[0012a] In one aspect, there is provided a cyclic peptide represented by Formula (IA),

R^N-X_g-[X_{p2}-X^4_r-X_{p1}-X^a-X_m-X^1-X^2-X^3-X_n-X^b-X_{q1}-X^5_s-X_{q2}]$_k$-X_h-R^C ··· (IA):

in Formula (IA),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_g, X_h, X_m, and X_n each represent g consecutive X's, h consecutive X's, m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

g and h each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X^4_r, X^5_s, X_{p1}, X_{p2}, X_{q1}, and X_{q2} each represent r consecutive X^4's, s consecutive X^5's, p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, and q2 consecutive X's;

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X^4_r, X^5_s, X_m,

X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and,

wherein the amino acid having a carboxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-aspartic acid, D-aspartic acid, L-glutamic acid, D-glutamic acid, L-homoglutamic acid, and D-homoglutamic acid, and the amino acid having a hydroxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-serine, D-serine, L-homoserine, D-homoserine, L-tyrosine, D-tyrosine, L-threonine, D-threonine, L-allothreonine, and D-allothreonine.

[0012b] In another aspect, there is provided a cyclic peptide represented by Formula (IC),

$R^N\text{-}X_{v1}\text{-}X^6{}_t\text{-}X_{v2}\text{-}[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]_k\text{-}X_{w2}\text{-}X^7{}_u\text{-}X_{w1}\text{-}R^C$ ··· (IC):

in Formula (IC),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_m and X_n each represent m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X_{p1}, X_{p2}, X_{q1}, X_{q2}, $X^4{}_r$, $X^5{}_s$, $X^6{}_t$, $X^7{}_u$, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, q2 consecutive X's, r consecutive X^4's, s consecutive X^5's, t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's';

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6 or X^7, the plurality of X^6's or X^7's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X^4_r, X^5_s, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and

wherein the amino acid having a carboxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-aspartic acid, D-aspartic acid, L-glutamic acid, D-glutamic acid, L-homoglutamic acid, and D-homoglutamic acid, and the amino acid having a hydroxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-serine, D-serine, L-homoserine, D-homoserine, L-tyrosine, D-tyrosine, L-threonine, D-threonine, L-allothreonine, and D-allothreonine.

[0012c] In another aspect, there is provided a cyclic peptide represented by Formula (IB),

$R^N\text{-}X_{v1}\text{-}X^6_t\text{-}X_{v2}\text{-}[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]_k\text{-}X_{w2}\text{-}X^7_u\text{-}X_{w1}\text{-}R^C$ ··· (IB):

in Formula (IB),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_i, X_j, X_m, and X_n each represent i consecutive X's, j consecutive X's, m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

i and j each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X^6_t, X^7_u, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6's or X^7's, the plurality of X^6's or X^7's may be the same as or different from each other;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, and X_n in a repeating unit $[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]$ each may be the same or different between the repeating units; and,

wherein the immobilizing functional group is an amino group or a thiol group.

[0012d] In another aspect, there is provided a cyclic peptide represented by Formula (IC),

$R^N\text{-}X_{v1}\text{-}X^6_t\text{-}X_{v2}\text{-}[X_{p2}\text{-}X^4_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5_s\text{-}X_{q2}]_k\text{-}X_{w2}\text{-}X^7_u\text{-}X_{w1}\text{-}R^C$ ··· (IC):

in Formula (IC),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_m and X_n each represent m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X_{p1}, X_{p2}, X_{q1}, X_{q2}, X^4_r, X^5_s, X^6_t, X^7_u, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, q2 consecutive X's, r consecutive X^4's, s consecutive X^5's, t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's';

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6 or X^7, the plurality of X^6's or X^7's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where

Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X^4_r, X^5_s, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and

wherein the immobilizing functional group is an amino group or a thiol group.

