Claims

[Claim 1]

An antibody or an antigen-binding fragment of the antibody having the properties of:

(a) specifically binding to human TLR7 or monkey TLR7 and not binding to mouse TLR7 or rat TLR7;

(b) inhibiting a function of human TLR7 or monkey TLR7; and

(c) comprising CDRH1 consisting of the amino acid sequence set forth in SEQ ID NO: 17, CDRH2 consisting of the amino acid sequence set forth in SEQ ID NO: 18 and CDRH3 consisting of the amino acid sequence set forth in SEQ ID NO: 19, as complementarity determining regions in the heavy chain, and CDRL1 consisting of the amino acid sequence set forth in SEQ ID NO: 20, CDRL2 consisting of the amino acid sequence set forth in SEQ ID NO: 21 and CDRL3 consisting of the amino acid sequence set forth in SEQ ID NO: 22, as complementarity determining regions in the light chain.

[Claim 2]

The antibody or the antigen-binding fragment of the antibody according to claim 1, wherein the human TLR7 is a molecule consisting of the amino acid sequence set forth in SEQ ID NO: 2 or SEQ ID NO: 4, the monkey TLR7 is a molecule consisting of the amino acid sequence set forth in SEQ ID NO: 85, the mouse TLR7 is a molecule consisting of the

amino acid sequence set forth in SEQ ID NO: 83, or the rat TLR7 is a molecule consisting of the amino acid sequence set forth in SEQ ID NO: 84.

[Claim 3]

The antibody or the antigen-binding fragment of the antibody according to claim 1 or 2, having a competitive inhibitory activity for binding to human TLR7 with:

an antibody comprising a heavy chain with a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 5 and a light chain with a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 11.

[Claim 4]

The antibody or the antigen-binding fragment of the antibody according to any one of claims 1 to 3, comprising a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 5 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 11.

[Claim 5]

The antibody or the antigen-binding fragment of the antibody according to any one of claims 1 to 4, wherein the antibody comprises a human-derived constant region.

[Claim 6]

The antibody or the antigen-binding fragment of the antibody according to claim 5, comprising a heavy chain consisting of an amino acid sequence at positions 20 to 465

in the amino acid sequence set forth in SEQ ID NO: 35 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 36.

[Claim 7]

The antibody or the antigen-binding fragment of the antibody according to any one of claims 1 to 3, being humanized.

[Claim 8]

The antibody or the antigen-binding fragment of the antibody according to claim 7, comprising:

a heavy-chain variable region consisting of an amino acid sequence selected from the group consisting of:

(a) the amino acid sequence set forth in SEQ ID NO: 41;

(b) the amino acid sequence set forth in SEQ ID NO: 42;

(c) an amino acid sequence having a homology of at least 95% or more to the sequence (a) or (b); and

(d) an amino acid sequence derived from the sequence (a) or (b) by deletion, substitution or addition of 1 to 10 amino acids; and

a light-chain variable region consisting of an amino acid sequence selected from the group consisting of:

(e) the amino acid sequence set forth in SEQ ID NO: 43;

(f) the amino acid sequence set forth in SEQ ID NO: 44;

(g) an amino acid sequence having a homology of at least 95% or more to the sequence (e) or (f); and

(h) an amino acid sequence derived from the sequence (e) or (f) by deletion, substitution or addition of 1 to 10 amino acids.

[Claim 9]

The antibody or the antigen-binding fragment of the antibody according to claim 8, comprising:

(a) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 41 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 43;

(b) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 41 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 44;

(c) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 42 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 43; or

(d) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 42 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 44.

[Claim 10]

The antibody or the antigen-binding fragment of the antibody according to claim 9, comprising a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 42 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 44.

[Claim 11]

The antibody or the antigen-binding fragment of the antibody according to claim 9, comprising:

(a) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 45 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48;

(b) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 45 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49;

(c) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48;

(d) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino

acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49;

(e) a heavy chain consisting of an amino acid sequence at positions 20 to 462 in the amino acid sequence set forth in SEQ ID NO: 47 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48; or

(f) a heavy chain consisting of an amino acid sequence at positions 20 to 462 in the amino acid sequence set forth in SEQ ID NO: 47 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49.

