

preferably satisfies $0 \leq w1 \leq 5$, and still more preferably satisfies $0 \leq w1 \leq 2$.

$w2$ preferably satisfies $0 \leq w2 \leq 20$, more preferably satisfies $0 \leq w2 \leq 10$, even more preferably satisfies $0 \leq w2 \leq 5$, and still more preferably satisfies $0 \leq w2 \leq 2$.

[0072] In Formula (IB), the number of amino acid residues $[(m + n + 5) \text{ residues}]$ in the cyclic portion $[X^a-X_m-X^1-X^2-X^3-X_n-X^b]$ is 8 to 14, preferably 9 to 13, and more preferably 10 to 12, similarly to Formula (I).

In a case where the number of amino acid residues in the cyclic portion is within the above range, the intramolecular strain of the cyclic peptide does not excessively increase, and the high-order structure such as α -helix is stabilized. Therefore, the antibody binding properties of the cyclic peptide according to the embodiment of the present invention become excellent.

[0073] In a case where $k \geq 2$, that is, in a case where the cyclic peptide represented by Formula (IB) includes two or more repeating units $[X_i-X^a-X_m-X^1-X^2-X^3-X_n-X^b-X_j]$, X^1 , X^2 , X^3 , X^a , X^b , X_m , X_n , X_i , and X_j in the repeating unit each may be the same or different between the repeating units.

[0074] The total number of amino acid residues in the cyclic peptide represented by Formula (IB) is preferably 8 to 50, more preferably 9 to 40, even more preferably 10 to 30, and still more preferably 10 to 20.

That is, in Formula (IB), $i, j, m, n, t, u, v1, v2, w1, w2$, and k preferably satisfy $8 \leq (i + j + m + n + 5) \times k + t + u + v1 + v2 + w1 + w2 \leq 50$, more preferably satisfy $9 \leq (i + j + m + n + 5) \times k + t + u + v1 + v2 + w1 + w2 \leq 40$, even more preferably satisfy $10 \leq (i + j + m + n + 5) \times k + t + u + v1 + v2 + w1 + w2 \leq 30$, and still more preferably satisfy $10 \leq (i + j + m + n + 5) \times k + t + u + v1 + v2 + w1 + w2 \leq 20$.

Generally, the larger the number of amino acid residues, the higher the manufacturing cost. Therefore, from the viewpoint of economic efficiency, it is preferable that the total number of amino acid residues is small.

[0075] The cyclic peptide according to the embodiment of the present invention is more preferably a cyclic peptide represented by Formula (IC).

$R^N-X_{v1}-X_t^6-X_{v2}-[X_{p2}-X_r^4-X_{p1}-X^a-X_m-X^1-X^2-X^3-X_n-X^b-X_{q1}-X_s^5-X_{q2}]_k-X_{w2}-X_u^7-X_{w1}-R^C$
... (IC)

[0076] In Formula (IC), all of R^N , R^C , X^1 , X^2 , X^3 , X^a , X^b , X_m , X_n , X , m , n , and k have the same definitions as those in Formula (I), all of X^4 , X^5 , $p1$, $p2$, $q1$, $q2$, r , and s have the same definitions as those in Formula (IA), and all of X^6 , X^7 , t , u , $v1$, $v2$, $w1$, and $w2$ have the same

10.

e_0 preferably satisfies $0 \leq e_0 \leq 5$, more preferably satisfies $0 \leq e_0 \leq 3$, and even more preferably satisfies $0 \leq e_0 \leq 2$.

f_0 preferably satisfies $0 \leq f_0 \leq 5$, more preferably satisfies $0 \leq f_0 \leq 3$, and even more preferably satisfies $0 \leq f_0 \leq 2$.

[0090] In Formula (II), p_0 and q_0 each represent an integer satisfying $0 \leq p_0 \leq 5$ and $0 \leq q_0 \leq 5$.

p_0 preferably satisfies $0 \leq p_0 \leq 3$, and more preferably satisfies $0 \leq p_0 \leq 2$.

q_0 preferably satisfies $0 \leq q_0 \leq 3$, and more preferably satisfies $0 \leq q_0 \leq 2$.

[0091] In Formula (II), r_0 and s_0 each represent an integer satisfying $0 \leq r_0 \leq 5$ and $0 \leq s_0 \leq 5$.

r_0 preferably satisfies $0 \leq r_0 \leq 3$, and more preferably satisfies $0 \leq r_0 \leq 2$.

s_0 preferably satisfies $0 \leq s_0 \leq 3$, and more preferably satisfies $0 \leq s_0 \leq 2$.