[0012e] In another aspect, there is provided a cyclic peptide represented by Formula (IB),

$R^N\text{-}X_{v1}\text{-}X^6_t\text{-}X_{v2}\text{-}[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]_k\text{-}X_{w2}\text{-}X^7_u\text{-}X_{w1}\text{-}R^C$ ··· (IB):

in Formula (IB),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_i, X_j, X_m, and X_n each represent i consecutive X's, j consecutive X's, m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

i and j each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X^6_t, X^7_u, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid

having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6's or X^7's, the plurality of X^6's or X^7's may be the same as or different from each other;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \mathrm{Max}\ (t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, and X_n in a repeating unit $[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]$ each may be the same or different between the repeating units; and,

wherein the amino acid having an immobilizing functional group on a side chain is at least one kind of amino acid selected from the group consisting of L-lysine, D-lysine, L-cysteine, D-cysteine, L-homocysteine, and D-homocysteine.

[0012f] In another aspect, there is provided a cyclic peptide represented by Formula (IC),

$R^N\text{-}X_{v1}\text{-}X^6{}_t\text{-}X_{v2}\text{-}[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]_k\text{-}X_{w2}\text{-}X^7{}_u\text{-}X_{w1}\text{-}R^C$ ··· (IC):

in Formula (IC),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_m and X_n each represent m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X_{p1}, X_{p2}, X_{q1}, X_{q2}, X^4_r, X^5_s, X^6_t, X^7_u, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, q2 consecutive X's, r consecutive X^4's, s consecutive X^5's, t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's';

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6 or X^7, the plurality of X^6's or X^7's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X^4_r, X^5_s, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and

wherein the amino acid having an immobilizing functional group on a side chain is at least one kind of amino acid selected from the group consisting of L-lysine, D-lysine, L-cysteine, D-cysteine, L-homocysteine, and D-homocysteine.

[0012g] In another aspect, there is provided a cyclic peptide represented by Formula (I'),

$$R^N\text{-}X_g\text{-}[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]_k\text{-}X_h\text{-}R^C \cdots (I')$$

in Formula (I'),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue,

an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond, or, one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_g, X_h, X_i, X_j, X_m, and X_n each represent g consecutive X's, h consecutive X's, i consecutive X's, j consecutive X's, m consecutive X's, and n consecutive X's;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X represents an amino acid residue derived from an amino acid other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X represents an amino acid residue derived from an amino acid other than L-serine and D-serine, and

in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

g, h, i, and j each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously; and

k is an integer equal to or greater than 1, and in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, and X_n in a repeating unit $[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]$ each may be the same or different between the repeating units.

[0012h] In another aspect, there is provided an affinity chromatography support comprising:

a water-insoluble support; and

the cyclic peptide as described herein,

wherein the water-insoluble support and the cyclic peptide are directly or indirectly bonded to each other.

WHAT IS CLAIMED IS:

1. A cyclic peptide represented by Formula (IA),

R^N-X_g-[X_{p2}-X^4_r-X_{p1}-X^a-X_m-X^1-X^2-X^3-X_n-X^b-X_{q1}-X^5_s-X_{q2}]$_k$-X_h-R^C ··· (IA):

in Formula (IA),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_g, X_h, X_m, and X_n each represent g consecutive X's, h consecutive X's, m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

g and h each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X^4_r, X^5_s, X_{p1}, X_{p2}, X_{q1}, and X_{q2} each represent r consecutive X^4's, s consecutive X^5's, p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, and q2 consecutive X's;

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$,

where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, $X^4{}_r$, $X^5{}_s$, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and,

wherein the amino acid having a carboxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-aspartic acid, D-aspartic acid, L-glutamic acid, D-glutamic acid, L-homoglutamic acid, and D-homoglutamic acid, and the amino acid having a hydroxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-serine, D-serine, L-homoserine, D-homoserine, L-tyrosine, D-tyrosine, L-threonine, D-threonine, L-allothreonine, and D-allothreonine.

2. A cyclic peptide represented by Formula (IC),

$R^N\text{-}X_{v1}\text{-}X^6{}_t\text{-}X_{v2}\text{-}[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]_k\text{-}X_{w2}\text{-}X^7{}_u\text{-}X_{w1}\text{-}R^C$ ··· (IC):

in Formula (IC),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_m and X_n each represent m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X_{p1}, X_{p2}, X_{q1}, X_{q2}, X^4_r, X^5_s, X^6_t, X^7_u, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, q2 consecutive X's, r consecutive X^4's, s consecutive X^5's, t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's';

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6 or X^7, the plurality of X^6's or X^7's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X^4_r, X^5_s, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and

wherein the amino acid having a carboxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-aspartic acid, D-aspartic acid, L-glutamic acid, D-glutamic acid, L-homoglutamic acid, and D-homoglutamic acid, and the amino acid having a hydroxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-serine, D-serine, L-homoserine, D-homoserine, L-tyrosine, D-tyrosine, L-threonine, D-threonine, L-allothreonine, and D-allothreonine.