[Claim 12]

The antibody or the antigen-binding fragment of the antibody according to claim 11, comprising a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49.

[Claim 13]

An antibody or an antigen-binding fragment of the antibody having the properties of:

(a) specifically binding to human TLR7,

(b) inhibiting a function of human TLR7, and

(c) comprising CDRH1 consisting of the amino acid sequence set forth in SEQ ID NO: 17, CDRH2 consisting of

the amino acid sequence set forth in SEQ ID NO: 18 and CDRH3 consisting of the amino acid sequence set forth in SEQ ID NO: 19, as complementarity determining regions in the heavy chain, and CDRL1 consisting of the amino acid sequence set forth in SEQ ID NO: 20, CDRL2 consisting of the amino acid sequence set forth in SEQ ID NO: 21 and CDRL3 consisting of the amino acid sequence set forth in SEQ ID NO: 22, as complementarity determining regions in the light chain.

[Claim 14]

The antibody or the antigen-binding fragment of the antibody according to claim 13, comprising a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 5 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 11.

[Claim 15]

The antibody or the antigen-binding fragment of the antibody according to claim 13 or 14, wherein the antibody comprises a human-derived constant region.

[Claim 16]

The antibody or the antigen-binding fragment of the antibody according to claim 15, comprising a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 35 and a light chain consisting of an amino acid sequence at

positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 36.

[Claim 17]

The antibody or the antigen-binding fragment of the antibody according to claim 13 being humanized.

[Claim 18]

The antibody or the antigen-binding fragment of the antibody according to claim 17, comprising:

a heavy-chain variable region consisting of an amino acid sequence selected from the group consisting of:

(a) the amino acid sequence set forth in SEQ ID NO: 41;

(b) the amino acid sequence set forth in SEQ ID NO: 42;

(c) an amino acid sequence having a homology of at least 95% or more to the sequence (a) or (b); and

(d) an amino acid sequence derived from the sequence (a) or (b) by deletion, substitution or addition of 1 to 10 amino acids; and

a light-chain variable region consisting of an amino acid sequence selected from the group consisting of:

(e) the amino acid sequence set forth in SEQ ID NO: 43;

(f) the amino acid sequence set forth in SEQ ID NO: 44;

(g) an amino acid sequence having a homology of at least 95% or more to the sequence (e) or (f); and

(h) an amino acid sequence derived from the sequence (e) or (f) by deletion, substitution or addition of 1 to 10 amino acids.

[Claim 19]

The antibody or the antigen-binding fragment of the antibody according to claim 18, comprising:

(a) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 41 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 43;

(b) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 41 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 44;

(c) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 42 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 43; or

(d) a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 42 and a light-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 44.

[Claim 20]

The antibody or the antigen-binding fragment of the antibody according to claim 19, comprising a heavy-chain variable region consisting of the amino acid sequence set forth in SEQ ID NO: 42 and a light-chain variable region

consisting of the amino acid sequence set forth in SEQ ID NO: 44.

[Claim 21]

The antibody or the antigen-binding fragment of the antibody according to claim 19, comprising:

(a) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 45 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48;

(b) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 45 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49;

(c) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48;

(d) a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49;

(e) a heavy chain consisting of an amino acid sequence at positions 20 to 462 in the amino acid sequence set forth

in SEQ ID NO: 47 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48; or

(f) a heavy chain consisting of an amino acid sequence at positions 20 to 462 in the amino acid sequence set forth in SEQ ID NO: 47 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49.

[Claim 22]

The antibody or the antigen-binding fragment of the antibody according to claim 21, comprising a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49.

[Claim 23]

An antibody or an antigen-binding fragment of the antibody comprising a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 45 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48.

[Claim 24]

An antibody or an antigen-binding fragment of the antibody comprising a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid

sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 48.

[Claim 25]

An antibody or an antigen-binding fragment of the antibody comprising a heavy chain consisting of an amino acid sequence at positions 20 to 465 in the amino acid sequence set forth in SEQ ID NO: 46 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49.

