110	42	23
111	52	21
113	48	11
114	43	17
117	51	16
125	35	14
129	59	31
130	50	33
131	56	31
132	62	34
133	46	24
134	53	22
135	54	39
136	59	31
137	53	31
138	45	18
139	46	17
140	54	56
141	65	50
142	44	20
143	64	66
144	63	48
145	52	58
146	45	23
147	43	23
150	57	40
151	62	35
152	65	37
153	69	39
154	48	34
155	62	29
156	66	55
157	61	50

[0573] Oral glucose tolerance test (2)

An oral glucose tolerance test (OGTT) was carried out using C57BL/6J mice with a glucose load of 3 nmol/kg. Each peptide or a solvent (control group) was subcutaneously administered 72 hours before glucose loading and the blood glucose levels 30 minutes after oral glucose administration were measured to evaluate the action of the compound. The action of the compound was calculated by the calculation formula below and expressed as the rate of increase in blood glucose level (%).

Rate of increase in blood glucose level (%) = (blood glucose level after glucose loading - blood glucose level before glucose loading of compound administered group) / (blood glucose level after glucose loading - blood glucose level before glucose loading of control group) x 100

Results are shown in Table 3-2. As shown in Table 3-2, it is verified that the compounds of the present invention suppress increase in blood glucose level caused by oral glucose loading.

[0574] [Table 3-2]

compound #	Rate of increase in blood glucose level (%)
	72 hr
341	47
349	69

[0575] Test Example 3: Conditioned taste aversion test in mice
(Fig. 1-1, Fig. 1-2)

0.1% Saccharine water and 14-residue Y2R agonist PYY-1119 (4-imidazolecarbonyl-Ser-D-Hyp-Iva-Pya(4)-Cha-Leu(Me)-Asn-Lys-Aib-Thr-Arg-Gln-Arg-Cha-NH₂ (SEQ ID NO: 164), which causes a sense of aversion, were given to male C57BL/6J mice to thereby induce conditioned taste aversion (CTA) to saccharin water, and the action of the compounds of the present invention on the PYY-1119-induced taste aversion was evaluated. The common procedure for the CTA experiment is as follows.

The conditioning was carried out in the following way: On day 1 and day 3, saccharine water is presented to the mice, and PYY-1119 (10 nmol/kg, s.c.) is administered 10 minutes later. Additionally, the test compound or a solvent is subcutaneously administered simultaneously with PYY-1119.

On day 2, only a solvent is administered 10 minutes after presenting tap water.

On day 4, only tap water is presented.

On day 5, a test of selection from the bottles of saccharine water and tap water is

carried out and preferential selection of saccharine water is evaluated.

[0576] Compound 6 was dissolved in 10% DMSO/saline and administered simultaneously with PYY-1119 in a dose of 1 nmol/kg, 3 nmol/kg, 10 nmol/kg, 30 nmol/kg, or 100 nmol/kg. As a result, Compound 6 suppressed the PYY-1119-induced taste aversion in a dose-dependent manner (Fig. 1-1).

[0577] Compound 117 was dissolved in 0.1% Tween 80/10% DMSO/saline and administered simultaneously with PYY-1119 in a dose of 0.003 nmol/kg, 0.01 nmol/kg, 0.03 nmol/kg, 0.1 nmol/kg, 0.3 nmol/kg, or 1 nmol/kg. As a result, Compound 117 suppressed the PYY-1119-induced taste aversion in a dose-dependent manner (Fig. 1-2).

[0578] Test Example 4: Vomiting suppression test in ferrets

1. Effect of subcutaneously injected Compound 6 in cisplatin-induced acute vomiting model

The ferret test was carried out by Nissei Bilis Co., Ltd. (Shiga prefecture, Japan). Cisplatin (10 mg/kg i.p.) was administered to male ferrets (10-week-old, n=6) to induce acute vomiting. A vehicle (10% DMSO/saline, s.c.), Compound 6 (16.7 or 167 nmol/kg/hour (corresponding to about 70.7 and 707 µg/kg/hour, respectively) was subcutaneously injected, started 1 hour before cisplatin administration) and aprepitant (NK1R antagonist, 3 mg/kg p.o., administered 1 hour before cisplatin administration) were evaluated using the above ferrets. The frequency of emesis (feeling queasy, vomiting) was monitored over a period of 8 hours after cisplatin administration. In the 167 nmol/kg/hour administration, Compound 6 completely eliminated the acute emesis to at least the same extent as the effect by aprepitant (Fig. 2-1). The plasma levels of Compound 6 evaluated at the test completion were 133.4 and 392.7 nmol/L in the 16.7 or 167 nmol/kg/hour administration, respectively.