3. The cyclic peptide according to claim 1 or 2,

wherein the amino acid having a carboxy group on a side chain is L-aspartic acid, and the amino acid having a hydroxy group on a side chain is L-threonine.

4. A cyclic peptide represented by Formula (IB),

R^N-X_{v1}-$X^6{}_t$-X_{v2}-[X_i-X^a-X_m-X^1-X^2-X^3-X_n-X^b-X_j]$_k$-X_{w2}-$X^7{}_u$-X_{w1}-R^C ··· (IB):

in Formula (IB),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_i, X_j, X_m, and X_n each represent i consecutive X's, j consecutive X's, m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

i and j each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

$X^6{}_t$, $X^7{}_u$, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6's or X^7's, the plurality of X^6's or X^7's may be the same as or different from each other;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \mathrm{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, and X_n in a repeating unit $[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]$ each may be the same or different between the repeating units; and,

wherein the immobilizing functional group is an amino group or a thiol group.

5. A cyclic peptide represented by Formula (IC),

$R^N\text{-}X_{v1}\text{-}X^6{}_t\text{-}X_{v2}\text{-}[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]_k\text{-}X_{w2}\text{-}X^7{}_u\text{-}X_{w1}\text{-}R^C$ ··· (IC):

in Formula (IC),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_m and X_n each represent m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X_{p1}, X_{p2}, X_{q1}, X_{q2}, $X^4{}_r$, $X^5{}_s$, $X^6{}_t$, $X^7{}_u$, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, q2 consecutive X's, r consecutive

X^4's, s consecutive X^5's, t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's';

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6 or X^7, the plurality of X^6's or X^7's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X^4_r, X^5_s, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and

wherein the immobilizing functional group is an amino group or a thiol group.

6. A cyclic peptide represented by Formula (IB),

$R^N\text{-}X_{v1}\text{-}X^6_t\text{-}X_{v2}\text{-}[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]_k\text{-}X_{w2}\text{-}X^7_u\text{-}X_{w1}\text{-}R^C$ ··· (IB):

in Formula (IB),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_i, X_j, X_m, and X_n each represent i consecutive X's, j consecutive X's, m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

i and j each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

$X^6{}_t$, $X^7{}_u$, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6's or X^7's, the plurality of X^6's or X^7's may be the same as or different from each other;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, and X_n in a repeating unit $[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]$ each may be the same or different between the repeating units; and,

wherein the amino acid having an immobilizing functional group on a side chain is at least one kind of amino acid selected from the group consisting of L-lysine, D-lysine, L-cysteine, D-cysteine, L-homocysteine, and D-homocysteine.

7. A cyclic peptide represented by Formula (IC),

$$R^N\text{-}X_{v1}\text{-}X^6{}_t\text{-}X_{v2}\text{-}[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]_k\text{-}X_{w2}\text{-}X^7{}_u\text{-}X_{w1}\text{-}R^C$$

··· (IC):

in Formula (IC),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

X^a and X^b each independently represent an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and are bonded to each other through a disulfide bond, or, one of X^a and X^b represents an amino acid residue derived from an amino acid, other than L-cysteine and D-cysteine, having a thiol group on a side chain, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_m and X_n each represent m consecutive X's, and n consecutive X's;

X represents an amino acid residue, and in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

X_{p1}, X_{p2}, X_{q1}, X_{q2}, X^4_r, X^5_s, X^6_t, X^7_u, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, q2 consecutive X's, r consecutive X^4's, s consecutive X^5's, t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's';

X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid having a hydroxy group on a side chain, and in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

X^6 and X^7 each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain, and in a case where there is a plurality of X^6 or X^7, the plurality of X^6's or X^7's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \mathrm{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \mathrm{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0;

k is an integer equal to or greater than 1, in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, $X^4{}_r$, $X^5{}_s$, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]$ each may be the same or different between the repeating units; and

wherein the amino acid having an immobilizing functional group on a side chain is at least one kind of amino acid selected from the group consisting of L-lysine, D-lysine, L-cysteine, D-cysteine, L-homocysteine, and D-homocysteine.