[Claim 26]

An antibody or an antigen-binding fragment of the antibody comprising a heavy chain consisting of an amino acid sequence at positions 20 to 462 in the amino acid sequence set forth in SEQ ID NO: 47 and a light chain consisting of an amino acid sequence at positions 21 to 233 in the amino acid sequence set forth in SEQ ID NO: 49.

[Claim 27]

The antibody or the antigen-binding fragment of the antibody according to any one of claims 23 to 26, having the properties of:

(a) specifically binding to human TLR7; and

(b) inhibiting a function of human TLR7.

[Claim 28]

The antigen-binding fragment of the antibody according to any one of claims 1 to 27, wherein the antigen-binding

fragment is selected from the group consisting of Fab, F(ab)2, Fab' and Fv.

[Claim 29]

A polynucleotide comprising a polynucleotide sequence encoding the antibody or the antigen-binding fragment of the antibody according to any one of claims 1 to 28.

[Claim 30]

The polynucleotide according to claim 29, comprising:

a polynucleotide sequence encoding CDRH1 consisting of the amino acid sequence set forth in SEQ ID NO: 17, a polynucleotide sequence encoding CDRH2 consisting of the amino acid sequence set forth in SEQ ID NO: 18 and a polynucleotide sequence encoding CDRH3 consisting of the amino acid sequence set forth in SEQ ID NO: 19, and a polynucleotide sequence encoding CDRL1 consisting of the amino acid sequence set forth in SEQ ID NO: 20, a polynucleotide sequence encoding CDRL2 consisting of the amino acid sequence set forth in SEQ ID NO: 21 and a polynucleotide sequence encoding CDRL3 consisting of the amino acid sequence set forth in SEQ ID NO: 22.

[Claim 31]

A polynucleotide comprising a polynucleotide sequence encoding the antibody or the antigen-binding fragment of the antibody according to any one of claims 7 to 12 and 17 to 22, comprising:

a polynucleotide sequence selected from the group consisting of:

(a) a polynucleotide sequence encoding the heavy-chain variable region set forth in SEQ ID NO: 77;

(b) a polynucleotide sequence encoding the heavy-chain variable region set forth in SEQ ID NO: 78; and

(c) a polynucleotide sequence of a polynucleotide which hybridizes with a polynucleotide consisting of a polynucleotide sequence complementary to the polynucleotide sequence (a) or (b) under stringent conditions; and

a polynucleotide sequence selected from the group consisting of:

(d) a polynucleotide sequence encoding the light-chain variable region set forth in SEQ ID NO: 79;

(e) a polynucleotide sequence encoding the light-chain variable region set forth in SEQ ID NO: 80; and

(f) a polynucleotide sequence of a polynucleotide which hybridizes with a polynucleotide consisting of a polynucleotide sequence complementary to the polynucleotide sequence (d) or (e) under stringent conditions.

[Claim 32]

The polynucleotide according to claim 31, comprising:

(a) a polynucleotide sequence encoding the heavy-chain variable region set forth in SEQ ID NO: 77 and a polynucleotide sequence encoding the light-chain variable region set forth in SEQ ID NO: 79;

(b) a polynucleotide sequence encoding the heavy-chain variable region set forth in SEQ ID NO: 77 and a

polynucleotide sequence encoding the light-chain variable region set forth in SEQ ID NO: 80;

(c) a polynucleotide sequence encoding the heavy-chain variable region set forth in SEQ ID NO: 78 and a polynucleotide sequence encoding the light-chain variable region set forth in SEQ ID NO: 79; or

(d) a polynucleotide sequence encoding the heavy-chain variable region set forth in SEQ ID NO: 78 and a polynucleotide sequence encoding the light-chain variable region set forth in SEQ ID NO: 80.

[Claim 33]

An expression vector comprising the polynucleotide according to any one of claims 29 to 32.

[Claim 34]

A host cell transformed with the expression vector according to claim 33.

[Claim 35]

The host cell according to claim 34, wherein the host cell is a eukaryotic cell.