[0579] 2. Effect of subcutaneously injected Compound 117 in cisplatin-induced acute emetic model

24 ferrets were divided into 6 groups of 4 each, and a vehicle (0.09 w/v% tween 80/10% DMSO/saline) and 0.15, 0.5, 1.5, 5, and 15 µg/kg (0.03, 0.1, 0.3, 1, and 3 nmol/kg) of Compound 117 were subcutaneously injected to the groups, respectively, and 1 hour later 10 mg/kg of cisplatin was intraperitoneally administered to each group. Up to 6 hours after cisplatin administration, the condition of the ferrets was monitored to record the frequencies and time points of abdominal contraction motions and vomiting behaviors occurring. As a result, the suppression of the vomiting symptom was noted in a dose-dependent manner in the groups to which Compound 117 was administered (Fig. 2-2).

[0580] 3. Effects of Compound 117 and Compound 341 in cisplatin-induced delayed vomiting model

28 ferrets were divided into 4 groups of 7 each, and 5 mg/kg of cisplatin was intraperitoneally administered, and 34 hours later a vehicle (0.09 w/v% tween 80/10% DMSO/saline), 1.5 µg/kg and 15 µg/kg of Compound 117, and 144 µg/kg of Compound 341 were subcutaneously injected to the groups, respectively. Up to 72 hours after cisplatin administration, the condition of the ferrets was monitored to record the frequencies and time points of abdominal contraction motions and vomiting behaviors occurring. As a result, when 1.5 µg/kg (0.3 nmol/kg) or 15 µg/kg (3 nmol/kg) of Compound 117 was administered, the latency of the vomiting symptom (the time from cisplatin administration to the initial occurrence of the vomiting symptom) was delayed (Fig. 2-3) and when 144 µg/kg (30 nmol/kg) of Compound 341 was administered, the suppression of the vomiting symptom was noted.

[0581] 4. Effect of subcutaneously administered GIP agonist analogue in morphine-induced acute emetic model

Male ferrets (4-month-old) were repeatedly used until 8-month-old. To evaluate the antiemetic effect, the GIP agonist analogues other than natural human GIP were subcutaneously administered 30 minutes before morphine administration. Natural human GIP was subcutaneously administered 5 minutes before morphine administration. Compound 6 in a dose of 4.2 µg/kg (1 nmol/kg) completely attenuated the morphine (0.6 mg/kg, s.c.)-induced emesis in the ferrets (Fig. 3). Compound 59 (0.45 µg/kg, 0.1 nmol/kg; 4.47 µg/kg, 1 nmol/kg; 13.4 µg/kg, 3 nmol/kg), Compound 75 (4.44 µg/kg, 1 nmol/kg), Compound 104 (4.35 µg/kg, 1 nmol/kg), Compound 113 (0.43 µg/kg, 0.1 nmol/kg; 4.35 µg/kg, 1 nmol/kg), and Compound 117 (4.45 µg/kg, 1 nmol/kg) also suppressed the morphine-induced emesis in ferrets (Fig. 4, Fig. 5).

[0582] 5. Effects of subcutaneously administered Compound 341, Compound 349, 253, 268, 284, 292 and 314 in morphine-induced acute emetic model

144 µg/kg (30 nmol/kg) of Compound 341, 144 µg/kg (30 nmol/kg) of Compound 349, 144 µg/kg (30 nmol/kg) of Compound 253, 145 µg/kg (30 nmol/kg) of Compound 268, 144 µg/kg (30 nmol/kg) of Compound 284, 145 µg/kg (30 nmol/kg) of Compound 292, and 145 µg/kg (30 nmol/kg) of Compound 314 dissolved with a vehicle (0.09 w/v% tween 80/10% DMSO/saline), respectively, to prepare test solutions. 0.5 mg/kg of the test solutions and the vehicle were subcutaneously administered to ferrets (4 in each group), respectively. At the time of each of 4 hours, or 120 hours after administration, 0.6 mg/kg of morphine was subcutaneously administered. Up to 60 minutes after morphine administration, the condition of the ferrets was monitored to record the frequencies and time points of abdominal contraction motions, vomiting behaviors, licking with the tongue, and fidgety behavior occurring.

