Claims

[Claim 1]

A Cas12a protein, having the amino acid sequence of SEQ ID NO: 1.

[Claim 2]

The Cas12a protein of claim 1, wherein the Cas12a protein having the amino acid sequence of SEQ ID NO: 1 is encoded by the nucleotide sequence of SEQ ID NO: 2.

[Claim 3]

The Cas12a protein of claim 1, wherein the protein has endonuclease activity.

[Claim 4]

The Cas12a protein of claim 1, wherein the Cas12a protein having the amino acid sequence of SEQ ID NO: 1 has optimal activity at pH 7.0 to pH 7.9.

[Claim 5]

A Cas12a protein, having the amino acid sequence of SEQ ID NO: 1, of which lysine (Lys) at position 925 is substituted with another amino acid.

[Claim 6]

The Cas12a protein of claim 5, wherein the other amino acid is any one selected from the group consisting of arginine (Arg), histidine (His), aspartic acid

(Asp), glutamic acid (Glu), serine (Ser), threonine (Thr), asparagine (Asn), glutamine (Gln), tyrosine (Tyr), alanine (Ala), isoleucine (Ile), leucine (Leu), valine (Val), phenylalanine (Phe), methionine (Met), tryptophan (Trp), glycine (Gly), proline (Pro), and cysteine (Cys).

[Claim 7]

A Cas12a protein, having the amino acid sequence of SEQ ID NO: 3.

[Claim 8]

The Cas12a protein of claim 7, wherein the Cas12a protein having the amino acid sequence of SEQ ID NO: 3 is encoded by the nucleotide sequence of SEQ ID NO: 4.

[Claim 9]

The Cas12a protein of claim 7, wherein the protein has endonuclease activity.

[Claim 10]

The Cas12a protein of claim 7, wherein the Cas12a protein having the amino acid sequence of SEQ ID NO: 3 has optimal activity at pH 7.0 to pH 7.9.

[Claim 11]

A Cas12a protein, having the amino acid sequence of SEQ ID NO: 3, of which lysine (Lys) at position 930 is substituted with another amino acid.

[Claim 12]

The Cas12a protein of claim 11, wherein the other amino acid is any one selected from the group consisting of arginine (Arg), histidine (His), aspartic acid (Asp), glutamic acid (Glu), serine (Ser), threonine (Thr), asparagine (Asn), glutamine (Gln), tyrosine (Tyr), alanine (Ala), isoleucine (Ile), leucine (Leu), valine (Val), phenylalanine (Phe), methionine (Met), tryptophan (Trp), glycine (Gly), proline (Pro), and cysteine (Cys).

[Claim 13]

A Cas12a protein, having the amino acid sequence of SEQ ID NO: 1, of which aspartic acid (Asp) at position 877 is substituted with another amino acid.

[Claim 14]

The Cas12a protein of claim 13, wherein the other amino acid is any one selected from the group consisting of arginine (Arg), histidine (His), glutamic acid (Glu), serine (Ser), threonine (Thr), asparagine (Asn), glutamine (Gln), tyrosine (Tyr), alanine (Ala), lysine (Lys), isoleucine (Ile), leucine (Leu), valine (Val), phenylalanine (Phe), methionine (Met), tryptophan (Trp), glycine (Gly), proline (Pro), and cysteine (Cys).

[Claim 15]

The Cas12a protein of claim 13, wherein the protein has decreased endonuclease activity.

[Claim 16]

A Cas12a protein, having the amino acid sequence of SEQ ID NO: 3, of which

aspartic acid (Asp) at position 873 is substituted with another amino acid.

[Claim 17]

The Cas12a protein of claim 16, wherein the other amino acid is any one selected from the group consisting of arginine (Arg), histidine (His), glutamic acid (Glu), serine (Ser), threonine (Thr), asparagine (Asn), glutamine (Gln), tyrosine (Tyr), alanine (Ala), lysine (Lys), isoleucine (Ile), leucine (Leu), valine (Val), phenylalanine (Phe), methionine (Met), tryptophan (Trp), glycine (Gly), proline (Pro), and cysteine (Cys).

[Claim 18]

The Cas12a protein of claim 16, wherein the protein has decreased endonuclease activity.

[Claim 19]

A pharmaceutical composition for use in treating cancer, comprising as active ingredients:

mgCas12a; and

crRNA that targets a nucleic acid sequence specifically present in cancer cells.

[Claim 20]

The pharmaceutical composition of claim 19, wherein the mgCas12a has any one amino acid sequence selected from the group consisting of SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 5, and SEQ ID NO: 6.