[0092] In Formula (II), t_0 and u_0 each represent an integer satisfying $0 \leq t_0 \leq 5$ and $0 \leq u_0 \leq 5$.

t_0 preferably satisfies $0 \leq t_0 \leq 3$, and more preferably satisfies $0 \leq t_0 \leq 2$.

u_0 preferably satisfies $0 \leq u_0 \leq 3$, and more preferably satisfies $0 \leq u_0 \leq 2$.

[0093] In Formula (II), v_0 and w_0 each represent an integer satisfying $0 \leq v_0 \leq 5$ and $3 \leq w_0 \leq 5$.

v_0 preferably satisfies $0 \leq v_0 \leq 3$, and more preferably satisfies $0 \leq v_0 \leq 2$.

w_0 preferably satisfies $0 \leq w_0 \leq 3$, and more preferably satisfies $0 \leq w_0 \leq 2$.

[0094] In Formula (II), A represents an L-alanine residue or a D-alanine residue; Y represents an L-tyrosine residue or a D-tyrosine residue; H represents an L-histidine residue or a D-histidine residue; G represents a glycine residue; E represents an L-glutamic acid residue or a D-glutamic acid residue; V represents an L-valine residue; and W represents an L-tryptophan residue.

[0095] In Formula (II), the total number of amino acid residues in the cyclic peptide is 11 to 50, preferably 11 to 40, more preferably 11 to 30, and even more preferably 11 to 20.

That is, in Formula (II), $e_0, f_0, p_0, q_0, r_0, s_0, t_0, u_0, v_0$, and w_0 satisfy $0 \leq e_0 + f_0 + p_0 + q_0 + r_0 + s_0 + t_0 + u_0 + v_0 + w_0 \leq 39$, preferably satisfy $0 \leq e_0 + f_0 + p_0 + q_0 + r_0 + s_0 + t_0 + u_0 + v_0 + w_0 \leq 29$, more preferably satisfy $0 \leq e_0 + f_0 + p_0 + q_0 + r_0 + s_0 + t_0 + u_0 + v_0 + w_0 \leq 19$, and even more preferably satisfy $0 \leq e_0 + f_0 + p_0 + q_0 + r_0 + s_0 + t_0 + u_0 + v_0 + w_0 \leq 9$.

[0096] Particularly preferable examples of the cyclic peptide according to the embodiment of

	11	Cyclic peptide 11	Triazole bond	13	A	A	-
	12	Cyclic peptide 12	Triazole bond	14	A	A	-
	13	Cyclic peptide 13	Triazole bond	15	B	A	-
	14	Cyclic peptide 14	Triazole bond	16	B	A	-
	15	Cyclic peptide 15	Triazole bond	17	B	A	-
	16	Cyclic peptide 16	Triazole bond	18	B	A	-
Comparative Example	1	Cyclic peptide 17	Amide bond	19	E (standard)	B	E
	2	Cyclic peptide 18	Amide bond	20	E	B	E
	3	Cyclic peptide 19	Disulfide bond	21	A	E	-

[0155] <Antibody binding properties and chemical resistance>

<<Examples 1 to 16 and Comparative Examples 1 to 3>>

Examples 1 to 16 were evaluated as C or a higher grade in terms of the relative binding activity and evaluated as B or a higher grade in terms of the chemical resistance. That is, Examples 1 to 16 had sufficient antibody binding properties and excellent chemical resistance. Among these, Examples 2 to 5, 11, and 12 were particularly excellent because they were evaluated as B in terms of both the relative binding activity and the chemical resistance.

In contrast, Comparative Examples 1 and 2 cross-linked through an amide bond were evaluated as B in terms of the chemical resistance and had sufficient chemical resistance. However, Comparative Examples 1 and 2 were evaluated as E in terms of the relative binding activity and had poor antibody binding activity. Furthermore, Comparative Example 3 cross-linked through a disulfide bond was evaluated as A in terms of the relative binding activity and had sufficient antibody binding activity. However, Comparative Example 3 was evaluated as E in terms of the chemical resistance and had poor chemical resistance.

[0156] <<Examples 2, 8, and 10>>

In Examples 2, 8, and 10, among the amino acid residues in the cross-linked portions, the amino acid residue on the N-terminal side of the polypeptide chain was an amino acid residue [Lys(N3)] derived from ϵ -azide-L-lysine, and the amino acid residue on the C-terminal side of the polypeptide chain was an amino acid residue [Bpg] derived from L-bishomopropargylglycine (Example 2), an amino acid residue [Hpg] derived from L-homopropargylglycine (Example 8), or an amino acid residue [Pra] derived from L-propargylglycine (Example 10).

Regarding the relative binding activity, Example 2 was evaluated as A, Example 8 was evaluated as B, and Example 10 was evaluated as C. Presumably, in the amino acid