As a result, in the experiment wherein morphine was administered 4 hours after administration, the vomiting behavior was noted in all of the 4 ferrets in the vehicle

group but the vomiting symptom was observed in none of the 4 ferrets in each of the group receiving 144 µg/kg of Compound 341, the group receiving 144 µg/kg of Compound 349, the group receiving 144 µg/kg of Compound 253, the group receiving 145 µg/kg of Compound 268, the group receiving 144 µg/kg of Compound 284, the group receiving 145 µg/kg of Compound 292, and the group receiving 145 µg/kg of Compound 314 (Fig. 6-1). In addition, the plasma levels of Compound 341, Compound 349, Compound 253, Compound 268, Compound 284, Compound 292, and Compound 314 4 hours after administration were 154.0 nmol/L, 143.4 nmol/L, 108.4 nmol/L, 104.9 nmol/L, 163.3 nmol/L, 96.7 nmol/L, and 172.7 nmol/L, respectively. Furthermore, in the experiment wherein morphine was administered 120 hours after administration, the vomiting behavior was noted in all of the 4 ferrets in the vehicle group but the vomiting symptom was observed in none of the 4 ferrets in the group receiving 144 µg/kg of Compound 341, and the suppression of the vomiting symptom was noted in the group receiving 144 µg/kg of Compound 349 (Fig. 6-2). In addition, the plasma levels of Compound 341 and Compound 349 120 hours after administration were 82.3 nmol/L and 43.3 nmol/L, respectively.

[0583] 6. PYY-1119-induced vomiting in dogs

Effects of single subcutaneous administration of Compound 6 and Compound 117 on PYY-1119 (10 µg/kg [about 5 nmol/kg], s.c.)-induced emesis were evaluated in beagles.

[0584] For Compound 6, the combined use and PYY-1119 sole administration were tested in 2 female and 2 male cases (24- to 32-month-old) at intervals of 7 days, and Compound 6 was administered 10 minutes before PYY-1119 administration. Compound 6 (150 nmol/kg), during a 2-hour observation period after PYY-1119 administration, notably suppressed the frequency of vomiting to 0 to 3 times, whereas the frequency of vomiting was observed to be 6 to 28 times for PYY-1119 alone (Fig. 7-1).

[0585] For Compound 117, the test was carried out as a cross-over test using 4 female cases (36-month old) at intervals of 7 days, and Compound 117 and a medium thereof were administered 1 hour before PYY-1119 administration. The compound 117 (10 nmol/kg), during a 2-hour observation period after PYY-1119 administration, notably suppressed the frequency of vomiting to 0 to 3 times, whereas the frequency of vomiting was observed to be 8 to 30 times in the medium group, and the average suppression rate of the frequency of vomiting was 93% (Fig. 7-2).

[0586] Formulation Example 1

- (1) Compound of Example 1 10.0 mg
- (2) Lactose 70.0 mg
- (3) Cornstarch 50.0 mg

(4) Soluble starch 7.0 mg

(5) Magnesium stearate 3.0 mg

Compound of Example 1 (10.0 mg) and magnesium stearate (3.0 mg) are granulated with an aqueous soluble starch solution (0.07 mL) (7.0 mg as soluble starch), dried and mixed with lactose (70.0 mg) and cornstarch (50.0 mg). The mixture is compressed to give a tablet.

[0587] Formulation Example 2

(1) Compound of Example 1 5.0 mg

(2) Sodium chloride 20.0 mg

(3) Distilled water to total amount 2 mL

Compound of Example 1 (5.0 mg) and sodium chloride (20.0 mg) are dissolved in distilled water, and water is added to a total amount of 2.0 mL. The solution is filtered, and filled in a 2 mL ampoule under aseptic conditions. The ampoule is sterilized and tightly sealed to give a solution for injection.

Industrial Applicability

[0588] The compound of the present invention has superior GIP receptor selective agonist activity, and is useful as a drug for the prophylaxis or treatment of various diseases associated with GIP receptor, for example, diabetes, obesity, disease associated with vomiting or nausea and the like.