8. The cyclic peptide according to any one of claims 1 to 7,

wherein X^a is an amino acid residue derived from an amino acid having a chloroacetyl group on a side chain, selected from the group consisting of
(2S)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid,
(2R)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid,
(2S)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid,
(2R)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid, N-δ-chloroacetyl-L-ornithine, N-δ-chloroacetyl-D-ornithine, N-ε-chloroacetyl-L-lysine, and N-ε-chloroacetyl-D-lysine,

X^b is an amino acid residue derived from L-homocysteine or D-homocysteine, and

X^a and X^b are bonded to each other through a thioether bond.

9. The cyclic peptide according to any one of claims 1 to 7,

wherein X^a is an amino acid residue derived from L-homocysteine or D-homocysteine,

X^b is an amino acid residue derived from an amino acid having a chloroacetyl group on a side chain, selected from the group consisting of
(2S)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid,
(2R)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid,

(2S)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid,

(2R)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid, N-δ-chloroacetyl-L-ornithine,

N-δ-chloroacetyl-D-ornithine, N-ε-chloroacetyl-L-lysine, and N-ε-chloroacetyl-D-lysine, and

X^a and X^b are bonded to each other through a thioether bond.

10. A cyclic peptide represented by Formula (I′),

R^N-X_g-[X_i-X^a-X_m-X^1-X^2-X^3-X_n-X^b-X_j]$_k$-X_h-R^C ··· (I′):

in Formula (I′),

R^N represents an N-terminal group;

R^C represents a C-terminal group;

X^1 represents an L-leucine residue, an L-isoleucine residue, an L-methionine residue, an L-lysine residue, or an L-arginine residue;

X^2 represents an L-valine residue or an L-isoleucine residue;

X^3 represents an L-tryptophan residue;

one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond, or, one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, and the other represents an amino acid residue derived from an amino acid having a haloacetyl group on a side chain, and X^a and X^b are bonded to each other through a thioether bond;

X_g, X_h, X_i, X_j, X_m, and X_n each represent g consecutive X's, h consecutive X's, i consecutive X's, j consecutive X's, m consecutive X's, and n consecutive X's;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X represents an amino acid residue derived from an amino acid other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X represents an amino acid residue derived from an amino acid other than L-serine and D-serine, and

in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

g, h, i, and j each independently represent an integer equal to or greater than 0;

m and n are integers satisfying $0 \leq m \leq 9$, $0 \leq n \leq 9$, and $3 \leq m + n \leq 9$ simultaneously;

and

k is an integer equal to or greater than 1, and in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, and X_n in a repeating unit $[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]$ each may be the same or different between the repeating units.

11. The cyclic peptide according to claim 10 that is represented by Formula (I'A),

$R^N\text{-}X_g\text{-}[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]_k\text{-}X_h\text{-}R^C$ ··· (I'A):

in Formula (I'A),

R^N, R^C, X^1, X^2, X^3, X^a, X^b, X_g, X_h, X_m, X_n, g, h, m, n, and k have the same definitions as those in Formula (I');

$X^4{}_r$, $X^5{}_s$, X_{p1}, X_{p2}, X_{q1}, and X_{q2} each represent r consecutive X^4's, s consecutive X^5's, p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, and q2 consecutive X's;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X represents an amino acid residue derived from an amino acid other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X represents an amino acid residue derived from an amino acid other than L-serine and D-serine, and

in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid, other than L-serine, D-serine, L-homoserine, and D-homoserine, having a hydroxy group on a side chain,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid, other than L-serine or D-serine, having a hydroxy group on a side chain, and

in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \text{Max}(r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$; and

in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, $X^4{}_r$, $X^5{}_s$, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]$ each may be the same or different between the repeating units.