[Claim 36]

A method for producing an antibody or an antigen-binding fragment of the antibody, comprising the steps of:

culturing the host cell according to claim 34 or 35; and

collecting the antibody or the fragment of interest from the culture obtained in the above step.

[Claim 37]

An antibody or an antigen-binding fragment of the antibody obtained by the production method according to claim 36.

[Claim 38]

The antibody according to any one of claims 1 to 27, comprising one or more modifications selected from the group consisting of glycosylation to N-linkage, glycosylation to O-linkage, N-terminal processing, C-terminal processing, deamidation, isomerization of aspartic acid, oxidation of methionine, addition of a methionine residue to N-terminal, amidation of a proline residue, and deletion of one or two amino acids at the carboxyl terminus of the heavy chain.

[Claim 39]

The antibody according to claim 38, comprising two heavy chains consisting of one kind of or a combination of any two kinds of heavy chains selected from the group consisting of the full length and deletion variants with one or two amino acids deleted at the carboxyl terminus.

[Claim 40]

The antibody according to claim 39, wherein one amino acid is deleted at the carboxyl terminus in each of the two heavy chains.

[Claim 41]

The antibody according to any one of claims 38 to 40, wherein a proline residue at the carboxyl terminus of the heavy chain is further amidated.

[Claim 42]

A pharmaceutical composition for treating and/or preventing a disease, comprising at least one of the antibodies or the antigen-binding fragments of the antibodies according to claims 1 to 28 and 37 to 41 or the expression vector according to claim 33 as an active ingredient.

[Claim 43]

The pharmaceutical composition according to claim 42, for treating a disease caused by a function of human TLR7, wherein the disease caused by a function of human TLR7 is an immune inflammation-related disease, an allergic disease, an infection or a cancer.

[Claim 44]

The pharmaceutical composition according to claim 43, wherein the immune inflammation-related disease is systemic lupus erythematosus, rheumatoid arthritis, juvenile idiopathic arthritis, adult-onset Still's disease, ankylosing spondylitis, systemic scleroderma, polymyositis, dermatomyositis, psoriatic arthritis, osteoarthritis, mixed connective tissue disease or muscular dystrophy.

[Claim 45]

The pharmaceutical composition according to claim 43 or 44, wherein the immune inflammation-related disease is systemic lupus erythematosus.

[Claim 46]

The pharmaceutical composition according to any one of claims 42 to 45, to be used in combination with an immunosuppressant, an anti-inflammatory drug, an antiallergic agent, an anti-infective agent or an anticancer agent.

[Claim 47]

The antibody or antigen-binding fragment according to claims 1 to 28 and 37 to 41 for use in the treatment of a disease caused by a function of human TLR7, wherein an effective amount of at least one of the antibodies or the antigen-binding fragment of the antibodies is to be administered to an individual in need thereof, and wherein the disease caused by a function of human TLR7 is an immune inflammation-related disease, an allergic disease, an infection or a cancer.

[Claim 48]

Use of the antibody or antigen-binding fragment according to claims 1 to 28 and 37 to 41 in the manufacture of a medicament for the treatment of a disease caused by a function of human TLR7, wherein an effective amount of at least one of the antibodies or the antigen-binding fragment of the antibodies is to be administered together with an immunosuppressant, an anti-inflammatory drug, an antiallergic agent, an anti-infective agent or an anticancer agent, simultaneously, separately or sequentially to an individual in need thereof, and wherein the disease caused by a function of human TLR7 is an immune

inflammation-related disease, an allergic disease, an infection or a cancer.

[Claim 49]

The use according to claim 48, wherein the immune inflammation-related disease is systemic lupus erythematosus, rheumatoid arthritis, juvenile idiopathic arthritis, adult-onset Still's disease, ankylosing spondylitis, systemic scleroderma, polymyositis, dermatomyositis, psoriatic arthritis, osteoarthritis, mixed connective tissue disease or muscular dystrophy.

[Claim 50]

The use according to claim 48, wherein the immune inflammation-related disease is systemic lupus erythematosus.