[0589] All the publications, patents, and the patent applications cited herein are incorporated herein by reference in their entireties.

Free Text for Sequence Listing

[0590] SEQ ID NO: 1: Synthetic peptide

SEQ ID NO: 2: Synthetic peptide

SEQ ID NO: 3: Synthetic peptide

SEQ ID NO: 4: Synthetic peptide (Reference Example 1)

SEQ ID NO: 5: Synthetic peptide (Reference Example 2)

SEQ ID NO: 6: Synthetic peptide (Reference Example 3)

SEQ ID NOs: 7 to 163: Synthetic peptides (Compounds 1 to 157, respectively)

SEQ ID NO: 164: Synthetic peptide (PYY-1119)

SEQ ID NO: 165: Synthetic peptide (formula (I))

SEQ ID NO: 166: Synthetic peptide (formula (II))

SEQ ID NO: 167: Synthetic peptide (formula (III))

SEQ ID NO: 168: Synthetic peptide (formula (IV))

SEQ ID NO: 169: Synthetic peptide (formula (V))

SEQ ID NO: 170: Synthetic peptide (formula (VI))

SEQ ID NOs: 171 to 480: Synthetic peptides (Compounds 158 to 467, respectively)

SEQ ID NO: 481: Synthetic peptide (Reference Example A: Compound 468)

SEQ ID NO: 482: Synthetic peptide (Reference Example B: Compound 469)

SEQ ID NO: 483: Synthetic peptide (Reference Example C: Compound 470)

SEQ ID NOs: 484 to 535: Synthetic peptides (Compounds 471 to 522, respectively)

SEQ ID NOs: 536 to 565: Synthetic peptides

SEQ ID NO: 566: Synthetic peptide (formula (X))

SEQ ID NOs: 567 to 569: Synthetic peptide (formulas (VII) to (IX))

[Claims]

[Claim 1]

A peptide represented by formula (I):

P¹-Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-
A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-
A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P² (SEQ
ID NO: 165)

wherein

P¹ represents

-R^{A1}, or

-CO-R^{A1},

wherein R^{A1} represents a hydrogen atom, or a C₁₋₆ alkyl
group;

P² represents -NH₂ or -OH;

A2 represents Aib or D-Ala;

A6 represents Iva, Phe, or Val;

A7 represents Ile, Lys, or Val;

A8 represents Ser;

A9 represents Asp, Leu, or Phe;

A10 represents Tyr;

A11 represents Aib or Ser;

A12 represents Ile;

A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;

A14 represents Leu;
A15 represents Asp, Glu, Lys, Ser, or Tyr;
A16 represents Arg or Lys;
A17 represents Aib, Gln, or Ile;
A18 represents Ala or His;
A19 represents Gln or Ser;
A20 represents Aib, Ala, or Gln;
A21 represents Asn, Asp, Glu, Leu, or Ser;
A22 represents Phe or α MePhe;
A23 represents Ile or Val;
A24 represents Arg, Asn, Asp, Lys, or Lys(Ac);
A25 represents Trp;
A26 represents Aib, Iva, or Leu;
A27 represents Leu;
A28 represents Ala, Arg, Lys, or Lys(Ac);
A29 represents Gln or Gly;
A30 represents Arg, Gly, or a deletion;
A31 represents Pro or a deletion;
A32 represents Ser or a deletion;
A33 represents Ser or a deletion;
A34 represents Gly or a deletion;
A35 represents Ala or a deletion;
A36 represents Pro or a deletion;
A37 represents Pro or a deletion;

A38 represents Pro or a deletion;
 A39 represents Lys, Ser, or a deletion;
 A40 represents Arg, Lys, or a deletion; and
 one or two amino acids selected from A12, A14 and A17
 optionally represent Lys(R), and R represents X-L-,
 wherein X-L- represents Trda-GGGG-, Trda-GGGGG-, Trda-
 GGGGGG-, Teda-GGGG-, Teda-GGGGG-, Teda-GGGGGG-, Peda-
 GGGG-, Peda-GGGGG-, Peda-GGGGGG-, Heda-GGGG-, Heda-GGGGG-,
 Heda-GGGGGG-, Hepda-GGGG-, Hepda-GGGGG-, Hepda-GGGGGG-,
 Oda-GGGG-, Oda-GGGGG-, Oda-GGGGGG-, Eda-GGGG-, Eda-GGGGG-,
 Eda-GGGGGG-, Eda-GGGGGGGGG-;
 provided that where all A31 to A40 represent deletions,
 then A2 represents Aib,
 or a salt thereof.