12. The cyclic peptide according to claim 10 that is represented by Formula (I'B),

$R^N\text{-}X_{v1}\text{-}X^6{}_t\text{-}X_{v2}\text{-}[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]_k\text{-}X_{w2}\text{-}X^7{}_u\text{-}X_{w1}\text{-}R^C$ ··· (I'B):

in Formula (I'B),

R^N, R^C, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, X_n, i, j, m, n, and k have the same definitions as those in Formula (I');

$X^6{}_t$, $X^7{}_u$, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X represents an amino acid residue derived from an amino acid other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X represents an amino acid residue derived from an amino acid other than L-serine and D-serine, and

in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X^6 and X^7 each independently represent an amino acid residue derived from an amino acid, other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine, having an immobilizing functional group on a side chain or each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X^6 and X^7 each independently represent an amino acid residue derived from an amino acid, other than L-serine and D-serine, having an immobilizing functional group on a side chain, and

in a case where there is a plurality of X^6's or X^7's, the plurality of X^6's or X^7's may be

the same as or different from each other;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \text{Max}(t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0; and

in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X_i, X_j, X_m, and X_n in a repeating unit $[X_i\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_j]$ each may be the same or different between the repeating units.

13. The cyclic peptide according to any one of claims 10 to 12 that is represented by Formula (I'C),

$$R^N\text{-}X_{v1}\text{-}X^6{}_t\text{-}X_{v2}\text{-}[X_{p2}\text{-}X^4{}_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5{}_s\text{-}X_{q2}]_k\text{-}X_{w2}\text{-}X^7{}_u\text{-}X_{w1}\text{-}R^C \quad \cdots (I'C):$$

in Formula (I'C),

R^N, R^C, X^1, X^2, X^3, X^a, X^b, X_m, X_n, m, n, and k have the same definitions as those in Formula (I');

X_{p1}, X_{p2}, X_{q1}, X_{q2}, $X^4{}_r$, $X^5{}_s$, $X^6{}_t$, $X^7{}_u$, X_{v1}, X_{v2}, X_{w1}, and X_{w2} each represent p1 consecutive X's, p2 consecutive X's, q1 consecutive X's, q2 consecutive X's, r consecutive X^4's, s consecutive X^5's, t consecutive X^6's, u consecutive X^7's, v1 consecutive X's, v2 consecutive X's, w1 consecutive X's, and w2 consecutive X's;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X represents an amino acid residue derived from an amino acid other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X represents an amino acid residue derived from an amino acid other than L-serine and D-serine, and

in a case where there is a plurality of X's, the plurality of X's may be the same as or different from each other;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid, other than L-serine, D-serine, L-homoserine, and D-homoserine, having a hydroxy group on a side chain,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X^4 and X^5 each independently represent an amino acid residue derived from an amino acid having a carboxy group on a side chain or an amino acid residue derived from an amino acid, other than L-serine and D-serine, having a hydroxy group on a side chain, and

in a case where there is a plurality of X^4's or X^5's, the plurality of X^4's or X^5's may be the same as or different from each other;

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, X^6 and X^7 each independently represent an amino acid residue derived from an amino acid, other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine, having an immobilizing functional group on a side chain or each independently represent an amino acid residue derived from an amino acid having an immobilizing functional group on a side chain,

in a case where one of X^a and X^b represents an amino acid residue derived from L-penicillamine or D-penicillamine, X^6 and X^7 each independently represent an amino acid residue derived from an amino acid, other than L-serine and D-serine, having an immobilizing functional group on a side chain, and

in a case where there is a plurality of X^6's or X^7's, the plurality of X^6's or X^7's may be the same as or different from each other;

p1, p2, q1, and q2 each independently represent an integer equal to or greater than 0;

r and s each represent an integer satisfying $0 \leq r \leq 5$, $0 \leq s \leq 5$, and $1 \leq \mathrm{Max}\ (r,s) \leq 5$, where Max (r,s) represents a larger one between two numbers represented by r and s in a case where $r \neq s$ and represents r or s in a case where $r = s$;

t and u each represent an integer satisfying $0 \leq t \leq 5$, $0 \leq u \leq 5$, and $1 \leq \mathrm{Max}\ (t,u) \leq 5$, where Max (t,u) represents a larger one between two numbers represented by t and u in a case where $t \neq u$ and represents t or u in a case where $t = u$;

v1, v2, w1, and w2 each independently represent an integer equal to or greater than 0; and

in a case where $k \geq 2$, X^1, X^2, X^3, X^a, X^b, X^4_r, X^5_s, X_m, X_n, X_{p2}, X_{p1}, X_{q1}, and X_{q2} in a repeating unit $[X_{p2}\text{-}X^4_r\text{-}X_{p1}\text{-}X^a\text{-}X_m\text{-}X^1\text{-}X^2\text{-}X^3\text{-}X_n\text{-}X^b\text{-}X_{q1}\text{-}X^5_s\text{-}X_{q2}]$ each may be the same or different between the repeating units.