[Claim 2]

The peptide according to claim 1 represented by
 formula (II):
 P^1 -Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-
 A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-
 A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-A39-A40- P^2 (SEQ
 ID NO: 166)
 wherein
 A2 represents Aib or D-Ala;
 A6 represents Iva, Phe, or Val;

A7 represents Ile, Lys, or Val;
A8 represents Ser;
A9 represents Asp, Leu, or Phe;
A10 represents Tyr;
A11 represents Aib or Ser;
A12 represents Ile;
A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;
A14 represents Leu;
A15 represents Asp, Glu, Lys, Ser, or Tyr;
A16 represents Arg or Lys;
A17 represents Aib, Gln, or Ile;
A18 represents Ala or His;
A19 represents Gln or Ser;
A20 represents Aib, Ala, or Gln;
A21 represents Asn, Asp, Glu, Leu or Ser;
A22 represents Phe or α MePhe;
A23 represents Ile or Val;
A24 represents Arg, Asn, Asp, Lys, or Lys(Ac);
A25 represents Trp;
A26 represents Aib, Iva, or Leu;
A27 represents Leu;
A28 represents Ala, Arg, Lys, or Lys(Ac);
A29 represents Gln or Gly;
A30 represents Arg or Gly;

A39 represents Lys or Ser; and
A40 represents Arg, Lys, or a deletion;
or a salt thereof.

[Claim 3]

The peptide according to claim 1 represented by
formula (III):

P¹-Tyr-A2-Glu-Gly-Thr-Val-A7-A8-A9-A10-A11-A12-A13-A14-
A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-
A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-A39-A40-P² (SEQ
ID NO: 167)

wherein

A2 represents Aib or D-Ala;
A7 represents Ile, Lys, or Val;
A8 represents Ser;
A9 represents Asp, Leu, or Phe;
A10 represents Tyr;
A11 represents Ser;
A12 represents Ile;
A13 represents Aib, Ala, Gln, Leu, or Tyr;
A14 represents Leu;
A15 represents Asp, Glu, Lys, Ser, or Tyr;
A16 represents Lys;
A17 represents Gln or Ile;
A18 represents Ala or His;

A19 represents Gln or Ser;
 A20 represents Aib or Gln;
 A21 represents Glu or Leu;
 A22 represents Phe;
 A23 represents Ile or Val;
 A24 represents Lys or Lys(Ac);
 A25 represents Trp;
 A26 represents Aib or Leu;
 A27 represents Leu;
 A28 represents Lys or Lys(Ac);
 A29 represents Gly;
 A30 represents Gly;
 A39 represents Lys or Ser; and
 A40 represents Lys or a deletion;
 or a salt thereof.

[Claim 4]

The peptide according to claim 1 represented by
 formula (IV):

P^1 -Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-
 A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-
 A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40- P^2 (SEQ
 ID NO: 168)

wherein

A6 represents Iva, Phe, or Val;

A7 represents Ile or Val;
A8 represents Ser;
A9 represents Asp or Leu;
A10 represents Tyr;
A11 represents Aib or Ser;
A12 represents Ile;
A13 represents Aib, Ala, or D-Iva;
A14 represents Leu;
A15 represents Asp;
A16 represents Arg;
A17 represents Aib, Gln, or Ile;
A18 represents Ala or His;
A19 represents Gln;
A20 represents Aib, Ala, or Gln;
A21 represents Glu, Asn, Asp, or Ser;
A22 represents Phe or α MePhe;
A23 represents Val;
A24 represents Arg, Asn or Asp;
A25 represents Trp;
A26 represents Leu or Iva;
A27 represents Leu;
A28 represents Ala or Arg;
A29 represents Gln or Gly;
A30 represents Arg or Gly; and

A40 represents Arg or a deletion;

or a salt thereof.

[Claim 5]

The peptide according to claim 1 represented by
formula (V):

P¹-Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-
A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-
A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P² (SEQ
ID NO: 169)

wherein

A6 represents Iva, Phe, or Val;

A7 represents Ile, Lys, or Val;

A8 represents Ser;

A9 represents Asp, Leu, or Phe;

A10 represents Tyr;

A11 represents Aib or Ser;

A12 represents Ile;

A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;

A14 represents Leu;

A15 represents Asp, Glu, Lys, Ser, or Tyr;

A16 represents Arg or Lys;

A17 represents Aib, Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln or Ser;

A20 represents Aib, Ala, or Gln;
 A21 represents Asn, Asp, Glu, Leu, or Ser;
 A22 represents Phe or α MePhe;
 A23 represents Ile or Val;
 A24 represents Arg, Asn, Lys, or Lys(Ac);
 A25 represents Trp;
 A26 represents Aib, Iva, or Leu;
 A27 represents Leu;
 A28 represents Ala, Arg, Lys, or Lys(Ac);
 A29 represents Gln or Gly;
 A30 represents Arg, Gly or a deletion; and
 A31 to A40 represent a deletion;
 or a salt thereof.

[Claim 6]

The peptide according to claim 1 represented by
 formula (VI):
 P^1 -Tyr-Aib-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-
 A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-
 A29-A30-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-A40- P^2 (SEQ
 ID NO: 170)

wherein

A6 represents Iva, Phe, or Val;
 A7 represents Ile or Val;
 A8 represents Ser;

A9 represents Asp or Leu;
A10 represents Tyr;
A11 represents Ser;
A12 represents Ile;
A13 represents Aib or Ala;
A14 represents Leu;
A15 represents Asp;
A16 represents Arg or Lys;
A17 represents Aib, Gln, or Ile;
A18 represents Ala or His;
A19 represents Gln;
A20 represents Aib or Gln;
A21 represents Asn, Glu, or Asp;
A22 represents Phe;
A23 represents Val;
A24 represents Arg, Asn, or Lys;
A25 represents Trp;
A26 represents Iva or Leu;
A27 represents Leu;
A28 represents Ala, Arg, or Lys;
A29 represents Gln or Gly;
A30 represents Arg or Gly; and
A40 represents Arg, Lys, or a deletion;
or a salt thereof.

[Claim 7]

The peptide according to claim 1 represented by formula (I):

P¹-Tyr-A2-Glu-Gly-Thr-A6-A7-A8-A9-A10-A11-A12-A13-A14-A15-A16-A17-A18-A19-A20-A21-A22-A23-A24-A25-A26-A27-A28-A29-A30-A31-A32-A33-A34-A35-A36-A37-A38-A39-A40-P²

wherein

A2 represents Aib or D-Ala;

A6 represents Iva, Phe, or Val;

A7 represents Ile, Lys, or Val;

A8 represents Ser;

A9 represents Asp, Leu, or Phe;

A10 represents Tyr;

A11 represents Aib or Ser;

A12 represents Ile;

A13 represents Aib, Ala, Gln, Leu, Tyr, or D-Iva;

A14 represents Leu;

A15 represents Asp, Glu, Lys, Ser, or Tyr;

A16 represents Arg or Lys;

A17 represents Aib, Gln, or Ile;

A18 represents Ala or His;

A19 represents Gln or Ser;

A20 represents Aib, Ala, or Gln;

A21 represents Asn, Asp, Glu, Leu, or Ser;

A22 represents Phe or α MePhe;
A23 represents Ile or Val;
A24 represents Arg, Asn, Asp, Lys, or Lys(Ac);
A25 represents Trp;
A26 represents Aib, Iva, or Leu;
A27 represents Leu;
A28 represents Ala, Arg, Lys, or Lys(Ac);
A29 represents Gln or Gly;
A30 represents Arg, Gly, or a deletion;
A31 represents Pro or a deletion;
A32 represents Ser or a deletion;
A33 represents Ser or a deletion;
A34 represents Gly or a deletion;
A35 represents Ala or a deletion;
A36 represents Pro or a deletion;
A37 represents Pro or a deletion;
A38 represents Pro or a deletion;
A39 represents Lys, Ser, or a deletion; and
A40 represents Arg, Lys, or a deletion,
or a salt thereof.