14. The cyclic peptide according to claim 11 or 13,

wherein the amino acid having a carboxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-aspartic acid, D-aspartic acid, L-glutamic acid, D-glutamic acid, L-homoglutamic acid, and D-homoglutamic acid,

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, the amino acid, other than L-serine, D-serine, L-homoserine, and D-homoserine, having a hydroxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-tyrosine, D-tyrosine, L-threonine, D-threonine, L-allothreonine, and D-allothreonine, and

in a case where one of X^a and X^b represents an amino acid residue derived from L-cysteine or D-cysteine, the amino acid, other than L-serine and D-serine, having a hydroxy group on a side chain is at least one kind of amino acid selected from the group consisting of L-homoserine, D-homoserine, L-tyrosine, D-tyrosine, L-threonine, D-threonine, L-allothreonine, and D-allothreonine.

15. The cyclic peptide according to claim 11 or 13,

wherein the amino acid having a carboxy group on a side chain is L-aspartic acid, and

the amino acid, other than L-serine, D-serine, L-homoserine, and D-homoserine, having a hydroxy group on a side chain and the amino acid residue derived from the amino acid, other than L-serine and D-serine, having a hydroxy group on a side chain are L-threonine.

16. The cyclic peptide according to claim 12 or 13,

wherein the immobilizing functional group is an amino group or a thiol group.

17. The cyclic peptide according to claim 12 or 13,

wherein the amino acid, other than L-serine, D-serine, L-homoserine, D-homoserine, L-arginine, and D-arginine, having an immobilizing functional group on a side chain and the amino acid residue derived from an amino acid, other than L-serine and D-serine, having an immobilizing functional group on a side chain are at least one kind of amino acid selected from the group consisting of L-lysine, D-lysine, L-cysteine, D-cysteine, L-homocysteine, and D-homocysteine.

18. The cyclic peptide according to any one of claims 10 to 17,

wherein X^a is an amino acid residue derived from an amino acid having a chloroacetyl group on a side chain, selected from the group consisting of (2S)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid, (2R)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid, (2S)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid, (2R)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid, N-δ-chloroacetyl-L-ornithine, N-δ-chloroacetyl-D-ornithine, N-ε-chloroacetyl-L-lysine, and N-ε-chloroacetyl-D-lysine,

X^b is an amino acid residue derived from L-cysteine or D-cysteine or an amino acid residue derived from L-penicillamine or D-penicillamine, and

X^a and X^b are bonded to each other through a thioether bond.

19. The cyclic peptide according to any one of claims 10 to 17,

wherein X^a is an amino acid residue derived from L-cysteine or D-cysteine or an amino acid residue derived from L-penicillamine or D-penicillamine,

X^b is an amino acid residue derived from an amino acid having a chloroacetyl group on a side chain, selected from the group consisting of (2S)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid, (2R)-2-amino-3-[(2-chloroacetyl)amino]propanoic acid, (2S)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid, (2R)-2-amino-4-[(2-chloroacetyl)amino]butanoic acid, N-δ-chloroacetyl-L-ornithine, N-δ-chloroacetyl-D-ornithine, N-ε-chloroacetyl-L-lysine, and N-ε-chloroacetyl-D-lysine, and

X^a and X^b are bonded to each other through a thioether bond.

20. The cyclic peptide according to any one of claims 1 to 19 that is an antibody binding ligand.

21. The cyclic peptide according to any one of claims 1 to 19 that is a linker for labeling antibodies.

22. The cyclic peptide according to any one of claims 1 to 19 that is a linker for antibody drug conjugates.

23. The cyclic peptide according to any one of claims 1 to 19 that is a drug carrier.

24. An affinity chromatography support comprising:

a water-insoluble support; and

the cyclic peptide according to any one of claims 1 to 19,

wherein the water-insoluble support and the cyclic peptide are directly or indirectly bonded to each other.