[Claim 8]

The peptide according to claim 1 represented by
formula: H-Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-
Ile-Aib-Leu-Asp-Lys-Gln-Ala-Gln-Aib-Glu-Phe-Val-Lys-Trp-

Leu-Leu-Lys-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Lys-NH₂ (SEQ ID NO: 12), or a salt thereof.

[Claim 9]

The peptide according to claim 1 represented by formula: H-Tyr-Aib-Glu-Gly-Thr-Val-Val-Ser-Leu-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Gln-Ala-Gln-Aib-Glu-Phe-Val-Arg-Trp-Leu-Leu-Arg-Gly-Gly-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 36), or a salt thereof.

[Claim 10]

The peptide according to claim 1 represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Ile-Ala-Gln-Gln-Asp-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 65), or a salt thereof.

[Claim 11]

The peptide according to claim 1 represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Leu-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 110), or a salt thereof.

[Claim 12]

The peptide according to claim 1 represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-

Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 119), or a salt thereof.

[Claim 13]

The peptide according to claim 1 represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Phe-Ile-Ser-Asp-Tyr-Ser-Ile-Ala-Leu-Asp-Arg-Aib-His-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-Arg-NH₂ (SEQ ID NO: 123), or a salt thereof.

[Claim 14]

The peptide according to claim 1 represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Lys (Eda-GGGGG-) -Asp-Arg-Aib-Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 354), or a salt thereof.

[Claim 15]

The peptide according to claim 1 represented by formula: Me-Tyr-Aib-Glu-Gly-Thr-Iva-Ile-Ser-Asp-Tyr-Ser-Ile-Aib-Leu-Asp-Arg-Lys (Oda-GGGGG-) -Ala-Gln-Aib-Asn-Phe-Val-Asn-Trp-Iva-Leu-Ala-Gln-Arg-Pro-Ser-Ser-Gly-Ala-Pro-Pro-Pro-Ser-NH₂ (SEQ ID NO: 362), or a salt thereof.

[Claim 16]

A medicament comprising the peptide according to claim 1, or a salt thereof.

[Claim 17]

The medicament according to claim 19, which is an activator of a GIP receptor.

[Claim 18]

The medicament according to claim 19, which is a suppressant for vomiting or nausea.

[Claim 19]

Use of the peptide of claim 1 or a salt thereof for the manufacture of a suppressant for vomiting or nausea.

[Claim 20]

The peptide of claim 1 or a salt thereof for use in suppressing vomiting or nausea.

[Claim 21]

The use according to claim 19, or the peptide according to claim 20, where the vomiting or the nausea is caused by one or more conditions or causes selected from the following (1) to (6):

(1) diseases such as gastroparesis, gastrointestinal hypomotility, peritonitis, abdominal tumor, constipation, gastrointestinal obstruction, cyclic vomiting syndrome, chronic unexplained nausea and vomiting, acute and chronic pancreatitis, hyperkalemia, cerebral edema, intracranial lesion, metabolic disorder, gastritis caused by an infection, postoperative disease, myocardial

infarction, migraine, intracranial hypertension, and intracranial hypotension (e.g., altitude sickness);

(2) drugs such as (i) alkylating agents (e.g., cyclophosphamide, carmustine, lomustine, chlorambucil, streptozocin, dacarbazine, ifosfamide, temozolomide, busulfan, bendamustine, and melphalan), cytotoxic antibiotics (e.g., dactinomycin, doxorubicin, mitomycin-C, bleomycin, epirubicin, actinomycin D, amrubicin, idarubicin, daunorubicin, and pirarubicin), antimetabolic agents (e.g., cytarabine, methotrexate, 5-fluorouracil, enocitabine, and clofarabine), vinca alkaloids (e.g., etoposide, vinblastine, and vincristine), other chemotherapeutic agents such as cisplatin, procarbazine, hydroxyurea, azacytidine, irinotecan, interferon α , interleukin-2, oxaliplatin, carboplatin, nedaplatin, and miriplatin; (ii) opioid analgesics (e.g., morphine); (iii) dopamine receptor D1D2 agonists (e.g., apomorphine); (iv) cannabis and cannabinoid products including cannabis hyperemesis syndrome

(3) radiation sickness or radiation therapy for the chest, the abdomen, or the like used to treat cancers;

(4) a poisonous substance or a toxin;

(5) pregnancy including hyperemesis gravidarum; and

(6) a vestibular disorder such as motion sickness or dizziness.